INTELLIGENT COLOUR AGENT IN WORLD WIDE WEB INTERFACE DESIGN

Alice Tan Wan Wu, Daniel Su Kuen Seong
The University of Nottingham, Malaysia

ABSTRACT

Colour management is a vital aspect in interfaces design as it retains an overall balanced and coherent appearance of the interfaces. The appropriate combination use of colours creates diverse effect and enhances the outlook as well as indirectly affects on the user acceptance and satisfaction of interfaces perceived. WWW interface designers often use up plenty of time and effort in mix-matching colours with the intention to obtain the most ultimate combination of the colours used. A poor colour management in WWW interfaces might not be able to convey its information to users efficiently and effectively. As a result, this paper aims to evaluate and resolve the appropriateness and inappropriateness use of colour in interface design, and proposed an intelligent colour agent to automate the process of considering and minimising the selection of the appropriateness use of colours. It has been safely concluded that the intelligent colour agent is capable of performing its tasks positively in analysing and consulting the suitable colours to be used and intensify the information transformation to and from the users. The visibility of interfaces has been examined to promote the contrast display between the users and machines.

KEYWORDS

Intelligent colour agent, interface design, WWW.

1. INTRODUCTION

Colours are important in designing field - web designing, graphics design or interior design, as they play the role of attracting the users (Marcus, Cowan, and Smith, 1989). Colours are often selected for user interfaces in an ad hoc manner, without detail consideration and further analysis the appropriateness of its use in their physical or psychological effects. In short, interface designers prefer to follow what they perceive the most relevant and appropriate for the design, or what they feel is right for the given task (look-and-feel conceptualisation). People working in this field often put in a lot of endeavours to pick the best and right colours to obtain the most excellent results. The appropriate use of colours can retain an overall balanced and coherent appearance of a interface design (Roberto, Moriyon, Szekely, and Neches, 1994). Eventually, colour is more complex than it had ever thought. Employing techniques of combining different colours, creating diverse effects thus enhancing the outlook. Even if colour does not enhance performance, it may have an effect on user acceptance and satisfaction of a particular interface (Johansson, 2002). The aims of the paper are to examining the appropriate and inappropriate use of colours, and to propose an automated intelligent colour agent to assist and recommend alternative solutions for WWW interface design on the selection and consideration of the colours used.

2. RELATED WORK

There are three main categories of colours. Primary colours are the colours that can be mixed to create other colours likes red, green and blue. Secondary colours, such as yellow, magenta and cyan, are the mixtures of any two adjacent primary colours. Tertiary colours are the colours which lie in between the

primary and secondary colours (Meier, 1998). The combination of these colours forms a complete colour wheel. The selection on the use of colours (primaty, secondary and tertiary) is often considered of what the interface designers feel and perceive right and appropriate without further consideration. For an illustration, according to Murch (Morton, 2002), a well-known human factors researcher, colours can be a powerful tool to improve the usefulness of an information display in a wide variety of areas if the colours are used appropriately. On the contrary, the inappropriate use of colour seriously reduce the functionality of a display system. In reality the preferable colours are influenced by environment and individual tastes. The latter are affected by factors such as age, gender, race and personality, whilst environmental factors include local climate, customs, habits and history. The appropriateness use of colours on World Wide Web (WWW) interfaces are still far from perfection to facilitate in achieving higher users' satisfaction. WWW interface designers are lacking in adopting intelligent tools to assist them in selecting colours for a web design. Primary or secondary colours or even random ones are often used without much consideration to the effect of the colours will have on the users (Johansson, 2002). Moreover, colours are essential in representing and delivery as effective information as possible to capture the users' attention at the first glance. Therefore getting the right colours to convey information to viewers is relatively essential (Morton, 2002). Selecting and using colours effectively is important for the integration process for any other parts of interface design which includes WWW interface, computer-based interface, mobile or even personal digital assistant interfaces (PDA). Apart from the colour management in user interface, the display contrast of interface is treated to enhance the visibility of interface when users communicate and interact with the machines through interfaces designed.

