Honours Project Report

Grout:
MANET application for Windows Phone
(Mobile HCI Component)

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	Category	Min	Max	Chosen
1	Requirement Analysis and Design	0	20	15
2	Theoretical Analysis	0	25	0
3	Experiment Design and Execution	0	20	15
4	System Development and Implementation	0	15	0
5	Results, Findings and Conclusion	10	20	15
6	Aim Formulation and Background Work	10	15	10
7	Quality of Report Writing and Presentation	10		10
8	Adherence to Project Proposal and Quality of Deliverables	10		10
9	Overall General Project Evaluation	0	10	5
Total marks		**80**		**80**

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Abstract

We live in a world today full of wonderful electrical gadgets and technological advancements. With all these technological advancements there develops a need to gain information in effective and easy manner, whether it be for study purposes, gaining an edge over competitors in business or wanting that cooking recipe; information is what drives us. A popular way of gaining and distributing information that has picked up in the last couple of years is through the use of file sharing systems. This particular type of system has been restricted to the desktop; effectively limiting the access people have to them. With the increasing amounts of people with access to smartphones, this report looks at how to successfully import a desktop-based file sharing system onto a mobile platform. In particular this report looks at the mobile HCI aspects of the system and makes use of Windows Phone and the design opportunities it brings as a mobile platform to develop the system. An iterative design process was implemented, and each stage included a design, implementation and evaluation phase with the various prototypes.

Acknowledgements

I would like to thank Professor Gary Marsden, my supervisor for all the feedback and guidance through the course of the project and providing us with the necessary equipment in order to complete the project successfully.

Next I would like to thank the participants from the second year Computer Science and third year Information Systems class for their valuable feedback and designs throughout the participatory design and evaluation sessions.

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1. Introduction

1.1 System Overview

The world we in live today is filled with vast amounts of information. This information is what enables us to complete fundamental tasks in our lives whether it is for studying purposes, gaining an edge over competitors in business or simply wanting that basic cooking recipe. With the realization that information plays a vital role in today's society, there becomes a need to gain access to this information in a quick and easy manner. One such way of distributing information that has become very popular in recent times is through the use of "peer-to-peer" file sharing systems. In recent times popular desktop file sharing systems such as Napster, Kazaa and Gnutella have allowed people from all over the world to share information in an effective yet controversial manner due to some copyright infringements. Despite this, file-sharing systems have managed to gain a lot of popularity throughout recent years[30]. One fundamental component to consider in a peer-to-peer system is that a peer is both a consumer and producer of the implemented service: a peer can both request files from its peers and store and serve files to its peers[10]. File sharing systems can be considered to be the most important application on the Internet today, with sites such as Megaupload having claimed to have had over 50,000,000 people per day[36].

The majority of file sharing systems in use today are desktop based and require an Internet or local connection. But consider having the power of such a system on a mobile device that could make use of Bluetooth and Wi-Fi to transfer files. This type of system would be beneficial in developing and third world countries where there are generally costs associated with data charges. An example of this would be MTN, which operates in many African countries such as South Africa, Ghana, Côte d'Ivoire, Nigeria and many more and each of them charging users for the use of cellular data[5]. One of the most important aspects to consider is the design of the system, as one would have to look at various factors that contribute to the success of importing a successful desktop-based system onto a mobile device. Desktop systems contain a number of attributes that are in many aspects different to mobile device these include things such as the screen size, sound and keyboards.

One of the key issues that need to be addressed when designing a file sharing system is that of co-presence. As Deorry et al. described in their paper, you want to create a system that will provide "a simulacrum of co-presence that is functionally equivalent to face-to-face interaction, allowing users to accomplish their communicative and creative goals as easily and efficiently as if they were physically co-present" [6]. In other words, the system that is being created needs to have the same communicative efficacy as face-to-face interaction. Considering this issue has major implications for the design and evaluation of the system. In designing the system the researcher must consider various co-presence factors together with the technology being used in order to achieve the best results to portray a sense of co-presence throughout the system. In evaluating the system, different outputs need to be assessed and how they affect the levels of co-presence throughout the system.

We live in a world whereby the smartphone market is dominated by mobile operating systems that are app-centric. According to Gartner, Android, iOS and Symbian have dominated the mobile market share in recent years[9]. In reaction to this, Microsoft

has decided to reintroduce its self into the mobile market, by scrapping their Windows Mobile platform and introducing Windows Phone. The Windows Phone platform has tried to move away from this app-centric notion and offers new exciting design opportunities (see Section 2.3.2) to developers to build applications that are available wherever the user is. These applications can be just as useful and engaging as anything built for desktop computing platforms.

1.2 Research questions

This research project will develop a unique interface for a file sharing system that will exploit the unique tiling interface of the Windows Phone platform. In addition to this, the project will pay close attention to design principles and develop a sense of co-presence for users using the system. The main research questions that will be addressed in this report are the following:

1. How can co-presence be incorporated effectively into the design of a mobile file sharing system?
2. Can desktop file sharing system interfaces be translated onto the mobile platform by efficiently making use of screen size?
3. Will users be able to adjust to the new never before seen Windows Phone interfaces (see Section 2.3.2) and efficiently navigate through an application?
4. Can synchronous and asynchronous transfers be represented effectively in the same application?

1.3 Thesis Outline

The next chapter will look at the history of Windows mobile interfaces as well as the design limitations and opportunities that exist as a design platform. Existing file sharing systems will be looked at and in particular looking at how co-presence is represented within these systems.

Following from this chapter 3 we will look at the overall design process and describe the design methods used as well as the various prototypes to be created. Chapters 4 and 5 look at the design, implementation and evaluation of the low and high fidelity prototypes respectively. Chapter 6 will look at the final iteration of the system.

