

# Designing for What is Usually Hidden

- Visualization Techniques for Design of Autonomous Media Agents

Master Thesis in Informatics, Design of Interactive Systems 15 ECTS

Presented: 2009-04

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# Abstract

<b>Titel/Title</b>	<i>Designing for What is Usually Hidden - Visualization Techniques for Design of Autonomous Media Agents</i>
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<b>Publiceringsår/ Publishing year</b>	2009
<b>Uppsattstyp/ Type of Thesis</b>	Magister uppsats Master Thesis
<b>Språk/ Language</b>	Engelska English
<b>Nyckelord/ Keywords</b>	Informatics, Visual Design, Autonomous Media Agents, Graphical User Interface, Affective computing, Colouring, Metaphors, Pictographic symbols

# Abstract

*Autonomous Agents are usually designed to work in the background and their work is mostly hidden from the user. This causes both ethical and practical problems that can be remedied by providing feedback and control to the user (Bellotti and Sellen, 1993). This thesis presents an overview study exploring advantages and disadvantages of four visualization techniques: colouring, pictographic symbols, metaphors, and affective computing, as they are employed in providing feedback and control regarding Autonomous Agents. The study is performed by evaluating an example project, with elements of Design Science. The thesis concludes that all techniques have both advantages and disadvantages regarding different aspects of their use.*

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# 1 Introduction

Our general studies of Informatics at Lund University have let us come in contact with two phenomena that we find rather interesting, namely visualization techniques of information systems on one hand, and Autonomous Agents on the other. As we thought about these subjects, our curiosity was piqued by the intersection of the two. We have employed the method of Design Science (Hevner et al 2004) where the evaluation of an example project is analysed, along with a literature study of already existing phenomena within this area.

This thesis concerns the visual language of information systems. This means the feedback that it is signalled to its users, as well as the control that is made available for navigation and interaction. Bellotti and Sellen (1993) argue for including feedback and control in ubiquitous computing systems. Autonomous Agents could be said to be an example of such systems, where a large part of this technology is intended to constantly work in the background.

A more general example of this kind of visual feedback is for instance the progress bar of a system, when downloading files over the Internet. We ourselves have many times wished we had a progress bar, even when we know from experience that such indicators seldom are 100% accurate. When we get a frozen progress bar we suspect that something is wrong. We try to fix it and thus save ourselves much time and confusion over why nothing happen.

The users' need for feedback may be further complicated because of the fact that concepts such as Autonomous Media Agents are sometimes difficult to grasp and their inner workings can be elusive to many if not most users. This may lead to a lacking mental model of what is going on, which in turn may, according to Preece, Rogers and Sharp (2002), lead to erroneous or problematic usage of the system. The mentioned authors give an illustrative example of many people's inappropriate mental images of a thermostat for central heating. Many regard the thermostat as a valve that can be more or less opened. This results in turning the thermostat to an excessively high setting believing that it will make the temperature rise more quickly. Considering how a thermostat really works, namely as a switch that periodically turns either fully on or fully off, it becomes clear that the high setting saves no time in achieving the desired temperature. The only thing achieved by the high setting is that the temperature continues to rise after the desired temperature is achieved. The only negative effects of the inappropriate handling are the unnecessary act of adjusting the thermostat, a minor waste of electricity and a too hot room. For Autonomous Agents on the other hand such an inappropriate mental model may have consequences

that involve inadvertent recording and spreading of data about the user's behaviour, which may be seen as private. In simple terms a developed mental model is helping people to understand their experiences and predict the outcome of their actions. The mental models are used to understand what to do when dealing with unfamiliar occurrences (Norman, 1988).

A large part of the feedback, that Bellotti and Sellen (1993) advocates, can be conveyed through different kinds of visualizations. These visualizations have to be carefully designed, in order to effectively convey the desired information and meet the criteria of Bellotti and Sellen's (ibid). From different branches of Human Computer Interaction one can employ a multitude of different visualization techniques (Preece, Rogers and Sharp, 2002).

## 1.1 Problem Area

We agree that valid visual feedback is an important aspect of the graphical user interface development. This is important when designing user interfaces with small displays. Of course large displays are in need of well designed visual feedback as well. One problem that we see in achieving this is, for researchers and developers, to choose what visualization techniques to use in different contexts. Literature on Interaction Design such as Preece, Rogers and Sharp (2002) devote large chapters to the choice of interaction paradigm, choice of metaphors and conceptual models. Logically this choice is especially difficult in new or unusual contexts that have not been explored much before as there are fewer points of reference and less previous experience to draw from. Examples of such new contexts can be the use of new technologies, which contribute to new user experiences and use of new systems. Such technologies can give opportunities to use old and mature visualization techniques in new ways. The problem with this is that one does not know if the visualization techniques will work well in such new context.

The problem area of this thesis involves qualitative investigation (Bryman, 2002) of different visualization techniques for mobile systems that include Autonomous Media Agents. This research paradigm seems to suit this thesis well as the problem area fits well to eight reasons to choose a qualitative approach that Creswell (1998) mentions (marked with italic typeface): As the context of Autonomous Media Agents is relatively untried one needs to *explore* aspects of the visualization techniques and find *what* qualities they have before one could measure the extent of influence for example. To understand what the qualities of the techniques entails a *detailed image* of them and *their natural context* needed to be described in a style that is more *literary* than quantitatively based theses usually are. We seemed to have *enough time and resources*. Researchers within informatics often use and thus seem to *be receptive* to qualitative science. Last but not least we would like to emphasise

our role of *actively learning* about our object of study rather than a judgemental role.

In summary words it is the qualities of visualization techniques that are in focus of this thesis, hence the choice of research paradigm. This thesis contains an over viewing survey of some means of visualization that is available for providing effective feedback (Bellotti and Sellen, 1993) from Autonomous Media Agents (Franklin and Graesser, 1996). Four different techniques such as *affective computing* (Preece, Rogers and Sharp, 2002), *colouring* (Post and Geiselman, 1999), *metaphors* (Stubblefield, 1998) and *pictographic symbols/icons* (Koblanck, 1997) are analysed. A definition of each of these concepts will be further described in the chapter *Literature Study*.

We have chosen these particular visualization techniques for three main reasons: 1) They are either recommended by Interaction Design authorities such as Preece, Rogers and Sharp (2002); Löwgren and Stolterman (1998; 2004); Cooper (1999). 2) They are frequently used in systems we have come across. 3) They appear in preliminary examination to have potential to work well. This selection is not scientifically optimised but rather scientifically secured. With this we mean that some may find other techniques more interesting, this selection is not the optimal one. On the other hand we have assessed the techniques to be sufficiently interesting to warrant scientific research.

The evaluation includes visualization techniques for scenarios specific for mobile platforms. For instance, when one user is geographically close to another user, we evaluate how this particular feedback can be displayed. Another scenario to evaluate is how the Agents interact with one and other.

## 1.2 Research Questions

The above mentioned problem area has lead to this research question:

*What advantages, disadvantages and relevance do the chosen visualization techniques have for design of user interfaces for systems on mobile platforms that include Autonomous Media Agents?*

## 1.3 Purpose

We wish to provide information enabeling makeing informed system design decisions regarding the chosen visualization techniques on mobile platforms. In this way, the informed design avoids hiding the Autonomous Agents'

background activities and what data they collect and thus avoiding the ethical problem of uninformed users.

Therefore the purpose of this thesis is to gain greater knowledge about the chosen techniques.

## 1.4 Delimitations

It is rather impossible not to say meaningless to attempt to investigate every visualization technique ever thought of and study them for use on every kind of Autonomous Agent. The area would also be too vast.

In this manner the overview perspective would be lost in the multitude of techniques and Agents. The reader of such a thesis would be confused as he/she tries to grasp comparisons between similar but not quite the same techniques in an unending row of descriptions.

Because of these problems and constraints we have decided to delimit our study to a defined set of visualization techniques that we find commonly mentioned in Interaction Design literature (Preece, Rogers and Sharp, 2002; Löwgren and Stolterman, 1998; 2004; Cooper, 1999) or commonly used in Human Computer Interaction. In order to answer our research question about advantages and disadvantages of visualization techniques we need a set of techniques to investigate. If we had extended our research to investigate what technique would be best we would not have room to answer our central research question, and the focus of our investigation would have shifted from qualitative into quantitative results. The delimitation is to investigate these techniques in the context of Autonomous Agents on mobile platforms. This way we will improve our chances of actually saying something meaningful, about the various techniques, other than the all too often used phrase: It depends on the context. Other platforms such as stationary computers for instance would demand too many completely different requirements of a visualization technique. These could even be directly conflicting so that what work well for a large display may be useless on smaller scale screen, but also mobile system units compared to stationary computer terminals.

We have not included visualization techniques that are clearly not applicable on the problem area. This includes for example techniques for printing of large images such as rastering, which does simply not work on small screens.

Regarding the technique of colour coding, we have intentionally not laid further focus on exploring the cultural differences in perception of colours.

We have chosen to obtain feedback from members of the target group for the example project, young people that have fairly good understanding of music share systems. More details can be found in chapter *Target group*. To focus on the cultural differences within the area of colour coding would not follow our purpose. We are making an overview study of the techniques, therefore not focusing on each parameter of every visualization possibility.

## 1.5 Definition

It is necessary to clarify and properly present the different concepts used in this study.

*Autonomous agents* has many definitions made by many scientists, several of which are reviewed in the chapter *Literature Study* later in this text. As one can see there, Franklin and Graesser (1996) have made a rather general definition that suit this thesis well:

“An Autonomous Agent is a system situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to effect what it senses in the future” (Franklin and Graesser 1996, p 6). In other words, they are small software units that act on their own initiative according to their environment and on the users’ behalf. More details can be found under chapter *Literature Study*, section *Autonomous Agents* as mentioned.

*Mobile platforms* includes small units to be carried in pockets, not larger devices such as PC tablets and laptops.

Due to the definition of mobile platforms, *small screens* are defined as no larger than 50x70 mm. These exact measurements are arbitrary, but serve the purpose of setting boundaries around what is and what is not a small screen.

## 2 Literature Study

### 2.1 Control and Feedback

Many Autonomous Agents could be said to be an example or part of ubiquitous computing systems as they are often designed to run continuously in the background helping the user without he/she knowing it is a computer system that does the work. By using Bellotti and Sellens' (1993 p 9-10) eleven evaluation criteria on the chosen example project we can see that some Autonomous Agents are sensitive to several issues. Here follows a description of the criteria which we will apply on the example projects system in the analysis section of this thesis.

*“Trustworthiness:* Systems must be technically reliable and instil confidence in users.”

*“Appropriate timing:* Feedback should be provided at a time when control is most likely to be required and effective.”

*“Perceptibility:* Feedback should be noticeable.”

*“Unobtrusiveness:* Feedback should not unnecessarily distract or annoy.”

*“Minimal intrusiveness:* Feedback should not involve information which compromises the privacy of others.”

*“Fail-safety:* In cases where users omit to take explicit action to protect their privacy, the system should permit only minimal information capture, construction and access.”

*“Flexibility:* What counts as private varies according to context and interpersonal relationships. Thus mechanisms of control over user and system behaviour may need to be adaptable to some extent by the individuals concerned.”

*“Low effort:* Design solutions must be lightweight to use requiring as few actions and as little effort on the part of the user as possible.”

*“Meaningfulness:* Feedback must provide meaningful representations of information captured, not just raw data.”

*“Learnability:* Proposed designs should not require a complex model of how the system works. They should exploit or be sensitive to natural, existing psychological and social mechanisms that allow people to perceive and

control how they present themselves and their availability for potential information exchanges or interactions.”

“*Low cost*: Naturally, we wish to keep costs of hardware, software and implementation down.”

## 2.2 Autonomous Agents

As we have delved into literature dealing with the concept of Autonomous Agents we have found that there are many definitions on what Agents are and how they differ from other kinds of software. In this section we give examples of existing definitions.

Turban et al (2007) explains that the definition of Intelligent Agents (which we interpret to be within the definition of Autonomous Agents) is rather novel as is the technology itself. There are many different names to describe Autonomous Media Agents, such as wizards, knowbots and intelligent software robots. These refer to different levels of intelligence. At present there are also many existing forms of Intelligent Agents. A more general definition of the word Agent is referring to someone hired to work on your behalf to execute defined tasks. “A person who acts for or represents another” (Cambridge Advanced Learner's Dictionary, 2007)

Franklin and Graesser (1996) suspect that many researchers tend to define the concept of Agents more or less directly according to the examples they have in mind. This makes it difficult to define what an Agent is as a more general concept. Among others Franklin and Graesser (1996) mention the following definitions:

- The AIMA Agent (Russell and Norvig 1995, page 33 through Franklin and Graesser 1996 page 2): "An Agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors."
- The Maes Agent (Maes 1995, page 108) "Autonomous Agents are computational systems that inhabit some complex dynamic environment, sense and act autonomously in this environment, and by doing so realize a set of goals or tasks for which they are designed."
- The KidSim Agent (Smith, Cypher and Spohrer 1994 through Franklin and Graesser 1996, page 2) "Let us define an Agent as a persistent software entity dedicated to a specific purpose. 'Persistent' distinguishes Agents from subroutines; Agents have their own ideas about how to

accomplish tasks, their own agendas. Special purpose' distinguishes them from entire multifunction applications; Agents are typically much smaller."

In total Franklin and Graesser (1996) quote and comment on eleven slightly but distinctly different definitions of what an Agent is. There are many others not mentioned by Franklin and Graesser (1996), for instance:

There are three main functions that an Intelligent Agent is carrying out continuously: reading the dynamic conditions of the surrounding environment, the ability to affect the environmental conditions and reasoning to interpret those conditions so that the outcome like determinate actions will be established (Aronson and Turban, 2001).

From all the definitions they have encountered Franklin and Graesser (1996) compose a definition of their own that is meant to be more general and to incorporate most if not all Agents that the above definitions have sprung from:

"An Autonomous Agent is a system situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to effect what it senses in the future." (Franklin and Graesser 1996, p 6)

*Table 2.1 Agent classifications (Franklin and Graesser, 1996 p. 8)*

<b>Property</b>	<b>Other names</b>	<b>Meaning</b>
Reactive	(Sensing and acting)	Responds in a timely fashion to changes in the environment
Autonomous		Exercises control over its own actions
Goal oriented	Pro-active purposeful	Does not simply act in response to the environment
Temporally continuous		Is a continuously running process
Communicative	Socially able	Communicates with other agents, perhaps including people
Learning	Adaptive	Changes its behaviour based on its previous experience
Mobile		Able to transport itself from one machine to another
Flexible		Actions are not scripted
Character		Believable "personality" and emotional state

The Agents can, within this definition, be classified according to different properties:

The level of intelligence defines the Agents as well. Here follows a description by Lee et al (1997 according to Aronson and Turban, 2001):

*Level 0:* On this level the Agent receives straight orders from the user. Web browser fall into this category of Agents, the user has to specify correct URL for the browser to be able to carry on the task of finding the web place.

*Level 1:* The users initiate key information and the Agent presents the relevant are of result. In this category search engines are included. The user gives keywords and the search engines are matches them with information from the databases.

*Level 2:* The Agents monitor and process the users' preferences, on this level. These Agents are categorized as semi-intelligent or Software Agents. Examples of these sorts Agents are so called WebWatchers. They are searching for relevant information and, when they find it, the Agent fortifies the user.

*Level 3:* Agents are defined as truly intelligent or learning. They are collecting the users' preferences over time and forming a query that fits the users' expectations.

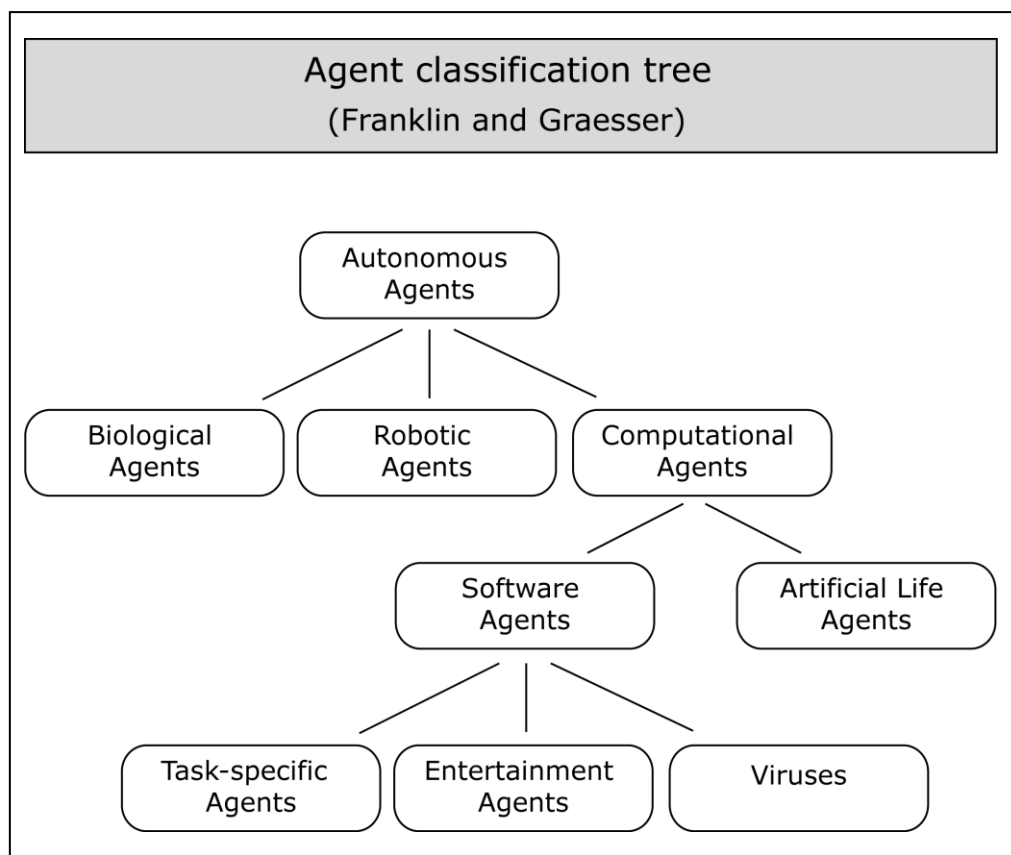


Figure 2.1 Agent classification tree (Franklin and Graesser, 1996, p. 10)

This way of classifying Agents could be complementary to Franklin and Graessers' (1996) although the lowest levels of intelligence seem to fall outside of Franklin and Graessers' (ibid) basic definition. To put all the properties and types of Agents into perspective Franklin and Graesser (1996) propose a more general classification.

Turban et al (2007) mention that the Intelligent Agents have potential of being the essential tools of 21st century within information technology that including the information systems. Intelligent Agents have the ability to overcome information overflow. With today's increasing new information channels this is not an unusual situation. Indeed the sheer volume of literature investigating different instantiations of software Agents publicised only year 2007 tells us that software Agents are a popular and often used means to attempt to fulfil users' needs.

More details on the definition of Agents used in the example project can be found in chapter *Autonomous Media Agents in Example Project*

## 2.3 Agents' Effect

Problems may occur when using Agents as middle-hand between computer and user. Issues involving usage of Agents in more general way might bring up dissatisfaction among users. More experience users have more potential to find the Agents annoying and distracting from their work due to information already known by the user.

## 2.4 Control

Throughout development of a system Preece, Rogers and Sharp (2002) underlines the importance of understanding and evaluating the level of control the users versus the system should be given. If there is too much or too little control there is a risk that the users will not use the system designed. As an example the authors mentions that the early systems of calendar sharing was open for anyone to look into anyone else's calendars and arrange a meeting. This was found to be intrusive of people's privacy.

## 2.5 Agents Appearance, Behaviour and Interaction Level

When illustrated characters are used on the screen various research findings to that simple cartoon characters are preferable to detailed and photo like characters that are human like (Scaife and Rogers, 2001; Haake, 2006).

Studies show that a stylistic cartoon character, with limited animation, is more likeable compared to a real life actor in a promotion video (Laurel, 1993 through Preece, Rogers and Sharp, 2002). An Agent's behaviour is an aspect to evaluate when designing Agents, for instance if an Agent wants to get the users attention on an object. At this moment it is important for the Agent to point at the relevant object in the right context. It is also important to make it clear for the user which object should be in focus. One way is to give a hint to the user by looking or pointing at an object. Another way is facial expression (affective computing), body movement (animation) and so on. The communication between Agent and user is also very important (Preece, Rogers and Sharp, *ibid*). When the characters achieve a relevant communication with the user, the chance of misunderstandings and misinterpretations is low. The chance of that the user gets relevant feedback from the Agent increases. The most acceptable kind of communication is the one that is based on simple artificial mode of interaction, where the user may answer in form of pre given options. This way of interaction proves to be most effective because in this case the users have more chance of understand the Agent (Preece, Rogers and Sharp, *ibid*).

## 2.6 Affective Computing

The term Affective computing was coined in the late 90's and referred to the computers to be designed to show and recognize emotions. The term was brought up from the discipline Artificial Intelligence, where the aim was to develop robots and other computer based systems to behave like humans and animals (Preece, Rogers and Sharp, 2002).

Affective stands for showing an emotional response, but it can also refer to causing an emotional response to others (Preece, Rogers and Sharp, 2002). When smiling to others, this can make other people feel good and therefore smile back. This has a natural link to designing affective and expressive interfaces. The typical purpose of designing expressive interfaces is to show the systems status. This kind of designed interfaces show wheather if the system is working well or not. Preece et al (*ibid*) give a commonly seen example in the smiling Mac figure that appears when an Apple Macintosh is rebooted. This is especially reassuring when rebooting a computer after a crash.

But there are other ways of giving the users feedback about the system status:

- Dynamic icons (when throwing a file into the trash bin it changes the look of being full)

- Animations (the animation of file transfers)
- Spoken messages (the system telling users what needs to be done)
- Sounds that communicating events and action (email arrival)

This kind of feedback can act informative, but also fun (Preece, Rogers and Sharp, 2002). Interfaces designed with many effective images are stated to be more engaging and pleasurable (Mullet and Sano, 1995 through Preece, Rogers and Sharp 2002). Research suggests that an aesthetically pleasing interface can have a positive effect on users' perception of the systems' usability. (Tractinsky, 1997 according to Preece, Rogers and Sharp 2002).

Much of the research on affective computing does not yet have a practical application. Take for example the robot Kismet developed by Breazel (1999, through Preece, Rogers and Sharp 2002), it is designed to engage in meaningful social interactions with humans. Though it is an interesting tool for research it has not yet found a practical application in everyday life other than being a fun gadget. A neighbouring interaction style to that of affective computing that has found a more practical application is virtual Agents. Haake (2006) has demonstrated that for pedagogical contexts, such virtual Agents are often used to enhance the engagement of the student. These Agents are characterized by four different properties: they are based on *Agents* that are in some sense autonomous, they are built on a *pedagogical* framework, they are *embodied* and thus represented with a visual character and they are *virtual* and thus do not have any physical representation. Haake (2006) has further demonstrated that a key factor in this definition is the embodiment. Many of the design elements of virtual Agents, that Haake (ibid) has found good research on, have to do with the embodiment and its affective effects. These design elements consists of:

- Movement characteristics
- Facial expressions
- Dialogue and conversational characteristics
- Emotional expression via voice, gestures and facial expressions
- Personality realized via voice, gestures, facial expression, verbal communication

Much of the research, according to Haake (2006), on facial expressions has been focused on how to actually generate the facial expressions with the help of different computational algorithms and such, while other research has dealt with recognition of facial expressions. Take for example the research of Kotsia et al (2008) that have identified seven different stereotypical facial expressions: neutral, anger, disgust, fear, happiness, sadness and surprise. They have then taken pictures of people expressing these emotions and

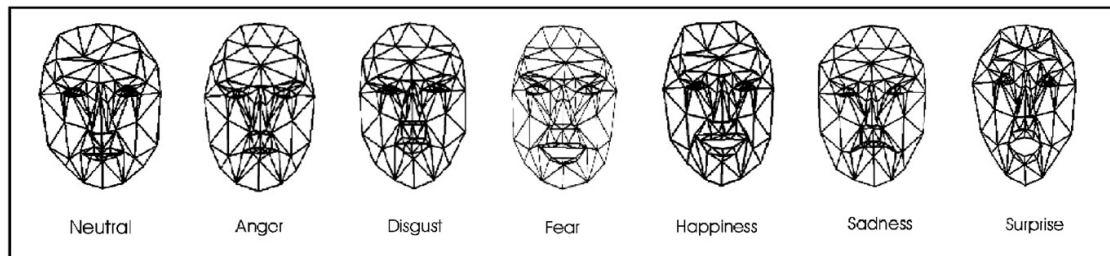


Figure 2.3 Kotsias seven stereotypical facial expressions in Candid grid. (Kotsia et al 2008 p.836)

applied a grid work of lines between key points in the face. This way they had built a conceptual model of different facial expressions. They also identified what in the facial expression was most significant by identifying which parts of the emotional face differs the most from the neutral one.