2.1 Intelligent Agent

An intelligent agent is known to provide the right solution to users with an objective of transferring important information to users via the functions designed in it. Agent has the connation of a software system which provides helpful and expert assistance. It is acknowledged that agent should be able to interact with users through a program to provide services to users (Eisenstein and Rich, 2002; Johansson, 2002). Over the years there are many programs, systems or applications that have been developed in relation with agents. For instance, Sukaviriya and Foley (Morton and Peterson, 2002) have developed a Graphic User Interface (GUI) design system where animated tutorials are used to show users the ways to accomplish various tasks using the designed GUI. The agent acts as a tutor in the designed GUI to provide run-time guidance for the users. Furthermore, Nack, Manniesing, and Hardman (2003) have built a system which allows users to ask questions about a GUI, such as 'What commands are available?' or 'What will happen if I click here?' The system has assigned the agent to provide answers to the system but not the step-by-step guidance accessing the system. Besides that, Pangoli and Paternó (1995) have designed an approach that permits users to ask questions on ways to carry out a complex task, and answering the questions in natural language. This is an enhancement to those previous designs but there is a drawback on this system. It is not integrated with the application, thus, not knowing the users have followed the design properly. A system is classified as good and efficient if it has well-designed agent that guides the users throughout the entire system and lead users to the promising results at the end of the session.

3. DESIGN RATIONALE

3.1 Intelligent Colour Agent

We proposed and developed an intelligent colour agent which allows interface designers to interact with the program to determine the appropriateness and inappropriateness use of colours. The colour agent acts when interface designers' input are accepted based on the conditions and rules and that have been pre- determined to obtain relevant information to produce the desire results at the end of the process.

The colour agent's knowledge base stores a Colour Look Up Table (CLUT) and algorithm designed with the combination of colours, and the colour conditions and rules which used to fire the recommended solutions.

3.2   Interface Display Contrast

Interface is a boundary across which two independent systems meet and act on or communicate with each other. Interface is a bridge (Hackos and Redish, 1998) between human and machines. The ingredients display on the interfaces determines the efficiency and effectiveness of a system. A system with poor interface design affects its usability and hinders users' interest. The use of colour to enhance communication from computer screens interfaces has resulted in an awareness of the problems created by the inappropriate assignment of colour (Wright, Mosser-Wooley, and Wooley, 1997). The current design of user interfaces often occurs with too little attention in achieving successful communication impact through the use of colours. The brightness level of an interface influences the degree of visibility where users are able to have a clearer vision of the screen interfaces at all time. It has been noticed that the visibility of computer screens are low at certain time especially mobile and PDA users where the visibility of the devices' screen is often too bright or too dark due to the surrounding. Thus, a function of adjusting the screen interface has been suggested to the WWW interface designers.

3.3   **Colour Combination**

It is an important issue in choosing the most appropriate and correct combination of colours to be used as they produce visual harmony interfaces and convey the information effectively to the WWW users. Table 1 details the main colours and the appropriate combination of the colours associated with each.

Table 1: Correct Colour Combination for User Interfaces.

Main Colour	Appropriate Colour Combination
Black	Yellow, White
Yellow	Black, Blue, Brown, Red, Magenta
White	Blue, Green, Brown, Red, Black
Green	White
Blue	Yellow, Orange, White, Red
Brown	Yellow, White
Red	Yellow, White, Orange, Black
Orange	Blue, White
Magenta	Black, Blue
Cyan	Blue, Red

Sources: Adapted and modified from: Brown and Cunningham (1993) and Morton
(2004)

4.   RESEARCH METHODOLOGY AND ARCHITECTURE

The overall system architecture as illustrated in Figure 1 describes the intelligent colour agent's architectural design.   The intelligent colour agent is the integration to all the other interfaces. In the software architecture, programming scripts are compiled and stored in database storage. Database consists of the colour selections, interfacing programming, conditions and rules, and recommends the results to the interface designers.   The database responses through software interface by means of an intelligent colour agent. The intelligent colour agent is embedded and integrated to devices through hardware interface such as desktop computers, laptops, or even mobile and PDA.   In short, the architecture provides the flexibility to enable interface designers to use colour agent for any interfaces design.   It provides modularity as the basic requirements and changes of the feature can be done at the software level in the database.