Finally chapter 7 will conclude this projects report and give possible directions for future work to be conducted.

2. Background and motivation

2.1 Introduction

The smartphone operating system market is currently dominated by Android and iOS[9]. However these operating systems are considered to be app-centric. In an attempt to differentiate themselves and move away from this app-centric notion, Microsoft have come up with a new mobile operating system known as Windows Phone. Instead it uses a data-centric model for organizing its interface; something that lends itself to creating a file sharing interface.

The following sections looks at how Windows Phone came about and talks about the potential design opportunities this new mobile operating system has to offer for potential developers and designers. In designing such an application it is important to consider how users will be represented within the system, and thus the notion of co-presence will also be addressed.

2.2 History of Windows User Interfaces

At the same time Microsoft began to work on research projects involving handheld portable devices they began working on Windows CE, an operating system developed by Microsoft for embedded systems, which was based on Windows 95. In April 2000, Pocket PC 2000 was released and was based on Windows CE 3.0 and was considered the debut of the Windows Mobile operating system. A second version of Pocket PC was released in October 2001 and for the first time could be used for smartphones. Soon after that the era Windows mobile and Windows phone started to emerge[2].

2.2.1 Windows Mobile

Windows mobile was originally released in June 2003 and was considered the first release under the Windows Mobile banner. Windows mobile is considered to be the predecessor of Windows phone and much like its desktop counterpart; Windows mobile had also gone through a number of version iterations. Window Mobile 2003 was powered by Windows CE 4.20 and boasted a communications interface that was enhanced by Bluetooth device management.

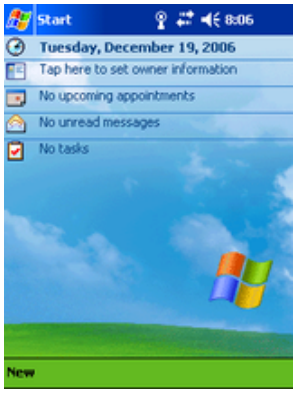

Figure 1 Windows mobile 2003 for Pocket PC

Following on from Windows Mobile 2003 was the release of Windows Mobile 5 that was released in May 2005. This version of Windows Mobile used the .NET Compact framework, which allowed user interfaces to easily be created using visual studio by placing .NET Compact Framework Controls on forms. The final iteration of Windows Mobile was Windows Mobile 6, which had two subversion Windows Mobile 6.1 and Windows Mobile 6.5. Windows Mobile 6.1 was the first mobile operating system that Microsoft released that included some form of tiling interface as the home screen contained horizontal tiles that when clicked displayed more information[7]. Windows Mobile 6.5 was released in May 2009 and included radical new changes to the GUI, which included a new Today screen resembling that of Microsoft's Zune player and also included a new Internet Explorer Mobile 6 browser with an improved interface[12].

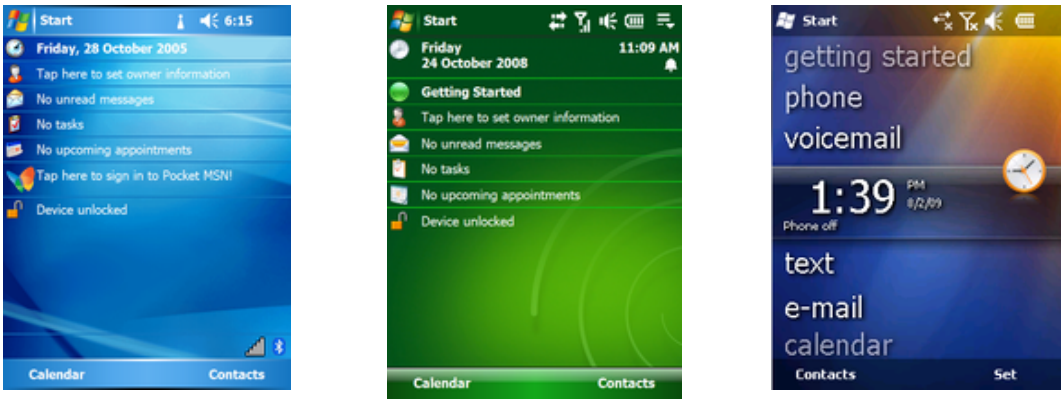

Figure 2 Windows Mobile 5, Windows Mobile 6.1 and Windows Mobile 6.5 "Today" screen interfaces

2.2.2 Windows Phone 7 (Metro design)

A couple of years ago the Windows design time realized that the design path Windows Mobile was on was not sustainable[8] and so in late 2010 Microsoft released their successor to the Windows Mobile platform and dubbed it Windows Phone . Unlike its predecessor, Windows Phone's primary market was the consumer market rather than the enterprise market [35].

Windows Phone 7 features a completely new user interface from its predecessor with a new design language otherwise known as Metro.

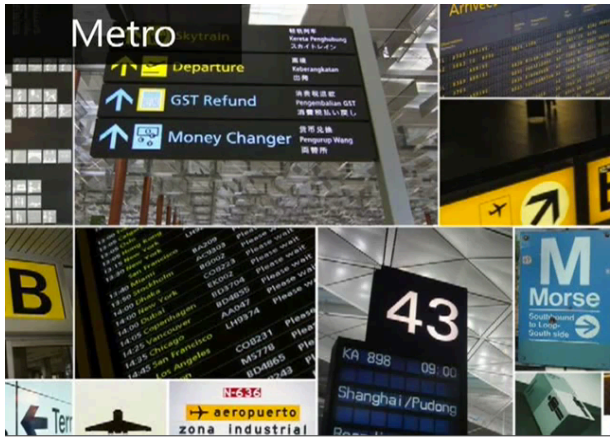

Figure 3 Metro, inspiration taken for Windows Phone 7 design language

As the name suggests Metro takes its inspiration from the visual design languages you would likely encounter in tube stations and airports that are designed to communicate globally. Metro differs visually from other Mobile Operating Systems as it focuses more on content, clean clear typography, good use of whitespace and less on graphics. The "Metro" design itself is based on the design principles of classic Swiss graphic design that focuses on cleanliness, readability and objectivity[13]. The design language places a lot of emphasis on large text that catches the eye and is said to be sleek, quick and modern.