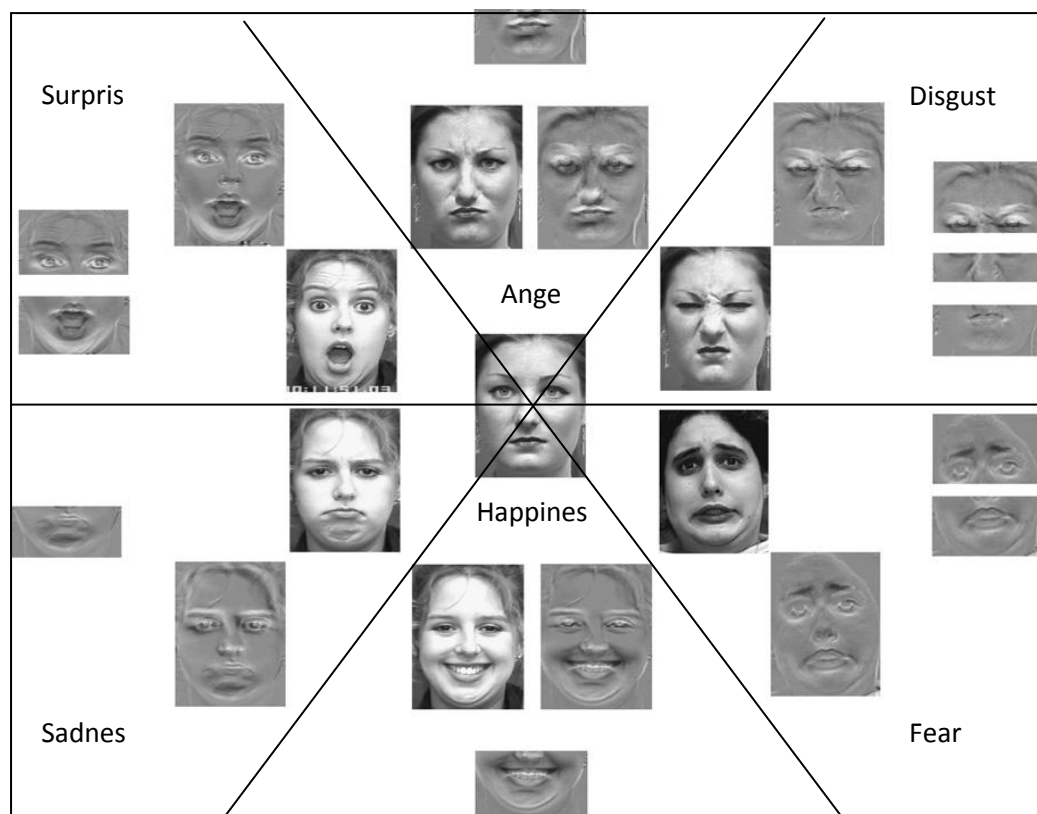


Figure 2.2 The most expressive parts of the face (Kotsia et al 2008 p.835)

Haake (2006) demonstrates that the use of different visual attributes, such as realism versus iconicity and visual stereotypes, can improve or deteriorate the engaging and motivational effects of pedagogical Agents.

## 2.7 Colouring

Colour is a good way to distinguish symbols from one another. The usefulness of colour coding has been demonstrated in several ways for several areas of use. Take for example Post and Geielmans' work with "Benefits of Colour Coding Weapons Symbology for An Airborne Helmet-Mounted Display" (Post and Geiselman 1999, title). The authors show that pilots recognize the symbols for a good missile launch solution faster and more accurately if the symbols are colour coded rather than monochrome.

If we summarize what we have learned from reading various literature concerning colour coding we concur with Hoadely (1990) that "The major findings from the colour literature in MIS and the reference disciplines can be summarized as follows:

- Colour improves performance in a recall task
- Colour improves performance in a search-and-locate task
- Colour improves performance in a retention task
- Colour improves comprehension of instructional materials
- Colour improves performance in a decision judgement task."(Hoadely 1990 p. 121)

So and Smith (2002) also seem to have ample evidence that "Colour coding can also be useful to emphasize distinctions and relationships in the information content, it may facilitate integration for the multiple dimensions" (So and Smith 2002 p. 571).

On the other hand, Hoadely (1990) also demonstrates that colouring can have bad as well as good effects on users' performance. This is specifically demonstrated for users' speed and accuracy in information extraction from charts and diagrams. Colour is shown to improve speed for bar, pie and table diagrams while it decrease speed for line diagrams. When it comes to accuracy colour improves pie and line diagrams, while bar diagrams are relatively unchanged and tables are worsened. An interpretation of Hoadely's (1990) results is that colour makes simple symbols easy to find and understand, but complex symbols, such as text and numbers, may become more difficult to read if they are coloured. This may be due to poorer contrast

between coloured text and background compared to black text on white background, which is the norm.

These physical properties of how colour coding is perceived according to the above are further complicated by influence from culture and conventions. Pancake (1998) has derived some colour coding guidelines from the work of Christ (1975, according to Pancake 1998). Pancake (ibid) especially warns against false coding that can occur when a culturally charged combination of colours such as red, yellow and green is used to colour code something that should not be emotionally influenced such as an impartial presentation of political parties.

Pancake's (1998) colour coding guidelines do well to summarize what we have learned:

- Avoid false coding
- Use focal colours (red, blue, yellow, green) for easy discrimination and recollection
- Avoid subtle distinctions in colour codes such as red and orange, unless they are part of a broad grading spectrum where exact distinction is not important

## 2.8 Metaphors

The human conceptual system is fundamentally metaphorical and metaphors are pervasive in everyday life, (Lakoff and Johnson, 1980). Our perception is structured and based on our concepts, how we relate to others and how we get around in the world. One kind of thing experienced and understood in the terms of another that is the essence of a metaphor. In other words the metaphor creates the perceptive resemblance. The human experience develops and creates metaphors, but at the same time the experience is developed and shaped through metaphors.

Metaphors have different meanings in different social context. In Cognitive science information processing metaphors are used to illuminate the field, differentiate it from other scientific domains such as Psychology (Stubblefield, 1998).

One way of describing the term Interface metaphors, can be by comparing it with a search engine (Preece, Rogers and Sharp, 2002). This tool is visualized for linking it to a physical object, different parts working together with an everyday action, searching for files to gather up relevant information and representing the significant findings to the user. The functions of this tool

work differently from how a human might carry out a search in the library. For information on a specific topic, the link can be recognized between a human action of searching and the search engine looking for relevant information. The link between, the action of the user and the tools search functionality, can help the user in further understandings of other parts of the search engine. Metaphors are recognized as an important aspect of interface design. The use of metaphors can enhance the usability of the system interface. This is stated by Stubblefield (1998). Metaphors are included in a lot of different aspects of a system interface and are influencing program functionality, system architecture and knowledge representation.

A common view on metaphors is that they develop, and by using the same metaphor in relevant circumstances, it becomes understood and recognised by more and more people. Ultimately the understanding of the metaphor becomes hard to vary or redefine. Another view on this matter is that the metaphor eventually loses the evocative understandings of what it stands for, and conclusively “dies”. Linguistic phrases are one example of dead metaphors. Stubblefield (1998) claims that design metaphors follow this life circle, from being broadly evocative to becoming more conventionalised. Many are convinced that they never really die, they keep the basic properties and some can develop new meanings. This is also indicated by the author applying the statement on his own project called Design for Machinability Advisor (DFM), a “spelling checker” metaphor Stubblefield (ibid, p. 75). Different stages of the project stimulated the metaphor. The success lay in that the metaphor was proposed for new. There are some essential statements about the metaphors according to Stubblefield (1998):

- Design metaphors that are strong can be beneficial and can be an obstacle. If the strong metaphor becomes valid for the design problem area it can lead to powerful solution, if not, it can be an obstacle for the design problem.
- Metaphors affect the design of the information system interface. It can also have an impact on the systems architecture and complexity.
- The design metaphors central purpose is to support communication among the team members. The design process is complex and different members provide different understandings, with often an unexpected outcome.

According to Marcus (1998, p 129):

*“Metaphors are the fundamental concepts, terms, and images by which information is easily recognized, understood, and remembered. Metaphors include the essential means by which choices for command/control are communicated and the status of*

*all data and functions is depicted. Because electronic displays can be transformed relatively easily and quickly, these metaphorical techniques can vary widely across systems and change over time”.*

## 2.9 Pictographic Symbols

There are different kinds of picture categories. A *symbol* is a picture that represents activity within the given situation, according to Koblanck (1997). A *pictogram* is a stylization of a concept for instance a road construction sign (Koblanck, ibid). *Graphical symbols* of different kinds have been used throughout the history in many different situations (Koblanck, ibid).

Choosing colour is essential when developing symbols (Koblanck, 1997). By manipulating colour it is possible to enhance the concept of the symbol. Pictographic symbols are used to convey a broad range of meanings, especially in the design of human-machine communication interfaces, such as product labels, traffic signs, computer icons, etc.

### 2.9.1 Icons

Icons are a type of pictographic symbols and the usage of them is not a novel invention. Reasons for using symbols are many, e.g.:

- Icons can be easily recognized and remembered (Weidenbeck, 1999 according to Huang, Shieh and Chi, 2002).
- Images have more universal recognition than text, since icon interfaces confront fewer obstacles than language (Lodding, 1983; Wickens, 1992 according to Huang, Shieh and Chi, 2002).
- Icons offer the perception of affordance, which can facilitate human-machine interaction in terms of ecological perception (Gaver, 1991; Lodding, 1983).

Users prefer icons to text for executing tasks, even though their performance may be neither better nor worse (Kacmar and Carey, 1991 according to Huang, Shieh and Chi, 2002; Nielsen, 1990).

According to Chen (2003) most of the books, tools, techniques, and consulting services on icon design are oriented towards an artistic way of designing icons. They focus too much on beauty and icons are often selected

according to the designers' preferences rather than those of the users. Chen (2003) proposes a method for icon design:

1. *Semantics-oriented*: The icon selection will emphasize the easiness of interpretation by the users based on
  - a. *Naturalness Principle*: The icons should be natural to users
  - b. *Resemblance Principle*: Resemblance to the real things or tasks.
  - c. *Differentiation Principle*: All the icons in the same system should be easily differentiated with each other and should not be easily misinterpreted.
2. *User-oriented*: The selection of icons should be based on users' preferences and extensive scientific user testing.
  - a. *Composition Principle*: Specific rules on how to compose icons. The composition rules should be natural and easy to understand and to learn. There are at least two sets of rules:
  - b. *Multiple-level icon composition Principle*: Rules to compose high-level icons from low-level icons based on similar concepts used in data/system modelling and English grammar.
  - c. *Grouping Principle*: Rules to design icons in groups based on the type and instance concepts found in data/system modelling and icon-based natural languages.
  - d. *Interpretation Rules*: These rules should be transferable to different systems.

In part as a counterweight Huang, Shieh and Chi (2002) claims that in most previous studies too much emphasis has been put on objective criteria such as meaningful, identifiable, concise, associable, and memorable for judging the quality of icons. In their study, they argue that criteria such as styling are also important. With styling they mean colour, layout, order, figure/ground, boundary, symbolism and typography.



Figure 2.4 Three styles of "go to home page" from Huang, Shieh and Chi (2002 p. 214)

## 2.10 Validity of Literature Study

Some of the books and articles are detailed enough in their description of how they arrived at their findings for us to decide if we believe them or not. Others are so short that we rather have to trust that renowned authors' articles in prestigious scientific journals describe results that are based on sound scientific research.

## 2.11 Literature review

When the literature study was performed the questions of Bryman (2002) were used as a basis for information gathering.

- *What is already known within the borders of the area you are applying your study in?*  
As seen under the headline *guidance from literature*, the different visualization techniques had varying amounts of information to be found. However, this literature was not in the most cases focused on Autonomous Agents on mobile platforms.
- *What terms and theories are relevant to your area?*  
To this question we found a multitude of slightly diverging instances. Each researcher seems to have his or her own set of expressions and definitions to each phenomenon.
- *Which methods and research strategies are applied on this area before?*  
A large percentage of studies concerning visualization techniques have been focused on positivistically operationalizing parameters such as number of clicks on buttons, seconds of hesitation and such. This provided a basis for us to build a more holistic view of each technique.
- *Do contradictions exist? Are there any existing contradictions or consequential results?*  
As mentioned about some techniques in the analysis above some of the literature were contradictory. This we used to identify difficult issues where often careful tradeoffs are needed. An example is different definitions of Autonomous Agents are made by different researches. Another example is that some researchers such as Chen (2003) advocate a more structured way of designing icons, while others such as Huang Shieh and Chi (ibid) emphasise the importance of styling the icons.
- *Are there any questions that need to be answered?*  
Questions were raised when gathering literature data. One

example was who should have control and how it should be handled. These questions were not aimed to specifically answer our research question, nevertheless, they were important to our problem area for a broader understanding. The importance of the privacy and control of who can access users' files was raised during the group interviews.

## 2.12 Summary

All in all this chapter has shown that there is research done that suggest that good visualizations are necessary for providing important feedback and control regarding Autonomous Agents (Bellotti and Sellen 1993).

Autonomous Agents can take many shapes and forms where the ones in the chosen project is an unusual but still representative example. Most of the four visualization techniques of colour coding, affective computing, metaphors and pictographic symbols are frequently used in contexts other than for Autonomous Agents on mobile platforms. There are also a multitude of what effects they may have and recommendations for how to use the techniques. In the following chapter we will apply these visualization techniques on the studied example project to see how they work in such context.

### 3 Research Methods of Thesis

The usefulness of different techniques have been assessed by studying reports of use in already developed systems as well as through testing the techniques in a example project, namely a user interface design of a system called Push!Music originally developed at the Viktoria Institute (Håkansson, Jacobsson and Holmquist, 2005).

In this chapter we describe the methodology used to answer the previously mentioned research question of this thesis. We have deliberately left out the development methodology of the object of study which will be described later in the chapter *Object of Study* subtitle *Research Methods of Push!Music*. This was done in order to separate the two methodologies, which is necessary because they have important differences in purpose and goals. Our goal of the research methodology (this chapter) was to find answer to our research question, while the goal of de development methodology (see chapter *Object of Study*) was to achieve a user interface that provides feedback and control (Bellotti and Sellen, 1993).

#### 3.1 Thesis Overview

The methodology of this thesis has three fundamental parts: literature study, empirical investigation and analysis of the empirical and literature data gathered. In the literature study previous research concerning the four different visualization techniques that we explored is represented. In the empirical investigation the visual techniques are developed, applied and tested on the project Push!Music. This has been done in order to find relevant techniques and gather information to base an analysis on.

Furthermore the investigation of the visualization techniques is carried out with one basic principle in mind: *feedback and control* (Bellotti and Sellen, 1993). The literature study, empirical investigation and analysis are connected. They are fundamental for this thesis. This process is highly iterative, by switching between the three fundamental parts and letting each part inform the others.

The empirical study lies within the borders of Design Science (Hevner et al 2004). The development of visualizations for Push!Music needed elements of Design Science, due to its exploratory nature (Hevner et al 2004). One way to test Design Science results is through use of an “observational evaluation method” (Hevner et al, 2004, p. 86) such as an evaluation of Push!Music interface design. This is the reason why the Design Science is a support for the evaluation and vice versa.

## 3.2 Design Science

According to Hevner et al (2004) there are two main aspects that are needed to reassure the quality of information systems research: Behavioural Science research and Design Science research. They continue to explain that Behavioural Science is mainly focused on the creation and evaluation of theories. These theories usually aim to predict or explain phenomena such as systems' perceived usefulness and impact on individuals or organisations. On the other hand Design Science mainly focuses on the creation and evaluation of information systems such as software, formal logic and informal natural language descriptions. According to Hevner et al (2004) the two research paradigms have slightly different but interdependent goals. Where Behavioural Science has the goal of truth, Design Science has the goal of utility. The goals are interdependent such as truth informs design and the utility of designs informs the formulation of theories.

This thesis' research exists in the border area between the two paradigms and in a way it illustrates their interdependency. Development of a chosen set of information systems is performed, namely visualisation techniques and Push!Music, which Hevner et al (2004) describes as a focus of Design Science. On the other hand, the results of the subsequent evaluations inform theories concerning the utility of visualisation techniques.

Hevner et al (2004) present a set of seven guidelines to let us understand the requirements for effective Design Science research. Below we will review them one by one and examine what bearing they have on our research.

*“Guideline 1: Design as an Artefact” (Hevner et al, 2004 p.84)*

The research aims to result in two artefacts. The primary artefact consists of a set of evaluated visualisation techniques, a toolbox that is specialised for use on Autonomous Agents. The secondary artefact is the illustrating exemplar project of Push!Musics' visual interface. The primary artefact is to create the secondary but also vice versa in order to evaluate the visualisation techniques with the help of testing them on Push!Music.

*“Guideline 2: Problem Relevance” (Hevner et al, 2004 p.84)*

The relevant problem in the Push!Music project is the black box appearance of the existing Autonomous Media Agents. According to Hevner et al (2004 p.84) the objective of information systems research is to acquire knowledge that enables solutions to business problems. “Design science approaches this goal through the construction of innovative artefacts aimed at changing the phenomena that occur”. In our case the set of visualisation techniques are designed to change the phenomena of black box appearing Autonomous Agents.

*“Guideline 3: Design Evaluation” (Hevner et al, 2004 p.84)*

The visualisation techniques are evaluated regarding their utility and efficiency. This is performed by the methods of literature study and application of the techniques on an evaluation project. Exactly how the evaluation is performed can be read in the next section, *Analysis Framework*. Two of the evaluation methods that Hevner et al (2004) recommend are used by us: observational and descriptive methods.

*“Guideline 4: Research Contributions” (Hevner et al, 2004 p.84)*

This is the part where this thesis' research differ the most from typical Design Science. Hevner et al (2004) state that what distinguishes Design Science from every day design is that routine design is the application of existing knowledge to organizational problems such as creating systems using best practice methods while Design Science addresses unsolved problems in innovative ways. Our visualisation techniques may not be considered innovative in themselves as many of them have been used in countless other applications.

On the other hand the area, on which they are applied, is relatively novel. The particular type of Agent employed in Push!Music has not been visualised for the purpose of illustrating their actions before. This means that our research contribution is an evaluation of already existing techniques for the use in a novel setting rather than a novel design in itself.

*“Guideline 5: Research Rigor” (Hevner et al, 2004 p.84)*

The rigour of our research is somewhat difficult to describe and test. There has not been found any well-defined and tested method for either constructing or evaluating a toolbox of visualization techniques. On the other hand it is utilised in a set of design and evaluation methods in the project of designing a new user interface for Push!Music.

*“Guideline 6: Design as a Search Process” (Hevner et al, 2004 p.84)*

Hevner et al (2004, p.88) claim that: “The search for the best, or optimal, design is often intractable for realistic information systems problems.” It is not aimed to come up with an optimal set of visualization techniques that is the best possible to give feedback from Autonomous Agents. The research aims to discover visualization techniques that work well for the aforementioned task. This thesis represents one or a few iterations of the “Generate/Test Cycle” that Hevner et al (2004 p.89) describes. We have generated a set of visualization techniques and tested them in a context.

The search process consisted of scanning existing literature for relevant visualization techniques, and then testing them on the exemplar project. It

has been an iterative search process where the focus lied in gathering knowledge of often used and recommended visualization techniques.

*“Guideline 7: Communication of research” (Hevner et al, 2004 p.84)*

Hevner et al (2004) advocates that Design Science research should be presented both for technology oriented as well as management oriented audiences.

It is aimed to address the technology-oriented audience by giving a rather detailed technological description of the Push!Music system, how it works and what have been attempted to visualize.

For the benefit of management oriented audiences we also stress the need for valid visualizations that can give appropriate feedback and control to the user. Evaluation of these visualisation techniques is meant to aid system design project managers in determining what resources will be needed.

### 3.3 Analysis Framework

In order to evaluate advantages and disadvantages of a visualization technique it is necessary to have some form of criteria that the visualizations have to fulfil. This criterion is a contribution to the concept of feedback and control that Bellotti and Sellen (1993) describe. In other words we needed to test if a visualization technique contributes to feedback and control. A form of check list of questions, to be applied on each technique, was developed. It reads as follows:

#### *Maturity of a technique*

1. Is it commonly used?

#### *Relevance*

2. Is it relevant for Autonomous Media Agents? Why? / Why not?  
This helps us decide if the technique is still worth exploring. This means we needed to verify that the technique really fits within our problem area.

#### *Bias reduction*

3. What was our general opinion of working with the technique?  
This was asked in order to collect our subjective thoughts and biases to a technique and to make them visible.

#### *Advantages and disadvantages*

4. Was the technique convenient?
5. Was the technique cumbersome?
6. Is it effective and/or resource demanding?
7. In what stages of the design process was the technique helpful?  
This question helps illustrate how a technique can develop or lose advantages and disadvantages over time.
8. Was the technique inspiring?  
Inspiration can lead to both advantages and disadvantages; you can be inspired to overcome hardship or be carried away and waste resources.

*Success with the chosen technique*

9. Did we succeed in using the technique?
10. Did the user follow our intention in using the technique?

These two last questions aim to support the previous ones with a more empirical connection.

These questions were created through a brainstorming (Löwgren and Stolterman, 2004) session about what is suitable analysis framework for the research question. To refine and further build them we used Preece, Rogers and Sharps' (2002) suggestions for "Identifying needs and establishing requirements" (ibid, p. 201). The user's need is feedback and control, as described above. The developers' needs regarding the techniques we identified to be practically applicable, sufficiently convenient and effective. This was incorporated into the above list as questions and counter questions.

This set of questions was meant to guide the evaluation of each technique so it would be done with a consistent severity. This reduced any bias that we may have towards any of the techniques, positive or negative. The idea was that if we forced ourselves to ask the same questions about all the techniques certain aspects of certain techniques would not be skimmed over by us out of bias. For instance if a particular technique is fun and inspiring to work with but very resource demanding the demand of resources would not be ignored because we liked it so much. In other words, having this predetermined set we were guided to ask the same questions about every technique, and in that way the critique was more equally distributed amongst them.

While considering these questions, regarding each of the techniques, a set of areas or aspects of the techniques emerged. This was done by grouping the

aforementioned questions into categories that deals with a respective aspect of the visualization techniques. We found that each aspect contains both *advantages* and *disadvantages* for the techniques. The aspects are as follows:

- Relevance
- Effectiveness
- Success in Push!Music
- Guidance from Literature
- Frequency of Earlier Use
- Stages of the Development Process
- General Impressions

The aspect of *relevance* we would judge as the most basic and important aspect of all techniques. It concerns the question whether the technique is at all applicable on the system in question.