4.1   **Algorithm of the colour agent**

The intelligent colour agent designed and derived from an object-orientation conceptualisation.   There are three main classes available in the architectural design. The (a) examine the combination of colours. This class assesses the users' input and examine against the CULT defined in the knowledge base. The (b) consult colour retrieving the conditions and rules, and fire the action when there is a matched in the colours assigned stored in a knowledge base. The (c) display contrast mainly responsible in dealing with the appropriateness use of the level of the contrast. Figure 2 depicts the algorithms of the three main classes designed in the intelligent colour agent's environment.
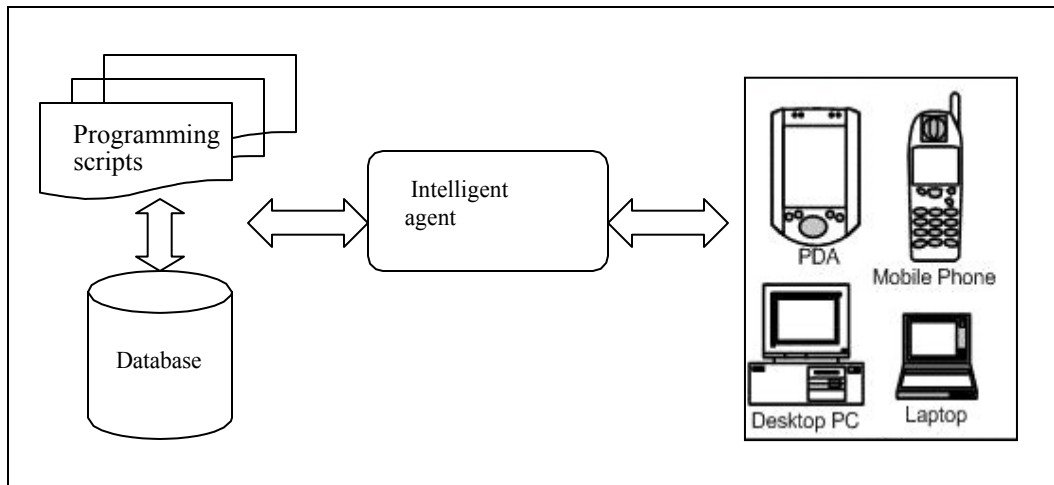
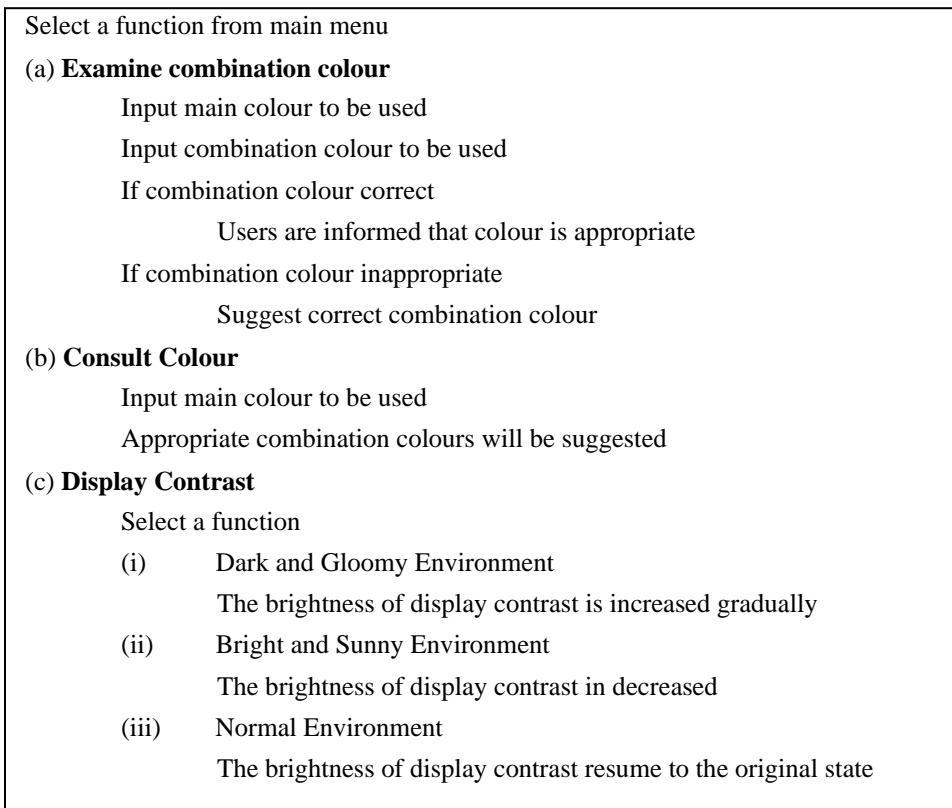Figure 1. Architectural design of intelligent colour agent in WWW interface design