The Windows Phone itself contains a home screen called the "Start Screen" which contains "Live Tiles". The tiles are dynamic and update in real time, which allow them to display valuable information back to the user allowing actual content to function as the main UI. Animations play a large part with user interaction as pressing and swiping across various screens are acknowledged by some form of natural animation or motion, which is intended to give the perception that the user interface is "alive"[8].

2.3 Windows Phone 7

Unlike Android and iOS, Windows Phone 7 is considered to be a departure from the app-centric designs used by its competitors. Like its desktop counterpart Windows Phone is based around centralized apps and folders and is considered to be a fresh approach to content organization[23]. The following section focuses on the design limitations and opportunities associated with Windows Phone 7.

2.3.1 Design Limitations

Design limitations are considered to be certain constraints that often restrict designers from implementing certain designs. Windows Phone has very few of these design limitations, never the less designing for a mobile platform can be a bit tricky and there are a number of general limitations designers must take into account.

One of the design limitations the researcher has come across in the Windows Phone 7 OS is that it puts a lot of faith in user discoverability.

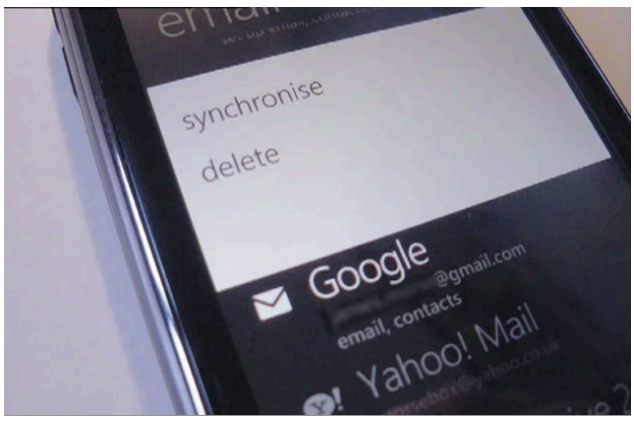

Figure 4 Windows Phone 7 interface to delete an email account

Take figure 4 for example, to delete a Google account you would need to tap and hold the screen to bring up a contextual menu and then option will be given to you to delete the account, but if you were to do a single tap it will take you into settings and you wont be able to delete the account. Tap and hold is used throughout the OS and in some cases may limit designs when choosing how to convey options to the users. Designers will have to think carefully about the notion of user discoverability and what how it is used effectively in the Windows Phone OS so as not to limit designs.

Other general design limitations, which designers must consider for a mobile application, include the following[15]:

- Small Screens
  Mobile phones of today generally have a small screen, because the device has to fit into a person's pocket or purse. The small screen size thus will limit designers as to the number of controls and the amount of content that they may incorporate into their design. Although there have been major developments of screen sizes in resolution in terms of colour support and pixels per cm, the screen sizes will remain small because of the need for portability and will continue to plague designers as a design issue.

- Navigation
  Many applications will require the user to make a decision from a series of menus. If the user is not familiar with the interface it is essential to provide some sort of feedback of where the user is in the application, in order for them to navigate successfully. Due to the limited screen size of a mobile device this makes this task much more difficult in comparison with a desktop-based menu system. Where the trouble comes in with regards to navigation is that most users have trouble from the navigation metaphor of a browser (many-to-many) to the navigation metaphor used on a mobile device system (one-to-many) [15].

- Speed
  The importance of being able to extract the correct information and perform tasks from an application in a quick and easy manner is vitally important. Unlike a desktop computer, mobile device have limited input/output facilities that will influence the speed at which the user is able to perform certain tasks. Most mobile phones applications make use of keyboards, however they are of limited size to there desktop counterpart and are often not quicker and easier to use in comparison. According to survey done by S. Kristoffersen et al. they found that keyboards limited the potential, a mobile device could bring: "In the study of mobile surveyors we also found several instances of situation in which the potential for mobile computing today is limited due to the prevalent reliance of keyboards and pen input"[16]. Keeping this in mind designers would have to think very carefully of the facilities provided by a mobile device and how it could be used so as not to affect the speed at which users may perform tasks.

2.3.2 Design Opportunities

Despite the number of design limitations in designing for a mobile platform, the Windows Phone OS has some unique features to counteract some of these limitations. By clearing the interface away of all unnecessary elements, the designers of the Windows Phone platform were able to focus on content as the design core, as the interface shows the actual content and not just a means to obtain it. With Metro being at the heart of Windows Phone design, it allows users to determine weather to dive into content or keep doing what there doing. In order to make this possible Microsoft introduced the concept of a "hub" which acts a central point of information and includes specific UI elements with new paradigms of navigation and content organization[14].

The Windows Phone OS is unlike any of its competitors and is still at the beginning of its design evolution; there are a number of design opportunities that exist with this new exciting OS which include the following:

- Panorama
  One of the paradigms of navigation infested with the hub is Panorama. The main purpose of panoramic applications is to pull information from different areas onto the same screen and is designed to give the user a birds-eye view of all the available information. Panoramic applications make use of a long horizontal canvas made up of texts and images that extends beyond the confines of the screen, which would allow users to view controls, data and services of an application in an effective manner and also entices the user to explore.

