DE MONTFORTUNIVERSITY

ADDING, RETRIEVING AND BROWSING CONTENT IN SOCIAL MEDIA AND E- JOURNALISM:

A MULTIMODAL INTERACTION APPROACH

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PhD

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ADDING, RETRIEVING AND BROWSING CONTENT IN SOCIAL MEDIA AND E- JOURNALISM:

A MULTIMODAL INTERACTION APPROACH

An empirical investigation into the role of multimodal interaction metaphors to improve usability of Electronic Adding, Retrieving and Browsing Comments in order to increase the user's Impact on the Public Opinion

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Thesis submitted for the degree of Doctor of Philosophy in Computer Science

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In the name of God, most compassionate, most merciful

The Noble Qur'ân

كِلْتُمْ وَزِنُوا۟ بِٱلْقِسْطَاسِ ٱلْمُسْتَقِيمِ ۚ ذَٰلِكَ خَيْرٌ وَ
٣٥

Sahih International

And give full measure when you measure, and weigh with an even balance. That is the best [way] and best in result.

17:36

to top

وَلَا تَقْفُ مَا لَيْسَ لَكَ بِهِۦ عِلْمٌ ۚ إِنَّ ٱلسَّمْعَ وَٱلْبَصَرَ وَٱلْفُؤَادَ كُلُّ
أُو۟لَٰٓئِكَ كَانَ عَنْهُ مَسْـُٔولًا ٣٦

Sahih International

And do not pursue that of which you have no knowledge. Indeed, the hearing, the sight and the heart - about all those [one] will be questioned.

فِى ٱلْأَرْضِ مَرَحًا ۖ إِنَّكَ لَن تَخْرِقَ ٱلْأَرْضَ وَلَن تَبْلُغَ ٱلْجِبَالَ

الى الرجل الذي طالما أشرق وجهه و ابتسمت محياه تضحيةً و سروراً بالعلم , اليك ابي و امي
ثمرة غربة سنين أهديها اليكما متنمنياً ان أكون رفعت بها راسكما و حققت بها آحلامكما

This thesis is dedicated to my father (Abdulghani) and mother (Khadijah) who taught me that the biggest source of love, pride, and meaning in life stems from the effect you have on the lives of those around you.

Here's my PhD thesis as gift just for Them.

Abstract

This thesis explores the use of avatars with facial expressions in social media and e-journalism communication interfaces. This thesis involved three experimental conditions. In the first experimental condition a survey (n=34) and an experiment (n=25) were carried out in order to explore the central problems faced by users during adding and retrieving comments and methods to overcome those problems. The survey intended to find out the position users took towards these metaphors. 25users from the Aljazeera Channel in Doha, Qatar took part. The first experimental condition consisted of two interfaces, TARCS (traditional adding and retrieving comments system) and CMARCS (classification multimodal adding and retrieving comments system). This was carried out in order to assess users' perception of unique text with graphic classification and multimodal in an EARCS (electronic adding and retrieving comments system) interface in the presence and absence of an interactive context. This was implemented in order to assess the role of these unique classification interfaces in a news comment in the term of usability. In the second experiment, forty users evaluated the use of the VARCS (visual adding and retrieving comments system) and MMARCS (multimodal adding and retrieving comments system). Both interfaces evaluated the effect on public opinion as media study and effectiveness, interactivity and user satisfaction in HCI studies. The third experimental condition consisted of one study that investigated the impactbility and usability of facial expressions compared text with graphic and multimodal metaphors. Sixty six users from Al-Arabiya Channel in Dubai, UEA took part in these two experiments. The results obtained show that users had some problems with adding and retrieving comments in social media such as missing data and lack of organisation. Also, the new classification performed better and faster under an interface that implemented avatars with specific facial expressions compared to a textual interface and multimodal. Practical guidelines were also introduced to provide assistance to multimedia designers who use avatars with facial expressions in e-journalism interactive systems as well as its impact on the public opinion.

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Glossary of Abbreviations

AI	Auditory Icons
ARCS	Add and Retrieve Comments System
AVARCS	Avatar Add and Retrieve Comments System
C	Classification
CC	Comments by Comments
Co	Confusion
CMARCS	Classification Multimodal Add and Retrieve Comments System
CP	Comments by Page
E	Earcons
E-ARCS	Electronic Add and Retrieve Comments System
IT	Incorrect Typing
G	Graphics
LL	Long Limited
ML	Mid Limited
MMARCS	Multimodal Add and Retrieve Comments System
NoAA	No. Action Add
NoAR	No. Action Ret
PO	Public Opinion
RS	Recorded Speech
SE	Selecting Errors
SL	Short Limited
SS	Synthesised
T	Text
TARCS	Traditional Add and Retrieve Comments System
UnL	Unlimited
VARCS	Visual Add and Retrieve Comments System

Acknowledgement

All praise is due to Allah, and may His peace and blessings be upon the Prophet (peace be upon him) who said: “Should not I be a grateful servant.” [Sahîh al-Bukhârî and Sahîh Muslim]. Thank to ALLAH forever.

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Chapter 1: Introduction

1.1Introduction

The invention of new technologies and the rapid development of social media and e-newspaper have changed dramatically the way people use the Internet. Nowadays, the Internet does not only enable users to read news and browse articles, but it also gives them the opportunity to intact with that news. New newspaper models rise in the World Wide Web, integrating innovative “online” technologies [1]. With the introduction of social networks, journalists can receive the opinion of the general public when writing their stories. In traditional journalism, reporters had to go into the field to obtain information whereas today digital journalism puts a lot more power in the hands of the user [39]. Digital journalism is also much easier and much more accessible to the general public; the world runs on electronics and the internet. With digital journalism, the public can receive the news immediately and not a day later. Blogs can enhance the coverage of news outlets because it can reveal potential information that was available to the public. Blogs also give a journalist a solid public opinion on certain topics or issues. Although blogs might not be a completely reliable source it can give a news outlet a good idea of what to look into and research. Web 2.0 is a collaboration of social media and it is available to the general public. With Web 2.0 technology news coverage can obtain a general demographic on a certain topic or issue. Web 2.0 such as Facebook or Twitter is a great way to interact with the public and socialize. Facebook offers a vast social network where a journalist can post a story for an opinion before publishing it [39].

1.2 Aims

This research was aimed at investigative and examining the usability (in terms of effectiveness, efficiency and user satisfaction) of adding and retrieving comments system in the interfaces that incorporate the use of metaphors of technology such as non-speech sounds along with different expressions animated avatars in the presentation of the electronic comments.

- More specifically, it aimed at examining the effectiveness of earcons and auditory icons in delivering supportive auditory messages related to add and retrieve comments material presented by expressions of avatar.
- It is also aimed at measuring the impactability of these metaphors of technology in terms of users ‘recollection of its meaning and use.
- Additionally, this experiment targeted measuring the user ‘satisfaction in relation to the applied social media and e-journalism applications interface.
- Furthermore, this experiment is aimed at assessing the users ‘performance in responding to the required experimental adding and retrieving comments activities.
- Likewise, to generate practical guidelines for the design of social media and e-journalism interfaces that incorporates expressive avatars.

1.3 Objectives

The direction of this research required the development of different experimental platforms, in order to meet the assumptions of the investigation. The platform facilitates products to be displayed in a textual mode of presentation and a multimodal version. This enabled measurement of the effect of each presentation method.

The avatars present in the multimodal version combined facial expressions to assist the communication of information to the users for adding and retrieving comments. The human-like avatars were the channel between the system and the user in the interest of facilitating communication of information, imitate in a sense a face-to-face communication.

1.4 Hypothesis

The assumption was that a multimodal E-ARCS interface that uses expressive human-like avatars with facial expressions is more effective and desirable for the users' decisions in accomplishment of social media and e-journalism over the web in contrast to a text-based E-ARCS interface.

1.5 Method

The method of the proposition followed the structure as shown in Figure 1. Stages included a literature survey, an initial survey, and an initial experiment and two further experimental studies. The data gathered was objective (e.g. data for effectiveness and efficiency) and subjective (e.g. Questions for user impactability and satisfaction and users' ratings). Moreover, in the last Chapter of the work the success criteria are revised with regards to the usability aspects of social media and e-journalism interfaces (i.e. effectiveness, Efficiency and user satisfaction).

Effectiveness criteria have indicated significant differences. The significant value was obtained at the level of $p>0.05$. Efficiency criteria were carried out by specifying the time spent for the completion, the errors happened and click mouse accounted of a task. Satisfaction levels are indicated by obtain in users' point of views on the presentation methods, and the multimodal metaphors use disinter faces. Below is outline of these activities:

1.5.1 Literature Survey

It Introduced definitions of the social media and e-journalism interfaces. It highlighted historical aspects with most widely known e-newspaper models. It presented a brief outline of the benefits and limitation of these models. Background information about this technological revolution was revised. The evaluation of its interactive such as adding and retrieving comments was carried out. Public opinion definitions were presented. Some of studies in regards to the measurement of public opinion and its aspects were highlighted. Evaluation of the previous experimental studies on multimodal metaphors was discussed. Some projects, Stefan Siersdorfer, Sergiu Chelaru, and Jose San Pedro about how useful are your comments as well Chiao-Fang Hsu, Elham Khabiri, and James Caverlee about Ranking Comments on the Social Web was evaluated. These projects assessed the human-computer communication in e-journalism and social media web. Multimodality was also evaluated. Other Newspaper interfaces were reviewed. Finally, non-verbal communication as facial expressions was reviewed as communicative metaphors.

1.5.2 Initial Survey and Experiment

Initial steps were undertaken in order to establish main issues in the interactivities field within e-journalism and social media interface. The investigation of the usability aspects of using traditional approach as communication metaphors in social media and e-journalism interfaces was compared with a unique classification multimodal usability aspect. Thirty four users have taken part in this initial survey. The overall opinions on the use of multimodal with speech input and output in a social media and e-journalism interactive system were gathered. Comparison was made with a traditional text and graphics interfaces that combined unique classification multimodal.

Forty users have taken part in the initial experiment which aimed to support the findings of the survey. The purpose of the experiment was to establish practical viewpoints on the use of multimodal metaphors including unique classification of opinion.

The multimodal metaphors were measured and compared in terms of usability (effectiveness and user satisfaction). These initial experiments are discussed in more details in Chapter 3.

1.5.3 Second Experimental Study

The purpose of the previous experiment was to assess the critical issues of comments, adding and retrieving, in social media and E-newspaper fields. To achieve this, new opinion classification, unique platforms and resolution approaches were applied. Assessment was carried out using the users' opinions. However, that previous experiment only investigated various E-ARCS perspectives with Visual (text and graphic) and multimode and graphics. Further, this Chapter explore the usability of E-ARCS by looking at contrast between text and graphic with multimodal metaphors. The impact of these on the users' opinion was evaluated. In other words, this Chapter demonstrated experiment specifically designed to assess the impact the approaches of add and retrieve comments (VARCS and MMARCS) have on the users' points of views. This experiment examines which of these are the most user-friendly in terms of usability, efficiency, effectiveness and satisfaction. The Chapter presents the main objectives of the research, experimental platform. It also outline hypothesis. Design of the study is presented; this includes description of tasks, variables, and sampling and data collections. Finally, analysis and results are presented. Experiments are precisely described in Chapter 4.

1.5.4 Third Experimental Study

In previous Chapter, the study compared the role of using visual metaphors and multimodality and its impact on public opinion with regards to adding and retrieving comments in the e-newspaper and social media field. It aimed to determine the ability of multimodal metaphors to facilitate the usability of ARCS interfaces by using Opinion Classification in both VARCS and MMARCS.

By applying variables, tasks and design to different interfaces, it was crucial to examine several combination metaphors, this included avatar with multimodal. This led the researcher to examine these tools to discover new aspects which impacted on opinion and usability of using adding and retrieving comments methods. This experiment aimed to achieve these goals in relation to E-ARCS. This study is discussed in Chapter 5.

1.5.5 Conclusions and Guidelines

The conclusion has been made following comparison of experiments. As a result, practical guidelines were formed for the use of expressive avatars with facial expressions in interfaces for adding and retrieving comments in social media and e-journalism applications. Results are discussed in Chapter 6.

1.6 Thesis Contribution

This thesis evaluated the usability of expressive avatars in social media and e-journalism interfaces with the impact on the public opinion. Also, it discusses the application of facial expressions in such interface. From this PhD thesis, it can be concluded that:

- AVATAR System has been proved scientifically and statistically that it is more usable compared to other systems because it decreases the errors and increases the number of successful tasks performed by the users. This, in turn, saves time and inevitably raises satisfaction levels.
- When people were exposed to the interfaces via Twitter, Facebook, YouTubeand E-Journalism, the research found that the AVARCS system was best preferred of the usability and the most impactability.
- Comments using facial expressions were combined with an opinion classification tone of speech, they were beneficial to the interaction procedure between the avatar and the user, namely by collecting information about their gender and opinion which had an encouraging impact on people's opinion.
- Using recorded speech made the interface for input comments easier to use and ensured that users stayed focused on the screen. The use of a clear concise voice ensured that the users remained interested.
- It can also be argued that the best system in retrieving short comments (less than 150 characters) is the VARCS system because of its input ease. This system

would be best suited for ***Twitter*** since it has been designed specifically for short character comments and not engaging in audio files.

The unique platform designed in this study depended on comments classification by different facial expressions with colour and multimodal metaphors. By experiments 1,2 and 3 the investigation of this study has created three unique platforms (Figure 1,19 and 31). The platform made the system of adding and retrieves comments in social media more usable. A creator of an interaction of social media and e-journalism needs the choice of being able to use when there was an interactive context present or absent; only the all facial expressions (Chapter 5) had a positive impact on the opinion and usability interaction between the interface and the user. To conclude, this study recommends the use of the AVARCS system in all electronic newspapers and new media with the exception of Twitter.

1.7 A Structure of Thesis

Six structured number of Chapters have been documented by of this thesis with appendices in such a way that it can be comprehendible and readable. This section explained how these Chapters and appendices organised.

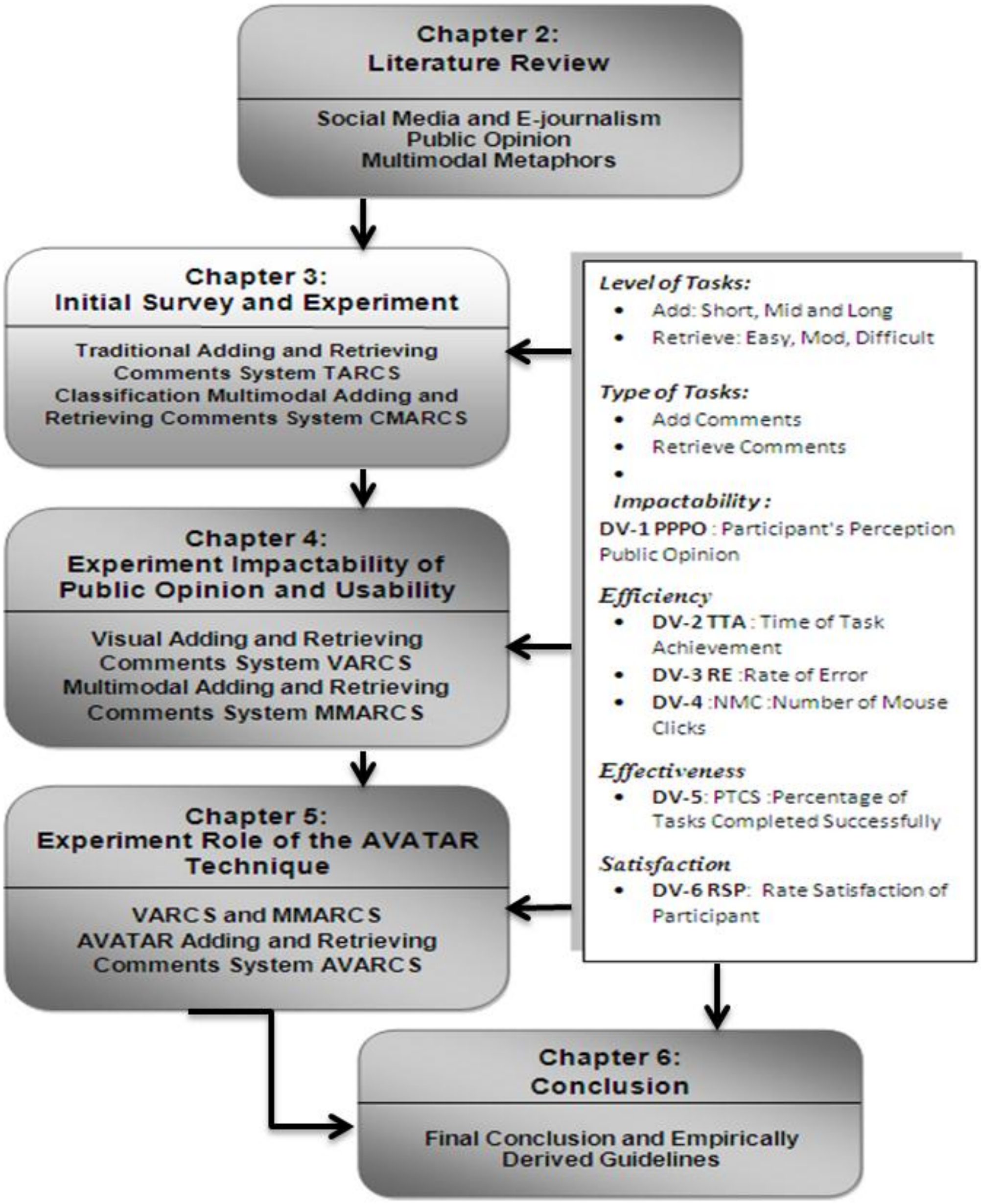

Figure 2Structure of the thesis

Chapter 1: Introduction: tried to describe the general outlines of the thesis which consists of aim, objectives, hypotheses and the method (show summarise of initial survey and experiment as well as the main two research experiments). Also, it gave general idea of literature and the contributions of the thesis.

Chapter 2: Multimodal Interactive System for Electronic Journalism and Social Media: Provides some background studies about terms of e-journalism and social media, its definitions and history highlights the benefits and limitations, and mentions the method of presentation in term of adding and retrieving comments of the environment and users to digital world. Moreover, it outlines the concept of public opinion by demonstrated the environment factor and some media studies theories. Some potential aspects are specified describing to multi-modal systems, considered the approach that these metaphors interact with electronic interface applications and real interaction studies developed by other researchers. Lastly, it reviews some recently enhanced method and interfaces for e-journalism and social media applications in the term of adding and retrieving comments systems.

Chapter 3: Initial Survey and Experimental: An Empirical Investigation into How the Interaction of E-Journalism can be enhanced– discusses a survey and an initial experiment achieved for the investigation of the usability features of e-journalism and social media applications in the term of adding and retrieving comments systems utilising multimedia metaphors.

Chapter 4: An Investigating the Role of the AVATAR Metaphors in the Improvement of the Impactability of Public Opinion on Social Media–discusses a set of experiments impacted on the public opinion and the performed for the investigation of the usability (efficiency, effectiveness and satisfaction) of between two interfaces, Visual and Multimodal with opinion classification.

Chapter 5: Main Trial Phase 3: An Investigation of the Role of the AVATAR Technique in the Improvement of the Impactability of Public Opinion on Social Media – discusses the third experiment performed for the further investigation of the interaction between specific combinations of facial expressions measuring the impacted on the public opinion and usability aspects.

Chapter 6: Empirical Guidelines for employing Multimodal and AVATAR metaphors in E-ARCS –evaluates the proposed experimental platforms, as well as their impact on public opinion and the usability aspects, and suggests a series of empirically derived guidelines for the use of human-like avatars that incorporate facial expressions in e-journalism and social media applications such as Facebook and Twitter.

APPENDIX A –Initial Survey presents the questionnaire given to the users (Appendix A-1) to get a first view of what are the main issues which the commenter encountered in the interactivities field within an e-journalism and social media interfaceas well as how users perceive a textual interface compared to a classification and multimedia one, for the initial survey in Chapter 3.

APPENDIX B – Scenarios Experiments present the questionnaire given to the users (Appendix B-1) to measure the usability aspect of the proposed interfaces (TARCS and CMARCS) by Scenarios of the Four Common Tasks in Chapter 3. It provides the questionnaire of two experiments two and three by Scenarios of the Six Common Tasks used in the proposed interfaces VARCS, MMARCS and AVARCS (Appendix B-2) in Chapter 4 and 5.

APPENDIX C – First Experiment presents the rates given by the users(AppendixC-1) to get the result for the Raw Data of Achievement Task Successfully, (AppendixC-2) for Raw Data of Task Completion Time, (AppendixC-3) for Raw Data of Task Mouse Click, (AppendixC-4) for Raw Data of Task Errors Rate and (AppendixC-5)Raw Data of Task Satisfaction for the first experiment took place in Chapter 3.

APPENDIX D – Second and Third Experiments present the rates given by the users(AppendixD-1) to get their result for Raw Data of Impactability of Public Opinion , (AppendixD-2) for Raw Data of Task Satisfaction, (AppendixD-3)for the Raw Data of Achievement Task Successfully, (AppendixD-4) for Raw Data of Task Completion Time, (Appendix D -5) for Raw Data of Task Mouse Click, (Appendix D -6) for Raw Data of Task Errors Rate for the second and third experiments took place in Chapter4 and 5.

Chapter Two: Multimodal Interactive System for Electronic Journalism and Social Media

2.1 Introduction

This chapter presents the reviews and analyses the practical and theoretical research work in relative to the research carried out within this thesis. Four main sections comprised; e- journalism and social media, public opinion concept, multimodal interaction and E-ARCS. The first section outlines introductory information about e-journalism and social media definitions and history as well as benefits with limitations. It also provides an insight into the types of environment and users underlying usability of using browsing comments in the net. Evaluation and methods of presentation for E-ARCS interfaces were provided during this section. During the next one, many different factors can impact on the general opinion of users presented with main public Opinion theories. Moreover, how the social networking sites have become a powerful force in shaping public opinion on virtually every aspect of electronic website. Also, the basic theories and fundamental of multimodal metaphors developed in this research delivered in the third section. Specifically, visual metaphors, speech and non-speech sounds in addition to avatars, covering previous research studies in order to shed light on the significance of these metaphors in enhancing user to computer interaction in a variety of problem domains. The last section however focuses on the use of multimodal interaction metaphors in e- journalism and social media interfaces and on the research studies evaluate of the previous experimental studies related with adding and retrieving comments in social media.

2.2 Technology of Multimodal Interaction

Some studies [58,178,193,194,196] indicated that the majority of users were not satisfied with the outcome of comments presentation. From their point of view, the information was too cramped, with disorganised data, and classification issues which were the main problems faced readers in retrieving comments in E-ARCS. Moreover, the spelling mistakes, confusing agreements, typing difficulties and missing data were the most common issues faced by commenters in using the adding comments system. Almost all of the users said that they preferred to engage with social media and e-newspaper including adding and retrieving comments when they are doing other work. A multimodal can be defined as a way to pass information, i.e., a visual channel through which information is communicated from or to a person. Communication among humans is multimodal, people interact visually, through body language (actions), and linguistically [30, 51 and 75]. On the other hand, computers mainly use visual communicators [84]. This potentially could cause overload of human sight sense during interactions. Further, this might result in loss of information received [34].

The technology of multimodal interaction with computer information can be given by speech and reply by movement, or vision [83]. In this way multimodal computer interfaces involve modalities that combat all human senses during the interaction. These modalities can be grouped into auditory (e.g. speech and non-speech sounds) [37], visual (e.g. text and graphics)[49,89], and audio-visual such as avatars with facial expressions and body gestures[25,85 and 99]. Multimodality is a key word to get rid of the WIMP1-style (computer user interface system) point-and-click metaphors. This graphical user interface is designed to make computers easy to use; this includes windows, icons, mice, and pull-down menus [19, 84]. However it is not advanced enough to satisfy its users. Therefore, it has been real achievement for researchers to build computer system that operate with features and characteristics similar to those of human beings.

It can be argued that applying multiple modalities could engage the human’s interest and facilitates processing of information. There has been growing demand on adapting information technology to users' needs. Adapting human-computer interaction as multimodal gives the opportunity to implement real life interactions [23]. This could potentially facilitate face-to-face communication in computer user interfaces. Multimodal interaction could benefit a person by enabling choice of interaction according to their preferences, needs and abilities [125,126]. The example is the usefulness of it for people who have been affected by disabilities. In this way, users with disabilities are not considered as a different class of users, but as a part of human diversity [19].

There were several research conducted that have given evidence of beneficial influence of multimodal interaction in improving the usability of user's communication. Multimodal makes the service applications much easier to use, improve time management, and give more choice and freedom.

Multimodal interaction offers flexibility and naturalness of the user interface. As a result, designers are faced with the large numbers of input and output devices which leads to grow in the interaction techniques. Virtual Reality (VR) applications are based on the complex interaction techniques (usually multimodal) [75,93].

Metaphors are used in the process of identifying, interpreting and processing information. Metaphors have huge effect on information representation. Metaphors are classified into direct manipulation, navigation and human interaction metaphors [83,123].In the direct manipulation, information is mapped to an object, such as files and folders that is manipulate din the computer desktop, whereas navigation through information is facilitated by mapping it to spaces, such as links used in websites [103,123]. Human interaction metaphors utilise animated characters, such as software agents and avatars, to promote social human-computer interaction [123]. Metaphors are organised into visual, speech, earcons, auditory icons and avatars [166,168,169 and 174].

2.2.1 Technology of Visual Metaphors

Vision is the most important sense used by human in order to gather information [49]. Visual metaphors have its information representation in form of visual symbols that are borrowed from daily life. Recycle bin icon is one of them. Visual metaphors can process information via textual and graphical format to visual channel of users.

These metaphors have been introduced in early 80s by Xerox Star system, later adapted by Apple Macintosh operating system. In Macintosh computer systems, it enabled users to use the mouse in treating pictorial and iconic representations of files and folders [89, 97]. For instance, delete a file by dragging its icon to recycle bin.

Operation of visual metaphors has been proven to have satisfactory effect on computer systems, by offering simple and easy way of communication between the user and the system. However, exposing the interfaces with graphical and textual information might overwhelm the users and affect attention span [97]. When receiving visual information user needs to keep an eye contact and direction toward receiving information. On the contrary, auditory information can be captured without necessity of keeping eye contact [81]. In addition, this allows, both information from two channels, to be received at the same time. This would allow two tasks to be performed spontaneously without putting unnecessary pressure on one of the channel. Visual metaphors are unable to process information of increasing complexity [89,105].

2.2.2 Technology of Speech Metaphors

The use of speech in Human-Computer Interaction is recognised as the most suitable metaphor to communicate textual information using the human auditory channel [20,174]. Speech output has been useful by providing the users with the information needed in different applications such as help disk, e-banking, e-news, and email, note-taking, and talking agents in e-commerce [72]. In addition, it provides assistance to the users with visual impairments. Speech sounds can be divided into two groups: natural speech and synthesised speech. Human spoken speech is recorded using digital technology [42]. This speech sounds very natural and enable human like interaction via computer system. However, the large storage space is needed for recorded speech.

For that reason, the human speech is not used in the systems that operate with a large vocabulary. On the other hand, synthetic speech is a simulation of human speech. This speech is generated by speech synthesizers depend on two methods, concatenation or synthesis by role [37]. In the concentration techniques, speech messages are produced by concatenating pre-recorded segments of human voices after being saved in the system. However, the synthesis by role, also defined as formant speech, construct the speech sounds artificially and thus can generate speech in run time [173,175].

In contrast to concatenate some users believed that speech, the formant speech is of poorer quality. Although the synthesizer technology is a faster and more flexible way of producing high quality speech sounds, the sounds still sound like computer generated. As a consequence, natural recorded speech is prioritised. Natural speech is comprehended better [42].

2.2.3 Technology of Non-Speech Metaphors

Non-speech sound is also involved in Human-Computer Interaction to generate the auditory channel in the interaction process. It can be categorized into types: earcons and auditory icons [173]. It has been demonstrated that by applying non-speech sounds users' performance and usability can be enhanced (see the following two subsections).

Non-speech sounds are language-independent, whereas speech sounds are not. They also can be understood faster after the sufficient practice.

2.2.3.1 Technology of Earcons

Earcons are brief sounds of musical instruments [31]. They are audio messages used in the user-computer interfaces to provide information and feedback about the computers [179,118]. Eacorns include messages, functions, states and labels. Eacorns have been proven to be effective mean to communicate information in human-computer interface.

They communicated information about objects, operations and interaction in computer interfaces. Analogically, earcons are categorised as abstract, synthetic tones used to create sound message [137]. Earcones combine more complex information [124]. It is important to make earcons attention-grabbing. Usually it is effectively done by using intensity. Rhythm or pitch combined with lower intensity can be applied. Further, high pitch, irregular harmonics can be used.

According to Blattner et al.[121], earcons are one-element (simple) or a compound. A single note and a single pitch are the one-element earcons. However, compound earcons are combinations of simple earcons. For effective discrimination of different earcons within this synthesis, sound attributes such as timbre, register, pitch, rhythm, duration, tempo, intensity and spatial location can be applied. When playing compound earcons one after another it is good to apply 0.1 second gap in order for users to tell when one finishes and the other starts in this way they can be easily recognisable and distinguishable by listeners. It has been demonstrated that earcons could be effectively used to communicate information [166,168]. The auditory earcons have been utilised to enhance users' interactions with graphical components such as scrollbars, buttons, menus, progress bars and tool palettes. The auditory feedback by earcons improved usability of those graphical widgets. As a result, this contributed to the reduction in error rate, error recovery time and mental workload. Task completion time was improved and users were less annoyed when using program [93,96].

In addition, earcons have enhanced users' interactions with mobile devices. Implementing these structured musical sounds helped the users to overpower the lack of visual feedback on small screen in these devices. Earcons are good solution for users with visual impairments in an assistive technology. They help to access graphical representations [97], spread sheets and numerical data tables. Earcons have been effectively used by audio graph (experimental platform). The purpose was to convey graphical information to users affected by visual impairments. In the autographic system, coordinate locations and graphical shapes such as lines, squares, rectangles and circles are all carried by musical sounds.

Including earcons in multimodality has proven to be beneficial for users, especially those with in need of special requirements. Earcons have also demonstrated its potential of enhancing usability in other application domains such as stock control systems, knowledge management systems, and email browsing and speech engines [168,134].

2.2.3.2 Technology of Auditory Icons

There is growing interest in the use of sounds to communicate the information in the human-computer interaction. The way they are employed is based on arbitrary or metaphorical relation between the sound and the data it represents. Auditory icons are non-speech sounds used to correspond with different objects and actions in interaction between the computer and users based on the mapping between these sounds and the information to be demonstrated. For instance, a noise can be performed as glass breaking sound [35,127,133,141]. Auditory icons are an intuitive way to use sound to provide organized information to users. Some studies represent the systems in which auditory icons have been utilised. In SonicFinder [197], environmental sounds are utilised to illustrate interface objects, operations and attributes along with visual feedback. For example, by selecting a file, the icon of that file is highlighted and the sound of hitting wood is played [147]. The advantage of using sound in this interface is an increase in direct engagement with the model world of the computer and flexibility in getting information.

On the other hand, the ARKola is a simulation system in which the auditory icons are communicated to monitor a nine-machine bottling factory [147]. The system accompanies each machine with specific sound to indicate its status. At the same time all sounds are played to communicate the overall processes in the factory. Auditory icons can also be combined with multimodal metaphors such as speech and earcons for mobile telephony users [168,169]. The implementation of environmental sounds in user's interfaces demonstrates that it could effectively convey simple and complex information. The important advantage of auditory icons is ability to carry completely different information using single sound [48, 81]. For example, in a messaging system, a weighty sound can indicate the arrival and the size of the receiving message. Because these sounds are familiar to users they provide natural mapping and are easily learned and remembered. On the other hand, earcons are more abstract sounds that do not have direct association with the data represented. Therefore, this relationship is required to be learned before associating it spontaneously [147]. However, these mappings have its limitations. They are sometimes hard to create. For instance, in Gaver • es SonicFinder copying have no equivalent environmental sound. As a result, it is presented by pouring a liquid auditory icon [147].

Types of Comments		Retrieve Comments				Add Comments			
		C	CC	L	CP	T-G	AI-E	SR	V
Social Media	Twitter	×	√	SL	×	√	×	×	×
	FaceBook	×	√	UnL	×	√	×	×	√
	YouTube	×	×	ML	√	√	×	×	√
The 1o Top E-news paper In the World	1st New York Times brand	√	×	LL	√	√	×	×	×
	2nd Mail Online	√	×	LL	√	√	×	×	×
	3th Huffington	×	×	UnL	√	√	×	×	×
	4th Tribune Newspapers	×	×	UnL	√	√	×	×	×
	5th Guardian.co.uk	√	×	LL	√	√ *	×	×	×
	6th USA Today sites	×	×	UnL	√	√ *	×	×	×
	7th Wall Street Journal Online	×	×	LL	√	√ *	×	×	×
	8th Xinhua News Agency	-	-	-	-	√	-	-	-
	9th Washingtonpost.com	√	×	LL	√	√ *	×	×	×
	10th Advance Internet	√	×	LL	√	√ *	×	×	×
C: Classification, CC: Comments by Comments , CP: Comments by Page , L: Long, SL: Short Comments, ML: Mid Comments , LL: Long Comments, UnL: Unlimited Comments, T-G: Text and Graphic, AI – E: Auditory Icons and Earcons, SR: Record Speech, V: Video.									

Table 1 Using Multimodal in E-Journalism and Social Media

Auditory icons are potentially confusing for the users, especially when they are derived from the same sound source such as hammering with walking [35, 141]. In comparison, the auditory icons are less flexible than the earcons. Earcons can represent any object, operation or interaction in computer interfaces. They can be created in structured combinations to carry hierarchical information (such as menus and its components that could be differentiated by pitch, timbre and other sound attributes. Auditory icons have been useful non speech sounds to convey occurrence of events. Table 1 shows the usage of multimodal in the top 10 e-newspapers and social media in the term of adding and retrieving comments system [127,133].

In summary, earcons and auditory icons come with its own limitations. As a result Brewster has suggested that combining both of them in a multimodal interface could be the best choice. This claim has been supported by the experimental studies.

2.2.4 Technology of Avatars

An avatar is multimodal interaction metaphor, which can involve visual and auditory human characteristics [45,146]. Avatars are used to communicate facial expression by animated characters. These computer-based characters tend to represent one part in an interactive context. Avatars convey verbal (speech, written messages) and nonverbal (facial expression) information [100].

In general, avatars can be distinguished between abstract, realistic and naturalistic. Abstract avatars are cartoon-like characters. The help avatar incorporated in Microsoft Office is an abstract avatar [179].Realistic avatars are real representation of humans being generated on captured static or video images. Realistic avatars appear in games, movies and teleconferences [118]. The difficulty is the cost of the hardware needed to implement realistic avatars. However, the naturalistic avatars look very personal and individual in its appearance. They use is wide in collaborative virtual environments such entertainment, education, e-learning, and e-commerce. The employment of avatars in virtual environments could provide users with a sense of presence and involvement in social computer-mediated activities.

This could enhance the interaction between users who are communicating in these environments. User’s avatar can reflect person's actions, attention and interactive behaviour, thus providing a high level of awareness [25,28,79].

Fabri et al.[45,100] have argued that facial expressions can be used effectively and efficiently by avatars in user interfaces. They found that the six universal facial expressions [147,179] happiness, surprise, anger, fear, sadness and disgust in addition to neutral, are recognised by users despite communicated with limited facial features. In addition, Fabri et al. demonstrated that avatars improve users' involvement in the communication tasks and create enjoyable experience, providing them with higher senses of presence [45,100]. Facial expressions were also explored as a therapeutic technology for autistic users. Autistic children have their own unique learning style. Users affected by autism were found capable of understanding and using the facial expression shown by their avatars [45,100].

By combining speech metaphors with expressive avatars, more natural auto-visual interaction occurs. In this interface verbal information are communicated with body language and facial expressions. It has been generally accepted that most of the human body gestures are common to all cultures and traditions [80,85]. For instance, head shaking indicate disagreement whereas nodding expresses agreement. However, some research have emphasised that culture specific differences in interactions need to be taken into account for human computer interaction. Therefore, as a result it is necessary to acknowledge these differences in the design of interfaces. Gazepidis and Rigas [179]argued that talking virtual salesman who communicates through facial expressions is more appealing to users compare to the textual presentation of products. Based on further empirical investigation, it has been proven that positive facial expressions and body language are preferred [147,179]. Furthermore, mixture positive, negative and neutral expressions improved users' ability to remember received information more accurately [33,45]. The happy expression was found to be useful in enhancing users' attitude, intentions and experience, making them more pleasant, confident and responsive to the required tasks [80,85,86,99].

Multimodal interfaces which integrate speech and facial expressions are found to provide more flexible, natural, and productive communications between computers and humans. Overall, avatars have been found to enrich quality of communication between user and computer.

2.3 Benefits and Limitation

E-Journalists now have more ways to obtain information from various blogs and twitter. With the invention of the many various social networks Journalists can receive the opinion of the general public when writing their stories. In traditional journalism reporters had to go into the field to obtain information whereas today digital journalism puts a lot more power in the hands of the user [65].

Digital journalism is also much easier and much more accessible to the general public; the world runs on electronics and the internet. Blogs can enhance the coverage of news outlets because it can reveal potential information that was available to the public. Blogs also give a journalist a solid public opinion on certain topics or issues. Although blogs might not be a completely reliable source it can give a news outlet a good idea of what to look into and research. With Web 2.0 technology news coverage can obtain a general demographic on a certain topic or issue. Web 2.0 such as Facebook or Twitter is a great way to interact with the public and socialise. Facebook offers a vast social network where a journalist can post a story for an opinion before publishing it [65]. Table 2 shows Positive and negatives of multimodality for e-journalism as results previous studies in this chapter.

Positive of Multimodality	Negatives of Multimodality
• It gives the opportunity to implement real life interactions. • It could potentially facilitate face-to-face communication in add and retrieve comments in e-journalism and social media interfaces. • It makes the service applications much easier to use, improve time management, and give more choice and freedom in e-journalism. • Earcones combine more complex information and it could be effectively used to communicate information. • It could engage the human's interest and facilitates processing of information.	• It could cause overload of human sight sense during interactions. • It might result in loss of information received. • Sometime it is not advanced enough to satisfy its users. • It is not used in the systems that operate with a large vocabulary. • Sometimes the formant speech is of poorer quality. • The synthesizer technology is a faster and more flexible way of producing high quality speech sounds, the sounds still sound like computer generated. • It can be understood faster after the sufficient practice.

Table 2 Positive and negatives of multimodality for e-journalism.

E-Journalists now use the new advances in technology to spread the news worldwide. The biggest change in journalism is the use of social networks. Twitter and Facebook are two of main ways the media presents the public with news. These websites allow journalists to post breaking news, links, videos, photos, etc. The other big way journalism has change is the use of websites. Traditional medium like newspapers are slowly dying because of the use of the internet. Many newspapers now use websites and require a subscription for people to read stories or news. Technology has changed the way journalists do just about anything. Digital journalism allows news to reach the public immediately. Traditional journalism is much slower. For example, newspapers cannot publish breaking news; they only publish “yesterday’s” news. With digital journalism, the media can produce news within minutes.

Many cell phones now have internet service, which allows journalists to post news on Facebook and Twitter [65]. With technology advancing at such a fast rate, many other things are changing and adapting as well. Journalism is no exception. Journalism is transforming from print to digital to keep up with people’s desire for news as soon as it happens. Digital journalism satisfies this need because it is virtually instantaneous [21]. Whereas traditional journalism features yesterday’s news, digital journalism has the capability to report something that happened a few minutes before. Digital journalism is also different from traditional in the fact that anyone can user and play the role of a journalist. With the popularity of social networking and blogs, anyone can share news or interact with a news story [65].

Despite the numerous advantages of online journalism, there are also limitations. The benefit of immediacy can give rise to some serious ethical issues. The desire to publish brand new information and the ease of which it can be altered may cause information to be made accessible before it is verified [161].This undermines the journalistic principle of accuracy and can lead to misinformation. Another problem is the dilemma of breaking a news story immediately on the internet and therefore alerting important news outlets, or waiting to break the news in another medium and have an exclusive story [160].

2.4 Evaluation Experimental in E-ARCS

This section will evaluate of the previous experimental studies related with adding and retrieving comments in social media.

2.4.1 How useful are Your Comments

Research into sentiment classification and opinion mining, for example [7, 184] involves the issue of automatically allocating opinion values, for example, ‘positive’ versus ‘negative’ versus ‘neutral’ to documents or subjects using many different text orientated and linguistic qualities. Research that has been done on this topic recently, utilises SentiWordNet [62] to make classifying easier and more successful. The problem setting used in this research however is different from our work as they investigate feedback comments from the community instead of attempting to predict the feelings behind the actual comments. Much research has been done in classification that uses probabilistic and discriminative models [8] together with learning regression and ranking functions [185, 189]. The SVM Light software package [180], which is very commonly used, provides many different types of parameterizations and variations of SVM training (for example, binary classification, SVM regression and ranking and transductive SVMs, etc.).

In this particular paper, the researchers used these techniques in a new context to automatically classify comment acceptance. Kim et al [181] classify product reviews with respect to how helpful they are when involved with various textual features and Meta data. However, their best results came from using a mixture of information gathered from the star ratings (for example, deviation from other ratings) supplied by the writers of the reviews; information like this cannot be obtained for all websites and more specifically, cannot be gathered for comments posted on YouTube. Weimer et al [7] use something very similar to automatically estimate the value of posts on Nabble.com (a software internet based forum). Liu et al [182] give details about a strategy for aggregating ratings for product characteristics,; making use of helpfulness classifications based on a predetermined ground truth and then measuring it against their summarisation with certain ‘editor reviews’ on these websites. The study also used community feedback to gather data and ground truths for classifying and regression [187].

Also they used tags and visual elements together with favourite assignments in Flickr to categorise photos and put them into order with regards to how attractive they are. In comparison with other work that has been done in the past, our paper is the first to utilise and assess automatic classification techniques for accepting comments in YouTube. Moreover, they were pioneers in giving a comprehensive analysis of how the comment ratings in YouTube are allocated. Both quantitative and qualitative studies were included as were dependencies on comment sentiment, the difference for ratings between categories and polarizing content.

2.4.2 News Comments

Past research has looked into the different features of the comment space dynamics. Mishne and Glance [193] researched into weblog comments and found that they were very beneficial for improving retrieval and for discovering disagreements in blog posts.

Duarte et al. [62] defined blogosphere access patterns from the blog server point and discovered three sets of blogs by utilising the amount of posts there were over comments. Kaltenbrunner et al. [190] assessed how long it took the community to respond with regards to comments on Slashdot stories, and found that there were frequent temporal patterns in the way that people commented. Lee and Salamatian [196] state that the number of comments in a discussion thread is indirectly proportional to how long it stays on the internet for. They found this out after researching into the clustering threads of two internet discussion forums and a social networking site. Schuth et al. [195] investigated into the comments on news stories on four Dutch media websites. They give details about the people who comment and come up with a technique for deciphering the discussion threads from the comments. De Choudhury et al. [8] categorise discussions on internet media with respect to how interesting they are.

The study investigates the commenting space on news articles on the internet and model the commenting behaviour for numerous sources of news. Research done in the past has found that the distribution of comments in blog posts is controlled by Zipf's law [191, 192]. Lee and Salamatian [196] utilise a Weibull distribution for modelling the comments made in discussion threads. Kaltenbrunner et al. [62] highlight arguments for using the log-normal instead of the Zipf distribution for modelling; they utilise four different log normal to model the reaction times on Slashdot stories. Ogilvie [195] model the distribution of comment counts in RSS feeds with the use of the negative binomial distribution. Tsagkias et al. [194] utilise a similar strategy to model comments made on news stories for prediction before it is published. Wu and Huberman [194] discovered that digs can be modelled using the log-normal distribution and Szab´o and Huberman model popularity growth of online content utilising a linear model.

2.4.3 Ranking Comments on the Social Web

Various new studies have investigated barriers to the value of user supplied content, such as the value of user supplied tags [15] blog comments [16] user supplied answers on question-answer forums [17] and product reviews on the Amazon website [18] etc. The majority of the time, these quality assessments depend on experts outside of the social internet community, for example a panel of experts can decide if a blog comment is ‘spam’ or is ‘not-spam.’

2.4.4 What Makes Conversations Interesting

Social Media Communication Analysis: Much work has been carried out into assessing discussions or comments left on blogs [62,117] and analysis has also been done on the use of this communication for estimating; how users will behave, sales and the movements of the stock market etc [114,116]. In [116] the study assessed the dynamics of communication (of conversations) in a technology blog and then used this to estimate stock market activity. However, in previous work, the relationship or effects of a particular conversation property, with regards to other features of the media object, has not been taken into consideration. In this paper researchers categorise the outcomes of conversations based on the effects of the themes and the communication characteristics of the users.

2.5 E-Journalism History

E-Journalism is the method where producers, reporters and editors reach to the public by broadcasting news, making the use of electronic recording devices to gather information and presenting it telecasts and radio transmission [5]. The internet users' consumption of a meaningful content is informed by their knowledge and understanding of a wider world, which is same as the television audience before them. Interpretation of the experience is largely drawn by the cultural framework which the viewer produce the visual text playfully [9]. Social media is on the other hand web-based and allows individuals to construct a public or semi-public profile within a closed system. Individuals articulate a list of users with whom they share connections, view and transverse their list with those within their system, the nature and nomenclature of which may vary [1]. Social media, since its introduction, has attracted millions of individuals, many of whom have inducted these sites into their day to day activities. Hundreds of social networking sites have come up since its introduction, with various technological advancements, supporting a wide range of interests. Most of these sites support the maintenance of pre-existing social networks. Many are also there which help connect strangers based on shared interest, political views and activities. This type of digital media vary to such an extent that they now have incorporated new and improved communications tools like mobile connectivity, blogging and video/photograph sharing [1].Before getting into the details of e-journalism, we have to understand how and to what extend journalism fell during the 1990's, what was the situation before internet and the rise of internet. Over the past two decades, it became evident that the practices of democratic journalism for the benefit of public, gradually faded out by the commercialisation of press in favour of profits swelling to a level of 20%-30% [7]. This means reduction in the quality of agencies handing news to the fortune of equity market, almost making a way out for the long term credibility for a shorter term fortune. This resulted in moving away from costly practices like investigative journalism, having a diverse reporting staff, with foreign correspondents, acting like a watchdog of politics and economy, despite having a constant outcry from disillusioned journalists [7]. In the wake of these absences, cheap and more saleable practises came-up, like sensitising the issues, having mock debates, more coverage of business news which are marketable, similar coverage of an issue across media with single ownership, no distinction between advertisements and editorials and relying on government press releases to fill the news gap [7]. This has given rise to more adverting friendly contents, marginalising complex political issues to just entertainment, where the importance is to images rather than on issues[13].Social media is not a new concept, only recently it has come in as a part of the mainstream culture and business environment. People have been using digital media to communicate, socialise and gather information. The birth of social media was on phone, contrary to the belief that it was started with computers [117]. The exploration of social media started to gain momentum in the 1950's. These early social media explorers were homemade electronic devices that generated tones allowing free calls and getting access to experimental back end of the system [17]. SixDegree.com was the first recognisable social network, which was launched in 1997, where users can create profiles and list their friends and in the early 1998, they could also surf the Friends lists. These kind of features already existed in one way or the other form even before SixDegree. Profiles were also there on some dating and community sites [115]. Classmates.com allowed individuals to associate themselves with their high school or college and can find out other people who are in the network, but could not create profile or friends lists. The pioneer in combining these features was Sixdegree.com [7].Even though there are number of advantages of online journalism there were also limitations attached. The advantages of this immediacy gave rise to some serious ethical issues. The desire to publish new information and the ease with which it can be changed, causes information to be available even bore it is verified [17]. This value reduction can be seen in the journalistic principle of accuracy and leads to misinformation. Another problem which arises is the dilemma of breaking a news story first on the internet, thus altering other important news or breaking the news in another form and having an exclusive story [14]. The spread of cyberspace and the volume of information available, intimidate audience and causes information overload [15]. This makes it difficult for the public to differentiate between credible news websites and other non-official news websites, which leads to confusion and misinformation. The issue of surveillance, censorship and privacy in online journalism is also having limitation.

2.5.1 Environment and Users

World Wide Web and the Internet cannot form an agenda, and because of the size of audience which are less in numbers and online publications depends on big brands for their information source. The news agencies and the broadcasters which own these websites maintain control on fixing the journalistic agenda and debates. Even after all this, online journalism plays a greater role in altering the traditional ways reporter and editor follows [17]. Enabling the readers to challenge the role of publication agencies as the gatekeepers of information, online journalism has given users great powers. Users can also dig deep into the basic documents of news or like in the case of traditional method can even select and filter the news. To sum it up, users can do a research by themselves and compare the original documents with other reporter's story, by going through all the contents published elsewhere in the country [17]. With the easy availability of archives, online journalism also paves the way of different ways of approach through various technicality of new medium. In other words, online journalists can also provide text, audio, video and photographs [39]. Access to information is easy through data searching which is not possible in other media [17].

Alongside these open services, various Social Networks Services (SNS) were launched to support niche demographics, later on spreading to a larger audience. Also, Facebook was conceived to support only social networks [1]. Facebook which began in early 2004 [199], started supporting other schools, and those users were supposed to have an university email addresses as a basic requirement which kept the site relatively closed and users perceived the site to be an intimate and private community. In the later part of 2005, during September, Facebook, started including students from schools who were not in that community, as well as corporate professionals and finally opened to all. Opening an account to all did not mean, users have access to networks which are closed and access was only granted to those having an appropriate .com address, while administrative approval was required to be in the networks of the universities. Facebook has a unique feature which was not present with other networking sites. It did not allow their users to make their public profile open to all [1]. Another differentiating factor for

Facebook is ‘Applications’ which can be developed by outside developers and allows account holders to maintain their profiles according to their preference and perform tasks like, comparing movies. While most of the SNSs try to grow horizontally and vertically, many are there which seek narrower audiences [1]. Small World and Beautiful People are sites which appear selective and elite and they do restrict intentionally. Activity –cantered sites like Couch Surfing, identity-driven like that of Black Planet and affiliation-focused like My Church, limit themselves to their targeted demography and thus tend to be smaller [18]. Research shows that many SNSs support social relation which are pre-existing, although exceptions do exist.

2.5.2 Methods of Presentation and Interfaces

Journalism is changing and going to continue to change. Most people used to just read the newspaper every morning and considered that to be their only news for the day, but now almost everything can be accessed online [10]. Anyone can be considered a journalist with the usage of blogs, twitter, and facebook [10]. Sooner or later newspaper will run out and digital journalism will be the only way to get our news. Digital journalism differs from traditional journalism in many ways. Digital journalism involves users, for example; if one finds a story online at the end of the story there is usually a space where you can comment on what was said in the story, or even share another website to give people more information about the relative topic [10]. Digital journalism is also free; people pay to receive the traditional journalism every day. Web 2.0 is web applicants that allow users to interact and collaborate with each other. It is a huge factor of why journalism is continuing to change because of websites such as;

Facebook, You tube, and Wikipedia [65]. Web 2.0 adds to news coverage because anything posted on the internet can be accessed by a wide variety of people. For example, people are now starting to get their news from Facebook because people can post videos or update their statues about breaking news that they have current found out. The use of visuals in digital journalism is very useful. It is easy for a journalist to add a link to a photo they found on Facebook or a link to you tube video that is relevant to their story. This could add more appeal to their story and catch more reader's attention. Blogs and websites such as Wikipedia have now made it seem like "anyone can be a journalist"[158]. It is free and easy to start a blog and anyone can start one. Someone could have no knowledge about journalism but can be considered one now because of digital journalism. Anything posted on Facebook, Twitter, or Blogs could be considered breaking news, or catch people attention so that they continue reading your thoughts [158]. Social networking sites let the audience act as a user and it is easy for sharing your thoughts. Social networks such as Facebook can allow you to conduct interviews that can be more personal than just sending an email. In class we conducted an interview over Facebook chat, and it allowed us to become more personal with the speaker and elaborate more on each question [158]. Digital journalism is soon going to take over traditional journalism.

2.5.3 Usability and Evaluation

Millions of dollars are being invested in the provision of electronic Journalism resources [6]. The assumption presumably is that, the investment is making documents readily and usefully available to all appropriate user communities where as the traditional way of operating journals are available to many people who are not concerned about the same or they do not know the actual use of the article or publication. Digitalisation makes the things to reach to appropriate person. At its simplest, the term "usable" means "can be used" and usability of e-documents are several advantages over traditional such as efficiently and effectively users can achieve their goals with a system where as traditional required a lot of “hard work”. Some 88 present of adult Internet users today report using a search engine to find information [160]. Now the information is just a click away from the users and in Europe or in western countries the training of internet is not a big deal. Traditional media are now diminishing from market even though they are important as far as information is concerned. The books which were available in printed form, now they are available in electronic form; we just need a subscription for the site which is more cheaper that the hard copy price, because we not only paying for one book, we can access many books, journals from one subscription [160]. In the evaluation part, the quality depends on how the site, article is designed and there are many ways. Paper based journals are attractive due to limitations on design because more will design the cost will go high which is not acceptable whereas the digital journals can be designed online [158].

2.6 Public Opinion

Public opinion is the aggregate of individual attitudes or beliefs held by the adult population. Public opinion can also be defined as the complex collection of opinions of many different people and the sum of all their views [66]. In this section will discuss the factors which impact on the public opinion as part of issues to add and retrieve comments as well as it will outlines some public opinion theories.

2.6.1 Factors Influencing Public Opinion

There are many different factors can impact on the users when the read comments in the news or articles. Some of them as external factors and the other are internal. This section will describe these factors.

2.6.1.1 Environmental Factors

Environment plays a crucial role in the development of attitude and opinions. Factors which influence the social environment are family, friends, surroundings, place of work or worship, etc [27]. People thus try to change their attitude according to the environment which is quite common in the group in which they live. Research shows that, if a United Sates citizen considers himself to be a liberal is likely to vote conservative candidates, if surrounded by people who profess conservatism in his home or at his workplace, than a liberal who is surrounded by people of similar political opinion. For example, during the World War II, people getting transferred to some other unit, adjust their views; according to the general views of the unit he got transferred [27].