Select a function from main menu

(a) **Examine combination colour**

      Input main colour to be used

      Input combination colour to be used

      If combination colour correct

            Users are informed that colour is appropriate

      If combination colour inappropriate

            Suggest correct combination colour

(b) **Consult Colour**

      Input main colour to be used

      Appropriate combination colours will be suggested

(c) **Display Contrast**

      Select a function

      (i)   Dark and Gloomy Environment

            The brightness of display contrast is increased gradually

      (ii)   Bright and Sunny Environment

            The brightness of display contrast in decreased

      (iii)   Normal Environment

            The brightness of display contrast resume to the original state

Figure 2. Algorithm design of intelligent colour agent in WWW interface design

5.   RESULTS AND DISCUSSIONS

Figure 3 illustrates the colour agent in evaluating and determining the appropriate use of colours based on the users' input.   If the colours fed are inappropriate, the suggested colours are recommended.For example, brown as main colour, yellow and white are the appropriate combination colours. Figure 4

displays the colour agent's suggestion on the correct combination colours to the interface designers when the colours input are inappropriate.

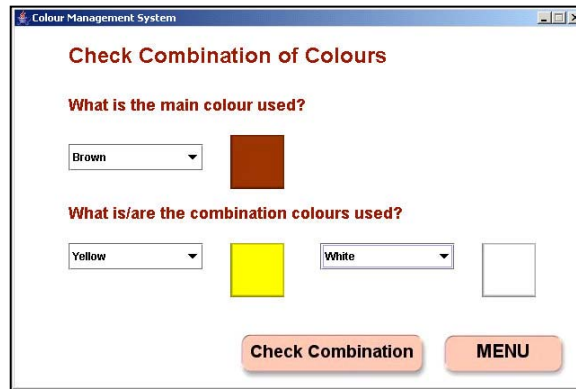(a) Examine Combination of Colour

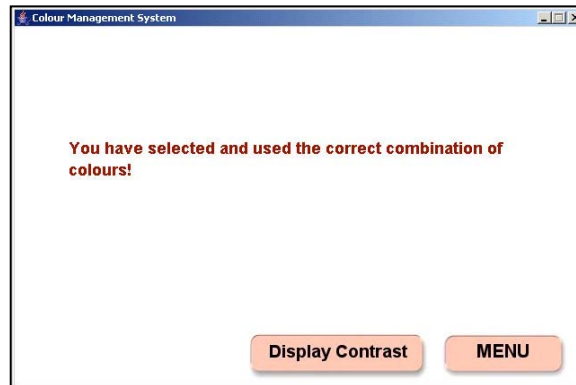Figure 3. Check combination colours – Brown, Yellow and White
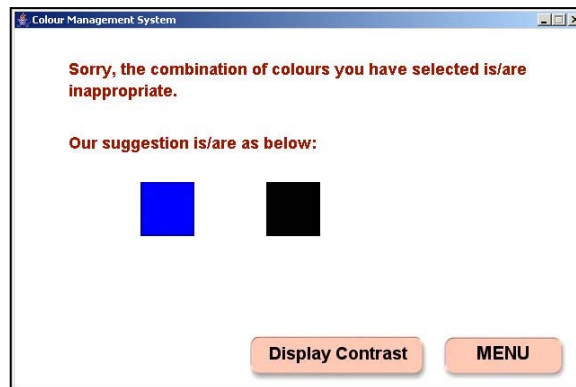