Figure 5 Panorama display of Windows Phone 7

- Pivot
  The other paradigm of navigation infested with the hub is Pivot. The pivot is used to order elements logically, which splits the information into categories and lists the elements available in each category[14].

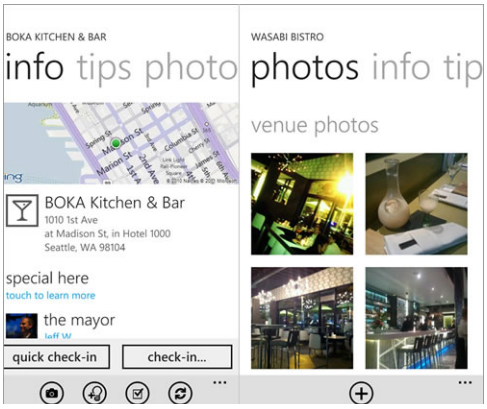

Figure 6 Windows Phone 7 Pivot Interface

- Live Tiles
  Another powerful hub element that is used on the Windows Phone OS is live tiles. Live tiles provide the user with an application's content directly on the home screen. In the earlier version of Windows Phone 7 the tiles were considered static much like the icons on iOS and Android. However with the recent communication model being introduced the tiles are now dynamic and are used by designers to display meaningful content that is immediately usable. The main purpose of the live tiles is to provide users with information without even having to open the application as seen in the figure 7 below, which shows a weather application which the user doesn't need to open if they want to check the weather, because all the information is already there.

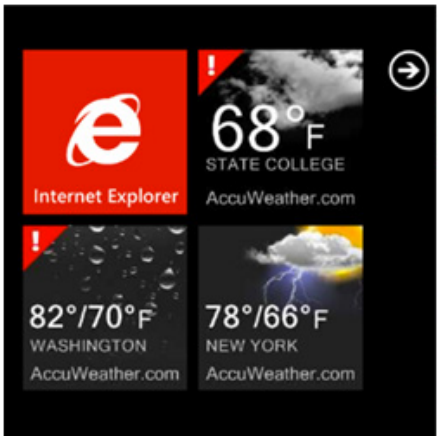

Figure 7 Windows Phone 7 Home screen showing live tiles

- Accent Colour
  Within an application designers might want certain content to stand out. The Windows Phone 7 OS allows designers to achieve this by the effective use of accent colour. This is a system wide colour that the user may customize, this will allow designers to better highlight information such as titles and headings and other important content. It is extremely important as it sets the users themselves at the system level, so all application on the phone will adopt it[14].

- Animation
  Animation plays a huge role in Windows Phone 7. In the past it was believed that animation was used in design to give subtle feedback to the user and that it could be used creatively only in specific circumstances. However this seems changing with Windows Phone 7. Animation is used effectively on the OS by not only providing feedback about what's going on, but also keeps the users attention on what is going to happen, for example when switching from a panorama screen to a textual new screen.

- Direct Interaction
  Windows Phone 7 relies a lot in direct interaction with the content. An interesting viewpoint is that it makes minimal use of buttons; but, rather, if you can see content and you can touch it then you can interact with it. This will allow the researcher to explore these information-centric features and create a file-sharing interface unique and effective.

2.4 File sharing systems

File sharing systems and in particular peer-to-peer file sharing systems have been around for quite some time now. The first releases of such systems include Napster, Gnutella, eDonkey2000 and Freenet which was released at the end of 1999, early 2000.

As users, we are constantly striving to gain access to the most relevant information to perform certain tasks. Peer-to-peer file sharing systems open up a window of opportunity to exploit this need. Until now, efficient peer-to-peer file sharing systems have been confined to the desktop; but what if we could extend this system to be able to run on one near-ubiquitous platform, the mobile cellphone. Importing such a system to a mobile device has its challenges, and one such challenge that will be extensively covered throughout this part of the project is that of the User Interface design.

2.4.1 Simulations of co-presence embodied in existing systems

As mentioned in Section 1.1 and 1.2, one of the key issues that need to be addressed when designing such a system is that of co-presence. In essence, the concept involves designing a file sharing system in such a way that it has the same communicative efficacy as face-to-face interaction[6].

It is considered that communication between two or more individuals is most effective when that communication is face-to-face. This allows the individuals in conversation to draw directly on a lifetime of communicative experience to organize their interaction[6]. Until now, ICTs have focused on facilitating communication at a distance; tele-phone, tele-learning, tele-presence, etc. The importance of co-present communication must not be overlooked. In a study conducted by Deorry et al. they measured the communicative efficacy of co-present, audio only and audio-video interactions and concluded that the communicative breakdowns occur less with co-present interactions[6].

In a paper written by Lerouge et al. they discuss a system known as weConnect, which introduces a notion of a personal media channel that enables individuals to share content on a continuous basis and supports unicast channels that one can create to transmit content to another person [18].These channels are one way only and are not visible by others not involved in the conversation. This type of communication allows individuals to attend to their individual relationships within a social environment. Within the paper, the authors hypothesized that the predominant use of weConnect will create a virtual co-presence. What they found was that participants expected that the potential recipients of weConnect would be among their personal network and were more than happy to share personal experiences with those who are not around at the time, thus creating a virtual co-presence. Party images, pictures of children to the husband while he was away were just a few examples of these.

Another system showing the importance of co-presence in a collaborative virtual environment was found in a study conducted by Gerhard et al. within a virtual art gallery called "CyberAxis" [11]. CyberAxis was built as a virtual art gallery, which provided a means to view and discuss artworks over the Internet. People using CyberAxis were represented by avatars in which they could interact in live debates with various artists who were also represented by their respective avatars. The study found that there was a direct relationship between the feeling of being present in a virtual environment as experienced by participants and the co-presence of other participants. The study also noted that people who were alone in a virtual environment, experienced a lack of co-presence and thus experienced reduced levels of presence.