*Effectiveness* concerns the issue of how clear and informative feedback the technique can provide. If the use of a technique lets a user understand exactly what you mean without confusion or delay, the technique is highly effective. It is also effective if it affords communication of large or complex amounts of information.

The *Success in Push!Music* aspect considers our actual rate of success so readers of this thesis can learn from our mistakes and accomplishments. Poor success would also be an important indicator of strong disadvantages of a technique.

The *Guidance from Literature* is an important aspect of a technique in itself. It would be a strong disadvantage to lack guidance from literature as it forces you to guess, try and make mistakes in order to learn for yourself.

The *Frequency of Earlier Use* indicates if the technique is popular among developers or not. High frequency may indicate strong advantages that make developers like it. It is also an indicator to a technique's maturity.

Different visualization techniques can have different advantages and disadvantages during different *Stages of the Development Process*. This section addresses how the work with a technique changes over the course of the development process.

Last but not least, is the aspect of a *General Impression* which is very subjective and difficult to make scientific conclusions of. Nevertheless this aspect plays an important part in the choice of techniques to use. If a technique gives the impression of being very useful and very fun to work with chances are that you will work long and hard to make it work well.

The different aspects mentioned above are evaluated with the literature study findings as well as the empirical data (see figure. 2.1). This analysis process was highly iterative so that what we found in literature we tested in practice and what we then found during the empirical investigation we researched further in literature.

### 3.3.1 Method of Data Analysis

The quantity of data after the evaluated project was extensive and therefore the data needed to be reduced into graspable amount. Data reduction is a part of analysis method and it refers to selecting the valid data from the notes or the transcriptions (Miles and Huberman, 1996). It is a procedure that continues throughout the study until the final report is done. In our study the reduction of data was as Miles and Huberman describe (1996), an iterative process that was ongoing until this thesis report was done.

Practically this was performed by listening to and watching recordings and reading through transcriptions while taking notes of statements. When statements appeared very similar they were paraphrased by selecting representative sections of the coinciding statements. Special strength was considered of statements consisting of paraphrases amongst participants preceded by statements like “I agree that...” (see Appendix 2). This way the group interviews allowed for a certain form of “Member validation” (Seale 1999, p.61)

## 3.4 Gathering Empirical Data

An overwhelming majority of the empiric data, on which this study is built, has its source in the Push!Music project. The same data that was used to develop the graphical interface of Push!Music was also analysed from the point of view of this thesis’ research question.

Notes and audio recordings where used for data gathering of group interviews. The user testing of the prototype was documented by video and notes. The recordings were later on transcribed, and observation notes were taken while watching the video recordings.

### 3.5 Validity

In order to enhance this thesis' quality and scientific trustworthiness, the validity need to be thought through and discussed. Validity is not a given fact and overall ruling convention, it is a matter of evaluating each study and deciding what is applicable at the given situation. "Validity is a goal rather than a product; it is never something that can be proven or taken for granted" (p. 105, Maxwell 2005).

#### 3.5.1 Credibility

The elements of literature study, interviews and user tests are used to refine and corroborate each other in something that resembles triangulation as mentioned in literature on scientific methodology (Creswell, 1998; Miles and Huberman, 1996; Seale, 1999; Maxwell, 2005). We investigated whether the statements that we found in the literature, regarding the chosen visualization techniques, came true in the applied context of our design project. When we came to any conclusion from our empirical study we also looked for literature on research that could either corroborate or contradict our findings. The data from our different empirical sources such as group discussion transcriptions, user test video recordings, design sketches and observational notes were also compared to each other, as a source triangulation.

#### 3.5.2 Transferability

We have chosen to study qualities of techniques, rather than something that is easily quantified and measured. Because of this the validity and transferability, of our research, has to be described by other means. "Not through random sampling or probabilistic reasoning but by detailed description of the setting studied so that readers are given sufficient information to judge the applicability of findings on other settings they know." (Seale 1999 p.45) We give an as rich description as we can of the visualization techniques and the context in which they were studied. Then it must be up to the reader to assess the similarities to contexts they know and see how one can transfer what we have found. This can be to greater or lesser extent depending on the context to which one wish to transfer our findings.

#### 3.5.3 Bias

We were trying to be aware of our own bias and by for instance having a set of questions and bullets of what the users should do when testing the

prototype we were aiming to get the same framework of questions and tasks for each respondent. The questions and tasks explained are attached in the appendix. When analysing the chosen visualization techniques we have also created a framework, a set of aspects for all the techniques to be analysed around. In one of the aspects called *General Impressions*, we were trying to include subjective opinions and in that way limit our opinions to this section. The researches bias should be exposed in an upfront matter (Maxwell, 2005).

### 3.5.4 Ethics

For this thesis to have correct approach to ethical issues we have followed three bullets that have helped us stay focused on this matter. We used these guidelines to control the ethical level of this investigation and to remind us of what to consider (Preece et al, 2002):

- For each activity that involved a user participant we have carefully explained what purpose and goals this investigation has. Within this area we have explain the time it will take, and what kind of data will be collected. Preece (ibid) mentions that one should go back to the respondent and give them possibility to view the data collected and represented but we decided not to do this. This decision was made on the basis that the data collected would not compromise the respondents because that data is anonymous and do not include personal information other than their perception of the design.
- The anonymity of the participants was promised and due to the video and audio recordings that we used.
- The users involved in the user tests were informed that they should not feel unintelligent if a task is hard to solve. This indicates more that the prototypes' visual feedback is rather unclear.

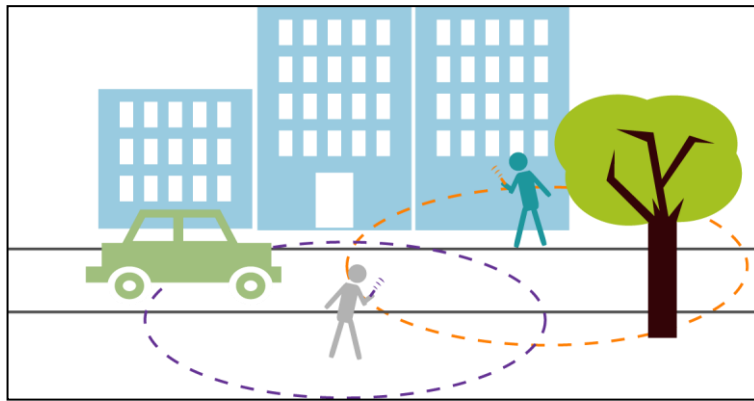
## 4 Object of Study

### 4.1 Background

As we looked for a suitable project to conduct our research on we came across a project started at the Viktoria Institute in a research group called Future Applications Lab. This group specialises in research on mobile Media and ubiquitous displays and among other projects started one called Push!Music. The researchers at the Viktoria Institute wanted to explore new graphical interfaces for the functionality they already had developed, and we were looking for an interesting design project. This ended up in a situation where the Viktoria Institute could get a draft on their interface and we could get an object of study. The evaluated project in itself entailed the development of a graphical user interface for the Push!Music system.

Push!Music project aimed to develop a system for music file sharing, enabling users to listen to audio files that they did not know existed before. The goal was to let the system act as a source of inspiration for listening to new music and it should serve the user as a new way of recommending music to others that have the same application.

Viktoria Institute had developed a functioning prototype that was not focused on Interaction Design and visualization of an interface on mobile devices but rather the aspects of technical design and social interaction between users. During 2004 and 2005 Maria Håkansson, Mattias Jacobsson and Lars Erik Holmquist at the Future Applications Lab of the Viktoria Institute performed a study investigating what roles mobile music can play in social contexts. This study was then used as a basis for developing the concept of Push!Music (Håkansson, Jacobsson and Holmquist 2005; Jacobsson et al 2005).



*Figure 4.1 Strangers sharing audio files.*



*Figure 4.2 Friends sharing files*

We would like to illustrate a couple of short scenarios. First scenario (see figure 4.1): When one user passes by where another user of the Push!Music is located, the first automatically receives a tune from the others selection. This is done due to their similar music taste.

Scenario two (see figure 4.2): The users know each other and manually share tunes through explicit recommendation.

The concept entailed that users of mobile units such as Personal Digital Assistants (PDA:s) swap music with each other over ad-hoc networks. People connected to the system that happen to be within range of each other give and receive music files, partly automatically at the initiative of Autonomous Agents and partly from explicit recommendations made by the other users.

In Push!Music's case the environment consists of the play lists of the users' PDA:s where Agents act as part of music files that copy themselves between users. This will be described in greater detail in the following chapter.

## 4.2 Push!Music – How it Works

The Push!Music application with its peer-to-peer technique runs on Wi-Fi enabled PDA:s. That gives the users opportunity to send or “push” tunes to others. In this way the user will be recommended a song and hopefully get inspiration on new kinds of music. Another significant feature of this application is tunes that recommend themselves to users. The spontaneous recommendation of songs could be the music that already exists in the PDA's music collection or other connected devices nearby. To solve the problem of implementation, the researchers of the Viktoria Institute came across the concept of Autonomous Media Agents. The researchers wanted to avoid actively searching for new tunes and wondered how it would be like if the tunes recommended themselves and actually succeed of recommending the songs the users actually wanted. The founders of Push!Music explains further:

“Imagine that you carry a mobile device that has the ability to store and play back music files, e.g. a mobile phone with an MP3 player. As you encounter various people, the devices you are carrying connect to each other, e.g. via Bluetooth. Media Agents from other nearby devices check the status of your media collection. Based on what you have been listening to in the past and which files you already own, some other music might spontaneously “jump” from another device to yours (and vice versa), on its own accord. Later, when you listen to your jazz songs, the system also plays a newly obtained Frank Sinatra tune that you had not heard before. “ (Håkansson, Jakobsson and Holmquist, 2005 p.1)

The user interface of the prototype developed by the researchers of the Viktoria Institute has five modes: Player, Users, Activity, Pool and Library mode. All the modes are based on textual lists above the ever-present play control and voting buttons. This prototype was developed with the purpose of testing people's attitude towards sharing music automatically.

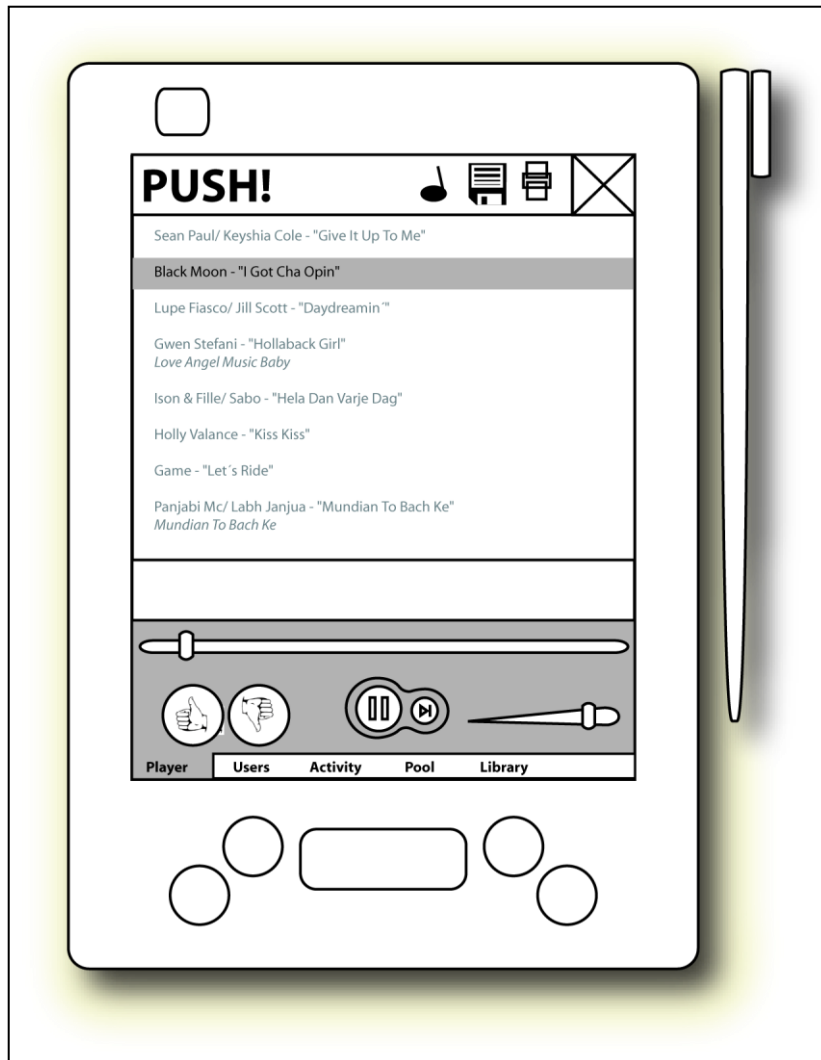


Figure 4.3 A illustration of the original Push!Music prototype interface that was developed by Victoria Institute.



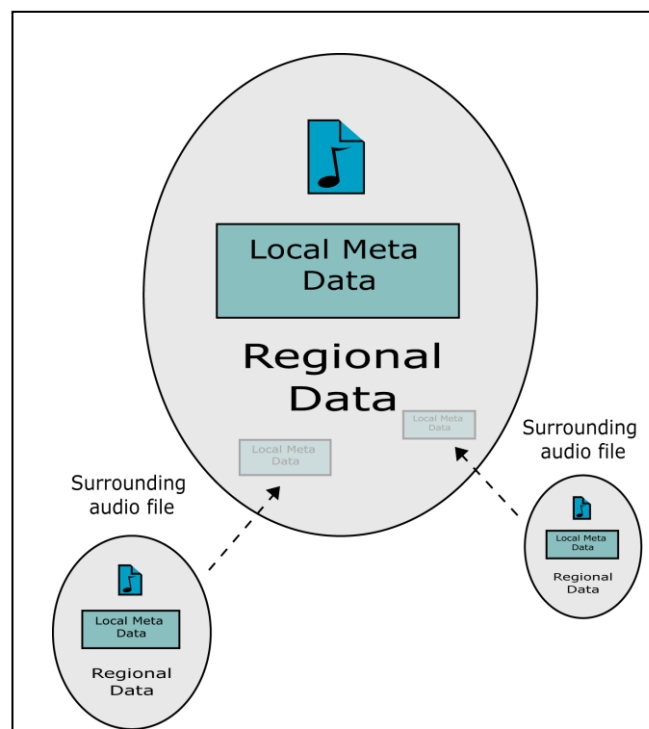
Figure 4.4 Snapshots of the system developed by researchers at Viktoria Institute

### 4.3 Autonomous Media Agents in Example Project

In their quest to find an Autonomous Agent that could achieve their goals the founders of the Push!Music project came across a multitude of different Agents. Håkansson, Jacobsson and Holmquist (2005) say they mostly have settled on a version defined by Pattie Maes:

"Autonomous Agents are computational systems that inhabit some complex dynamic environment, sense and act autonomously in this environment, and by doing so realize set of goals or tasks for which they are designed" (Maes 1995, p. 108).

So what do we include in our definition of an Autonomous Media Agent? An Autonomous Media Agent is a programmable entity that has a property that continually is working in the background. Here follows a brief description of how Push!Music's Agents work (see also figure 4.5):



*Figure 4.5 How Push!Music Agent works in a environment containing other Agents, music files.*

To achieve the above mentioned automatic recommendations every tune has two databases connected to it; one local that collects meta-data about how and when the associated tune is played and what the user thinks about it, and another one regional one that collects data from adjacent tunes' local database. This way each tune "knows" in what context it is played; how often it is played, how often other tunes are played etcetera. When two Push!Music

units are connected the databases are compared. Depending on this comparison certain tunes copy themselves to the other unit.

The picture represents a schematic over the function of Push!Music's collection of metadata. Local meta-data consists of data about how that particular tune is played. Note how the active tune records local metadata from the surrounding tunes and puts it into its regional database.

## 4.4 Target Group

We chose to start involving the users early in the development project. Push!Music did not originally have a clearly defined target group; it was intended to fit all people from young age to seniors, everyone who is interested in music. Maxwell (2005) claims that it is easy to fall into the trap of using what the researchers might think is good design instead of actually asking the users of a system. For us not to fall in this trap we decided to define a more limited target group.

A second reason why we decided to define the target group was that the design itself will be more focused when having a clear definition of what people will use the application (Preece, Rogers and Sharp, 2002). Imagine for example trying to develop a car that suits any user. It might end up like a sports car (for young users) with a back end like a pickup truck (for craftsmen), soft suspension like a comfortable limousine (for business people) and four doors like a family car. One might think this would suit almost everyone but in reality it suits none, not to mention that it would be impossible to build at all. The target group of Push!Music is limited to people that have used mobile devices, which do not necessarily have to be restricted to music players. The people that represent our target group do also not necessarily have to have deep understandings in technology and to be for instance engineers but they have a general familiarity with the most common terms. They are about 20 to 35 years of age and have an interest in music.

One reason why we chose this particular target group is because these were easily accessible to us (Bryman 2001). It is broad enough for us to have an ample body to select respondents to our inquiries from but narrow enough to guide our design decisions.

## 4.5 Methods of Example Project

We started up by gathering information on what has been done until the start of our study when it comes to the Push!Music project itself. For this

purpose we used unstructured discussions (Creswell 1998) with the founders of the Push!Music project. As these discussions were meant as a preliminary gathering of background information, we were content to use only scribbled notes as means of documentation. Besides, we had articles published by the Viktoria Institute researchers (Håkansson, Jacobsson and Holmquist 2005; Jacobsson et al 2005) as a source of more detailed information. The unstructured discussions informed us about different reference, such as other projects within the general area. They also contributed with inspiration as well as guidance for our research. We also discussed how the specific Push!Music Agent works. Result and details are described in previous chapters *Push!Music – How it works* and *Autonomous Media Agents in Example Project*.

Later on we decided that we needed a good basis for whom we were developing the application. That is why we continued our research process by identifying and deciding the target group.

Based on the preliminary investigations described above as well as our estimates of the selected target group we continued our empirical investigation with developing series of sketches, as means of visual representation of our ideas and concept. These sketches depict a concept of possible visualizations. This course of action is in line with Löwgren and Stolterman's (2004) description of a good design process. They argue that such sketches with details based on preliminary assumptions and ideas may be a good tool for acquiring information about how to develop and refine a design. As mentioned in the chapter *Research Methods of this Thesis* some questions arose during this work: What and how can we visualize communicating our ideas and concepts? What are the size implications? Which visualization techniques should be used and are best suited at this point in the process? These questions we found to be relevant for our design process. They are implicitly answered in the *Analysis* chapter.

Group interviews were used mainly to provoke reactions and to serve as a focal point in discussions with potential users. This method contributed in open communication, basic feasibility testing and something to confront respondents with, to create discussion. Our goal at this stage was to get fresh ideas and opinions from the people we intended to develop this application for. We wanted to get inspired from people within the specific group and also to receive critique on design and as well as other design alternatives. Question that have been asked are: Which is difficult to understand? What metaphors work? What is pleasant or unpleasant? In Bryman's (2002) description of this method we found several advantages in the interaction between the members of the groups and how they can inspire each other to reveal more.

The participants in these group discussions were selected with a principle of spreading the risks and benefits between mainly two different selection methods. Creswell (1998) strongly advocates against investigating “your own back yard” (p.114). With this in mind, we selected one group of complete strangers whom we chose randomly from people sitting in a cafeteria at Lund School of Economics. To counteract the apprehension the participants of this procedure exhibited, we also selected participants that we had contact with prior to engaging them as respondents in our study. This way these respondents did not seem to feel as attacked by strangers asking weird questions. This way our data was balanced between people that may have bias for and respectively against us. This may apply to any bias on our part, for or against any respondents, as well. Thus we have utilized a mixture of convenience and randomized selection (Bryman 2002).

Furthermore we continued the design process by designing a semi-functional and interactive prototype. Here we focused on our four visualization techniques for further exploration of design alternatives by introduction of colour, animations and audio effects and so on. Question to solve where: What can we do with colours, animation, programming and audio? And so on.

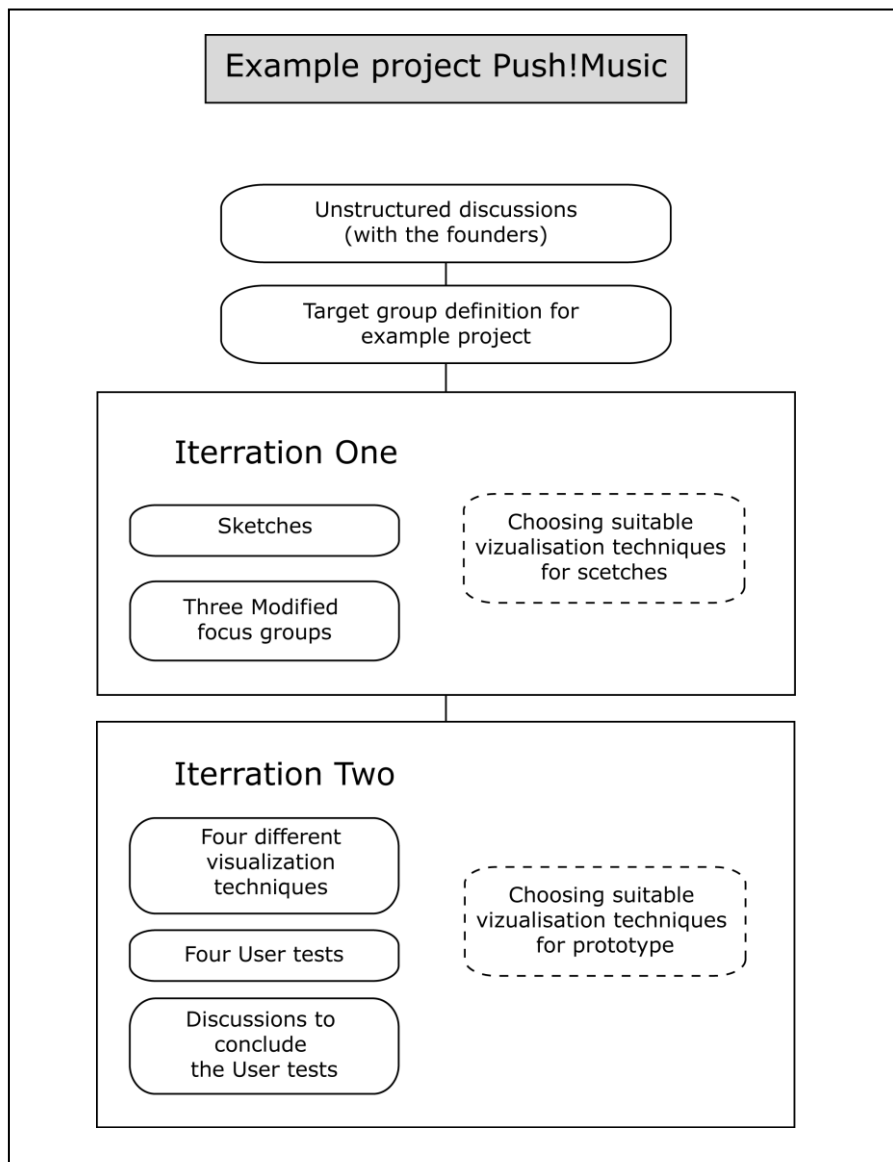
By involving the users for a second time, (but this time in user tests) we focused on further critique and suggestions. Questions that were considered where: Does our concept work? Do the users get a functional mental image? What is difficult to design? What can be done to improve our concept? A small discussion with the participants concluded each session (see Appendix 8).

Usability testing is used for the developers to measure amount of errors and time to complete the tasks (Preece, Rogers & Sharp, 2002). We used it in a way to get the types of errors that occur in a design process, to get an orientation of what the users may think of the interface provided. The importance of the error was in focus for us, though the time consumption was estimated as a secondary focus point. On the other hand we did lead the users in doing some tasks in order to see if errors occur when all of them test the interface. We documented the results from each test with video recording, in order to later analyse the data.