2.6.1.2 The Mass Media

Mass media channels such as Newspaper, radio, television and internet, including e-mails and blogs, may not have that influencing power, but still they are important, especially when conforming to already established attitude and views. The focus of public attention on certain personalities and issues by the news media, leads to form opinions about them. Public's trend to follow the headlines was also affirmed by government officials' [27]. Mass media has the capability to activate the dormant attitude and to prompt them to act. For example, before elections, voters having an inclination towards a single party or a particular candidate may also get de-inclined by media and start voting or even giving monetary support to the party. It also enables a person to know what others are thinking or give political leaders to reach a larger audience [27]. This makes possible for the mass media to reach to a large number of individuals and wider geographies influencing opinions. In fact, some European countries have seen an effect on their parliamentary system because of a wider reach of mass media like Television [112]. Previously elections were a contest to secure a seat in the parliament, but television changed it, and that happened only between candidates of different parties [38]. But with the advent of e-media which grew more with sophisticated technology, elections became a personal fight even within the parties [112].

In underdeveloped and developing countries the spread of mass media is low and here the information flow is largely dependent on word of mouth, although on a smaller scale. This is also same for countries where media is under strict control. Newspapers and gatherings in villages around radios or community television; are the common source for information flow among people who are literates through words of mouth. Countries having a controlled media, a substantial number of news are spread through rumours [38]. Spread of words though rumours and ways such as text messaging are the only channel though which public views are circulated, even though the movement of message is slow and involve number of people rather than in a country where the media network is dense and controlled.

2.6.1.3 Interest Groups

Non-Government Organisations (NGO), Interest groups, labour unions and religious groups form and spread public opinions on issues which are connected. They may have common issues on politics, economics or ideology and most of them work with mass media along with other form of person to person communication. Many of these large and influential groups around the earth use advertisements and relationships. An effective and popular tactics is informal polling or straw vote. In these polling members are supposed to vote "vote" on unsystematic "polls" of public opinions carried out without proper public sampling procedures, usually through phone or internet. Multiple votes are encouraged by the group and once they publish it through a credible media, they claim it legitimate by providing references [38].

2.6.2 Public Opinion Theories

To understand the public opinions, surveys are conducted which is also a scientific. But as per James c. Scott, in a political environment which is authoritative, individuals who are part of the survey, stay on at two levels, official and un-official. Official Level also known as public transcript level, people say what is to be considered as official. Questions on sensitive political issues, they provide the "Correct" answer. Individuals are structural forced to associate with the existing system, to save them along with the family, where Leninist system is there, which control of economy, access to housing, jobs, passport, education and administrative services. But at the un-official level, individuals are tied together on trust and local views of expressed justice like; jokes, gossips, etc. Low levels of censorships provide views, which are not present on the official version. To capture an alternative meaning of the public opinions, analysts of political culture, must decrypt, what is encoded in official and un-official versions [66,112].Therefore in China, surveying of public opinions, requires a great deal of interpretation, assuming one can capture the unofficial story, to understand the forces that inform public views [161].

2.7 Previous Evaluation and Experiments

The crucial matter behind the study in the thesis (Chapters 3, 4 and 5) is whether the enclosure of unique classification of opinion readers with recording metaphors is capable of enhancing the usability in social media and e-journalism interfaces. Some studies [58,178,193,194,196] indicated that the majority of users were not satisfied with the outcome of comments presentation. From their point of view, the information was too cramped, with disorganised data, and classification issues which were the main problems faced readers in retrieving comments in E-ARCS. Moreover, the spelling mistakes, confusing agreements, typing difficulties and missing data were the most common issues faced by commenters in using the adding comments system. Almost all of the users said that they preferred to engage with social media and e-newspaper including adding and retrieving comments when they are doing other work. So, fowling Chapter (3,4 and 5) will investigate these issues by suggested employing multimodal and AVATAR metaphors in E-ARCS and measuring the impact on the public opinion as media studies and usability as computer issues.

2.8 Summary

To sum up, this Chapter provided some background studies about terms of multimodal interactive for e-journalism and social media, its definitions and history, highlighted the benefits and limitations, and mentioned the method of presentation in term of adding and retrieving comments of the environment and users to digital world. Moreover, it outlined the concept of public opinion by demonstrated the environment factor and some media studies theories. Some potential aspects were specified describing to multi-modal systems, considered the approach that these metaphors interact with electronic interface applications and real interaction studies developed by other researchers.

Lastly, it reviewed some recently enhanced method and interfaces for e-journalism and social media applications in the term of adding and retrieving comments systems.

Chapter 3:Initial Survey and Experimental: How the User Interface Interaction of E-Journalism can be enhanced?

3.1 Introduction

This Chapter is designed to investigate the issues of adding and retrieving comments by taking into account the perspectives and interests of those involved in the social media and e-journalism fields. An empirical examination is carried out in accordance with this purpose to explore the usability aspects of the interface of the Electronic Adding and Retrieving Comments System (E-ARCS) that integrates a combination of traditional techniques, typical text with graphic, and compares it with a unique multimodal classification metaphors interface.

The critical issue that prompted the initial survey and experiment is whether the enclosure of unique classification of opinion-readers with recording metaphors is capable of enhancing the usability in social media and e-journalism interfaces.

From the initial survey, the basis for this investigation was determined to be sited around the main issues of adding and retrieving comments. It was, however, sustained to design a unique platform (opinion classification and sound tools) to contrast with the traditional approach in electronic newspaper system. In line with this development, users were thus invited to measure the achievement times for four tasks, the number of mouse clicks, tasks completed successfully, as well as, to give their feedback in respect of satisfaction.

3.2 Aim

One of the aims of this study is to evaluate the issues of the utilisation of comments by users of social media, hence the initial survey to obtain the perspectives of such users. Another aim would be to investigation various aspects of usability, including effectiveness, efficiency and satisfaction. The research aim's questions for this study would therefore, more specifically, include the following questions:

- What are the main issues which the commenter encountered in the interactivities field within an e-journalism and social media interface, in terms of adding and retrieving comments in E-ARCS?
- Does the use of speech metaphors with either Recorded or Synthesised Speech have an effect upon adding comments compared with typing within the interaction of e-journalism and social media interfaces?
- Does the change of the output by using graphic classification have an effect on the retrieving comments and recollecting information successfully compared with the traditional approach within the interaction of e-journalism and social media interfaces?

3.3 Objectives

In order to achieve the above aims a number of objectives were determined, that would elucidate the performance of the initial survey (questionnaire and interviews) as well as justify the experimental design (hypotheses, implementation and analysis of feedback result).

To gain a deeper insight on the issues, the initial survey was used to manage users' attitudes and viewpoints. This involved the use of a unique approach of applying visual classification using speech for adding comments to express information in E-ARCS.

The findings from the initial survey showed how the information could be seized and placed in specially developed experimental interfaces. As a result of this, the unique platform was designed to enable comments to be manipulated with classification of commenter’s opinions, as well as adding such opinions with the use of sound metaphors.

The opinion classification is considered to be built to reorganise and represent information in comments by employing diverse colour, graphics, and natural recorded speech. The experiment measured under this platform demonstrated no unfairness from the point of observation of the users towards this unusual presentation method with regards to adding and retrieving comments.

3.4 Initial Survey Outcome

The main idea behind this section is to explain the feedback of the initial survey by the result analysis. The initial survey demonstrated that overcrowded information with unorganised data, and classification issues were the main problems faced by users in retrieving comment while the spelling mistakes, confusing agreements, typing difficulties and missing data were the issues in adding comments. The majority of the users preferred the CMARCS, classification and multimedia platform over the traditional technique in terms of the number of tasks completed successfully, number of errors, and mouse clicks as well as for saving time. In addition, a questionnaire evaluated the feelings of users which supported the dominance of CMARCS over TARCS. This appraisal was reached with 34 users who has an interest in comment usability in the social media field. The outcome cleared that, the perspective of users was the same in accepting approaches, (hearing or reading the comment). Also, it showed that more than 61% preferred to add comments by recording sound rather than by typing as well as the majority of users want comments to be classified by the opinion of commenter.

Understanding and identifying the commenter's experiences with E-ARCS led to the design of the CMARCS from user's perspective. These experiences were classified into the preferred approach for interactivities as well as preferred categories about comment and commenter.

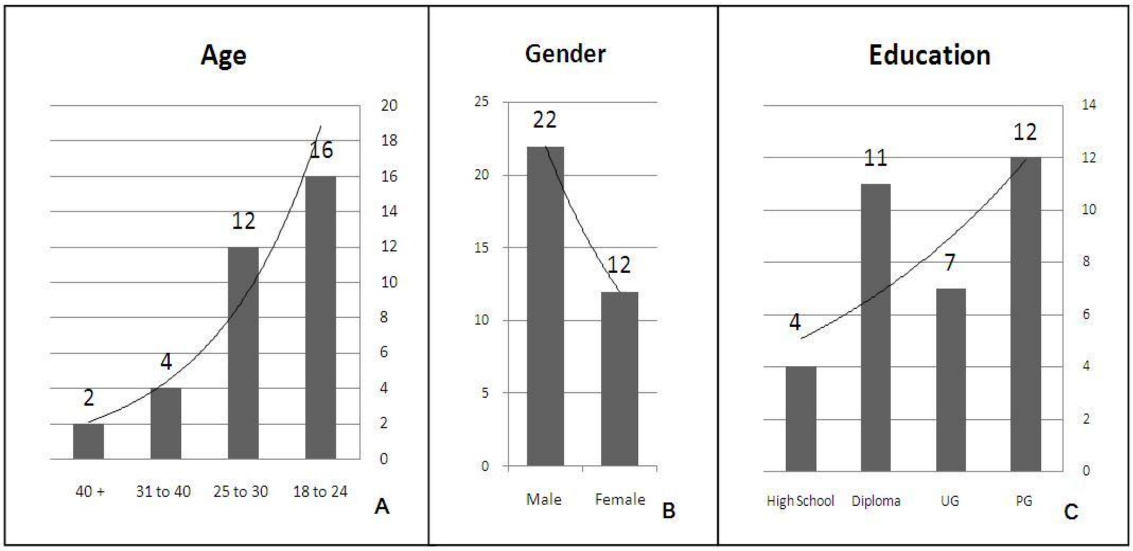

Figure 3Initialsurvey personal details outcome for Age, Gender and Education

3.4.1 E-Journalism Usage

The next two sections describe users' views about their internet experiences, and the usage represented by the number of articles which the users read weekly as well as spending time with e-journalism and social media websites.52.9 per cent, (18 out of 34) were sport and local news while the lowest percentage was business news. The result led us to choose article tasks about sport and local news, being more interesting, during the experimental measurements.

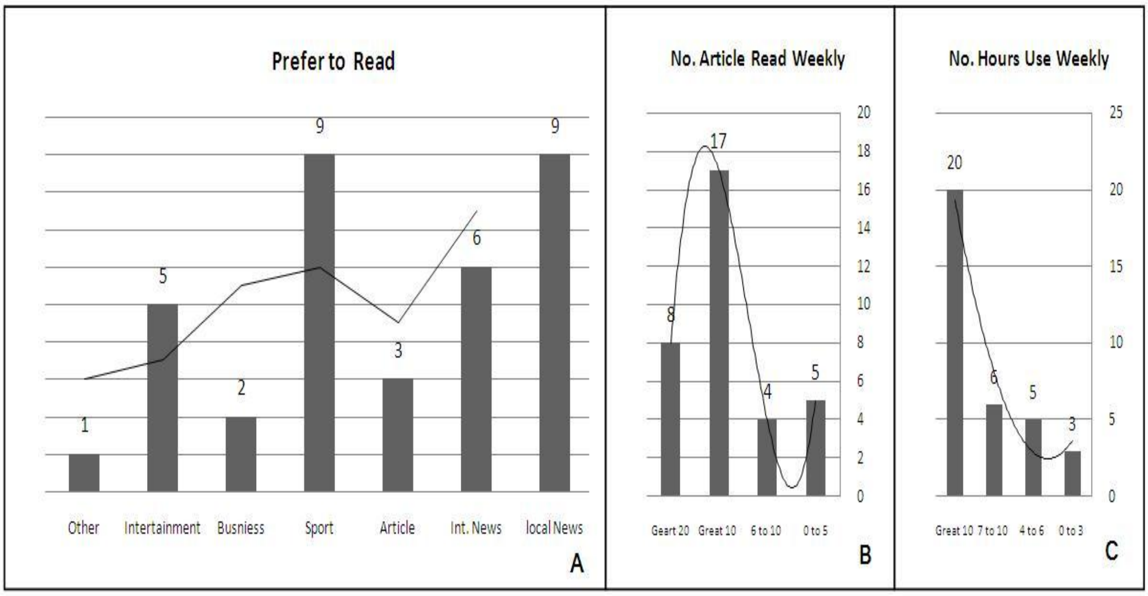

Figure 4 Internet experience and usage of users' view.

Figure 3 (A) demonstrates that the most news articles preferred to visited by readers are the sport and local news while business news were the lowest subjects. It can be seen in Figure 2 (B, C) that more than 44% (15 out of 34) read more than 10 articles weekly. Approximately 11% (4 out of 34) read between six to ten articles weekly which meant that the majority of users spent time to read an average of with articles daily.

Nevertheless, nearly 60% (20 out 34) of the initial survey users spent more than 20 hours weekly involved with the e-journalism, between reading and writing comments. Most of them mentioned some comment issues which wasted readers' time such as the difficulty of tracking feedbacks, disorganised layout of comments, no classification and filtering approach, as well as some spelling and selecting problems.

3.4.2 Experience with Comments

The employed multimodal metaphors in E-ARCS were one of the primary questions to be measured from the perspectives of users in the initial survey.

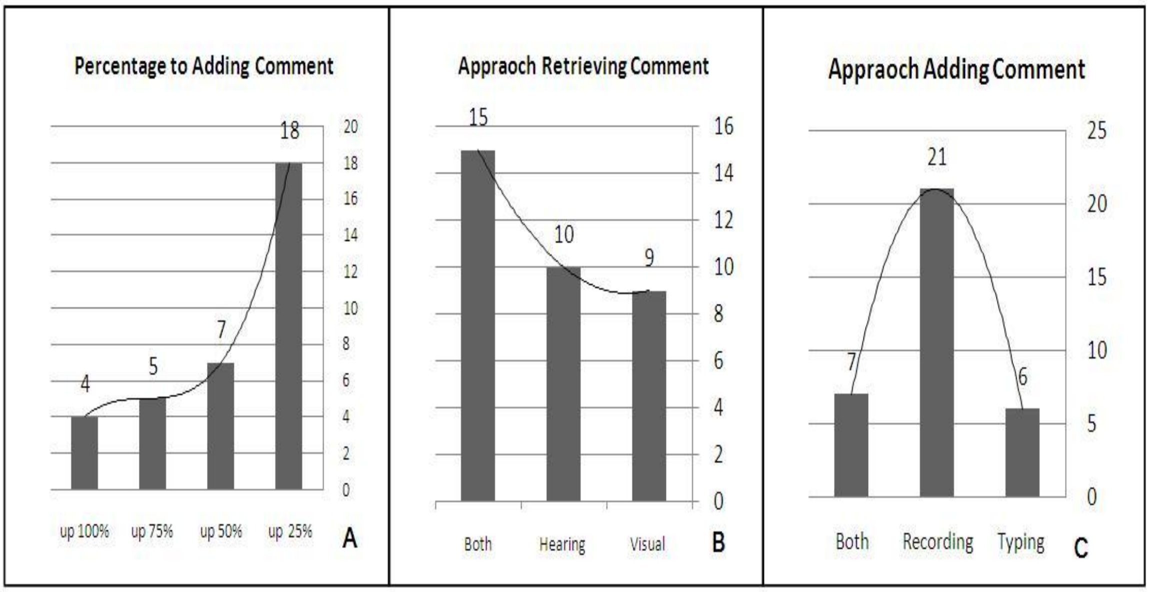

Figure 5user's view about dealing with comments and preferred approach to use.

However, the other question was to employ multimodal metaphors as a new approach for retrieving (hearing) the comments. The perspective of users was the same in accepting approaches, (hearing or reading the comment) as can be seen in Figure 4 (B).

On the other hand, Figure 4 (C) shows that more than 61% (21 out of 34) preferred to add comments by recording sound rather than by typing, which had less than 15 per cent (6 out of 34) support The users gave their reasons as being to save time, reduce spelling errors, as well as concentration on the presentation of their arguments. The last question in the initial survey aimed to determine the user's perspective concerning the distinction between comments and commenter.

In Figure 5 (A the majority i.e. nearly 70% of users, (23 out of 34), want comments to be classified by the opinion of commenter while the next percentage related to gender (c.15%) as well as occupation (12%).

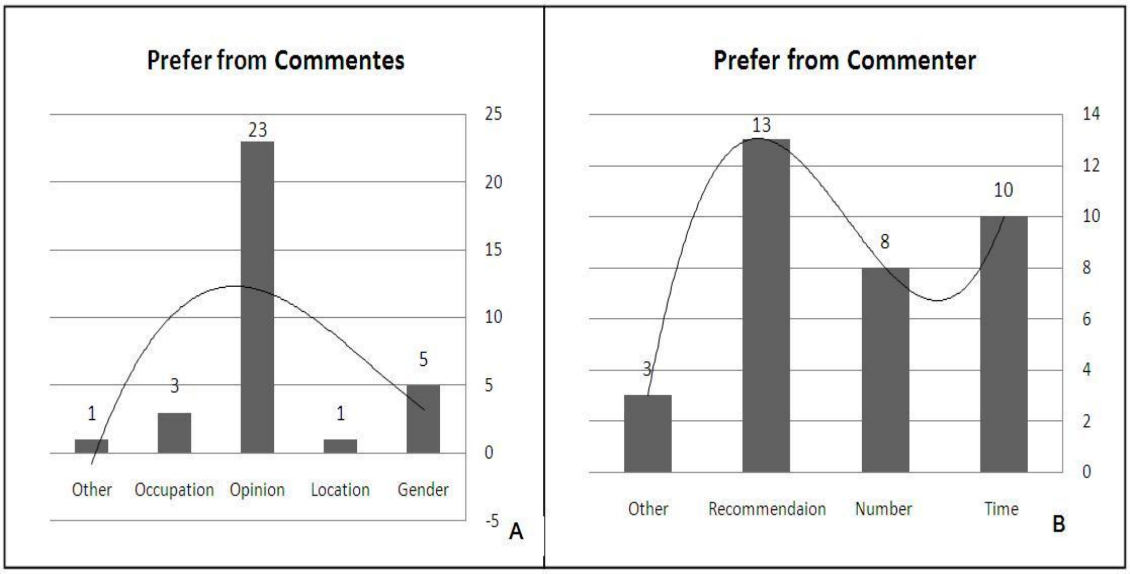

Figure 6User's preference about comments and commenter.

Moreover, users agreed that the classification of comments would enhance the usability of dealing with the comments. On the other hand, the recommendation of the highest percentage (38%, i.e. 13 out of 34) chosen to know with reference to commenter while the time was the second category (29%, i.e.10 out of 34) wanted to be distinguished by.

Finally, many users made suggestions regarding the comments classification, stating their preference to categorise the opinion as Agree, Neutral and Disagree, stating that this could make the comments interface much easier to use.

3.5 Initial Experiment Aim

The aim for the initial trial was to examine and compare the effect of using a new classification of opinion and multimodal metaphors, with the new way of interactivity of adding and retrieving comments, in social media and e-journalism. This new classification using speech and non-speech tools was designed as the product of the initial survey feedback.

The main aim of this trial, however, was to determine the most user-friendly interface in terms of satisfaction, effectiveness and efficiency from the perspective of users.

More specifically, the different interfaces which were implemented and evaluated against one another were the Traditional Adding and Retrieving Comments System (TARCS) and the Classification Multimodal Adding and Retrieving Comments System (CMARCS).

3.6 Initial Experiment Objective

The use of TARCS and CMARCS platforms supports the aims of this study; the "Traditional" way of adding and retrieving comments using text and graphics without classification as against the "Opinion "classification with multimodal built-in speech and non-speech metaphors. An empirical examination was carried out on the implementation of these platforms.

Additionally, they were evaluated by groups of users (n=25) to enable the objectives to be examined unbiased, measuring the usability of the TARCS and CMARCS in terms of their effectiveness. This involved the counting of the number of tasks completed successfully.

Also, the efficiency of the platforms was subsequently evaluated by measuring the average number of mouse clicks, error rate and time of task completion. A research-designed questionnaire was, moreover, used to evaluate users' satisfaction for both TARCS and CMARCS.

3.7 Initial Experiment Design

The experiment was designed to use both the traditional platform (which is existed in the real social media and e-journalism) and classification multimodal approaches. The first interface (TARCS) used text and graphic to add and retrieve information comments without classification compared with multimodal system (referred to as the traditional approach).

The multimodal platform used new metaphors such as speech tools (record sound or synthetic sounds) or non-speech tools (Auditory Icons and Earcons). These concentration techniques, speech messages are produced by concatenating pre-recorded segments of human voices after being saved in the system as well as enable human like interaction via computer system.

This platform was used by a control group and Figure 5 shows its interface. In contrast, the second interface (CMARCS) used by the experimental group employed sound metaphors and graphic tools (colours and pictures) to deal with comments functions. In addition, classification of readers' opinions was provided within the CMARCS interface to reorganise and make the comments more useful, with two main functions: “statistic" and “view all” comments. Figure 6 shows its use.

The statistical part contained all comments related to gender, opinion or the approach adding by using graphic and colour tools. Also, it provided the commenter with two different options to add the comment either by typing or recording with sound system.

The other section was the View Comments part that facilitated feedback presentation by classifying them as Agree, Disagree or Neutral. Each gathered its main information into three different colours (Green, Red or Amber).

Figure 7 Experiment interfaces; the up side shows TARCS and the down side CMARCS.

3. 7.1 Hypotheses

This section details the six hypotheses on the usability of TARCS compare with CMARCS. Below are the hypotheses upon which this research is based (2,5,31,77,118):

H1-01 Adding and retrieving comments in the E-ARCS by CMARCS will be more effective than TARCS (suggests that there will more tasks completed successfully by users)

H1-02 Adding and retrieving comments in the E-ARCS by CMARCS will be more efficient than TARCS (suggests that there will be time savings experienced by users in each task)

H1-03 Adding and retrieving comments in the E-ARCS by CMARCS will be more efficient than TARCS (suggests that there will be a reduction in the rate of errors in accomplishing all tasks)

H1-04 Adding and retrieving comments in the E-ARCS by CMARCS will be more efficient than TARCS (suggests that there will be reduction in the number of mouse clicks in accomplishing all tasks)

H1-05 Using CMARCS will be more satisfying than using TARCS due to all of the above hypotheses

H1-06 the usability of CMARCS will be better than for TARCS due to all of the above hypotheses.

3. 7.2 Tasks

It is important to mention that many studies in the field of measuring the usability of multimodal interaction [22, 27,31,97,99,123,125,103,152 and 166] have recommended examining the experiment by different methods. The outline of the experiment should also be mentioned, consisting of three variables: Interfaces of Interactive, Task Level and Task Type.

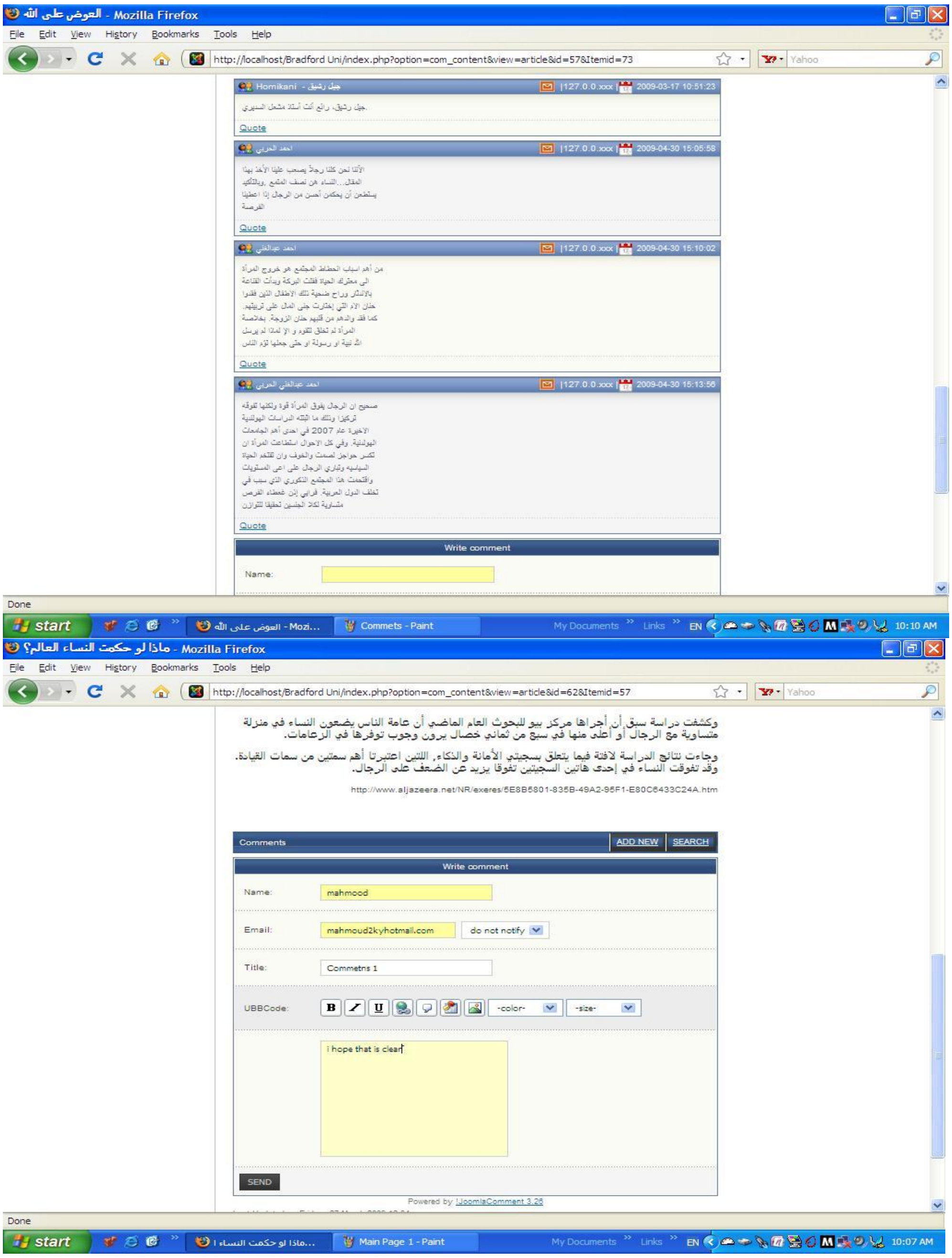

Figure 8 The approach to adding and retrieving comments using TARCS.

By way of explanation, Interfaces of Interactive are divided into two interfaces (a control and an experimental) and Task Type with two types (*Add and Retrieve Comments*). In this study, all users in the same group of tasks were asked to undergo training tasks before starting the experiment tasks. The reasons for the training tasks were to assist users in how to perform the tasks as well as all users being informed about training tasks, and then asked to complete the same group of tasks. These tasks were designed for four different tasks, two for adding and the other two for retrieving comments.

3.7.3 Tools

Many tools have used to design and create all platforms in this research. Some of them combine the colours with graphics or with speech and non-speech sounds. Also, some of them used to create the official platforms which consist of AVATAR and new classification metaphors.

Visual Basic .NET (2008 VB 9.0) which is implemented on the .NET Framework as object-oriented programming language. The VB was made by Microsoft which added many features such as XML Literals ,extension methods, type Inference, anonymous types, Support for LINQ as well as Lambda expressions.

CrazyTalk is innovative tool for generating exceptional digital content. The study used CrazyTalk 6 which conveys the critical solution for images and graphics digital content creators to add a video projects and websites in Stereoscopic 2D or 3D as well as to add digital actor to their movies.

3.7.4 Add Comments Tasks

The experiment created scenarios in each Add Comments tasks to cover two different tasks, namely Add Task1 and Add Task 2, as well as each one differing from each other. For example, in task 1, the user was asked to fill in the information for registration which included Name, City, Gender, Email and Title of Comments. The user was also free to start adding comments by filling in the registration part first, then to add a short comment which was approximately 350 characters, by selecting the Add Comment button.

Using TARCS, however, users do not need to write every single item as is normally the case. In the registration section, for example, the users were required to select gender by using a picture which showed either a man or woman rather than needing to type it in. The user was then able to type the comment using the keyboard and mouse. On the other hand, in MMARCS in the registration part, users needed to complete the main requirements by using speech recording. In addition, users selected gender by using auditory earcons which link to graphics showing gender. To select the type of opinions, MMARCS were required to select one of three colours: red, amber or green to show their opinion. Each colour refers to the type of opinion (agree, neutral or disagree).

Furthermore, users needed no longer to type in order to add comments in MMARCS: instead, recording sound was used to add it as multimodal metaphors. Task 2has the same steps to add comments in Adding Comments tasks but by the different data which required adding.

In the classification of commentators' review part, the number of “Agree”, “Disagree” or “Neutral” reviews was dependent on the number of those who added them. Figure 8 summarises the approach to adding and retrieving comments using TARCS.

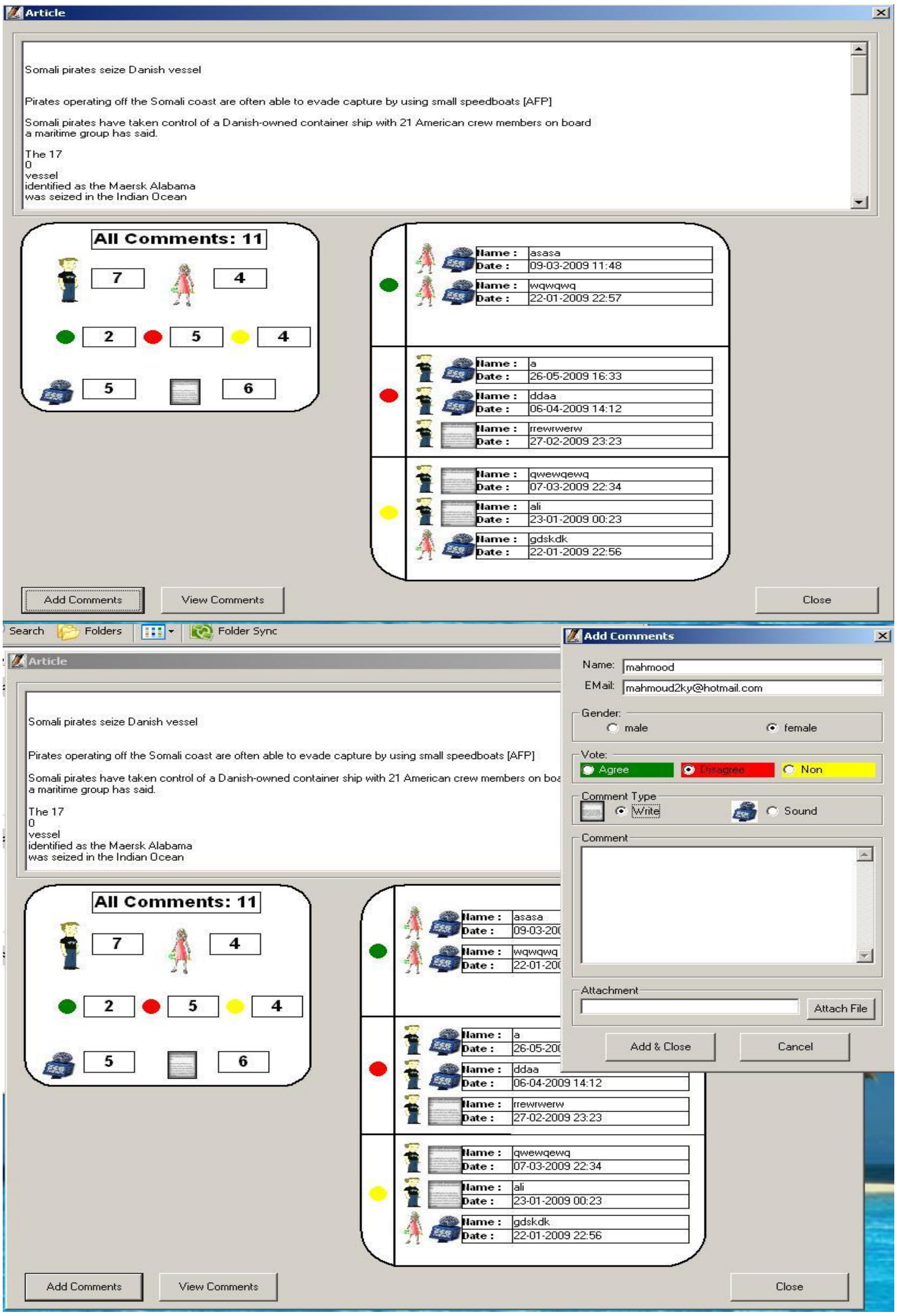

Figure 9 The method of adding and retrieving comments using CMARCS.

3.7.5 Retrieve Comments Tasks

The second type of tasks was Retrieve Comments selection tasks which also have different scenarios that facilitate levels of task. In the first, task 3was users needing to retrieve a comment from the list of view comments, which was added from previous tasks. After that, they were given questions to answer tasks 1 and 2 without looking into the interfaces, TACS or CMARCS. The last task, task 4 was to locate some information from all comments such as names or gender, a man and woman, number who agree or do not agree first or last comment in practical opinion as well. In this difficult task, users have to retrieve them and the study observed the result.

Each user was given time to retrieve all the comments in each retrieving task and a piece of paper to answer all questions asked. Figure 8 shows the method to adding and retrieving comments using CMARCS.

3. 7.6 Dependent Variables

The Definition of dependent variable should be as a variable that is being measured in an experiment. For instance, in a research on the possessions of teaching on test scores, the dependent variable would be the students or participants test scores. These impacts reflect the influence of the independent variable. Below shows the dependent variable which is reproduced during the study-steps on the outcome measured.

DV1-1: Time of Task Achievement: during the experiment, a user‘s performance was observed to calculate the time taken to complete each individual task, as well as all the tasks.

DV1-2: Rate of Error: there are many types of errors (Incorrect Typing Registration, Selecting Errors, and Confusion) recorded to measure error ratios in the experiments.

DV1-3: Number of mouse clicks: users were observed and counts taken of the number of mouse clicks to achieve each task, as well as all tasks.

DV1-4: Percentage of tasks completed successfully: to measure the success for each task, the experiment determined the number of tasks completed successfully. Users were observed counting these tasks and the percentage of tasks completed successfully was calculated.

DV1-5: Rate satisfaction of users: the SUS approach [161] was applied to discover the range of user's satisfaction by completing a questionnaire consisting of five characteristics. Appendix C-5 has a description of these characteristics.

3.7.7 Independent Variables

During the experiment there were two independent variables which related to the impact on the dependent variables. Table 2 outlines these independent variables.

IV1-1: Interfaces of Interaction**:** two different interfaces were designed to improve the functionality of E-ARCS: the traditional approach to adding and retrieving comments (TARCS), and a unique platform with classification multimodal opinion (CMARCS).

IV1-2: Task type: users were asked to carry out tasks designed with the Interfaces of Interaction system into two types: Add Comments and Retrieve Comments tasks.

Independent Variable		Measurement	
Description	Code	NA	Aspects
Interfaces of Interaction	IV1-1	2	TARCS and CMARCS
Task Type	IV1-2	2	Add Comments and Retrieve Comments

Table 2 The main independent variables used in the initial trial.

3.7.8 Control Variables

The study defined a number of control variables in order to determine which factors needed to be controlled, as well as which had an impact on the dependent variable. Below is an outline of these variables:

CV1-1: Achievement Tasks: all tasks which have been achieved by users need to be the same. For example, they should be asked to add the same length of comments and the same retrieve task in each platform here.

CV1-2: Experience familiarity: users who took part with CMARCS had not used it before. They were given a short training course about the system and how it worked.

CV1-3: Experiment Contents: groups using TARCS and CMARCS had the same data to measure for adding and retrieving the information.

3.7.9 Case Study Sampling

One of the main aims of this trial is to employ users who have basic familiarity with adding and retrieving comments on electronic newspaper or social media and accessible to the Internet.

The users who took part in this experiment were employees from Aljazeerah Channel since they were considered as credible representatives for e-journalism users. The strategy used to choose users was of unknown people from the newsroom or Aljazeerah staff, as employees in Aljazeera Channel in Doha, and this method is commonly used in many psychology experiments [127,128,129,130 and 171].

In this experiment 25 users looked at in both platforms, TARCS and CMARCS, and each group was split into two subgroups which enabled the experiment to have a balance between the types of task.

Group A: Odd user Id Group B: Even user Id			Groups used	
Balancing Between Tasks		Order	A	B
Pre-Experimental Questions		1	1	1
Add Comment:	Task 1	2	2	3
	Task 2	3	3	2
Retrieve Comments:	Task 3	4	4	5
	Task 4	5	5	4
Post-Task Questions		6	6	6
Evaluate Satisfaction of user		7	7	7

Table 3 The approach used to balance betwen all tasks by using two subgroups

Table 3 shows the number of tasks with the number of users who achieved their tasks by subgroups. Almost all the users had an average time spent in social media and reading e-newspapers of approximately 15 hours weekly, with their ages being between 18 and 55 years old.

They were given time to read the main article then asked to complete the Adding Comments part followed by the Retrieving section by randomly choosing. In addition, they were given training to make sure they understood the concept and the testing methodology.

3.7.10 Data Collection

During this part of the experiment, two types of data, quantitative and qualitative, were collected using different approaches such as observation, questionnaires and interviews. The experiment was observed to calculate the time which it took to complete each task by recording start and finish times precisely. Also recorded was the number of tasks that were done by each user so as to know whether or not the task was completed successfully.

Following on from this, the observation tracked the errors and numbers of mouse clicks used in adding and retrieving comments for each user. Furthermore, returned questionnaires reflected the views of users about the level satisfaction.

After finishing the experiment, users were interviewed to get feedback about the experiment and its effects. A full description of the raw data obtained from these experiments presented in appendices. A full description of pre-experimental, post-task and post-experimental items can be found in Appendix B-1and C-1 to C5.

3.8 Analysis of Results

This section applies descriptive and inferential statistics of the analysis results for the initial trial. This included measurement of central tendencies (mean, mode, median) and measurement of statistical significance using t-test. As well as this, the results of examining the two platforms (TARCS and CMARCS) are discussed in terms of effectiveness, efficiency, and satisfaction.

3.8.1 Measuring the Effectiveness

Analysis of system effectiveness consists of evaluating the interface of interaction, evaluation of task type and evaluating at the individual task level (4 common tasks: two of them to add comment and the others to retrieving). Analysis was carried out using the t-rest to assess if the distribution of the categorical variables differs from one another. The t-test compared the counts of categorical responses between the independent variables with interface of interaction such as VCKMS/MCKMS as well as between task achievements such as “successful” or “not successful”[128 and 129].

3.8.1.1Interface of Interaction

It can be seen in Figure 9the percentage of tasks completed successfully using the TARCS and CMARCS experimental systems. It shows that the CMARCS experimental group completed more tasks successfully (96%) compared to the TARCS group (71%). In addition, the t-test result revealed that there was a significant difference between the two interfaces of interaction with regard to the task completed successfully (t = -4.804; df = 24; p<0.05).

The t-test results did not exceed the critical value for 0.05 probability level (0.0002). A paired-samples t-test was conducted to compare TARCS and CMARCS conditions: this showed that there was a significant difference in the TARCS (M=2.8400, SD=0.987)and CMARCS (M=3.840, SD=0.374) which suggest that CMARCS does have a positive effect on users over that of TARCS.

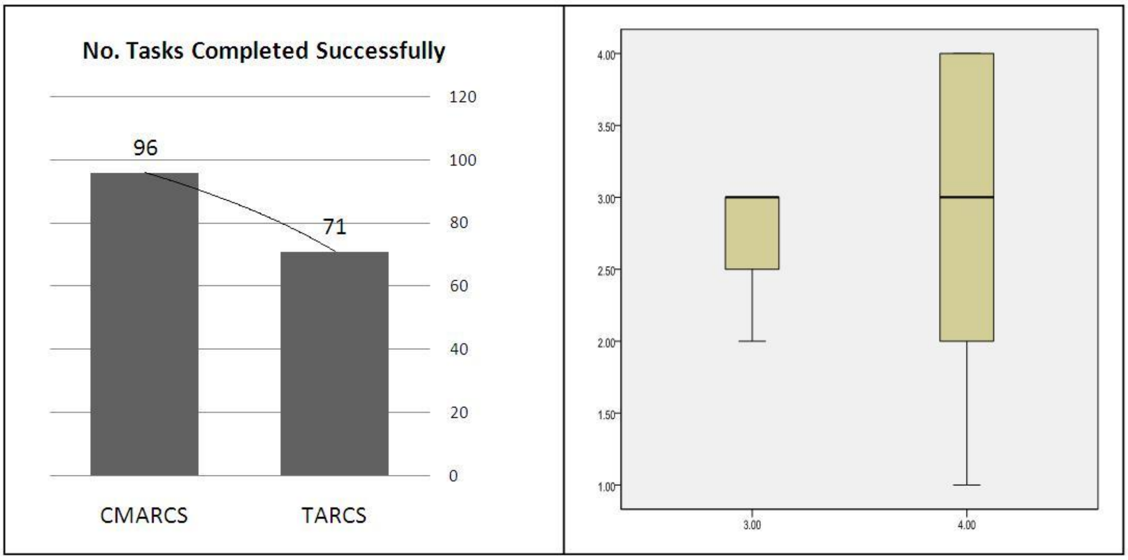

Figure 10 The percentage of tasks completed successfully using TARCS and CMARCS interfaces.

3.8.1.2 Task Type

Figure 10 shows the percentages of number of tasks completed successfully according to the two task types (Add and Retrieve Comments) using the TARCS and CMARCS experimental systems. It will be noted that adding comments tasks recorded the highest rate of accuracy (98 %) for CMARCS, and the lowest (72%) for TARCS. The rate of number of tasks completed successfully for retrieving comments task in CMARCS (94 %) was higher than that for retrieving comments task in TARCS (70 %). The result shows that there were large differences between adding comments for CMARCS (26%) while it was 24% for retrieving comments tasks. One would expect to find a significant difference between the completion rate of the adding comment tasks and retrieving comments tasks for TARCS and CMARCS.

The t-test result revealed an insignificant difference between the completion rates of the two types of tasks. There was a difference between the two tasks in the ability to complete them successfully by the two groups (TARCS and CMARCS).

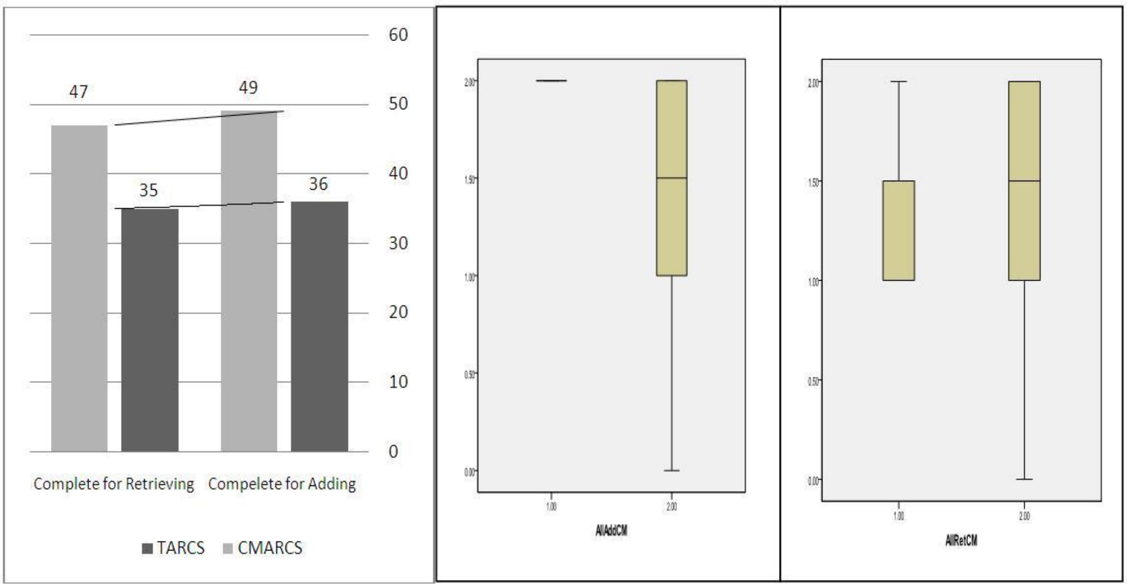

Figure 11 The number of tasks completed successfully using TARCS and CMARCS interfaces.

Both tasks were successfully completed by almost the same percentage in both groups. The t-test statistic test showed ($t = -3.641$; $df = 24$; $p<0.05$) a significant difference in the adding task accuracy between TARCS ($M=1.4400$, $SD=0.65064$) and CMARCS ($M=1.9600$, $SD=.20000$) for the adding comment type. On the other hand, the t-test showed a significant difference between TARCS ($M=1.4000$, $SD=0.64550$) and CMARCS ($M=1.8800$, $SD=0.33166$) in relation to the rate of retrieve task accuracy by ($t = -3.361$; $df = 24$; $p<0.05$). The reasons behind the difference are that many users felt some difficultly in typing comment texts compared with recording them. As well as this, the positive effect on CMARCS comes from the opinion classification when using the multimodal recording system which enabled accessibility to the system more than the traditional approach.

3.8.1.3 Each Individual Task

The main aim of presenting the completion rate of all tasks was to illustrate the task completion of each single task. Figure 11 shows the mean number of tasks completed successfully according to the four common tasks using the TARCS and CMARCS experimental systems. This Figure illustrates that the successful completion rate was higher for CMARCS than for TARCS for each individual task. In general, it can be noted that there is improvement by 30% in the number of tasks completed successfully in all CMARCS's task compared with that of TARCS.

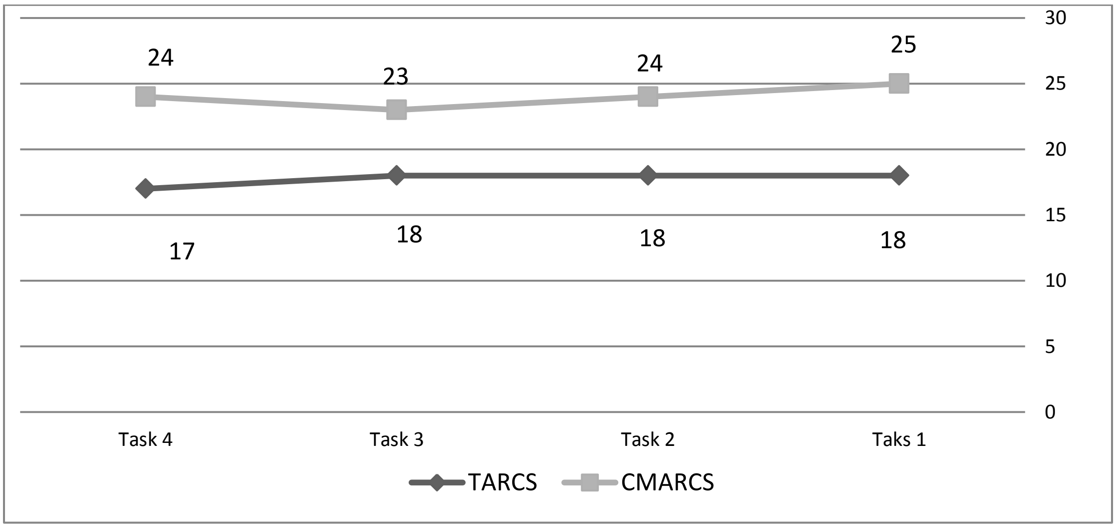

Figure 12The mean number of tasks completed successfully for each single task by using TARCS and CMARCS interfaces.

The t-test result suggested that TARCS and CMARCS differ significantly in completion rate for tasks 1 ($t = -3.055$; $df = 24$; $p<0.05$). Also the t-test result showed a significant difference in completion rate for task 2 between the two systems ($t = -2.295$; $df = 24$; $p<0.05$). Similarly the t-test result showed a significant variance in retrieval task 4 completion rate between the two interaction modes ($t = -2.585$; $df = 24$; $p<0.05$).

However, there was no significant difference in the t-test result revealed in task 3. This means that the t-test result showed no significant difference in the completion rate of task 3 between the two systems ($t = -1.732$; $df = 24$; $p<0.05$). Familiarity with CMARCS may play a role in reducing the difference in task 3, some users find it not recognizable the first time.

3.8.2 Measuring the Efficiency

The effectiveness of E-CKMS was analysed with regard to the interface of interaction, task type, alongside the analysis at the individual task levels. The variables were at the categorical level and as a result appropriate t-tests were applied. Conversely, measurements of efficiency are parametric variables. For this reason, the related t-tests were performed to test the statistical significance between the TARCS (control group) and CMARCS (experimental group). The measurement of efficiency was established by looking at the mouse clicks required to accomplish the task, task achievement time and rate of errors in both interfaces of interaction. The assumption was that the CMARCS system was more efficient compared to TARCS. The research was interested in finding evidence in support of this claim.

3.8.2.1 Interfaces of Interaction

Figure 12shows the mean value of task achievement time (a), count of mouse clicks (b), and the error rates (c) for the overall performance using the TARCS and CMARCS experimental systems.

The charts below show that CMARCS outperformed TARCS in relation to all system efficiency attributes. CMARCS had the smaller rate of error, completed the tasks significantly more quickly, and the mouse clicks required to accomplish task in the CMARCS system were noticeably fewer than those required in the TARCS platform.

The conclusion was reached that the classification and multimode approach was more efficient than the visual approach. The significance of the difference between the TARCS and CMARCS was tested by conducting a t-test analysis at 0.05 significance level . It can be seen in Figure 12 (A) that the mean value of the task achievement time for CMARCS was approximately two and a half times lower than that for TARCS. Mean task completion time to accomplish both retrieve and add tasks was 17 min13sec for TARCS (M=17:13, SD=1:41) as opposed to 06 min 15 sec for CMARC (M=5:46:, SD=1:09). This provides evidence that classification and multimode system is more efficient than the traditional system with regards to the time required for completing tasks. The t-test result showed that there was a significant difference between the two groups in respect of task achievement time ($t = 29.521$; $df = 24$; $p<0.05$).

It can be seen in Figure 12 (b) that the mean value of number of mouse clicks required to accomplish the task was approximately three times higher for TARCS (M=52.1600, SD=6.97424) platform compared with CMARCS (M=14.4000, SD=2.78388). The t-test result showed the significant difference between two interfaces in relation to the mouse clicks ($t = 25.224$; $df = 24$; $p<0.05$).

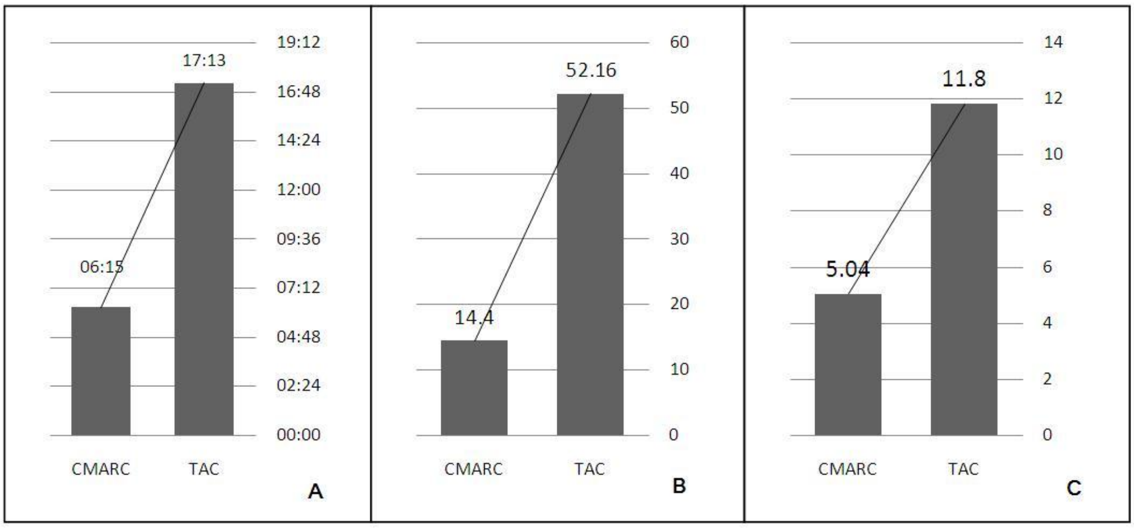

Figure 13 The mean task achievement time (A), count of mouse clicks (B) and the error rates (C) for TARCS and CMARCS

It will be noted in Figure 12 (c) that the error rate for CMARCS (M=5.0400, SD=2.11108) was much lower, by approximately a half, that for TARCS (M=11.8000, SD=2.58199). The related t-test revealed that there were significant differences in the error rate between the two groups ($t=9.307$, $df = 24$, $p<0.05$).The mean of errors made in the CMARCS platform was 5.04 and the TARCS reported 11.8.

In conclusion, the charts and results indicate that the CMARCS significantly outperformed the TARCS interface in three efficiency factors: task completion time, error rate, and number of mouse clicks. The feedback of users will be clarified in the next section and provides the reasons behind the significant reduction in terms of mouse clicks, errors, and savings in the time in all tasks.

3.8.2.2 Type Tasks

It can be seen in Figure 13 the mean value of task achievement time (a), count of mouse clicks (b) and the error rates (c) for the overall performance using the TARCS and CMARCS experimental platform according to the two task types (Add and Retrieve Comments). It will be observed in (A) that adding comments tasks recorded the highest time rate of four times for TARCS compared that with CMARCS, whereas retrieving comments tasks scored the lowest three times less for CMARCS compared with TARCS. Similarly, in Figure 13 (B) the mean value of the number of mouse clicks was the highest in TARCS in adding comments by 37 clicks compared with that of CMRCS which reduced to 10 clicks, while it was 15 clicks in retrieving comments in TARCS evaluated with that of CMARC which was about quarter of that number. And the third, Figure 12 (C), illustrated the mean number of errors that took place for each type in both platforms. In both types (adding and retrieving comments) has dropped by half times and more for CMARCS contrasted with TARCS.