2.4.2 The Ideal file sharing system

As discussed above the issued surrounding co-presence cannot be over-looked. Incorporating co-presence into a design of a file sharing system will not only increase the feeling of presence but also give the user a sense of security. Giving users a sense of connecting with other users on a personal level will help ensure this sense of security when sending files as mentioned in the example above with WeConnect with regards to being able to send pictures of children to a husband while he is away.

With the unique tiling interface offered by Windows Phone, designers may exploit levels of co-presence as each tile may be represented as a different person thus when users of the system send a file they feel as if they are sending it directly to a particular person with a specifically designated tile, thus creating a level of presence.

3. Design Chapter

3.1 Introduction

The previous chapter discussed Windows Phone and the design opportunities this operating system would bring to developers and designers. Moving forward from there, this chapter focuses on design elements that are likely to make a mobile file sharing application successful.

Section 3.2 focuses on understanding the users of the system. Section 3.3 focuses on the methodology used which was user-centered design. Section 3.4 looks design methods to be used, as these are vitally important as it provides a key insight into what the users needs are for a particular system. The user centered design process was closely followed and thus the rest of the chapter will look closely at the prototyping and evaluation stages of this process.

3.2 Understanding the users

User interface design requires a good understanding of user needs. By understanding the users the researcher can mold and create an application that satisfies what people want to accomplish when using the system. In order to better understand the type of users that would use the system the researcher had to gage and converse with potential users such as students, researchers etc. through the use of participatory design[24] sessions to gain a greater understanding for their particular needs. It is vitally important for the researcher to include the users as early as possible in the design process and continue to include them thereafter. By doing so the researcher was able to improve the completeness and accuracy of user requirements and was also able to identify parts of the system that were most often unused.

3.3 Methodology

The design methodology followed throughout the course of the project is user-centered design. User-centered design is an approach taken that grounds the process in the people who will use the product. It is used as a broad term to describe the design process in which end users influence how the design will take shape[3]. The user-centered design process followed for this project can be seen in the figure below. The diagram depicts an iterative process, which includes understanding the users needs, designing and building prototypes and evaluating their success.

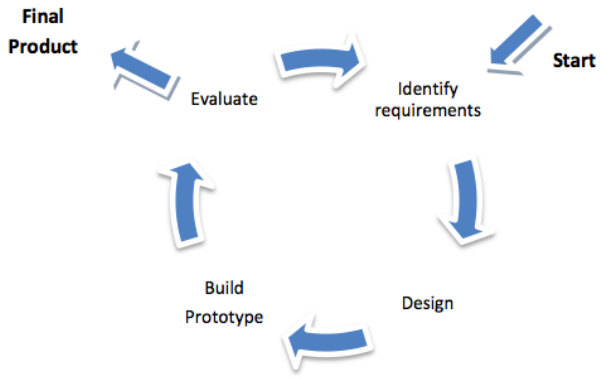

Figure 8 The User-Centered design processes

The user-centered design process was chosen because it allowed the researcher to ensure that focus was placed on understanding the users needs. The user-centered design process adopted by the researcher included users having a deep impact on the design by involving them as partners with the researcher throughout the design process. It is important to consider who the users are and how to involve them in the design process. According to the article "User-Centered Design" [3] written by C. Abras et al. they have identified three types of users: primary, secondary and tertiary users. Primary users are those who use the actual artifact, secondary users are those who will occasionally use the artifact and tertiary users are those that will be affected by the use of the artifact. In order for a product to become successful it must take into account a wide range of stakeholders and note that not all stakeholders need to be represented on the design team, however the effect of the artifact on them must be considered. Involving the users in design in one way or another has been shown to lead to developing more usable satisfying designs[3]. A variety of methods have been developed to support user-centered designs that include the use of participatory design and design guides, which will be discussed in greater detail below.

3.4 Design Methods

The primary goal of design methods is to gain a key insight into the required solution of a particular task in order to achieve a better experience for the users. From these methods designers can apply the knowledge of design principles and heuristics to achieve a uniform design. It was of upmost importance for the researcher to include the users as early as possible in the design process, thus the design method that was closely followed was participatory design. By choosing this method the researcher will able to able to work very closely with the users and thus be able to grasp a better understanding for answering some the of the research questions posed in Section 1.2. Being able to successfully import a desktop-based system onto a mobile platform remains a challenge but by working closely with the users from the beginning, the researcher can identify what the users needs are and thus designing an application whereby users can easily make the transition between a desktop to a mobile application. These design methods allow the researcher to gain feedback on the system that is vitally important, as Windows Phone is a fairly new mobile platform to which a lot of users have never come into contact with. By gaining regular feedback from the users the researcher will be able to design a Windows Phone interface to which users will be able to easily navigate through.

3.4.1 Participatory Design

In participatory design the users are involved in the development of the application and can be regarded as co-designers. By using participatory design sessions the researcher is able to engage with the users and ensure that the application met their need and is usable.

In order for the researcher to gain the most out of these sessions; the researcher will look at adopting two formats of evaluation into the design session which taken from the paper written by Martine, "The Importance of Describing Participatory Design in the Making" [19] , first an Ethnographic studied was applied followed by a Future Workshops. According to the literature written by Martine, Ethnography is a

technique used whereby an activity is described in its day-today environment as accurately as possible. The purpose of the ethnographic study is to give a detailed account of a specific experience of people who carry out the activity. Once the ethnographic analysis is completed, it is used stimulate ideas and anticipate their repercussions in the field. The ethnographic study used for the participatory design session included a case study whereby it shows how the file sharing application could be used in a rural village in Kenya. This can be seen in Appendix A. Future workshops are used in order to stimulate ideas about a particular system that is considered to be problematic. The participants are first asked to make a list of negative aspects of a system, followed by a list of ideal characteristics. In this case participants were asked to give a brief critic of existing file sharing systems and then asked how they envision these file sharing systems should operate in the future.