Overall the empirical investigation has two major parts called iteration one and iteration two (see figure 4.6). These were created and named for an easier overview. Iteration one included the development of sketches in purpose of provoking feedback. They were presented, during the group interviews. The second iteration includes the process of making a design proposal in form of a semi functional and interactive digital prototype. Also included here are the actual user tests and the small discussions to wrap up the tests. To simplify and to give an overview of our methods we have made

the chart (see figure 4.6). The findings of the discussions were documented with pen and paper.

Both for the group interviews and the user tests interview guides were developed in order to help keep the discussions within our area of interest. They were however applied rather loosely so that the respondents could answer freely.



*Figure 4.6 Push!Music had two main iterations The first including sketches as to provoke feedback and the second one including semi-working prototype*

## 5 Empirical Findings

In the beginning of our study we developed a series of sketches in order to present our original ideas to potential users, as mentioned before. These sketches depict a concept of possible visualizations and were used mainly to provoke reactions and to serve as a focal point in discussions with potential users. The sketches consist of a short series of simple images. Some depicts a neutral non-living embodiment of our Agents and simple symbolic representations of their connections and actions. The other set has a more living feel to it. They consist of faces as representations of the Agents themselves. The same set of sketches was used at all group meetings of iteration 1. We made, however, some minor variations in how the meetings were conducted and documented. This way we got three sufficiently comparable meetings while we still could refine our questioning technique. The questions we asked were in essence the same; they only got more precisely put. Four different groups of sketches were made. We chose to call them: groups A, B, C and D. We decided to combine modes and only to have three different modes (play list, Push! and Library) compared to the original, which had five different ones (Player, Users, Activity, Pool and Library). Push! mode was later renamed to Share mode, more details on this will follow later on in this text.

Play list mode in the original prototype consists of a traditional looking play list. It is built upon features common to other music Players such as MP3-Players, Win Amp, Windows Media Player and QuickTime Player. We did this in order to ensure that the user gets a familiar interface with easily recognisable functionality. There is one added function however. Two buttons marked with symbols of *thumb up* and *thumb down* respectively are intended to let the user vote if he/she like or dislike the tune currently played, these are also found in the original prototype. We choose not to take away the software Player-operation buttons in our prototype such as play, pause etc. We did not place that functionality exclusively in hardware buttons. The reason is the usage patterns of PDAs are not the same as of mobile phones. The PDAs are bigger devices and usually it is necessary to use both hands to operate the device: one hand to hold it and the other to navigate with the stylus<sup>1</sup>. Mobile phone is nowadays a smaller device and could be easily controlled by one hand. This is only a matter of hardware and because of that we decided to continue having PDAs as the main device to base the study on and we decided to not take away the software buttons.

Share mode has songs represented with symbols that have affective expressions of being happy or sad. The symbols are clustered, connected and

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<sup>1</sup> Pen like tool to operate a PDA.

given affective expression according to the metadata that is stored in the songs. We have attempted to make the symbols look as alive and intelligent as possible to let the user know that the agent tunes are autonomous and that they store and use information about the user's listening habits.

Other users are also represented on the same screen. The exchange of tunes between users is represented by the tune symbols emerging from and disappearing into the user symbols.

Library mode look and work in essence like an ordinary file browser in Windows. It is intended to let the user import music into and remove music from the Push!Music system.

## 5.1 Group A Sketches

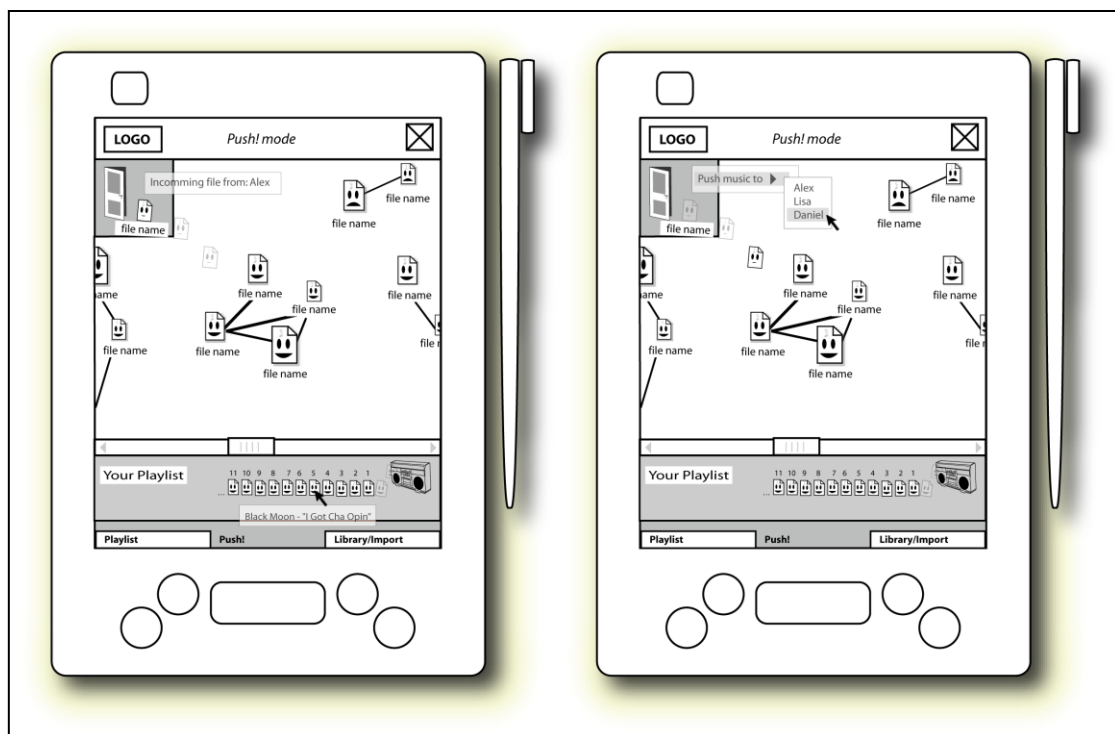


Figure 5.1 Illustrations starting from the left represents A.1. and A.2.

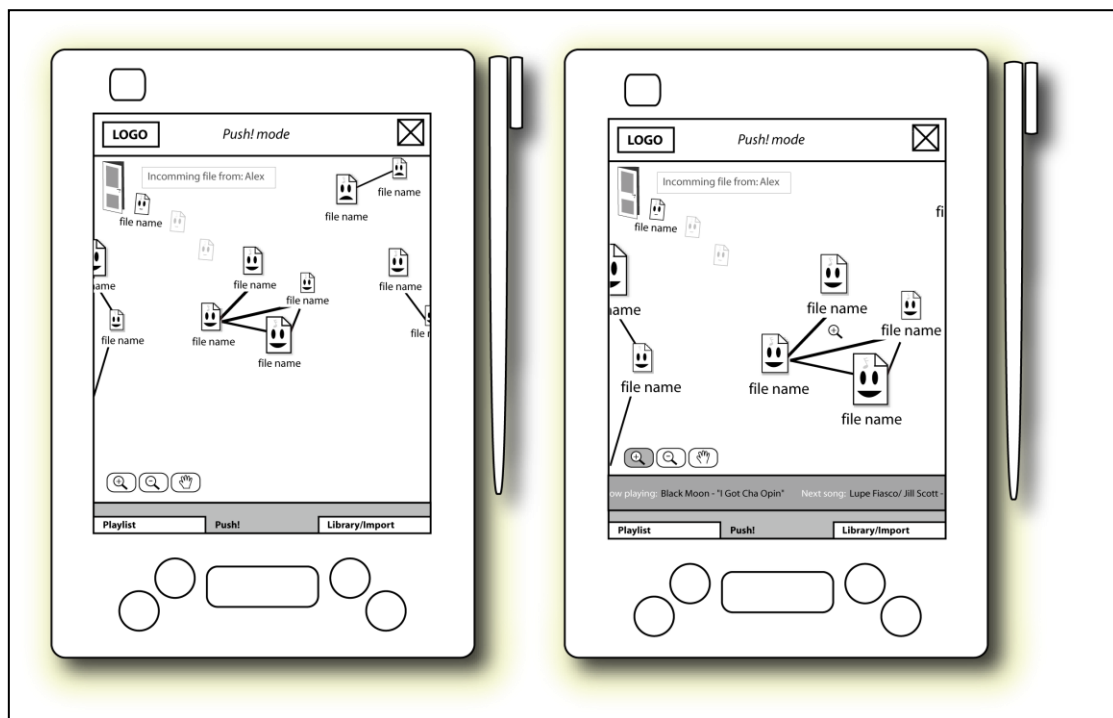


Figure 5.2 Illustrations starting from the left: A.3. and A.4.

The tunes are represented by symbols that we hoped would be easily recognisable for the user. The names of the files are written underneath. The illustrations A.1. and A.2. have scroll navigation for the user to have access to the other files that do not fit in the display while the A.3. and A.4. have a zoom functionality instead. The door represents the import and export function. When a file is received a small pop up becomes visible and informs the user that a file from another user is incoming. If a user wishes to push a tune to another user, he/she can do so by moving the file icon into the door area so that a menu pops up to give the user the possibility to choose to whom he/she wants to give the file. Illustration A.1. and A.2. have a play list that contains the files that are in line to be played. In illustration sketch A.3. we decided to make a variation and take it away completely in order to give more space for more tunes in the main area. Illustration A.4. features an animated list of the played tunes (name, album and artist). The lines between the tunes represent in what order they were played the last time. The size of the tunes represents how many people have voted on that particular tune and what rating it contains. In the lower end of the display there are tabs available for being able to quickly jump from one mode to the next. All the sketches illustrate this feature.

5.2 Group B Sketches

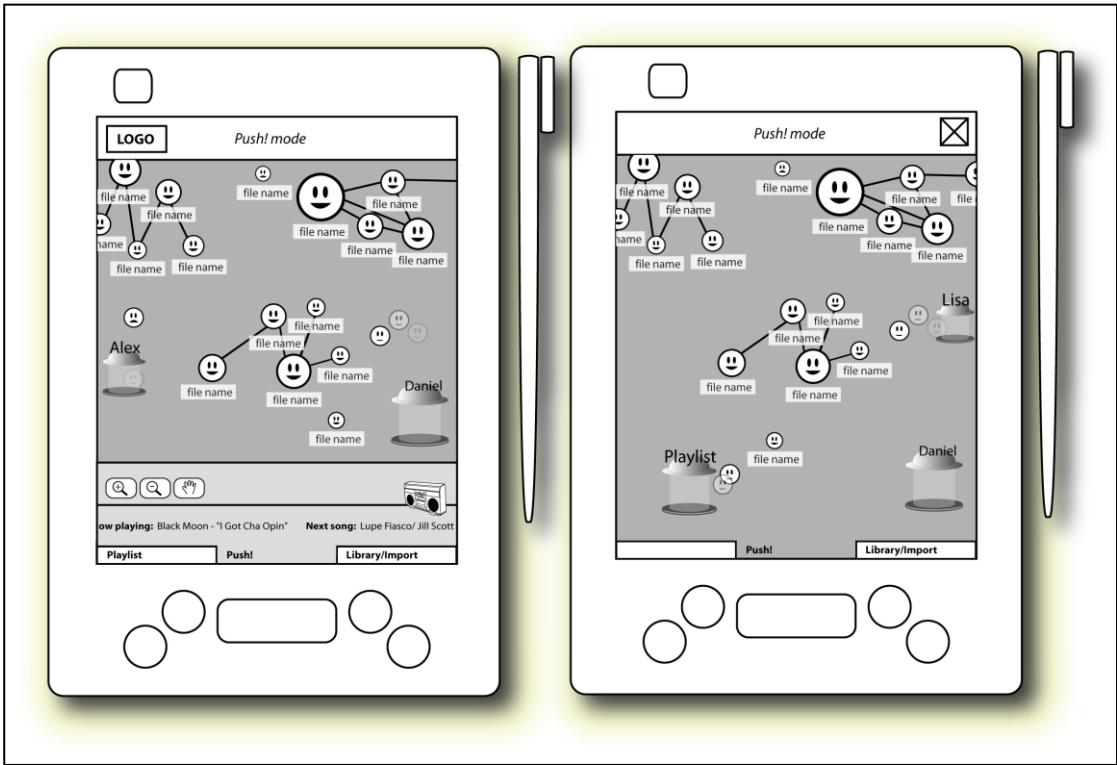


Figure 5.3 Illustration B.1 and B.2.

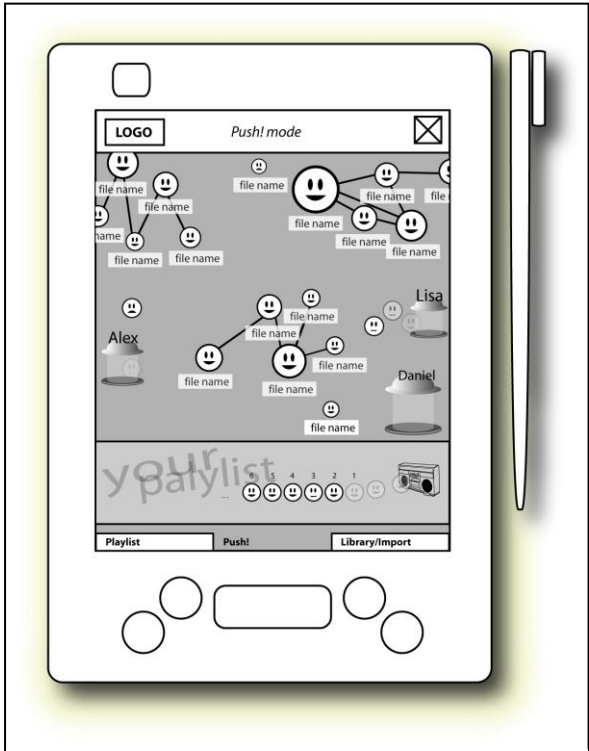


Figure 5.4 Illustration B.3.

In this set of sketches we took bits and pieces previous ones and tried to combine them in different possible ways. The play list is also illustrated differently in all of the variation in this group. The tune files are represented in form of smiles with the same connections as in sketches of the first group, group A. Here the play list of illustration B.2. is represented in form of a teleport station.

### 5.3 Group C Sketches

This version of Push! and Library modes have some traditional features represented, but yet with some novel symbols, as the teleports. The Push! mode contains only the teleports representing the other users in the system and a Library folder to send the files to and receive them from. The Library mode is where the user can access the tunes stored locally in the device, here represented in the left light grey field in illustration sketch C.2. The file list field have software buttons such as add and delete. In the Push! mode the tune icons have no face, and the connection between the tunes is not used here.

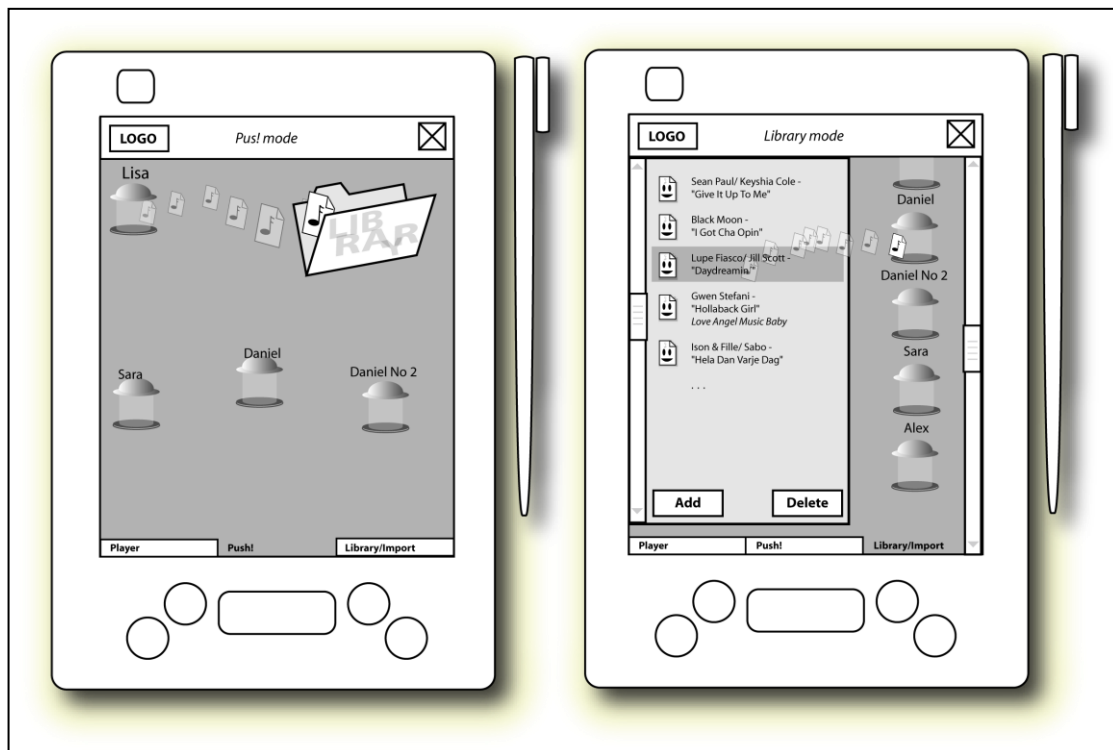


Figure 5.5 Group C sketches C.1. and C.2.

## 5.4 Group D Sketches

The play list mode was visualized in more traditional way so that it would be easily recognisable for the user. The concept of anonymous Agents is abstract and because recognisability is an important positive factor (Preece, Rogers and Sharp, 2002) it is good to have an environment that the users could recognize where that is possible. Other parts of Push!Music may be novel enough so that it is better not to add to the memory load (Preece, Rogers and Sharp, *ibid*). The play list mode consists of a list and a field where the played tune, artist and the album are visible. In the lower end of the interface there are software buttons: Play, Stop and Next, Volume and the time line of the song. There is also thumb Up and Down button for the users to vote for the song. This mode was combined with the previous group sketches A, B and C.

The differences in Library / Import -mode is representing the PDAs file explorer, the user is able to drag and drop the tunes to the music library, represented to the right. The files can be added and removed by pushing the software buttons. This function can also be accessed by placing and holding down the stylus on the tune. After a short while there will appear a small list that is usually found in the existing PDAs systems. The latter corresponds with the right-click function of a mouse for a PC. This mode should be combined with group A and B illustrations, while the group C have an own version of the mode.

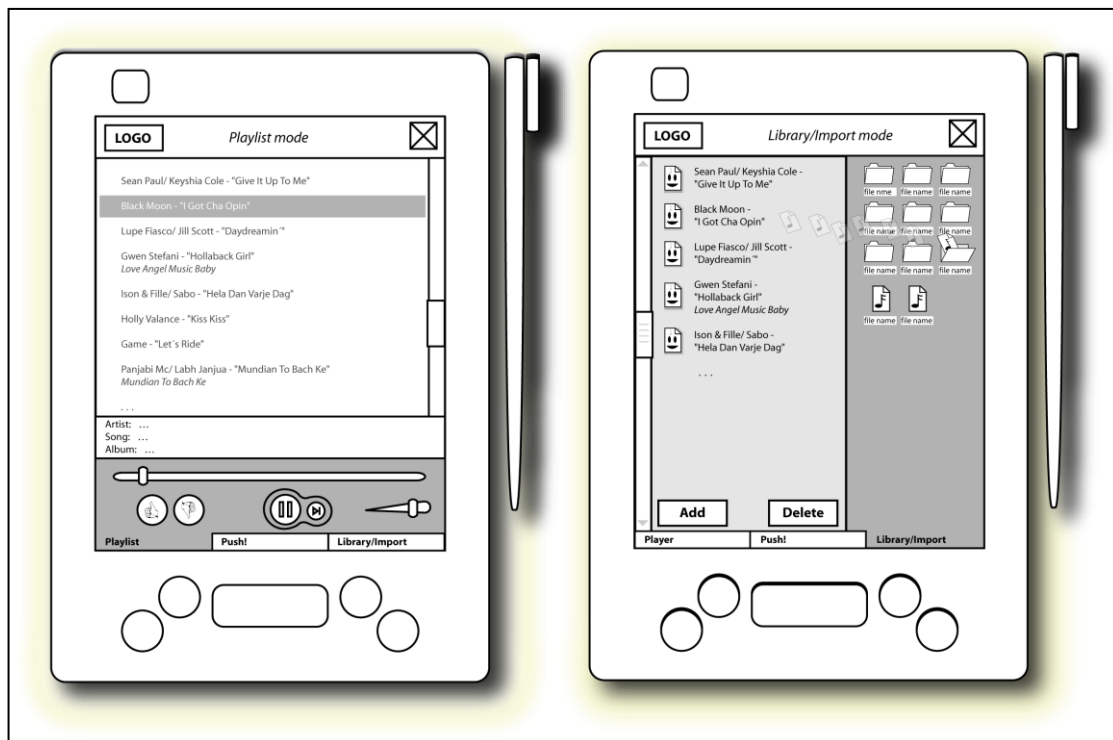


Figure 5.6 Group D sketches: D.1. and D.2.

## 5.5 The Process of Group Interviews (Iteration one)

The three meetings started by explaining the basics of how the application works and the technology behind it (having still in mind not to reveal too much and influence the participants). Further on we explained the purpose of this group interview. We informed them that we have a goal of gathering feedback and that the information will be a basis for work on a concept for our master thesis report. When everybody agreed that they understood the basics of the application we continued by showing one sketch at the time. We also mentioned that agents are relatively new concept, and it is understandable if they do not grasp the idea of it in the beginning. This did not imply that the participants are less intelligent. At the first group interview we were contented just to make notes, but in order to get more details we decided that the two last ones should be audio recorded and transcribed.

### 5.5.1 Group Interview One

When we decided to make the first group meeting we considered that it was time for us to make a break in the development of our concept sketches and to get the target groups' opinion. Our goal at this stage was to get fresh ideas and opinions from the people we intended to develop this application for. We document by pen and paper the interview findings. This because we thought it, at this initial stage, was important with speed and easy analysis but not yet necessary with exact nuances and minute detail. As the project continued forward the need for more detailed and exact documentation increased.

The first interview that we performed was based on four people's opinions. We gathered participants that were representative for our target group of this application. We chose deliberately one that is an engineer and the rest of the participants did not have that deep knowledge of the technology but they did use mobile mp3 music players. This created a dynamic in the group that resulted in that many advantages and disadvantages in our design were addressed.

### 5.5.2 Group Interview Two

The focus this time was to try to continue the design process by involving users in the development. We wanted to get more details of what the potential users would think of this kind of concept and collect further suggestions for improvements. We also tried to get a first hint of whether our visualizations were understandable or not, that is if the users could, without

too much explaining from us, understand the general idea of what we wanted to put across.

We chose three persons that did join our group. They were students and did not have any connection with computer engineering. Two of them did use mobile music devices and the third one did use them but did not like them.

### 5.5.3 Group Interview Three

This last group consisted of five persons that were more interested in new technology and studied at the moment Computer Science. This group was nationally mixed. Even though cultural differences were not our main area of focus, this played an important role. By having different nationalities we were able to test if some techniques could transcend language barriers.

## 5.6 Findings of Group Interviews

The results from all the group interviews consisted mainly of two types of statements: suggestions for improvements and critique.

It was suggested when exploring files, to use a common interface like explorer. We should use traditional interfaces to show what is going on in the application. We should also look at other design solutions and reuse them in our application. It was suggested to use the options that already exist in the PDA (hold-down-function equivalent to right click-function). In that way it is needed only one click for playing and two clicks for options.

Instead of different sizes (representing different amount of data the file is carrying) it could be replaced with different colours. They also suggested a profile when beginning using the system. The profile could be used as a filter for how much and what kind of tunes they would receive.

They did not want physical buttons that already existed on the device. One of the participants mentioned that his father and brother use their PDAs and that they only use the appended stylus.