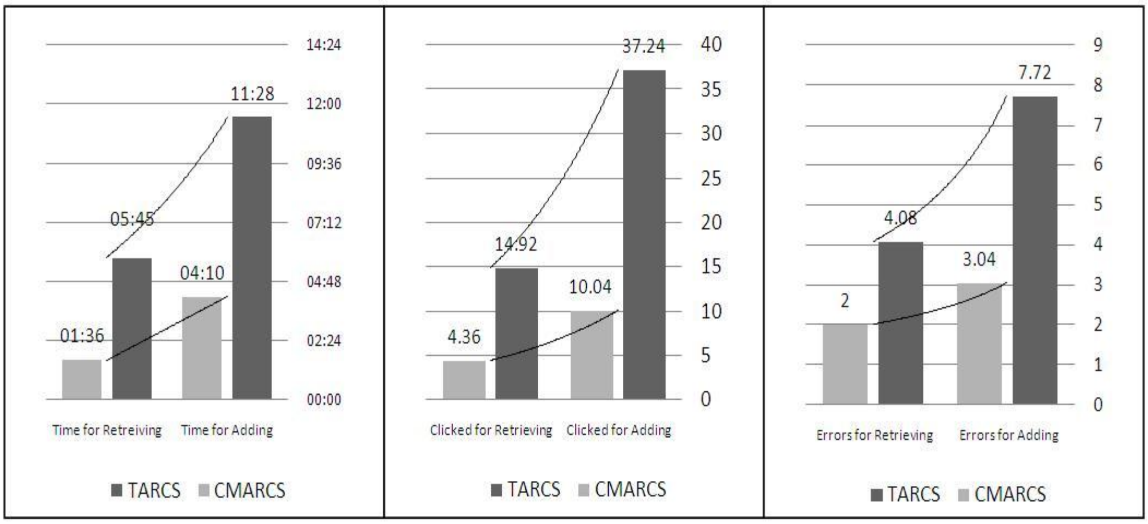

Figure 14The mean value of task achievement time (A), count of mouse clicks (B) and the error rates (C) of both types in adding and retrieving comments for TARCS and CMARCS.

The t-test result revealed an insignificant difference between the achievement time, the number of clicks, and errors of the two types of tasks. This simply means that thet-test statistic test showed a significant difference in add task for achievement time(t = 19.905; df = 24; $p<0.05$), the number of clicks (t = 25.588; df = 24; $p<0.05$), and the errors (t= 8.606; df = 24; $p<0.05$) between TARCS and CMARCS. Analogous to that for retrieving comments was for achievement time (t = 36.050:; df = 24; $p<0.05$) , number of clicks (t = 15.345; df = 24; $p<0.05$) and errors (t= 4.578; df = 24; $p<0.05$).

The previous results supported the hypothesis that CMARCS is more efficient in terms of adding and retrieving comments. The motivation for the users focus in all the tasks on their arguments without hesitation is reflected by the mouse clicks and text typing. As well as this, visual tracking was easier in graphic classification in retrieving the comments compared to the traditional approach.

3.8.2.3 Each Individual Task

The main reason for presenting the efficiency values of all tasks was to describe performance at an individual task level and identify possible variances between the task types. Figure 14 illustrates the mean value of task achievement time according to the four common tasks using the TARCS and CMARCS experimental systems. In Task, 1 the mean task achievement time for CMARCS (2:18) was more than half of that for TARCS (5:02). In Task 2, the mean value for CMARCS (1:52) was reduced to a third of that for TARCS (6:25).

In Task 3, the mean rate of task achievement time for CMARCS (1:24) was nearly the same as for TARCS (1:52). In Task 4, there was a considerable difference between the two interfaces by a factor of more than 15.

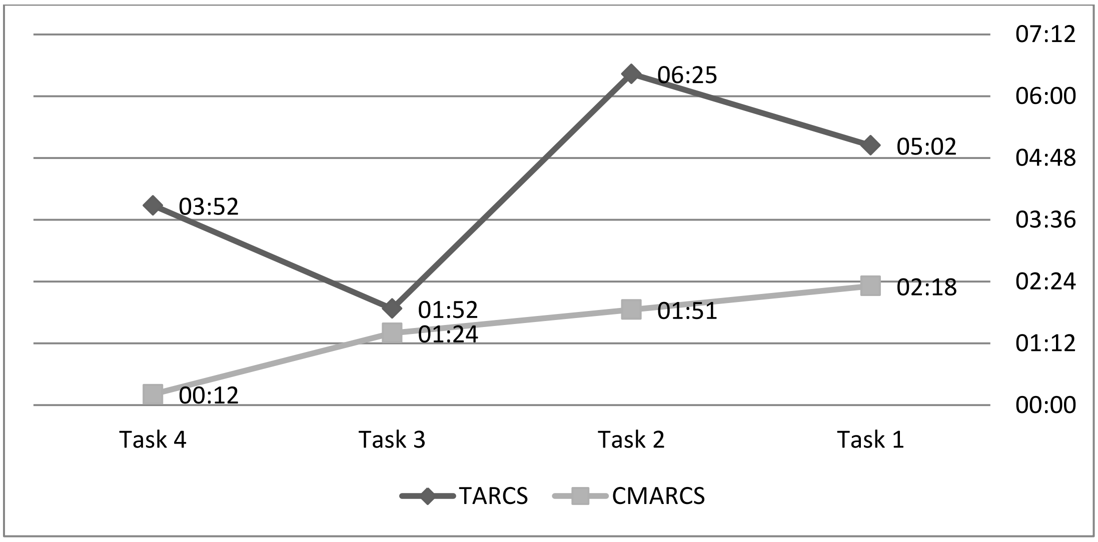

Figure 15 Mean value of achievement time which involved completing tasks in TARCS and CMARCS in relation to the four common tasks.

The related t-test revealed that there were significant differences in the tasks achievement time rate between all individual tasks, : Task1 ($t=7.151$, $df = 24$, $p<0.05$); Task2 ($t=20.423$, $df = 24$, $p<0.05$);Task3 ($t=5.130$, $df = 24$, $p<0.05$) and Task4 ($t=57.603$, $df = 24$, $p<0.05$). The result in task 3 is an anomaly because the length of time hearing comments to be retrieved was long compared with reading it. In Figure 15there are the mean counts of mouse clicks required to accomplish the four common tasks using the TARCS and CMARCS experimental systems. In general, the number of actions required to accomplish the tasks using CMARCS was in a ratio of 1:3.5that for TARCS. Breaking this down, it is noteworthy that the mean count of clicks needed to accomplish, using CMARCS, task 1 was 5.12, for task 2. 4.92, task 3 was 2.36 and task 4 was2areductionsbeing of a factor of more than three times that of TARCS which was, for task1, 18.08, task 2, 19.16, task 3, 7.72 and for task 4, 7.2.

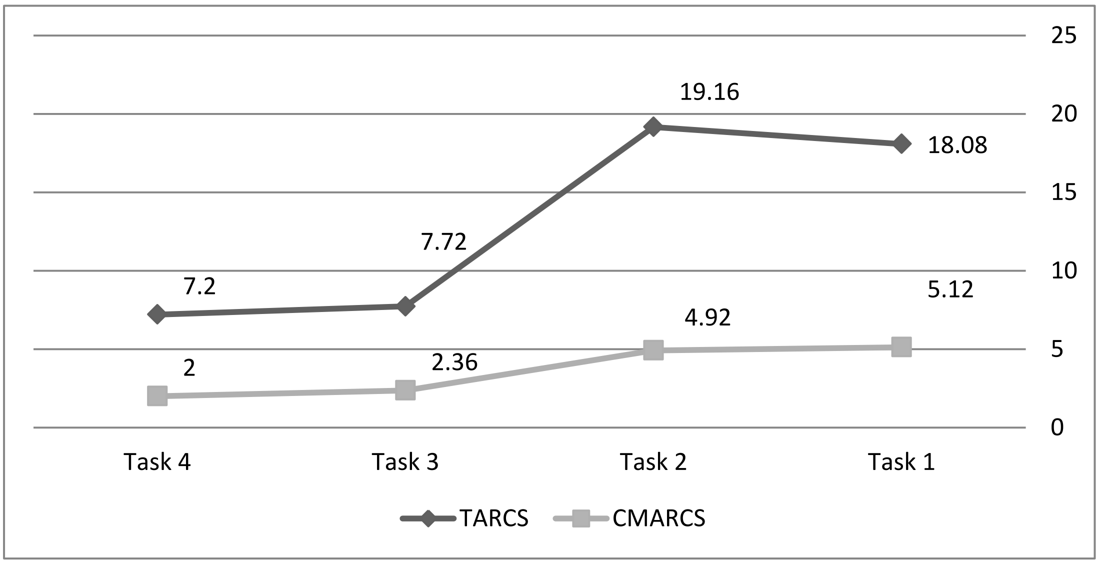

Figure 16 Mean value of mouse clicks which involved completing tasks in TARCS and CMARCS in relation to the four common tasks

By way of further explanation, the related t-test revealed that there were significant differences in the number of mouse clicks rates between all individual tasks: Task1 ($t=13.751$, $df = 24$, $p<0.05$);Task2 ($t=20.053$, $df = 24$, $p<0.05$); Task3 ($t=11.106$, $df = 24$, $p<0.05$) and Task 4 ($t=13.426$, $df = 24$, $p<0.05$). The classification and sound tools made users browse without using mouse clicks as much as when using the traditional approach. The last measurement factor of efficiency shown in Figure 16 is the mean number of errors occurring while accomplishing four common tasks using the TARCS and CMARCS platforms. In general, the number of errors recorded in the four tasks using CMARCS were less than half that for TARCS. To clarify this, in task 1, the mean error counted was 4 in TARCS (it was 1.64 in CMARCS) this being the highest recorded. In contrast, the lowest recorded was in Task 4 where there was less than one error in CMARCS while nearly two errors in TARCS.

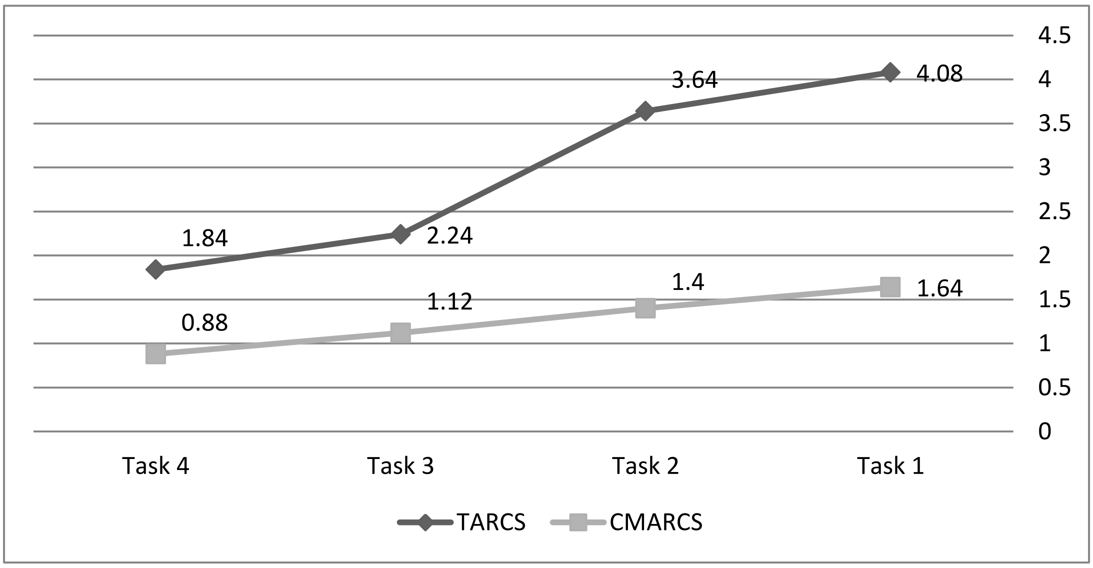

Figure 17 Mean values of errors when completing tasks in TARCS and CMARCS in relation to the four common tasks

The related t-test revealed that there were significant differences in the number of errors rate between all individual tasks:, Task1 ($t=8.121$, $df = 24$, $p<0.05$); Task2 ($t=6.627$, $df = 24$, $p<0.05$); Task3 ($t=3.855$, $df = 24$, $p<0.05$) and Task4 ($t=3.507$, $df = 24$, $p<0.05$). The reason behind this is that users preferred using multi-channel, (eyes, hands, ears and mouth), which were employed in classification and multimodal system, unlike the traditional approach. Overall, users' responses suggested that they favour CMARCS (100 per cent) compared with TARCS (92 present do not like it).

3.8.3 Users' Satisfaction

Users' rating of the statement was given a range; from one to two was regarded as satisfactory, three was neutral, and four and five were unsatisfactory. In general, what is noteworthy was a significant enhancement in user satisfaction from the interface of TARCS to CMARCS in respects of the adding and retrieving function in the system.

Satisfaction Statement	TRACS			CMARCS		
	Satisfactory	Neutral	Unsatisfactory	Satisfactory	Neutral	Unsatisfactory
Add and Retrieve Comments is easy ARCE	4 16%	9 36 %	12 48%	0 0%	0 0 %	25 100%
Function is confusing FC	23 92 %	2 8%	0 50 %	2 8%	1 4%	22 88%
System is boring SB	24 96%	1 4%	0 0%	0 0%	0 0%	25 100%
Easy to deal with the menu EDM	1 4 %	13 52 %	11 44%	25 100%	0 0%	0 0%
Overall, I am satisfied OALLS	0 0%	2 8 %	23 92%	25 100 %	0 0%	0 0 %

Table 4 Users' rate of recurrence for five satisfaction statement in relation to TRACS and CMARCS.

The statements were to measure the ease and confusion of adding and retrieving the comments, whether it was boring, the simplicity of the menu as well as the simplicity overall of the system. Overall, the users were much quicker with adding and retrieving functions in the CMARCS system, compared to TARCS. Better performance was reflected in their satisfaction surveys. In particular, when asked if using the adding and retrieving functions in the system was easy, 16 per cent of users agreed that TARCS was easy, compared to CMARCS, where 100 per cent (25 out 25) agreed. Furthermore, 48 per cent (12 out 25) of users said using adding and retrieving functions, was 'not easy' in the TARCS and were not satisfied, and all those using CMARCS disagreed with the statement. These opinions came from the difficultly of adding comment by typing evaluated against that by recording using sounds. Also, in terms of saving time, reducing errors and ease of accessing information, CMRCS was more satisfactory.

In contrast, when users were asked to give their opinion about whether the function was confusing, 92 per cent (23 out 25) of users agreed they were confused particularly in retrieving the comment in the TARCS system, contrasted to 8 per cent (4 out 25) in CMARCS. Users stated that using colour with the opinion classification reduced confusion with the E-ARCS functions. This result supported the hypotheses of this research. Nonetheless, users were more comfortable with the CMARC system (100 per cent) as opposed to the TARCS system (96 per cent found it boring). Similarly menu handling was preferred by 100 per cent of CMARCS users, as measured against 4 per cent (2 out 25) of TARCS users.

The reason behind is that users prefer using multi-channel, (eyes, hands and ears), which employ the classification and multimodal system rather than the traditional approach. Overall, users' responses suggested that they favoured the CMARCS (100 per cent) compared with TARCS (92 per cent do not like it).

3.9 Conclusion

This section outlines the results of the initial survey and trial by presenting the main results of the discussion as well as the summary of this Chapter.

3.9.1 Result Discussion

No further of this study, an initial survey and experiment consisted of a number of observations, clarifications and results of empirically derived at conclusions and has been achieved. Two approaches were used to analyse the results. An initial survey, questionnaires and interviews were carried out for users to evaluate social media and e-journalism's interaction technique issues. Also in the initial experiment, the second part designed a unique platform as the result of users' perspectives to examine and compare it with the traditional way of adding and retrieving comments.

The interview indicated that the majority of users (91 per cent) were not satisfied with the outcome of comments presentation. From their point of view, the information was too cramped, with disorganised data, and classification issues which were the main problems faced readers in retrieving comments in E-ARCS. Moreover, the spelling mistakes, confusing agreements, typing difficulties and missing data were the most common issues faced by commenters in using the adding comments system. Almost all of the users said that they preferred to engage with social media and e-newspaper including adding and retrieving comments when they are doing other work. Some users suggested a reorganised comments approach by employing multimodal and graphic tools to make it more user-friendly. On the other hand, the questionnaire showed that most users(c.62% or 21 out of 34) preferred using sound (either recording or synthesised)a s multimodal presentation metaphors in adding comments rather than typing it, while in the region of29% or 10 out of 34 users preferred hearing and reading the comments.

In the second part of the analysis results, the experiment demonstrated that users preferred the classification and multimodal system for adding comments in terms of effectiveness and efficiency rather than using the traditional approach. The results showed that the number of tasks completed successfully by CMARCS were more than 30 per cent higher when compared with TARCS.

Similarly, it was approximately 20 per cent better in CMARCS in each individual task. Correspondingly, in terms of efficiency, users achieved enhancement by around 70 per cent of time saving, 75 per cent of the number of mouse clicks and 50 per cent in the number of errors in CMARCS evaluated against TARCM. These results were supported by the improvement reflected by users' measurements of effectiveness and efficiency of the utility in the new system in adding comments. The users believed that this improvement occurred by using recording rather than typing, because it saves time and reduces errors. They also thought the sound system facilitated the expressionof their opinions without being worried.

On the other hand, the retrieving comments utility has been improved in terms of effectiveness and efficiency in the CMARCS. The results illustrated that the percentage of number of tasks completed successfully were less than 30 per cent in TARCS compared with CMARCS. In the same way, the time spent completing all tasks and number of errors was in the region of four times as much in the traditional approach, and was three times as much for mouse clicks, compared with CMARCS.

The second conclusions demonstrate the favourable usage of the classification platform from the users' point of view. The new classification reorganised the comments and made them more accessible and usable in the opinion of the majority of users. However, a number of applicants (6 out of 25) did not prefer to hear their recording sound during comments retrieval. Satisfaction statements were required to obtain on users' expressions about two interfaces as part of usability factors. In general, 25 out of 25 of users felt that the platform employing the opinion of classification and sound system were better than the traditional approach while 92 per cent, (i.e. 23 out of 25) did not feel satisfied with TARCS when compared with CMARCS. Several reasons were behind this feedback from users. The confusing of foundations, complexity of adding and retrieving comments, as well as the difficulty of dealing with the menu in TARCS made it more difficult when compared with CMARCS.

In conclusion, this Chapter consisted of an initial survey and an experiment which were the preparatory aim of this study. The initial survey obtained an overall perspective of the users' viewer the main issues which meet in adding and retrieving electronic comments system as well as using multimodal metaphors in E-ARCS. The trial obtained a set of empirical data to evaluate the usability between two platforms. The results demonstrated that using the unique platform which employs multimodal tools and opinion classification are better than the traditional approach to add and retrieving comments system. Consequently, the next step in this study is to investigate the usability of this unique platform with different interfaces as well as its impact on the opinion of users.

3.9.2 Summary

In this Chapter an initial survey and trial have been evaluated by users who have an interest in the social media and e-journalism field. The feedback from the initial survey contributed to the design and implementation of a unique platform used for classification of opinion and sound recording tools.

The aim, objectives, hypotheses and trial design have been documented in order to show the organised structure followed through, the background and the results obtained in the investigation for the usability between two different interfaces. Various Figures and Tables obtained from the initial survey and trial have been discussed and explained. Feedback demonstrated that overcrowded information with unorganised data, and classification issues were the main problems faced by users in retrieving comment while the spelling mistakes, confusing agreements, typing difficulties and missing data were the issues in adding comments. The majority of the users preferred the CMARCS, classification and multimedia platform over the traditional technique in terms of the number of tasks completed successfully, number of errors, and mouse clicks as well as for saving time. In addition, a questionnaire evaluated the feelings of users which supported the dominance of CMARCS over TARCS.

Finally, additional experiments are essential to investigate some media ethics such as the impact of those unique platforms on public opinion with different interfaces. Chapter4discusses more advanced experiments and research contributions in media aspects and technique issues. Next Chapter will demonstrate the exploration and investigation of usability of the unique classification for E-ARCS by comparing text and graphics with multimodal metaphors to enhance and evaluate the impact on users' opinions. Consequently it will be to investigate what the impact was on people's views of the approaches to add and retrieve comments (VARCS or MMARCS). It also discusses which of these is the most user-friendly in terms of usability, efficiency, effectiveness and satisfaction.

Chapter 4: Investigating the Impactability of Public Opinion on Visual and Multimodal Metaphors

4.1 Introduction

The aim of the initial experiment in this study was to investigate and discover critical issues relating to comments, addition and retrieval, in browsing elections comments fields. As a result of that study, new opinion classification, unique platforms, and resolution approaches were designed, and subjected to examination by users. However, the initial experiment discussions have also led to the investigation of various E-ARCS perspectives with Visual only (text and graphic) as well as multimode and graphics functions. This Chapter discusses the investigation of the usability of E-ARCS; the comparison of text and graphics with multimodal metaphors for its enhancement, and the evaluation of the impact on users' opinions. Consequently, this Chapter presents the main experiment designed to investigate what the impact on people's views of the approaches to add and retrieve comments (via VARCS or MMARCS). It also focuses on distinguishing the most user-friendly of the systems in terms of usability, efficiency, effectiveness and satisfaction.

In summary, the Chapter describes the main aim and objectives of the research, the experimental platforms used, the hypotheses, the design which includes tasks, variables, sampling and data collection, and finally presents the analysis and results of the experiment.

4.2 Aims

In the field of HUC there are many empirical studies that compared the performance of texts with graphics and audio-visual interaction, as well as investigating which of them is more useable [23, 37, 97, 98,101,125 and 174]. However, a few of these studies have applied multimodal metaphors in the field of E-ARCS [178].

The main rationale for this experiment, and thus, this Chapter, is to observe the repercussions of using multimodal interaction metaphors in the interfaces of E-ARCS, and to establish the appliance of the audio-visual metaphors in the application domain of E-ARCS.

More explicitly, this Chapter has been designed to determine the impact on users' public opinion, as well as to measure the usability (i.e. effectiveness, efficiency and satisfaction) of adding multimodal interaction metaphors in E-ARCS interfaces.

This research, therefore, aims to examine the difference between two types of interfaces of interaction in graphics including text and multimodal interfaces, through the comparison and establishment of the difference in task completion and user performance applied at three different complexity levels of task on two different task types (Adding and Retrieving Comments).

4.3 Objectives

For the purpose of this study, two E-ARCS experimental platforms were selected: the text with graphics, and the multimodal built-in speech and non-speech metaphors. An empirical investigation was carried out on the implementation of these interfaces, and were evaluated by two independent groups of users (n=22 for each group).

The study sought out to achieve its research aims by setting some variables, which are defined in measurable terms, and covers the aspects of the impact on public opinion and usability. To this end, i.e. to enable the objectives to be examined, questionnaires were designed to measure the impact on users' public opinion towards the E-ARCS, as well as that to evaluate users' satisfaction.

In more details, measuring the usability of E-ARCS by effectiveness involved counting the number of task's actions completed successfully. The efficiency was subsequently evaluated by evaluating the number of mouse clicks, error rate, time and percentage of task completion.

4.4 Experiment Design

Electronic Adding and Retrieving Comments Systems (E-ARCS) normally consist of two components: the Information of Registration ("IR") section and the section for the main comments ("MC") in E-ARCS [178]. In essence, the IR element is the basic knowledge for the writer of comments in adding and retrieving systems. As well as this, it may be the case that the IR part provides the readers with a general idea about the commentators and comments such as Name, Email, City, Way to add or retrieve comments and Gender of commentator. It also helps the system to classify the opinion: Agree, Disagree or Neutral by determining the opinion initially. Some e-newspapers and social media use more than these Information of Registration and others less, depending on the policy of the organisation. The MC section shows the body of comments which are provided by readers in two general forms, *Comment by Comment* or *Comment by Page* form Table 1. All of the comments are usually shown underneath the article or news in all activities of adding and retrieving comments in e-journalism and social media such as Facebook, Twitter, blogs and forums. The *Comment By Comment* form is the commoner and traditional technique to present comments and is used by the top e- journalism in the world [see Table1]. For more information, the *Comment By Comment* method shows comments either by the earliest time added or the most recent on the same page. However, one major criticism of the *Comment By Comment* form is that readers find it very difficult to track the comments because they appear in one long page without any classification of them [result of Chapter 3]. On the other hand, the *Comment By Page* form presents comments by time and divide the numbers of comments on many pages. Figure 17 demonstrates a normal view of the system to add and retrieve comments as seen in the electronic version of The Guardian and Twitter with different methods to retrieve comments, which provided two main forms: *Comment By Comment*, and *Comment By Page,* in E-ARCS *interaction* modes. Due to several issues related to e-journalism and software application suitability, Retrieve Comments is considered among the two types of ARC styles for further evaluation, using Twitter and The Guardian e-newspaper as examples of them.

As a result of the objectives and scope of this study, consideration was given as to how to present add and retrieve comments into end users on electronic interface, and an assumption was designed and created so that IR and MC functions and components were fully implemented, that is to say, creating registration items (name, gender, city, email and title) of comments in RI functions and components, in both Adding and Retrieving systems. It added the function of being able to classify the opinions of writer: Agree, Disagree or Neutral, which helps the system to determine that initially. Moreover, the MC viewed all comments as opinion's classification as well as to add them either by Text Graphic or Multimodal metaphors.

The experimental work of this research added new metaphors such as auditory icons and earcons onto the existing field of ARCS in order to observe and examine them. The use of graphics with text is very common in applications such as Facebook and Twitter (in social media) or TimeOnline and Guardian (in e-newspapers). On the other hand**,** the use of multimodal metaphors such as auditory icons and speech earcons are not common in social media or e-newspapers in terms of adding and retrieving comments [Table 1]. This hassled to examining the role of multimodal metaphors to communicate ARCS into various E-ARCS activities. As a result of these, the new platform evaluates various multimodal metaphors in this study such as *auditory icons*, *recorded speech*, *synthesised speech*, *speech recognition* and earcons.

As this research aims to investigate the role of multimodal interaction, some researchers and studies recommend [76, 77, 83 103 and 157] examining and comparing different environments of user interface, which for this research are multimodal and visual interface. Consequently, this research is concerned with designing different interfaces of E-ARCS, text with graphics (VARCS), multimodal with speech and non-speech metaphors included earcons and auditory icons (MMARCS).

Tables 5 and 6 demonstrate the differences between the two E-ARCS interfaces of interactive. It can be seen that there were several types organised into four categories: Registration to Add Comments (add name, add opinion, add email, add city, add title and add gender); Summary of Retrieve (opinion, gender and recommendation); Add Main Comments (by text or by speech metaphors) and Retrieve All Comments (by new classification). Additionally, there were two visual-only metaphors employed: text and graphics and four auditory ones: synthesised speech; earcons; auditory icons and recorded speech.

4.4.1 Multimodal Metaphors Design

The study integrates various types of sound metaphors into the E-ARCS interface to measure the impact on public opinion and to improve the usability of several technologies, such as "musical notes, a speech agent [184], a text-to-speech tools, environmental sounds [141], sound recording software [185] and multi-timbre synthesiser software [186]". In order to integrate these metaphors on the platforms of the experiment, the study used rules and guidelines for creating auditory icons and earcons as approved by Rigas and Brewster [22, 31,124 and 146].

The study was designed to convey different types of families of earcons by integrating timbre to design MMARCS. For instance, pianos were mapped by adding comments which communicate by up/down pitch to describe a *Neutral* opinion. Additional differentiation metaphors were used to retrieve comments by employing rising pitch such as a drum to signal the rating of "not recommended comments" and an organ to represent "agree" for the opinion about the article. All timbre of earcons used middle C in the chromatic scale (150Hz) for rising or up /down pitch metaphors[34, 91, 92,118,127 and 144].

It can be seen it Table 6 how different relations of earcons were discriminated by range, duration, timbres and rhythms in MMARCS[124,169 and 141]. Earcons were run with a 0.1 second gap in sequence which helps the user to differentiate between the start and finish of the sound. Similarly, other auditory icons tools were played to examine the communications of MMARCS interface which integrate into the system. For example, in the part for adding comments many auditory icons were used, such as clapping, breaking glass, whistle/whistling and laughing in the IR part, or recording speech sound in the MC section. On the other hand, gasping and typing as auditory icons were used to retrieve some elements of the information of comments or text to speech and recording speech sound in the main comments. Table 8 demonstrates how auditory icons and recorded speech were related with different groups in the experimental system of MMARCS.

4.4.2 Retrieve Comments Design

One of the main functions in E-ARCS is Retrieving Comments which is utilised to examine the usability for, and impact on, users. In this study, MC and RI include name, opinions, title, recommendation, city and email with the Retrieving Comments part in both VARCS and MMARCS.

Both were designed to retrieve the same information of two parts, RI and MC, by different levels of complexity.

Adding CommentsSystem Metaphors			Adding Comments																										
				Short Comment T1									Mid Comment T2									Long Comment T3							
				Add Name	Add E-mail	Add Title	Add Gender	Add City	Add Opinion	Add Comment	Recommend		Add Name	Add E-mail	Add Title	Add Gender	Add City	Add Opinion	Add Comment	Recommend		Add Name	Add E-mail	Add Title	Add Gender	Add City	Add Opinion	Add Comment	Recommend
No. of Actions in Tasks				1	2	3	4	5	6	7	8		9	10	11	12	13	14	15	16		17	18	19	20	21	22	23	24
TAC	Text		√	√	√	√		√		√		√	√	√	√		√		√		√	√	√	√		√		√	
	Graphics		√				√		√		√	√				√		√		√	√				√		√		√
MMAC	Text		√	√		√		√				√	√		√		√				√	√		√		√			
	Graphics		√				√		√		√	√				√		√		√	√				√		√		√
	Non Speech	Auditory Icons	√						√		√	√						√		√	√						√		√
		Earcons	√						√		√	√						√		√	√						√		√
	Speech	Synthesised	√							√		√							√		√							√	
		Recorded Speech	√	√	√	√	√	√		√		√	√	√	√	√	√		√		√	√	√	√	√	√		√	

Table 5 The comparison between types of ARCS and metaphors in the VARCS for Adding Comments Tasks.

Retrieving CommentsSystem Metaphors			Retrieve Comments																										
				Easy Comment T4									Moderate Comment T5									Complex Comment T6							
				Retrieve Agree	Retrieve Disagree	Retrieve Neutral	Retrieve Gender	Retrieve Name	Retrieve City	Retrieve Comment	Retrieve Recommend		Retrieve Agree	Retrieve Disagree	Retrieve Neutral	Retrieve Gender	Retrieve Name	Retrieve City	Retrieve Comment	Retrieve Recommend		Retrieve Agree	Retrieve Disagree	Retrieve Neutral	Retrieve Gender	Retrieve Name	Retrieve City	Retrieve Comment	Retrieve Recommend
No. Of Actions in Tasks				25	26	27	28	29	30	31	32		33	34	35	36	37	38	39	40		41	42	43	44	45	46	47	48
TAC	Text		√					√	√	√							√	√	√							√	√	√	
TAC	Graphics		√	√	√	√	√				√		√	√	√	√				√			√	√	√				√
MMAC	Text		√					√	√								√	√								√	√		
MMAC	Graphics		√	√	√	√	√				√		√	√	√	√				√		√	√	√	√				√
MMAC	Non Speech	Auditory Icons	√		√						√			√						√			√				√		
MMAC	Non Speech	Earcons	√	√		√							√		√							√		√					√
MMAC	Speech	Synthesised	√														√	√	√										
MMAC	Speech	Recorded Speech	√					√	√	√																√	√	√	

Table 6 The comparison between types of ARCS and metaphors in the VARCS for Retrieving Comments Tasks.

However, an extra feature was added into MMARCS to allow the user to exploit multimodal metaphors in their functions such as speech and non-speech tools for the retrieval of RI and MC. For more information, retrieving some data of RI such as opinion or gender of writer can be checked by choosing an audio button linked to each comment. In addition, retrieving any comments can be achieved by clicking another button to hear MC as recording or synthesised sound. Three different sounds were used to represent the opinion type such as the "agree" opinion used the rhythm of an organ's rising pitch, "disagree" by the sound of breaking glass and the rhythm up/down pitch piano music signalled "neutral" comments .These buttons run a combination of earcons and auditory icons that transfer all information about either RI or MC.

Platform of ARCS		Forms of Earcons			
		Timbre	Rhythm	Duration	Range
Adding Comments					
1	Neutral Opinion	Piano	Up Down pitch	0.4 Sec	1 - 10
2	Gender Women	Violin	Rising Pitch	0.3 Sec	1 -10
Retrieving Comments					
3	Not Recommended	Drum	Rising Pitch	0.4 Sec	1 -10
4	Agree Opinion	Organ	Rising Pitch	0.4 Sec	10 -90

Table 7 Explanation of how families of earcons work in MMARCS for Adding and Retrieving Comments

VARCS users, alternatively, were required to retrieve the data of RI and MC by navigating to view a comments page and all details which only contained text or graphics. The graphics helped users to determine the classification of opinion type and area by suitable colours. These were designed using three colours, green being used for "agree", amber for "neutral" and red for "disagree".

Platform of ARCS		Forms Metaphors		
		Recording	Synthesised	Auditory Icons
Adding Comments				
1	Short Comments ≤ 150 Characters	√		
2	Name	√	√	
3	Agree Opinion			Clapping
4	Disagree Opinion			Breaking Glass
5	Title	√	√	
6	City	√	√	
7	E-mail	√	√	
8	Recommended			Whistle
9	Gender Man			Laughing
10	Mid Comments 151 ≤ Characters ≤ 650		√	
11	Long Comments 651 ≤ Characters ≤ 850	√		
Retrieving Comments				
12	Short Comments ≤ 100 Characters	√		
13	Name	√	√	
14	City	√	√	
15	Email	√	√	
16	Title	√	√	
17	Gender Women			Gasping
18	Neutral Opinion			Typing
19	Mid Comments 151 ≤ Characters ≤ 650		√	
20	Long Comments 651 ≤ Characters ≤ 850	√		

Table 8 Explanation of how families of auditory icons and recorded speech work in MMARCS for Adding and Retrieving Comments.

In addition to this, the interface used many different aspects of graphics such as a picture of Mr Mohamed Alrashed to represent a man and Mrs Reima Maktabi as a woman. Two different graphics were used to show the respective number of people giving their positive or negative opinion using up and down fingers.

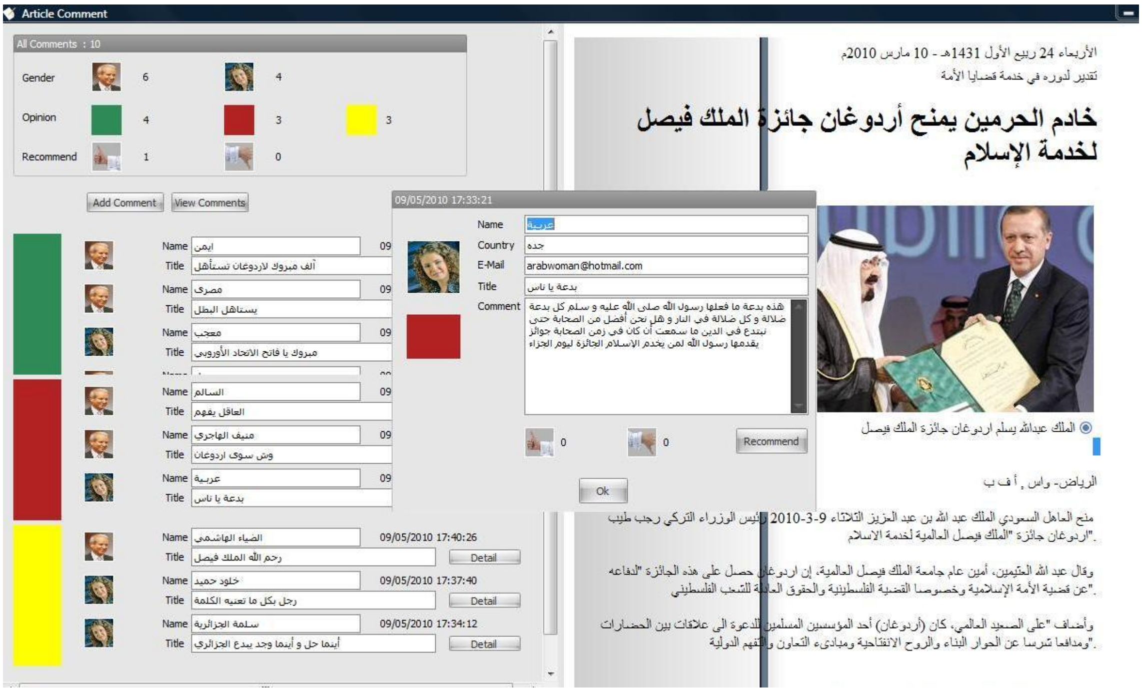

Figure 18 VARCS interface to retrieve comments with visual opinion classification and list of the functions control group.

Figure 17, 18 provide and demonstrate a paradigm of retrieving comment demonstration from implementation for both VARCS and MMARCS. It can be seen in Figure 17 that the opinion functions of VARCS as well as parameters of the solution space were placed on the left hand side of the interface. The user can manipulate three boxes as parameters in the solution space (green box for Agree Comments, amber for Neutral Comments and red for Disagree Comments).

The classified opinion engine contacts the enterprise-wide new classification view comments engine (implemented specifically for this experiment) with the customised schemes to simulate the new classification view comments process. In addition, it can be seen the page of *view comments* by different colour of opinion classification as well as in the middle there is one particular comment chosen by the reader. Also, there can be shown the RI part which appears as text (name, title, city, e-mail and main comments) and graphics (who and how many people agree, disagree or are neutral, plus those recommending yes or no).

In addition, in Figure 17 it was common between the two interfaces of interactive to communicate some details about MC or RI information by using Visual and Multimodal metaphors. For example, in the summary of comments box in the corner, some general information about the comments could be heard and seen. As well as this, the audio buttons in the middle and left hand side were introduced into MMARCS to deliver information from different sources, such as retrieve all data of RI or MC by using different types of multimodal metaphors, as described in the previous section.

Figure 19 MMARCS interface to retrieve comments with multimodal metaphors opinion classification and list of the functions experimental group.

This allowed the commentator to perform new classification view comments by adding comments interface to repeat the result several times to reach the comments of the last person.

4.4.3 Adding Comments Design

It can be observed from Figure 19 that a different method of adding comments was used based on the interface of interactive, VARCS and MMARCS. These have a list of functions which facilitate the role and method of commentators in RI and MC by supporting them in using graphics and text tools or multimodal metaphors. These tools included different functions to successfully applying comments, but the aim of this study was limited to focussing on the impact on users' opinions and principally the method to add and retrieve comments. Thus, in VARCS, the adding comments functions classified all opinions by choosing the appropriate colour as described previously. This classification provided the users with a choice of suitable colours rather than having to type in the comment. In addition to this, pictures were used to determine gender and level of recommendation, or not. These graphics were the faces of Mr Mohamed Alrashed to represent “Man” and Mrs Reima Maktabi for ”Woman”. In addition a thumbs- up finger shows that this comment is recommended while thumbs-down means “not recommended”. Finally, the rest of the information of RI and MC (including Name, City, Email, Title of comment and the main body of comment) can be added by typing it in the traditional approach to add comments by users as shown in Figure 19 on the left hand side. The design of adding comments in MMARCS was implemented differently by adding both graphics and multimodal such as speech and non-speech metaphors.

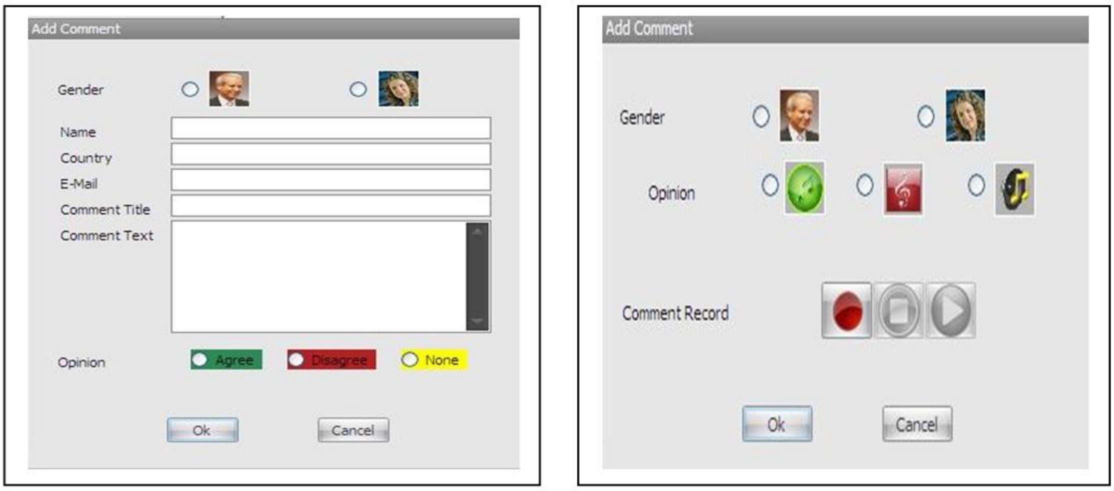

Figure 20 Design of the method to add comments in the VARCS (left hand) and MMARCS (right hand) experimental systems.

It can be seen from Figure 19 on the right hand side that MMARCS provided users with the ability to add comment's information RI and MC by many different channels such as sound environment, recording speech and text to speech tools.

In addition to this, users could express their opinion by using the rhythm up/down pitch piano music to represent a neutral opinion, a clapping sound to signal agreement or using the sound of breaking glass to express disagreement. Furthermore, different sounds were fitted into the MMARC system to add comments such as the sound of a man laughing to show the gender as being male and the sound of whistling to express a recommended comment as auditory icons.

A number of earcons were utilised to represent female gender such as violin music with rising pitch. Finally, some information of RI and MC including, City, Email , Title of comment and the main body of comment can be added by using either recording speech or synthesised non speech multimodal way to add comments from users.

Figure 21 Description of the way for Speech and Non-Speech message in Adding Comments of MMARCS

4.4.4 Construction of Auditory Metaphors

Earcons and auditory icons were added into the MMARC system to reduce errors and save time for users by avoiding adding or retrieving some information of RI and MC actions. As a result, the multimodal metaphors which were added into the interface could affect the usability by, and impact on, users. These earcons and auditory icons were integrated as messages into the Add and Retrieve Comments interfaces in almost all parts of RI and MC.

Figure 20 demonstrates the construction of Add Comments description, earcons and auditory icons message, with all actions in RI and MC. What can be seen is that the construction in Figure 5 is divided into two parts, Registration Add comment (RI) and Add Comment (MC). In the first part there should be mentioned the use of recording speech to add Name, City and E-mail. Also, to add the opinion (agree, disagree or neutral) recommend (Yes or No) and the gender (male/female) by using different auditory icons and earcons tools. Some studied made "part of the message was followed by a 0.5 second period of silence, to allow distinguishing between each part" [118] which applied it in this studied.

Figure 22 Description of the way for Speech and Non-Speech message in Retrieving Comments of MMARCS

As well as that, each sound from these messages had a distinct sound which is described in Tables 7 and 8. It can be seen in the second part the method used to add the main comment by using recording speech metaphors. Similarly, to communicate Retrieve Comments parts in MMARCS from the new classification of view comments, a series of earcons and auditory icons was designed to standardise the retrieving information for RI and MC. This was divided into two parts from the Add Comments description message. As demonstrated in Figure 21, in the first part there can be mentioned the use of synthesised and recording speech to retrieve Name, City, and Title of the comment and E-mail. In addition, in part one the construction can retrieve the opinion (agree, disagree or neutral), Recommend (yes or no) and the gender (man/ woman) by using different auditory icons and earcons tools. Each section such as opinion and gender messages was tracked by a 0.5 secondbreak with no sound, so the commentator could distinguish between sound messages. Each sound from these messages had its own distinct sound (described in Tables 7 and 8). Retrieval of the body of the main comment was achieved by synthesised (using text to speech tools) and recorded speech in a sequential pattern.

4.5 Experiment Hypotheses

In this section, the author aims to present the hypotheses which help to measure the impact and the usability of E-ARCS in both interfaces, VARCS and MMARCS. These hypotheses are divided into Adding and Retrieving Comments sections or are common to both.

H2-01: The impactability on Public Opinion of MMARCS will be better than for those of VARCS due to these unique interfaces of retrieving comments.

H2-02: Adding comments in the E-ARCS by MMARCS will be more effective than VARCS (suggests that there will be more tasks completed successfully by users).

H2-03: Adding comments in the E-ARCS by MMARCS will be more efficient than VARCS (suggests that there will be time savings experienced by users in each task).

H2-04: Adding comments in the E-ARCS by MMARCS will be more efficient than VARCS (suggests that there will be reduction in the rate of errors in accomplishing all tasks).

H2-05: Adding comments in the E-ARCS by MMARCS will be more efficient than VARCS (suggests that there will be a reduction in the number of mouse clicks in accomplishing all tasks).

H2-06: Retrieving comments in the E-ARCS by MMARCS will be more effective than VARCS (suggests that there will more tasks completed successfully by users).

H2-07: Retrieving comments in the E-ARCS by MMARCS will be more efficient than VARCS (suggests that there will be time savings experienced by users in each task).

H2-08: Retrieving comments in the E-ARCS by MMARCS will be more efficient than VARCS (suggests that there will be a reduction in the rate of errors in accomplishing all tasks).

H2-09: Retrieving comments in the E-ARCS by MMARCS will be more efficient than VARCS (suggests that there will be a reduction in the number of mouse clicks in accomplishing all tasks).

H2-10: Using MMARCS will be more satisfying than using VARCS due to all of the above hypotheses.

H2-11: The usability of MMARCS will be better than for those of VARCS due to all of the above hypotheses.

4.6 Implementation of Experiment

This section will give a full description of the experimental design used to investigate the role of adding communication multimodal metaphors on the E-ARCS. As part of this study, there was a comparison between interfaces, these being an experimental interface MMARC (multimodal adding and retrieving comments system) and control interface VARC (visual adding and retrieving comments system). This used users who were randomly assigned to two independent groups [187, 188]. MMARC was provided with many multimodal metaphors such as earcons, auditory icons, speech and non-speech to add and retrieve the comments. VARC was implemented by text with graphics. Both interfaces used the new opinion classification to examine the impact on users' opinion and the usability attributes (efficiency and effectiveness), and satisfactions. In addition, the users' groups were asked to execute six common tasks which varied in task levels and different types (Adding and Retrieving Comment). Also, the usability, satisfaction and perception of impact on opinion were measured by two post-task questions and questionnaire.

4.6.1 Tasks of Experiment

Before starting to describe the design of tasks, it is important to mention that many studies in the field of measuring the usability of multimodal interaction [22, 31, 97,100,125,136 and 166] recommended examining the experiment by complexity task levels and different types. The outline of the experiment should also be mentioned, consisting of three variables: Interfaces of Interactive, Task Level and Task Type.

Main Tasks			Level and Complexity		
Description	Code	Type	MNOA	Level	ET
Registration Short Comment with ≤ 150 Characters	TA1	Add	9	Short	5 Mins
Registration Mid Comment with 151 ≤ Characters ≤ 650	TA2	Add	18	Middle	8 Mins
Registration Long Comment with 651 ≤ Characters ≤ 850	TA3	Add	27	Long	11 Mins
Retrieve Easy Comment by One info of Registration	TR4	Retrieve	8	Easy	4 Mins
Retrieve Moderate Comment by Two info of Registration	TR5	Retrieve	17	Moderate	7 Mins
Retrieve Complex Comment by Two info of Registration	TR6	Retrieve	23	Complex	9 Mins

Table 9 Outlines of the complexity level of main task in Add and Retrieve Types for both systems.

By way of explanation, Interfaces of Interactive are divided into two interfaces (control and experimental), Task Level with six levels (Easy, Moderate and Complex in the retrieving or Short, Middle and Long in adding comments) and Task Type with two types (*Add and Retrieve Comments)*. In this study, all users in the same group of tasks were asked to undergo training tasks before starting the experiment tasks. The reasons for the training tasks were to assist users in how to perform the experiment tasks as well as all users being informed about training tasks then asked to complete the same group of experiment tasks.

The experiment tasks were designed at six levels of complexity which depended on task type: either short, middle or long for adding comments or easy, moderate and complex for retrieving comments Also, all tasks were classified as low (TA1 and TR4), moderate (TA2 and TR5) or high (TA3and TR6).

4.6.1.1 Add Comments Tasks

The experiment created scenarios in each Add Comments tasks to cover three levels of task, namely Short, Middle and Long Comments, and tasks differed from each other. For example, in TA1, the user was asked to fill in the information for registration which included Name, City, Gender, Email and Title of Comments. The user was also free to start adding comments by filling in the registration part first, then to add a short comment which was approximately 150 characters by selecting Add Comment Button.

Using VARCS, however, users do not need to write every single item as is normally the case. In the registration section, for example, the users were required to select the gender by using a picture which referred either to man or woman rather than needing to type it in. Also, users were required to select one of three colours red, amber or green to show their opinion. Furthermore, the recommendation rate was available in VARCS by selecting OK or Not OK finger. The user was then able to type the comment using the keyboard and mouse. On the other hand, in MMARCS in the registration part, users needed to complete the main requirements by using speech recording and non-speech metaphors. Moreover, users selected gender by using auditory earcons which linked to graphics showing gender as well as using sound icons to determine the level of recommendation. To select the type of opinions, MMARCS added to the graphic classification (red, amber and green) a number of icons and earcons to link with them Examples include, with red, the sound of breaking glass. The sound of up-down guitar rhythm was added to amber (Neutral Opinion).The sound of clapping as an icon was added to relate to Agree Opinion with green colour graphics. Furthermore, users needed no longer to type to add comments in MMARCS: instead, recording sound was used to add it as multimodal metaphors. TA2 and TA3 have the same steps to add comments in Adding Comments tasks but by different lengths of comments which were between 150 and 650 characters in TA2 and less than 850 characters in TA3. In the classification of commentators' review part, the number of "Agree", "Disagree" or "Neutral" reviews was dependent on the number of those who added them. Table 9 summarises the requirements of Adding Comments selection tasks.

4.6.1.2 Retrieve Comments Tasks

The second type of tasks was Retrieve Comments selection tasks which also have different scenarios that facilitate levels of task, easy, moderate and complex. In the first, in TR4, the user was provided with a scenario to retrieve an easy level task. This task was that a user needed to retrieve a comment from the list of view comments, which was added by the first person, whose opinion was "agrees" as well as her gender was female. Similarly in TR5, the user was asked to retrieve moderate level task by a high level of questions which requested the name of the commentator's title and its classification such as a neutral opinion. The last task, TR6 was difficult as it was a complex task which looked for information about two different comments, a man and woman, one of them agreeing and the other disagreeing, by different order and city as well. In this difficult task, users had to retrieve them and the study observed the result. Each user was given time to retrieve all the comments in each retrieving task and a piece of paper to answer all questions asked. Table 8 summarises the requirements for Retrieve Comments tasks.

4.6.2 Experiment Research Variables

In research studies, variables play role in the illustration of characteristics that require be recording and measuring. These variables should be dependent, independent or control variables. This section will explain and determine them. Secondly, the variable can be measured by discrete values within a range, such as the number of error occurrences during the task performance. Finally, categorical variables take values in categories form, such as student, employee etc.

Within experimental design, variables can be categorised, based on its role in the experiment, into dependent, independent or control variables.

4.6.2.1 Experiment Dependent Variables

Some studies state that there are many approaches that help to examine usability such as to compare it with another approach by using a number of measurement factors [127,128,129 and 188].

Dependent Variable		Measurement	
Description	Code	Area	Impact
user's Perception Public Opinion PPPO	DV2-1	Press	Public Opinion
Time of Task Achievement TTA	DV2-2	bi a	Efficiency

Rate of Error RE	DV2-3		
Number of Mouse Clicks NMC	DV2-4		
Percentage of Tasks Completed Successfully PTCS	DV2-5		Effectiveness
Rate Satisfaction of user RSP	DV2-6		Satisfaction

Table 10 Outlines of the main dependent variables

Table 10, shows the dependent variable which is reproduced during the study steps on the outcome measured. These variables can outline them as factors of impact and usability.

DV2-1: user's Perception Opinion: each user was asked to rate their opinion of some statements associated to the range of impact on their opinion. These were five aspects of user opinion. Appendix D-1 gives a description of these.

DV2-2: Time of Task Achievement: during the experiment, a user‘s performance was observed to calculate the time taken to complete each individual task and all the tasks.

DV2-3: Rate of Error: there are many types of errors (Incorrect Typing Registration, Selecting Errors, Confusion and Action Not Completed in Add or Retrieve.) recorded to measure error ratios of the experiments.

DV2-4: Number of mouse clicks: users were observed and counts taken of the number of mouse clicks to achieve each task and all tasks.

DV2-5: Percentage of tasks completed successfully: to measure the success for each task, the experiment determined the number of actions which a user needed to complete each task. Users were observed to count these actions then the percentage of tasks completed successfully was calculated.

DV2-6: Rate satisfaction of users: the SUS approach [161] was applied to discover the range of user satisfaction by completing a questionnaire consisting of nine characteristics. Appendix A4-2 has a description of these characteristics.

4.6.2.2 Experiment Independent Variables

During the experiment there were three independent variables which related to the impact of the dependent variables. Table 11 outlines these independent variables.

Independent Variable		Measurement	
Description	Code	NA	Aspects
Interfaces of Interactive	IV2-1	2	VARCS and MMARCS
Task Complexity Level	IV2-2	6	Short, Middle and Long for Add Comments Easy, Moderate and Complex for Retrieve
Task Type	IV2-3	2	Add Comments and Retrieve Comments

Table 11 Outlines of the main independent variables

IV2-1: Interfaces of Interactive**:** two different interfaces were designed to improve the functionality of E-ARCS, with the opinion classification improved from a previous experiment. These Interfaces of Interactive were texts with graphics only, ARCS and Multimodal MMARCS.

IV2-2: Task Complexity Level: in each type of Interfaces of Interactive there were three different levels to move user from the low to high stage. These were Short, Middle and Long for Add Comments as well as Easy, Moderate and Difficult for Retrieve Comments.

IV2-3: Task type: users were asked to carry out tasks designed with the Interfaces of Interactive system into two types: Add Comments and Retrieve Comments tasks.

4.6.2.3 Experiment Control Variables

The study defined a number of control variables in order to determine which factors required to be controlled as well as having an impact on the dependent variable. Below is an outline of these variables:

CV2-1: Achievement Tasks: all tasks which have been achieved by users need to be the same.

CV2-2: Experience knowledge effect: users got knowledge since the effect of performance increases so all tasks have changed and counterbalanced its order.

CV2-3: Experience familiarity: users who took part had not used it before as well as having been given a short training course about the system and how it worked.