3.4.2 Interface Design Guides

The interface design of an application is vitally important for a number of reasons. If one were to think of a normal computer system it would consist of a number of a number of hardware and software components that would receive a form of input and communicate an output to the user supporting their specific request. Although the user interface is a part of the computer system, to most users they consider the interface as the actual system as shown in the figure below [33].

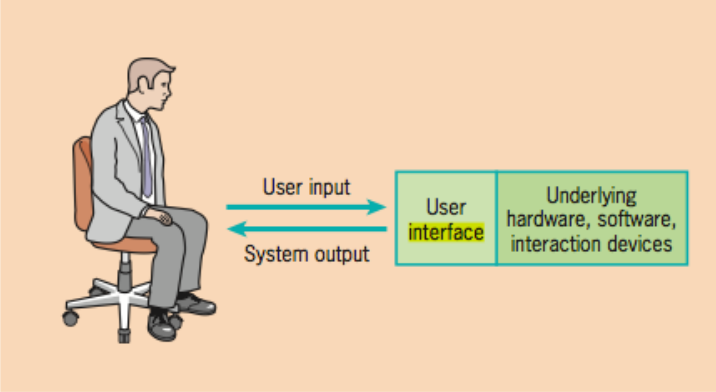

Figure 9 to the user, the interface is the computer system

A good user interface design encourages an easy, natural and engaging interaction between the users and the system and allows them to carry out their required tasks in a simple, efficient manner.

When it comes to mobile applications, interface design plays a vital role as the number of people that have access to mobile devices far outweigh those that have access to desktop computers. Mobile phone usage is huge and growing fast, some analysts predict that by 2015 mobile phones will overtake desktop computers as a primary means for accessing the Internet[31]. Although desktop computers and mobile phone are often lumped together as computing devices, they are very different in many respects. Some of these differences include: small vs big screen, low vs high bandwidth, battery powered vs plugged in and so on[31]. Of these one of the most important differences to consider in the design of this application is screen size. Screen sizes for mobile device have always been a major design issue for designers. Essentially what users will want is for a mobile device to operate like a desktop

computer but the screen size seems to be contentious issue according some literatures. “As mobile technology improves, the features of mobile devices will become equivalent to those of desktop computers, except for the screen size. Some mobile devices, such as the Nokia 9290 communicator, have larger screens, but even these remain much smaller than the smallest desktop display”[27]. Given that there are so many differences in designing for mobile as apposed to desktop applications, there are a number of design principles and design heuristics; designers may abide to in order to ensure an efficient design for their application is created.

3.4.2.1 Design Principles

In order for an interface to be successful it must adhere to certain design principles. These principles are important to adhere to because without them you loose the foundations and essence of what you’re supposed to be designing. These principles will allow the design of the interface to be more creative as it forms a base of something to work with. Most of these principles aren’t so obvious to the naked eye and therefore most people tend to ignore them and forget their importance. The design principles that the researcher will be closely working with come from a book written by G. Marsden et al. “Mobile Interaction Design [15]”. These design principles will be used as a checklist against possible designs (see Section 4.3.1 and 4.3.2)

- Affordance
  The affordance of an object are those properties of an object which give us clues as to how the object is used. It is important to consider affordance into a design as it deals with end users and how they believe they interact with a particular design. If the users aren’t able to interact with a design it may cause frustration and thus the affordances are being badly communicated which could lead to a negative portrayal of the design.

Figure 10 Showing off affordance by portraying itself perfectly as a phone and camera

Take figure 10, which is the Sony Erricson c905 cybershot. The design of the phone has purposely been built to look like a camera when held horizontally. Take the snapshot button for example it is perfectly placed where it would be on a normal camera and people can easily pick up on this, which shows great

affordance. Turn this vertically though and it has the look and feel of a normal cellphone.

- Mapping
  Mapping is concerned with ensuring that there is a natural correlation between objects and the interfaces controlling them. Mapping appears everywhere in our daily lives from oven controls to light switches to car radios; we expect there to be a direct relationship between the artifact and the interface controlling it. Mapping is vitally important and like affordances may lead to user frustration if not catered for properly. Consider figure 11 which portrays a bad example of interface mapping[15].

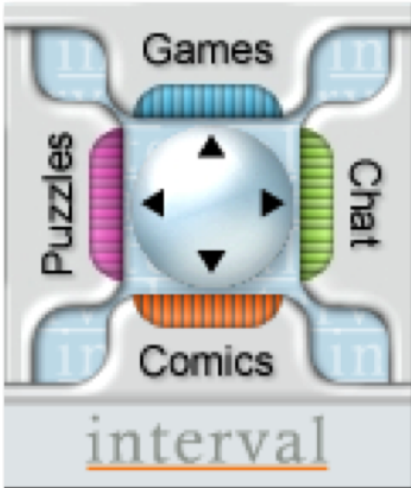

Figure 11 Mobile games portal showing bad mapping

This image shows a prototype for a mobile phone-based games portal. There are essentially four channels a user may choose with the use of a joystick. The natural thing to do when choosing a channel would be to move the joystick towards the desired channel, however the concept employed in this design was one of drawers where the user would pull to open and push to close. This example shows a bad choice of mapping, as users wouldn't normally associate a pull push action with a joystick.