All of the groups expressed that it was not interesting what a stranger thinks of a song but it is interesting to know what a friend thinks or someone that the user knows his taste in music.

In the beginning it was a bit hard for the groups to understand what the sketches represented. The functionality that the sketches represented was compared to file sharing systems. Recommendation systems was known phenomenon. Most of the participants eventually agreed that it was

understandable. This could indicate that they understood the basics of the interface but their mental image was not complete and they needed help in forming a better functioning one.

They were afraid that they would get a lot of music they were not interested in. All participants also expressed a general scepticism towards the concept of getting songs when you have not asked for them. It should not be a lot of songs or you get tired of it as a user. To have friends recommend music, on the other hand, would be fun, one of the participants suggested. Another participant was interested of the fact that the system would recommend a song in the same category of his music taste. A user said it would also be interesting to know who is sending you a file. In essence the users asked for better control over what the system sends and receive. They agreed that it is acceptable to have one's music listening history and voting public so that other users that they do not know could see. Most of the participants agreed that they would also like to have control over how many new files they receive.

The response regarding the details of visualizations of the Agents was to some extent similar for all of the groups. They also preferred the representation of Agent files more close to looking like traditional file icons rather than those that did not.

Another more practically oriented issue concerned the navigation of the area on the screen where the representation of the Agent tunes would move around to illustrate their status. Here a zoom function was preferred instead of scroll.

One of the participants understood right away that the thumb up and thumb down buttons have the functionality of voting, and likewise the explorer mode. These are traditional symbols and metaphors that were familiar to the members of this particular group.

What is more interesting is that one of the participants saw right away that the representations that we call teleport stations represent people you are connected to and that they are sharing files with. The name for Push! mode made them a bit confused.

Icons are hard to see but they suggested that if they had colour and better resolution it would be easier. One of the participants suggested that the icons took a lot of space and said that maybe a list would be better. All agreed however that the autonomy and relationship of the files, which they eventually figured out, would not be represented then. They thought that there were too many relations and smiles for one to guess what they do. It might have given a too jumbled impression that was confusing so that they could not figure out why some of the icons are bigger than the others.

It was suggested that songs could be clustered according to the context they were played in and clusters could in turn be positioned in relation to one another. This is rather similar to what we intended for our sketches but is a good refinement of the concept. This, according to one group, would lead to an easier navigation. One user confessed that he initially did not understand that what was represented on the screen only included the files currently in the Push!Music system of the own PDA and not others. The users preferred the familiar drag and drop technique for pushing files to others. They also suggested that the screen should be divided into a files area and a user area to make it appear more structured.

Another of the participants mentioned that the new Media Player in MS Windows show stars in the play list as a rating for if you listen to one song many times or not. But on the question of if the stars would be more suitable for our system the participants said it would not. The stars would not represent the relations between the files and that this way is new and useful. But the relations should not be based on the order on which they have been played, but on music taste.

Instead of representing the connection of one file to the rest it may be easier to duplicate the file to the other clusters, they are related to. Picture the following example: you have a play list based on your mood. The mood is sad on one particular occasion, but the play list includes a neutral song. When the same neutral song is listened at another occasion, when your mood is happier and the play list is more upbeat. It would be confusing if that particular neutral song had many relations for different clusters.

After some discussion, the group agreed that we have to limit ourselves to a set of sizes for the files. There must also be limits to how much of information that can be stored in the file. And in the end if the file is not played any more it should go back to a neutral size.

One user said that the most interesting way of testing this application would be to put all the songs on random shuffle and repeat and see how the relations look. Another participant said that the mode of shuffle and repeat should not affect the relations between the files.

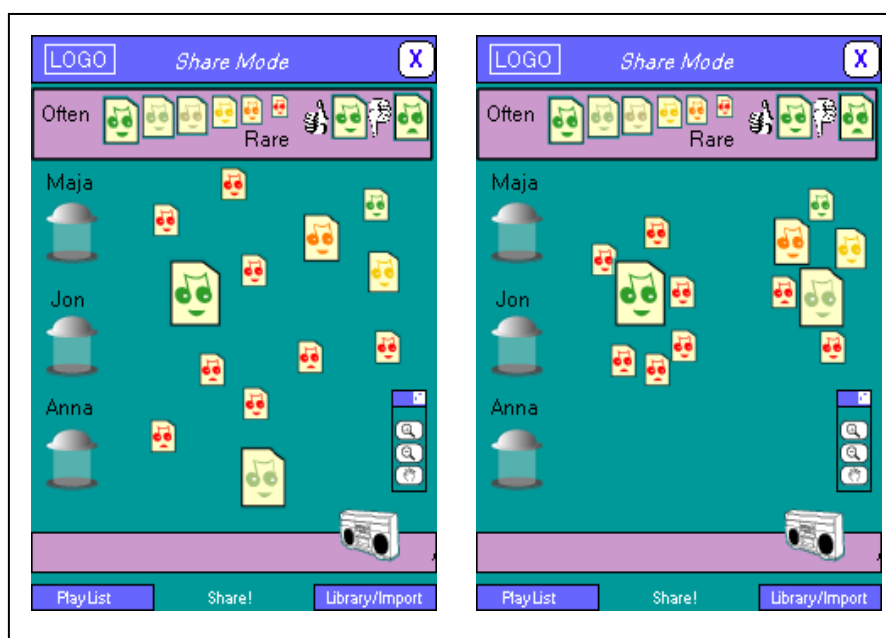
## 5.7 Further Development (Iteration two)

After gathering all data from the free discussion groups we continued with an analysis. A sketch was made on how our interactive prototype should work and look like. The rectangular symbols are representing the tunes. Happy or sad depending how the users voted for that particular song. When

a tune is dragged and held over a teleport station a speech bubble appears asking if the user wants to send (Push) this file or not.

Thanks to the generally positive attitude towards the concept in combination with the scepticism towards unchecked sharing of information and tunes, we believed we were well on track for the continued development of visualizations for the Push!Music Agents. Our assumptions about that the users want to know what is going on was confirmed (they did not want to share the tunes with everyone). They wanted to have feedback, but did not want to be bothered too often. We decided to forgo the lines between the tunes as they seemed to cause so much confusion. They only represent a small part of the data that is stored and by using the proposed method of clustering the tunes, the essence of the data is still represented. Further, we tried to clean up the screen as much as we could and make it more organized. We placed the user representations, still in the form of teleport stations, at one side of the screen and let the tunes move about on the rest.

Because some of the movements of the tunes happen slowly as the Agents accumulate data over extended periods of occasional listening to music, we



*Figure 5.7 Left snapshot: The system starts and the tunes are spread evenly. Right snapshot: The system has been used and the tunes are grouped accordingly.*

needed to simulate this in a time-accelerated fashion. This was needed due to limited access to the users, so that the necessary repeated meetings would be too difficult to perform.

The above-mentioned time accelerated simulation of extended use worked as follows. We began with showing the user a screen as it would look like when

Push!Music is just installed and a start-up set of tunes is imported. Note how in the left snapshot the tunes are evenly spread over the entire screen. Then, on a press of a key, we started an animation of how the tunes would move across the screen to form clusters (5.7 the right snapshot). We did not tell the users that this happened according to how the tunes were played but only that this would happen over a long time as they used the system. Then we asked them what they thought this represented.

Finally, we changed the name of the mode that handles most of the visualization of the Autonomous Media Agents from Push mode to Share mode. This was suggested during the third group meeting when we explained that this mode not only afford pushing files to others but also shows how files come and go on the Agents' own initiative.

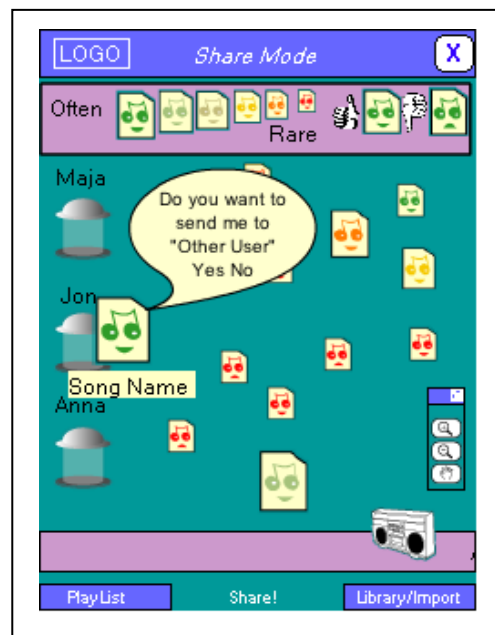


Figure 5.8 Prototype with dialogue.

## 5.8 User Tests (Iteration two)

After changing the application we decided that it was time for the next step. Considering what has been said in the group meetings the next step for us was to continue with user tests. We did four of them and the result was video recorded for the reason of easily getting back to the data and to be able to refer for further development of the function representation. Every user test took about 45 minutes and was started by presenting the application. The tests sessions where summed up by semi-structured discussion to fill in the gaps, information that did not come forward under the tests. The four participants were chosen to be from the target group.

### 5.8.1 User Test Number One

As the user looked around in the Library/Import mode he soon realized that it handled import of files into the system. Also the Play List mode was rather unproblematic for this user. He commented that the play list is easy to understand because it is simple. Only minor problems were found in these modes such as the lack of a *Back* button in play list mode. Regarding the Share mode, this user was initially confused with the different files. However after some time he figured out some of the visualizations and functions. He eventually guessed that the size of the icons depends on the files stored information.

The respondent did not understand what the clustering of the songs represented so the moderators (we) had to explain this.

The respondent said that he wanted to have the function of playing the songs in the Share mode to. This function is already available by dragging the songs to the boom box in the lower right corner of the screen. This, however, had obviously gone unnoticed by this respondent.

This user also suggested the symbol explanation area which was added to the second version of the prototype. Finally he summed up by saying that he thought that if a user gets acquainted with the system then it would be an easy way of sharing music.

### 5.8.2 User Test Number Two

This user was quicker to understand many of the functions than the others. He understood right away the functions in the play list and library mode. He said he thought we had made a clear visualization with the smiley icon. He also promptly figured out the size and the colouring. He said that clustering is a bit difficult to understand, but it would only take some time getting to know the system. He wanted to have control over the systems sharing but he thought that it is a good system of sharing to friends.

### 5.8.3 User Test Number Three

This user adopted a trial-and-error method and fumbled around in Share mode to see what is interactive. In contrast to most other users this one guessed right away that the clustered files are played in a certain order and therefore related. He also guessed that the smiles represent if the song is liked or not. This user was the most sceptical to sharing music and information with others.

Overall he thought that our interface was visually pleasing but a little confusing, disorganized and hard to get a good overview. He suggested a sort of matrix that shows the different clusters. He did not think that the size and colouring represented was intuitive.

He thought that the song names should appear right away and not in a small tool tip text, as it is now, but rather that the names are displayed right away. He also suggested that if the user marked one cluster, a list on the side could appear giving the specifications over the selected songs. Situations can occur when one wants to play a special kind of songs and that then it is good with clustering the files. Finally he thought that it is bad with an icon explanation in the top, especially if one already is experienced user of the system.

#### 5.8.4 User Test Number Four

Also this user had troubles identifying the meaning of the clustering of the files. He thought that the files are clustered after different functions but did not know what kind of functions it had. The colour, on the other hand, he identified as representing how often a specific file is played. He also understood that the beamers, or teleport stations, are representing other users. He eventually, after some hinting, associated the different clusters with different occasions like when bicycling or clubbing.

This user wanted to have the information of what other users have sent. He also did not mind sharing his music taste to others. He also mentioned that the information that is present in Share mode is easy to understand. During this part of our discussion he suggested a function that asks the user if he wants to receive the file or not, instead of getting it automatically into the play list as the original Push!Music prototype is constructed.

Another suggestion that came up was to be able to select a whole cluster and send it to the play list and also to be able to manually make clusters out of explicit choice.

## 6 Analysis

In this section we will go through each visualization technique and analyse how they have worked in our particular context. We will also engage in a more general discussion about visualization and our project. In order to do the analysis of each technique we have followed the set of standard questions, as mentioned in chapter *Research Methods of Thesis*.

### 6.1 Affective Computing (Facial Expressions)

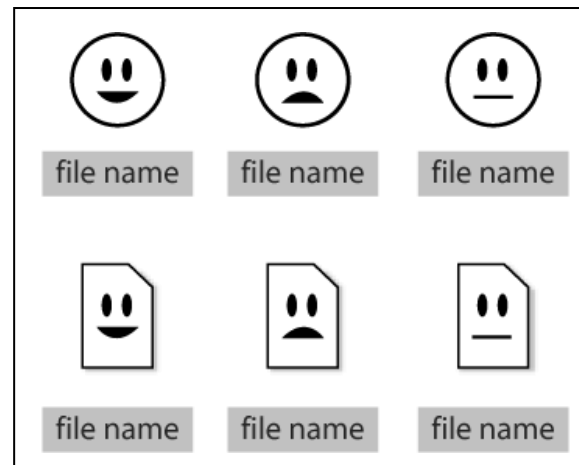
#### 6.1.1 Relevance

The Push!Music project's attempt at using affective computing became rather limited. Because of the small size of the screen and the fact that we needed to deal with multiple Autonomous Agents at the same time, we chose to use the variation of affective computing called expressive icons. As a result the respondents in the user tests and discussion groups seemed to respond well to some of the variations of music file icons that we showed them. Some preferences to more traditional file representations were expressed, but several other respondents reacted positively towards the same icons. Even though the push music project did not succeed perfectly in using affective computing we detected some indications that the technique has great potential for communicating the status of Autonomous Agents. The research made by Haake (2006), and his predecessors referenced in his dissertation, indicates strong positive effects from the use of affective computing and bordering techniques such as making the user more engaged in the system, taking control over the mood of the interaction through the use of visual stereotypes and so forth.

#### 6.1.2 Effectiveness

There were some trouble in finding a balance between traditional file representations and the expressiveness of the icons. The circular smiley variation of the file representations was not recognized as files, but at the same time, the more traditional file representations were not recognized as autonomous or intelligent. One of the concerns when designing our Agent is to make it appear genuine, in the sense of being pleasing to the users to be willing to interact with it.

One of the earliest main responses from the first group was that the first smiley seemed to be associated with being a bit unintelligent and just a smiley head of happiness. By changing the Agents appearance to more file



*Figure 6.1 We tried with different visual expressions of the Agents in the first iteration.*

associated look, this made it possible to get away from the association with lacking intelligence and make it have a natural connection with what the Agents actually do and what they represent, which is a music file.

To find an optimal compromise we would have had to go through even more iterations of sketches, testing, redesigning, testing again and then more refining.

The small size of the screen also caused some problems. It is difficult to read the expression of a too small icon. During some of the user tests the respondents didn't notice that some of the icons had happy faces and some sad. Some users said that they couldn't tell whether the smallest icons were happy or sad even when they were looking for the difference.

We also experienced the phenomenon of visual stereotypes that Haake (2006) has researched. Some of the icons were perceived as more intelligent than others. We attempted to give the files an alert look by adjusting the eyes and mouth. However, we didn't have the answer to the question of what makes a face look intelligent, especially not one that needs to be so highly stylised as the clarity demands on such small icons. We think that more research is needed in order to pinpoint ways too highly stylise certain expressions or stereotypical looks for small screens. Even though some expressions are easy to design such as happy or sad other expressions may be more difficult. This is why further research is needed. This research needs to answer questions like: What makes an icon look intelligent? What makes an icon look friendly? What makes an icon look satisfied? What makes an icon look stylish? Here research such as Kotsia et al's (2008) could then be the basis for new guidelines on how to design expressive icons. What remains is to adapt the identification of the different facial expressions to small highly stylised icons.

All of these problems show that affective computing is a very powerful but clumsy tool that is not yet adapted to our intended domain. A large portion of our design work we reserved for designing the expressions and the general image of the Agents representations on the screen.

### 6.1.3 Success in Push!Music

The technique of affective computing was, after all, a success in push music. In spite of some bewilderment our test subjects expressed a positive attitude towards the facial representations of the Agents. Several of them said they were fun and interesting. This indicates that affective computing were used to communicate important aspects of Autonomous Agents on mobile platforms

### 6.1.4 Guidance from Literature

Solid research on how to design interfaces based on affective computing we find rather sparse. There are some investigating whether it can be useful or not and what impact it may have on interaction (Haake 2006), but only very little on how to design interfaces with affective computing. Haake (2006) gives some input to the visual style of Virtual Pedagogical Agents from which some parallels could be drawn to the visualization of other Autonomous Agents.

### 6.1.5 Frequency of Earlier Use

The limited amount of guidance from the literature may be due to the rather small frequency of use for similar contexts.

### 6.1.6 Stages of the Development Process

Affective computing needs to be worked upon throughout the entire development process. Very early in the Push!Music project, we had ideas and visions of faces as visualizations of the status of the agents. These visions were gradually refined and developed through sketches to the final prototype. The above described advantages and disadvantages did not shift much as the project went along.

### 6.1.7 General Impressions

Affective computing is a new and exciting technique that seems promising in communicating many and subtle nuances of the status of Autonomous

Agents. On the other hand it takes a lot of hard work to actually implement it, especially onto mobile platforms.

## 6.2 Colouring

### 6.2.1 Relevance

The relevance of colouring as a visualization technique is very strong due to reactions and feedback from user tests. When taking the colours out of focus, like we did with the black and white sketches, this can also contribute to reactions and focus on other areas. Codes of colour are easily detected (Post and Geiselman, 1999).

### 6.2.2 Effectiveness

As a whole, we find the colour coding guidelines, as described by Pancake (1998), easy to follow and they ensure good results. Actually, we were not aware of some of the guidelines until we had made some of the design. We then found out that we had followed the guidelines instinctively. This speaks well to the validity of the guidelines. We instinctively chose to use the focal colours of red and green for the extremes of listening frequency. This worked rather well, partly because it is easy to understand and remember due to existing cultural conventions.

However, the colours along the continuum in between the focal colours became rather difficult to distinguish. This is probably a source to some of the confusion that the users seemed to experience during the user tests. Pancake (1998) does make an exception for colours that are part of a broad grading spectrum but warns us to do it with care. Indeed we had some trouble in selecting the intermediate colours. Just as easy as it was to determine the extremes of red and green, it was difficult to find clear, good looking and suitable colours that are a mix of the two. Just as green is a positive colour that fits the convention of traffic lights and such, yellowish green may be seen as pale, sickly or otherwise ambiguous. Brown that would be the most accurate mix in the middle between green and red, maybe even worse as it can look dirty and unattractive. In the end we managed to find a reasonably good compromise but not without difficulty.

### 6.2.3 Success in Push!Music

We found the cultural aspects of colour coding rather easy to handle in the Push!Music project. This was in a large degree thanks to the fact that we had

a rather well defined target group. This target group was also quite familiar to us and belongs to the same kind of culture as we do. This made it easy to stick to the correct colour coding conventions that fit the culture. Thus, we managed to follow the guidelines of avoiding false colour coding (Pancake, 1998).

#### 6.2.4 Guidance from Literature

As colouring is such a powerful tool it can also have a disastrous effect if you fail to use it well. As we see that some users completely misunderstood the meaning of our colour code we see that the guidelines for colour coding that we have seen in the literature (Hoadely 1990, Pancake 1998) are well motivated. However, there is still the matter of finding a good set of guidelines as there are so many to choose from. This is complicated due to the fact that colouring has so many aspects to it. As we saw in the literature: colouring can affect their readability of text. Our findings corroborate those we found in the literature when it comes to the readability of symbols. In our user tests, when we had applied colour to our design, some users had difficulty in reading if our symbols had smiley faces or sad faces. This may partly be due to the small screens and the somewhat poorer resolution than that of our sketches, but some of the difficulty is, with a high probability, due to the decrease in their readability that colour causes.

#### 6.2.5 Frequency of Earlier Use

Ever since computer screens became able to display different colours this technique has been used frequently and successfully in communicating information between computer and user (see for instance menus in test editor built into Ms DOS 5.3).

Outside the realm of computers, colour codes have been used for as long as humans developed the ability to paint, starting with early cave paintings (Balter, Oct. 20, 2000).

#### 6.2.6 Stages of the Development Process

Colouring can be a matter of personal taste. This is a phenomenon that we have experienced both before and during the Push!Music project. This have sometimes led to heated discussions about what colour looks better. Though these discussions have their place we believe they should not take up too much time from the rest of the project. Sometimes one might just have to settle for what looks good enough.

### 6.2.7 General Impression

Our general impression of colouring as a technique is that it is very powerful and offers many opportunities. It is also very inspiring to work with colours as they are not only useful but also make the visualizations pleasant to look at.

## 6.3 Metaphors

### 6.3.1 Relevance

The use of metaphors seems to come automatically to many designers' mind. Indeed its use has proven to be relevant to many different contexts. Some of the most commonly used and successfully implemented metaphors are those of a desktop with notebooks, a trash bin and a calculator. Even though those particular metaphors did not seem relevant to visualize something as dynamic as Autonomous Agents, the techniques' versatility allow it to be adapted to nearly any context (Marcus, 1998). As soon as you can make some interaction tool, like a screen look or behave like something that it is not it is possible to create a metaphor.

We used several different metaphors in our final semi-functional prototype. One is that the users are able to "push" or shove the music file to another system user, by the action of taking a file and dragging it on top of the icon of a teleport. The metaphor of a teleport station is analogue to the Agents' use of the PDA's wireless transmission equipment to copy itself.

The representation of a smiley vs. sad face can also be described as a well-known metaphor for something positive or negative. In our case it was the amount of votes that people decided to put if a song was good or bad.

When choosing a song to play drag and drop function is available to put the song in the play list. This visualization technique is used commonly throughout the example project and it is very much relevant for the project. As the empirical results prove that the users where able to recognise this well-known metaphor rather quickly.

This visualization technique is commonly used throughout the example project. And it is relevant when visualizing phenomenon in scientific domains not common for everyone such as Autonomous Media Agents. Why invent the wheel again? We wanted to use the conventions already known to the user to explain a more unknown area.

### 6.3.2 Effectiveness

Metaphors have been proven to be effective in many forms of communication (Stubbenfield, 1998) and we can see no indications to that it cannot be so in the context of communicating the status and doings of Autonomous Agents. Some of our user test respondents had difficulty in recognizing the symbols with user names under them as teleport stations, but once that was pointed out to them it became clear that they understood the function of the symbols.

The user tests also revealed that some metaphors are easier to design and make understandable than others. The metaphor of letting the music files appear to become friends and group up together because they had common use data stored was difficult to make immediately recognizable. However, with some explanation the users eventually got the general idea.

### 6.3.3 Guidance from Literature

The greatest difficulty in using metaphors that we encountered lies in what metaphor to choose. We tried several before finding one that worked and even that one did not work perfectly. When looking through literature on the subject we get some interesting but rather general guidance. The aspect that one may come to design the system according to a metaphor instead of choosing a metaphor for a system Stubblefield (1998) is interesting, but we cannot categorically say if that is good or bad. If the system becomes easier to understand it seems good, if the system becomes less effective it may be bad. This illustrates that even though the literature addresses interesting issues, it still can only make vague indications to the most central and difficult issue of what metaphor to choose.

### 6.3.4 Success in Push!Music

As mentioned before Push!Music employs several different metaphors, some much more successful than others. Therefore we had troubles deciding whether the technique is successful or not, at least not as a whole. The success is dependent on a long range of variables where we find the balance between two important factors. They include likeness of the actual process on one hand and immediate recognisability on the other. Take for instance the Teleport stations of our prototype: they represent a process very similar to copying files over a wireless network. This should have been good for letting the user know what actually happens; the problem with this was that only a few of the users recognized the illustrations as teleport stations. It seems likely that this has to do with the fact that teleport stations are not something you see every day, which makes them have poor recognisability.