CV2-4: Experiment Contents: groups using VARCS and MMARCS had the same data to measure adding and retrieving the information.

4.6.3 Case Study Sampling

One of the main aims of this experiment is to use people who have basic familiarity with adding and retrieving comments on electronic newspaper or social media accessible on the Internet. The users who took part in this experiment were employees from Alarbyia Channel since they were considered as useful representative for e-journalism users. The strategy used to choose users was of unknown people from the newsroom, as employees in Alarabiyah Channel in Dubai and this method is commonly used in many psychology experiments [118].

In this experiment 22 users in both groups looked at both interfaces, VARCS and MMARCS, and each group was split into three subgroups which enabled the experiment to have a balance between the levels of task complexity.

Group A: 1,4,7,10,13,16,19,22 Group B: 2,5,8,11,14,17,20 Group C: 3,6,9,12,15,18,21		Groups		
Balancing Between Tasks		A	B	C
Pre-Experimental Questions		√	√	√
Add Comment:	Short, Mid and Long	√		
	Mid ,Short and Long		√	
	Long ,Mid and Short			√
Post-Task Questions		√	√	√
Retrieve Comments:	Easy, Moderate and Difficult	√		
	Moderate ,Easy and Difficult		√	
	Difficult, Moderate and Easy			√
Post-Task Questions		√	√	√
Evaluate Satisfaction of user		√	√	√
Test for Accomplishment		√	√	√
Questions for Accomplishment		√	√	√

Table 12Thescheme of balancing between tasks of sub-groups

Table 12 shows the number of tasks with the number of users who achieved their tasks by subgroups. Almost all users had an average time spent in social media and reading E-newspapers in the region of 15 hours weekly, with their ages being between 18 and 55 years old. They were given time to read the main article then asked to complete Adding Comments part followed by the Retrieving section by randomly choosing. Also, all of them were given training to make sure they understood the concept and the testing methodology.

4.6.4 Data Collection

During this part of experiment, two types of data, quantitative and qualitative, were collected using different approaches such as observation, questionnaires and interviews.

Experiments were observed to calculate the time which it took to complete each task by recording start and finish times precisely. Also recorded was the number of actions done by each user in each task so as to know whether the task was completed successfully or not. Afterwards, it tracked the errors and numbers of mouse clicks in adding and retrieving comments for each user. Furthermore, questionnaires gave the views of users about the level satisfaction and the range of impact on opinions. After finishing the experiment, users were interviewed to get feedback about the experiment and its effects. A full description of the raw data obtained from these experiments presented in appendices from D-1 to D-6. A full description of pre-experimental and post-task and post-experimental items can be found in Appendix B-2.

4.7 Analysis of Results

Quantitative research was conducted in order to test the difference between the two systems; VARCS and MMARCS. Numerical data was gathered, the statistical generalisation was made, and the research was tested for significant differences between the two interfaces. The research used descriptive and inferential statistics. Inferential statistics are concerned with significance testing from the specific samples to the general world. Descriptive statistics report patterns existing within the data set. This method is used to summarise relatively large numbers of raw data into meaningful, informative and fair representations of the data.

The research summarises measures of central tendencies. The central tendencies are the *mode, mean* and *median*. The *mode* is used to indicate the central tendency of categorical data. The *mode* is the most commonly occurring value. This is useful when we have frequency data, and when it is needed to know the most frequent value. The *median* is the mid-point of a set of data points and is appropriate where the values are organised in an ordinal manner. If there is an even number of data points, the *median* is the mean of the two central values. The *mean* is the most common central tendency measure. It can be taken on an interval level scale, such as measure of time, length, quantity or on a standardised psychological scale. The problem with the *mean* is that it can be easily affected by extreme or rogue scores. Charts and Tables were produced to illustrate the findings of the study with multiple column charts being used to present data with interval scales (time, percentage, counts) for comparison of the data.

In significance testing we are faced with two options to take; either take samples from different populations of scores (or there is an effect) or the sampling error is responsible for the difference between the samples and they both originate from the same population. The assumption of no effect is known as the null hypothesis. If the probability is high we retain the null hypothesis, if it is low we reject the hypothesis. In this study, the null hypothesis is rejected if the probability is less than 0.05. However, a significant result does not necessarily mean that there is a real effect; we accept the assumption only provisionally.

This study is based on the experimental design methodology. It focuses on the comparison between two groups of controls and experimental systems, with the same users analysed with regards to several continuous discrete and categorical variables. Related t-tests were used to test for difference between the two groups of paired data within groups designed on repeated measures. The Wilcoxon's test was performed as a non-parametric equivalent of related t-test. The t-test was performed for the data at categorical levels. These two tests were performed to investigate if there was a significant difference between the conditions.

4.7.1 Users' Attitude

Analysis of system attitude of users consists of analysing the impact on the public opinion and the satisfactions in respect of users' view. Five statements aimed to measure the impactability of users which were the functions of adding and retrieving in this system increased the impact of my Public Opinion (IOI), i felt that this system show the real public opinion of users (ROI), in the approach of classification of opinion I would use the traditional way (POU), i felt that this system is unprofessional and incompetent (UOI) as well as i felt that this system is impact (IOS). Analysis was carried out using the t test to assess if the distribution of the categorical variables differs from one another. This is t tests for independence. On the other hand, the nine statements attempted to evaluate the user's satisfaction which divided into measuring the easy, confusing, navigating and frustrating of system functions for both adding and retrieving as well as to take comfortable between the interfaces. The users' ratings for the statement for one to two were regarded as disagreement, three as neutral, and four and five as agreement. Overall, what is noteworthy was a considerable improvement in user impact on the public opinion and the satisfaction from interfaces of interactive of VARCS to MMARCS in relation to the adding function in the system.

4.7.1.1 Impact on Public Opinion

In Table 13 is shown the frequency of the agreement and disagreement of users when using the VARCS and MMARCS systems. In general, the users indicated a preference for the VARC system when asked about the five aspects of impact on their public opinion , apart from when they responded to whether they thought the system was unprofessional and incompetent (UOI), for which more agreed that MMARCS was.

Impact In Public Opinion Statement	VARCS			MMARCS		
	Agree	Neutral	Disagree	Agree	Neutral	Disagree
The functions of adding and retrieving in this system increased the impact of my Public Opinion IOI	15 68.2%	1 4.5%	6 27.3%	12 54.6%	3 13.7%	7 31.9%
I felt that this system show the real public opinion of users ROI	18 81.8%	0 0 %	4 18.2%	17 77.3%	2 9.1%	3 13.7%
In the way of classification of opinion I would use the traditional way POU	0 0 %	0 0 %	22 100 %	0 0 %	0 0 %	22 100 %
I felt that this system is unprofessional and incompetent UOI	1 4.5%	1 4.5%	20 91%	2 9.1%	0 0 %	20 91%
I felt that this system is impact IOS	18 81.8%	0 0 %	4 18.2%	16 72 %	3 13.7%	3 13.7%

Table 13User's Rate of Recurrence for five impacts on public opinion statement in relation to VARACS and MMARCS.

Noted from the Table, is that 68.2% of users agreed that the functions of adding and retrieving in the VARCS (M=3.36, SD=1.364) system increased the impact of their Public Opinion (IOI), compared to 54.6% of MMARCS (M= 3.32, SD=1.427) users by no statistically significant difference them ($t = .108; df = 42; p>0.05$). Only a slightly higher percentage of VARCS users (M=3.50, SD=1.336) than MMARCS users (M= 3.91, SD=1.109), even though the system showed the real public opinion of users (ROI) (81.8% and 77.3%, respectively) which was not statistically significant (t = -1.105; df =

42; $p>0.05$). Noon of the VARCRS or MMARCS users agreed that in the way of classification of opinion that they would use the traditional way (POU) (in fact 100% of all users disagreed with this for VARCS (M=3.50, SD=1.336) and MMARCS (M= 3.91, SD=1.109)) which was not statistically significant ($t = -1.351$; $df = 42$; $p>0.05$). The bulk of users of VARCS (M=1.41, SD=.796) stated that they thought the system was unprofessional and incompetent (91%), as did the users of MMARCS (M= 1.68, SD=.945) (91%) which was not statistically significant ($t = -1.03$; $df = 42$; $p>0.05$). Ultimately, the general consensus in relation to whether the MMARCS (M= 3.77, SD=1.193) users thought that the system had impactability (IOS) (81.8%). Also, 72 per cent of the users of VARCS (M=3.77, SD= 1.307) felt that the system had impactability. The t-test was used to test these results and demonstrated that there was no statistically significant difference between the two interfaces ($t = .000$; $df = 42$; $p>0.05$).

The results of the Wilcoxon's T test indicated that the difference between VARCS and MMARCS was insufficient in UOI ($U=2.178$, $cv=65$, $p<0.05$). Nevertheless, there was a significant statistical difference found between the two system in relation to IOI ($U=0.033$, $cv =65$, $p<0.05$), ROI ($U=1.046$, $cv =65$, $p<0.05$), POU ($U=1.265$, $cv =65$, $p<0.05$) and IOS ($U=0.000$, $cv =65$, $p<0.05$).

The impact on the public opinion was slightly different between the visual and multimodal metaphors with no a significant improvement because the colour in the opinion classification helped users to direct their opinion quicker than sound.

4.7.1.2 Satisfaction statement

In general, there was not a significant improvement in users' satisfaction from one interface of interactive to another in retrieving comments type while it was in adding. This will, however, show in the task achievement time and clicks of mouse required to accomplish tasks.

Satisfaction Statement	VARCS			MMARCS		
	Agree	Neutral	Disagree	Agree	Neutral	Disagree
Using Adding functions in the system was easy EOA	11 50%	0 0 %	11 50%	18 81.1%	0 0 %	4 18.9%
Using Adding functions in the system was confusing COA	10 45.5 %	1 4.5%	11 50 %	3 13.6%	2 9.1%	17 77.3%
Navigating in Adding in the system was easy NOA	6 27.3%	2 9.1%	14 63.6%	17 77.3%	1 4.5%	4 18.2%
Using Adding functions in the system was frustrating FOA	10 45.4 %	0 0 %	12 54.6%	4 18.2%	1 4.5%	17 77.3%
Using Retrieving functions in the system was easy EOR	15 68.2%	0 0 %	7 31.8%	10 45.5 %	2 9 %	10 45.5 %
Using Retrieving functions in the system was confusing COR	8 36.4%	1 4.5 %	13 59.1 %	7 31.9%	2 9 %	13 59.1 %
Navigating in Retrieving in the system was easy NOR	17 77.3%	0 0 %	5 22.7%	14 63.6%	1 4.5 %	7 31.9%
Using Retrieving functions in the system was frustrating FOR	5 22.7%	0 0 %	17 77.3%	7 31.9%	1 4.5 %	14 63.6%
In general , I felt comfortable COAll	15 68.2%	2 9 %	5 22.8%	18 81.8%	1 4.5 %	3 13.7%

Table 14User's Rate of Recurrence for nine satisfaction statement in relation to VARCS and MMARCS and out of 22.

Also, the users were much quicker with adding functions in the MMARCS system when compared to VARCS. Better performance in adding tasks was indicated in their satisfaction surveys. Table 14 shows that the adding comments function in the system improved user satisfaction. Particularly, when asked if using adding functions in the system was easy, 50 per cent of users agreed that VARCS was easier compared to MMARCS, where more than 81 per cent agreed. In addition, 45.5 per cent of users, using adding functions in the VARCS were equally confused and 13.6 per cent in MMARCS.

Also, 27.3 per cent of users agreed that navigating in adding for the VARCS system was easier compared to 77.3 per cent for MMARCS. Even though the difference was large, it was interestingly in favour of the MMARCS system, which overall had been regarded as more efficient and effective compared to VARCS. Likewise, “using adding functions in the VARCS system was frustrating” was disagreed with by 54.6 per cent of users. Nevertheless, for the MMARCS adding function, it was reported “disagreed to be frustrating” by 77.3 per cent of users. However, users were more satisfied with the MMARCS system (81.8 per cent) as opposed to the VARCS system (68.2 per cent). On the whole, it was suggested by users’ responses that the experimental conditions were easier to use, less confusing and less frustrating when using adding function. When operating with retrieving functions, control conditions were reported to be easier to navigate, use and less frustrating, although not less confusing.

In conclusion to this, users’ satisfaction surveys revealed a variation between the two conditions, however, further analysis of mode, frequency of mode, and mean is required. Conversely, the retrieving function in the system did not improve user satisfaction. Particularly, when asked if using retrieving functions in the system was easy, 68.2 per cent of users agreed that VARCS was easier compared to MMARCS, where only 45.5 per cent agreed. In addition, 59.1 per cent of users, using retrieving functions in the VARCS and MMARCS were equally confused.

In addition, 77.3 per cent of users agreed that navigating in retrieving for the VARCS system was easier compared to 63.6 per cent for MMARCS. Even though the difference was slight, it was interestingly in favour of the VARCS system, which overall had been regarded as less efficient and effective compared to MMARCS. Likewise, using retrieving functions in the VARCS system was viewed by 22.7 per cent of users as frustrating. Nevertheless, for the MMARCS retrieving function, it was reported to be frustrating by 31.9 per cent of users. Nevertheless, users were more satisfied with the MMARC system (81.8 per cent) as opposed to the VARCS system (only 68.2 per cent). On the whole, it was suggested by users' responses that the experimental conditions were easier to use, less confusing and less frustrating when using adding function. When operating with retrieving functions, control conditions were reported to be easier to navigate, use and less frustrating, although not less confusing.

The results of Wilcoxon's T test indicated that the difference between VARCS and MMARCS was insufficient in COA ($U=0.809$, $cv=65$, $p<0.05$), FOA ($U=1.651$, $cv=65$, $p<0.05$), EOR($U=1.925$, $cv=65$, $p<0.05$), FOR ($U=0.249$, $cv=65$, $p>0.05$) and COAll ($U=0.899$, $cv=65$, $p>0.05$). Nonetheless, there was a significant statistical difference found between the two system with respect to EOA ($U=2.335$, $cv=65$, $p<0.05$), NOA ($U=2.4889$, $cv=65$, $p<0.05$). COR ($U=0.811$, $cv =65$, $p<0.05$) and NOR ($U=2.913$, cv=65, p<0.05). The level of user's satisfaction was better in the adding rather than retrieving comment in multimodal metaphors compared with the visual one. The reason behind that, users found using either recording or synthesised easier and quicker to submit their ideas. Also, there are no spelling mistakes, confusing agreements, typing difficulties and missing data with employing speech tools compared with traditional approach. However, in the retrieving specially with short comments (less than 150 characters) was easier compared with hearing them. Users prefer that because the eye tracking in visual interfaces is more potential compared with multimodal one.

4.7.2 Measuring the Effectiveness

Analysis of system effectiveness consists of analysing the interface of interactive, analysis of task complexity included the individual task level (6 common tasks: difficult retrieve, moderate retrieve, easy retrieve, long adding, mid adding, short adding) and analysis of task type.

Interfaces of Interactive	Number of Action's Tasks Completed	
	Not Successfully	Successfully
VARCS (n= 132, 990 actions)	429 (43.33%)	561 (56. 67%)
MMARCS (n= 132, 990 actions)	232(23.43%)	758 (76.57%)

Table 15Percentages of action's tasks completed successfully for using the VARCS and MMARCS correspondingly.

Analysis was carried out using the t test to assess if the distribution of the categorical variables differs from one another. This is t tests for independence. The t test compared the counts of categorical responses between the two independent variables with two levels (i.e. interface of interaction: VARCS/MMARCS and task achievement: successfully/not successfully).

4.7.2.1 Interface of Interaction

As can be seen, Table 15 demonstrates the percentage of action's tasks completed successfully using the VARCS (Visual Adding Retrieving Comments System) and MMARCS (Multimode Adding Retrieving Comments System) experimental systems. It is noted that the MMARCS experimental group completed more tasks successfully (76.57%) compared to VARCS (56.67%). In addition, the t test results revealed that there was a significant difference between the two interfaces of interaction with respects to the task completed successfully ($t = -9.187$; $df = 42$; $p<0.05$).

Level of Add Tasks		Short		Middle		Long	
Interfaces of Interactive		VARCS	MMARCS	VARCS	MMARCS	VARCS	MMARCS
Rate Number of Action Completed	Successfully	122 out 198 61.62 %	157 out 198 79.29 %	103 out 198 52.02 %	154 out 198 77.78 %	97 out 198 48.99 %	151 out 198 76.26 %
	Not Successfully	76 out 198 38.38 %	41 out 198 21.79 %	95 out 198 47.98 %	44 out 198 22.22 %	101 out 198 50.01 %	47 out 198 23.74 %

Table 16 Percentages of action's tasks completed successfully in relation to the three levels of task complexity for adding comments for using the VARCS and MMARCS correspondingly

The t-test results are noted to exceed the critical value for 0.05 probability level (3.035). Then, to compare VARCS and MMARCS interfaces an Independent Samples t-test was conducted, and a significant difference in the VARCS ($M=25.50$, $SD=3.419$) and MMARCS ($M=34.45$, $SD=3.035$) was noted which suggests that MMARCS really does have an effect on VARCS.

4.7.2.2 Level of Complexity

The information in Table 16 shows the percentage of number of action's tasks completed successfully according to the three complexity levels for adding comments using the VARCS and MMARCS experimental systems. The percentages of the number of task actions completed successfully were consistently higher in every level of complexity for the MMARCS experimental system in comparison to VARCS system. The VARCS group analogically reported a higher percentage of tasks completed unsuccessfully. The rate of successful completion for long adding comment for MMARCS (76.26%) was seen to be 26.27% higher than that in VARCS.

Analysis using t-test on these showed, ($t = -5.692$; $df = 42$; $p<0.05$), a significant difference between them, for long adding comment of VARCS ($M=4.41$, $SD=1.72644$) and MMARCS ($M=6.86$, $SD=1.726$). A similar occurrence is seen for mid adding comments in MMARCS: the result obtained was 77.78 %, 24.76% higher than that in VARCS, and the t-test analysis showed a significant difference for MMARCS ($t = -4.915$; $df = 42$; $p<0.05$).

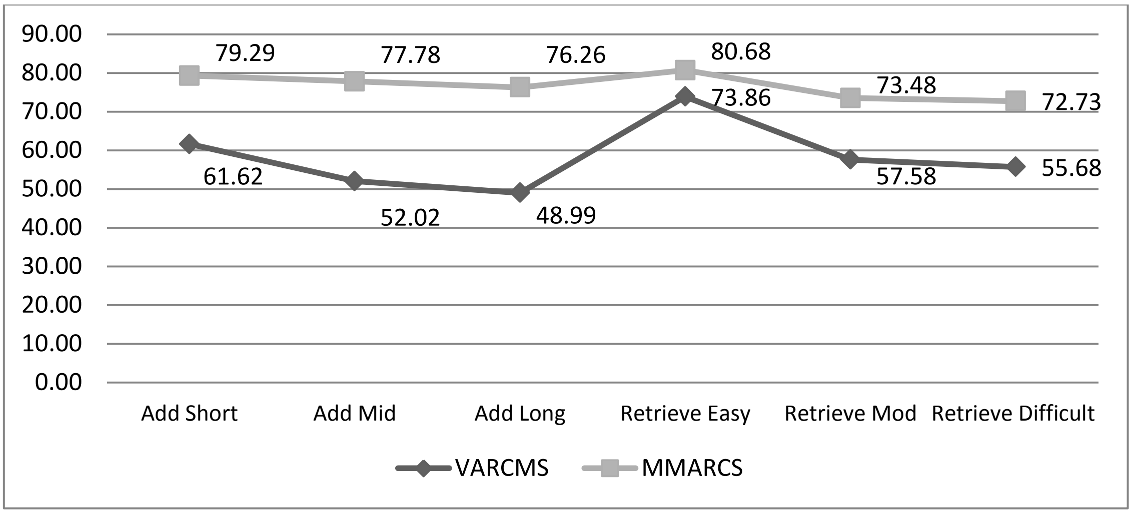

Figure 23Percentages of action's tasks completed successfully in relation to six common tasks for using the VARCS and MMARCS correspondingly

There was also a higher percentage that successfully completed the short adding comments in VARCS (17.67%) compared with MMARCS. Noted as well was a significant difference for MMARCS ($t = -3.070$; $df = 42$; $p<0.05$).It would be expected to find significant difference among the three levels. Analysis using the t-test to identify the difference between the three levels of task complexity for adding comments, showed results that suggest that adding comments in MMARCS do have an effect on VARCS. Additionally, Table 17 shows the percentages of number of action's tasks completed successfully according to the three levels of task complexity for retrieving comments using the VARCS and MMARCS experimental systems.

On the whole, it can be noted that the MMARCS system had a higher percentage of number of action's task completed successfully compared to the VARCS system. This was found to be common to all three retrieving tasks.

Level of Retrieve Tasks		Easy		Moderate		Difficult	
Interfaces of Interactive		VARCS	MMARCS	VARCS	MMARCS	VARCS	MMARCS
Rate Number of Actions Completed	Successfully	65 out 88 73.68 %	71 out 88 80.68 %	76 out 132 57.58 %	97 out 132 73.48 %	98 out 176 55.68 %	128 out 176 72.73 %
	Not Successfully	23 out 88 26.14 %	17 out 88 19.32 %	56 out 132 42.42 %	35 out 132 26.52 %	78 out 176 44.32 %	4 out 176 27.27 %

Table 17 Percentages of action's tasks completed successfully in relation to the three levels of task complexity for retrieving comments for using the VARCS and MMARCS correspondingly.

The rate of completion for the difficult task in MMARCS (72.73%) was found to be higher than that for those tasks in VARCS (55.68%) as the complexity of task increased (from easy to moderate and from moderate to difficult). Using the t-test analysis on these showed, ($t = -3.14$;$df = 42$; $p>0.05$), a significant difference was found between them, for long retrieving comment of VARCS ($M=4.45$, $SD=1.405$) and MMARCS ($M=5.82$, $SD=1.468$). On the other hand, the moderate task, surprisingly had a less successful percentage rate in VARCS (57.58%) than in MMARCS (73.48 %) but not a significant difference for MMARCS ($t = -2.87$; $df = 42$; $p>0.05$). A similar difference was noted in easy retrieving comments which showed a decrease in VARCS by 17%. However, the t-test, ($t = -1.13$; $df = 42$; $p>0.05$), shows that there is no statistically significant difference noted between the easy retrieve of VARCS ($M=2.95$, $SD=.785$) and that of MMARCS ($M=3.23$, $SD=.813$).

4.7.2.3 Task Type

Table 18 demonstrates percentages of number of tasks actions completed successfully according to the two task types (Add and Retrieve Comments) using the VARCS and MMARCS experimental systems. Findings show that adding comments tasks recorded the highest rate of accuracy (77.87 %) for MMARCS, whereas adding comments tasks scored the lowest (54.21%) for VARCS. It is also shown that the rate of number task actions completed successfully for retrieving comments task in MMARCS (74.75 %) was lower than that for retrieving comments task in VARCS (60.35 %).

The difference, however, was only minimal (14.40%). However, there were large differences between adding comments for MMARCS of more than 22%.It would not be expected to find significant difference between the completion rate of the adding comment tasks and retrieving comments tasks for VARCS and MMARCS.

An insignificant difference between the completion rates of the two types of tasks was revealed by the t-test. The t-test outcomes ($t = -8.883$; $df = 42$; $p<0.05$) showed a significant difference in add task accuracy between VARCS ($M=14.64$, $SD=2.341$) and MMARCS ($M=1.807$, $SD=2.410$) for adding comment type. Nonetheless, the t-test showed a significant difference between VARCS ($M=10.86$, $SD=1.807$) and MMARCS ($M=13.45$, $SD=1.371$) with respect to the rate of retrieve task accuracy ($t = -5.358$; $df = 42$; $p<0.05$). An almost equal effect on the contribution of multiple metaphors was noted.

Interfaces of Interactive	Number of Tasks Action Completed			
	Adding Comments		Retrieving Comments	
	Not Successfully	Successfully	Not Successfully	Successfully

VARCS (n= 66)	272 out 594 45.79 %	322 out 594 54.21 %	157 out 396 39.65 %	239 out 369 60.35 %
MMARCS (n= 66)	132 out 594 22.22 %	462 out 594 77.87 %	100 out 369 25.25 %	296 out 369 74.75 %

Table 18 Percentages of action's tasks completed successfully in relation to the two task types of (Add and Retrieve Comments) for using the VARCS and MMARCS correspondingly

For both adding and retrieving comments, there was improvement of MMARCS compared with TARCS for the number of task achievement successfully. The reasons behind those users made less selecting and typing errors in multimodal metaphors as well as hearing the information and main comments with graphic were more powerful to achieve retrieving comments.

4.7.3 Measuring the Efficiency

An analysis of the effectiveness of this study in relation to interface of interactive, task type, task complexity level was conducted. Conversely, for the reason that measurements of efficiency are parametric variables, the related t tests were performed to test the statistical significance between the VARCS (control group) and MMARCS (experimental group).

The measurement of efficiency was established by looking at mouse clicks required to complete the task, task achievement time and rate of errors in both groups. The assumption was that the MMARCS system was more efficient when compared to VARCS is the research focuses on finding evidence in support of this claim.

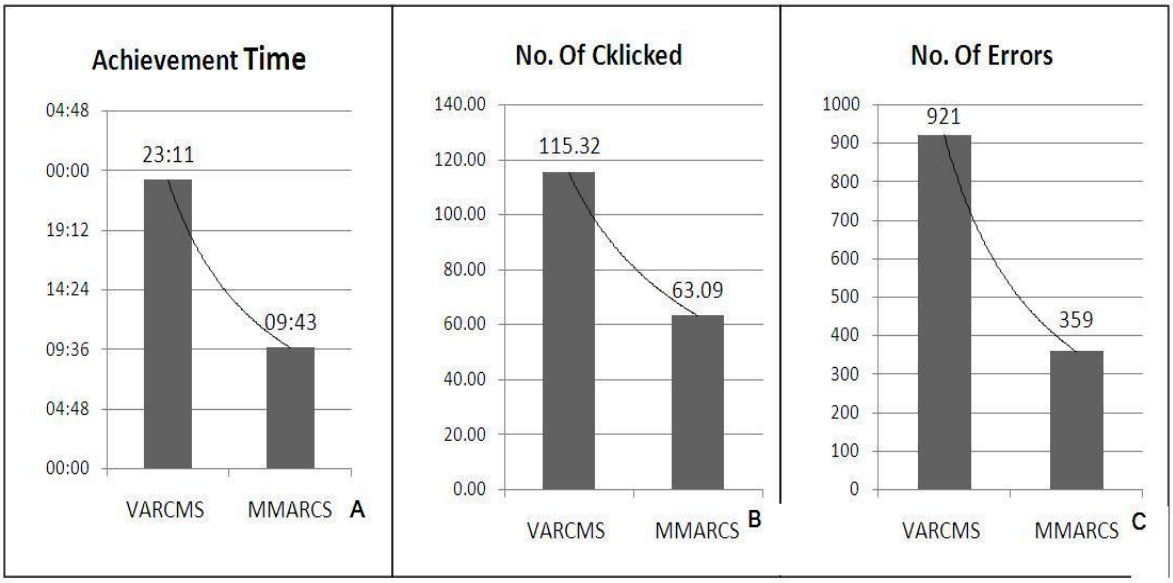

Figure 24 Mean value which involved to complete tasks in VARCMS and MMARCS for achievement time per minutes (A), mouse clicks (B) and errors rate (C).

4.7.3.1 Interfaces of Interactive

Note in Figure 23, the mean value of percentage of (a) task achievement time per minutes, (b) count of mouse clicks and (c) the error rates, for the overall performance using the VARCS and MMARCS experimental systems. The above charts show that MMARCS outperformed the VARCS with regard to all system efficiency attributes. As seen in Figure 23 (A), the mean value of the task achievement time for MMARCS was approximately 42 per cent lower than that for VARCS. The mean task completion time to accomplish both retrieve and add tasks was 23min11sec for VARCS (M=9:43, SD=0:46) as opposed to 9 min 43 sec for MMARC (M=14:28, SD=10:20). It is therefore evident that multimode system is more efficient than the visual in relation to the time required for completing the task. The t-test result showed that there was a significant difference between the two interfaces in relation to task achievement time (t

= 2.149; df = 21; $p<0.05$). Figure 23 (B) shows the mean value of number of mouse clicks required to complete tasks was approximately double for the VARCS (M=115.32, SD=9.311) group, as compared to MMARCS (M=63.09, SD=9.481). The t test result drew attention to the significant difference between the two groups as to mouse clicks ($t = 18.434$; df = 21; $p<0.05$).

In Figure 23 (C), the error rate for MMARCS was seen to be much lower than that for VARCS (marginally more than 60 per cent lower). The errors made in the MMARCS group were reported to be 359 and that for VARCS was 921. The related t test showed that there were significant differences in the error rate between the two interfaces as will describe in section4.7.3.4 (Errors Result).

In conclusion, the use of multimodal metaphors reduced the numbers of mouse clicks required to complete tasks by almost half. MMARCS is seen to have the smaller rate of error, completed add and retrieve task significantly more quickly and the mouse clicks required to complete task in MMARCS system were noticeably fewer than those required in the VARCS group. It was also the case that the multimode approach had greater efficiency than the visual approach. A t-test analysis, at a 0.05 significance level, was conducted to test the significance of the difference between the VARCS and MMARCS. As before, if the probability occur lower rate than 0.05 the null hypothesis is rejected and the significant difference between the two groups is provisionally accepted. As well as this, the indications from the charts and results revealed that MMARCS significantly outperformed the VARCS group with respect to the three efficiency factors: task completion time, error rate count of mouse clicks.

4.7.3.2 Level Complexity

In figure 24, the mean value of percentage of task achievement time for adding and retrieving comments according to the three task complexity levels using the VARCS and MMARCS experimental systems is shown. On the whole, it is noted that the level of the efficiency variable (task achievement time) varied in favour of the MMARCS experimental group. The use of multimodal metaphors was proven to have an effect on the task completion time. Figure 24 (A) shows that the successful completion of three add tasks was achieved significantly faster (four times as fast) in short, twice as fast in Mid and twice as fast in long comments with the MMARCS experimental system when compared to the tasks using VARCS.

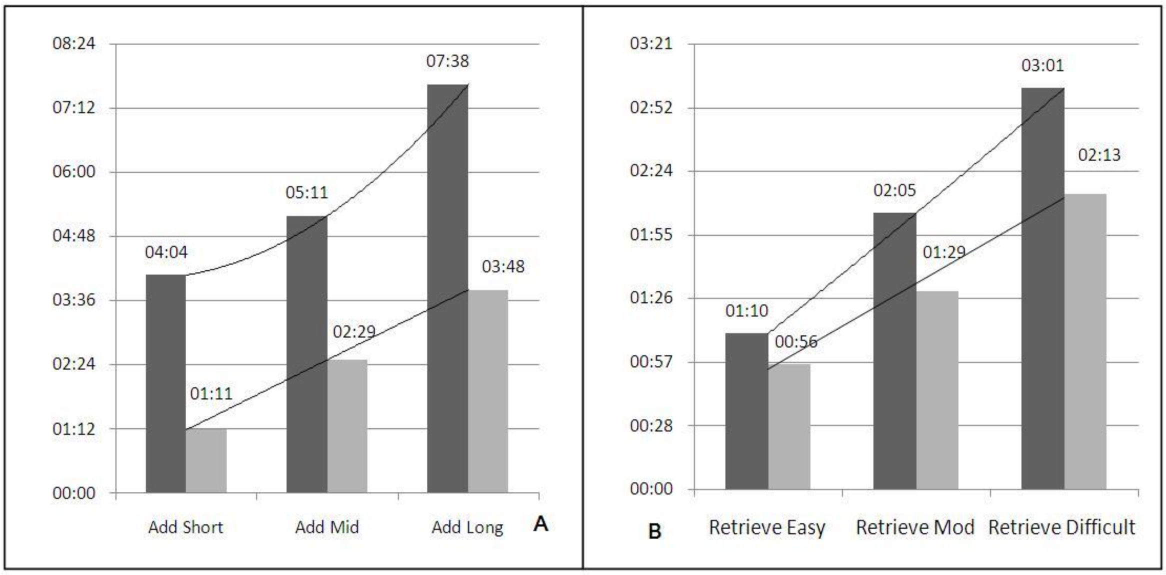

Figure 25 Mean value of Achievement Time which involved completing tasks in VARCS and

MMARCS in relation to the three levels of task complexity for Adding Comments (A) and Retrieving Comments(B).

As evidence to this, the t-test revealed that a significant difference was found between adding short comment ($t = 22.669$; $df = 42$; $p>0.05$), adding mid comment ($t = 12.527$; $df = 42$; $p<0.05$) as well as for long comment ($t = -6.913$; $df = 42$; $p<0.05$) for MMARCS compared with VARCS.It is also illustrated in Figure 24 (B) that the trends of task achievement time are consistent in all three complexity levels of retrieval. It shows the tasks achieved significantly faster (more or less twice as fast) using the MMARCS experimental system as opposed to using VARCS. The t- test revealed that a significant difference between moderate ($t = 6.092$; $df = 42$; $p<0.05$) and difficult comment ($t = 7.12$; $df = 42$; $p<0.05$) for MMARCS compared with VARCS. Conversely, the difference was not as significant as for easy retrieve ($t = 2.004$; $df = 42$; $p<0.05$) tasks as found between both types of tasks. Moreover, Figure 25 shows the mean count of mouse clicks for adding and retrieving comments required to complete the three levels of task complexity using the VARCS and MMARCS experimental systems. The difference between the two conditions in terms of mouse click counts is noted to be consistent throughout the task complexity levels. The MMARCS group required fewer mouse clicks in order to accomplish all the tasks undertaken.

Figure 25 (A) illustrates the use of multimodal metaphors considerably reducing(42 per cent in short comments, 42 per cent in mid and approximately 52 per cent in long comments), the mean count of mouse clicks when compared to VARCS in adding comment tasks. The t-test results revealed that the difference was found between all levels, short (t = 7.699; df = 42; p<0.05), mid (t = 8.136; df = 42; p<0.05) as well as clicking in long comments (t = 11.362; df = 42; p<0.05) for MMARCS compared against VARCS.

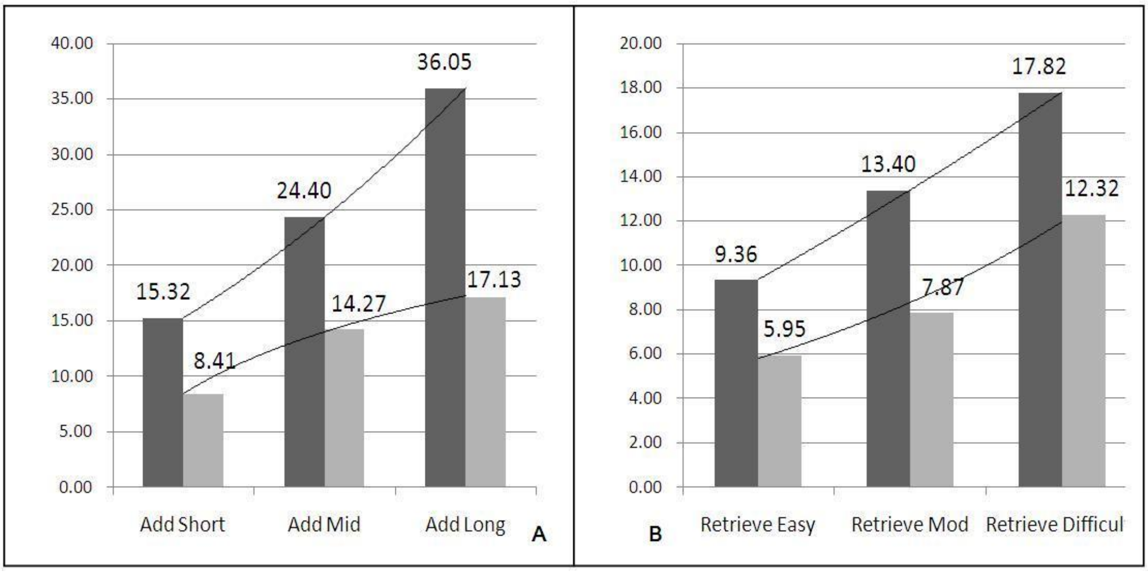

Figure 26 Mean value of mouse clicks which involved completing tasks in VARCS and MMARCS in relation to the three levels of task complexity for Adding Comments (A) and Retrieving Comments (B).

However, Figure 25 (B) showed that at all levels of retrieving comments task, there were also differences between them for MMARCS by approximately 38 per cent in easy, 41 per cent in moderate and 31 per cent in difficult comments .

For instance, the mean number of clicks required in easy task was found to be (t = 3.462; df = 42; p<0.05) while (t = 6.52; df = 42; p<0.05) was in moderate and (t = 6.12; df = 42; p<0.05) in difficult tasks.

In conclusion, it can be stated that the use of multimodal metaphors considerably reduced the number of actions required to complete the tasks with respect to the number of mouse clicks and task completion time. In this research, therefore, the MMARCS system was found to improve efficiency of performance.

4.7.3.3 Task Type

In Figure 26 (A) the mean values of the task achievement time according to the two task types using the VARCS and MMARCS experimental systems are shown. On the whole, higher mean values of the task achievement time were found in the add task type in VARCS (16:48 min:sec) and a significant ($t = 25.312$; $df = 42$; $p<0.05$) difference was also found between VARCS (M=16:54, SD=1:38) contrasted to that of MMARCS (M= 7:29 SD=0:36). It is worth noting that the mean value of task accomplishment time for adds comments task using MMARCS was more than two and a half times that for the VARCS system. The quickest time for task achievement was noted for the MMARCS (4 mins 39 sec) interface for the retrieve task type. There was also a significant ($t = 8.310$; $df = 42$; $p<0.05$) difference between the retrieve task for MMARCS (M=8.14, SD=2.396) as against that for VARCS (M=13.18, SD=2.719).

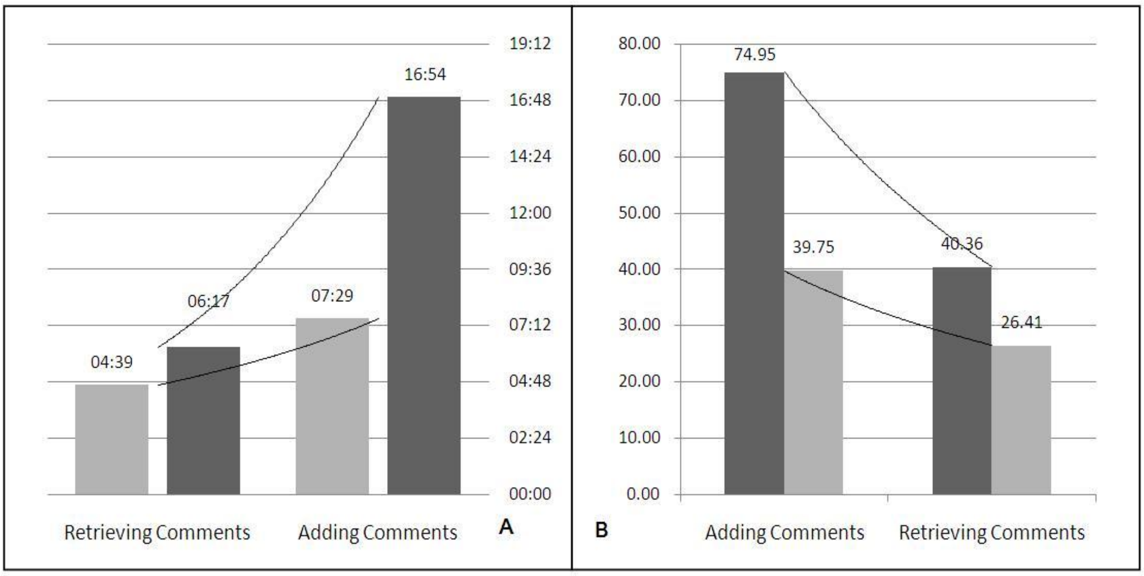

Figure 27 Mean value of Adding and Retrieving Comments (task types) which involved completing tasks in VARCS and MMARCS in relation to achievement time (A) and the count of mouse click (B).

Conversely, Figure 26 (B) shows the mean count of mouse clicks for each, and for both task types; adding and retrieving comments by using the VARCS and MMARCS experimental systems. At first sight, the difference between the two interfaces was almost the same for the two task types. The MMARCS (M= 36.68, SD=8.231) interface required nearly 48% fewer mouse clicks compared to the VARCS (M=74.95, SD=9.214) in adding comments while it was in the region of 40% in retrieving comments for MMARCS (M=26.41, SD=5.207). The related t-test showed that there were significant differences in the number of mouse clicks rate between two task types, for adding comments (t = 14.529; df = 42; $p<0.05$)and for retrieving (t = 9.092; df = 42; $p<0.05$).

4.7.3.4 Errors Result

Figure 27 illustrates the number of errors made using the VARCS and MMARCS experimental systems. The chart shows the values for the five error types; incorrect typing, selecting error, confusion, no action addition, and no action return. It is noted that MMARCS had lower values for all error types. This indicates that substantially fewer errors were made using the MMARCS system. VARCS had a considerably higher (387) value for incorrect typing errors, compared with MMARCS (79). Likewise, the VARCS had high values for No action add and No action return error types, whereas values for MMARCS for the same error types were both lower, with its No action add value being half that of VARCS, and it's No action return value being slightly less than two-thirds (63%) that of VARCS.

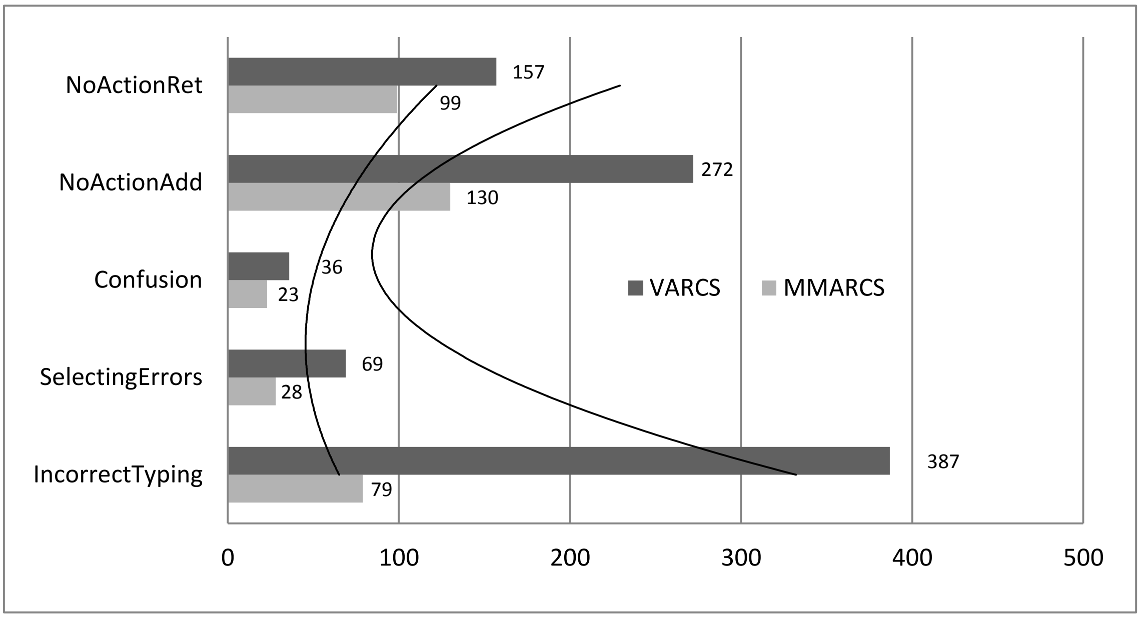

Figure 28 The number of value of errors executed in all tasks in VARCS and MMARCS in relation to five different types of errors.

The confusion and selecting error types for both systems were both far less than that for the other error types. However, the values for MMARCS are seen in both cases to be less than approximately half of those of the VARCS in the respective error types. The results of the t-test indicated that, apart from the confusion error type, all other error types showed a significant difference between the two groups. The mean value for incorrect typing errors during tasks was far higher in VARCS (M=17.59, SD=4.182) as against those of MMARCS (M=3.59, SD=1.532). The t-test results showed that there was a significant difference between the two groups in relation to incorrect typing errors (t=14.74, df=42, $p<0.05$).The mean value for selecting errors during tasks was lower in MMARCS (M=1.27, SD=.935) as opposed to VARCS (M=3.14, SD=2.007). The t-test result showed that there was a significant difference between both groups with respects to selecting errors (t=3.948, df=42, $P<0.05$).The mean values for the confusion errors during tasks was lower in MMARCS (M=1.64, SD=1.177) as opposed to VARCS (M=1.05, SD=.785) which is slightly higher. The t-test result showed an insignificant difference between both groups in relation to the confusion error (t=1.959, df=42, $P>0.05$).For the No action add error during tasks, the mean value was found higher in VARCS (M=12.36, SD=4.45) as against MMARCS (M=5.91, SD=2.524). The results of the t-test revealed a significant difference between both groups with respects to the No action add error (t=6.162, df=42, $P<0.05$).And lastly, for the No action return error during tasks, the mean value is found to be (M=7.14, SD=3.152) for VARCS as contrasted to MMARCS (M=4.50, SD=2.24). From the results of the t-test, a significant difference is noted between both groups with regards to the No action return error ($t=3.197$, $df=42$, $P<0.05$).

In general, users felt that using multimodal metaphors reduces the time to achieve each task and the number of mouse clicks as result using recording or synthesised. MMARCS tools supported the users to considerate on their opinion rather than the distraction between using the mouse or keyboard. Also, users made some typing mistake, confused with selecting icons in visual interface compared with multimodal metaphors.

4.8 Conclusion

In concluding this Chapter, the overall findings obtained from the tests conducted are given in this section. The results of the analysis of the systems effectiveness for VARCS and MMARCS, in relation to the interface of interaction, task complexity, task type and the individual task levels, show that the MMARCS has a more effective interface of interaction than the VARCS, more tasks having been completed successfully. The MMARCS was also found to have greater efficiency, outperforming the VARCS group in the three efficiency factors; task completion time, error rate, and count of mouse clicks, as well as in terms of the task types. MMARCS is seen to have reduced the number of mouse clicks required to complete tasks by almost half indicating a higher efficiency than that of the VARCS. Lastly, from the analysis of VARCS and MMARCS on user's satisfaction, from the satisfaction statement survey, the general opinion indicated was that the MMARCS was more satisfactory overall as opposed to the

VARCS although, due to the variations between the two conditions, further analysis is recommended.

4.8.1 Result Discussion

This study has examined twenty two pairs of users even as interacting with two interfaces of interactive (VARCS and MMARCS) which observed that the auditory cues had an extensive role in the enhancement of task achievement success. This was by generating users concentration, as the audio-visual interface of interactive applied into adding and retrieving comments with evaluated to the text with graphics. In actual fact, the experimental platform is to which multimodal metaphors (non-speech, speech) support the communication in social media and e-journalism interaction. The system employed a number of environmental sounds to express general trends, especially in RI data, which was effective to impact and alter the user's opinion about those trends. Speech metaphors, either synthesised or recording, were expected to enhance user interaction in adding tasks that involve all actions in RI and MC. It was I do not understand this Noteworthy that using multimodal interaction in MMARCS reduced user response errors, clicking mouse and time, which led to greater user impactability on public opinion and satisfaction. Similarity, non-speech metaphors had different effectiveness on user's work such as in retrieving tasks, where the earcons were found to be not as helpful as auditory icons. The reason behind that was the interpreted naturally of earcons whiles it supported the communication in RI data, like the opinion classification and comments recommendation.

In general, the analysis of the trial's efficiency showed that there were significance of multimodal metaphors in improving the interaction of adding and retrieving comments in the field of e-journalism and social media. In particular, multimodal interaction facilitated an efficient representation of RI and MC by aural and oral communication rather than rely on traditional approach.

The results pointed that, users were more comfortable with aural and oral communication because they experienced fewer errors, mouse clicks and saving time when sounds were inserted and conveyed the comments than with typing and reading them. On the other hand, the levels of user impactability on public opinion and satisfaction were enhanced, because users felt that MMARCS with the use of audio-visual metaphors made them feel free and less confused when multimodal metaphors were used when compared with the traditional approach.

In particular, the result showed that using MMARCS decreases the effect of prior experience during the adding comments and has an enhancement on perception of reader's satisfactions and impact on their opinion while there was a slight improvement in retrieving comments tasks in terms of satisfaction. Some users gave the reason as being the benefit of scan reading rather than listening, especially in long comments. However, the feedback and analysis demonstrated that the audio-visual interface contributed to all levels of retrieving comments for those who prefer to keep up with the news while working; it has the improvement of the user's attitudes.

In general, the usage MMARCS (multimodal interface) has been accepted as having a positive effect in all usability aspects, effectiveness, efficiency of E-ARCS, and the user attitude ,either impactability on opinion or satisfaction statements. However, some studies and users suggested that it would better to make MMARCS interface with facial expressions. This idea, as with face-to-face communication, can enhance the readers' interaction, familiarity and understanding. As result of this, this Chapter led to the investigation of the role of the AVATAR technique in the improvement of the impactability of opinion and the usability of interfaces.

4.8.2 Summary

The analysis in this Chapter focuses on the results obtained from the tests conducted in the experiment. These are the related t-tests and Wilcoxon's tests, based on the controls and experimental systems which were used to investigate the significant difference in conditions, on users of the two groups. From the analysis, we find that the systems effectiveness of the VARCS and MMARCS, in relation to the interface of interaction, task complexity, task type and the individual task levels, are as follows:

- MMARCS has a more effective interface of interaction than the VARCS, illustrated by the amount of more tasks successfully completed.
- On the level of complexity, the MMARCS is noted to be more effective than the VARCS also, in relation to the percentage of tasks completed.
- Overall on the task types, the MMARCS and VARCS were found to have almost equal effect on the contribution of multiple metaphors, despite the fact that MMARCS had a higher rate of tasks actions completed and from the analysis of the efficiency of the VARCS and MMARCS:

On the interface of interaction, we find the following outcomes from the experiments conducted:

- The MMARCS was found to have greater efficiency, outperforming the VARCS on the three efficiency factors; task completion time, error rate, and count of mouse clicks.
- On the level of complexity, the MMARCS was also noted to improve the efficiency of performance as it considerably reduced the number of actions required for each task as opposed to the VARCS.
- Overall on the task types, on MMARCS the number of mouse clicks required to complete tasks was reduced by almost half, indicating a higher efficiency than that of the VARCS.

Lastly, from the analysis of VARCS and MMARCS systems based on user’s satisfaction, it can be observed from the satisfaction statement survey that the general opinion indicated that the MMARCS system was more satisfactory overall as opposed to the VARCS.

However, taking all of the above into consideration, further analysis is recommended due to the variations in results between the two conditions, and to further investigate the results on the impact on public opinion, which indicated that the overall response showed a preference for the VARCS system as opposed to the MMARCS.

Chapter 5: An Investigating the Role of the AVATAR Metaphors in the Improvement of the Impactability of Public Opinion on Social Media

5.1 Introduction

In the previous Chapter of this study, the role of visual metaphors and multimodal were compared to discover their impact on opinions in relation to the means of adding and retrieving comments in e-newspaper and social media fields.

The previous chapter also aimed at determining the ability of multimodal metaphors to enhance the usability of ARCS interfaces, by using Opinion Classification in both VARCS and MMARCS. And it was found that as a result of using previous variables, tasks and experiment design in different interfaces it is vital to investigate several combinations of metaphors such as avatar within the multimodal. This led the researcher to evaluate and examine those tools to discover new aspects which impact on public opinion and usability of the browsing comments methods. This Chapter's intention is to achieve these aims in relation to E-ARCS.

5.2 Aims

The study in this chapter is aimed at comparing the AVARCS as a third interface of interaction to investigate utility of avatars in E-ARCS. The idea justifying this proposal is the possibility of unique outcomes of the evaluation of the effectiveness, efficiency and satisfaction of users when avatars are used in communication to add and retrieve comments.

The aim here is to examine the impact of avatars on the opinions of readers, in different types of task, in interfaces with three different levels of complexity, as compared to multimodal (MMARCS) and the text with graphics (VARCS) interfaces.

5.3 Objectives

To achieve the objectives at this stage, three E-ARCS experimental platforms were required to measure the impact on opinion and usability. One of the objectives was to design a platform consisting of an Avatar-aided MMARCS (AVARCS).

The AVARCS platform was therefore designed as the third E-ARCS into the interfaces interaction, and led to an extension of the earlier study which compared MMARCS, multimodal built-in speech and non-speech metaphors, to VARCS with graphics and text. An empirical study was, thus, carried out by implementing these interfaces which were evaluated by three independent groups of users (n=22 for each group).

This further study was intended to research its goals by setting variables which have been designed to be measurable; such include the aspects of the impact on opinion and usability. And as such, to enable the objectives to be examined, measuring the usability of E-ARCS for effectiveness involved counting the number of task's actions completed successfully.

Furthermore, the efficiency of the E-ARCS, as before, was evaluated by measuring the number of mouse clicks, error rate, time and percentage of task completion. There was also a research-designed achievement test to measure the knowledge, plus a questionnaire to measure the impact on user‘s opinion of the E-ARCS, as well as for the evaluation of users' satisfaction.

5.4 Experiment Design

As a result of the various successful enhancements of the previous study platform(an explanation being provided in Section 4.4) relating to discovering the impact and usability of E-ARCS, a new interface adding AVATAR metaphors was built to further improve E-ARCS. In the first study multimodal metaphors reduced the errors and saved time by using serial combination sounds in E-ARCS.

This led the researcher to investigate whether the use of avatar expressions makes a difference in E- ARCS compared with AVARCS and MMARCS. The implementation and interfaces of VARCS and MMARCS involved some differences and similarities. Tables19 and 20show the comparisons between AVARCS and MMARCS (the comparison between VARCS and MMARCS in Table 5) and explains how AVARCS employed both different and similar tools to avatar expressions.