- Constraints
  Constraints aid the designer in ensuring that a particular system is used in the correct way. This eliminates errors that may occur and is useful for obtaining information in the correct form from the user as illustrated in the image below

Figure 12 Constraining the design to obtain the correct date

- Metaphor consistency
  This principle implies borrowing behaviors from other system familiar to users using the intended designed system. The advantage of using metaphor consistency is that a complex software system may be understood more easily if the user interface is depicted in a way that resembles a familiar system. An example of a metaphor that is commonly used is the "desktop metaphor" which is used to treat the computer monitor as if it is the users desktop, upon which documents and folders. A document can be opened up into a window, which represents a paper copy of the document placed on the desktop. It is important to note that once a metaphor is chosen, it should be spread widely throughout the interface rather than used at one specific point[1].

- Principle of least astonishment
  One of the key goals of user interface design is that of consistency. This has been stated as "the principle of least effort" which is the assertion that the most usable system is the one that leaves users astonished [32]. Consistency plays a huge role in this principle, as users will expect certain pre-knowledge to uphold in a particular system. Take for example the F1 function key; most people would associate this key for opening some sort of help screen when using certain software. If this key were to be used for another function it would cause astonishment at the lack of help[20].

3.4.2.2 Usability Heuristics

Design heuristics can be used in computer software to help identify usability problems in the User Interface design. A heuristic evaluation is very beneficial at the early stages of design and does not require user testing. This form of evaluation will thus reduce the number and severity of design errors discovered by users. In recent years, the use heuristic evaluations have seemed to gain a lot of popularity and are often used by most designers and some have even formed their own set of heuristics. A usability consultant, Jakob Nielsen's, developed the most commonly used heuristics for user interface design that is in use today [25]. These design heuristics will be used as a checklist against possible designs (see Section 4.3.1 and 4.3.2)

- Visibility of system status
  The system should always keep users informed about what's going on via appropriate feedback within a reasonable time frame. For example if you were to take a desk lamp, you can turn it on or off. We know what the status of the lamp due to the light omitted, thus when designing a system it is important that the system communicates clearly and thoroughly with the user.

- Match between system and the real world
  The system should speak the users language, with words, phrases, and concepts that are familiar to the user. It is important to follow a real world convention, thus making information appear in a natural and logical order.

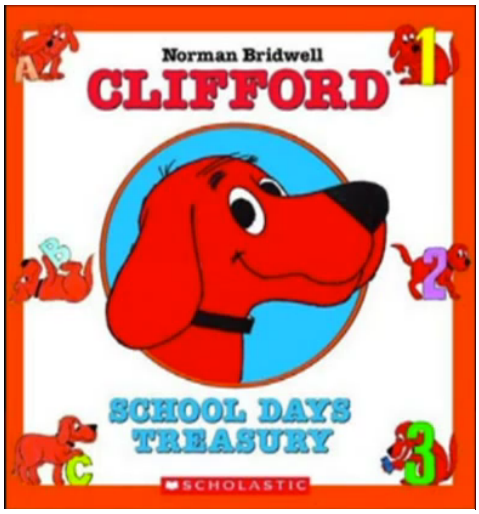

Figure 13 Children's book emphasizing the match between the system and the real world

A good example of this heuristic is children's books. For example the wording is simple, clear and concise so that children can understand and relate to what's being said. When designing a system, designers will have to make sure that users know what the system is trying communicating to them.

- User control and freedom
  Users will often choose system functions by mistake and will need an "emergence exit" to leave the unwanted state as fast as possible without having to go through extended dialogue. The system must always have a simple and efficient emergency exit to fix human error. A good example of this can be seen in the figure below, as iPhone's have the home button that would immediately take the user out of an application.

Figure 14 iPhone4S Home button

- Consistency and standards
  Users should not have to wonder weather different words, situations or actions mean the same thing. Designers should have a convention and continuity across the entire platform. For example if you look at public rest rooms we know which one is for men and which one is for woman because the symbols are conventional.

- Error prevention
  Often users may use an application and they may encounter an error message. A good design will prevent problems from occurring in the first place. Designers should aim to eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action. A crucial example of this is a car dashboard, which has excellent error prevention; we wouldn't want something to go wrong when driving at a high speed on a highway. A car dashboard clearly informs the users of what will go wrong if nothing is altered or fixed.

Figure 15 car dashboard-warning lights

- Recognition rather than recall
  In a design it is a good idea to minimize the users memory load by making objects, actions and options visible. Instructions for use of the system should be visible and easily retrievable where appropriate. Google has made good use of this principle, as for example when you type a search term in the search box we don't have to remember what we are searching for as there is a smart search that constantly attempts to help us recognize what we are

searching for. It is important that a system prioritizes recognition over recall wherever appropriate.

- Flexibility and efficiency of use
  Accelerators, which are not known to novice users, may often speed up interaction for the expert user such that the system can cater for both the inexperienced and experienced users. A good example of this is using Adobe Photo shop. For a novice user, they may select various tools with the mouse but an expert user can access the tools via keyboard shortcuts therefore accelerating repetitive tasks and making the usage more effective for the expert user whilst not affecting the novice user experience.

- Aesthetic and minimalist design
  Dialogues should not contain information that is irrelevant or rarely needed. It is important that a design needs to be minimal and therefore as efficient as possible but also aesthetically beautiful.

- Help users recognize, diagnose and recover from errors
  Error messages should be expressed in plain language with no codes. The messages should be precise and suggest a solution.