Figure 4. Combination Colours is Correct

Figure 5. Suggested combination colours – Blue and Black

The consult colours merely in advising the interface designers the suitable colours to be used upon receiving the main colour into the system. By only contributing the main colour to be used, such as yellow, the agent suggests the appropriate combination colours such as magenta and brown.   See Figure 6 and 7 respectively.
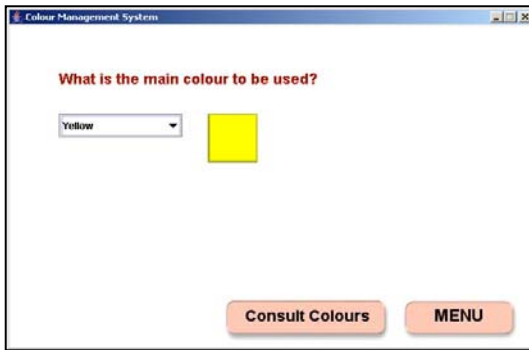
(b) Consult Colour

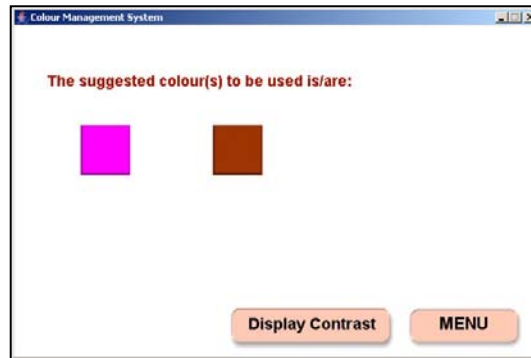Figure 6. Consult colour – Yellow as main colour

Figure 7. Suggested colours for Yellow – Magenta and Brown

Figure 8 shows that by choosing the 'Dark and gloomy' option, the contrast of display is lightened. It is noticed that the contrast of display is darkened when 'Bright and sunny' option is selected as shown in Figure 9. As for Figure 10, it demonstrates that when the 'Normal environment' option is selected, the contrast of the display resumed to its original state.
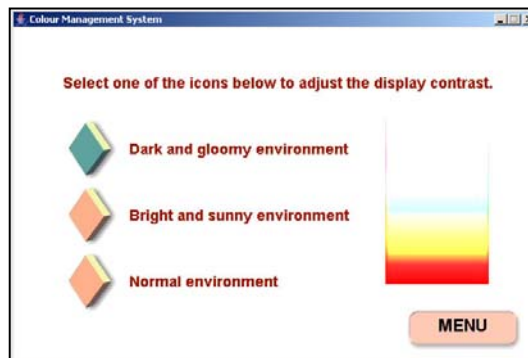
(c) Display Contrast

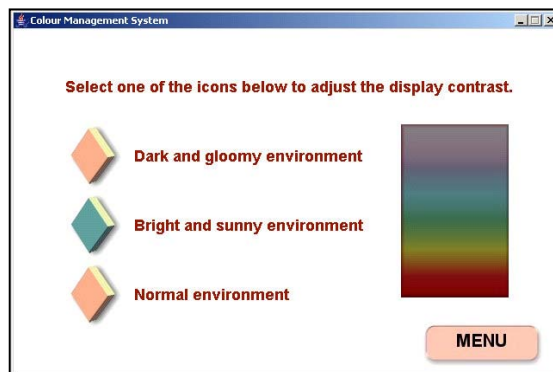Figure 8. Display contrast for 'Dark and gloomy' environment

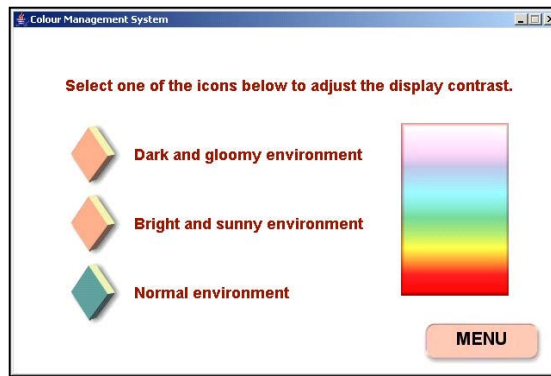Figure 9. Display contrast for 'Bright and sunny'environment