Adding CommentsSystem / Metaphors			Adding Comments																										
				Short Comment T1									Mid Comment T2									Long Comment T3							
				Add Name	Add E-mail	Add Title	Add Gender	Add City	Add Opinion	Add Comment	Recommend		Add Name	Add E-mail	Add Title	Add Gender	Add City	Add Opinion	Add Comment	Recommend		Add Name	Add E-mail	Add Title	Add Gender	Add City	Add Opinion	Add Comment	Recommend
No. Of Actions in Tasks				1	2	3	4	5	6	7	8		9	10	11	12	13	14	15	16		17	18	19	20	21	22	23	24
MMARC	Text		√	√		√		√				√	√		√		√				√	√		√		√			
MMARC	Graphics		√				√		√		√	√				√		√		√	√				√		√		√
MMARC	Non Speech	Auditory Icons	√						√		√	√						√		√	√						√		√
MMARC	Non Speech	Earcons	√						√		√	√						√		√	√						√		√
MMARC	Speech	Synthesised	√							√		√							√		√							√	
MMARC	Speech	Recorded Speech	√	√	√	√	√	√		√		√	√	√	√	√	√		√		√	√	√	√	√	√		√	
AVARC	Text		√	√		√		√				√	√		√		√				√	√		√		√			
AVARC	Graphics		√				√		√		√	√				√		√		√	√				√		√		√
AVARC	Visual Special Effect		√				√		√	√						√		√	√						√		√	√	
AVARC	Non Speech	Auditory Icons	√						√		√	√						√		√	√						√		√
AVARC	Non Speech	Earcons	√						√		√	√						√		√	√						√		√
AVARC	Speech	Synthesised	√							√		√							√		√							√	
AVARC	Speech	Recorded Speech	√	√	√	√	√	√		√		√	√	√	√	√	√		√		√	√	√	√	√	√		√	
AVARC	Facial Expression						√		√	√						√		√	√						√		√	√	

Table 19 The comparison between section of VARCS and metaphors in the MMARCS and AVARCS for Adding Comments tasks.

Retrieving Comments System / Metaphors				Retrieve Comments: Easy Comment T4								Moderate Comment T5								Complex Comment T6							
				Retrieve Agree	Retrieve Disagree	Retrieve Neutral	Retrieve Gender	Retrieve Name	Retrieve City	Retrieve Comment	Retrieve Recommend	Retrieve Agree	Retrieve Disagree	Retrieve Neutral	Retrieve Gender	Retrieve Name	Retrieve City	Retrieve Comment	Retrieve Recommend	Retrieve Agree	Retrieve Disagree	Retrieve Neutral	Retrieve Gender	Retrieve Name	Retrieve City	Retrieve Comment	Retrieve Recommend
No. Of Actions in Tasks				**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
MMACS	**Text**		√					√	√							√	√							√	√		
	Graphics		√	√	√	√	√				√	√	√	√	√				√	√	√	√	√				√
	Non Speech	**Auditory Icons**	√		√						√		√						√		√				√		
		Earcons	√	√		√						√		√						√		√					√
	Speech	**Synthesised**	√													√	√	√									
		Recorded Speech	√					√	√	√														√	√	√	
AVARCS	**Text**		√					√	√							√	√							√	√		
	Graphics		√	√	√	√	√				√	√	√	√	√				√	√	√	√	√				√
	Non Speech	**Auditory Icons**	√	√	√	√			√		√	√	√	√			√		√	√	√	√			√		
		Earcons		√						√		√						√		√				√			
	Speech	**Synthesised**	√		√								√								√					√	
		Recorded Speech													√	√	√										
	Facial Expression		√					√	√	√														√	√	√	

Table 20 The comparison between section of ARCS and metaphors in the MMARCS and AVARCS for Adding Comments tasks.

5.4.1 Multimodal Metaphors Design

Table 21 demonstrates the serial combination of earcons described by timbre, rhythms, duration and range. Firstly, serial combinations of earcons were employed with different rhythms in the AVARCS interface, both for adding, and retrieving, comments. These rhythms expressed neutral opinion and female gender with visual graphic and avatar expressions as well as AVARCS in the section for adding commendams.

Platform of AVARCS		Forms of Earcons			
		Timbre	Rhythm	Duration	Range
Adding Comments					
1	Neutral Opinion with avatar expression	Piano	Up/ down Pitch	0.4 Sec	1 - 10
2	Gender Women with visual graphic	Violin	Rising Pitch	0.3 Sec	1 -10
Retrieving Comments					
3	Not Recommended with visual graphic	Drum	Rising Pitch	0.4 Sec	1 -10
4	Agree Opinion with avatar expression	Organ	Rising Pitch	0.4 Sec	10 -90
6	Agree Comment with avatar expression	Guitar	Down Pitch	0.4 Sec	1 -10

Table 21 Explanation how families of Earcons works in AVARCS for Adding and Retrieving Comments

In addition, the different types of timbre, duration and its range compared with MMARCS can be seen. In comparison, in the retrieving comments area, more rhythms were employed by using serial combination earcons communication so as to insert Not Recommended. This involved a drum with visual graphics. An organ rising pitch with avatar expression was used to represent Agree Opinion while Disagree was shown by guitar down pitch. The forms of earcon's rhythm played between longer period separated time and sequence to reduce the confusion of users, in accordance with guidelines set out by Rigas and Brewster [22, 31,123,124 and 166].

5.4.2 Facial Expressions Design

Figure 28 shows the types of AVATAR facial expressions based on the opinion classification as result user's perspective from the initial survey (chapter three). These types of AVATAR expressions were designed to replace the use of words in the two types of adding and retrieving comments beside multimodal metaphors.

Interface		Negative	Neutral	Positive
Adding Comments	Male			
		Angry	Thinking	Happy
	Female			
		Sad	Neutral	Joyful
Retrieving Comments	Male			
		Shocked	Hesitate	Positive Surprised
	Female			
		Disgusted	Waver	Agree

Figure 29 Explanation how facial expressions of AVATAR work in AVARCS for Adding and Retrieving Comments

Table 22, on the other hand, shows the different categories of recorded and synthesised speech as well as those designed into the sections of AVARCS. It uses a number of different and similar tools to MMARCS with three types of facial expression: agree, neutral and disagree. In the adding comments part, all levels of AVATAR facial expressions were used to convey some data from IR and MC into AVARCS.

Platform of AVARCS		Forms Metaphors		
		Recording	Synthesised	Expression
Adding Comments				
1	Short Comments ≤ 150 Characters with avatar expression		√	√
2	Name	√	√	
3	Agree Opinion with visual graphic and avatar expression			√
4	Disagree Opinion with visual graphic and avatar expression			√
5	Neutral Opinion with visual graphic and avatar expression			√
6	Title	√	√	
7	City	√	√	
8	E-mail	√	√	
9	Recommended with visual graphic			
10	Gender Man with visual graphic			√
11	Med Comments 151 ≤ Characters ≤ 650 with avatar expression	√		√
12	Long Comments 451 ≤ Characters ≤ 850 with avatar expression		√	√
Retrieving Comments				
13	Easy Comments ≤ 150 Characters with avatar expression		√	√
14	Name	√	√	
15	City	√	√	
16	Email	√	√	
17	Title	√	√	
18	Gender Women			√
19	Agree Opinion with visual graphic and avatar expression			√
20	Disagree Opinion with visual graphic and avatar expression			√
21	Neutral Opinion with visual graphic and avatar expression			√
22	Med Comments 151 ≤ Characters ≤ 650 with avatar expression	√		√
20	Complex Comments 451 ≤ Characters ≤ 850 with avatar expression		√	√

Table 22 Explanation how families of facial expressions and recorded speech work in AVARCS for Adding and Retrieving Comments expression (three different opinions displayed) in each single statement in both sections, IR and MC.

For example, the shocked face (meaning “disagree”) showed, in a summary box, that the number of readers disagreeing was less than the other opinions. Meanwhile the level of “agree” responses was shown by the joyful face, whether man or women, depending on the gender. However, in the case when the reader was uncertain in their view, the avatar facial expression was shown by Hesitate (as the neutral opinion level).In contrast, in the Retrieving Comments part, the level of avatar facial expression played a role in showing the real status of the commentator in IR and MC. For instance, Positive Surprised AVATAR explained the reasons of the commentator by varying levels of "agree" sounds and expressions while moving between both levels (agree and disagree)was used by the Waver face to represent a neutral opinion.

5.4.3 Audio-AVATAR Design

Figures29 and 30 show the structure of audio-avatar message to add and retrieve comments which were used in the experiment with AVARCS. It showed the comparison between the message format used in the previous experiment (VARCS with MMARCS) and the modified metaphors which were used by adding AVATAR tools.

Figure 30 Description of the audio-avatar message in Adding Comments in AVARCS

By way of further explanation, the third experiment suggested that using AVATAR would add visual metaphors with sound tools to help users enhance the usability and impact of adding and retrieving IR and MC. Consequently, in the Adding Comments section, it combined the Gender and Opinion field because using the AVATAR provided them as one facial expression. Also, this combining used adding main comments by different levels of sound depending on the commentator's opinions (agree, neutral or disagree). In contrast to this, in the Retrieving Comments part, the system provided users with the ability to hear and see the comments with full suitable facial expression AVATAR.

As Figure29 has shown, users can add Name, Gender, Opinion and Main Comments by hearing them with different facial expressions, with natural recorded speech and earcons. Figure 30 VARCS showed the similarities and differences of design of retrieving parts compared to MMARCS. The main aspects of the similarities are the classification of opinion and the approach of adding MC by using sound system and summary box of IR., The differences between AVARCS and the previous experiment can be seen by combining gender type with level of opinion to make them six facial expressions.

Figure 31 Description of audio-avatar message in Retrieving Comments of AVARCS

5.5 Experiment Hypotheses

This section states the research hypotheses to facilitate the next steps of the study structure. As a platform of experiment consisted of two types of measurement so that eleven hypotheses were designed to measure the aims of the study. These hypotheses were written in both forms of Adding and Retrieving Comments, and shown below:

H3-01: The impactability on Opinion of AVARCS will be better than for that of MMARCS and VARCS due to these unique interfaces of retrieving comments.

H3-02: Adding comments in the E-ARCS by AVARCS will be more effective than MMARCS and VARCS (suggests that there will more tasks completed successfully by users).

H3-03: Adding comments in the E-ARCS by AVARCS will be more efficient than MMARCS and VARCS (suggests that there will be time savings experienced by users in each task).

H3-04 Adding comments in the E-ARCS by AVARCS will be more efficient than MMARCS and VARCS (suggests that there will be a reduction in the rate of errors in accomplishing all tasks).

H3-05: Adding comments in the E-ARCS by AVARCS will be more efficient than MMARCS and VARCS (suggests that there will be a reduction in the number of mouse clicks in accomplishing all tasks).

H3-06: Retrieving comments in the E-ARCS by AVARCS will be more effective than MMARCS and VARCS (suggests that there will more tasks completed successfully by users).

H3-07: Retrieving comments in the E-ARCS by AVARCS will be more efficient than MMARCS and VARCS (suggests that there will be time savings experienced by users in each task).

H3-08: Retrieving comments in the E-ARCS by AVARCS will be more efficient than MMARCS and VARCS (suggests that there will be reduction in the rate of errors in accomplishing all tasks).

H3-09: Retrieving comments in the E-ARCS by AVARCS will be more efficient than MMARCS and VARCS (suggests that there will bea reduction in the number of mouse clicks in accomplishing all tasks).

H3-10: Using AVARCS will be more satisfying than using MMARCS and VARCS due to all of the above hypotheses.

H3-11: The usability of AVARCS will be better than for those of MMARCS and VARCS due to all of the above hypotheses.

Figure 32 AVARCS interface to retrieve comments with Facial Expression metaphors, opinion classification and list of the functions experimental group.

5.6 Implementation of Experiment

The main aim of this investigation is to measure the implications of utilizing different interfaces of interactions to exchange a limited number of words in adding and retrieving comments systems in the newspaper and social media fields. This Chapter will discuss how AVARCS as a third experimental interface was designed to be a different interaction approach as well as to evaluate the previous interfaces of interactions, VARCS and MMARCS in terms of impact on public opinion and usability aspects The same tasks described in Chapter four took place. The AVATAR interfaces of interactions were used by 22 users to carry out six common tasks. In addition, a questionnaire was designed to be filled in by users to measure a number of aspects associated for the study such as impact on opinion and to assess user satisfaction.

5.6.1 Tasks of Experiment

Throughout this experiment, users were asked to complete six tasks, three for adding comments and three for retrieving comments. These tasks were designed to cover a range of complexity from easy comments to those which were difficult in the retrieving part as well as from short to long comments in the adding part. Due to the relationship with the previous Chapter, the experiment's tasks were replicated from Chapter 4 (all details in 4.6.1 as well as an explanation of the six comments ask attached in Appendix B-2 and C-1 to C-6).

5.6.2 Experiment Variables

Three main types of variables were created for use in this experiment: *dependent*, *independent* and *control* variables. The following section gives a full description for each, with a summary Table.

5.6.2.1 Experiment Dependent Variables

Dependent Variable		Measurement	
Description	Code	Area	Impact
user's Perception Public Opinion PPPO	DV3-1	Press	Public Opinion
Time of Task Achievement TTA	DV3-2	Usability	Efficiency
Rate of Error RE	DV3-3		
Number of Mouse Clicks NMC	DV3-4		
Percentage of Tasks Completed Successfully PTCS	DV3-5		Effectiveness
Rate Satisfaction of users RSP	DV3-6		Satisfaction

Table 23 Outline of the main dependent variables

Table 23 provides a review of the dependent variables examined in this experiment. Due to the relationship with the previous Chapter, the experiment's dependent variables were the same as in Chapter 4 (all details being in 4.6.2.1) as well as a full explanation of the related work, such as impact and user attitudes questionnaire, as attached in Appendix C-1 to C-6.

5.6.2.2 Experiment Independent Variables

In Table24there is a review of the three independent variables designed to identify the consequences on the experiment's dependent variables. The first type of variables was the interfaces of interaction, consisting of Visual, Multimodal and AVATAR which were VARCS, MMARCS and AVARCS. The other variable was the level of tasks which was divided into two types: short, middle and long task in adding comments system; and easy, moderate complex task in retrieving comments system. The last independent variable was Adding Comments and Retrieving Comments. As a result of it being related to the previous Chapter, the experiment used the same independent variables (all details in 4.6.2.2).

Independent Variable		Measurement	
Description	Code	NA	Aspects
Interfaces of Interaction	IV3-1	3	VARCS MMARCS and AVARCS
Task Level	IV3-2	6	Short, Middle and Long for Add Comments Easy, Moderate and Complex for Retrieve Comments
Task Type	IV3-3	2	Add Comments and Retrieve Comments

Table 24 Outlines of the main independent variables

5.6.2.3 Experiment Control Variables

The study needed control variables to make an effective judgement between the three interfaces of interactions. The same main factors were chosen from Chapter four to make these controls such as the system contents, perceptual context, task criterion time, required familiarity, tasks and learning effect. A full description of these is in 4.6.2.3 in Chapter 4.

5.6.3 Case Study Sampling

The third experiment used 22 users in a group from Alarbiya Channel who had a basic knowledge of how to use a computer and were interested in the field of social media. Each group was split into three subgroups which enabled the experiment to be balanced in terms of the level of task complexity. Almost all of the users spent an average of approximately 15 hours weekly using social media and reading e-newspapers. Their ages ranged from 18 to 55 years old.

Table 25 shows the number of tasks with number of users who achieved their tasks by They were given time to read the main article and then asked to complete the Adding Comments part followed by the Retrieving part by random choosing. All were given training to ensure understanding of the purpose and testing methodology.

Group A: 1,4,7,10,13,16,19,22 Group B: 2,5,8,11,14,17,20 Group C: 3,6,9,12,15,18,21		Groups		
Balancing Between Tasks		A	C	C
Pre-Experimental Questions		√	√	√
Add Comment:	Short, Mid and Long	√		
	Mid ,Short and Long		√	
	Long ,Mid and Short			√
Post-Task Questions		√	√	√
Retrieve Comments:	Easy, Moderate and Complex	√		
	Moderate ,Easy and Complex		√	
	Complex , Moderate and Easy			√
Post-Task Questions		√	√	√
Evaluate Satisfaction of Users		√	√	√
Test for Accomplishment		√	√	√
Questions for Accomplishment		√	√	√

Table 25The scheme of balancing between tasks of sub-groups.

5.6.4 Data Collection

The two types of data, quantitative and qualitative, were collected by using different approaches such as observation, questionnaires and interviews. Experiments were observed to calculate the time it took to complete each task by recording start and finish times precisely.

Also, it recorded the number of actions done successfully by each user in each task. It then tracked the errors and numbers of mouse clicks in adding and retrieving comments for each user.

Questionnaires recorded the opinion and views of users in terms of the level of satisfaction and the range of impact on opinions. After finishing the experiment, users were interviewed to get feedback about the experiment and its effects. A full description of the raw data obtained from these experiments presented in appendicesC-1 to C-6.

5.7 Analysis of Results

The analysis of the results detailed in this section is similar to those found in the previous Chapter (see section 4.7) as it also utilised both descriptive and inferential statistics. This also includes the use of measurement of central tendencies (mean, mode, median) and measurements of statistical significance using Wilcoxon's test and independent t-test.

Furthermore, because of the difference in the number of independent variables in the interface of interaction, other statistical tests were also utilised which was ANOVA test. The One factor analysis of variance is used to test if two levels of one factor (independent variable) have a significant effect on the results (dependent variable). Factorial ANOVA is used to demonstrate the interactive effect of two or more independent variables on one dependent variable. In this section, the outcomes of examination of the three E-ARCS conditions (VARCS, MMARCS, and AVARCS) are discussed in relation to effectiveness, efficiency, as well as impact on public opinion.

5.7.1User's Attitude

Analysis of system attitude of users consists of analysing the impact on the public opinion and the satisfactions in the respective of users view. Five statements tried to measure the impactability of users which were the functions of adding and retrieving in this system increased the impact of my Public Opinion (IOI), i felt that this system show the real public opinion of users (ROI), in the approach of classification of opinion I would use the traditional way (POU), i felt that this system is unprofessional and incompetent (UOI) as well as i felt that this system is impact (IOS). Analysis was carried out using the t test to assess if the distribution of the categorical variables differs from one another. This is t tests for independence. On the other hand, the nine statements attempted to evaluate the user's satisfactions which divided into measure the easy, confusing, navigating and frustrating of system functions for both adding and retrieving as well as to take comfortable between the interfaces. The users' ratings for the statement for one to two were regarded as disagreement, three as neutral, and four and five as agreement. Overall, what is noteworthy was a considerable improvement in user impact on the public opinion and the satisfaction from interfaces of interactive of VARCS to MMARCS in relation to the adding function in the system.

5.7.1.1 Impact on Public Opinion

In general, table 26 shows that there was a significant improvement in public opinion mixed between VARCS to MMARCS, but a clearly visible improvement was noted using AVARCS, which had the least overall variance value to prove its constituency.

In the influence of the adding and retrieving functions on public opinion, IOI, AVARCS had a mean value of 4.1364 on the statement that the function had an increased impact. The AVARCS also had the least variance (1.171) on the results indicating that more users agreed to the statement. For MMARCS and VARCS, the mean values and variance were (M=3.3182, V=2.037) and (M=3.3636, V=1.861) respectively.

The average number of users in agreement that the system shows real public opinion of users, ROI, was least in VARCS (3.5) and most in AVARCS (4.4091), and MMARCS (3.9091) was in between, the variance of their results sets them even apart.

Public Opinion Statement		IOI	ROI	POU	UOI	IOS
VARCS	Mean	3.364	3.500	1.182	1.409	3.773
	Mode	4.00	4.00	1.00	1.00	4.00
	Variance	1.861	1.786	.156	.634	1.708
MMARCS	Mean	3.318	3.909	1.3636	1.682	3.773
	Mode	4.00	4.00	1.00	1.00	4.00
	Variance	2.037	1.229	.242	.894	1.422
AVARCS	Mean	4.136	4.409	1.046	1.182	4.319
	Mode	5.00	5.00	1.00	1.00	5.00
	Variance	1.171	.444	.045	.156	.894

Table 26User’s Rate of Recurrence for five impacts on public opinion statement in relation to VARCS, MMARCS and AVARCS for the mode, Variance of the mode and mean values.

Like before, the variance indicates a close acceptance of the mean value for AVARCS (0.444), proving the consistency of result. And larger variances were noted in MMARCS (1.229) and VARCS (1.786).On whether users agreed that in the way of classification of opinion, they would use the traditional way, POU, the highest mean value is seen for MMARCS (1.3636), also with the lowest variance of .242, indicating that users in general felt this way about the MMARCS, although, there were clearly variations in their opinions. Again, we find that the AVARCS and VARCS had lower means values (1.0455 and 1.1818) and variances (0.045 and 0.156) respectively. Again, the AVARCS had the lowest mean value (1.1818) and variance (0.156) on the statement that users felt that the system is unprofessional and incompetent, UOI.

The MMARCS was highest, with a mean value of 1.6818 and variance of 0.894. The VARCS values on the same were found to be (M=1.4091 and V=0.634). Users' opinions indicated it was AVARCS was the least bit unprofessional and incompetent. On the whole, all three systems had recorded a mode of users who strongly disagreed with the statement. On impactability, the indication that the AVARCS had the highest impact was implied by a higher mean value (4.3182) than VARCS (3.7727) and MMARCS (3.7727), as well as, a lower variance in opinions for AVARCS (0.894) indicating consistency of opinions. Also noteworthy is that the opinions indicated that VARCS (having a higher variance, 1.708) than MMARCS (variance, 1.422) implying that the results on impactability for MMARCS is more consistent and therefore, more credibly accepted over that of VARCS.

satisfaction statements	Sig. Or No	F	Sig.
IOI	Not	2.753	.071
ROI	Yes	5.105	.009
POU	Yes	56.709	.000
UOI	Not	4.562	.014
IOS	Yes	53.494	.000

Table 27 The result of ANOVA test for all impactability statements on the public opinion

Table 27 show the result of ANOVA test for all impactability statements on the public opinion which reported that, there is a statistically significant difference in the statements of (ROI, POU and IOS) while there is no significant difference in IOI and UOI.

5.7.1.2 User Satisfaction

The users' ratings of the nine satisfaction statements in relation to the VARCS, MMARCS, and AVARCS results were computed for the mean, mode, and variance of the mode and mean values for purpose of analysis. The details are given in the Table 28 below. In general, there was a significant improvement in users' satisfaction from VARCS to MMARCS and then, even more improvement was noted using AVARCS, which had the least overall variance value to prove its constituency.

In the using of the adding functions, AVARCS had a mean value of 4.5 on the statement that the function was easy to use. The AVARCS also had the least variance (0.357) on the results indicating that more users agreed to the statement. For MMARCS and VARCS, the mean values and variance were (M=3.86, V=0.989) and (M=2.95, V=1.474) respectively. The average number of users in agreement that the systems were confusing was least in AVARCS (1.5) and most in VARCS (2.86), although MMARCS

(2.5) was close to VARCS, the variance of their results sets them apart. Like before, the variance indicates a close acceptance of the mean value for AVARCS (0.452), proving the consistency of result. And larger variances were noted in MMARCS (1.119) and VARCS (2.981).

Statement		EOA	COA	NOA	FOA	EOR	COR	NOR	FOR	COALL
VARCS	Mean	2.955	2.864	2.728	2.728	3.364	3.046	4.090	2.455	4.137
	Mode	4.00	1.00	2.00	4.00	4.00	2.00	5.00	2.00	5.00
	Variance	1.474	2.981	2.017	2.113	1.481	2.141	1.515	1.879	1.742
MMARCS	Mean	3.682	2.500	3.819	2.182	2.909	2.772	3.409	2.409	3.909
	Mode	4.00	2.00	4.00	2.00	2.00[a]	2.00	4.00	1.00	4.00
	Variance	.989	1.119	1.013	1.870	1.706	2.184	1.968	2.063	1.706
AVARCS	Mean	4.500	1.500	4.409	1.682	4.182	1.864	4.318	1.682	4.500
	Mode	5.00	1.00	5.00	1.00	5.00	1.00	5.00	1.00	5.00
	Variance	.357	.452	.634	.894	1.203	1.171	.894	1.180	.738

Table 28 User's Rate of Recurrence for nine satisfaction statement in relation to VARCS, MMARCS and AVARCS for the mode, variance of the mode and mean values.

On whether the navigating in adding functions in the systems was easy, the highest mean value is seen for AVARCS (4.409) with the lowest variance of 0.634 indicating that users in general felt this statement was true about the AVARCS and there were little variations in their opinions. Again, we find the MMARCS and VARCS lagging behind with a means values (3.818 and 2.727) and variances (1.013 and 2.017) respectively. Again, the AVARCS had the lowest mean value (1.6818) and variance (0.894) on the statement of whether the adding function in the system was frustrating. The MMARCS was higher, with a mean value of 2.1818 and variance of

1.870.The VARCS values on the same were found to be highest (M=2.7372 and V=2.113) showing that users' opinions indicated it was the most frustrating system to use in the adding function tasks. And on using the retrieving function, the indication that the AVARCS was the easiest to use was implied by a higher mean value (4.182) than VARCS (3.364) and MMARCS (2.909), as well as, a lower variance in opinions for AVARCS (1.203).

Satisfaction statements	Sig. Or No	F	Sig.
EOA	Yes	13.989	.000
COA	Yes	7.230	.001
NOA	Yes	13.111	.000
FOA	Yes	3.700	.030
EOR	Yes	6.254	.003
COR	Yes	4.599	.014
NOR	Yes	3.375	.040
FOR	Not	2.423	.097
COAll	Not	1.401	.254

Table 29The result of ANOVA test for all satisfaction statements

Also noteworthy is that the opinions indicated that VARCS (having a lesser variance, 1.481) was easier to use than MMARCS (variance, 1.706). On whether, it was confusing to use the retrieving function, the VARCS had the highest mean value (3.0455) followed by the MMARCS of 2.772 which indicated that on average these systems were more confusing to use than the AVARCS with a mean value of 1.8636. A higher number of users strongly disagreed that using the AVARCS was confusing. Looking at whether navigating in the retrieving function in the systems is easy, the AVARCS noted the highest mean values (4.3182) and least variance value (0.894) over VARCS (4.0909) and least in MMARCS (3.4091). The variance value of AVARCS coupled with its mode values (indicating the frequency of agreement to the statement) indicated the navigating with this system was easiest in AVARCS followed by VARCS. Lastly, on the statement that using the retrieving function in the system is frustrating, the findings are similar to the previous indicating that AVARCS system performed better than the VARCS and MMARCS. The VARCS had the highest values (M=2.4545 and V=1.879) with a mode of (2) showing that despite a large users in the group collectively disagreeing with the statement, a significant number in the group had mixed opinions. According to results, therefore, it was found to be the most frustrating to use of the three systems, with AVARCS and MMARCS values being (M=1.6818, V=1.180) and (M=2.4091, V=2.063) respectively. The AVARCS is found to be the least frustrating to use with the retrieving function.Table 29 shows the result of ANOVA test for all satisfaction statements which referred into that, there is a statistically significant difference in all statements accept in (FOR and COALL).

5.7.2 Measuring the Effectiveness

The analysis of effectiveness was conducted based on interface of interaction, tasks complexity consisted of an individual task and task type. In Figures bellow is shown the mean value of percentage of number of tasks actions completed successfully according to interface of interactive, task complexity and task type using the VARCS, MMARCS and AVARCS experimental systems. It was imperative to introduce the overall completion rate in all versions.

5.7.2.1 Interface of interactive

As can be seen, Figure 32 illustrates the percentage of action's tasks completed successfully (A) using the VARCS (Visual Adding Retrieving Comments System) , MMARCS (Multimode Adding Retrieving Comments System) and AVARCS (AVATAR Adding Retrieving Comments System) experimental systems. It was noted that the AVARCS (over 90%) experimental group completed more tasks successfully compared with MMARCS (76.57%) and VARCS (56.67%). However, on the number of actions not completed successfully the VARCS scored over 40% of tasks not completed and MMARCS was better with less than 25% of tasks not completed. The AVARCS is also seen here to outperform the other two systems, having the lowest percentage of tasks not completed (less than 10%).

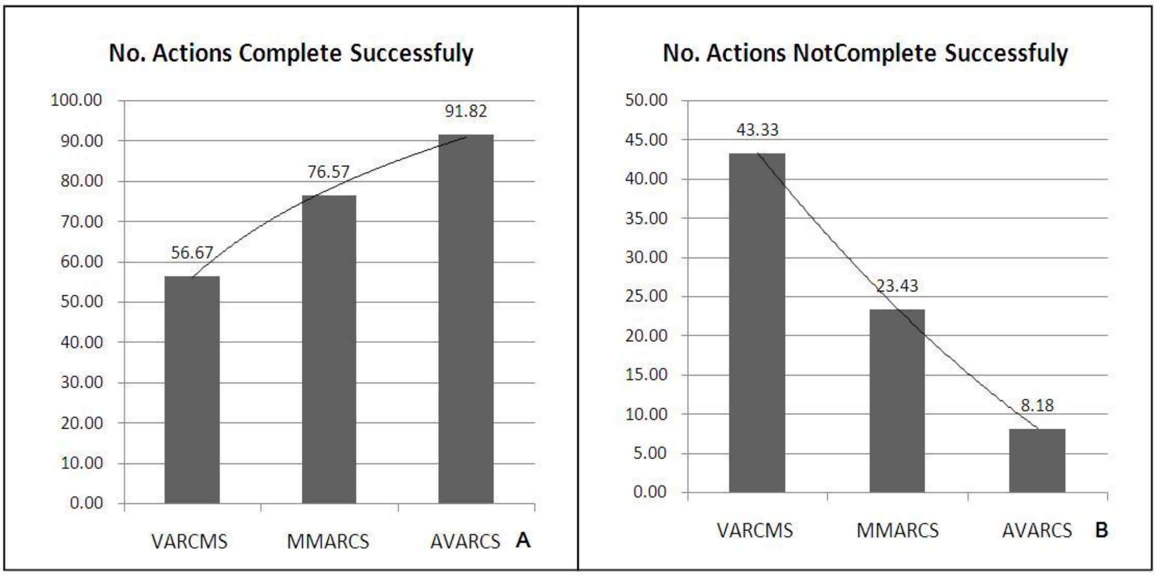

Figure 33 Percentages of action's tasks completed successfully (A) and not completed successfully (B) for using the VARCS, MMARCS and AVARCS correspondingly.

The result of the t-test showed a statistically significant difference in the interface of interactive for the number of tasks completion successfully rate between AVARCS (M= 41.32, SD=3.213) and VARCS (M=25.50, SD=3.419) of($t = -15.814$; $df = 42$; $p<0.05$), as well as, for AVARCS and MMARCS (M=34.45, SD=3.035) of ($t = -7.284$; $df = 42$; $p<0.05$).

5.7.2.2 Level of Complexity

In this study, the level of complexity was used as one of independent variables to distinguish between tasks; the design was based on adding the comments depending on their length, and the complexity of retrieving comments. For example, easy retrieve and short add tasks, communicated the lower tasks required to measure the number of action's tasks completed successfully, compared to higher tasks measured of the effectiveness.

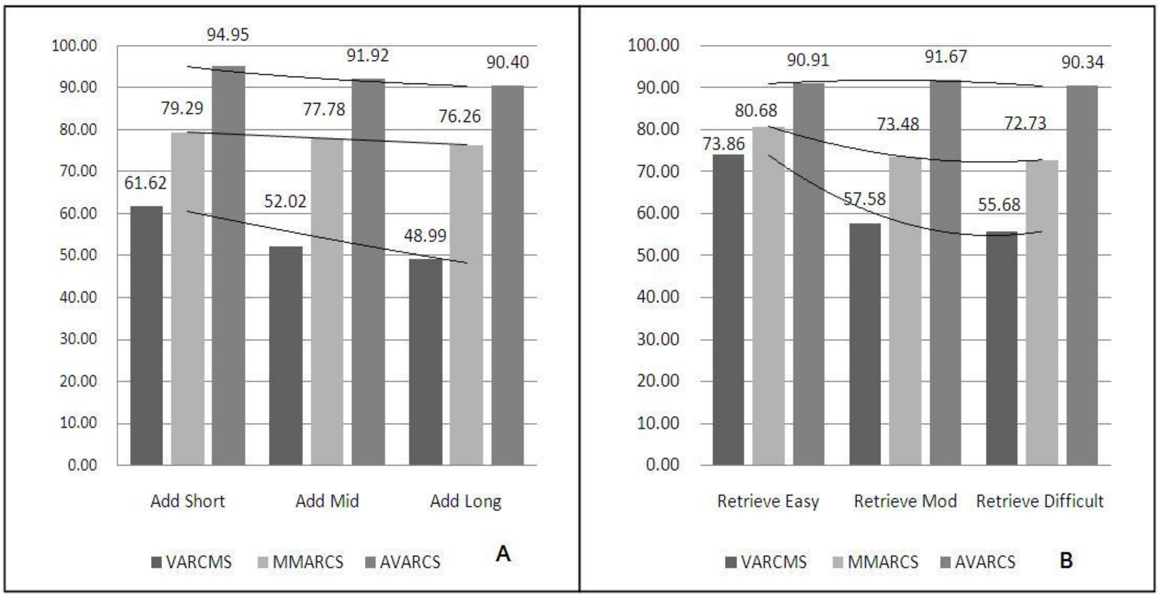

Figure 34 Percentages of action's tasks completed successfully in relation to the three levels of

task complexity for adding comments (A) and for retrieving comments (B) using the VARCS, MMARCS and AVARCS correspondingly.

The analysis of the outcomes obtained from the type of complex task illustrated that the completion rate decreased steadily from retrieving easy to difficult comments as well as from adding short to long comments Nonetheless, there is a slight inconsistency in this result. Figure 33 (A) shows the mean value of tasks completed successfully according to the three levels of adding comments using VARCS, MMARCS and AVARCS experimental systems. Emphasis should be drawn to the fact thatall tasks showed the variance between the three interfaces, in add long tasks; it was clear that AVARCS users completed long add task with 90.40% completion rate compared to VARCS (48.49%) and MMARCS (76.26%). The observation is in support of the result found in the interface of interactive. The result of the t-test showed a statistically significant difference in long add task completion rate between AVARCS (M= 8.14, SD= 1.037) and VARCS (M=4.41, SD=1.054) of ($t = -11.824$;$df = 42$; $p<0.05$), as well as for AVARCS (M= 8.14, SD=1.037) and MMARCS (M=6.86, SD=1.726) of ($t = -2.964$; $df = 42$; $p<0.05$). In addition, the result of the t-test showed that the difference in add mid task completion rate was found to be significant between AVARCS (M= 8.27, SD= 1.162) and MMARCS (M=7.00, SD=1.480) of ($t = -8.365$; $df = 42$; $p<0.05$), as well as there was a statistically significant difference between AVARCS(M= 8.27, SD= 1.162) and VARCS(M=4.68, SD=1.644) by ($t = -3.172$; $df = 42$; $p<0.05$). Moreover, in the add short tasks examined by t-tests, there was also found to be significant difference between AVARCS(M= 8.55, SD= .858) and VARCS (M=5.55, SD=1.845) of (t = -

6.917; df = 42; $p<0.05$), as well as between AVARCS (M= 8.55, SD= .858) and MMARCS(M=7.14, SD= 1.583) of (t = -3.672; df = 42; $p<0.05$).

Figure 33 (B) illustrates that the number of task actions completion rate was slightly higher for retrieving easy comments for all interface types. Conversely, it was significantly higher for retrieving moderate and difficult comments from VARCS to MMARCS and AVARCS (from approximately 55 % to more than 90%).

Furthermore, the t-test results revealed a highly significant difference between the three interfaces of retrieving comment tasks by (t = -6.960; df = 42; $p<0.05$) from VARCS (M=4.45, SD=1.405) to AVARCS (M= 7.23, SD= 1.232) and (t = -3.449; df = 42; $p<0.05$) from MMARCS (M=5.82, SD=1.468) to AVARCS (M= 7.23, SD=1.232) in difficult task.

It was significant by (t = -7.436; df = 42; $p<0.05$) from VARCS (M=3.45, SD=.963) to AVARCS (M= 5.50, SD= .859) and (t = -3.427; df = 42; $p<0.05$) from MMARCS (M=4.41, SD=1.221) to AVARCS (M= 5.50, SD= .859) in the moderate task. Likewise, in the easy task it was significant by (t = -3.121; df = 42; $p<0.05$) from VARCS (M=2.95, SD=.785) to AVARCS (M= 3.64, SD= .658) and it was not a significant difference (t = -1.835; df = 42; $p>0.05$) from MMARCS (M=3.23, SD= .813) to AVARCS (M= 3.64, SD= .658).

5.7.2.3 Task Type

As shown in Figure 34 (A) below, the mean percentage value of the number of task actions completed successfully in adding comments task type using the VARCS, MMARCS and AVARCS experimental systems is illustrated. On the whole, the effectiveness variance between the three groups is seen to be different for both of the task types compared to all interfaces except MMARCS and AVARCS. It was completed successfully by 54 per cent in VARCS while nearly into 78 per cent in MMARCS and more than 90 per cent in AVARCS.

Furthermore, t-test showed that the difference in add task completion rate between the AVARCS (M= 8.55, SD=.858) and VARCS (M=14.64, SD=2.341) was statistically significant (t = -15.303; df = 42; $p<0.05$), as well as the difference between AVARCS (M= 24.95, SD=2.410) and MMARCS (M=21.00, SD=2.410) was (t = -5.771; df = 42; $p<0.05$).In addition to that, Figure 34 (B) showed the increasing from 60 per cent in VARCS to be the nest volume in AVARCS by 90 per cent.

Also, the result of the t-test was the different in the retrieve task completion rate between AVARCS(M= 16.36, SD=1.866) and VARCS(M=10.86, SD=1.807) to be significant (t = -9.932; df = 42; $p<0.05$), as was also the case between AVARCS(M= 16.36, SD=1.866) and MMARCS(M=13.45, SD=1.371) of(t = -5.894; df = 42; $p<0.05$).

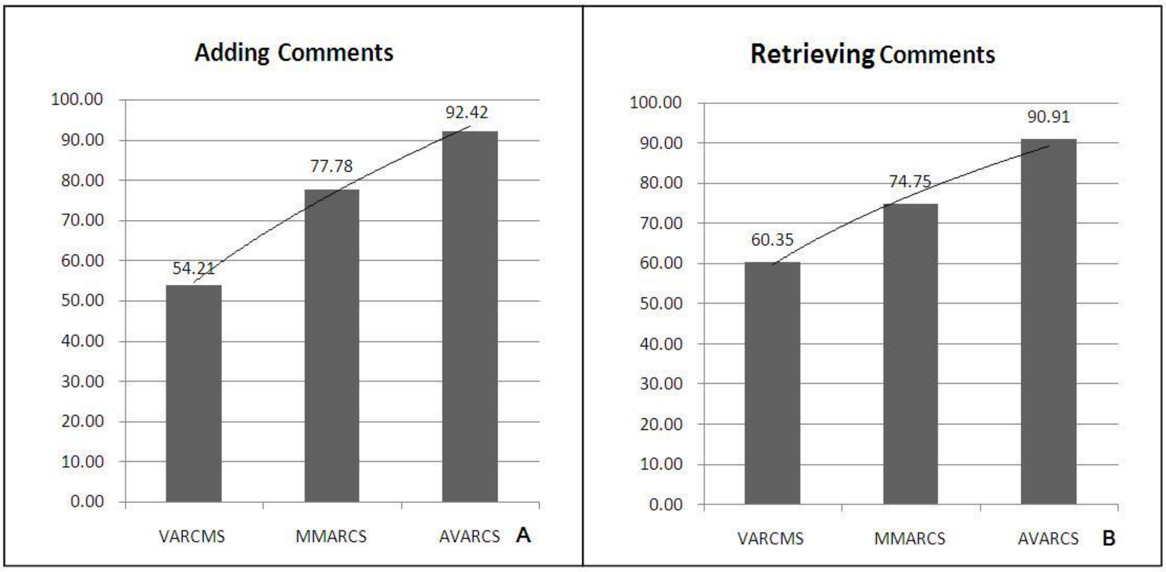

Figure 35Percentages of action's tasks completed successfully in relation to the two task types of Add (A) and Retrieve (B) Comments for using the VARCS, MMARCS and AVARCS correspondingly.

5.7.3 Measuring the Efficiency

The analysis of the effectiveness of the experimental systems, AVARCS, MMARCS, and VARCS, was conducted, based on the three independent variables: interface of interactive, task complexity plus task type. The efficiency was measured with respects to the task completion time, mouse clicks required to accomplish the task and rate of errors. The assumption held here was that the AVARCS system would perform better than the VARCS and MMARCS. Also, it was predicted MMARCS would have a greater efficiency level compared to VARCS.

5.7.3.1 Interface of Interactive

Figure 35 shows the mean value of percentage of task achievement time (a)count of mouse clicks (b) and error rate (C)using the VARCS, MMARCS and AVARCS experimental systems. On the whole, efficiency attributes for AVARCS were considerably improved, compared to that for MMARCS and VARCS.

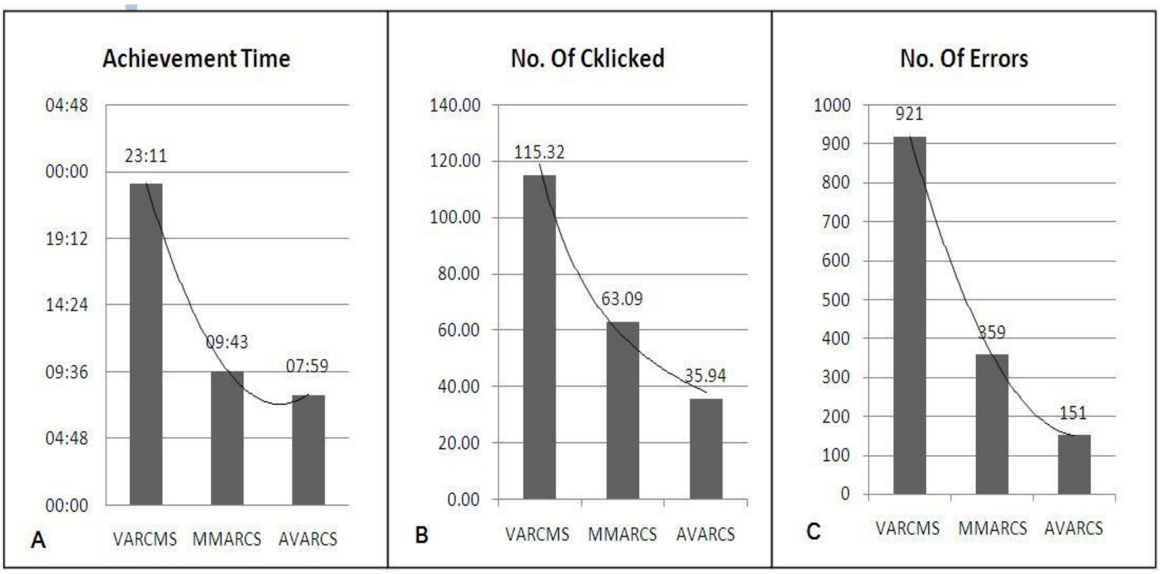

Figure 36Mean value involved to complete tasks in VARCS, MMARCS and AVARCS for achievement time (A), mouse clicks (B) and errors rate (C).

The result of the t-test revealed an insignificant difference in the mean value of task accomplishment time between AVARCS (M= 7:59, SD=0:49) and VARCS (M=14:28, SD=10:20) of ($t = 2.9277$; $df = 42$; $p<0.05$); but, the mean value of time required to accomplish tasks using AVARC (M= 7:59, SD=0:49) slightly decreased compared to MMARCS (M=9:43, SD=0:46), and this decrement was found not to be significant ($t = 7.460$; $df = 21$; $p<0.05$).As shown in Figure 35 (A), the mean value of task achievement time for AVARCS (07:59) was lower than that for MMARCS (9:43), and considerably lower than for VARCS (23:11). Figure 35 (B) illustrates the mean value of mouse clicks required to accomplish the task using AVARCS (36 clicks) was nearly half that of MMARCS (63 clicks), and was considerably lower (three times) than that for VARCS

(115 clicks). The difference in number of mouse clicks was noted to be significant between the AVARCS (M= 36.32, SD=5.575) and MMARCS (M=63.09, SD=9.481) of ($t = 34.14$; $df = 42$; $p<0.05$), as well as for AVARCS (M= 36.32, SD=5.575) and VARCS (M=115.32, SD=9.311) of ($t = 11.417$; $df = 42$; $p<0.05$).

Figure 35 (C) shows that the mean error rates for using AVARCS (30 errors) was less than half that for MMARCS (72 errors) and more than six times smaller than for VARCS (184 errors).. The t-test, however, revealed significant differences in the occurrence of errors between all aspects of errors which will be described in section 5.7.3.4 (Errors Results).

In summary, AVARCS significantly outperformed both MMARCS and VARCS in all efficiency variables.

5.7.3.2 Level of Complexity

In Figure 36 is shown the mean values of task achievement in relation to the three levels of task complexity for adding Long, Mid and Short (Table A) as well as for retrieving Difficult, Moderate and Easy (Table B).In general, using the VARCS system took the longest time to achieve tasks, followed by MMARC and then AVARCS. The Add Long tasks, for VARCS, were those that took the longest time to achieve; it took approximately double the time compared with MMARCS and three times compared with VARCS.

The t-test noted a significant difference between VARCS (M=7:38, SD=0:43) and AVARCS (M= 2:08, SD=0:22) of ($t = 31.454$; $df = 42$; $p<0.05$) and also, when

MMARCS (M=3:48, SD=0:19) was compared with AVARCS, to be (t = 15.69; df = 42; p<0.05).Correspondingly, Add Mid was the task that took the shortest time to achieve by AVARCS; it decreased nearly 25% time compared with MMARCS and in the region of 70% compared with VARCS.

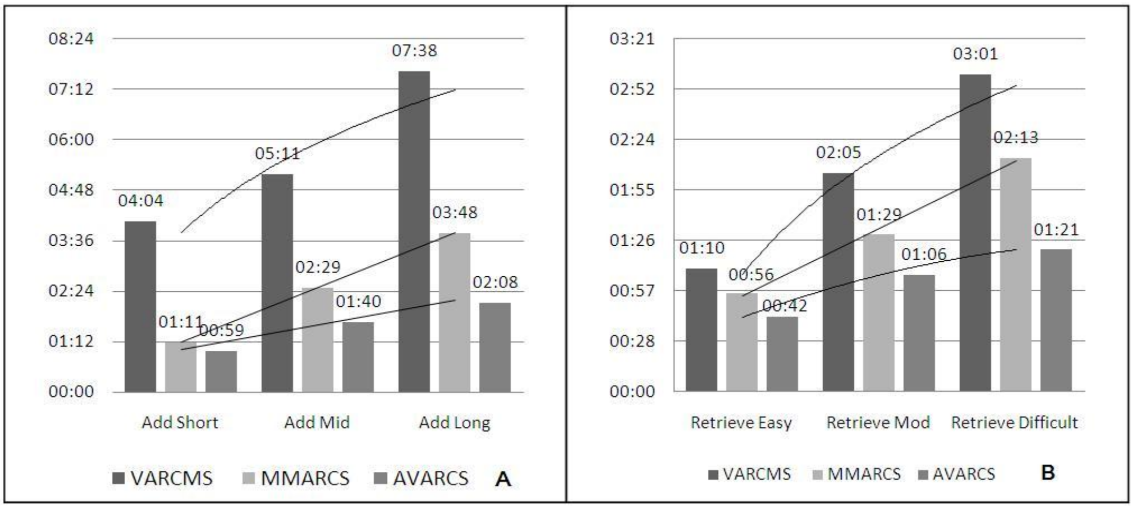

Figure 37 Mean value of Achievement Time which involved completing tasks in VARCS, MMARCS and AVARCS in relation to the three levels of task complexity for Adding Comments (A) and Retrieving Comments(B).

T test showed a significant difference between VARCS (M=5:11, SD=0:58) and AVARCS (M= 1:40, SD=0:21) of (t = 15.896; df = 42; p<0.05) as well as when MMARCS (M=2:29, SD=0:16) was compared with AVARCS of (t = 8.470; df = 42; p<0.05). Likewise, Add Short was the task that took the similar amount of time to achieve between AVARCS and MMARCS; it decreased nearly 5% time compared with MMARCS, approximately 78% compared with VARCS.

The result of the t-test showed a significant difference between VARCS (M=33:02, SD=19:37) and AVARCS (M= 0:59, SD=0:14) of (t = 15.473; df = 42; p<0.05) as well as for MMARCS (M=4:04, SD=0:54) compared with AVARCS of ($t = 7.657$; $df = 42$; $p<0.05$). Figure 36 also shows that for Table B, the VARCS was again the system where the users took the longest time to accomplish all of the different levels of tasks, followed by MMARC and AVARCS. It was noted that all levels of task on the AVARCS system were completed by users in the quickest time.

For Retrieve Difficult task in VARCS, users took the longest time to complete all three of the experimental systems by more than double the time compared to that of AVARCS and less than that compared with MMARCS. The t- test revealed a significant difference between VARCS (M=3:01, SD=0:21) and AVARCS (M= 1:21, SD=0:10) of ($t = 19.334$; $df = 42$; $p<0.05$)as well as, for MMARCS (M=2:13, SD=0:22) compared with AVARCS of ($t = 9.907$; $df = 42$; $p<0.05$).

Likewise, Retrieve Mod was the task that took the shortest to achieve by AVARCS; it decreased by around 20% of the time compared with MMARCS and approximately 50% compared with VARCS. The t-test revealed a significant difference between VARCS (M=2:05, SD=0:19) and AVARCS (M= 1:06, SD= 0:12) of ($t = 11.751$; $df = 42$; $p<0.05$).

Similarly, the Retrieve Easy task took the least time to achieve using AVARCS; it decreased by around 20% of the time compared with MMARCS, and around 42% compared with VARCS. The t-test noted a significant difference between VARCS (M=1:10, SD=0:20) and AVARCS (M= 0:42, SD=0:11) of ($t = 5.608$; $df = 42$; $p<0.05$) as well as for MMARCS (M=0:56, SD=0:26) compared with AVARCS of ($t = 2.251$; $df = 42$; $p<0.05$).

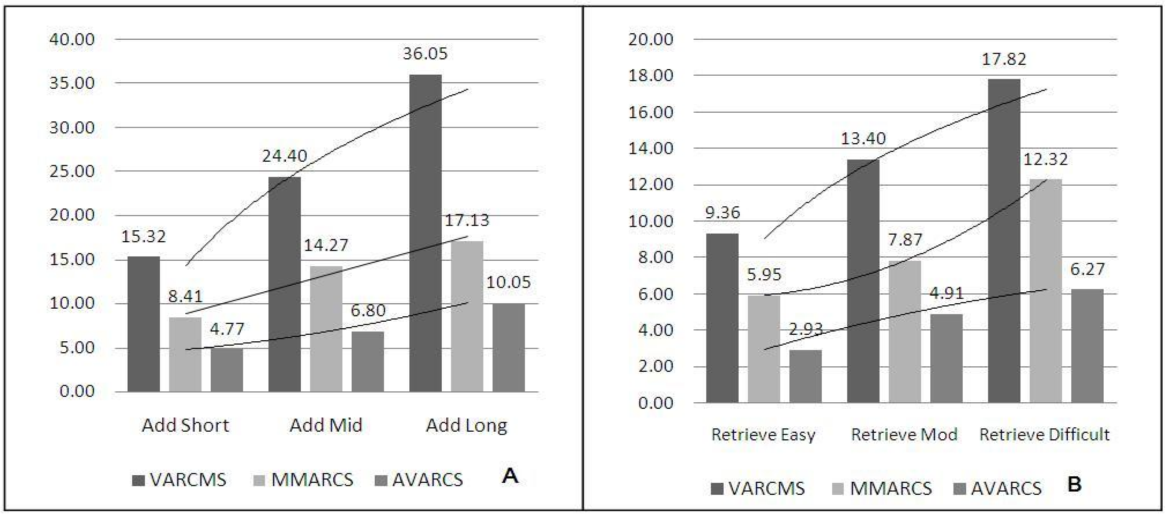

Figure 38 Mean value of mouse clicks which involved completing tasks in VARCS, MMARCS and AVARCS in relation to the three levels of task complexity for Adding Comments (A) and Retrieving Comments (B).

However, Figure 37 shows the mean values of count of mouse clicks in each level for adding (Table A) and for retrieving (Table B) that were required to complete the three different levels of task complexity using the VARCS, MMARCS and AVARCS systems. Table 37 (A) notes that for adding, the VARCS system took the most amounts of mouse clicks to achieve the tasks in all three levels of task complexity, and in Add Long took approximately up to four times compared with that of AVARCS and less than double compared with MMARCS.

The t-test revealed a significant difference between VARCS($M=36.05$, $SD=7.712$) and AVARCS ($M= 10.05$, $SD=2.903$) of ($t = 17.056$; $df = 42$; $p<0.05$) as well as, for MMARCS, ($M=15.86$, $SD=3.152$) compared with AVARCS of ($t = 6.369$; $df = 42$; $p<0.05$).Likewise, the Add Mid task took the least number of mouse clicks to achieve tasks in AVARCS; it decreased by approximately 45% compared with

MMARCS and around approximately 79% compared with VARCS. The results of the t-test revealed a significant difference between VARCS (M=23.59, SD=4.817) and AVARCS (M= 6.77, SD= 2.308) of (t = 14.768; df = 42; $p<0.05$) as well asfor MMARCS (M=12.41, SD=4.284) compared with AVARCS of (t = 5.433; df = 42; $p<0.05$).

Similarly, the Add Short task took the least amount of mouse clicks to achieve using AVARCS; it decreased by nearly 50% the time compared with MMARCS, and around 81% compared with VARCS. In the t-test results there was noted a significant difference between VARCS (M=15.32, SD=3.092) and AVARCS (M= 4.77, SD= 2.202) of (t = 13.029; df = 42; $p<0.05$) as well as, for MMARCS (M=8.41, SD=2.856) compared with AVARCS of (t = 4.729; df = 42; $p<0.05$).

The information in Table 37 (B) also reveals that, out of all the systems (VARCS, MMARC and AVARCS) it took users using VARCS the most amount of mouse clicks to accomplish all the different levels of task and the least mouse clicks to complete all task levels on the AVARCS system.

In the Retrieve Difficult task, it took over two and a half the time using VARCS compared with AVARCS, and around double the time, comparing MMARCSwith AVARCS. The t-test revealed a significant difference between VARCS(M=17.82, SD=3.333) and AVARCS (M= 6.64, SD=2.128) of (t = 13.263; df = 42; $p<0.05$) as well as, for MMARCS (M=12.32, SD=2.571) compared with AVARCS of (t = 7.986; df = 42; $p<0.05$). In addition, the Retrieve Mod task took the least amount of mouse clicks to achieve using AVARCS; it decreased by nearly 35% the time compared with MMARCS and approximately 65% compared with VARCS.