The opposite example in Push!Music is the file representations. They were very easily recognized because they build upon a very common illustration of files seen in almost all modern operating systems such as Microsoft Windows and Mac OS. However, they illustrate something that is not quite similar to the actual files.

### 6.3.5 Frequency of Earlier Use

Both our literature studies and our observations show that metaphors are frequently and more or less successfully used in very many modern systems. This may be due to the fact that most common operating systems are based upon metaphors, but more likely, it is because the fact Lakoff and Johnson (1980) mention: Metaphors are a part of everyday life. Metaphors are something that readily comes to us as we try to explain things. It is an easy way to make people understand what you are trying to say and this makes us use it in all kinds of situations including the user interfaces for information systems.

### 6.3.6 Stages of the Development Process

Stubblefield (1998) mentions the phenomenon that a choice of interaction metaphor may influence the structural design of a system and vice versa. This raises interesting issues of when to work with the design of interaction metaphors. Some of the metaphors of Push!Music were conceived rather early in the development process. Take for instance the metaphor of the Autonomous Agents being little intelligent beings running about the screen according to how their corresponding music files are played. The early conception and development of this metaphor may have caused us to paint ourselves into a corner when it comes to the thereafter following design decisions. It lay as basis for the grouping principle of similar songs collect themselves in groups on the screen. This principle proved relatively difficult to make understandable in an intuitive way so that users catch on without having it explained. Had we not been so excited about this metaphor we may have been more open to other courses of design. On the other hand the same idea served us well in illustrating the Agents' autonomy and intelligence both to ourselves and those we came in contact with regarding the project. A high-quality understanding of what it is you are designing an interface for is probably a good thing.

### 6.3.7 General Impressions

Metaphors are something that comes easily and intuitively to us as we try to explain complex or abstract things. It inspires the imagination and can provide a more rich understanding of what you try to communicate. The

difficulty lies, as mentioned before, in the choice of metaphor to best suit the situation and avoid misunderstanding.

## 6.4 Pictographic symbols

### 6.4.1 Relevance

We intuitively saw the technique of pictographic symbols in general and icons in particular as very usable way to visualize the multitude of entities we wished to represent. As one can see in the description of our object of study the Push!Music project relies heavily on pictographic symbols. Not only are the music files represented with pictographic symbols in the form of icons, but also the other users, the function buttons and the playlist. This was done with a varying degree of success. Through some of the symbols we managed to reap all or most of the benefits that pictographic symbols afford according to the literature that we had encountered. Thus, it is evident that the use of pictographic symbols and icons is highly relevant for the domain in question.

### 6.4.2 Effectiveness

For instance we could see that our icons were understandable for people of a wide range of nationalities. This was observable thanks to the fact that some of our respondents were of different nationalities. Thus, we had respondents that either didn't know Swedish or had limited skills in English. The fact that pictographic symbols and icons have the ability to bridge the barrier of languages makes the technique a very useful tool in the design of systems intended for an international market. This strength of the technique was available regardless of the specific attributes of the context of Autonomous Agents for use on mobile platforms. The face icons were considered as representations of music files of a certain type just as other similar icons have been in other contexts, for instance wav file types in Microsoft Windows.

### 6.4.3 Success in Push!Music

The fact that all users did not understand all the status signals of the icons, including size and happy or sad face may not indicate the usefulness of icons as a visualization technique. It may rather indicate the success of the specific design of the icons' status signals and the success of the use of affective computing. In other terms it may not be failure in the icon design

but rather what we tried to apply other techniques such as affective computing (smiling faces, or sad) or colour coding.

When evaluating the example project we could see that size does matter when considering icon design on mobile platforms. During the group interviews, but more clearly during the user tests, the respondents had troubles distinguishing the happy and sad icons, from each other. This was applicable especially on the smallest icons.

The icons, as they are used in push music, follow a rather traditional pattern. They are designed as pictographic symbols that emulate the look of two things: a file of musical data and a human face. As the design guidelines for icons dictates these images should be highly stylized (Koblanck, 1997).

#### 6.4.4 Guidance from Literature

We found a duality in the literature between those who side with Chen (2003) that goes for the objective approach in icon design and those who side with the likes of Huang, Shieh and Chi (ibid) that emphasize the importance of subjective qualities in icon design. This represents a difficult dilemma that gets especially emphasized in a case such as Push!Music and in Agents' visual design in general. On one hand it is clear that our design benefited from guidelines of objectivity. For example, it is obvious that it is a good thing that our icons representing the Agents were easily distinguishable from the other icons. Some respondents in our discussion groups also expressed a wish for the Agent icons to look like something recognizable from other systems, such as typical file icons. These examples are in line with the objective guidelines of Chen (2003).

On the other hand it is also evident that the more subjective aspects of the look and feel of the icons play an important role for the visualization of Autonomous Agents. We saw these aspects as an asset through which we could communicate the autonomy and status of the Agents. This attempt was partially successful as the respondents showed some understanding or impression of the Agents' status. It also caught on some snags in the early stages of the design process. For instance, an ill conceived look and feel caused associations with hallucination inducing pills. This would have been a bad failure to communicate the intentions of the system that were that the Agents are, in a sense, intelligent entities that collect information on how you listen to music and what music you like.

As a summarization we would like to say that the guidelines from the literature proved mostly quite sound. Even though the guidelines were sometimes contradictory they provided useful input into the development and design of push music. When the contradicting guidelines did not provide

clear instructions at least they indicated dilemmas that need to be addressed.

#### 6.4.5 Frequency of Earlier Use

It is easy to see, both in literature and simple observations, that pictographic symbols and icons have been used quite frequently within the domain of information technology as well as many others such as traffic signs and appliances etc. Not to mention that they are the very basis of many of the leading modern graphically oriented operating systems such as Microsoft Windows, Apples Mac OS, etcetera.

#### 6.4.6 Stages of the Development Process

The pictographic symbols came in rather early in the design process. Already in the idea stage of the design process, the use of icons was thought of. It was also very easy to make simple sketches of icons thanks to the inherent stylization of such pictographic symbols. The difficulties were encountered later in the development process when the finer subtleties of the icon design were to be decided.

All in all, the design of icons and other pictographic symbols seem to be following the same patterns as other design work. Many of the design guidelines for pictographic symbols are identical, or very similar, to other general design guidelines and design methods. Take for instance Chens' (2003) *user orientation principle*. It guides us in the same direction as Gulliksen and Göransson (2002).

#### 6.4.7 General Impressions

Our general impressions of this technique are that it is quite useful and effective. It's easy to work with thanks to good and plentiful guidelines as well as a rich flora of earlier use.

### 6.5 The project as a whole

During the last iterations of the development the users seemed to start developing a useful mental image of the workings of the Autonomous Agents of Push!Music. Some of the users did have a hard time understanding some of the visualizations but with only a little help from us they too seemed to get the hang of it. Other users seemed to understand it right away. This indicates that our visualizations are at least partially successful.

### 6.5.1 Control and Feedback

Many Autonomous Agents could be said to be an example or part of ubiquitous computing systems as they often are designed to run continuously in the background helping the user without he/she knowing it is a computer system that does the work. By using Bellotti and Sellens' (1993) eleven evaluation criteria on Push!Music, we can see that some Autonomous Agents are sensitive to several issues. By investigating the possibilities of visual feedback and information about control level this can overcome the criteria.

*“Trustworthiness:* Systems must be technically reliable and instil confidence in users.” Even when a system of Autonomous Agents has no technical glitches the Agents' autonomy may cause them to perform tasks that may harm the users' trust in them. For example, Push!Music Agents may give you tunes that you do not like.

*“Appropriate timing:* Feedback should be provided at a time when control is most likely to be required and effective.” The prototype of Push!Music developed at the Viktoria Institute does not notify the user when a tune is being received but rather waits until the tune is fully transmitted and added in the play list. By then, the damage may already be done. By visualising from whom and when a tune is coming, we can partly solve the problem of trustworthiness and timing.

*“Perceptibility:* Feedback should be noticeable.” Push!Music's only way of feedback regarding reception of tunes is for the user to deliberately go to a specific tab among many and look for the information.

*“Unobtrusiveness:* Feedback should not unnecessarily distract or annoy.” Push!Music automatically adds tunes to the play list which may be rather annoying.

*“Minimal intrusiveness:* Feedback should not involve information which compromises the privacy of others.” Because of the minimal feedback this is not an issue in Push!Music

*“Fail-safety:* In cases where users omit to take explicit action to protect their privacy, the system should permit only minimal information capture, construction and access.” As Push!Music by default let users swap music automatically, this is also an issue.

*“Flexibility:* What counts as private varies according to context and interpersonal relationships. Thus mechanisms of control over user and system behaviour may need to be tailorable to some extent by the individuals

concerned.” The original version of Push!Music has only one setting which is to always allow sending and receiving music.

“*Low effort*: Design solutions must be lightweight to use requiring as few actions and as little effort on the part of the user as possible.” As the Agents do all automatically it seems that the designers at Viktoria institute have focused too much on this criterion at the cost of the others.

“*Meaningfulness*: Feedback must provide meaningful representations of information captured, not just raw data.” The lists of transferring files are rather sparse and can only barely be called meaningful.

“*Learnability*: Proposed designs should not require a complex model of how the system works. They should exploit or be sensitive to natural, existing psychological and social mechanisms that allow people to perceive and control how they present themselves and their availability for potential information exchanges or interactions.” As Push Music presents only a rather sparse image of how it works, almost a complete black box, it would have low learnability. It actually took us quite some effort to learn how the system works, and we are trained in the field of information systems.

“*Low cost*: Naturally, we wish to keep costs of hardware, software and implementation down.” We do not know the cost of developing Push!Music.

Of course Push!Music is only one single example but this example shows how ill designed Autonomous Agents can be sensitive to the same criteria as Bellotti and Sellen (1993) advocates for ubiquitous computing.

Who should have control? This is an important question and we agree with Bellotti and Sellen (1993) that one should provide ample feedback to enable control on the users part to enable the user make an informed decision of whether to participate or not. On the other hand one could debate whether entities, such as record companies, should have unrestricted access to data stores in systems like Push!Music.

### 6.5.2 Design Process

As mentioned in the chapter on *Object of Study*, this project resulted in tangible artefacts: four groups of sketches and a semi functional interactive prototype. The prototype was not developed into fully implemented system because we wished to focus on the most dynamic part of the design process. This was done in order to avoid spending too much time on correcting bugs and other technical problems, relatively to actual research of visualization techniques.

## 7 Conclusions

It is clear that all the investigated visualization techniques are more or less relevant to the domain of Autonomous Media Agents on mobile platforms. Even though affective computing is somewhat of an outsider compared to the other techniques, it also has some relevancy to the domain. It seemed new and interesting when we first came in contact with it and further investigation of the literature promised great potential. Our investigation showed it can be quite useful in communicating the status of the Autonomous Agents in an intuitive, unobtrusive and yet obvious manner. Many of the statements of our respondents, both in group interviews and the user tests indicate that a status of intelligence and mood was communicated even though it sometimes was not the intended one. This confirms findings we encountered in the literature presented by Haake (2006) and expands the area of context within which his findings are indicated to be valid.

In systems including Autonomous Agents our results show that the users appreciate knowledge of the agents' progress and their choices to be visible for them.

To combine two or more visual techniques is a delicate matter; we discovered that one has to be observant and careful. Our combination of colour and size representation of the tunes as well as sad or happy tunes needed an explanation key to the signs to show how they were represented, what the size and colours stand for. Our empirical study shows that it was confusing for some of our test subjects when having both the size and colour representing the single parameter of how often the tune got played. Our intention from the beginning was to use only the size that shows how often a song was played and if it was popular. We wanted to enhance the visualization of the Agents' popularity in this system and that is why we involved colour representation. The boundaries of our techniques are not absolute and most of our visualization techniques overlap each other.

Another technique used on the tunes was the happy/sad face. That the respondents could understand.

### 7.1 Affective Computing

The most difficult technique that we experienced was the affective computing. The expressive face visualizations are hard to represent on small screens. Therefore the representation of our tunes was kept simple and minimalistic without many details. Some of our respondents did not see the difference of sad and happy on the smallest music file icons.

*Advantages:*

- It has great potential for intuitive communication of status
- Its intuitive nature enables unobtrusive awareness of the Agents status
- It has an engaging effect on users if applied correctly

*Disadvantages:*

- It is a novel and in many aspects untested technique
- To be fully effective it requires subtle expressions of emotion that is difficult to show on small screens

## 7.2 Colouring

The first group of sketches was black and white. The purpose was not to combine many parameters. The black and white represented early sketching level in our design. The colouring of the tunes was expressing a status, if the tune is popular or not. The background colour was differing from the playlist area. It has no semantic value and do not represent a status, but is for visualize clear border of the different part of the system.

When we have the answers in front of us the semi functional prototype could still have the black and white details and only the parts of the system that should be in focus should have been in colour.

*Advantages:*

- It is inspiring for the designer as it can make things look good
- Codes are easily and immediately detectable (Post and Geiselman, 1999)
- Sound and useful guidelines for colour coding design are readily available
- A multitude of colour codes and conventions are available to be utilized

*Disadvantages:*

- It is difficult to use in early sketches

- It's easy to get caught in endless debates about what shades of colour would look the best
- Does not work for colour-blind people
- The interpretation of colour codes may vary between people due to cultures and personal perception

## 7.3 Metaphors

This technique is commonly used in our study and the variables that are included here are:

File icons that move, are copied and when the files are pushed to the play list beside the radio as well is when they are pushed to another user through the teleport. The metaphor for paper is also used in the shape of the icon that looks like a file and a figure. The size metaphor is also present so is the door, teleport and music player. The files queued in play list is a metaphor of waiting in line. A more commonly used metaphor is drag and drop of things and we have been using this too in the form of dragging and dropping the files into, play list, teleport and so on. The metaphor of belonging somewhere and grouping is also used (the files are grouped depending on how they are played). Another common metaphor is the tab metaphor that we used.

### *Advantages:*

- It is a very versatile technique which can be applied to almost anything
- The choice of metaphor can guide further design
- Our study shows it can transcend language barriers

### *Disadvantages:*

- The multitude of possible metaphors make it difficult to choose which one to use
- The choice of metaphor can inadvertently effect overall system design

## 7.4 Pictographic Symbols

The visual representations within this area were the music file, the tune, as well as the door and the magnifying glass. Although the last mentioned is a usually common pictographic symbol, it is not specific for only our project, but nevertheless it is needed, in our study of visual design of the Push!Music system. Other pictographic symbols used were the voting, thumb up and thumb down, and the radio as the music player.

### *Advantages:*

- Sound and well proven design guidelines are readily available
- Transcends language barriers
- Easily recognizable through well established traditions

### *Disadvantages:*

- The need of high level of stylizations makes it difficult to include subtle details
- If the icons are restricted in size, they can be difficult to tell apart

## 7.5 Future Work

Mobility in system does affect the use of different visualization techniques in various ways. When the user tests were performed, the prototype was tested on a stationary unit due to technical difficulties in transferring the prototype on a mobile unit. Because of these difficulties and because the focus of our study lays on the user interface and the visualization techniques rather than how the system worked in real life environment, we assessed the stationary test to give sufficient information. The prototype was rendered in matching scale on the screen as to how it would appear on a mobile unit. The fact that the user test respondents were not able to move around with the prototype we assessed not to have too large influence on the results at this point in the study. For further research we would recommend studies on more fully functional systems which should be studied over extended periods of time. For instance letting the users test the system and interact with it for couple of weeks and in real life environment (if the focus would lie on the interaction). If one uses our study as a basis one could extend it to achieve richer information by using mobile units that have more complete technical functionality. In this way one can study how the users understanding of the system progresses over time.

Another area to be researched further is to apply our kind of research on other visualization techniques. This would enable comparison between different systems so that eventually one could get a complete picture of when to use which technique and how to apply it.

If this project would be continued to a fully implemented system more advantages and disadvantages could be discovered and more visualization techniques could be researched.

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# Appendices

## 1. Transcript - Group Interview Two

M	Vi använder en handdator eftersom det var det vi kunde få tag på. Anders, du kanske kan förklara bättre.
A	Där är ett antal lägen. Det här är själva spellistläget, det fungerar ungefär som en vanlig mediaspelare
M	...en helt vanlig som finns t.ex. i telefoner
A	...Windows Media Player och allt vad det nu är.
M	Lista på allt det, låten som spelas. Den enda skillnaden här är att man kan rösta på om man tycker den här låten är bra eller dålig. Det i sin tur leder till...
A	För att importera filer till systemet så har vi en sån här filebrowser så man kan plocka in låtar in i systemet.  De här lägena är inte så viktiga så vi lägger dem åt sidan så länge så kommer vi till det fina i kråksången. Det här är då själva huvudläget i systemet där man då... Ja, Ni kan ju börja med att titta på den här bilden och se vad ni tror händer på den här bilden. (Nr1)
1	Vad är de här extacygubbarna, jag fattar inte?
A	Det är kanske rätt kryptiskt så vi har den här varianten också. (Nr2)
1	Jag är ju jätkligt oteknisk.
M	Du ska inte behöva va teknisk, det är inte det...
1	Ok... jag fattar ingenting
2	Det är väl hur bra man tycker att låtarna är
M,A	Ja
2	Det är storleken som...
1	Du menar att när man trycker på den knappen så kommer det här upp

A	De olika modesen har vi här nere i flikssystemet
M	Alltså olika fönster, det finns tre olika fönster. Den (pekar på flik) representerar den här (pekar på fönster), den representerar denna och den representerar att föra in filerna.
A	Och i det här läget (push) då visas låtarna så här.
1	Och detta är ens eget då alltså?
A	Det är ens egna låtar.
M	Ja
1	Jaa... Ok
A	Som man har importerat härifrån
1	Och så ser man vad man själv har satt... vad man tycker om dem?
M	Ja
1	Vad är poängen med det?
A	Poängen är... Det här systemet lagrar hur ofta du har lyssnat på låtarna och i vilken ordning du har lyssnat på låtarna, det är strecken här
1	OK
A	Och utifrån den informationen som då visualiseras med de här strecken här så räknar systemet ut vilka låtar som andra skulle vilja ha utav dina låtar. Så kopieras de automatiskt till andra användare som tycker ungefär som du.
M	Vilket innebär... Det kan vara flera stycken som kan vara online
A	Här är alltså...
1	Lisa, Daniel, Alex
A	Och när de då kommer online och det visar sig att Lisa har lyssnat på ungefär likadana låtar men har inte alla som du har, då får de låtarna till Lisa.
M	Automatiskt över ett nätverk ...liknande Internet fast trådlöst

A	Känner ni till WiFi tekniken?
1	Nä
A	Det är ok dt spelar ingen roll. Ett trådlöst nätverk i alla fall.
1	Jaja.
M	Den rekommenderar alltså automatiskt låtar som den tror du kommer att tycka om. Så om du spelat jättemycket rockiga låtar som du tycker om så kommer den automatiskt rekommendera andra rocklåtar som den tror att det är ungefär det du tycker om.
A	Det bygger alltså på hur man lyssnar
1	Jaja
M	Själva systemet är ett rekommendationssystem. Har du varit inne på några hemsidor där de har automatiska låtar som du lyssnar på som på radio
1	Nej
2	Nej
3	Nej
2	Du menar som på boksidor där de rekommenderar liknande?
M	Exakt, som Amazon.com
2	När man söker på en så ser man vad andra...
A	Det är lite samma princip
1	Laddas det ner automatiskt eller måste man tacka ja till låtarna eller...? Sker det uppdateringar hela tiden eller?
A	Det kommer ner låtar automatiskt men sedan kan du välja om du vill behålla dem eller inte.
M	Från denna fliken kan du också lägga till... Detta är alla dina låtar som du har. Du kan ju välja att den här låten vill jag ha och så drar du den till din spellista.
A	Om vi nu hejdar oss lite grand så får de fundera lite över...

1	Vad ska vi fundera över?
A	Hur ni förstår det här...
1	Ja, jag förstår det helt och hållet nu, men det enda som jag
M	Det här behöver ju inte vara bra
1	Nej det är väl det jag tänker faktiskt, det känns som man får väldigt mycket musik som man inte över huvud taget inte bryr sig om för att jag har svårt att hitta någon som tycker om ungefär samma som en själv, Hur ska man hitta det liksom?
1	Är detta kompisar som man har kanske? Det kan ju vara en kul grej liksom
A	De namnen som är här, det är dem som råkar vara i närheten för tillfället.
1	Ok
A	Så det kan vara om du sitter på bussen så ploppar namn upp där.
1	Det är ju en kul grej liksom men jag hade ju inte... jag är ju väldigt oteknisk så jag gillar inte nya grejor
M	Men du har MP3-spelare eller?
1	Nej jag har inte det. Min flickvän har så jag har haft det ibland men...
3	Ja jag har iPod
M	Skulle du vilja att den automatiskt rekommenderar en låt som den tror att du...
3	Ja, varför inte
M	Ja bara för inspiration. Sedan kan du välja själv om du tycker det är bra eller dåligt
3	Ja
2	Problemet är om man får hur mycket som helst så det blir för mycket så att man tröttnar på det
A	Det gäller att man har ett filter

2	Ja
A	Det är ju lite så som det är tänkt att du ska bara få sådant som du troligen är intresserad av.
2	Det är ett gissel att hitta just det som... hur man kategoriserar
1	Man ska kanske fylla i ett formulär först innan man börjar använda den här.
A,M	Ja...
A	Grejen är lite att man ska slippa det där. Man ska få det som man inte visste att man tyckte om.
1	Då förstår jag. Det är lite som det här som ni sa om böcker. Det har varit t.ex. fågelböcker då har där varit rekommenderade andra och då har det lett till att jag har gått och lånat dem på biblioteket. Nu är jag inte så jättemycket ... med musik på samma sätt som jag läser böcker
M	Om det då är det...?
1	Det är ju lite intressant, som du sade, om man hittar böcker som man tror man inte tycker om. Det samma som min far när han köper böcker ibland så bara lägger han dem så när jag kommer hem så "den här boken kan du ta" och han har läst den redan. Det blir lite samma grej. Då hittar man nya grejor. Man blir mer och mer enkelspårig när det inte är någon annan som ger det rakt till mig.
A	Det är annars att man ska veta vad man ska leta efter
1	Att man får hjälp av andra som redan har letat
A	Det viktigaste är nu hur vi har... Vi har några andra varianter här också
1	Du menar hur nu har lagt upp...?
A	Så att ni förstår bara genom att titta på det här.
1	Bara man vet vad det är... Jag förstod inte det första här...
1	Den här gillar jag bättre, så det inte blir de här smileygubbarna... när det är fyrkanter...
M	De representerar inte riktigt musik för dig?
1	Nej, det blir mer knark och grejor. [skatt]

A	Jajaja, du menar acidgubbar
1	Ja, piller och sånt
M	Här har man i stället bara en ut-och-in-port eller vad man ska säga. När man tar en låt och känner att nu vill jag skicka den till någon så så tar du och drar den till den och så väljer du med en sådan här vanlig meny som man har på datorn, bestämmer du vem du ska skicka till.
1	Alltså om man vill gen den till någon?
M	Man kan också ge låtar till någon
A	Ja man kan rekommendera... "Jag tycker att du ska lyssna på den här."
1	Aha...
M	Skulle du rekommendera någon låt till någon annan?
1	Nja inte låt men böcker... När jag rekommenderar böcker är det ofta något politiskt eller något annat så då brukar inte andra läsa det men jag förstår själva poängen men sen så är det hela det här tekniska runt omkring som jag tänker på. Det bygger ju på att det är rätt många som har det. Det är ju en ungdomsgrej. De börjar använda det i unga år. Nu är jag kanske för gammal redan
M	Nej det tror jag inte
1	Jo det tror jag, jag är för gammal för detta
M	Vad tror du åldersgruppen är här då?
1	Börjar de med det när de åt tretton fjorton... jag vet inte när de börjar med internet och sånt men de börjar väl rätt tidigt med det. Sen kanske det fortsätter så att det blir en fluga bara. Det kommer ju nya saker hela tiden men det är väl den åldern väl. Det ostar väl en hel del så de ska väl ha råd vid 13-14 om de är tillräckligt bra på att tjata så det är väl den åldern. Sen är det väl för de som är väldigt intresserade av musik, som tycker om det väldigt mycket. Då kanske det kan vara en grej också
M	Om det nu var att få... lite information om just din musiksmak som andra skulle titta på skulle du kunna tänka dig att använda ett sådant system
1	Hur då menar du?
M	Kanske bara rent musiksmaksmässigt