Figure 10. Normal display
contrast

6.   CONCLUSIONS

Colour management in WWW user interface is an essential feature and should not be overlooked. The contribution of intelligent colour agent is promising in resolving the conflict between appropriateness and inappropriateness use of colours. The research outcomes have exemplifies that a good combination of colour management increases the efficiency and effectiveness of information transmission over the WWW. Proficient in managing the user interfaces is critical as the interfaces are the main interaction and communication between users and the machines. Consequently, the proper and good management of user interfaces are the derivation of a successful information transmission.   The   employment   of intelligent colour agent has significantly offer an alternative solutions for WWW interface designers to automate the process of selecting and considering the most appropriate colours to be used.   Additionally, the intelligent colour agent is capable of performing its task ideally based on the knowledge that has been designed based on the colour conditions and rules.   The feature of visibility is one of the core characteristics in interface design has proved to be practical when the contrast is of unsatisfactory.   It also facilitates the process of interaction and communication between users and machines when the suitable contrast is displayed. Explicitly, the intelligent colour agent is a realistic and yet valuable approach designed to ease the WWW interface designers or other designers (in mobile and ubiquitous environments) in eliminating the chances of look-and-feel, and to save time and effort in order to produce the most appropriate and safely colours used to improve users' acceptance and enhance users' satisfaction.

7.   RECOMMENDATIONS

The following recommendations for future research are suggested:
- Enhances the intelligent colour agent by incorporating the sensory human factors design likes users' demography profile, age, gender, occupation, and races and cultures.This will undoubtedly promote interface designers to have in-depth analysis as to provide the accurate colours to the right target audience.
- Integrates and automates the built-in light sensor on computer and mobile devices (or any hand-held devices) to offer the capability of detecting and sensing the light brightness of its surrounding environment.   Upon receiving the result and feedback to the sensor, the intelligent colour agent will automatically adjust the contrast and brightness of the interface display making it clearer to the user without much hassle to change the settings and parameters manually.

REFERENCES

Brown, J. R., and Cunningham, S. (1993). *Programming the User Interface: Principles and Examples*. Wiley- Interscience.

Eisenstein, J., and Rich C. (2002). Agents and GUIs from Task Models. *In Proceedings of the 7th international conference on Intelligent User Interfaces.* San Francisco, California, USA, ACM Press, pp. 47-49.

Hackos, J. T., and Redish, J. C., (1998). *User and Task Analysis for Interface Design*. John Wiley & Sons, Inc, New York, NY, USA.

Johansson, D. (2002). *Colours on the Web - Colour Theory and Colour Matching*. Available [Online] WWW URL http://www.webwhirles.com/colors/colourandweb.asp Date Accessed: 24 July 2005.

Marcus, A., Cowan, W. B., and Smith, W. (1989). Colour in User Interface Design: Functionally and Aesthetics. ACM SIGCHI Bulletin , *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: Wings for the mind CHI '89*. Austin, Texas, ACM Press, Vol. 20, Issue SI, pp. 25-27.

Meier, B. J. (1998). ACE: *A Colour Expert System for User Interface Design*. ACM Press, pp. 117-128.

Morton, J. L. (2002). *Colour Matters - Colour and E-commerce*. Available [Online] WWW URL http://www.colormatters.com/des_ecom.html Date Accessed: 30 August 2005.

Morton, J., (2004). *Colours That Sell: Tried and Tested Color Schemes*, Colorcom.

Morton, J., and Peterson, L. (2002). *Colorcom - Colour Consultation:User Interface and Web Design*. Available
[Online] WWW URL http://www.colorcom.com/ui.html Date Accessed: 18 August 2005.

Nack, F., Manniesing, A., and Hardman L. (2003). Colour Picking: The Pecking Order of Form and Function. *In Proceedings of the 11th ACM International Conference on Multimedia*. Berkeley, CA, USA, ACM Press, pp. 279-
282.

Pangoli, S., Paternó, F. (1995). Automatic Generation of Task-Oriented Help. *In Proceedings of the 8th annual ACM Symposium on User interface and Software Technology*. Pittsburgh, Pennsylvania, United States, ACM Press. pp.
181-187.

Roberto, Moriyon, Szekely, P., and Neches, R. (1994). *Automatic Generation of Help From Interface Design Model. In Proceedings of Conference on Human Factors in Computing Systems*. Boston, Massachusetts, United States, ACM Press, p. 215.

Wright, P., Mosser-Wooley, D., and Wooley, B. (1997). *Techniques & Tools for Using Colour In Computer Interface Design*. Crossroads, Vol 3, Issue 3, ACM Press, pp. 3-6.