The t-test revealed a significant difference between VARCS (M=13.18, SD=2.719) and AVARCS (M= 4.91, SD=1.540) of ($t = 12.416$; $df = 42$; $p<0.05$) as well as, for MMARCS, (M=8.14, SD=2.396) compared with AVARCS of ($t = 5.314$; $df = 42$; $p<0.05$). Additionally, the Retrieve Easy task was achieved with the least number of mouse clicks using AVARCS; it decreased by nearly 50% time compared with MMARCS, and around 73% compared with VARCS. The t-test revealed a significant difference between VARCS (M=9.36, SD=2.341) and AVARCS (M= 3.18, SD=1.006) of ($t = 11.379$; $df = 42$; $p<0.05$) as well as, for MMARCS (M=5.95, SD=3.982) compared with AVARCS of ($t = 3.167$; $df = 42$; $p<0.05$).

5.7.3.3 Task Type

Figure 38(below) shows the mean value of percentage of task achievement time in relation to the two task types (adding and retrieving comments) using AVARCS, MMARCS and VARCS experimental systems. It was evident that for AVARCS the users' performance was better in relation to the time taken to accomplish tasks for the adding comments task types (4min 49sec) when compared with MMARCS users (7min 29sec). As well as this, the performance of the AVARCS users was considerably faster compared with VARCS users (16min 54sec). In addition, there was a slight improvement in accomplishing tasks for the retrieving comments task types in AVARCS (from 3min10sec) to 3min39sec in MMARCS and 6min17sec for VARCS. The difference between the AVARCS and MMARCS was found to be significant in add tasks ($t = 13.225$; $df = 42$; $p<0.05$) and retrieve tasks ($t = 9.293$; $df = 42$; $p<0.05$). Also, significant differences were noted between the AVARCS and VARCS in add tasks (t = 31.737; df = 42; p<0.05) and retrieve tasks (t = 20.042; df = 42; p<0.05).Nonetheless, Figure 39 shows the mean value of mouse clicks according to the two task types using the AVARCS, MMARCS and VARCS experimental systems.

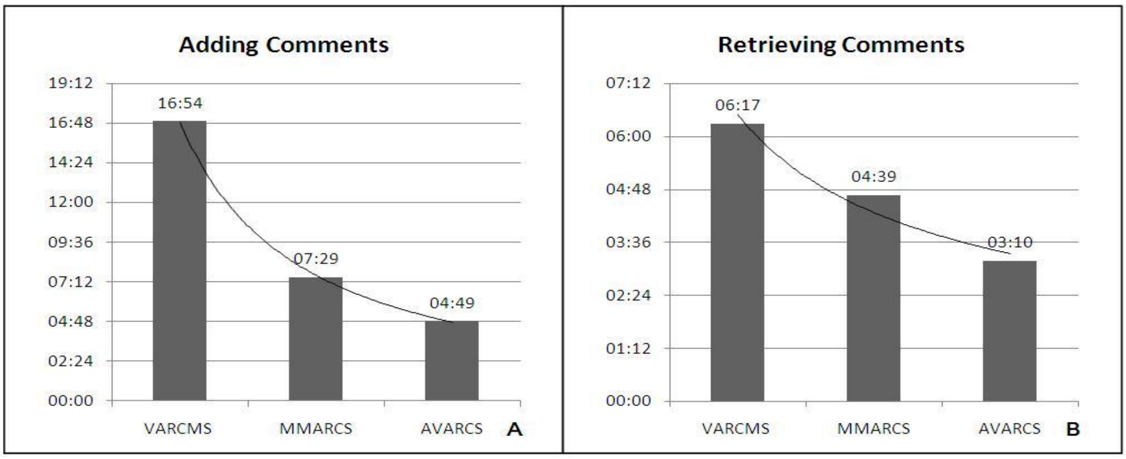

Figure 39Mean value of Adding (A) and Retrieving(B) Comments (task types) which involved completing tasks in VARCS, MMARCS and AVARCS in relation to achievement time.

In general, the number of clicks required to complete tasks differed for AVARCS, MMARCS and VARCS in the two task types with the e clicks required to complete retrieve tasks found to be lower than in add tasks. Generally, the mean value of clicks for using AVARCS was lower when compared to using MMARCS and VARCS.

The mean value in Add tasks for AVARCS (22 clicks) was lower than for MMARCS (40 clicks) and less than half that for VARCS (75 clicks). The mean value of mouse clicks in Retrieve tasks for AVARCS (14 clicks) was around 40% lower than for MMARCS (26 clicks) and approximately three times lower than for VARCS (40 clicks).

The results of the t-test revealed a significant difference in the mouse click count when comparing AVARCS and MMARCS with respect to Retrieve tasks (t = 3.284; df = 42; p<0.05) and add tasks (t = 7.545; df = 42; p<0.05).

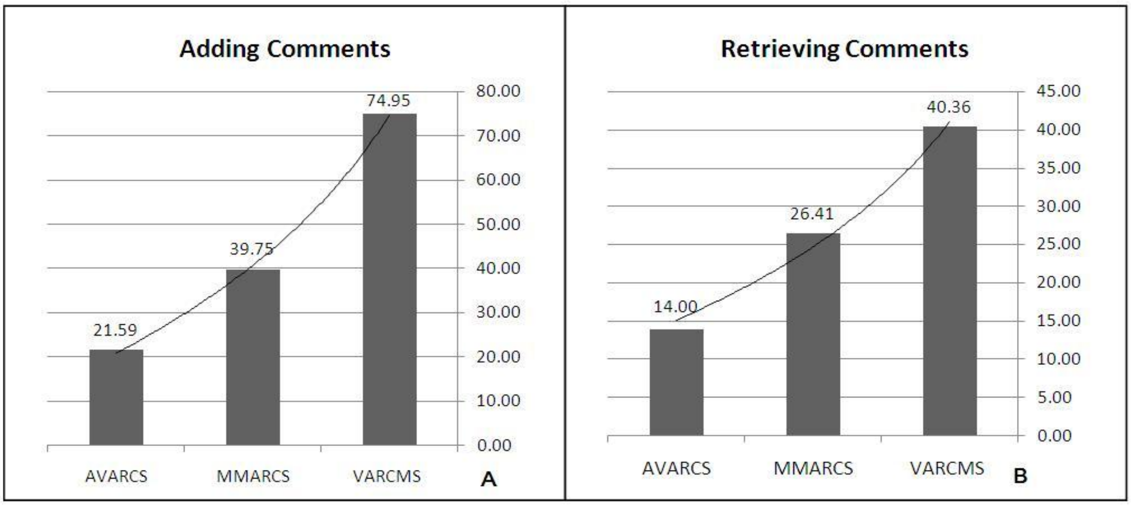

Figure 40Meanvalue of Adding (A) and Retrieving (B) Comments (task types) which involved completing tasks in VARCS, MMARCS and AVARCS in relation to the number of mouse clicks.

Furthermore, it illustrated a significant difference in the number of clicks between the AVARCS and VARCS in relation to the retrieve (t = 19.666; df = 42; p<0.05) and add tasks (t = 24.408; df = 42; p<0.05).

5.7.3.4 Errors Results

Figure 40 illustrates the number of errors made using the VARCS, MMARCS, and AVARCS experimental systems to perform various tasks. The chart displays the values for the five error types; incorrect typing, selecting errors, confusion, no action add, and no action ret. The highest occurring error is noted to be the incorrect typing error, followed by the no action add, no action ret, selecting, and the least being the confusion error, listed from highest to lowest in that order. For the incorrect typing errors, users recorded the highest in the VARCS system, which was far greater than in the other two systems. The AVARCS had the lowest errors recorded in this error type, indicative of better performance than the MMARCS and VARCS.

However, the MMARCS also had a relatively very low incorrect typing error count compared to the VARCS. The selecting errors had the second lowest occurrence, with VARCS, once again, having the highest, and AVARCS the lowest, amount of errors here. The selecting errors in MMARCS were more or less an intermediate value to the other two systems. For MMARCS, the selecting errors value was less than half of that of VARCS and about twice that of AVARCS.

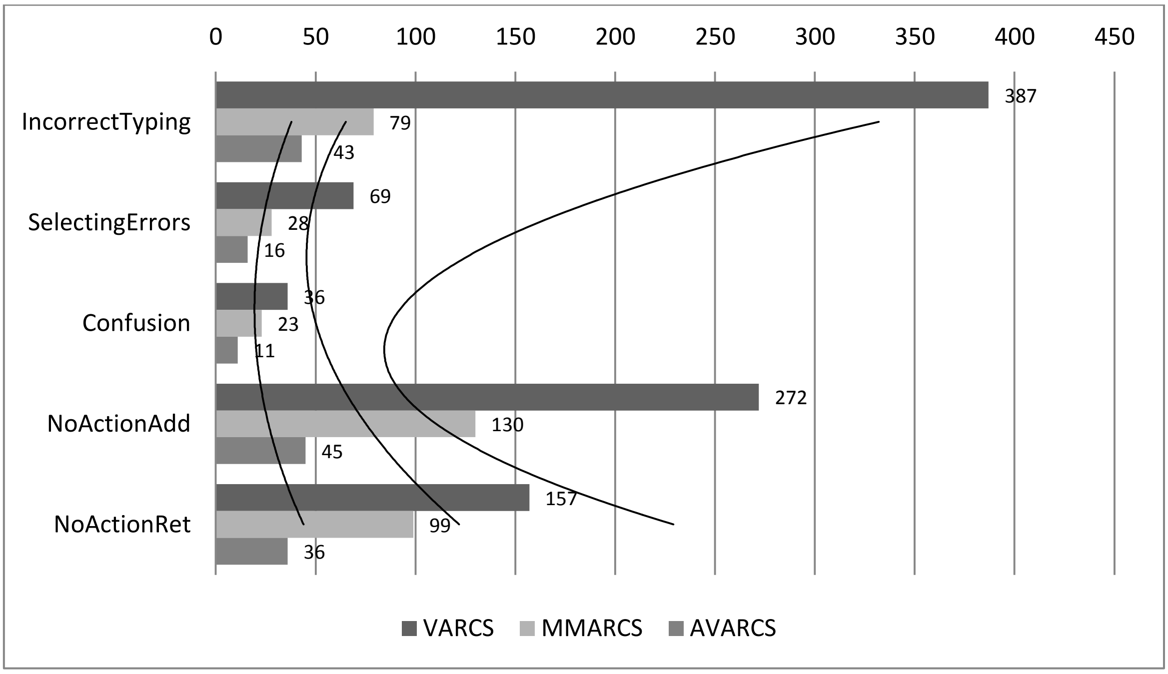

Figure 41Mean value of Adding number of errors in VARCS, MMARCS and AVARCS in relation to the five different types.

The confusion errors, however, had the least occurrence as stated above, with those recorded for VARCS equal to about twice that of MMARCS, and the value for MMARCS about twice that of AVARCS, that is four time less that of VARCS. The results of the no action add errors illustrated in the chart also shows the amount of errors for the MMARCS was more than double that of AVARCS and about half of that recorded for VARCS.

Errors Statements	Mean	N	Std. Deviation	t	df	Sig. (2-tailed)
Incorrect Typing VAARCS	17.59	22	4.182	16.799	42	.000
Incorrect Typing AVARCS	1.95	22	1.253			
Incorrect Typing MMARCS	3.59	22	1.532	3.878	42	.000
Incorrect Typing AVARCS	1.95	22	1.253			
Selecting Errors VARCS	3.14	22	2.007	5.31	42	.000
Selecting Errors AVARCS	.73	22	.703			
Selecting Errors MMARCS	1.27	22	.935	2.187	42	.034
Selecting Errors AVARCS	.73	22	.703			
Confusion VARCS	1.64	22	1.177	4.038	42	.000
Confusion AVARCS	.50	22	.598			
Confusion MMARCS	1.05	22	.785	2.592	42	.013
Confusion AVARCS	.50	22	.598			
No Action Add VARCS	12.36	22	4.215	10.645	42	.000
No Action Add AVARCS	2.05	22	1.704			
No Action Add MMARCS	5.91	22	2.524	5.950	42	.000
No Action Add AVARCS	2.05	22	1.704			
No Action Ret VARCS	7.14	22	3.152	6.665	42	.000
No Action Add AVARCS	2.05	22	1.704			
No Action Ret MMARCS	4.50	22	2.241	5.119	42	.000
No Action Ret AVARCS	1.64	22	1.364			

Table 30 The result of t test for all errors statements between all interfaces.

The VARCS was found to be up to six times that of AVARCS, which apparently indicates the better performance of AVARCS in this regard when compared to the other systems. The no action ret errors were quite substantial, unlike those captured in the confusion and selecting errors results. In comparison, the AVARCS is seen to have the lowest error occurrence in this type, followed by the MMARCS which had more than double the value for AVARCS. It would also seem to be the case that, of the three systems, the VARCS had the highest error value of this type, which was about twice that of MMARCS and around six times that of AVARCS. Overall, the AVARCS was found to have the least amount of errors, followed by the MMARCS and the highest was the VARCS having the most occurrences of errors in all error types.

The AVARCS experimental system, as is evident, substantially reduced errors in the completion of all the tasks tested. In table 30 the result of t test for all errors statements reported that, there is a statistically significant difference in all types of errors between all interfaces accepts in the Selecting Errors of MMARCS and AVARCS.

5.8 Conclusion

In concluding this Chapter, the overall findings obtained from the tests conducted are given in this section.

The results of the analysis of the systems' effectiveness (the VARCS MMARCS, and AVARCS) in relation to the interface of interaction, task complexity, task type and the individual task levels, show that the AVRCS has a more effective interface of interaction than the other two experimental systems, having completed more tasks successfully.

The AVARCS was also found to have greater efficiency, outperforming the MMARCS and VARCS group in the three efficiency factors; task completion time, error rate, and count of mouse clicks, as well as in terms of the task types. AVARCS is seen to have reduced the number of mouse clicks required to complete tasks by almost half that for

MMARCS and about one-third of VARCS. The use of the AVARCS experimental system also resulted in fewer errors during task operations thus indicating a higher efficiency than in the other systems. Lastly, from the analysis of VARCS, MMARCS, and AVARCS on user's satisfaction, (from the satisfaction statement survey), the general opinion indicated was that users were more satisfied overall with AVARCS as opposed to the VARCS and MMARCS, and also believed it had more impact on the public.

5.8.1 Result and Discussion

It is important to note that during the experiment, AVARCS users completed tasks of different e-journalism and social media interaction styles and different complexity significantly better than VARCS and MMARCS users. AVARCS users had significantly increased accuracy of adding and retrieving comments approach; this was closely related to RI and MC. In contrast, only fifty seven per cent of VARCS and seventy six per cent MMARCS users made accurate adding comments due to typing and selecting errors.

As a conclusion, it can be suggested that AVARCS has communicated the information in the way which gave the users sufficient clues to help them deal with the increasing complexity of task requirements.

This clues included incorporating natural recorded speech (which made it easier to add RI and MC), earcons (which conveyed opinion classifications), and facial expressions (communicated trends of RI and MC in relation to speech and earcons). Interaction of three channels of communication (speech, earcons, and facial expressions) facilitated the increase in efficiency of AVARCS's completion speed. The information received was interpreted faster using AVARCS as opposed to MMARCS, this being due to the fact that the user could use at least two channels at the same time. During this processing of information the user could add and select comments saved. There was an occasion when AVARCS was similar to MMARCS. The user's navigational behaviour revealed a similar pattern. This was due to systems being multimodal and relying on interact add and retrieve information exactly from the opinion classification. Therefore, the patterns of navigation did not affect the number of actions required in order to accomplish tasks.

The difference found between the AVARCS and MMARCS resulted from the miss-selecting of conveyed RI and MC. In E-ARCS contexts, e-journalism and social media could show the interaction of adding and retrieving comments that corresponded to those of RI and CB. However, implementation of E-ARCS socially rich could be difficult to accomplish. For instance, large interface space located to the avatar and the lack of avatar ability to communicate arbitrary strings need to be taken into consideration. In addition there could occur operational issues, such as slow video playing. In addition, the confusion caused by MC data, being communicated simultaneously with the lengthy communication messages. Nevertheless, the implementation of avatars with facial expressions has been associated with increased user's confidence, improved interface attractiveness, perceived impact on people's opinion, plus improved encouragement and engagement.

It has been noticed that users of the E-ARCS environment which combined avatars were more confident, had higher levels of content understanding and devoted less mental work. This was accomplished by exposure to a human-like character that speaks and shows emotions. As well as this,, users appeared enthusiastic about the phenomena of social presence and advanced technology, which is not easy to implement or manage.

Avatars were attractive with the consistency between its verbal and non verbal communication of information; the AVARCS was intelligent with a pleasant appearance. It appears as an attractive, new approach. Furthermore, combining avatars with facial expressions into E-ARCS communication has partly compensated for the absence of interpersonal interaction. This kind of human computer interaction has been perceived as "warm" and sociable. This has proven to be an effective approach to change public opinion in terms of media studies. This social aspect of avatars has brought positive changes such as improvement of the user's engagement in e-journalism and social media interaction-related activities and encouragement to interact with the system. The previous two experiments were particularly comprehensive. They illustrated the usability of multimodal metaphors in the field of E-ARCS. The advantages and limitations of avatar social presence were discussed.

The aim of this study was to assess users' attitude, impact on public opinion as well as the usability of these metaphors in a E- ARCS unique application domain. Nevertheless, it was worthwhile to pay close attention to the user's satisfaction from different perspectives in order to enrich the experimental programme. By way of explanation, it was very important to make distinctions between beliefs and intentions in the context of impact on public opinion evaluation. The measurement of the impact is better accomplished by differentiating between cognitive and behavioural views. Furthermore, because of the different usability levels of the three experimental platforms, it was worth considering investigating the evaluation from a different standpoint.

5.8.2 Summary

The analysis in this Chapter focuses on the evaluating the results obtained from the tests conducted. Such tests include the related t-tests, Wilcoxon's and ANOVA tests which were conducted on the users of the three groups, and was based on the controls and experimental systems and were used to investigate the significant difference in conditions.

From the analysis of the effectiveness of these platforms (VARCS, MMARCS, and AVARCS) in relation to the interface of interaction, task complexity, task type and the individual task levels, the following conclusions have been surmised:

- The AVARCS platform is found to have a more effective interface of interaction than the VARCS and MMARCS, due to its completion of more tasks successfully.
- On the level of complexity, the AVARCS platform was noted to be, also, more effective than the VARCS and MMARCS, owing to its higher percentage of tasks completed.

- Overall, in relation to task types, the AVARCS platform was also found to outperform the other platforms. However, the MMARCS and VARCS platforms were found to have almost equal effect on the contribution of multiple metaphors, despite the fact that MMARCS had a higher rate of tasks actions completed

And from the analysis of the efficiency of the VARCS, MMARCS, and AVARCS platforms, we have deduced the following:

- On the interface of interaction, the AVARCS platform was found to have greater efficiency, outperforming the VARCS and MMARCS platforms on the three efficiency factors; task completion time, error rate, and count of mouse clicks.
- On the levels of complexity, the AVARCS platform was also noted to improve the efficiency of performance as it was to considerably reduce the number of actions required for each task more as opposed to the figures for VARCS and MMARCS platforms respectively.
- Overall, regarding all task types, AVARCS platform was also found to reduce the number of mouse clicks required to complete tasks by almost half of that of MMARCS and about one-third of AVARCS, indicating a higher efficiency than that of the other platforms.

And lastly, the analysis of the results of VARCS, MMARCS, and AVARCS on user's satisfaction and public impact, obtained from the surveys conducted, we find that:

- For the satisfaction statement survey, the general opinion indicated that the AVARCS platform was more satisfactory overall as opposed to the VARCS and MMARCS platforms whose results showed a mixture of advantages and disadvantages against each other according to users' opinion.
- For the impact on public opinion, the overall response showed a preference for the AVARCS platform as opposed to the MMARCS and AVARCS platforms.

Chapter 6: Empirical Guidelines for employing Multimodal and AVATAR metaphors in E-ARCS

6.1 Introduction

This Chapter is, in a few words, looks at the analysis and result of experimental studies undertaken to evaluate the impactability for media studies and the usability for HCI studies, in social media and e-journalism interaction. Furthermore, it presents the investigation outcomes of this thesis and interprets the results of the three experiments phases for browsing comments. The outcomes used unique opinion classification for text with graphics, multimodal metaphors and the use official expressions in expressive avatars in social network and electronic news communication interfaces. Future work discusses also in this Chapter that can be affected to improve the recommended empirical derived guidelines.

6.2 Brief Critical Evaluation of the Experimental

During the process of this research many critical reviews have been achieved. This section will outline the results from main experiments such as: Firstly, in Chapter 3 the crucial matter behind the initial survey and experiment was whether the enclosure of no unique classification of opinion readers with recording metaphors is capable of enhancing the usability in social media and e-journalism interfaces communication. The initial survey determined the main adding and retrieving comment issues as a basis for this investigation such as spelling mistakes, cramped information layout, comments being disorganised and no classification of data. The majority of the users preferred the CMARCS, classification and multimedia platform over the traditional technique in terms of the number of tasks completed successfully, number of errors, and mouse clicks as well as for time saving. Additionally, a questionnaire evaluated the feelings of users which supported the dominance of CMARCS over TACRS.

Conversely, Chapter 4 in general, analysis of the trial's efficiency demonstrated that there were significant effects of multimodal metaphors in improving the interaction of adding and retrieving comments in the field of e-journalism and social media. In particular, multimodal interaction facilitated an efficient representation of RI and MC by aural and oral communication rather than relying on the traditional approach.

The results pointed to the fact that users were more comfortable with aural and oral communication because they found it resulted in fewer errors, reduced mouse clicks and a saving of time when sounds were inserted and conveyed the comments than for typing and reading them. On the other hand, the levels of user impact on public opinion and the satisfaction were enhanced, because users felt that MMARCS with the use of audio-visual metaphors made them feel relaxed and less confused when multimodal metaphors were used rather than the case with traditional approach.

In particular, the result showed that using MMARCS decreased the effect of prior experience during the adding comments and had an enhancement on perception of reader’s satisfactions and impact on their opinion while there was a slight improvement in retrieving comments tasks in term of satisfaction. Some users gave the reason as being the advantage of scan reading as opposed to than listening, especially in long comments. However, the feedback and analysis demonstrated that audio-visual interface had contributed at all levels of retrieving comments for those who preferred to keep up to date with the news while carrying out other tasks; it led to an improvement in the user‘s attitudes.

In general, the usage MMARCS (multimodal interface) was accepted as having a positive effect on all usability aspects, effectiveness, efficiency of E-ARCS, and user attitude - either the impact on public opinion or satisfaction statements. However, a number of studies and users suggested that it would be of benefit to make MMARCS interface with facial expressions. This idea, as with face-to-face communication, would enable the enhancement of the readers’ interaction, familiarity and understanding.

Chapter5has been noticed that users of the E-ARCS environment which combined avatars were more confident, had higher level of content understanding and spent less time. This was accomplished from exposure to a human-like character that speaks and shows emotions. Users also appeared enthusiastic about the phenomena of social presence, the advanced technology, which is not easy to implement or manage.

Avatars were attractive with the consistency between its verbal and nonverbal communication of information the AVARCS being intelligent with a pleasant appearance: an attractive, new approach. Furthermore, combining avatars with facial expressions into E-ARCS communication partly compensated for the absence of interpersonal interaction. This type of human computer interaction viewed as kindlyand sociable. This proved to be an effective approach in changing people's opinion in term of media studies. This social aspect of avatars has brought positive changes such as improvement of user's engagement with e-journalism and social media interaction related activities, and encouragement to interact with the system. The previous two experiments were particularly comprehensive.

6.3 Empirical Guidelines

The results resulting from this investigation were analysed and the main points summarised (the features of impact and usability interfacing in social media). The results can be used to create instructions for users that will make the adding and retrieving comments function in e-journalism interaction better. The achievement guidelines that were outlined in Chapter 1 were reiterated with regard to usability indicators, for example finishing tasks, decreasing the amount of time they took and reducing the amount of mouse clicks or errors. It also included the public opinion and how satisfied the users were. For a more in-depth explanation, the users expressed their impact on opinion for the multimodal interfaces and compared them with a regular textual interface in all of the experiments. The general consensus of the last experiment was that the facial expressions were preferred compared with the other interfaces.

Furthermore, the experimental interfaces demonstrated that, when different facial expressions with multimodal metaphors were included in the presentation approach, users could work more effectively and completed 77.78% to 92.42% of tasks successfully in adding comments tasks. As well as this, 74.75% to 90.91% of tasks were completed successfully for the retrieving comment for AVATAR. For the interfaces that used facial expressions as AVATAR, users completed the tasks in a shorter time (23 mins 11 sec in VARCS to 07 mins 59 sec in AVARCS); the amount of errors made reduced (921 to 151) and the number of mouse clicks was less (115 to 36) in the two types of interfaces (see Figures 35). Users preferred the multimodal interfaces rather than the regular textual interface in all the experiments. Most of the users preferred facial expressions compared with the others. Creators of social networks could make use of these results when they develop comment systems for e-journalism and new media comment systems. The guidelines are grouped according to types and size of comments, speech and non- speech metaphor, utilisation of facial expressions and a mixture of facial expressions and multimodal metaphors.

6.3.1 Size of Comments

In the case of having to express short text (less than 140 characters as Twitter Style) descriptions in retrieving comments tasks, the expressive avatars did not improve how well the interface could be used. The number of action tasks completed successfully, the amount of clicks mouse and errors rate that users made were slightly different statistically between the different interfaces of presentation (i.e. textual with graphic, multimodal metaphors and face animation– see Chapters 4 and 5). When the comments were longer in length, the results that resulted suggested that multimodal I do not understand this and facial animations as Avatar expression were more effective and made the interface easier to use (see Figure 36). However, in adding comments all tasks level enhanced how well the interfaces could be used from VARCS into AVARCS throughout MMARCS. A creator of an interaction of social media and e-journalism needs the choice of being able to use a textual with graphic method of presentation regardless of the length of the text. For example, Twitter has to be used employing text with graphics rather than using facial expression Avatar and multimodal metaphors. This is due to the fact that some users who do not like the multimodal metaphors therefore do not want to use the Avatar expression methods of presentation to send information on the internet. Finally, an interface for the multimedia approach of presentation should always provide users with the choice of switching between texts.

6.3.2 Speech Metaphor

Using recorded speech made the interface easier to use and ensured that users stayed focused on the screen. The use of a clear concise voice ensured that the users remained interested. This study examined the use of recorded speech with each facial expression. When tones were used with the opinion AVATAR facial expressions, the users were more interested and listened more carefully to the comments.

The results showed that there was a dramatic increase in how well the users interacted with the interface. Moreover, it had an encouraging impact on people's opinion. As well as the text, speech improved how well the interface could be used.

Janse [163] stated that users will understand a natural voice better than a synthetic one. As stated in Chapter 2, many studies have examined natural voices versus synthetic and all of them have found that natural speech is more audible and better understood. Machines that can synthesise speech are the Voltrax, Echo, DECTalk, Voder [167, 172].

When speech that did not sound very happy or enthusiastic was applied to the positive facial expressions, the listeners took less of an interest in the presentations. Due to this, users frequently missed important information from the text, which is shown in the answers that they gave (see Chapter 4, Experiment II).

Therefore when comments using facial expressions were combined with an opinion classification tone of speech, they were beneficial to the interaction procedure between the avatar and the user, namely by collecting information about their gender and opinion (whether they disagreed, agreed or were neutral).

Another aspect that needs to be considered with regards to the speech articulation pattern is the use of an English accent.

An international accent is normally easier for non-English people to understand. Users stated that if social media sites used an English language it would not cause them to leave the site. Synthesised speech can be changed according to the type of presentation and the audience. They can also emphasise certain words or take additional pauses to get points across and can also change the tone.

6.3.3 Use of Facial Expressions

Expressive avatars are able to involve users more with the interface, this being because the user will normally copy the avatar's expression. In the experiment, 12 facial expressions were examined (6 with Turki Aldakheel as the man and 6 with Muntah Alromhi as the woman). It was seen that when there was an interactive context present or absent, only the all facial expressions (Chapter 5) had a positive impact on the opinion and usability interaction between the interface and the user.

The expressions suggested for use with the avatar are; positive, surprised and very happy to express the “agree” opinion. The users believed these types of facial expressions were the best to use when communicating information. The results showed that the users performed better in their interface tasks. With the neutral facial expressions, users liked the hesitate expression but not the thinking expression. When the thinking expression was in use, the users were not encouraged to recover comments on the internet as they thought the expression depicted doubt. For this reason, it would not be advisable to use the thinking facial expression in social media interfaces. The “disagree” facial expressions (seesection6.3.2) should be used by the avatar to suggest anger and shock. These expressions caused the users to concentrate on the information.

6.4 Using Avatars

This section will discuss the problems that can occur when using an avatar. It can take a lot of time to carry out the on-demand frame by frame manipulation of an animation(facial expression) so that a realistic flow is achieved on which the avatar can represent. There is not much interaction between the input from the user and the time that it takes the avatar to respond with respect to recognizing speech. Long comments (more than 1000 characters as majority of e-Journalism style) presentations may mean that large files are placed on the internet server.

As a result of this, it may be that the animation is slow and therefore the users lose interest. To overcome this, the animation could be sectioned off into smaller files.

6.5 Future Work

This section will discuss future work that could be done to carry the research forward. The following section will outline research questions that would enable this research to carry on. With new knowledge the guidelines could therefore be improved.

6.5.1 Gender, Ethnicity and Age

This thesis recommends a study into avatars that are realistic, that are varying ages, different gender and from ethnic backgrounds than that which was used in project. The effect that this has on users when they are retrieving comments should then be looked into. This investigation would answer questions such as 1) whether an avatar with a realistic male or female voice is more convincing than actual speech or 2) whether a realistic animated avatar persuades users more easily to make certain decisions than a static picture one for adding or retrieving comments. Finally, it would answer the question of what the main variations are and how the tone of the avatar's voice affects the user.

Furthermore, the ethnic background and Figures are other suggested limitations to examine. E- Journalists face barriers when on social network interfaces when working in various different countries around the world, due to religion, politics and culture. A question that may come to light is whether an avatar from one specific ethnic background could be used for every country and culture. According to Ekman [164], different cultures use different facial expressions. Finally, age is another constraint that needs to be investigated when developing realistic avatars; it needs to be considered whether the age of the avatar should be the same as those it is targeting.

6.5.2 Use of Body Gestures

Body gestures need to be considered for the interaction of new media. It could perhaps be argued that positive body language such as open hands, holding the head up could make the interface easier to use. Negative body language such as keeping arms folded, scratching the skin, and crossing legs is seen as defensive, therefore appearing dubious and should not therefore be used by avatars. Users could be asked how they view these gestures and whether they sway them towards particular decisions. Gestures should not be used widely by avatars as they can divert the attention of the users away from listening to the information being communicated.

6.5.3 Combining Facial Expressions and Body Gestures

This project also recommends studying the effect of facial expressions and body language when being carried out by several avatars, or when several different expressions and gestures are being used, at the same time. Some objectives should suggest that a mixture of those voted the best by users would enhance the performance and impact on people's opinion and how satisfied the users are with the new media interfaces. The designer should incorporate those that have been voted the best.

6.5.4 Earcons and Auditory Icons

Research should be carried out into other multimodal metaphors, for example earcons and auditory icons in addition to those examined in this project. The research questions that need further investigation are; "Would these metaphors improve the usability of a social network platform on the internet?" "Would these metaphors sway the user's judgement and cause problems with usability?" "Should earcons and auditory icons be used at the same time as each other or should use in conjunction with the metaphors previously been utilized on the platform?” “Can metaphors be used in an e-journalism interface?” In a study undertaken by Rigas et al [37,97,98,100,101,125,128,130,136,174 and 178] it was discovered that sounds that are not generated by speech can considerably add to communicable information in user interfaces in emails, inventory control systems and internet learning tools.

6.5.5 Intelligence

A study into whether making avatars intelligent should be carried out, aimed at examining the role of intelligence in social media and e-journalism interfaces and answer questions such as: “Will avatars that are intelligent improve the navigation and interaction between users and the interface?” and “By making avatars intelligent will this enhance the appeal of new media systems in the adding and retrieving comments system?” According to [165] intelligent avatars can react to input from users and respond with non-verbal gestures. It would therefore make for interesting research to study the role that these conversations play in swaying users’ decisions.

6.6 Epilogue

This thesis has shown various usability characteristics of social media and e-journalism interaction interfaces. These interfaces can be improved by incorporating realistic avatars that make expressions similar to those of humans, which also improves the communication between the user and the interface. Normally, interfaces designed for adding and retrieving use text and images with a small amount of multimodal metaphors such as speech or avatars that make human facial expressions when talking. This thesis has studied human-like avatars that use all of the above-mentioned metaphors and has demonstrated usability and impactability on improved communication between the user and the e-journalism interface.

It can be stated that the use of facial expressions in avatars for portraying different emotions and speech is a key aspect to consider when designing new media interactive systems. As the avatar is so realistic, it mimics real communication. The empirical guidelines that have come about from this study provide an argument for the use of facial expressions in avatars to enhance and improve social network interactive systems. More research does however need to be undertaken so that more information can be added to the guidelines, thus improving the imitation of realistic communication in the e-media interface.

References:

1 C.DanceyandJ.Reidy,"VariablesandResearchDesign,"in*StatisticswithoutMaths for Psychology:Using SPSS forWindows*: PrenticeHall, 2004, pp. 1-33.

2 *N. Salkind, "The Research Process: Coming to Terms," in Exploring research, Sixth ed. New Jersey, USA: Pearson Education International, 2006, pp. 19-32.*

3 C.DanceyandJ.Reidy,"AnalysisofVariancewithmorethanoneIV,"in *Statistics withoutMaths for Psychology: Using SPSS for Windows*. Essex, England: PrenticeHall, 2004, pp. 321-373.

4 NigelBevanandMilesMacleod,“Usabilitymeasurementincontext”,National PhysicalLaboratory,Teddington,Middlesex,UK,

5 N. Salkind, "Methods ofMeasuring Behavior” in*Exploring research,*Sixth ed. New Jersey, USA: Pearson EducationInternational, 2006, pp. 123-144.

6 Boyd DM, Elison NB (2010). Social Network Sites: Definition, History, and Scholarship. Journal of Computer-Mediated Communication. 13:210–230.

7 M. Thomas, B. Pang, and L. Lee. Get out the vote: Determining support or opposition from Congressional floor-debate transcripts. In EMNLP ’06: Proceedingsof the ACL-02 conference on Empirical methods innatural language processing, pages 327–335, 2006.

8 M. De Choudhury, H. Sundaram, A. John, and D. D. Seligmann. What makes conversations interesting? In WWW’09, pages 331–331, April 2009.

9 F. Duarte, B. Mattos, B. A., A. V., and A. J. Traffic characteristics and communication patterns in blogosphere. In ICWSM’06, March 2007.

10 Kawamoto K. Digital journalism: emerging media and the changing horizons of journalism (2008).

11 López García, Xosé et al. (2003). La formación de los ciberperiodistas: punto de partida. Comunicação apresentada no IV Congresso Nacional de Jornalismo Digital de Huesca , 16 a 17 de enero de . Huesca, Espanha.

12 Scott B (2005). A Contemporary History of Digital Journalism. Television New Media. 6: 89-126.

13 Small, Jay (2000). Economics 101 of Internet News. Nieman Reports. 54 (4):

41-42.

14 Wilson T, Hamzah A, Khattab U (2003). The ‘cultural technology of clicking’ in the hypertext era. Sage Publication: 5(4): 523-545.

15 S. Sen, M. F. Harper, A. Lapitz, and J. Riedl, “The quest for quality tags,” in GROUP ’07: Proceedings of the 2007 international ACM conferenceon Supporting group work. ACM, 2007

16 G. Mishne and D. Carmel, “Blocking blog spam with language model disagreement,” in Adversarial Information Retrieval on the Web, 2005.

17 E. Agichtein, C. Castillo, D. Donato, A. Gionis, and G. Mishne, “Finding high-quality content in social media,” in WSDM. ACM, 2008.

18 N. Jindal and B. Liu, “Opinion spam and analysis,” in WSDM. ACM,2008

19 W. Gaver, "Auditory Icons: UsingSound in Computer Interfaces," *Human-Computer Interaction*, vol. 2, pp. 167-177, 1986.

20 KYDsoft, "Easy MP3 Sound Recorder (Sound Recording Software)," in www.softplatz.com/Soft/Audio-Multimedia/Audio-Encoders-Decoders/Easy-MP3-Sound-Recorder.html, 3.1 ed, 2006.

21 S. Shah, "Visual Music (Software Programme)," in www.shitalshah.com/vmusic, 1.1 ed, 2006.

22 S. Brewster, P. Wright, and A. Edwards, "Experimentally derived guidelines for the creation of earcons," Adjunct Proceedings of HCI, vol. 95, pp. 155-159, 1995.

23 K. Alomar and D. Rigas, "A platform for Investigating Effectiveness for Static, Adaptable, Adaptive, and Mix-Initiative Environments in E-Commerce," in International Conference on E-Business, ICETE ICE-B. Porto, Portugal, 2008, pp. 191-196.

24 Fabio Paternò, “Model-Based Design and Evaluation of Interactive Applications”, Springer, pp. 141-151, 2000.

25 N. Gazepidis and D. Rigas, "Evaluation of Facial Expressions and Body Gestures in Interactive Systems," International Journal of Computers, vol. 2, pp. 92-97, 2008.

26 N. Awad and A. Ragowsky, "Establishing Trust in Electronic Commerce Through Online Word of Mouth: An Examination Across Genders," Journal of Management Information Systems, vol. 24, pp. 101-121, 2008.

27 D. Rigas and K. Alomar, "A platform for Investigating User Satisfaction for Static, Adaptable, Adaptive, and Mix-Initiative Environments in E-Commerce," in the Saudi International Innovation Conference 2008. Leeds, United Kingdom, 2008, pp. 63-67.

28 G. Theonas, D. Hobbs, and D. Rigas, "The Effect of Facial Expressions on Students in Virtual Educational Environments," International Journal of Social Sciences, vol. 2, pp. 42-49, 2008.

29 M. Etgar, "A descriptive model of the consumer co-production process," Journal of the Academy of Marketing Science, vol. 36, pp. 97-108, 2008.

30 Rigas, D. and D. Hopwood, The Role of Multimedia in Interfaces for On-Line Learning. 9th Panhellenic Conference on Informatics (PCI'2003). , Thessaloniki, Greece, 2003.

31 Rigas, D.I., Guidelines for Auditory Interface Design: An Empirical Investigation. 1996: PhD thesis,
Loughborough University of Technology.

32 K. Alomar and D. Rigas, "A platform for Investigating Effectiveness for Static, Adaptable, Adaptive, and Mix-Initiative Environments in E-Commerce," in International Conference on E-Business, ICETE ICE-B. Porto, Portugal, 2008, pp. 191-196.

33 N. G. Gazepidis and D. Rigas, "Facial Expressions and Body Gestures in E-Commerce: an Empirical Investigation," in Department of Computing, School of Informatics, vol. PhD. Bradford: University of Bradford, 2008.

34 D. Rigas and A. Stergiou, "An Empirical Approach to Audio-Visual Guided Electronic Commerce," WSEAS Transactions on Computer Research, vol. 2, pp. 177-182, 2007.

35 K. Al-Diri, D. Hobbs, and R. Qahwaji, "Are Media Cues Really a Key Driver Towards Trust in Business to Consumer e-Commerce," in the Second International Conference on E-business ICE-B07. Barcelona, Spain, 2007, pp.

227-234.

36 J. McGrenere, R. M. Baecker, and K. S. Booth, "An evaluation of a multiple interface design solution for bloated software," Proceedings of the SIGCHI conference on Human factors in computing systems: Changing our world, changing ourselves, pp. 164-170, 2002.

37 D. Rigas, H. Yu, and D. Memery, "Experiments using speech, non-speech sound and stereophony ascommunication metaphors in information systems," 2001.

38 D. Rigas and M. Sallam, "The Use of Multimodality Metaphors in E-learning," in the 8th WSEAS International Conference on Software Engineering, Parallel and Distributed Systems (SEPADS '09). Cambridge, UK, 2009, pp. 127-130.

39 D. Huggins-Daines, M. Kumar, A. Chan, A. W. Black, M. Ravishankar, and A. I. Rudnicky, "Pocketsphinx: A free, real-time continuous speech recognition system for hand-held devices," 2006.

40 J. McGrenere, "The design and evaluation of multiple interfaces: A solution for complex software," The University of Toronto, 2002.

41 S. Pan and J. Lee, "Using e-CRM for a unified view of the customer," Communications of the ACM, vol. 46, pp. 95-99, 2003.

42 M. Alsuraihi and D. Rigas, "Speech Displaces the Graphical Crowd," Journal of Computers, vol. 3, pp. 47-58, 2008.

43 E. von Hippel, "User Toolkits for Innovation," Journal of Product Innovation Management, vol. 18, pp. 247-257, 2001.

44 K. Al-Diri, D. Hobbs, and R. Qahwaji, "Are Media Cues Really a Key Driver Towards Trust in Business to Consumer e-Commerce," in the Second International Conference on E-business ICE-B07. Barcelona, Spain, 2007, pp. 227-234.

45 M. Fabri, S. Y. A. Elzouki, and D. Moore, "Emotionally Expressive Avatars for Chatting, Learning and Therapeutic Intervention," in Lecture Notes in Computer Science, vol. 4552: Springer Berlin / Heidelberg, 2007, pp. 275-285.

46 F. Davis, R. Bagozzi, and P. Warshaw, "User acceptance of computer technology: a comparison of two theoretical models," Management Science, vol. 35, pp. 982-1003, 1989.

47 C. Ong and J. Lai, "Measuring user satisfaction with knowledge management systems: scale development, purification, and initial test," Computers in Human Behavior, vol. 23, pp. 1329-1346, 2007.

48 M. Alsuraihi and D. Rigas, "Efficiency on Speech Recognition for Using Interface Design Environments by Novel Designers," in the 7th WSEAS International Conference on Applied Informatics and Communications. Athens, Greece, 2007.

49 A. Bunt, "Mixed-Initiative Support for Customizing Graphical User Interfaces," The University Of British Columbia, 2007.

50 D. I. Rigas and D. Memery, "Utilising audio-visual stimuli in interactive information systems: A two domain investigation on auditory metaphors," 2002.

51 A. Ciuffreda and D. Rigas, "A usability Study of multimodal interfaces for the presentation of Internet Search Results," International Journal of Computers, vol. 2, pp. 120-125, 2008.

52 M. Alseid and D. Rigas, "Users' Views of Facial Expressions and Body Gestures in E-Learning Interfaces: An Empirical Evaluation," in the 8th WSEAS International Conference on Software Engineering, Parallel and Distributed Systems (SEPADS '09). Cambridge, UK, 2009, pp. 121-126.

53 J. Brooke, "SUS: a quick and dirty usability scale," Usability Evaluation inIndustry, pp. 189-194, 1996

54 N. Salkind, "Sampling and Generalizability," in Exploring research, Sixth ed.New Jersey, USA: Pearson EducationInternational, 2006, pp. 85-98.

55 C. Dancey and J. Reidy, "Non-parametric Statistics," in Statistics without Maths for Psychology: Using SPSS for Windows. Essex, England: Prentice Hall, 2004, pp. 523-557.

56 R. Likert, "A technique for the measurement of attitudes," Archives of Psychology, vol. 140, pp. 1-55, 1932.

57 D. Gefen, E. Karahanna, and D. W. Straub, "Inexperience and experience with online stores: the importance of TAM and trust," Engineering Management, IEEE Transactions on, vol. 50, pp. 307-321, 2003.

58 S. Chelaru, J. Pedro *How Useful are Your Comments? - Analyzing and Predicting YouTube Comments and Comment Ratings*. WWW 2010, April 26–30, 2010, Raleigh, North Carolina, USA. ACM 978-1-60558-799-8/10/04.

59 De Wolk, R. (2010) Introduction to Online Journalism: Publishing News and Information, Needham Heights, MA. Allyn and Bacon.

60 Hall, J. (2008) Online Journalism: A Critical Primer, London: Pluto Press.

61 Millison, D. (2005) Online Journalism FAQ retrieved August 9, 2004, from http://home.comcast.net/~dougmillison/faq.html

62 A. KALTENBRUNNER, V. GOMEZ and V. LOPEZ (2007). *Description and Prediction of Slashdot Activity*. Proceedings of the 2007 LatinAmerican Web Conference, IEEE Computer Society: 57-66.

63 Leitch S and Warren M. The use of Social Networking technologies within a tertiary education environment. Education in a technological world: communicating current and emerging research and technological efforts.

64 Palacios M, Noci JD. Online journalism: research methods. ISBN: 978-84-9860-191-6

65 George Buchanan (2003). Usability of digital libraries A source of creative tensions with technicaldevelopments. http://www.ieeetcdl.org/Bulletin/v1n1/blandford/blandford.html

66 Vissler PS , Holbrookland A, Krosnick KA. Theories of public opinion formation and change. Part III. Donsbach: Public Opinion Research (SAGE Handbook) Page: 123–140

67 Stevens R. Usability 10 Years Later: Are We Listening? A Research Paper Submitted for the International symposium on online journalism.

68 Nielsen, J. (1999). Designing Web Usability: The practice of simplicity.

Indianapolis: New Riders Publishing.

69 Pearrow, M (2000). Web Site Usability. Rockland, MA. Charles River Media.

70 Shneidermann, B (1998). Designing the User Interface: Strategies for Effective Human-Computer Interaction. Reading.

71 S. Alharbi and D. Rigas, "E-Mail Visualisation: A Comparative Usability Evaluation," in Human-Computer interaction of Tenth International Conference on Enterprise Information Systems (ICEIS). Barcelona, Spain, 2008, pp. 319-324.

72 C. Lopez-Nicolas and F. Molina-Castillo, "Customer Knowledge Management and E-commerce: The role of customer perceived risk," International Journal of Information Management, vol. 28, pp. 102-113, 2008.

73 M. Alsuraihi and D. Rigas, "How effective is it to design by voice?," in the 21st British HCI Group Annual Conference. University of Lancaster, Lancaster, UK, 2007.

74 S. Rashid and D. Rigas, "A Two-Group Evaluation to e-Note," International Journal of Education and Information Technologies, vol. 2, pp. 7-12, 2008.

75 D. Rigas and M. Alsuraihi, "A Toolkit for Multimodal Interface Design: an Empirical Investigation," in 12th International Conference of HCI. Beijing, China, 2007.

76 D. Rigas and A. Ciuffreda, "An Empirical Investigation of Multimodal Interfaces for Browsing Internet Search Results," in the 7th WSEAS International Conference on Applied Informatics and Communications. Athens, Greece, 2007.

77 A. Ciuffreda and D. Rigas, "An Empirical Investigation in Using Multi-modal Metaphors to Browse Internet Search Result," in Department of Computing, School of Informatics, vol. PhD. Bradford: University of Bradford, 2008.

78 E. Fang, "Customer Participation and the Trade-Off Between New Product Innovativeness and Speed to Market," Journal of Marketing, vol. 72, pp. 90-104, 2008.

79 G. Theonas, D. Hobbs, and D. Rigas, "Employing Virtual Lecturers‘

FacialExpressions in Virtual Educational Environments," The International Journal of Virtual Reality, pp. 31-44, 2008.

80 D. Rigas and N. Gazepidis, "A Further Investigation of Facial Expressions and Body Gestures as Metaphors in E-Commerce," in the 7th WSEAS International Conference on Applied Informatics and Communications. Athens, Greece, 2007.

81 D. Rigas and I. Bahadur, "A Two Platform Empirical Study to Investigate the Use of Audio in a Stock Control Application," WSEAS Transactions on Computers, vol. 5, pp. 21-40, 2006.

82 N. Gazepidis and D. Rigas, "Evaluation of Facial Expressions and Body Gestures in Interactive Systems," International Journal of Computers, vol. 2, pp. 92-97, 2008.

83 M. Alsuraihi, "Multimodal Interface Design: A Software Engineering Approach " in Department of Computing, School of Informatics, vol. PhD. Bradford: University of Bradford, 2008

84 S. Kieffer and N. Carbonell, "Computer Science> Human-Computer Interaction Title: How really effective are Multimodal Hints in enhancing Visual Target Spotting? Some evidence from a usability study," Journal reference: Journal on Multimodal Interfaces (JMUI), vol. 1, pp. 1-9, 2007.

85 N. Gazepidis and D. Rigas, "Evaluation of Facial Expressions and Body Gestures in Interactive Systems," International Journal of Computers, vol. 2, pp. 92-97, 2008.

86 D. Rigas and N. Gazepidis, "Facial Expressions and Body Gestures as Metaphors for B2C Interfaces: An Empirical Study," in the International Conference on e-Business. Setubal, Portugal, 2006.

87 L. Findlater and J. McGrenere, "Evaluating reduced-functionality interfaces according to feature findability and awareness," LECTURE NOTES IN COMPUTER SCIENCE, vol. 4662, pp. 592, 2007.

88 Q. Dunsworth and R. K. Atkinson, "Fostering multimedia learning of science: Exploring the role of an animated agent‘s image," Computers & Education, vol.

49, pp. 677-690, 2007.
89 K. Al-Diri, "The Effect of Visual Media Cues on Initial Trust in Business to Consumer Electronic Commerce Websites in Saudi Arabia," in Department of Department of Electronic Imaging and Media Communications (EIMC), vol. PhD. Bradford: University of Bradford, 2008.
90 B. Fineman, "Computers as people: human interaction metaphors in human-computer interaction," in The School of Design. Pittsburgh, USA: Carnegie Mellon University, 2004.
91 D. Rigas and J. Alty, "The rising pitch metaphor: an empirical study," International Journal of Human-Computer Studies, vol. 62, pp. 1-20, 2005.
92 E. Hoggan, A. Crossan, S. A. Brewster, and T. Kaaresoja, "Audio or tactile feedback: which modality when?," 2009.
93 D. Rigas and M. Alseid, "Multi-modal aided Presentation of Learning Information: A Usability Comparative Study," in ADIS International Conference on Interfaces and Human-Computer Interaction. Amsterdam, Netherlands, 2008, pp. 234-238.
94 K. Ayad and D. Rigas, " An Empirical Investigation on Effectiveness of Game Based Learning" Recent Advances in Software Engineering , Parallel and Distributed Systems, UK, 2010, pp. 124-127, ISBN: 978-960-474-156-4
95 Cartwright, W., Exploring Games and Gameplay as a Means of Accessing and Using Geographical Information. Human IT, 2006. 8(3): p. 28-67.
96 K. Ayad and D. Rigas, " Multi-Modal Game Based Learning: Satisfaction and Users Achievement Approach" Recent Advances in Software Engineering , Parallel and Distributed Systems, UK, 2010, pp. 166-171, ISSN: 1790-5117
97 K. Ayad and D. Rigas, " Guidelines for Edutainment in E-learning Systems" Recent Advances in Software Engineering , Parallel and Distributed Systems, UK, 2011, pp. 185-188, ISBN: 978-960-474-277-6
98 M. Alseid and D. Rigas, "Efficiency of Multimodal Metaphors in the Presentation of learning Information," in the 22nd Annual Conference of Interaction, People and Computers, O. A. a. D. England, Ed. Liverpool, UK: British Computer Society, 2008.

99 M. Alseid and D. Rigas, " Three Different Modes of Avatars as Virtual Lecturers in E-learning Interfaces: A Comparative Usability Study" The Open Virtual Reality Journal, 2010, 2, 8-17.

100 M. Fabri, S. Y. A. Elzouki, and D. Moore, "Emotionally Expressive Avatars for Chatting, Learning and Therapeutic Intervention," Lecture Notes in Computer Science, vol. 4552, pp. 275, 2007.

101 J. Holmes, "Designing agents to support learning by explaining", Comput. Educ., vol. 48, pp. 523-547, 2007.

102 L. A. Annetta and S. Holmes, "Creating Presence and Community in a Synchronous Virtual Learning Environment Using Avatars", Intern. J. Instruct. Technol. Dist. Learn., vol. 3, pp. 27-43, 2006.

103 M. Jovanovic, D. Starcevic, and Z. Obrenovic, "Designing Aircraft Cockpit Displays: Borrowing from Multimodal User Interfaces," *Transactions on Computational Science III*, pp. 55, 2009.

104 J. Sodnik, C. Dicke, S. Tomaži, and M. Billinghurst, "A user study of auditory versus visual interfaces for use while driving," *International Journal of Human-Computer Studies*, vol. 66, pp. 318-332, 2008.

105 D. Rigas and S. Alharbi, "Using Graphical Representation to improve Usability of Email Clients," in *the Eighth Joint Conference on Knowledge-Based Software Engineering (JCKBSE'08)*. Piraeus, Greece: IOS press, 2008, pp. 241-249.

106 C. Dancey andJ. Reidy, "Introduction to multivariate analysis of variance (MANOVA)," in *Statistics without Maths for Psychology: Using SPSS for Windows*. Essex, England: PrenticeHall, 2004, pp. 484-522.

107 Brooke, J., SUS: a" quick and dirty" usability scale. Usability evaluation in industry, 1996: p. 189-194.

108 A. Ciuffreda and D. Rigas, "A usability Study of multimodal interfaces for the presentation of Internet Search Results", Intern. J. Comput., NAUN, vol. 2, pp. 120-125, 2008.

109 A. Holzinger, Kickmeier-Rust, M., & Albert, D., "Dynamic Media in Computer Science Education; Content Complexity and Learning Performance: Is Less More?," Educational Technology & Society,, vol. 11, pp. 279-290, 2008.

110 A. Jaimes and N. Sebe, "Multimodal human–computer interaction: A survey," Computer Vision and Image Understanding, vol. 108, pp. 116-134, 2007.

111 Venkatesh, Viswanath, V. Ramesh and Anne P. Masseey (2003). Understanding Usability in Mobile Commerce. Communications of the ACM. 46 (12): 53-56.

112 Lyndon Johnson (1999). Vietnam, and public opinion: Rethinking realist theory of leadership. Presidential Studies Quarterly. Research Library. 29(3); pg. 592.

113 J. Lee, K. Salamatian, *Understanding the Characteristics of Online Commenting*. ACM CoNEXT 2008 Student Workshop, December 9, 2008, Madrid, SPAIN. 2008 ACM 978-1-60558-264 1/08/0012

114 E. ADAR, D. S. WELD, B. N. BERSHAD, et al. (2007). *Why we search: visualizing and predicting user behavior*. Proceedings of the 16th international conference on World Wide Web. Banff, Alberta, Canada, ACM: 161-170.