A	Eller böcker
M	Att du tyckte om de här
1	Varför inte
M	Det är inte något som ni tycker är för personligt
1	Nej inte om det inte står en massa annat om en så jag skulle uppskatta om folk kunde läsa vilka böcker jag kunde rekommendera och nå ut med dem också. Jag känner många som håller på med musik också som vill att andra ska ta del av det för att det är så bra
M	Ni då?
2	Jag hade gärna tackat ja till det om någon man känner kan rekommendera en låt, Det är ju det folk gör men det är ju ett enklare system om man kan... Om båda har det och kan skicka så kan man tacka ja om man vill eller nej
M	Så det är viktigt att tacka ja och nej också?
2	Jag känner att jag vill inte bara... det känns som man får en hel lista överfylld...
1	Det blir lite att pracka på annars.
2	Men sen vill man inte få förfrågning varje gång den uppdateras för då blir det rätt många förfrågningar hela tiden
A	Det plingar till hela tiden liksom
2	Så tekniskt sett man kanske en gång går igenom de nyaste
A	Du menar att man samlar upp nya och så...
2	Ja, så att det inte bli att man från början har 100 låtar och sen när dagen är slut så har man 1000 låtar i sin spelningslista. Det känns lite...
3	Det är ändå bra att man får förslag så kan man avgöra om man ska tacka ja eller nej
M	Så man ska välja från början om man känner för att bli inspirerad eller inte ...om man bara vill lyssna på sina låtar eller...
2	Ja det kanske är ett bra tips... Ifall man vill bli inspirerad eller inte för om det nu finns äldre som nu 1 som är så gammal som bara vill lyssna på

	musik och vill ha rekommendationer så kan det vara bra om man kan klicka för om man vill få rekommendationer så kan man ändra det.
1	Vad läser ni?
M	Informatik
1	Jaha ni läser här. Vem är det som tar fram det tekniska då?
M	Ett forskningscenter i Göteborg ...det programmeringstekniska, vi gör det bara snyggt ...förhoppningsvis i alla fall.
1	Så iden är deras?
A	Ja, iden är deras så ska vi visualisera det så att man begriper
M	Så du föredrog den här?
1	Jag föredrar den ja. 2a
3	Jag tycker den
A	Varför då?
3	Jag vet inte...
2	I alla fall om där är ett dokument så är det lättare att förstå att det är en fil man skickar
1	Det ser ut som... där har du den, där har du bara... den är avskuren... Jag förstod inte riktigt
3	Det har mer med musik att göra
M	Om nu föreställer er att det här är en handdator, så har man en penna som man bruka trycka med och dra och ha sig. Har ni använt handdatorer
123	Ja
M	Tycker ni det är bättre att zooma ut eller in eller bara scrolla fram och tillbaka när man letar efter filerna?
1	Vad var alternativen? Zooma in...
M	Zooma in och zooma ut och så ta handen ... ni vet ... snurra runt så man hittar rätt

3	Jag tycker det är lättare med handen
2	Scrolla blir lite... Har man mycket så blir det
1	Så kan man dra hur långt som helst
2	Om zoomar in har man kategorier eller?
A	De är klustrade så att de låtar som du har lyssnat på i samma sammanhang hamnar i ett kluster
2	Då är det lättare att hitta igen... då är det lättare med zoom tycker jag för då ser man vad man har i gruppen man lyssnade på nyss. Ska man hålla på att dra och det är i samma storlek... det känns lite jobbigare
A	Vilken spelningsrepresentation föredrar ni?
M	Spellistan här är att låtarna bara går i en slinga
A	Ja alltså "Nu spelas" och "nästa"
M	Medans här är att du radar upp ikonerna
A	Låtarna här de... När man skickar dem till spellistan så ställer de sig i kö där
M	Så du kan dra den här neråt. Och så här... Du vet när man högerklickar så får man se
1	Vad det är för något?
M	Ja precis
A	När man håller den över
12	Mm
M	Här visas det inte alls utan du bara skickar iväg det så får du klicka där för att kolla på den vanliga spellistan.
A	Är det bättre att dela upp det eller...?
2	Je en kombination tror jag nästan. Att man kan trycka på playlist då för jag vill gärna ha det så också så att man ser hela listan men också att man snabbt kan om man inte pallar att trycka och gå in ock läsa att man kan snabbt se så.

A	Det är om man kombinerar de här två?
2	Ja precis. Kan man under tiden man håller på att rekommendera till kompisar lyssna då också?
AM	Ja
2	Då tycker jag att det här är bra för man kan se vilken ordning man har det på just när man håller på att dela med sig av det. Sen om man vill se mer vad det är så kan man gå in i playlist som känns bättre men just under tiden man håller på att dela med sig så är det bra att kunna se vilken ordning det kommer. Man kanske håller på länge och dela med sig till kompisar.
A	Här ser man också om du får en låt av Lisa så ploppar den upp ur Lisas
M	Medan här är det att det kommer..
A	...ur dörren
M	...upp en liten ruta där det står att det kommer en fil från Herr Alf eller vem det nu är.
1	Kommer det när man har tryckt på den eller den kommer utan att man vill ha den?
A	Den kommer utan att man har frågat efter den men sedan kan man välja om man vill behålla den eller inte.
1	Ok
2	Risken är att det blir lite när de här... Bara så länge det står vem man får den ifrån så... för det är viktigt... om det bara kommer en låt så vet man inte var man fått den ifrån. Det känns som det viktiga är att man ser var det kommer ifrån
A	Sedan om det är i form av sådana representationer eller bara i form av små etiketter?
2	Det är ju personligt. Jag vet inte vad vissa föredrar. Jag tycker dörren känns lite svår och sen kan det vara fräckare att det kommer ut ur en liten ikon så här
A	Hur tycker ni, om vi återgår till de här filrepresentationerna? Tanken är ju då att i själva verket så är det själva låtarna som tänker ut att "jag skulle trivas här hos honom" så att det är låtarna som är lite intelligenta. Vilka av de här ikonerna ser ut till att representera låtarna som tänker lite själv

	och som rör sig på eget bevåg?
1	Nja ingen. De ser inte särskilt intelligenta ut
A	Ser de levande ut i alla fall?
2	Jag kan tänka mig den här... Det ser ut som en liten mun där. De där ser lite... konstiga... Dedär ser lite mer musikfilaktiga ut. Dedär ser mer hemmagjort ut. Dedär känns lite mer levande
A	Då tackar vi så mycket.
M	Ja tack så jättemycket!

## 2. Transcript - Group Interview Three

A	<p>This system is about sharing music with other people and it has two ways to share the music: One where you explicitly say yourself that "I want to recommend this song to you" or one here the music recommends itself to users like if you usually play a certain set of songs and our friend or someone that happens to be near usually listens to about the same set of music but you don't have all songs that he has. Those songs that you don't have are recommended to you.</p> <p>So first we have the playlist mode. This is rather simple. It is a traditional playlist.</p>
1	This is the buttons to vote if it is good or bad right?
A	Yes, the voting helps the system to evaluate what songs you might like. These are not sp important as they are rather traditional but then we have this mode.
M	So we have three modes
A	Yes we have these three modes and this is the import mode and this is the playlist mode and they are rather traditional, then we have this
1	This is an explorer right?
A	<p>Yeah it's kind of an explorer and it's just to import new files into the system that comes from elsewhere.</p> <p>So if you look at this image here, can you tell me about how you interpret it? What different functions do you see?</p>
2	That's almost impossible to say. What is this supposed to be?
1	I think that there are people that are somehow connected or related for sharing some files and like some files the most
2	How do you get to that or how does it look before it looks like that?
A	How do you mean?
2	You have to do something to get that screen to appear. What do you have to do?
A	You choose the different modes by clicking the different tabs down here. It's a traditional tab system.
2	Ok, so you click "Push" there and you get to that sceen
A	Exactly
2	How do you find out what Push means?

A	Yeah, that's a point.
1	I think I agree with that because I think it looks like... almost every popup in windows for example that have three tabs they usually are in the top instead of there but I think it is easy to see how it works because of the colour shows in which one you are in which helps you. For me it is easy to see.
3	About this particular...
4	Different size of icons... and some files are related to others
5	And maybe size of icons represents relatedness or similarities with music
2	What is that supposed to be?
1	I guess it is persons that are connected with wireless that the PDA can detect. I don't see very good...
3	It is actually quite difficult to understand... these look kind of buttons
1	Perhaps if it was in colour and better resolution it would be easier.
M	Yes of course
3	I can't see how the persons are related to the [???
1	Exactly
4	I agree
A	The idea is that... because it is on paper now you cannot see it but songs appear in this...
3	Jar
A	Yes jar...
M	It's a beamer
A	A teleport station
1	All right! Now I can see it. You drag-and-drop... You drop it there and then it goes to Daniel
1234	Ok
2	What is that in the corner there?
A	It is a representation of the playlist
1	So that is you and that is the other people?
A	Exactly
M	And that is the files that exist in your system

1234	Aha, ok
2	What does the connection between the faces mean?
3	Maybe they are from the same queue
4	R the same file...
3	I think that usually if I had a PDA I would carry a lot of songs in it would be very difficult to represent them in a small display like smiles. It would be quite a lot of relations.
A	We have a few versions of this
3	I think this is more representative. That is actually files. Here when you just see smiles it looks like they represent people more than...
1	We have to consider that here it says "file name" you will probably have the name .mp3. Then you will recognize it easily.
3	I see file name and I thought about it but I thought maybe this smiley has some file in it somehow. If these are people and they have some additional files or... So I would personally prefer this ...I think more clearly...
1	They say something and here you have that information that you have here
3	Maybe it somehow can be combined
4	I think it's difficult to understand the relation with this system. I mean the relation about the song... I don't know but if this is different song the same group for example... Why is one smiley bigger than another? Are they more song?
M	The size of the smiles... Should we explain?
A	Yes maybe ... We can say first that the shaded ones are those that... maybe they should not be beside but rather inside here. It's during the transfer the shaded file is not fully transferred yet
13	Ok, better
A	Yes, so it's not fully transferred yet so then the transfer is completed it becomes full colour.
1	Let me tell you something: I can see here that you have developed another way to push music, to send music. I prefer much this one the one you have here because here you just have drag-and-drop but you have users in different places instead of having them all on this side. If you have then at different places you tend to relate different files or different list with this and that is wrong. If you have all of them in one part of the screen you do not try to relate with other things.
3	You try to relate songs with these boxes or jars or teleport or whatever.

1	You wouldn't try to relate if you have a small line and all of the users here. You wouldn't relate them but it would still work in the same way
2	So here you work with a context menu and here you work with drag and drop? How do you get the context menu to pop up? Do you have to push some button or do you have to hold down?
A	Here our thought was to take a file, drag it to the door and the door represent that you send it away and then it pops up to choose to whom to send it.
2	So it's not a context menu to the items?
A	No not immediately when you put the pen on there, it's rather for the door.
2	So it pops up as a continuation of what happens when you drop it there
A	Exactly
2	What is filename? Is that the label for like the song name?
M	Yeah
2	Could it be like all the songs in an album or something?
A	Yeah that is ... The representation here, the clusters and the lines are thought to be information that gets stored into the system.
2	You mean when you put them together?
A	When you listen to a set of songs they get clustered so the songs that you listen to in one context, at one time, they get clustered and the lines represent in what order you have played the songs, so when you go from that one to that one a line connects between them.
2	But how do you see the order, because that one is connected to those three.?
A	Well it represents that one time you started with that one and played that one next and at another time you started with that one and continued with <i>that</i> one next.
2	But you can't see in what order
A	No it's not numbered
M	It's more about how many times have you played
1	That could go crazy. If I listen to for a month every day some music and I use random order it would go crazy
A	Yeah then there would be a lot of lines crisscrossing within the group
2	Is that line thicker because of a bigger connection or is it the size of the

	icon
A	I think that might be accidental
3	It might be a direction
M	For example this one? This one is easier it goes like this while this one goes like this.
1	Is it really important in what order?
M	Yea well sometimes you want to play your favourite song or songs that belongs to each other.
A	It's just to represent what information is stored basically
1	So if you play that song and then that song on one occasion and on another occasion you play that song and that song you don't get another cluster but you get an amplification of the first cluster.
A	Yes, it depends also on the situation so that songs that you often play together ends up in one cluster and then perhaps you play another cluster at other times and that forms another cluster
1	Anyway... This information these strange connections just when you are in Push mode. When you are in Push mode it means you want to send something to someone and why do you need this information? I don't know... if I want that information if I want to know in what order I played or which one was I listened to yesterday. I don't know why I need for the Push Mode instead of the library mode or the play list mode. In Push mode you want to look for a song and just send it. I don't dislike this idea but not in Push mode
A	Ahaa... so you would have a more clean cut like.... One mode that is purely for representing your way of listening to things and another mode for sharing.
1	Yeah that is what you have here.
3	If your friend told you that he want this file and then you say ah you like this music then I can send you some more
1	So it has to be related to the kind of music but not the order. Maybe my favourite song is one funky song and one rap song and one heavy metal song and then the relation would be...
A	Do you listen to all these disparate types of music at the same time within the same play list or do you listen to rock music at one time and hip-hop at another.
1	No 20% of the time I listen to music I use random because I don't know what I want to listen to.
M	And the rest of the time?

1	Then I think "now I want to listen to hip-hop
A	Well, that is what it represents. The different moods get clustered
2	What do the sad faces mean?
A	The sad faces...
2	And that one looks neutral
A	It's about this voting thing, so if you press thumb up you get a smiley face and if you press thumb down you get a sour face and if you haven't voted yet it has a neutral face. So perhaps quite often you listen to a song that you think is really bad but you listen to it quite often because it is funny how bad it is then it gets large but has a sour face.
M	The thing is also that this song... the smiles are also related to how other people liked the songs and if they just threw them away so it's not just your information on how you played the songs it's also the others.
A	So when you get your song you can see if the one you got it from liked it or not. Maybe you want to recommend a song and say "listen to this awful song"
M	Do you think it's relevant?
4	But voting for songs... I don't know... For example when I listen to music I am not very much into looking at a small screen and voting for that song
A	You don't have to do it. It's optional
4	Yeah but if I do not do it these smiles will not make any sense
2	If you never ever vote for anything you would still have smiley faces based on what other people voted for
3	If you get these songs from other people
2	So you will not have all neutral but you will have some smiley from other people
1	This I think is great the idea that... Usually you have icons with no information. You can read the information or not it's up to you but you have information, the icons give you more information that any icon gives you so I think it's good.
4	I also like the idea with icons with smiles. For example especially this one with a note and also have a smiley
1	Aah I didn't see that
4	So it's a good combination of these two
1	Yeah you are right. So then you can recommend that music and you can see the face

4	And see the face yeah
1	But they are all happy
M	No not all of them... They're not supposed to be anyway
1	I like this idea to look for music you have listened to because for example you make a play list for when you are sad or play list when you are happy so its good that you don't have to do it again but I still don't think it's good in the push mode. Maybe you should add another mode that is called history. Then you can look for that in the mode history. In the mode push...
A	Would you like a traditional list that you send to other people?
3	What does it mean, push I mean, what does it represent?
A	Maybe it's a bad name for it...
M	The projects name is Push!Music which means to push a song to another person.
3	Ah, now I get it.
2	So the playlist is just your playlist and push is a collaborative playlist somehow?
M	Push is all the existing files in your system.
A	The information in this list is gathered from other users as well but it is basically the songs that you have in your system and in this alternative you also see different users in this mode... that you are near, that you are connected to.
M	Is the data of your usage of the music files, like if you like then or not, will be exposed to anybody the data of if you like the song or not if it is made public, would that be a problem for you?
3	If I like some music and it's made public?
M	Mmm
3	In some cases yeah.
M	For example this... if you get a file from this user and this user... er... let me think....
A	So it's public information then, what songs you listen to, from who you get...
2	How far is the reach? Is this like using Blue Tooth or radio LAN
A	It's WiFi so it's like a hundred meters or so
4	I like to share it with a friend but not with everyone.

2	Could you set the range and who you let into the system
A	Perhaps yes
2	Maybe you have some music you would share with everybody that is close enough and some that you only share with friends
1	I would love to share music. First I don't give a crap about if they like my music or not but the thing is I can share my music with other people that I probably like so I don't lose anything and I win something
M	It's a similar system to file sharing programs like eMule or whatever
A	Think about this information that is represented on these screens is information that has to be stored in order to let the system work so it's about... these representations is about visualising what is stored so that you know that something is stored
M	What did you want to say?
4	If it's like file sharing everyone can have access on you
M	No, the thing is you can share your files but nobody can take your files right? Not actively because there are some files that are recommended automatically without you doing it because the system... it comes out like... this user likes this kind of songs so maybe he will like this song as well. So we have two things, one, you actively push a song to another person or the system recommend to you a song depending on what data you have stored.
2	When you push a song do you actually send a file
M	Yes, you take a file and you go like [swip] and drop it or you like there...
2	All right
1	The system gets music for you without you notice anything
M	Do you want to be noticed?
1	No that thing I think is great. I go for a walk and I will come back with more music in the same way that I like. It's like that right? When you have like eMule you have like a couple of folders that you send to people that could be the same. You don't get to have it in eMule. Having that you are able to have another thing you can download from eMule that would work in the same way so
A	That is what you do here. You import the music that you want to import into the system so you can choose what music you want to share and to have in the system
2	That's usually the problem when you use Direct Connect. You search for something and you find that on somebody's computer and you also take a look at the other files. Perhaps he or she has other things that I like and the problem is that that persons' computer is like a rat's nest of files so

	you can't find anything. So this is supposed to make that easier?
A	Yeah, it's supposed to... You don't have to know what to look for, you get music anyway and it's hopefully music that you like.
M	It's like turning on the TV and flick through different channels
A	But you flick through channels that are adapted to your liking. We can also draw similarities to amazon.com's "who bought this also bought" system. It works slightly similar to this.
3	How does the system evaluate what music I would prefer? According to what? The recommendations or...?
	[jumbled]
A	That is why we have chosen to make these representations about living. That's why we asked about that too. Because it is the music files that actually stores information and then get asked "Would you like it on this PDA too?". Then the music file looks on the other PDA and see if that PDA have songs that are same as the songs that have been listened to in the same context as itself at the current user
2	So it's a database operation. You have two sets of things and you see what is common between those sets
A	Yes exactly
2	What do you call that? Not union but...
1	Join
M	How about if you listen to a song... a play list, a set of songs, a file that come in and it put itself directly after the song you are listening to? Would that bother you?
2	You mean if you are listening to a song and the system puts another song that it thinks you like after
3	You should choose somehow explicitly if I want this or not
2	So that you have chosen that you want to listen to nothing else but if you are listening to something you haven't put in that next I want to listen to this song it could suggest
A	A setting of how open to suggestions you are?
1234	Yes
2	So that do not override anything you have selected.
3	Another thing maybe you could also select how much deviation of the taste you prefer. For example maybe you only like just the same music I listen to, very similar... So I can choose like only ten percent of deviation or maybe I'm more open minded and want to listen to something not so

	similar I can increase this distance between taste.
A	How open...?
3	Yes.
A	That is very interesting information but slightly aside to what we need to know here. It's completely new functions but the focus is how we can visualise the information the system has
3	Actually it's interesting but the only problem I see is that if you have hundreds or thousands of files this visualization would be problematic, especially on a small screen.
A	It would be a whole lot of scrolling
M	We have two different navigation systems. We have the zoom and hand where you move everything and you have the traditional scroll bar. What do you prefer?
3	I don't like scrolling but I don't like zooming either
1	Personally I wouldn't put two scrolls. If you use two scrolls you can go up, down, right, left, that would be crazy. You could use up-down or right-left but not both. Up-down is what we are used to.
2	You usually learn to hate to scroll left and right when you use the web so...
4	Can you search for a song here by...?
A	You mean by key word search?
4	Yes
A	Well we haven't thought of that before but perhaps...
4	It would be better. If you have a lot of songs it is not easy to find it here
2	If you have thousands of songs you got to have...
4	Maybe you could have relations between these clusters as well. Maybe after one cluster I prefer to listen to another cluster and maybe by these relations you could navigate more easily
A	So you would differentiate between different kinds of associations then
4	Yes probably, because... Maybe it shouldn't represent all the relations like first I listened to that then that all the relations like first I listened to that then that but maybe one common because if I listen to one song many times it would have many relations with other songs but if I get to many of these relations they will not tell me much so maybe it should be the most common relations would represent more. For example if I listen to one song and then I <i>usually</i> I listen to some other so the relation is kind of strong. Maybe that was a good idea of Mats that the relation itself

	could be represented by the thickness of the line or something like that.
2	I think I would prefer to have a small list instead of these icons because icons always takes much room. When I can change settings in programs I usually remove all icons and have text instead because after a while I get fed up with that they take up a lot of space so if you could have a small list
4	Another thing with icons, an idea also
A	If you have a list... oh sorry...
4	No continue
A	If you have a list would you still recognise that the icons are...the music files are autonomous, they think for themselves, they do things on their own?
3	Probably not
A	This is the idea of making faces is to make it look like... and to animate them moving to different users and stuff is to illustrate that they do things on their own initiative, that they sort of intelligent
2	How many stages do you have? Sad face, neutral and smiley. Do you have more stages of happiness?
A	It would probably be hard to have many stages it would not be so clear
2	You could compare that with three stars
M	That is totally depending on the illustration. I saw things where you can represent 5 6 7 levels with smiles
2	In the windows media player now they have built in a rating system with five stars. You can give them more or less stars and also when you play them a lot they get an extra star or one less star if you never play them. If you stop them or always skip them they deduct a star
A	That sort of is what happens here too but we try to illustrate it in a more visual way
2	They represent that within the regular list of files with the names and dates and stuff and they have an extra...
A	Does this more visual way add anything or would it be more obvious with only the stars in the playlist?
4	No stars will not illustrate the interrelations with songs. This is a new way of showing files, not in according to filename or album or who but according to relations so that's why I think it could be useful but still I don't think the relations should be based on the order of how they were played but maybe on the taste. It should clearly be connected with some kind of particular reason but not the order because I really doubt if order represents true connection.

1	I think for example one thing you should consider here is that if you have a group of songs here, and another group of songs here, and another group of songs here and all the three groups have the same songs they have a line connect the same song they have a line that connect all of them. That will be kind of confusing. I think it will be better to have the same file in all of them. You understand? For example you have one day I listen to a sad playlist where I have a neutral song for me. Another day, I like that song so, I put it also in my happy playlist. It is better to have one here and one here instead of a line that connects them. It will be more clear if you have a copy of the song instead of connect all the playlists
A	That is interesting...
4	I think you have to recognize this to find good [?]  If we have a lot of these files the scrolling should be implemented somehow easily. I mean you should be able to navigate fast and maybe not in random order but according to relations in these clusters. If there is any relation between the clusters maybe I could navigate according to them.
A	So if you put different axes, left-right and up-down and these axes' represent different moods. So happy is up and sad is down
3	Yes but maybe not both axes.[...] At least one axle. For another thing it shouldn't be like pressing one button many times to scroll. It should be easy for example like iPod with this wheel. Then you can navigate fast. If it was buttons I wouldn't use this function because it's too... you have to put too much effort to press this button
A	Maybe...
3	Drag it
A	...drag-bar that you can zoom by... what's the word in English...regel...
2	Slider?
A	Mmm
2	What if I start this system...? I have all my music and I start it up for the first time. What does it look like on the screen. Is it just like a lot of these dots all over the place?
A	If you have a bunch of never associated music then they would be rather random on the screen
2	So it would be one big sea of these little fellas
A	Yes basically, and as you listen to them they will order themselves more and more.
2	Group together?