115 Garrison, B (2007). Computer Assisted Reporting. Lawerence Erlbaum Associated, Publishers. 3rd Edition, United States of America.

116 D. CHOUDHURY, H. SUNDARAM, A. JOHN, et al. (2008). *Can blog communication dynamics be correlated with stock market activity?* Proceedings of the nineteenth ACM conference on Hypertext andhypermedia. Pittsburgh, PA, USA, ACM: 55-60.

117 V. GÓMEZ, A. KALTENBRUNNER and V. LÓPEZ (2008). *Statistical analysis of the social network and discussion threads in slashdot*. Proceedings of the 17th international conference on World Wide Web. Beijing, China, ACM: 645-654.

118 Alotaibi, M. (2009)ELECTRONIC CUSTOMER KNOWLEDGE MANAGEMENT SYSTEMS: A MULTIMODAL INTERACTION APPROACH. PhD, University of Bradford.

119 D. GRUHL, R. GUHA, R. KUMAR, et al. (2005). *The predictive power of online chatter* Proceeding of the eleventh ACM SIGKDD internationalconference on Knowledge discovery in data mining Chicago,

Illinois, USA 78-87

120 Communication Discontents: Democratising Cyberspace', Information, Communication and Society 4(1): 1–13.

121 S. Y. A. Elzouki, M. Fabri, and D. J. Moore, "Teaching severely autistic children to recognise emotions: finding a methodology," Proceedings of The 21st British HCI Group Annual Conference on HCI, vol. 2, pp. 137-140, 2007.

122 Matthrew Fraker (2011). Final Journalism Essay. http://wudigital.wordpress.com/

123 S. Brewster, G. Leplâtre, and M. Crease, "Using non-speech sounds in mobile computing devices," 1998.

124 S. A. Brewster, P. C. Wright, and A. D. N. Edwards, "An evaluation of earcons for use in auditory human-computer interfaces," Proceedings of InterCHI, vol. 93, pp. 222-227, 1993.

125 M. Alotaibi and D. Rigas, "A Usability Evaluation of Multimodal Metaphors for Customer Knowledge Management," International Journal of Computers and Communications, universitypress, UK, vol. 2, 2008.

126 M. B. Alotaibi and D. I. Rigas, "A usability evaluation of multimodal metaphors for customer knowledge management," International Journal of Computers and Communications, University Press, UK, vol. 2, pp. 59-68, 2008.

127 D. Rigas and M. Alotaibi, "The Role of Audio-Visual Metaphors in Aiding the Communication of Customer Knowledge: User Satisfaction Perspective," In Proceedings of International Conference on E-Business (ICETE ICE-B), pp. 143-148, 2008.

128 M. Alotaibi and D. Rigas, "Interactive Customer Knowledge Management Systems: a Comparative Evaluation of Users' Perception of Trust and Level of Knowledge," Proceedings of the 7th WSEAS International Conference on E-ACTIVITIES, pp. 54-59, 2008.

129 M. Alotaibi and D. Rigas, "How efficient is it to communicate customer knowledge with the aid of audio-visual metaphors?," Proceeding of the 2008

conference on Knowledge-Based Software Engineering: Proceedings of the Eighth Joint Conference on Knowledge-Based Software Engineering, pp. 233-240, 2008.

130 M. Alotaibi and D. Rigas, "How Effective is it to Communicate Customer Knowledge with the aid of Audio-Visual Metaphors," In Proceedings of the Saudi International Innovation Conference 2008, pp. 29-34, 2008.

131 S. H. Liu, H. L. Liao, and J. A. Pratt, "Impact of media richness and flow on e-learning technology acceptance, " Computers & Education, vol. 52, pp. 599-607, 2009.

132 M. Alotaibi and D. Rigas, "The Role of Avatars with Facial Expressions to Communicate Customer Knowledge," International Journal of Computers, NAUN, vol. 3, pp. 1-10, 2009.

133 S. Garzonis, S. Jones, T. Jay, and E. O'Neill, "Auditory icon and earcon mobile service notifications: intuitiveness, learnability, memorability and preference," in the 27th international conference on Human factors in computing systems: ACM New York, NY, USA, 2009, pp. 1513-1522.

134 S. Alharbi and D. Rigas, "Email Threads: A Comparative Evaluation of Textual, Graphical and Multimodal Approaches," International Journal of Computers, NAUN, vol. 3, pp. 238-250, 2009.

135 M. Alotaibi, "Electronic Customer Knowledge Management Systems: a Multimodal Interaction Approach," in Informatics Research Institute, vol. PhD. Bradford, UK: University of Bradford, 2009.

136 M. Alotaibi and D. Rigas, "How satisfactory is it to communicate customer knowledge with the aid of multimodal interaction metaphors?," in Proceedings of the 8th WSEAS International Conference on Software engineering, parallel and distributed systems. Cambridge, UK: World Scientific and Engineering Academy and Society (WSEAS), 2009.

137 Rashid, S. (2008)AN EXPLORATORY INVESTIGATION ON COMPUTER BASED NOTE-TAKING. PhD, University of Bradford

138 L. Findlater and J. McGrenere, "Evaluating reduced-functionality interfaces according to feature findability and awareness," LECTURE NOTES IN COMPUTER SCIENCE, vol. 4662, pp. 592, 2007.

139 A. Bunt, "Mixed-Initiative Support for Customizing Graphical User Interfaces," The University Of British Columbia, 2007.

140 A. Jaimes and N. Sebe, "Multimodal human–computer interaction: A survey," Computer Vision and Image Understanding, vol. 108, pp. 116-134, 2007.

141 J. Sodnik, C. Dicke, S. Tomaži, and M. Billinghurst, "A user study of auditory versus visual interfaces for use while driving," International Journal of Human-Computer Studies, vol. 66, pp. 318-332, 2008.

142 L. Findlater and J. McGrenere, "Impact of screen size on performance, awareness, and user satisfaction with adaptive graphical user interfaces," 2008.

143 L. Findlater, Moffatt, K., McGrenere, J., and Dawson, J. , "Ephemeral adaptation: The use of gradual onset to improve menu selection performance," Proc. SIGCHI Conference on Human Factors in Computing Systems (CHI 2009), pp. 10, 2009.

144 E. Hoggan, A. Crossan, S. A. Brewster, and T. Kaaresoja, "Audio or tactile feedback: which modality when?," 2009.

145 M. Jovanovic, D. Starcevic, and Z. Obrenovic, "Designing Aircraft Cockpit Displays: Borrowing from Multimodal User Interfaces," Transactions on Computational Science III, pp. 55, 2009.

146 Alseid, M. and D. Rigas. Users' views of facial expressions and body gestures in e learning interfaces: an empirical evaluation. 2009: World Scientific and Engineering Academy and Society (WSEAS).

147 Alseid, M. (2009) MULTIMODAL INTERACTIVE E-LEARNING: AN EMPIRICAL STUD.PhD, University of Bradford .

148 M. Sallam and D. Rigas, “Comparing effectiveness and efficiency between multimodal and textual note-taking interfaces" in the International Journal of Computers, Issue 2, Volume 4, 2010.

149 M. Sallam and D. Rigas, " Multimodal E-learning on Note-Taking: A user Satisfaction Perspective" Recent Advances in Software Engineering , Parallel and Distributed Systems

, UK, 2010, pp. 128-131, ISSN: 1790-5117.
150 M. Sallam and D. Rigas, " Multimodal Metaphors for Note taking in E-learning" Recent Advances in Software Engineering , Parallel and Distributed Systems , UK, 2011, pp. 180-184, ISBN: 978-960-474-277-6.
151 D. Rigas and M. Sallam, " Efficiency of multimodal metaphors in e-learning platform" in the 9th WSEAS International Conference on Software Engineering, Parallel and Distributed Systems . Cambridge, UK, 2010, ISBN: 978-960-474-156-4.
152 R. E. Mayer, "principles for managing essential processing multimedia learning: segmenting, pretraining, and modality principles," Cambridge handbook of mulrimedial learning, pp. 169-182, 2005.
153 A. Dix, G. Abowd, J. Finlay, and R. Beale, Human- Computer Interaction (3rd Edition). Prentice Hall, 2004.
154 N. B. Sarter, "Multimodal information presentation: Design guidance and research challenges. International Journal of Industrial Ergonomics," 2006.
155 R. Sheth, "Avatar Technology: Giving a Face to the e-Learning Interface," The eLearning Developers‟ Journal, 2003.
156 T. Lindberg and R. Näsänen, "The effect of icon spacing and size on the speed of icon processing in the human visual system," Displays, vol. 24, pp. 111-120, 2003.
157 S. A. Brewster, "The design of a sonically-enhanced interface toolkit," Department of Computing Science Technical Report TR-1996-23, June, 1996.
158 Pat Aufderheide (2011). Scan and Analysis of Best Practices in Digital Journalism In and Outside U.S. Public Broadcasting. http://www.centerforsocialmedia.org/future-public-media/documents/white-papers/scan-and-analysis-best-practices-digital-journalism-and-o
159 George Buchanan (2003). Usability of digital libraries A source of creative tensions with technical developments. http://www.ieee-tcdl.org/Bulletin/v1n1/blandford/blandford.html
160 Kurt Weimer (June 2010). Digital Journalism: The Audience Is Here. But who’s Monetizing the Content? The media Institute. Pp:1-8
161 Bakardjieva, M. and R. Smith (2001). The Internet in Everyday Life: Computer.

Networking from the Standpoint of the Domestic User, New Media & Society. 3(1): 67–83.

162 Rayuso (2011). Mass Media Influence on Society. http://hubpages.com/hub/Mass-Media-Influence-on-Society

163 Esther Janse, “Time-Compressing Natural and Synthetic Speech”, University of Utrecht, The Netherrlands, 2002.

164 Paul Ekman, “Facial Expressions - The Handbook of Cognition and Emotion”. pp. 301-320, Sussex, U.K.: John Wiley & Sons, Ltd., 1999.

165 M. Fabri, D. J. Moore, and D. J. Hobbs, "The emotional avatar: Non-verbal communication between inhabitants of collaborative virtual environments," Lecture Notes in Computer Science, pp. 269-276, 2000.

166 S. Brewster, "Using earcons to improve the usability of a graphics package," PEOPLE AND COMPUTERS, pp. 287-302, 1998.

167 Mary E. Reynolds, Charlene Isaacs-Duvall, Michelle Lynn Haddox, “A Comparison of Learning Curves in Natural and Synthesized Speech Comprehension”, Marshall University, Huntington, West Virginia, 2002.

168 Rigas D., Memery D. and Yu H., "Experiments Using Structured Musical Sound, Synthesised Speech and Environmental Stimuli to Communicate Information: Isthere a Case for Integration and Synergy?", International Symbosium on Intelligent Multimedia, Video and Speech Processing, IEEE Hong Kong Chapter of Signal Processing, pp. 465-468, Hong Kong, 2001.

169 Rigas D., Yu H. and Memery D., "Experiments Using Speech, Non-Speech and Stereophony as Communication Metaphors in Information Systems", 27th EUROMICRO Conference: A Net Odyssey, IEEE Computer Society, pp. 383-390, Warsaw, Polland, 2001.

170 Rigas D, Yu H, Klearhou K and Mistry S, "Designing Information Systems with Audio-Visual Synergy: Empirical Results of Browsing E-Mail Data", Panhellenic Conference on Human-Computer Interaction: Advances on Human-Computer Interaction, Patras, Greece, 960-7620-18, 2001.

171 A. Abran, A. Khelifi, W. Suryn, and A. Seffah, "Usability Meanings and Interpretations in ISO Standards," *Software Quality Journal*, vol. 11, pp. 325-338, 2003.

172 Sami Lemmetty, Matti Karjalainen, “Review of Speech Synthesis Technology”, Department of Electrical and Communications Engineering, Helsinki University of Technology, 1999.

173 Rigas D. and Memery D., "Multimedia E-Mail Data Browsing: The Synergistic Use of Various Forms of Auditory Stimuli", International Conference on Information Technology: Coding and Computing, IEEE Computer Society, Las Vegas, Nevada, USA, 2003.

174 Rigas D., Hopwood D. and Yu H., "The Role of Multimedia in Interfaces for On- Line Learning", 9th Panhellenic Conference on Informatics, Thessaloniki, Greece, 2003.

175 S. A. Brewster, "Chapter 13: NonSpeech Auditory Output," In Sears, A. and Jacko, J. (Eds.), The Human Computer Interaction Handbook 2nd Edition: Lawrence Erlbaum Associates, USA, 2008, pp. 247-264

176 W. W. Gaver, "Auditory interfaces," in Handbook of human-computer interaction, 2nd ed, 1997, pp. 1003-1041.

177 D. I. Rigas, D. Memery, D. Hopwood, and M. A. Rodrigues, "Empirically derived design issues in auditory information processing for mobile telephony," Information Technology: Coding and Computing, 2000. Proceedings. International Conference on, pp. 462-469, 2000.

178 M. Alharbe, D. Rigas. "*Initial Experiment to Improve the Interface to Input-Output of the Comments in E-Newspaper*". 2009 International Conference on CyberWorlds. Bradford. ISBN: 978-0-7695-3791-7

179 Gazepidis, N.(2008)FACIAL EXPRESSIONS AND BODY GESTURES IN E-COMMERCE: AN EMPIRICAL INVESTIGATION.PhD, University of Bradford.

180 T. Joachims. Making large-scale support vector machine learning practical. Advances in kernelmethods: support vector learning, pages 169–184, 1999.

181 S.-M. Kim, P. Pantel, T. Chklovski, and M. Pennacchiotti. Automatically

assessing review helpfulness. In Proceedings of the Conference on Empirical Methods in Natural Language Processing (EMNLP), pages 423–430, Sydney, Australia, July2006. Association for Computational Linguistics.

182 J. Liu, Y. Cao, C.-Y. Lin, Y. Huang, and M. Zhou. Low-quality product review detection in opinion summarization. In Proceedings of the Joint Conference on Empirical Methods in Natural Language Processing and Computational Natural Language Learning (EMNLP-CoNLL), pages 334–342, 2007. Poster paper.

183 [K. Denecke. Using sentiwordnet for multilingual sentiment analysis. In Data Engineering Workshop,2008. ICDEW 2008, pages 507– 512, 2009.

184 [B. Pang and L. Lee. Thumbs up? Sentiment classification using machine learning techniques. In Conference on Empirical Methods in Natural LanguageProcessing (EMNLP), Philadelphia, PA, USA, 2002.

185 [M. Richardson, A. Prakash, and E. Brill. Beyond pagerank: machine learning for static ranking. In WWW '06: Proceedings of the 15th international conference on World Wide Web, pages 707–715, New York, NY, USA, 2006. ACM.

186 A. Rosenberg and E. Binkowski. Augmenting the kappa statistic to determine interannotator reliability for multiply labeled data points. In HLT-NAACL '04: Proceedings of HLT-NAACL 2004: Short Papers on XX, pages 77–80, Morristown, NJ, USA, 2004. Association for Computational Linguistics.

187 J. San Pedro and S. Siersdorfer. Ranking and classifying attractiveness of photos in folksonomies. In WWW '09: Proceedings of the 18th international conference on World wide web, pages 771–780, New York, NY, USA, 2009. ACM.

188 S. Siersdorfer, J. San Pedro, and M. Sanderson. Automatic video tagging using content redundancy. In SIGIR '09: Proceedings of the 32nd international ACM SIGIR conference on Research and development in information retrieval, pages 395–402, New York, NY, USA, 2009. ACM.

189 A. J. Smola and B. Sch¨olkopf. A tutorial on support vector regression. Statistics and Computing, 14(3):199–222, 2004.

190 A. Kaltenbrunner, V. G´omez, A. Moghnieh, R. Meza, J. Blat, and V. L´opez. Homogeneous temporal activity patterns in a large online communication space.

CoRR, 2007.

191 G. Mishne and M. de Rijke. Capturing global mood levels using blog posts. In AAAICAAW, pages 145–152, 2006.

192 G. Mishne and M. de Rijke. A study of blog search. In ECIR'06. Springer, April 2006.

193 G. Mishne and N. Glance. Leave a reply: An analysis of weblog comments. In Third annual workshop on the Weblogging ecosystem, 2006.

194 M. Tsagkias, W. Weerkamp, and M. de Rijke. Predicting the Volume of Comments onOnline News Stories. In CIKM'09, pages 1765–1768, 2009.

195 T. Joachims. Making large-scale support vector machine learning practical. Advances in kernelmethods: support vector learning, pages 169–184, 1999.

196 J. G. Lee and K. Salamatian. Understanding the characteristics of online commenting. In CONEXT'08, pages 1–2, 2008.

197 W. W. Gaver, "The SonicFinder: An Interface That Uses Auditory Icons," Human-Computer Interaction, vol. 4, pp. 67-94, 1989.

198 Redbridge Marketing (2008). Social Network Marketing: The Basics.Page:1-3.

199 Tanni Haas, Linda Steiner (2006). Public journalism A reply to critics. Sage Publications. Vol. 7(2): 238–254

Appendix A-1: Questionnaire items (Initial Survey of Experimental Phase I)

I. Personal Information:

This section has two questions (Q1 and Q2) which are general information about you.

1. Age: (please tick one)

( ) 18 to 24 ( ) 25 to 30 ( ) 31 to 40 ( ) more than 40 years

2. Gender: (please tick one)

( ) Female ( ) Male

3. Education: (please tick one)

( ) Postgraduate ( ) Undergraduate ( ) Diploma ( ) High School

Complete Section…

II. Reading E-newspaper:

Thank you for answering the section about yourself. Now we would like to ask you (Q4 and Q6) about your experience for reading e-newspaper.

4. How many hours do you usually read the e-newspaper per week? (please tick one)

( ) 0 to 3 hours ( ) 4 to 6 hours ( ) 7 to 8 hours ( ) more than 10 hours

5. How many articles do you usually read the e-newspaper per week? (please tick one)

( ) 0 to 5 articles ( ) 6 to 10 articles ( ) 11 to 20 articles ( ) more than 20 articles

6. Choose from the following, the categories you prefer to read from e-newspaper (please tick as many as applicable):

( ) Local News ( ) International News ( ) Opinion and Articles ( ) Sport

( ) Business ( ) Entertainment ( ) Other, please specify ………………………

Complete Section…

III. <u>Using comments in E-newspaper:</u>

Thank you for answering the section about Reading E-newspaper. Now we would like to ask you (Q7 and Q14) about your experience for using comments in e-newspaper.

7. In general, when you read articles in e-newspaper do you prefer to add comments? (please tick one)

( ) Always, around 75% ( ) Sometimes, around 30% ( ) Rarely

8. If it is possible, which is the best way to read the comments in e-newspaper from the following (please tick one)

( ) Visual (reading from Screen) ( ) Hearing (Hearing by headphone) ( ) Both

9. If it is possible, which is the best way to add comments in e-newspaper from the following (please tick one)

( ) Typing (by using the keyboard) ( ) Recording (by using microphone)

10. Put the order from 1 (most important) to 5 (less important) to know something about the ***<u>commenter</u>*** when you are reading the comments in e-newspaper

( ) The opinion of commenter (agrees or disagrees)

( ) The gender of commenter (Male or Female)

( ) The location of commenter (From which area has come)

( ) The position of commenter (Academic, Writer, Manager….)

( ) Other please specify …………………………..

Go to Q10 please…

11. Put the order from 1 (most important) to 4 (less important) to know something about the ***<u>comments</u>*** when you are reading the comments in e-newspaper

( ) The recommendation on comments.

( ) The time of comments (when it was, how many hours ago).

( ) Number of comments on the article.

( ) Other please specify …………………………..

12. How would you rate the satisfaction of using the comments on the articles in the e-newspaper? (please tick one)

( ) Very Unsatisfied ( ) Unsatisfied ( ) Undecided ( ) Satisfied ( ) Very Satisfied

13. How would you rate the effectiveness of adding comments on the articles in the e-newspaper? (please tick one)

( ) Very Ineffective ( ) Ineffective ( ) Undecided ( ) Effective ( ) Very Effective

14. Please provide us some suggestions or problems which you meet when adding comments in e-newspaper

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Complete Section…

This is the last question, thank you for your time and helping us for this initial survey.

Appendix B-1: Scenarios of the Four Common Tasks(Experimental 1)

Dear User:

I am pleased to introduce myself to you as one of PhD students in the University of Bradford , the UK. To answer these questions help me to collect some data regarding to improve the system of adding and getting information from e-newspaper.

This system is called MMAC, Multimodal Adding Comments, which used new classification to help user to get specific information quickly as well as to add comments to the e-article. So, we will ask you to use TAC, traditional Adding Comments, as control system to compare the result with new system.

To complete this Experiment successfully please follow these steps:

1. Step One: Answer the general questions about yourself.
2. Step Two: Listen and Read instructions of each task carefully.
3. Step There: Try to complete all tasks.
4. Step Four: Then answer the quotations of feedback and post-experiment questions

Step One: General Questions

15. Age: (please tick one)

( ) 18 to 24 ( ) 25 to 30 ( ) 31 to 40 ( ) more than 40 years

16. Gender: (please tick one)

( ) Female ( ) Male

17. Education: (please tick one)

( ) Postgraduate ( ) Undergraduate ( ) Diploma ( ) High School

18. How many hours do you usually read from e-newspaper per week? (please tick one)

( ) 0 to 3 hours ( ) 4 to 6 hours ( ) 7 to 9 hours ( ) more than 10 hours

19. How many articles do you usually read from e-newspaper per week? (please tick one)

( ) 0 to 5 articles ( ) 6 to 10 articles ( ) 11 to 20 articles ( ) more than 20 articles

20. In general, when you read articles or news in the internet do you prefer to add comments? (please tick one)

( ) 0% to 25% ( ) 25% to 50% ( ) 50% to 75% ( ) 75% to 100%

<u>Step Two and Three: Traditional Interface Tasks</u>

First of all, there is article called "E-Newspaper" in the front page of our Interface; you have to read the article once quickly. Then there are many comments from some readers which we need form you add and get information for it.

Task 1: *Registration and Adding Comments*

1- Move the mouse to E-Newspaper Icon on the left hand side and click it.
2- New page will open, then go in the end of article and see reader's comments.
3- In the area of "Write Comment" fills the normal registration by Adding
   Name: Dr Rigas **E-mail**: rigas@bradford.ac.uk **Title**: Comment 1.
4- When you finish please add the following text by typing in the textbox.
   I thought interest-based lending was considered as usury, prohibited under Sharia law. Without such financing, tho', Western-type commercial development would be impossible. I thought this was why so many ME countries did business thru' the "backdoor" with Western banks. But the Saudi laws described here are clearly centered on interest-based lending and financing. Can anyone explain?
5- After that click "Send" button to add your comment to the article.

Task 3: *Registration and Adding Comments*

1- Move the mouse to E-Newspaper Icon on the left hand side and click it.
2- New page will open, then go in the end of article and see reader's comments.
6- In the area of "Write Comment" fills the normal registration by Adding
   Name: Kholoud **E-mail:**kholoud@bradford.ac.uk**Title**: Comment 3.

3- When you finish please add the following text by typing in the textbox.

Shakespeare's saying is still valid for Syria today. Give Assad time and transformation may occur gradually and peacefully. The handful of protesters very much like those in Libya are being pushed on the wrong track which suits Zionists interests and this is not in their interest. Assad must prevent Syria from becoming another Iraq or Libya!

4- After that click “Send” button to add your comment to the article.

Task 4: *Check the inserted for Adding Comments*

1- Check the textual comment for the ***Dr Rigas*** by going up on the comments area for the E-Newspaper Article.
2- Check the textual comment for the ***Mahmood*** by going up on the comments area for the E-Newspaper Article.
3- Check the textual comment for the ***Kholoud*** by going up on the comments area for the E-Newspaper Article.

Task 4:*Check the Opinion Time from Getting Comments*

See the area of the Comments on the E-Newspaper’s Article then try to find out what is opinion (agree, disagree or none) by time for:

Time	**Theo pinion of first Commenter**	**Theo pinion of last Commenter**
Opinion		

Check the Opinion from Getting Comments

See the area of the Comments on the E-Newspaper Article then try to find out how many commenter their opinion are Agree , Disagree and None about writer:

Opinion	**Agree**	**Disagree**	**None**
Number			

Step Four: Feedback and Post-Experiment questions

After you have finished using this system, please express your opinion by circle the best choose in the appropriate column.

	Statement	Strong Disagree ⟷ Strongly Agree				
1	I think that I would like to use this system frequently	5	4	3	2	1
2	I found the system unnecessarily complex	5	4	3	2	1
3	I thought the system was easy to use	5	4	3	2	1
4	I think that I would need the support of a technical person to be able to use this system	5	4	3	2	1
5	I found the various functions in this system were well integrated	5	4	3	2	1
6	I thought there was too much inconsistency in this system	5	4	3	2	1
7	I would imagine that most people would learn to use this system very quickly	5	4	3	2	1
8	I found the system very cumbersome to use	5	4	3	2	1
9	I felt very confident using the system	5	4	3	2	1
10	I needed to learn a lot of things before I could get going with this system	5	4	3	2	1
11	Overall, I am satisfied with this system	5	4	3	2	1

To get information from the comments, it would be helpful if the comments were reclassified and re-visualisation in e-newspaper:

( ) Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree

To add comments on the article, it would be helpful if the multimodal tools were used in e-newspaper:

( ) Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree

Using Typing only:

( ) Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree

Using Record:

( ) Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree

Using both Typing and Record:

( ) Strongly Disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly Agree

Please provide us some suggestions or problems which you meet when adding or getting comments in e-newspaper

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This is the last question, thank you for your time and helping us for this experiment

Appendix B-2: Scenarios of the Six Common Tasks(Experimental Phase 2 and 3)

Dear User:

I am pleased to introduce myself to you as one of PhD students in the University of De Montfort , the UK. To answer these questions help me to collect some data regarding to improve the system of adding and retrieving information from e-newspaper.

This system is called ARCS, Adding and Retrieving Comments System, which used new classification to help user to get specific information quickly as well as to add comments.

To complete this Experiment successfully please follow these steps:

5. Step One: Answer the general questions about yourself.
6. Step Two: Listen and Read instructions of each task carefully.
7. Step There: Try to complete all tasks.
8. Step Four: Then answer the questions of feedback and post-experiment questions

<u>Step One: General Questions</u>

1. Age: (please tick one)

( ) 18 to 24 ( ) 25 to 30 ( ) 31 to 40 ( ) more than 40 years

2. Gender: (please tick one)

( ) Female ( ) Male

3. Education: (please tick one)

( ) Postgraduate ( ) Undergraduate ( ) Diploma ( ) High School

4. How many hours do you usually use e-newspaper per week? (please tick one)

( ) 0 to 3 hours ( ) 4 to 6 hours ( ) 7 to 9 hours ( ) more than 10 hours

5. **How many articles do you usually read from e-newspaper per week? (please tick one)**

( ) 0 to 5 articles ( ) 6 to 10 articles ( ) 11 to 20 articles ( ) more than 20 articles

6. **In general, when you read articles or news in the internet do you prefer to add comments? (please tick one)**

( ) 0% to 25% ( ) 25% to 50% ( ) 50% to 75% ( ) 75% to 100%

<u>Step Two and Three: Visual Interface Tasks</u>

First of all, there is article from Alarbiay.net called “Reward from Saudi Arabia” in the right hand of our Interface; you have to read the article once quickly. Then there are many comments on that article which we need to deal with them.

Task 1: Retrieve Easy Comments

1- Have a look to the two sides in the page (The article and Article Comment).
2- Move the mouse to View Comment Icon on the left hand side and click it.
3- New page will open; try to find the **Last Comment in Neutral** box then Retrieve the comment.

Task 2: Retrieve Moderate Comments

1- Have a look to the two sides in the page (The article and Article Comment).
2- Move the mouse to View Comment Icon on the left hand side and click it.
3- New page will open; try to find the **Women** by the Comment **“Oh people listen to me please “then** retrieve the comment.

Task 3: Retrieve Complex Comments

1- Have a look to the two sides in the page (The article and Article Comment).
2- Move the mouse to View Comment Icon on the left hand side and click it.
3- New page will open; try to find the **Last Agree Man and Woman who her Name " Moajabah"** then Retrieve the comments.

Task 4: ***Registration and Adding Short Comments***

7- Have a look to the two sides in the page (The article and Article Comment).
8- Move the mouse to Add Comment Icon on the left hand side and click it.
9- New page will open, try to fill the AVATAR registration by :

Gender	**Male - Agree**
Name	**Waheeb Alharbe**
Country	**Saudi Arabia**
E-mail	**Wam@yahoo.com**
Comment Title	**Best Person**
Comment Record	I cannot believe anyone would say Egypt was just the next domino as if the people who put their lives on the line and rose up against a brutal regime were nothing.

10- After that click “Ok” button to add the comment to the article.

Task 5: ***Registration and Adding Mid Comments***

1- Have a look to the two sides in the page (The article and Article Comment).
2- Move the mouse to Add Comment Icon on the left hand side and click it.
3- New page will open, try to fill the AVATAR registration by :

Gender	**Woman - Neutral**
Name	**Sounds Abdulghani**
Country	**Bahreen**
E-mail	**malikah@hotmail.com**
Comment Title	**Reward forever**
Comment Record	Nothing noticable will be realized among the lower ranks of society as long as the cops are allowed to function without accountability. The US has elections all the time and yet very little actually changes within it's cities police departments. Abuse periodically comes to light through the media yet it persists due to a systemic culture of corruption and coverup.The two cops, Mahmoud Salah and Awad Ismail Suleiman still await trial for the murder for Khaled Said.

4- After that click “Ok” button to add the comment to the article.

Task 6: ***Registration and Adding Long Comments***

1- Have a look to the two sides in the page (The article and Article Comment).
2- Move the mouse to Add Comment Icon on the left hand side and click it.
3- New page will open, try to fill the AVATAR registration by :

Gender	**Man - Disagree**
Name	**Turki Bin Mahmood**
Country	**The UK**
E-mail	turki@dmu.ac.uk
Comment Title	**Tried the Best**
Comment Record	Don't be surprised if the cops are acquitted. What do you expect - that a countries politicians, bureaucrats and institutions not to cede authority to itself? There's not one government or court in the world that won't back it's police or military against another country or it's own population. That's what gives it legitimacy. The cops lie and the judges rule in their favor. In this case the victim has postumous advocacy so the cops may get what's coming to them. Had the protests not taken place and Mubarak still been in place they'rd be no trial and those murderers would still be on the street. Don't think for an instant that the judges are seeking to render justice. They knew what they were going to do before the case started. It's kabuke and it's the same all over the world. Khaled Said was murdered on June 6, 2010 by two corrupt cops almost a year ago. How long do you think it would have taken to convict Khaled Said had he murdered a cop? It's pretty rare for a cop to loose a case much less be convicted of anything. Louis Eppolito and Stephen Caracappa - Mob Cops.

4- After that click “Ok” button to add the comment to the article.

Effect on the Public Opinion:

	Statement	Strong Disagree ⟷ Strong Agree				
1	I think everyone should resign by his opinion and No one effect on it	5	4	3	2	1
2	In general no one effect on my opinion unless they give me reason	5	4	3	2	1
3	I will not use this system also i will resign my opinion by my self	5	4	3	2	1
4	I feel that, this system will direct my general opinion	5	4	3	2	1
5	I feel that, this system helps to understand the general opinion of the people	5	4	3	2	1

Step Four: Feedback and Post-Experiment questions

After you have finished using this system, please express your opinion by circle the best choose in the appropriate column.

	Statement	Strongly Disagree ⟷ Strongly Agree				
1	Using Adding functions in the system was easy EOA	5	4	3	2	1
2	Using Adding functions in the system was confusing COA	5	4	3	2	1
3	Navigating in Adding in the system was easy NOA	5	4	3	2	1
4	Using Adding functions in the system was frustrating FOA	5	4	3	2	1
5	Using Retrieving functions in the system was easy EOR	5	4	3	2	1
6	Using Retrieving functions in the system was confusing COR	5	4	3	2	1
7	Navigating in Retrieving in the system was easy NOR	5	4	3	2	1
8	Using Retrieving functions in the system was frustrating FOR	5	4	3	2	1
9	In general , I felt comfortable COAll	5	4	3	2	1

Memorise Test

Try to choose the best answer for all of these equations:

Q1: What was the Gender of the first person who added comment?

◯ Male ◯ Female ◯ I don't know

Q2: What was the opinion of the second person who added comment?

◯ Agree ◯ Disagree ◯ None ◯ I don't know

Q3: What was the opinion of the second person for the last comment?

◯ Agree ◯ Disagree ◯ None ◯ I don't know

Q4: What was the name of the last person who added comment?

Please provide us some suggestions or problems which you meet when adding or getting comments in e-newspaper

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This is the last question, thank you for your time and helping us for this experiment

Appendix C-1:

Raw Data of Achievement Task Successfully Rate for (Experimental Phase 1)

UserID	TARCS							CMARCS						
	Add Comments			Retrieve Comments			Total	Add Comments			Retrieve Comments			Total
	Task 1	Task 2	Total	Task 3	Task 4	Total		Task 1	Task 2	Total	Task 3	Task 4	Total	
P1-01	1.00	0.00	1.00	0.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-02	1.00	1.00	2.00	1.00	0.00	1.00	3.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-03	0.00	1.00	1.00	1.00	1.00	2.00	3.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-04	1.00	0.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-05	1.00	1.00	2.00	1.00	1.00	2.00	4.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-06	0.00	0.00	0.00	1.00	1.00	2.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-07	1.00	1.00	2.00	0.00	1.00	1.00	3.00	1.00	1.00	2.00	1.00	0.00	1.00	3.00
P1-08	0.00	1.00	1.00	1.00	1.00	2.00	3.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-09	1.00	0.00	1.00	1.00	0.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-10	1.00	1.00	2.00	1.00	1.00	2.00	4.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-11	0.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-12	1.00	1.00	2.00	1.00	1.00	2.00	4.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-13	1.00	1.00	2.00	1.00	1.00	2.00	4.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-14	1.00	1.00	2.00	1.00	1.00	2.00	4.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-15	0.00	1.00	1.00	1.00	0.00	1.00	2.00	1.00	1.00	2.00	0.00	1.00	1.00	3.00
P1-16	1.00	0.00	1.00	1.00	1.00	2.00	3.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-17	1.00	1.00	2.00	0.00	1.00	1.00	3.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-18	1.00	1.00	2.00	1.00	1.00	2.00	4.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-19	1.00	0.00	1.00	1.00	0.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-20	1.00	1.00	2.00	0.00	1.00	1.00	3.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-21	0.00	1.00	1.00	1.00	1.00	2.00	3.00	1.00	1.00	2.00	0.00	1.00	1.00	3.00
P1-22	1.00	1.00	2.00	1.00	0.00	1.00	3.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-23	1.00	1.00	2.00	0.00	1.00	1.00	3.00	1.00	0.00	1.00	1.00	1.00	2.00	3.00
P1-24	1.00	1.00	2.00	1.00	1.00	2.00	4.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00
P1-25	0.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	2.00	4.00

Paired Samples Test Effectiveness

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	BothOfT - BothOfCM	-1.00000	1.04083	.20817	-1.42963	-.57037	-4.804	24	.000
Pair 2	Ad1T - Add1CM	-.28000	.45826	.09165	-.46916	-.09084	-3.055	24	.005
Pair 3	Ad2T - Add2CM	-.24000	.52281	.10456	-.45581	-.02419	-2.295	24	.031
Pair 4	Ret1T - Ret1CM	-.20000	.57735	.11547	-.43832	.03832	-1.732	24	.096
Pair 5	Ret2T - Ret2CM	-.28000	.54160	.10832	-.50356	-.05644	-2.585	24	.016
Pair 6	AllAddT - AllAddCM	-.52000	.71414	.14283	-.81478	-.22522	-3.641	24	.001
Pair 7	AllRetT - AllRetCM	-.48000	.71414	.14283	-.77478	-.18522	-3.361	24	.003

Appendix C-2: Raw Data of Task Completion Time Rate for (Experimental Phase 1)

UserID	TARCS							CMARCS						
	Add Comments			Retrieve Comments			Total	Add Comments			Retrieve Comments			Total
	Task 1	Task 2	Total	Task 3	Task 4	Total		Task 1	Task 2	Total	Task 3	Task 4	Total	
P1-01	8:01	6:07	14:08	1:51	3:41	5:32	19:40	1:48	2:45	4:33	1:29	0:17	1:46	6:19
P1-02	6:22	6:31	12:53	1:38	3:31	5:09	18:02	2:58	3:02	6:00	1:21	0:09	1:30	7:30
P1-03	2:42	6:01	8:43	2:02	3:49	5:51	14:34	1:59	1:02	3:01	0:59	0:08	1:07	4:08
P1-04	3:59	6:31	10:30	2:50	4:21	7:11	17:41	2:49	1:33	4:22	1:23	0:29	1:52	6:14
P1-05	3:04	7:48	10:52	1:51	4:01	5:52	16:44	2:45	2:15	5:00	1:35	0:11	1:46	6:46
P1-06	6:26	6:21	12:47	1:48	3:35	5:23	18:10	2:01	2:20	4:21	1:13	0:13	1:26	5:47
P1-07	2:21	7:51	10:12	2:09	3:41	5:50	16:02	3:09	3:14	6:23	1:29	0:17	1:46	8:09
P1-08	2:49	6:01	8:50	2:03	3:53	5:56	14:46	2:06	0:58	3:04	1:24	0:27	1:51	4:55
P1-09	4:21	6:49	11:10	1:59	3:39	5:38	16:48	1:43	1:45	3:28	0:51	0:09	1:00	4:28
P1-10	3:51	8:05	11:56	1:41	3:57	5:38	17:34	1:51	1:36	3:27	1:16	0:11	1:27	4:54
P1-11	8:42	6:21	15:03	2:21	4:25	6:46	21:49	1:20	2:02	3:22	2:11	0:07	2:18	5:40
P1-12	6:48	5:35	12:23	1:51	3:39	5:30	17:53	2:39	2:30	5:09	1:43	0:09	1:52	7:01
P1-13	5:36	5:59	11:35	1:59	3:41	5:40	17:15	1:50	1:58	3:48	1:32	0:11	1:43	5:31
P1-14	3:33	6:48	10:21	2:01	4:01	6:02	16:23	1:44	1:40	3:24	1:21	0:12	1:33	4:57
P1-15	5:23	6:51	12:14	1:48	3:42	5:30	17:44	1:22	1:44	3:06	0:58	0:08	1:06	4:12
P1-16	4:23	5:01	9:24	1:39	3:31	5:10	14:34	1:31	1:45	3:16	1:36	0:12	1:48	5:04
P1-17	5:57	7:36	13:33	1:51	3:59	5:50	19:23	1:02	1:22	2:24	2:01	0:08	2:09	4:33
P1-18	4:19	6:51	11:10	2:02	4:03	6:05	17:15	3:02	1:17	4:19	1:39	0:16	1:55	6:14
P1-19	3:11	8:02	11:13	1:49	4:31	6:20	17:33	1:32	1:55	3:27	1:26	0:09	1:35	5:02
P1-20	3:54	8:09	12:03	1:58	4:01	5:59	18:02	2:49	2:23	5:12	1:37	0:08	1:45	6:57
P1-21	6:02	5:07	11:09	1:38	3:41	5:19	16:28	1:30	1:21	2:51	0:59	0:11	1:10	4:01
P1-22	5:51	5:21	11:12	1:36	3:33	5:09	16:21	2:45	1:04	3:49	1:21	0:13	1:34	5:23
P1-23	7:01	3:34	10:35	0:53	3:21	4:14	14:49	4:01	1:12	5:13	1:31	0:08	1:39	6:52
P1-24	5:18	4:56	10:14	1:24	4:31	5:55	16:09	3:29	2:13	5:42	1:18	0:13	1:31	7:13
P1-25	6:11	6:32	12:43	2:09	4:09	6:18	19:01	4:06	1:26	5:32	0:48	0:24	1:12	6:44

Paired Samples Test Time

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	BothOfT - BothOfCM	11:26:38.400	1:56:17.884	0:23:15.577	10:38:38.071	12:14:38.729	29.521	24	.000
Pair 2	Ad1T - Add1CM	2:43:45.600	1:54:29.679	0:22:53.936	1:56:29.936	3:31:01.264	7.151	24	.000
Pair 3	Ad2T - Add2CM	4:34:38.400	1:07:14.298	0:13:26.860	4:06:53.123	5:02:23.677	20.423	24	.000
Pair 4	Ret1T - Ret1CM	0:28:24.000	0:27:40.693	0:05:32.139	0:16:58.500	0:39:49.500	5.130	24	.000
Pair 5	Ret2T - Ret2CM	3:39:50.400	0:19:04.947	0:03:48.989	3:31:57.789	3:47:43.011	57.603	24	.000
Pair 6	AllAddT - AllAddCM	7:18:23.999	1:50:07.314	0:22:01.463	6:32:56.635	8:03:51.365	19.905	24	.000
Pair 7	AllRetT - AllRetCM	4:08:14.400	0:34:25.813	0:06:53.163	3:54:01.674	4:22:27.126	36.050	24	.000

Appendix C-3: Raw Data of Task Mouse Click Rate for (Experimental Phase 1)

UserID	TARCS							CMARCS						
	Add Comments			Retrieve Comments			Total	Add Comments			Retrieve Comments			Total
	Task 1	Task 2	Total	Task 3	Task 4	Total		Task 1	Task 2	Total	Task 3	Task 4	Total	
P1-01	14.00	18.00	32.00	8.00	7.00	15.00	47.00	5.00	4.00	9.00	3.00	2.00	5.00	14.00
P1-02	21.00	12.00	33.00	5.00	6.00	11.00	44.00	4.00	3.00	7.00	2.00	1.00	3.00	10.00
P1-03	19.00	18.00	37.00	6.00	8.00	14.00	51.00	9.00	5.00	14.00	4.00	3.00	7.00	21.00
P1-04	11.00	19.00	30.00	4.00	5.00	9.00	39.00	4.00	5.00	9.00	2.00	3.00	5.00	14.00
P1-05	14.00	21.00	35.00	8.00	7.00	15.00	50.00	3.00	6.00	9.00	1.00	2.00	3.00	12.00
P1-06	17.00	28.00	45.00	11.00	9.00	20.00	65.00	7.00	5.00	12.00	3.00	2.00	5.00	17.00
P1-07	19.00	21.00	40.00	9.00	11.00	20.00	60.00	5.00	4.00	9.00	2.00	2.00	4.00	13.00
P1-08	25.00	14.00	39.00	4.00	6.00	10.00	49.00	6.00	6.00	12.00	3.00	3.00	6.00	18.00
P1-09	14.00	19.00	33.00	10.00	7.00	17.00	50.00	4.00	5.00	9.00	4.00	3.00	7.00	16.00
P1-10	19.00	21.00	40.00	7.00	9.00	16.00	56.00	3.00	4.00	7.00	2.00	3.00	5.00	12.00
P1-11	23.00	18.00	41.00	6.00	6.00	12.00	53.00	4.00	4.00	8.00	2.00	1.00	3.00	11.00
P1-12	11.00	14.00	25.00	8.00	9.00	17.00	42.00	5.00	3.00	8.00	3.00	1.00	4.00	12.00
P1-13	18.00	21.00	39.00	5.00	6.00	11.00	50.00	5.00	6.00	11.00	2.00	1.00	3.00	14.00
P1-14	9.00	22.00	31.00	6.00	4.00	10.00	41.00	6.00	5.00	11.00	4.00	2.00	6.00	17.00
P1-15	18.00	26.00	44.00	12.00	8.00	20.00	64.00	4.00	6.00	10.00	2.00	2.00	4.00	14.00
P1-16	26.00	18.00	44.00	7.00	9.00	16.00	60.00	8.00	7.00	15.00	1.00	1.00	2.00	17.00
P1-17	22.00	16.00	38.00	11.00	5.00	16.00	54.00	5.00	4.00	9.00	1.00	1.00	2.00	11.00
P1-18	14.00	23.00	37.00	9.00	7.00	16.00	53.00	6.00	7.00	13.00	3.00	1.00	4.00	17.00
P1-19	16.00	15.00	31.00	6.00	9.00	15.00	46.00	6.00	5.00	11.00	2.00	3.00	5.00	16.00
P1-20	21.00	21.00	42.00	8.00	8.00	16.00	58.00	3.00	4.00	7.00	2.00	1.00	3.00	10.00
P1-21	24.00	19.00	43.00	7.00	5.00	12.00	55.00	5.00	4.00	9.00	1.00	2.00	3.00	12.00
P1-22	18.00	16.00	34.00	10.00	7.00	17.00	51.00	4.00	5.00	9.00	3.00	2.00	5.00	14.00
P1-23	14.00	18.00	32.00	9.00	7.00	16.00	48.00	6.00	5.00	11.00	2.00	4.00	6.00	17.00
P1-24	22.00	24.00	46.00	6.00	9.00	15.00	61.00	7.00	5.00	12.00	2.00	1.00	3.00	15.00
P1-25	23.00	17.00	40.00	11.00	6.00	17.00	57.00	4.00	6.00	10.00	3.00	3.00	6.00	16.00

Paired Samples Test Mouse Click

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	BothOfT - BothOfCM	37.76000	7.48487	1.49697	34.67040	40.84960	25.224	24	.000
Pair 2	Ad1T - Add1CM	12.96000	4.71240	.94248	11.01482	14.90518	13.751	24	.000
Pair 3	Ad2T - Add2CM	14.24000	3.55059	.71012	12.77439	15.70561	20.053	24	.000
Pair 4	Ret1T - Ret1CM	5.36000	2.41316	.48263	4.36390	6.35610	11.106	24	.000
Pair 5	Ret2T - Ret2CM	5.20000	1.93649	.38730	4.40066	5.99934	13.426	24	.000
Pair 6	AllAddT - AllAddCM	27.20000	5.31507	1.06301	25.00605	29.39395	25.588	24	.000
Pair 7	AllRetT - AllRetCM	10.56000	3.44093	.68819	9.13965	11.98035	15.345	24	.000

Appendix C-4: Raw Data of Task Errors Rate for (Experimental Phase 1)

UserID	TARCS							CMARCS						
	Add Comments			Retrieve Comments			Total	Add Comments			Retrieve Comments			Total
	Task 1	Task 2	Total	Task 3	Task 4	Total		Task 1	Task 2	Total	Task 3	Task 4	Total	
P1-01	4.00	3.00	7.00	4.00	3.00	7.00	14.00	2.00	3.00	5.00	2.00	1.00	3.00	8.00
P1-02	5.00	2.00	7.00	2.00	2.00	4.00	11.00	2.00	2.00	4.00	1.00	1.00	2.00	6.00
P1-03	6.00	4.00	10.00	0.00	1.00	1.00	11.00	3.00	1.00	4.00	1.00	1.00	2.00	6.00
P1-04	5.00	5.00	10.00	2.00	3.00	5.00	15.00	1.00	0.00	1.00	0.00	0.00	0.00	1.00
P1-05	5.00	6.00	11.00	3.00	2.00	5.00	16.00	2.00	1.00	3.00	1.00	0.00	1.00	4.00
P1-06	4.00	3.00	7.00	2.00	2.00	4.00	11.00	3.00	2.00	5.00	1.00	0.00	1.00	6.00
P1-07	7.00	6.00	13.00	1.00	1.00	2.00	15.00	1.00	2.00	3.00	0.00	2.00	2.00	5.00
P1-08	4.00	3.00	7.00	4.00	1.00	5.00	12.00	1.00	2.00	3.00	0.00	0.00	0.00	3.00
P1-09	3.00	4.00	7.00	3.00	2.00	5.00	12.00	0.00	1.00	1.00	0.00	1.00	1.00	2.00
P1-10	5.00	4.00	9.00	2.00	0.00	2.00	11.00	1.00	0.00	1.00	2.00	1.00	3.00	4.00
P1-11	2.00	3.00	5.00	2.00	1.00	3.00	8.00	1.00	1.00	2.00	1.00	2.00	3.00	5.00
P1-12	4.00	2.00	6.00	4.00	2.00	6.00	12.00	2.00	2.00	4.00	1.00	0.00	1.00	5.00
P1-13	5.00	3.00	8.00	3.00	1.00	4.00	12.00	1.00	2.00	3.00	2.00	1.00	3.00	6.00
P1-14	4.00	5.00	9.00	4.00	3.00	7.00	16.00	3.00	1.00	4.00	3.00	2.00	5.00	9.00
P1-15	3.00	5.00	8.00	3.00	3.00	6.00	14.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00
P1-16	5.00	3.00	8.00	3.00	4.00	7.00	15.00	2.00	1.00	3.00	0.00	0.00	0.00	3.00
P1-17	4.00	3.00	7.00	2.00	1.00	3.00	10.00	1.00	1.00	2.00	0.00	1.00	1.00	3.00
P1-18	4.00	4.00	8.00	2.00	2.00	4.00	12.00	2.00	1.00	3.00	1.00	1.00	2.00	5.00
P1-19	2.00	3.00	5.00	2.00	1.00	3.00	8.00	1.00	2.00	3.00	1.00	2.00	3.00	6.00
P1-20	2.00	2.00	4.00	1.00	2.00	3.00	7.00	1.00	1.00	2.00	2.00	1.00	3.00	5.00
P1-21	6.00	4.00	10.00	1.00	1.00	2.00	12.00	3.00	3.00	6.00	1.00	1.00	2.00	8.00
P1-22	3.00	5.00	8.00	0.00	2.00	2.00	10.00	1.00	1.00	2.00	1.00	2.00	3.00	5.00
P1-23	5.00	4.00	9.00	1.00	2.00	3.00	12.00	2.00	1.00	3.00	2.00	0.00	2.00	5.00
P1-24	4.00	3.00	7.00	2.00	3.00	5.00	12.00	2.00	2.00	4.00	3.00	0.00	3.00	7.00
P1-25	1.00	2.00	3.00	3.00	1.00	4.00	7.00	3.00	2.00	5.00	2.00	1.00	3.00	8.00

Paired Samples Test Errors

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	BothOfT - BothOfCM	6.76000	3.63180	.72636	5.26087	8.25913	9.307	24	.000
Pair 2	Ad1T - Add1CM	2.44000	1.50222	.30044	1.81991	3.06009	8.121	24	.000
Pair 3	Ad2T - Add2CM	2.24000	1.69017	.33803	1.54233	2.93767	6.627	24	.000
Pair 4	Ret1T - Ret1CM	1.12000	1.45258	.29052	.52040	1.71960	3.855	24	.001
Pair 5	Ret2T - Ret2CM	.96000	1.36870	.27374	.39503	1.52497	3.507	24	.002
Pair 6	AllAddT - AllAddCM	4.68000	2.71907	.54381	3.55762	5.80238	8.606	24	.000
Pair 7	AllRetT - AllRetCM	2.08000	2.27156	.45431	1.14234	3.01766	4.578	24	.000

Appendix C-5: Raw Data of Task Satisfaction Rate for (Experimental Phase 1)

UserID	TARCS					CMARCS				
	IOI	ROI	POU	UOI	IOS	IOI	ROI	POU	UOI	IOS
P1-01	4.00	2.00	2.00	3.00	4.00	1.00	5.00	5.00	1.00	1.00
P1-02	3.00	2.00	1.00	3.00	4.00	2.00	4.00	5.00	1.00	1.00
P1-03	4.00	1.00	1.00	3.00	3.00	2.00	5.00	5.00	2.00	1.00
P1-04	3.00	3.00	1.00	3.00	4.00	1.00	5.00	5.00	1.00	1.00
P1-05	2.00	1.00	2.00	4.00	4.00	1.00	4.00	5.00	1.00	1.00
P1-06	4.00	2.00	1.00	4.00	4.00	1.00	5.00	4.00	1.00	2.00
P1-07	3.00	2.00	1.00	3.00	4.00	1.00	4.00	5.00	2.00	1.00
P1-08	4.00	2.00	2.00	4.00	3.00	1.00	5.00	5.00	1.00	1.00
P1-09	3.00	1.00	2.00	4.00	5.00	1.00	3.00	5.00	1.00	1.00
P1-10	4.00	2.00	1.00	4.00	4.00	2.00	2.00	5.00	2.00	1.00
P1-11	2.00	1.00	1.00	3.00	5.00	1.00	4.00	5.00	2.00	2.00
P1-12	3.00	1.00	1.00	4.00	4.00	2.00	4.00	5.00	1.00	1.00
P1-13	4.00	2.00	2.00	3.00	5.00	1.00	5.00	5.00	1.00	1.00
P1-14	3.00	2.00	1.00	3.00	4.00	1.00	5.00	5.00	1.00	1.00
P1-15	4.00	1.00	2.00	3.00	5.00	1.00	3.00	4.00	2.00	1.00
P1-16	2.00	2.00	3.00	3.00	4.00	2.00	4.00	5.00	1.00	2.00
P1-17	3.00	1.00	2.00	4.00	4.00	1.00	5.00	5.00	1.00	1.00
P1-18	4.00	2.00	2.00	2.00	4.00	1.00	5.00	4.00	1.00	2.00
P1-19	4.00	2.00	1.00	4.00	5.00	1.00	5.00	4.00	1.00	1.00
P1-20	3.00	1.00	1.00	3.00	5.00	1.00	4.00	5.00	1.00	1.00
P1-21	4.00	1.00	1.00	4.00	5.00	1.00	5.00	4.00	2.00	2.00
P1-22	2.00	1.00	2.00	3.00	4.00	1.00	4.00	5.00	1.00	2.00
P1-23	3.00	2.00	2.00	3.00	4.00	2.00	5.00	5.00	1.00	1.00
P1-24	4.00	1.00	1.00	4.00	5.00	1.00	5.00	5.00	1.00	1.00
P1-25	4.00	3.00	2.00	4.00	4.00	1.00	4.00	5.00	1.00	1.00

Paired Samples Test Satisfaction

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	ACEt - ACEcm	2.08000	.90921	.18184	1.70470	2.45530	11.438	24	.000
Pair 2	RICt - RICcm	-2.72000-	.93630	.18726	-3.10649-	-2.33351-	-14.525-	24	.000
Pair 3	SBt - SBcm	-3.28000-	.67823	.13565	-3.55996-	-3.00004-	-24.180-	24	.000
Pair 4	EDMt - EDMcm	2.16000	.74610	.14922	1.85202	2.46798	14.475	24	.000
Pair 5	OALLSt - OALLScm	3.00000	.70711	.14142	2.70812	3.29188	21.213	24	.000

Appendix D-1: Raw Data of Impactability of Public Opinion Rate for (Experimental Phase 2 and 3)

UserID	VARCS					MMARCS					AVARCS				
	IOI	ROI	POU	UOI	IOS	IOI	ROI	POU	UOI	IOS	IOI	ROI	POU	UOI	IOS
P2-01	5.00	4.00	1.00	1.00	4.00	1.00	3.00	1.00	5.00	1.00	4.00	4.00	1.00	1.00	5.00
P2-02	4.00	4.00	1.00	1.00	5.00	1.00	4.00	1.00	2.00	5.00	4.00	5.00	1.00	2.00	4.00
P2-03	2.00	1.00	1.00	2.00	4.00	2.00	5.00	2.00	2.00	4.00	5.00	5.00	1.00	1.00	5.00
P2-04	1.00	4.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	1.00	5.00	3.00	1.00	1.00	4.00
P2-05	4.00	5.00	1.00	1.00	4.00	3.00	4.00	2.00	1.00	4.00	2.00	5.00	1.00	2.00	5.00
P2-06	4.00	4.00	1.00	3.00	4.00	4.00	4.00	1.00	1.00	4.00	5.00	5.00	1.00	1.00	5.00
P2-07	4.00	4.00	1.00	1.00	1.00	5.00	5.00	1.00	1.00	3.00	4.00	4.00	1.00	1.00	4.00
P2-08	1.00	1.00	2.00	2.00	4.00	5.00	5.00	1.00	1.00	3.00	4.00	5.00	1.00	1.00	3.00
P2-09	1.00	4.00	2.00	1.00	5.00	1.00	4.00	1.00	2.00	4.00	5.00	5.00	1.00	1.00	4.00
P2-10	4.00	4.00	1.00	1.00	4.00	4.00	4.00	2.00	1.00	5.00	1.00	4.00	1.00	1.00	1.00
P2-11	3.00	2.00	1.00	2.00	2.00	3.00	2.00	1.00	1.00	5.00	4.00	5.00	1.00	1.00	5.00
P2-12	4.00	4.00	1.00	1.00	5.00	5.00	4.00	1.00	2.00	4.00	5.00	5.00	1.00	1.00	4.00
P2-13	1.00	4.00	1.00	1.00	4.00	1.00	5.00	2.00	1.00	4.00	5.00	4.00	1.00	1.00	4.00
P2-14	4.00	5.00	1.00	1.00	5.00	4.00	5.00	1.00	1.00	5.00	5.00	4.00	1.00	1.00	5.00
P2-15	4.00	4.00	1.00	1.00	4.00	4.00	4.00	1.00	2.00	3.00	4.00	5.00	1.00	2.00	4.00
P2-16	4.00	4.00	2.00	1.00	5.00	3.00	4.00	1.00	2.00	4.00	3.00	5.00	1.00	1.00	5.00
P2-17	5.00	4.00	1.00	2.00	4.00	4.00	4.00	2.00	2.00	5.00	5.00	4.00	1.00	1.00	4.00
P2-18	2.00	1.00	1.00	1.00	4.00	4.00	2.00	2.00	1.00	4.00	4.00	4.00	2.00	1.00	5.00
P2-19	4.00	4.00	1.00	1.00	4.00	5.00	4.00	1.00	1.00	4.00	3.00	3.00	1.00	2.00	5.00
P2-20	4.00	5.00	2.00	4.00	1.00	5.00	5.00	2.00	3.00	2.00	5.00	4.00	1.00	1.00	5.00
P2-21	5.00	4.00	1.00	1.00	5.00	4.00	3.00	1.00	1.00	4.00	4.00	5.00	1.00	1.00	5.00
P2-22	4.00	1.00	1.00	1.00	4.00	3.00	5.00	1.00	2.00	5.00	5.00	4.00	1.00	1.00	4.00

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	IOIv	22	3.3636	1.36436	.29088
	IOImm	22	3.3182	1.42716	.30427

Group Statistics

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	.071	.791	.108	42	.915	.0455	.42094	-.80405	.89495
	Equal variances not assumed			.108	41.915	.915	.0455	.42094	-.80410	.89501

Group Statistics

	GROUPB	N	Mean	Std. Deviation	Std. Error Mean
B	ROIv	22	3.3636	1.36436	.29088
	ROImm	22	3.9091	1.10880	.23640

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
B	Equal variances assumed	2.654	.111	-1.455	42	.153	-.5455	.37483	-1.30189	.21098
	Equal variances not assumed			-1.455	40.314	.153	-.5455	.37483	-1.30283	.21192

Group Statistics					
	GROUPC	N	Mean	Std. Deviation	Std. Error Mean
C	POUv	22	3.5000	1.33631	.28490
	POUmm	22	1.3636	.49237	.10497

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
C	Equal variances assumed	11.338	.002	7.036	42	.000	2.1364	.30362	1.52362	2.74910
	Equal variances not assumed			7.036	26.599	.000	2.1364	.30362	1.51294	2.75979

Group Statistics					
	GROUPD	N	Mean	Std. Deviation	Std. Error Mean
D	UOIv	22	1.1818	.39477	.08417
	UOImm	22	1.6818	.94548	.20158

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
D	Equal variances assumed	6.912	.012	-2.289	42	.027	-.5000	.21844	-.94084	-.05916
	Equal variances not assumed			-2.289	28.106	.030	-.5000	.21844	-.94738	-.05262

Group Statistics					
	GROUPE	N	Mean	Std. Deviation	Std. Error Mean
E	IOSv	22	1.4091	.79637	.16979
	IOSmm	22	3.7727	1.19251	.25424

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
E	Equal variances assumed	1.971	.168	-7.731	42	.000	-2.3636	.30572	-2.98061	-1.74666
	Equal variances not assumed			-7.731	36.623	.000	-2.3636	.30572	-2.98331	-1.74397

Group Statistics					
	GROUPF	N	Mean	Std. Deviation	Std. Error Mean
F	IOIv	22	3.3636	1.36436	.29088
	IOIav	22	4.1364	1.08213	.23071

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
F	Equal variances assumed	2.713	.107	-2.081	42	.044	-.7727	.37127	-1.52198	-.02348
	Equal variances not assumed			-2.081	39.930	.044	-.7727	.37127	-1.52313	-.02233

Group Statistics

	GROUPG	N	Mean	Std. Deviation	Std. Error Mean
G	ROIv	22	3.5000	1.33631	.28490
	POIav	22	4.4091	.66613	.14202

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
G	Equal variances assumed	6.325	.016	-2.856	42	.007	-.9091	.31834	-1.55152	-.26666
	Equal variances not assumed			-2.856	30.829	.008	-.9091	.31834	-1.55849	-.25969

Group Statistics

	GROUPH	N	Mean	Std. Deviation	Std. Error Mean
H	1.00	22	1.1818	.39477	.08417
	2.00	22	1.0455	.21320	.04545

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
H	Equal variances assumed	9.705	.003	1.426	42	.161	.1364	.09566	-.05668	.32940
	Equal variances not assumed			1.426	32.290	.164	.1364	.09566	-.05841	.33114

	Group Statistics				
	GROUPI	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
I	**UOIv**	22	1.4091	.79637	.16979
	UOIav	22	1.1818	.39477	.08417

		Independent Samples Test								
		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
I	**Equal variances assumed**	5.967	.019	1.199	42	.237	.2273	.18950	-.15516	.60970
	Equal variances not assumed			1.199	30.733	.240	.2273	.18950	-.15936	.61390

	Group Statistics				
	GROUPJ	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
J	**1.00**	22	3.7727	1.30683	.27862
	2.00	22	4.1364	1.08213	.23071

		Independent Samples Test								
		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
J	**Equal variances assumed**	.285	.596	-1.005	42	.321	-.3636	.36174	-1.09365	.36638
	Equal variances not assumed			-1.005	40.589	.321	-.3636	.36174	-1.09440	.36713

One way AVNOVA

Descriptives								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
IOIv	22	3.36	1.364	.291	2.76	3.97	1	5
IOImm	22	3.32	1.427	.304	2.69	3.95	1	5
IOIav	22	4.14	1.082	.231	3.66	4.62	1	5
Total	66	3.61	1.334	.164	3.28	3.93	1	5

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9.303	2	4.652	2.753	.071
Within Groups	106.455	63	1.690		
Total	115.758	65			

Descriptives								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
ROIv	22	3.36	1.364	.291	2.76	3.97	1	5
ROImm	22	3.91	1.109	.236	3.42	4.40	1	5
POIav	22	4.41	.666	.142	4.11	4.70	3	5
Total	66	3.89	1.152	.142	3.61	4.18	1	5

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.030	2	6.015	5.105	.009
Within Groups	74.227	63	1.178		
Total	86.258	65			

Descriptives								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
POUv	22	3.50	1.336	.285	2.91	4.09	1	5
POUmm	22	1.36	.492	.105	1.15	1.58	1	2
POUav	22	1.05	.213	.045	.95	1.14	1	2
Total	66	1.97	1.370	.169	1.63	2.31	1	5

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	78.394	2	39.197	56.709	.000
Within Groups	43.545	63	.691		
Total	121.939	65			

Descriptives								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
UOIv	22	1.18	.395	.084	1.01	1.36	1	2
UOImm	22	1.68	.945	.202	1.26	2.10	1	5
UOIav	22	1.18	.395	.084	1.01	1.36	1	2
Total	66	1.35	.668	.082	1.18	1.51	1	5

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.667	2	1.833	4.562	.014
Within Groups	25.318	63	.402		
Total	28.985	65			

Descriptives								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
IOSv	22	1.41	.796	.170	1.06	1.76	1	4
IOSmm	22	3.77	1.193	.254	3.24	4.30	1	5
IOSav	22	4.32	.945	.202	3.90	4.74	1	5
Total	66	3.17	1.604	.197	2.77	3.56	1	5

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	105.212	2	52.606	53.494	.000
Within Groups	61.955	63	.983		
Total	167.167	65			

Appendix D -2: Raw Data of Task Satisfaction Rate for (Experimental Phase 2 and 3)

UserID	VARCS								Both
	Adding Comments System				Retrieving Comments System				
P2-01	EOA	COA	NOA	FOA	EOR	COR	NOR	FOR	COALL
P2-02	4.00	1.00	5.00	1.00	4.00	2.00	5.00	2.00	5.00
P2-03	2.00	5.00	2.00	4.00	2.00	4.00	2.00	4.00	2.00
P2-04	4.00	5.00	2.00	4.00	4.00	5.00	5.00	2.00	5.00
P2-05	2.00	1.00	1.00	1.00	4.00	4.00	2.00	1.00	5.00
P1-06	2.00	4.00	2.00	4.00	5.00	5.00	4.00	2.00	5.00
P2-07	4.00	5.00	2.00	4.00	4.00	2.00	5.00	1.00	5.00
P2-08	1.00	2.00	1.00	1.00	1.00	2.00	4.00	2.00	5.00
P2-09	2.00	1.00	2.00	2.00	4.00	2.00	5.00	2.00	5.00
P2-10	2.00	5.00	2.00	5.00	2.00	2.00	2.00	5.00	3.00
P2-11	4.00	5.00	5.00	4.00	4.00	5.00	5.00	2.00	5.00
P2-12	2.00	2.00	2.00	1.00	2.00	1.00	4.00	2.00	2.00
P2-13	4.00	3.00	4.00	2.00	4.00	3.00	5.00	1.00	5.00
P2-14	4.00	4.00	3.00	4.00	4.00	5.00	5.00	2.00	2.00
P2-15	4.00	4.00	2.00	4.00	4.00	5.00	2.00	5.00	5.00
P2-16	4.00	1.00	5.00	1.00	4.00	2.00	5.00	2.00	5.00
P2-17	2.00	1.00	2.00	2.00	2.00	2.00	4.00	2.00	3.00
P2-18	2.00	5.00	1.00	4.00	4.00	5.00	5.00	5.00	5.00
P2-19	1.00	1.00	2.00	2.00	1.00	2.00	5.00	2.00	2.00
P2-20	4.00	4.00	5.00	5.00	5.00	4.00	5.00	1.00	5.00
P2-21	2.00	1.00	2.00	2.00	2.00	2.00	2.00	5.00	2.00
P2-22	4.00	2.00	3.00	1.00	4.00	1.00	4.00	2.00	5.00

UserID	MMARCS								Both
	Adding Comments System				Retrieving Comments System				
P2-01	EOA	COA	NOA	FOA	EOR	COR	NOR	FOR	COAL L
P2-02	4.00	2.00	4.00	1.00	4.00	1.00	4.00	1.00	4.00
P2-03	2.00	2.00	2.00	2.00	1.00	5.00	2.00	4.00	1.00
P2-04	4.00	2.00	4.00	1.00	4.00	2.00	5.00	2.00	4.00
P2-05	4.00	2.00	4.00	2.00	2.00	1.00	1.00	5.00	5.00
P1-06	4.00	3.00	2.00	5.00	2.00	4.00	4.00	1.00	5.00
P2-07	4.00	5.00	4.00	3.00	4.00	2.00	4.00	1.00	4.00
P2-08	4.00	2.00	5.00	2.00	2.00	5.00	2.00	2.00	4.00
P2-09	5.00	2.00	4.00	1.00	5.00	5.00	5.00	2.00	5.00
P2-10	4.00	2.00	4.00	5.00	1.00	4.00	1.00	3.00	3.00
P2-11	4.00	2.00	5.00	4.00	4.00	5.00	5.00	1.00	5.00
P2-12	2.00	2.00	2.00	1.00	2.00	2.00	4.00	1.00	1.00
P2-13	4.00	3.00	5.00	2.00	2.00	3.00	5.00	4.00	5.00
P2-14	4.00	5.00	3.00	5.00	4.00	3.00	4.00	4.00	4.00
P2-15	4.00	2.00	4.00	2.00	3.00	4.00	2.00	1.00	4.00
P2-16	4.00	2.00	5.00	1.00	4.00	1.00	5.00	1.00	4.00
P2-17	1.00	2.00	4.00	2.00	2.00	2.00	4.00	2.00	5.00
P2-18	4.00	2.00	4.00	1.00	5.00	4.00	3.00	4.00	5.00
P2-19	5.00	2.00	4.00	2.00	1.00	2.00	4.00	2.00	1.00
P2-20	4.00	5.00	4.00	1.00	4.00	2.00	1.00	4.00	5.00
P2-21	2.00	2.00	2.00	2.00	2.00	1.00	2.00	5.00	4.00
P2-22	4.00	2.00	4.00	2.00	4.00	1.00	4.00	1.00	4.00

UserID	AVARCS								Both
	Adding Comments System				Retrieving Comments System				
P2-01	EOA	COA	NOA	FOA	EOR	COR	NOR	FOR	COALL
P2-02	5.00	1.00	4.00	1.00	5.00	2.00	5.00	1.00	5.00
P2-03	5.00	2.00	5.00	2.00	2.00	4.00	4.00	5.00	4.00
P2-04	4.00	1.00	5.00	2.00	5.00	1.00	4.00	1.00	5.00
P2-05	4.00	1.00	5.00	1.00	4.00	1.00	5.00	2.00	5.00
P1-06	4.00	3.00	2.00	1.00	5.00	2.00	5.00	2.00	3.00
P2-07	5.00	1.00	5.00	3.00	4.00	1.00	3.00	1.00	5.00
P2-08	4.00	2.00	5.00	2.00	5.00	3.00	4.00	1.00	5.00
P2-09	5.00	1.00	4.00	1.00	1.00	2.00	5.00	1.00	4.00
P2-10	4.00	2.00	5.00	1.00	5.00	1.00	5.00	1.00	2.00
P2-11	5.00	2.00	4.00	2.00	5.00	1.00	5.00	1.00	4.00
P2-12	5.00	1.00	4.00	1.00	3.00	4.00	5.00	2.00	5.00
P2-13	5.00	3.00	5.00	2.00	4.00	2.00	4.00	1.00	5.00
P2-14	5.00	1.00	3.00	5.00	5.00	1.00	5.00	1.00	5.00
P2-15	4.00	2.00	4.00	1.00	5.00	2.00	4.00	1.00	5.00
P2-16	5.00	1.00	5.00	1.00	4.00	1.00	5.00	2.00	5.00
P2-17	3.00	2.00	4.00	2.00	4.00	4.00	1.00	1.00	5.00
P2-18	4.00	1.00	5.00	1.00	5.00	2.00	4.00	1.00	4.00
P2-19	5.00	1.00	5.00	2.00	5.00	1.00	5.00	3.00	5.00
P2-20	4.00	2.00	4.00	1.00	5.00	1.00	4.00	2.00	5.00
P2-21	5.00	1.00	5.00	2.00	4.00	1.00	4.00	1.00	5.00
P2-22	5.00	1.00	4.00	2.00	4.00	1.00	5.00	4.00	5.00

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	eoav	22	2.95	1.214	.259
	eoamm	22	3.68	.995	.212

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	6.979	.012	-2.173	42	.035	-.73	.335	-1.403	-.052
	Equal variances not assumed			-2.173	40.433	.036	-.73	.335	-1.403	-.051

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	coav	22	2.86	1.726	.368
	coamm	22	2.50	1.058	.226

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	17.905	.000	.842	42	.404	.36	.432	-.508	1.235
	Equal variances not assumed			.842	34.821	.405	.36	.432	-.513	1.240

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	noav	22	2.73	1.420	.303
	noamm	22	3.82	1.006	.215

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	4.913	.032	-2.939	42	.005	-1.09	.371	-1.840	-.342
	Equal variances not assumed			-2.939	37.843	.006	-1.09	.371	-1.842	-.339

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	foav	22	2.73	1.453	.310
	foamm	22	2.18	1.368	.292

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	2.312	.136	1.282	42	.207	.55	.425	-.313	1.404
	Equal variances not assumed			1.282	41.845	.207	.55	.425	-.313	1.404

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	eorv	22	3.36	1.217	.259
	eormm	22	2.91	1.306	.278

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	.676	.416	1.194	42	.239	.45	.381	-.313	1.223
	Equal variances not assumed			1.194	41.791	.239	.45	.381	-.314	1.223

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	norv	22	4.09	1.231	.262
	normm	22	3.41	1.403	.299

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	1.096	.301	1.714	42	.094	.68	.398	-.121	1.485
	Equal variances not assumed			1.714	41.303	.094	.68	.398	-.122	1.485

Group Statistics

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	forv	22	2.45	1.371	.292
	formm	22	2.41	1.436	.306

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	.650	.425	.107	42	.915	.05	.423	-.809	.900
	Equal variances not assumed			.107	41.909	.915	.05	.423	-.809	.900

Group Statistics

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	coallv	22	4.14	1.320	.281
	coallmm	22	3.91	1.306	.278

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	1.681	.202	.574	42	.569	.23	.396	-.572	1.026
	Equal variances not assumed			.574	41.995	.569	.23	.396	-.572	1.026

	Group Statistics				
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	eoaav	22	4.50	.598	.127
	eorav	22	4.18	1.097	.234

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	2.988	.091	1.195	42	.239	.32	.266	-.219	.856
	Equal variances not assumed			1.195	32.455	.241	.32	.266	-.224	.860

Independent Samples Test

	Group Statistics				
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	coav	22	2.86	1.726	.368
	coaav	22	1.50	.673	.143

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	52.938	.000	3.452	42	.001	1.36	.395	.566	2.161
	Equal variances not assumed			3.452	27.231	.002	1.36	.395	.553	2.174

	Group Statistics				
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	noav	22	2.73	1.420	.303
	noaav	22	4.41	.796	.170

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	9.477	.004	-4.844	42	.000	-1.68	.347	-2.382	-.981
	Equal variances not assumed			-4.844	33.016	.000	-1.68	.347	-2.388	-.976

	Group Statistics				
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	foav	22	2.73	1.453	.310
	foaav	22	1.68	.945	.202

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	14.802	.000	2.828	42	.007	1.05	.370	.299	1.791
	Equal variances not assumed			2.828	36.073	.008	1.05	.370	.296	1.795

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	eorv	22	3.36	1.217	.259
	eorav	22	4.18	1.097	.234

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	1.422	.240	-2.342	42	.024	-.82	.349	-1.523	-.113
	Equal variances not assumed			-2.342	41.557	.024	-.82	.349	-1.523	-.113

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	corv	22	3.05	1.463	.312
	corav	22	1.86	1.082	.231

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	6.859	.012	3.046	42	.004	1.18	.388	.399	1.965
	Equal variances not assumed			3.046	38.683	.004	1.18	.388	.397	1.967

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	norv	22	4.09	1.231	.262
	norav	22	4.32	.945	.202

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	2.370	.131	-.687	42	.496	-.23	.331	-.895	.441
	Equal variances not assumed			-.687	39.381	.496	-.23	.331	-.896	.442

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	forv	22	2.45	1.371	.292
	forav	22	1.68	1.086	.232

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	1.256	.269	2.072	42	.044	.77	.373	.020	1.525
	Equal variances not assumed			2.072	39.914	.045	.77	.373	.019	1.526

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
A	coallv	22	4.14	1.320	.281
	coallav	22	4.50	.859	.183

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
A	Equal variances assumed	10.008	.003	-1.083	42	.285	-.36	.336	-1.041	.314
	Equal variances not assumed			-1.083	36.085	.286	-.36	.336	-1.045	.317

One way ANOVA

Descriptives								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
eoav	22	2.95	1.214	.259	2.42	3.49	1	5
eoamm	22	3.68	.995	.212	3.24	4.12	1	5
eoaav	22	4.50	.598	.127	4.24	4.76	3	5
Total	66	3.71	1.147	.141	3.43	3.99	1	5

ANOVAA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	26.303	2	13.152	13.989	.000
Within Groups	59.227	63	.940		
Total	85.530	65			

Descriptives								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
coav	22	2.86	1.726	.368	2.10	3.63	1	5
coamm	22	2.50	1.058	.226	2.03	2.97	2	5
coaav	22	1.50	.673	.143	1.20	1.80	1	3
Total	66	2.29	1.345	.166	1.96	2.62	1	5

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	21.939	2	10.970	7.230	.001
Within Groups	95.591	63	1.517		
Total	117.530	65			

Descriptives								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
noav	22	2.73	1.420	.303	2.10	3.36	1	5
noamm	22	3.82	1.006	.215	3.37	4.26	2	5
noaav	22	4.41	.796	.170	4.06	4.76	2	5
Total	66	3.65	1.295	.159	3.33	3.97	1	5

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	32.030	2	16.015	13.111	.000
Within Groups	76.955	63	1.222		
Total	108.985	65			

Descriptives								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
foav	22	2.73	1.453	.310	2.08	3.37	1	5
foamm	22	2.18	1.368	.292	1.58	2.79	1	5
foaav	22	1.68	.945	.202	1.26	2.10	1	5
Total	66	2.20	1.327	.163	1.87	2.52	1	5

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.030	2	6.015	3.700	.030
Within Groups	102.409	63	1.626		
Total	114.439	65			

Descriptives								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
eorv	22	3.36	1.217	.259	2.82	3.90	1	5
eormm	22	2.91	1.306	.278	2.33	3.49	1	5
eorav	22	4.18	1.097	.234	3.70	4.67	1	5
Total	66	3.48	1.304	.160	3.16	3.81	1	5

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	18.303	2	9.152	6.254	.003
Within Groups	92.182	63	1.463		
Total	110.485	65			

Descriptives								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
corv	22	3.05	1.463	.312	2.40	3.69	1	5
cormm	22	2.77	1.478	.315	2.12	3.43	1	5
corav	22	1.86	1.082	.231	1.38	2.34	1	4
Total	66	2.56	1.426	.176	2.21	2.91	1	5

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	16.848	2	8.424	4.599	.014
Within Groups	115.409	63	1.832		
Total	132.258	65			

Descriptives								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
norv	22	4.09	1.231	.262	3.55	4.64	2	5
normm	22	3.41	1.403	.299	2.79	4.03	1	5
norav	22	4.32	.945	.202	3.90	4.74	1	5
Total	66	3.94	1.251	.154	3.63	4.25	1	5

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9.848	2	4.924	3.375	.040
Within Groups	91.909	63	1.459		
Total	101.758	65			

Descriptives								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
forv	22	2.45	1.371	.292	1.85	3.06	1	5
formm	22	2.41	1.436	.306	1.77	3.05	1	5
forav	22	1.68	1.086	.232	1.20	2.16	1	5
Total	66	2.18	1.335	.164	1.85	2.51	1	5

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.273	2	4.136	2.423	.097
Within Groups	107.545	63	1.707		
Total	115.818	65			

Descriptives								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
coallv	22	4.14	1.320	.281	3.55	4.72	2	5
coallmm	22	3.91	1.306	.278	3.33	4.49	1	5
coallav	22	4.50	.859	.183	4.12	4.88	2	5
Total	66	4.18	1.189	.146	3.89	4.47	1	5

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.909	2	1.955	1.401	.254
Within Groups	87.909	63	1.395		
Total	91.818	65			

Appendix D -3: Raw Data of Achievement Task Successfully Rate for (Experimental Phase 2 and 3)

UserID	VARCS								
	Add Comments				Retrieve Comments				Total
	Short	Mid	Long	Total	Easy	Mod	Diff	Total	
P2-01	3.00	4.00	5.00	12.00	3.00	4.00	7.00	14.00	26.00
P2-02	7.00	3.00	4.00	14.00	3.00	4.00	6.00	13.00	27.00
P2-03	6.00	5.00	4.00	15.00	3.00	2.00	5.00	10.00	25.00
P2-04	5.00	3.00	5.00	13.00	4.00	4.00	4.00	12.00	25.00
P2-05	8.00	6.00	4.00	18.00	3.00	3.00	5.00	11.00	29.00
P1-06	8.00	4.00	3.00	15.00	2.00	4.00	4.00	10.00	25.00
P2-07	4.00	5.00	4.00	13.00	3.00	3.00	5.00	11.00	24.00
P2-08	4.00	8.00	3.00	15.00	4.00	5.00	4.00	13.00	28.00
P2-09	9.00	6.00	6.00	21.00	3.00	3.00	8.00	14.00	35.00
P2-10	6.00	8.00	3.00	17.00	2.00	4.00	5.00	11.00	28.00
P2-11	7.00	4.00	6.00	17.00	4.00	4.00	4.00	12.00	29.00
P2-12	5.00	3.00	4.00	12.00	3.00	2.00	4.00	9.00	21.00
P2-13	4.00	4.00	6.00	14.00	4.00	5.00	3.00	12.00	26.00
P2-14	5.00	7.00	4.00	16.00	3.00	4.00	4.00	11.00	27.00
P2-15	9.00	4.00	4.00	17.00	2.00	3.00	5.00	10.00	27.00
P2-16	3.00	3.00	6.00	12.00	3.00	2.00	4.00	9.00	21.00
P2-17	5.00	5.00	3.00	13.00	2.00	5.00	3.00	10.00	23.00
P2-18	6.00	4.00	4.00	14.00	4.00	4.00	4.00	12.00	26.00
P2-19	6.00	3.00	6.00	15.00	2.00	3.00	3.00	8.00	23.00
P2-20	5.00	4.00	5.00	14.00	2.00	3.00	6.00	11.00	25.00
P2-21	3.00	7.00	4.00	14.00	4.00	2.00	2.00	8.00	22.00
P2-22	4.00	3.00	4.00	11.00	2.00	3.00	3.00	8.00	19.00

UserID	MMARCS								
	Add Comments				Retrieve Comments				Total
	Short	Mid	Long	Total	Easy	Mod	Diff	Total	
P2-01	8.00	8.00	7.00	23.00	3.00	4.00	7.00	14.00	37.00
P2-02	9.00	7.00	8.00	24.00	4.00	5.00	7.00	16.00	40.00
P2-03	9.00	7.00	7.00	23.00	3.00	3.00	6.00	12.00	35.00
P2-04	8.00	5.00	5.00	18.00	3.00	5.00	4.00	12.00	30.00
P2-05	8.00	6.00	6.00	20.00	3.00	6.00	4.00	13.00	33.00
P1-06	9.00	5.00	9.00	23.00	4.00	4.00	8.00	16.00	39.00
P2-07	7.00	8.00	7.00	22.00	3.00	4.00	5.00	12.00	34.00
P2-08	4.00	9.00	8.00	21.00	4.00	6.00	6.00	16.00	37.00
P2-09	9.00	5.00	9.00	23.00	3.00	2.00	8.00	13.00	36.00
P2-10	6.00	8.00	9.00	23.00	4.00	4.00	6.00	14.00	37.00
P2-11	6.00	8.00	7.00	21.00	3.00	6.00	5.00	14.00	35.00
P2-12	8.00	5.00	9.00	22.00	3.00	3.00	7.00	13.00	35.00
P2-13	8.00	8.00	8.00	24.00	4.00	3.00	5.00	12.00	36.00
P2-14	7.00	9.00	5.00	21.00	1.00	5.00	7.00	13.00	34.00
P2-15	9.00	8.00	7.00	24.00	4.00	4.00	5.00	13.00	37.00
P2-16	7.00	6.00	5.00	18.00	3.00	6.00	4.00	13.00	31.00
P2-17	6.00	9.00	4.00	19.00	4.00	5.00	4.00	13.00	32.00
P2-18	5.00	8.00	8.00	21.00	4.00	3.00	6.00	13.00	34.00
P2-19	6.00	5.00	9.00	20.00	2.00	5.00	6.00	13.00	33.00
P2-20	8.00	5.00	5.00	18.00	3.00	3.00	7.00	13.00	31.00
P2-21	4.00	7.00	4.00	15.00	4.00	5.00	3.00	12.00	27.00
P2-22	6.00	8.00	5.00	19.00	2.00	6.00	8.00	16.00	35.00

UserID	AVARCS								
	Add Comments				Retrieve Comments				Total
	Short	Mid	Long	Total	Easy	Mod	Diff	Total	
P2-01	9.00	9.00	8.00	26.00	4.00	6.00	8.00	18.00	44.00
P2-02	9.00	9.00	9.00	27.00	4.00	6.00	8.00	18.00	45.00
P2-03	9.00	9.00	9.00	27.00	2.00	5.00	4.00	11.00	38.00
P2-04	9.00	8.00	5.00	22.00	4.00	5.00	8.00	17.00	39.00
P2-05	7.00	9.00	8.00	24.00	4.00	6.00	5.00	15.00	39.00
P1-06	9.00	9.00	9.00	27.00	3.00	6.00	8.00	17.00	44.00
P2-07	9.00	7.00	9.00	25.00	4.00	6.00	8.00	18.00	43.00
P2-08	9.00	9.00	7.00	25.00	4.00	6.00	8.00	18.00	43.00
P2-09	9.00	9.00	9.00	27.00	4.00	5.00	8.00	17.00	44.00
P2-10	9.00	5.00	9.00	23.00	4.00	6.00	6.00	16.00	39.00
P2-11	9.00	9.00	9.00	27.00	4.00	6.00	8.00	18.00	45.00
P2-12	9.00	7.00	8.00	24.00	3.00	4.00	8.00	15.00	39.00
P2-13	9.00	9.00	9.00	27.00	4.00	6.00	7.00	17.00	44.00
P2-14	9.00	9.00	8.00	26.00	4.00	6.00	8.00	18.00	44.00
P2-15	9.00	9.00	8.00	26.00	4.00	6.00	8.00	18.00	44.00
P2-16	8.00	9.00	8.00	25.00	2.00	6.00	8.00	16.00	41.00
P2-17	7.00	6.00	7.00	20.00	3.00	6.00	7.00	16.00	36.00
P2-18	6.00	7.00	7.00	20.00	4.00	5.00	5.00	14.00	34.00
P2-19	9.00	8.00	7.00	24.00	4.00	4.00	6.00	14.00	38.00
P2-20	8.00	8.00	9.00	25.00	3.00	3.00	8.00	14.00	39.00
P2-21	9.00	9.00	8.00	26.00	4.00	6.00	7.00	17.00	43.00
P2-22	8.00	9.00	9.00	26.00	4.00	6.00	8.00	18.00	44.00

T test of Achievement Task Successfully Rate for (Experimental Phase 2 and 3)

		Mean	N	Std. Deviation	df	t	Sig. (2-tailed)
Independent Samples Test	VARCS	25.50	22	3.419	42		
	MMARCS	34.45	22	3.035		-9.187	.000

		Mean	N	Std. Deviation	df	t	Sig. (2-tailed)
Independent Samples Test	ADD1V	5.55	22	1.845		-3.070	.004
	ADD1MM	7.14	22	1.583	42		
Independent Samples Test	ADD2V	4.68	22	1.644		-4.915	
	ADD2MM	7.00	22	1.480	42		.000
Independent Samples Test	ADD3V	4.41	22	1.054	42	-5.692	
	ADD3MM	6.86	22	1.726			.000

		Mean	N	Std. Deviation	df	t	Sig. (2-tailed)
Independent Samples Test	RET1V	2.95	22	.785		-1.13	.264
	RET1MM	3.23	22	.813	42		
Independent Samples Test	RET2V	3.45	22	.963		-2.87	
	RET2MM	4.41	22	1.221	42		.006
Independent Samples Test	RET3V	4.45	22	1.405	42	-3.14	
	RET3MM	5.82	22	1.468			.003
Independent Samples Test	ADDV	14.64	22	2.341		-8.883	.000
	ADDMM	21.00	22	2.410	42		
Independent Samples Test	RETV	10.86	22	1.807		-5.358	.000
	RETMM	13.45	22	1.371	42		

Appendix D -4: Raw Data of Task Completion Time Rate for (Experimental Phase 2 and 3)

UserID	VARCS								
	Add Comments				Retrieve Comments				Total
	Short	Mid	Long	Total	Easy	Mod	Diff	Total	
P2-01	4:45	5:32	7:54	18:11	1:39	2:12	3:21	7:12	25:23
P2-02	3:59	4:31	7:41	16:11	0:49	2:14	2:35	5:38	21:49
P2-03	3:55	5:31	6:58	16:24	0:56	1:54	2:52	5:42	22:06
P2-04	5:21	5:56	8:12	19:29	0:49	2:12	3:03	6:04	25:33
P2-05	3:34	4:45	6:14	14:33	1:41	2:28	3:14	7:23	21:56
P1-06	2:47	6:37	7:14	16:38	1:14	1:45	2:53	5:52	22:30
P2-07	3:28	5:39	6:53	16:00	1:21	1:54	2:46	6:01	22:01
P2-08	4:10	6:24	8:09	18:43	0:59	2:21	2:39	5:59	24:42
P2-09	3:39	5:14	7:55	16:48	1:41	2:12	2:51	6:44	23:32
P2-10	4:26	4:49	7:14	16:29	1:12	2:08	3:14	6:34	23:03
P2-11	3:09	4:12	7:45	15:06	0:46	2:12	3:32	6:30	21:36
P2-12	2:54	4:01	7:51	14:46	0:39	1:58	2:59	5:36	20:22
P2-13	3:19	4:53	8:31	16:43	1:13	1:29	2:36	5:18	22:01
P2-14	2:49	3:55	6:27	13:11	1:31	1:34	3:16	6:21	19:32
P2-15	3:17	4:01	8:54	16:12	1:14	2:21	2:49	6:24	22:36
P2-16	4:45	4:31	7:14	16:30	0:45	1:54	2:53	5:32	22:02
P2-17	3:55	6:24	7:29	17:48	0:56	2:28	2:52	6:16	24:04
P2-18	4:26	6:54	7:51	19:11	1:12	2:39	2:53	6:44	25:55
P2-19	5:21	6:31	6:53	18:45	1:31	2:32	2:46	6:49	25:34
P2-20	5:41	3:55	8:54	18:30	0:51	1:54	3:52	6:37	25:07
P2-21	5:39	4:21	8:31	18:31	1:13	1:29	2:46	5:28	23:59
P2-22	4:26	5:34	7:25	17:25	1:41	2:01	3:51	7:33	24:58

UserID	MMARCS								
	Add Comments				Retrieve Comments				Total
	Short	Mid	Long	Total	Easy	Mod	Diff	Total	
P2-01	35:00	2:45	3:59	8:19	0:45	1:26	1:59	4:10	10:18
P2-02	25:00	2:31	3:56	7:52	0:51	1:01	2:31	4:23	10:23
P2-03	51:00	2:25	3:51	8:07	0:52	1:47	2:54	5:33	11:01
P2-04	32:00	2:41	3:57	8:10	1:19	1:02	1:45	4:06	9:55
P2-05	41:00	2:54	3:21	7:56	0:25	1:46	1:45	3:56	9:41
P1-06	13:00	2:12	3:01	6:26	0:36	1:36	1:59	4:11	8:25
P2-07	54:00	2:45	3:51	7:30	1:23	1:01	2:31	4:55	10:01
P2-08	59:00	2:41	3:53	7:33	0:38	1:59	2:01	4:38	9:34
P2-09	1:00	2:49	3:59	7:49	0:36	1:49	1:51	4:16	9:40
P2-10	3:00	2:39	3:02	6:44	0:51	1:46	1:37	4:14	8:21
P2-11	54:00	2:14	4:11	7:19	0:41	1:51	2:11	4:43	9:30
P2-12	41:00	2:01	3:23	6:05	1:21	1:38	2:14	5:13	8:19
P2-13	51:00	2:11	4:02	7:04	0:51	1:29	2:15	4:35	9:19
P2-14	49:00	2:14	3:51	6:54	0:36	1:19	2:14	4:09	9:08
P2-15	53:00	2:36	3:45	7:14	0:41	1:02	1:59	3:42	9:13
P2-16	32:00	2:45	3:56	8:13	1:59	1:26	2:54	6:19	11:07
P2-17	54:00	2:25	3:57	7:16	1:59	1:02	2:24	5:25	9:40
P2-18	3:00	2:12	3:51	7:06	0:55	1:36	2:39	5:10	9:45
P2-19	25:00	2:14	3:59	7:38	0:49	1:38	1:51	4:18	9:29
P2-20	13:00	2:11	4:11	7:35	0:36	1:19	2:14	4:09	9:49
P2-21	3:00	2:36	3:51	7:30	1:21	1:36	2:44	5:41	10:14
P2-22	35:00	2:54	3:56	8:25	0:36	1:46	2:31	4:53	10:56

UserID	AVARCS								
	Add Comments				Retrieve Comments				Total
	Short	Mid	Long	Total	Easy	Mod	Diff	Total	
P2-01	1:12	1:39	2:22	5:13	0:38	0:51	1:11	2:40	7:53
P2-02	1:23	2:16	2:45	6:24	0:49	1:25	1:18	3:32	9:56
P2-03	1:10	2:16	2:39	6:05	0:25	1:03	1:21	2:49	8:54
P2-04	0:54	1:35	1:59	4:28	0:31	1:21	1:02	2:54	7:22
P2-05	0:59	1:27	2:02	4:28	0:36	1:01	1:25	3:02	7:30
P1-06	1:23	1:31	1:59	4:53	1:01	0:49	1:13	3:03	7:56
P2-07	1:01	1:25	1:57	4:23	0:45	1:11	1:11	3:07	7:30
P2-08	0:49	1:06	1:45	3:40	0:41	1:02	1:10	2:53	6:33
P2-09	0:46	2:13	2:41	5:40	0:35	0:52	1:24	2:51	8:31
P2-10	0:43	2:01	2:35	5:19	0:29	1:31	1:46	3:46	9:05
P2-11	1:02	1:41	1:59	4:42	0:41	1:21	1:31	3:33	8:15
P2-12	1:14	1:39	2:21	5:14	0:38	1:02	1:39	3:19	8:33
P2-13	0:41	1:31	2:03	4:15	0:37	0:56	1:12	2:45	7:00
P2-14	0:51	1:08	1:45	3:44	0:43	1:21	1:16	3:20	7:04
P2-15	0:57	1:25	1:57	4:19	0:49	1:19	1:26	3:34	7:53
P2-16	0:54	1:39	2:39	5:12	0:39	0:59	1:11	2:49	8:01
P2-17	1:23	1:49	1:45	4:57	1:08	1:11	1:21	3:40	8:37
P2-18	0:46	1:35	1:35	3:56	0:49	1:11	1:34	3:34	7:30
P2-19	1:19	1:16	2:13	4:48	0:43	0:52	1:24	2:59	7:47
P2-20	0:54	1:31	2:39	5:04	1:09	1:07	1:31	3:47	8:51
P2-21	0:39	1:43	1:35	3:57	0:41	0:56	1:19	2:56	6:53
P2-22	0:54	2:26	1:59	5:19	0:32	1:08	1:22	3:02	8:21

T test of Achievement Task Complete time Rate for (Experimental Phase 2 and 3)

		Mean	N	Std. Deviation	df	t	Sig. (2-tailed)
Independent Samples Test	ADD V	14.64	22	2.341		-8.883	.000
	ADD MM	21.00	22	2.410	42		
Independent Samples Test	RET V	10.86	22	1.807		-5.358	.000
	RET MM	13.45	22	1.371	42		

		Mean	N	Std. Deviation	df	t	Sig. (2-tailed)
Independent Samples Test	Add Short V	4:04	22	0:54		-6.913	.000
	Add Short MM	33:02	22	19:37	42		
Independent Samples Test	ADD MID V	5:11	22	0:58		12.527	
	ADD MID MM	2:29	22	0:16	42		.000
Independent Samples Test	ADD LONG V	7:38	22	0:43	42	22.669	
	ADD LONG MM	3:48	22	0:19			.000

		Mean	N	Std. Deviation	df	t	Sig. (2-tailed)
Independent Samples Test	RET EASY V	1:10	22	0:20		2.004	.052
	RE TEASY MM	0:56	22	0:26	42		
Independent Samples Test	RET MOD V	2:05	22	0:19		6.092	
	RET MOD MM	1:29	22	0:18	42		.000
Independent Samples Test	RET DIFF V	3:01	22	0:21	42	7.12	
	RET DIFF MM	2:13	22	0:22			.000

Appendix D -5: Raw Data of Task Mouse Click Rate for (Experimental Phase 2 and 3)

UserID	VARCS								
	Add Comments				Retrieve Comments				Total
	Short	Mid	Long	Total	Easy	Mod	Diff	Total	
P2-01	17.00	24.00	49.00	90.00	8.00	15.00	19.00	42.00	132.00
P2-02	14.00	27.00	34.00	75.00	7.00	13.00	13.00	33.00	108.00
P2-03	19.00	19.00	14.00	52.00	11.00	18.00	16.00	45.00	97.00
P2-04	14.00	32.00	45.00	91.00	15.00	11.00	18.00	44.00	135.00
P2-05	14.00	24.00	31.00	69.00	12.00	12.00	19.00	43.00	112.00
P1-06	16.00	29.00	39.00	84.00	7.00	14.00	14.00	35.00	119.00
P2-07	19.00	24.00	24.00	67.00	11.00	16.00	24.00	51.00	118.00
P2-08	21.00	26.00	29.00	76.00	8.00	11.00	22.00	41.00	117.00
P2-09	14.00	29.00	38.00	81.00	9.00	13.00	19.00	41.00	122.00
P2-10	15.00	14.00	36.00	65.00	6.00	15.00	22.00	43.00	108.00
P2-11	17.00	16.00	43.00	76.00	12.00	16.00	14.00	42.00	118.00
P2-12	19.00	19.00	39.00	77.00	9.00	17.00	19.00	45.00	122.00
P2-13	12.00	25.00	41.00	78.00	6.00	11.00	23.00	40.00	118.00
P2-14	9.00	31.00	33.00	73.00	8.00	9.00	18.00	35.00	108.00
P2-15	18.00	27.00	35.00	80.00	9.00	10.00	17.00	36.00	116.00
P2-16	10.00	25.00	38.00	73.00	8.00	13.00	18.00	39.00	112.00
P2-17	12.00	18.00	36.00	66.00	12.00	15.00	20.00	47.00	113.00
P2-18	18.00	25.00	41.00	84.00	7.00	13.00	16.00	36.00	120.00
P2-19	14.00	23.00	33.00	70.00	11.00	17.00	17.00	45.00	115.00
P2-20	17.00	18.00	44.00	79.00	9.00	11.00	14.00	34.00	113.00
P2-21	15.00	24.00	42.00	81.00	12.00	8.00	19.00	39.00	120.00
P2-22	13.00	20.00	29.00	62.00	9.00	12.00	11.00	32.00	94.00

UserID	MMARCS								
	Add Comments				Retrieve Comments				Total
	Short	Mid	Long	Total	Easy	Mod	Diff	Total	
P2-01	10.00	14.00	20.00	44.00	6.00	9.00	15.00	30.00	74.00
P2-02	12.00	17.00	19.00	48.00	5.00	8.00	13.00	26.00	74.00
P2-03	9.00	16.00	17.00	42.00	4.00	7.00	11.00	22.00	64.00
P2-04	13.00	12.00	15.00	40.00	6.00	9.00	16.00	31.00	71.00
P2-05	8.00	18.00	19.00	45.00	4.00	9.00	12.00	25.00	70.00
P1-06	7.00	19.00	20.00	46.00	5.00	6.00	17.00	28.00	74.00
P2-07	8.00	11.00	14.00	33.00	3.00	7.00	11.00	21.00	54.00
P2-08	11.00	12.00	16.00	39.00	5.00	11.00	11.00	27.00	66.00
P2-09	12.00	11.00	17.00	40.00	8.00	7.00	13.00	28.00	68.00
P2-10	8.00	17.00	18.00	43.00	12.00	7.00	15.00	34.00	77.00
P2-11	12.00	13.00	15.00	40.00	3.00	8.00	14.00	25.00	65.00
P2-12	13.00	15.00	14.00	42.00	3.00	9.00	16.00	28.00	70.00
P2-13	7.00	11.00	19.00	37.00	5.00	4.00	11.00	20.00	57.00
P2-14	7.00	19.00	17.00	43.00	4.00	9.00	12.00	25.00	68.00
P2-15	8.00	9.00	17.00	34.00	5.00	8.00	11.00	24.00	58.00
P2-16	7.00	4.00	9.00	20.00	8.00	11.00	12.00	31.00	51.00
P2-17	6.00	11.00	16.00	33.00	6.00	14.00	8.00	28.00	61.00
P2-18	9.00	7.00	15.00	31.00	5.00	5.00	10.00	20.00	51.00
P2-19	4.00	10.00	9.00	23.00	21.00	12.00	9.00	42.00	65.00
P2-20	3.00	8.00	11.00	22.00	7.00	6.00	8.00	21.00	43.00
P2-21	5.00	5.00	14.00	24.00	3.00	5.00	15.00	23.00	47.00
P2-22	6.00	14.00	18.00	38.00	3.00	8.00	11.00	22.00	60.00

UserID	AVARCS								
	Add Comments				Retrieve Comments				Total
	Short	Mid	Long	Total	Easy	Mod	Diff	Total	
P2-01	6.00	8.00	15.00	29.00	3.00	5.00	10.00	18.00	47.00
P2-02	4.00	6.00	13.00	23.00	3.00	4.00	9.00	16.00	39.00
P2-03	3.00	3.00	11.00	17.00	4.00	5.00	8.00	17.00	34.00
P2-04	5.00	4.00	11.00	20.00	2.00	5.00	7.00	14.00	34.00
P2-05	4.00	8.00	12.00	24.00	4.00	3.00	4.00	11.00	35.00
P1-06	3.00	6.00	17.00	26.00	3.00	3.00	5.00	11.00	37.00
P2-07	4.00	5.00	9.00	18.00	5.00	3.00	4.00	12.00	30.00
P2-08	10.00	7.00	8.00	25.00	3.00	4.00	4.00	11.00	36.00
P2-09	4.00	6.00	7.00	17.00	3.00	7.00	6.00	16.00	33.00
P2-10	4.00	4.00	6.00	14.00	2.00	6.00	7.00	15.00	29.00
P2-11	3.00	5.00	6.00	14.00	3.00	4.00	5.00	12.00	26.00
P2-12	9.00	8.00	10.00	27.00	2.00	5.00	5.00	12.00	39.00
P2-13	4.00	11.00	14.00	29.00	3.00	5.00	6.00	14.00	43.00
P2-14	3.00	9.00	10.00	22.00	2.00	4.00	5.00	11.00	33.00
P2-15	3.00	12.00	10.00	25.00	2.00	8.00	9.00	19.00	44.00
P2-16	5.00	8.00	8.00	21.00	5.00	5.00	5.00	15.00	36.00
P2-17	7.00	6.00	10.00	23.00	3.00	4.00	7.00	14.00	37.00
P2-18	3.00	7.00	9.00	19.00	3.00	3.00	9.00	15.00	34.00
P2-19	6.00	9.00	8.00	23.00	4.00	8.00	11.00	23.00	46.00
P2-20	4.00	4.00	12.00	20.00	5.00	7.00	4.00	16.00	36.00
P2-21	2.00	5.00	8.00	15.00	2.00	4.00	8.00	14.00	29.00
P2-22	9.00	8.00	7.00	24.00	4.00	6.00	8.00	18.00	42.00

T test of Achievement Task Mouse Click Rate for (Experimental Phase 2 and 3)

		Mean	N	Std. Deviation	df	t	Sig. (2-tailed)
Independent Samples Test	ClickVARCS	115.32	22	9.311	42		
	ClickMMARCS	63.09	22	9.481		18.434	.000

Independent Samples Test		Mean	N	Std. Deviation	df	t	Sig. (2-tailed)
Independent Samples Test	AddShortV	15.32	22	3.092	42	7.699	.000
	AddShortMM	8.41	22	2.856			
Independent Samples Test	ADDMIDV	23.59	22	4.817	42	8.136	.000
	ADDMIDMM	12.41	22	4.284			
Independent Samples Test	ADDLONGV	36.05	22	7.712	42	11.362	.000
	ADDLONGMM	15.86	22	3.152			

		Mean	N	Std. Deviation	df	t	Sig. (2-tailed)
Independent Samples Test	RETEASYV	9.36	22	2.341		3.462	.003
	RETEASYMM	5.95	22	3.982	42		
Independent Samples Test	RETMODV	13.18	22	2.719	42	6.52	
	RETMODMM	8.14	22	2.396	42		.000
Independent Samples Test	RETDIFFV	17.82	22	3.333	42	6.12	.000
	RETDIFFMM	12.32	22	2.571			

Appendix D -6: Raw Data of Task Errors Rate for (Experimental Phase 2 and 3)

UserID	VARCS					MMARCS					AVARCS				
	IT	SE	C	NoAA	NoAR	IT	SE	C	NoAA	NoAR	IT	SE	C	NoAA	NoAR
P2-01	22.00	5.00	3.00	17.00	11.00	6.00	2.00	2.00	8.00	3.00	3.00	0.00	1.00	3.00	1.00
P2-02	17.00	3.00	2.00	12.00	4.00	3.00	1.00	2.00	7.00	8.00	1.00	0.00	1.00	3.00	2.00
P2-03	9.00	4.00	2.00	4.00	3.00	2.00	2.00	1.00	3.00	5.00	1.00	0.00	0.00	0.00	1.00
P2-04	19.00	5.00	0.00	17.00	14.00	4.00	1.00	1.00	5.00	4.00	0.00	2.00	0.00	2.00	0.00
P2-05	22.00	2.00	1.00	19.00	9.00	6.00	0.00	2.00	12.00	6.00	2.00	1.00	1.00	3.00	4.00
P2-06	15.00	5.00	3.00	9.00	4.00	3.00	2.00	1.00	4.00	3.00	3.00	0.00	0.00	1.00	1.00
P2-07	18.00	0.00	1.00	10.00	6.00	2.00	1.00	0.00	6.00	3.00	1.00	2.00	0.00	2.00	2.00
P2-08	13.00	3.00	4.00	7.00	3.00	4.00	2.00	1.00	5.00	1.00	3.00	1.00	1.00	3.00	3.00
P2-09	15.00	1.00	1.00	13.00	8.00	4.00	1.00	0.00	7.00	5.00	0.00	1.00	0.00	2.00	3.00
P2-10	19.00	2.00	0.00	14.00	6.00	2.00	0.00	1.00	4.00	3.00	0.00	1.00	0.00	0.00	0.00
P2-11	19.00	1.00	2.00	10.00	5.00	3.00	3.00	1.00	4.00	7.00	2.00	0.00	0.00	4.00	2.00
P2-12	21.00	4.00	1.00	14.00	8.00	5.00	1.00	0.00	3.00	8.00	3.00	1.00	0.00	1.00	3.00
P2-13	14.00	0.00	2.00	8.00	4.00	1.00	3.00	1.00	6.00	1.00	1.00	2.00	1.00	4.00	2.00
P2-14	15.00	3.00	1.00	11.00	8.00	2.00	0.00	0.00	3.00	2.00	3.00	1.00	0.00	0.00	1.00
P2-15	28.00	6.00	0.00	21.00	9.00	6.00	2.00	2.00	6.00	4.00	3.00	0.00	0.00	0.00	2.00
P2-16	13.00	2.00	1.00	10.00	4.00	3.00	1.00	0.00	4.00	3.00	2.00	1.00	1.00	1.00	0.00
P2-17	19.00	3.00	2.00	16.00	12.00	2.00	0.00	1.00	4.00	7.00	0.00	0.00	0.00	2.00	5.00
P2-18	13.00	5.00	1.00	7.00	5.00	3.00	2.00	1.00	6.00	3.00	3.00	1.00	1.00	0.00	0.00
P2-19	18.00	0.00	3.00	16.00	9.00	4.00	0.00	2.00	11.00	7.00	3.00	1.00	1.00	3.00	2.00
P2-20	23.00	7.00	3.00	13.00	7.00	3.00	1.00	2.00	5.00	3.00	4.00	0.00	2.00	2.00	0.00
P2-21	18.00	3.00	0.00	11.00	6.00	6.00	2.00	0.00	7.00	5.00	2.00	1.00	1.00	2.00	1.00
P2-22	17.00	5.00	3.00	13.00	12.00	5.00	1.00	2.00	10.00	8.00	3.00	0.00	0.00	7.00	1.00

T test of Errors in each types of Task for (Experimental Phase 2 and 3)

		Mean	N	Std. Deviation	t	df	Sig. (2-tailed)
Independent Samples Test	Incorrect TypingV	17.59	22	4.182	14.74	42	.000
	IncorrectTypingMM	3.59	22	1.532			
Independent Samples Test	SelectingErrorsV	3.14	22	2.007	3.948	42	.000
	SelectingErrorsMM	1.27	22	935.			
Independent Samples Test	ConfusionV	1.64	22	1.177	1.959	42	.05
	ConfusionMM	1.05	22	785.			
Independent Samples Test	NoAction AddV	12.36	22	4.215	6.162	42	.000
	NoAction AddMM	5.91	22	2.524			
Independent Samples Test	NoActionRetV	7.14	22	3.152	3.197	42	.003
	NoActionRetMM	4.50	22	2.241			


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