A	Yes exactly.
2	Does it make any difference, the clusters themselves how are they dispersed...?
A	Maybe the suggestion was good that the different clusters are organized along certain axes
2	Because if you have these songs separately and play them together then you connect them and have a cluster and then you play a song with another song here do that song part with these three or do they form another cluster
A	That depends on... That's a good question...
1	Can you for example drag and drop here, this one and here...
2	Does every song have one of these or can they have many different
A	Wouldn't it be confusing to many copies of each song in this representation?
2	What if you play all the songs one after another and let it play for a couple of days. Would you have one big cluster with everything then?
1A	Yes
3	That's not a good idea. It should be based on how you usually play them. Not...
1	You have scrolling like this and here like time. Here is what you listened to yesterday. Then you can look for the playlist you had some days ago or a month ago. That would be useful because I think for example one week ago I did a cool playlist I would like to listen to again. That would be easy. All you have to do is move the scope and...
M	Do you think the basic thing that decides your music is your mood?
1	Basically, not 100% but basically.
A	Then you can have different axes. One for time and one for mood.
1	That would make it difficult
A	...so that you have the happy one yesterday that's up there [left], and then you have the sad one today that would be down here [right]. Then you have a happy one today that would be here [up right]
1	You see this line as a time line?
A	Yes
1	And here you can just drag here and click in the scroll and move it and you look here and you see the latest playlist you listened to and you go here you listened to first...playlist

A	So it's a time axis, a time line according to how far you scroll it
1	So you can look for a playlist you have listened to...
4	I don't like this because it's more important how many times you have listened to a song but not if I played... I mean not really time but if one day I play ten times this song in the same day I have a big icon for example but...
2	If you have five songs and they have one icon each if you play then in order how would it look like then?
A	Then it would be like this and then next time you play this one first and then you play nr five and after five four and all these that you play they would get slightly larger. Then yo stop with the four. And then you start again and then you play this one again it gets even larger and then you play four and that one gets even larger. And next time this gets even larger again.
1	What if you never play nr one again does it disappear? Does it get smaller and smaller until you can't see it?
A	Yes we would have to limit ourselves to sort of a set of sizes so that one song cannot become unlimited large it would cover the whole screen so it would have to be relative, a relative scale.
2	Yes because this would be difficult even on a regular screen.
4	So it should shrink if I do not play it for some time
A	So if that one is ignored it gets smaller but I think it will still be there but perhaps after a time... perhaps you could have... because there is also a limit to what information that is stored. A certain set of megabytes so that after a time this connection would disappear because it is so old so it is not relevant any more
2	So it will be free floating?
A	So it will be free floating and very small because it's never played.
4	Does the distance represent anything... between icons?
A	If two songs are played after each other often they would get closer to each other so that one and that one would be bumped away by this one because this one is played often by that one so it would after a while look like the big one and the almost as big one and the one that is not played so often together with those would become a bit further away. So that those that are played very often together get close together and have lines between them. There is a representation of how strongly associated they are
2	A most interesting edge case if you implemented this would be to put it on random repeat for all the songs and let it play for a week and see what it looks like after that

A	Then it would basically be a mess and the system would not work very well because
2	That would be one extreme setting when everything is connected to everything and the other extreme would be when nothing is connected to anything.
4	It shouldn't count these relations when you play it at random
A	Yes maybe. If you set your player to random mode it won't record as much data because the data is random anyway so it's irrelevant, it doesn't say anything about how you listen to music because it's random
2	Yes but over time your behaviour would be random
3	Maybe it should still count time the music was played
A	All of us listen to music in a certain pattern. It's not completely random is it? You get into the mood of listening to music
3	Even if a play in random and for example there is a song that I don't like so I skip it
A	Yeah, even in random mode you skip songs
M	If we start from the beginning do you think these connections are useful?
4	I think the connections are useful but...
A	Maybe they shouldn't be represented in this way?
M	What do you think they should represent instead?
4	I think we have to separate the visualization about different kind of icon and connections because I think it's important... more useful... more easy to find a song but after I want to go what connect this song
3	I think they should not represent order, maybe it can be based on order but they should represent how often you played and what other songs you like
A	Basically skip the lines between them and just cluster them?
3	Yes, probably that make sense
2	So when they are close to each other or perhaps touching a little bit then they are a cluster?
A	Yes, and that would represent that they are often played together.  Maybe within a cluster it might not be so interesting to know that you played one before the other
2	Then it would be possible to just display it as a little list of songs like this with perhaps a frame around it. Like a post it with song names on it

M	When you take the pen on a cluster?
2	That it would display the cluster itself would be a little list of song names
M	You mean one icon sckfj clusters?
A	One list for each cluster?
2	Just a little list floating in space
M	Aha
2	Then you save a lot of space. If you don't have to represent the relations between them anyway
1	I think it's relevant that they are connected. You like to listen to those songs connected but not all
3	The main point is the connection not order
1	That they are connected not the line. They, these are connected
2	At least you could save one dimension of connection. When you have a list you could have one order. I think you could switch between having icons or having lists like when you switch in folders in windows for example.
A	That is partly what this play list mode is about so you get the list of the play list you are playing now you have the list. That's one mode so this mode still exist while you are looking at this.
M	What do you think if there is some kind of colour representation of different moods and in that the clusters are represented depending on the mood?
2	Instead of smiley-faces you can have a shade of colour
3	If you have this list the size of icon can be represented by the size of text. I don't remember exactly where I saw this tagging stuff and the most popular tags were bigger not so popular smaller but you see the relations between these and get an idea of what is popular so maybe this can be implemented as you said a floating list tha also represent size.
2	<p>If you are going to implement something fast like this there is a really good framework you can use for just this if you don't want to know a lot of mathematics but you want to have bubbles connected I can e-mail you a link to you. You can build anything around that framework without knowing anything about mathematics. Some guy have built a thing that analyzes websites that shows bubbles depending on what kind of tags they have kind of headline tags then it shows it in different colours. You can see in a picture if it's a good layout, if there is a lot of frames or</p> <p>It looks nice because it keeps the distance and spreads them out nicely and you get a nice bouncy effect when you change something</p>

M	How do you know how the bubble represents what website
2	It's a program that writes itself and has a kind of scripting language
A	That would be cool to see
M	Do you have any
2	Write down your e-mail address and I'll send it to you. I think I have the link at home. There is a home page for this framework
3	I also think you should check out last FM. Have you herd about it? It is about also radio based on your taste and they measure how much you like some, how often you listen to some kind of music and according to that you have neighbours of users that listen to similar music and you can listen to their music that is similar. There are a lot of features implemented actually that you are trying to do but it is not visualised like this so maybe it could be useful
2	You also have like Pandora in flash interface that fins music that you probably like based on what music you put in. You put in a name of a band or a song and you get like a radio station that plays another song and another song and another song. The interface is horrible flash but it's a nice idea.
A	Thank you!
M	Thank you very much!

### 3. Guidance for Group Interviews

**Presentera** oss och inleda med att säga detta är ett skolprojekt och vi vill se om ni kan tyda systemet. Vi vill få reda på vad ni tror dessa skisser föreställer.  
Present our self and say that this is a project within the university and we are interested in if they can understand the project. We want to see what they think about the sketches.

**Presentera projektet och vad** agenter är.

Present the project and what agents are.

**Tänk på, stödfrågor/punkter:**

Gruppens datorvana (the groups computer experience)

Hur vana är de vid mobila funktioner, spel, handdatorer, mediaspelare?  
(Experience of mobile functions, games, PDAs, mediaplayers?)

Använder de något annat musikdelar program? (Do they use any file sharing program?)

Vad tror de händer på bilderna, vad är det för feedback presenteras? (What is happening on the sketches?)

Vad representerar symbolerna? (What do the symbols stand for?)

Vad finns i systemet? (What is present within the system?)

Hur kan man skicka filen till andra? (How do you send files to other users?)

Känner de att de kan lita på systemet? (Do they feel like that can trust the system?)

Avslutande frågor/diskussion: Hur upplever de dessa musikfiler? Intelligent, passiva osv...

Summarizing questions/discussion: What do you feel about this kind of music files? Intelligent? Passiv?

## 4. Transcript - User Test One

*Startar PM och hamnar i Library*

Jag har ingen aning vad som händer här.

Jag provar att trycka på "Add" och ser vad som händer

Jaha där kom en låt upp

*Växlar till Playlist och startar en låt*

Aha titta!

Det är väldigt lätt. Inte så mycket knappar man kan ta fel på.

Skulle kanske ha en bakåtknapp också

Här är ett par knappar som jag inte har en aning om vad det kan va'

M: Den ena är en tumme upp och den andre är tumme ner

Så om man tycker låten är bra så trycker man på tummen upp och tumme ner om den är dålig.

*Prövar Library*

Aha samma

*Prövar Push*

*Klickar runt på låtarna*

Det händer ingenting

Man blir lite förvirrad det finns ingen förklaring

A: Här kan man skicka låtar till andra användare

Man klickar på en låt och så drar man den nånstans

*Drar till tomt ställe på skärmen*

A: Du kan dra den till en annan användare

Aha

*Drar till "Other user" och klickar på "Yes"*

Så skickades den iväg nu

*Klickar runt lite*

Man kan inte se vilken låt man skickar men annars så...

A: Hur tror du placeringen av ikonerna fungerar?

Inkommande till vänster egna till höger?

A: Färgerna? Storlek

Storlek på låten och rang. Tumme upp

Men det kunde vara som en vanlig spelare så att det står t.ex Cat Stevens...

*Visar under filen*

'Den är väldigt begränsad

Man borde kunna klicka på filerna i Push utan att gå ti spelaren

Man kan kanske dra en linje här och göra spalter för att visa skillnaden

*Mellan grupperna*

A: Det är inte meningen. Grupperingen är låtar som spelas ofta i samma sammanhang grupperas

A: De blir större ju oftare man spelar dem och färgen korrelerar. Glad och ledsen är tummen upp och ner

Man kan kanske ha teckenförklaring

Library är de filer man har på sin dator så om man har en mapp med Mina låtar så kommer den upp här.

Markerar man så kan man klicka "Add" och markerar man här så tar man bort.

Ahaaa

## 5. Transcript - User Test Two

A: OK, du kan börja med att titta runt lite... Nu är den ju så att allt funkar inte

Nej precis

A: Du kan väl berätta högt vad du tror att de olika...

Ja här har man "Add" så att man kan lägga till låtar för ditt bruk och här samma sak "Remove" Så har du Player för att få fram spellistan och Push där man kan skicka vidare till andra aktörer där ute.

*Allt pekas på och gås igenom i rask och säker takt*

Man kan flytta runt till "Other users", mina sångtitlar tydligen Så får jag fram texten "Do you want to send me to other user" och om jag vill det så trycker jag på "Yes".

De skulle gärna vara mer separerade

*Pekar på "Yes"/"No"*

Här har du sångtitlar så du inte är helt blind på vad du skickar

Här kan man komma tillbaka till Library med menysystemet här nere Här dyker då filerna upp som ett vanligt filsystem och

*Pekar på Library till höger*

Här får man det mer specificerat med låttitlar vad du har i ditt bibliotek

Enkel avstängningsknapp där ja

*Stänger och startar upp Push!Music*

*Går till Playlist*

Här har vi spellistan. Kan tänka mig att den fungerar som WinAmp eller liknande...

*Klickar på Play*

Ja precis

Paus verkar inte funka för tillfället

Volymkontroll

*Pekar på volymkontrollen*

De här är lite svåra att se...

A: Det är meningen att den ena är tummen upp och den andre är tumme ner

Aha Ok Då är det att det är min favoritmusik och den andre att det inte är det

Eller så är det att acceptera eller neka när du fått in dem i spellistan

Så kan du byta enkelt i menysystemet

Ganska rent och enkelt utseende

Lite tydligare som sagt på när man ska skicka "Yes"/"No" och vad man vill skicka till "Other users". Det är svårt att se vad som finns

A: Ja gubbarna är alltså låtarna

Ja

Ja det är mina låtar som jag vill skicka ut

A: Det finns fler stycken så istället för "Other user" så står det Anna och Pelle...

*Ja precis*

A: Vad tror du färgkodningen och storleken signifikerar?

Hur mycket du lyssnar på dem... Storleken är hur mycket du lyssnar på dem

Sen har vi glada och mindra glada gubbar och det är vad jag tycker om låtarna

Vad färgkodningen symboliserar kan vara olika typer av låtar Antingen olika artister eller olika genrer eller liknande

Eller möjligtvis längd eller storlek på filen storleken alltså.

Om det skulle vara storleken så skulle färgen vara vad jag tycker istället

A: Om du ser på när du startar det läget hur filerna är arrangerade. Vad tror du den arrangeringen betyder?

Ingen aning... De ligger i två olika grupper det kan vara antingen som min kompis har skickat till mig eller som jag vill skicka till min kompis

A: Det har något att göra med vilken information som sparas i systemet.

Ok Ja då är det väl antingen vad man har levererat ut eller vad man levererar ut

Det kunde kanske vara tydligare men det är väl som med alla system att man lär sig med tiden och det blir lite vanesak av det

Storleken skulle jag kunna ändra på ett annat sätt

A: Zoomen menar du eller?

Nej för att få en större ruta

A: Jaha. Det glömde vi kanske säga. Det är tänkt att vara på en PDA och en PDA är inte större än så

Aha Om det hade varit på en dator hade det varit smidigt men om det är på en PDA så är det de här man får använda

*Pekar på zoom och navigeringsknapparna*

A: Systemet är uteslutande utvecklat för PDA:er

Det är ganska smidigt system och det är lätt att se var allt hör hemma

Lätta menysystem, Lätt spelare, enkelt att förstå sig på Så det är den här Push som är lite

Det är frågan om man ska ha någon speciell inloggning så att man inte delar med sig till ven som helst och tar emot från vem som helst. Sprider det sig för mycket så kan det bli väldigt irriterande

M: Tyckte du det var roligt?

Ja om man konverterar det till mobilanvändande som vi har idag istället för PDA:er så... Möjligt vis nu när det kommer större MP3-spelare som iPod och liknande

M: Skulle du kunna tänka dig och använda det?

Ja definitivt sen är det ju frågan om kostnaden men det är ju ett väldigt smidigt system om man vill utbyta musik med vännerna.

Idag sitter ju många och gör det över Internet på datorn för att sedan ladda ner det i sina PDA:er eller mobiler. Sedan är det ju frågan hur snabbt det hade varit. Det är ju krångligt att ta en låt med Bluetooth här är det ju snabbt dragmässigt

M: Skulle du kunna tänka dig att dela med dig till folk du inte känner? Att ditt system automatiskt...

Ja det skulle jag men då skulle det finnas ett val att "nu vill jag dela ut till alla/nu vill jag inte dela ut alls.

## 6. Transcript - User Test Three

Jaha vad ska jag göra nu då?

A: Du kan först titta på skärmen och se vad de olika sakerna betyder, vad de gör och så.

Jaha, vad ska man göra? Vad går det ut på?

A: Det är alltså ett system för att dela musik med andra

*Drar en låt till en användare*

Var står "Yes" och "No"?

*Efter en stunds tvekan klickar på "Yes"*

*Växlar till Playlist*

Oj vad smått det var!

A: Ja det är väldigt smått. Det är inte meningen att det ska va' det.

*Pekar på tumme upp*

A: De där knapparna är meningen att vara tumme upp och tumme ner

Ok... Vad betyder tumme upp och tumme ner då?

A: Ja vad tror du?

Godkänd eller inte godkänd eller bra eller dålig

A: Vad tror du man röstar på då?

Hur bra man tycker låten var

*Växlar till Push i sitt ursprungsläge*

A: Såhär ser det ut när man börjar med systemet innan man har använt det och om du klickar en gång

*Animering sker*

A: Så blir det efter ett tag när man har lyssnat på olika låtar

*Ska det betyda att de liknar varandra?*

*Ringar in en grupp*

Att man lyssnar på dem samtidigt?

A: Just det. Och de andra skillnaderna mellan låtarna?

Ja, hur bra man tyckte de var och hur ofta man spelat dem, det står ju här.

Sen är där en liten mun som är glad eller ledsen beroende på om den är bra eller dålig

*Drar ett par låtar till andra användare*

Oj vad hände nu?

A: Ja vad tror du det betyder att låten blev grå?

Att man skickar den till någon annan

*Växlar till Library*

A: De olika kolumnerna, vad tror du de innebär?

Den vänstra är väl lagringen och Push!Music är det man delar med sig

Om jag vill ta emot från någon annan då?

A: Grejen med detta är att utifrån den informationen som representeras här så läser systemet av så att om någon annan har nästan samma låtar som du har men några fler så kopieras de låtarna automatiskt till dig. De du inte har. Eller så kan den här personen skicka låtar explicit så som du gjorde här.

Kan man själv be om att få en explicit?

A: Nej. Man kan inte se vad andra har för låtar

Kan man simulera hur det skulle se ut när man får...?

A: Nja, de dyker upp i de här små beamers och så far de ut på rutan där'

Kan jag påverka hur de här ser ut?

A: Hur de ordnas påverkas av hur du lyssnar på dem. De som du lyssnar på i samma sammanhang hamnar nära varandra

Det kommer den att anpassa automatiskt

A: Ja

A: Om du ser på den informationen som finns representerad här, din lyssningshistorik och så. Hur ställer du dig till att sådan information kan bli tillgänglig för andra?

Vad för låtar jag lyssnar på?

Nej det vet jag inte om jag skulle tycka är så roligt. Inte till vem som helst i alla fall

A: Vad tycker du då om vårt sätt att representera detta jämfört med om det bara hade varit en vanlig lista?

Det är visuellt men ganska rörigt. Man har svårt att få en överblick över vad det är för låtar. De här kan man ha som en rolig pop-up kanske. Om jag skulle administrera det skulle jag vilja ha kolumner efter kluster så att man kan se hur man har spelat dem men ändå i excel-aktigt. Olika kolumner beroende på olika grupper om man vill få överblick. Den här ordningsformen skulle mest göra mig förvirrad om jag skulle använda den för att göra en spellista. Eller kanske inte. Det beror lite på... Om man måste hovra för att se låttitlarna så är det svårt att göra urval till sin Playlist.

Detta läget skulle kunna vara rätt fräckt om där var en extra kolumn här bredvid

*Indikerar höger om arbetsytan*

Så kommer det upp här vilka man markerat vilka låtar det motsvarar. Så kan man lätt välja bland dem vilka man vill ta till sin Playlist just nu. På så vis skulle jag kunna få en överblick över vad jag vill spela. Det blir omständligt när det bara är ikoner som ligger huller om buller.

Jag kanske är lite strikt av mig när det gäller sånt.

Det här om de ler eller inte är kanske inte helt intuitivt

## 7. Transcript - User Test Four

A: Så här ser det ut från början när man precis har installerat programvaran och startat upp det. Klicka en gång. Så där ser det ut efter du har lyssnat på en massa musik. Det här är en semifunktionell prototyp så att allt funkar inte på den. Du får prata högt om vad du tror händer på skärmen och vad du tror ska hända, sen om det verkligen händer är inte säkert.

Jag tror att de är grupperade efter olika funktionsgrupper och de stora gröna är sådana man använder ofta och de små röda man använder sällan av musik ikonerna. De gula är väl något mellanting men skillnaden mellan de stora och små är helt klart

A: Som du ser så korrelerar de, färg och storlek.

*Växlar till play list*

Det här är väl vad man har i sin Playlist

A: De där är en tumme upp och en tumme ner

Då är det om man tycker bra om den eller inte. Då antar jag att någon kommer att ändra sig här

*Växlar till Push!*

Jag förstår inte riktigt varför den grupperar in dem så här.

A: Det här systemet kopplar upp sig mot andra användare

*Pekar på användarsymbolerna*

A: Vad representerar de?

De borde representera andra såna här grejer som någon annan har

Ska man kunna markera flera samtidigt?

A: Ja det skulle man kunna

Kan man gå in på andras och se?

A: Liksom du drog en låt till en användare kan det också komma en låt från en sån in till dig.

Aha då är det någon som skickar till mig. Är de kopplade i något slags nätverk.

A: Ja

Så det är så att man kan tipsa varandra om låtar.

A: Sedan är det så att systemet tittar på de andras vad de har i sina bibliotek och ser om du har något likadant och om du har något likadant men saknar något som den andra har så får du det som du saknade automatiskt utan att någon behöver skicka till någon annan.

Så den känner liksom av vad man tycker om

A: Det är ju det som visas här som du sade. Det är alltså utifrån hur du lyssnar på...

Ja då blir de såhär i olika färger och så men de olika grupperna?

A: Just det, det är de som är grupperade tillsammans har du lyssnat på i samma sammanhang

Jaha då har man till exempel lugn musik i en och jag-sitter-på-cykeln i en

A: Ungefär så ja.

Om man har en låt i båda två då?

A: Då hamnar grupperna nära varandra och den hamnar mitt emellan. Så att de överlappar.

*Växlar till Library och pekar på vänstra halvan*

Den här förstår jag, det är vad man har på sitt eget minneskort men den andre?

A: Det är den musiken som finns importerad i det här systemet

Så det är vad alla andra har?

A: Nej det är vad du har i ditt system. Du kanske har musik som du inte vill dela med dig till andra av. Då importerar du inte in den där.

Aha då är jag med

*Växlar till Push*

Hur får man de att bli glada eller ledsna här?

A: Det gör man bara i spellistan.

Jaha det här tog väl en 10 min att lära sig

A: Vilken information tror du då sparas i systemet?

Det måste vara vad man lyssnar på och vad man tyckte om det och måste man väl ha ett system som känner av olika genrer av musik. Och så har vi vad man lyssnar på vid olika tillfällen

A: Hur ser du på att den information som sparas här sprids till andra?

Ja det är en bra fråga... Ska man sprida det man själv...? Det borde inte göra någonting det är ju bara musik men annat... Jag vet ju inte hur hackvänliga de här datorerna är

A: Den informationen som visas på skärmen här det är i princip det som lagras i systemet och som kan göras tillgänglig för andra

Det borde inte göra någonting

A: Om systemet hade kört på utan att representera informationen på det här sättet

Jag tycker att det behöver kanske inte vara det mest uppenbara men att man ska kunna ta reda på det just för att man ska få reda på vad som finns.

## 8. Guidance for User Tests

### **Presentera projektet (present the project)**

System är till för att byta musik med andra användare av systemet på en mobil enhet (the system is to exchange music with other users of the system. The system is for mobile units)

Systemet heter Push!Music, att "push" musik till andra enheter (The systems name is Push!Music, to push the music to other units)

Det är ett test av programmet, inte test av din kunskap (This is a test of the system and not of your knowledge)...

.. för att se om systemets användargränssnitt är bra utformat, försör du inte systemet så kan det bero på systemet (... to see if the systems interface is good designed. If you do not understand the system this can depend on the system)

### **Uppgifter (tasks)**

Starta låten (start a song)

Ge den kritik + - (give critique)

Dela med dig en av filerna (Share the files)

Avslutning, titta runt och bekanta dig med systemet (for the ending, look around and get familiar with the system)

### **Frågor ställda efter/under testen (Questions asked after the tests, or ongoing)**

Intryck (Impressions)

Bekvämt (Comfortability)

Undrar du över något/när? (Did you feel puzzled and so when?)

Roligt? (Fun?)

Några funderingar om symbolerna? (Thoughts about file symbols?)

(Ser de ut om filer) Do they look like files?

Tänkar om färgkodningen? (Thoughts about the colours represent?)

Storleken (Different size of the files?)