3.5 Prototypes

Prototyping forms an essential part of the application and design for a number of significant reasons. Prototyping will help the researcher smooth out design issues and provide specifications for a working system rather than a theoretical one. From the participatory design sessions, the researcher would gather a number of low fidelity prototypes. Once the researcher gathered these prototypes he will then apply the relevant design heuristics and principles to evaluate each design. A uniform low fidelity prototype will be created, from which the researcher will be able to create a horizontal high fidelity prototype. Within the various prototypes the researcher must take into account very important aspects of the system, which are synchronous and asynchronous transfer.. Synchronous transfer will allow communication between two parties. For this model, the researcher will look into designing a model that allows a user to send files from one user to another.

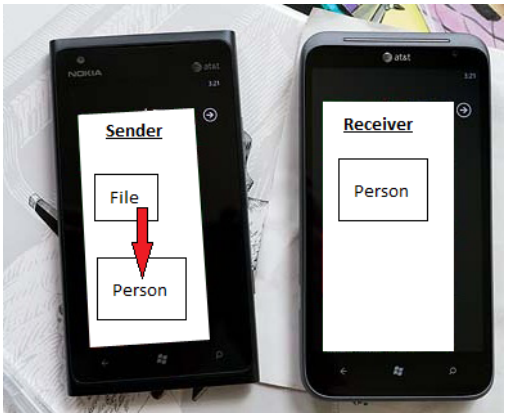

Figure 16 Example of synchronous transfer

Asynchronous transfer will allow for data transfer between multiple devices. The ability for one user to send a file to multiple users at the same time becomes extremely useful in a file sharing application as it eliminates redundancy of the user having to send a file to each other recipient.

3.6 Evaluations

Once the design cycle is complete, an evaluation needs to take place. An evaluation is necessary to ensure that the users can use the product and that they like it. It is important to take into account they users don't just look for a usable system, but rather they look for a system that will deliver a pleasing and engaging experience. When choosing an evaluation technique the researcher had to consider a technique that will allow insight and results appropriate to the prototype iteration level to be given. The evaluation techniques to be considered were taken from the book "Mobile Interaction Design"[15].

The evaluation techniques that will be closely followed are conceptual model extraction and formative evaluations[28].

Conceptual model extraction can be used for the low fidelity prototypes, this will allow the researcher to gain an understanding as to how users interpreted the interface and apply design principles and heurists to highlight things the users did not understand. This is vital as some users will not be used to the Windows Phone interface and thus finding out how they interpret the interface will allow the effectiveness of the interface to be evaluated. For the high fidelity prototype, a formative evaluation can be used to ensure that the system is on track, meets it goals and discover improvements that could be made. This evaluation highlights any errors the users have missed and uncover navigation difficulties in the interface. The formative evaluation can be used as a qualitative mode of enquiry to evaluate the system with particular end users, for this a methodology known, as constructive interaction will be used[22]. From this methodology, users are required to perform a set of tasks on a particular system and talk a loud on what they are experiencing. The researcher can then record these conversations to extract valuable qualitative data about the system. This evaluation can be used to uncover the effectiveness of importing a desktop-based application to a mobile platform.

4. Low Fidelity Prototype Iterations

4.1 Introduction

This chapter focuses on how the requirements for the system were defined as well as the first iteration prototype that was developed. The requirements gathering process involved co-design with potential users of the application through participatory design. Each design was evaluated using a formative evaluation technique. From this, a uniform paper and computerized low fidelity prototype was constructed.

4.2 Requirements Gathering

The requirements gathering is a phase in the design process that allows the researcher to gain a better understanding of the users' needs and is critical to the success of the system. Once the users' needs have been identified the researcher is then able to move on to the next design process and start to consider what the system should include and how it should function.

The researcher was able to conduct the requirements gathering process through use of participatory design sessions. As mentioned in Section 3.4.1, the structure of participatory design sessions comprised of two formats, an ethnographic study and future workshops. For the future workshop part of the design session the researcher had asked participants to give a brief critique of existing file sharing systems and asked what these systems should encompass in the future. This allowed the researcher to obtain what users were looking for in a file sharing system and how they should function. Low-Fidelity prototypes were then gathered from the design sessions that showed how users would like the system to be designed.

4.2.1 Participatory Design Subjects

The subjects for the participatory design session were comprised of students from the University of Cape Town. The researcher wanted to get subjects from various faculties, as they would have had different technological backgrounds, some more advanced than others. In total there were 12 subjects who participated in the participatory design sessions who were from the commerce, science and information systems department. This would then allow the designs gathered from the participatory design sessions to vary as they all had different outlooks on mobile development. The participants were all given chips and coke throughout the participatory design session to help stimulate design ideas and reward them for their participation in the design sessions.

4.2.2 Structure of the Participatory Design Sessions

The structure of the participatory design sessions was very important to the researcher. The first hurdle the researcher had to overcome when planning for the participatory design session was the venue. According to the article by Michael J. Muller, "Participatory design: The third space in HCI"[24] , he recommends the venue is very important as there are two major avenues discussed in the paper, "1. Bring the designers to the workplace. 2. Bring the workers to the design room". After much thought the researcher decided that the computer science honours classroom at the University of Cape Town would be the ideal venue as potential users such as

students and fellow researchers would feel at ease in there environment at the university and will help focus there minds in the design process. By using the honours room users will be able to gage in the asynchronous design of the application (see Section 3.5), as it involves the sending of files in a room, such as the one they would currently be in.

Once a venue had been chosen, the participatory design sessions (see Section 3.4.1) could commence. The researcher used an ethnographic study which can be seen in Appendix A, whereby the application was explained on how it could be used in a day-to-day environment for the users to gage a better understanding for the application. With this understanding taken from the ethnographic analysis, users were then asked to critic existing file sharing systems at present and then allowed them to envision the future of how these file sharing systems should operate. Sometimes there might be cultural differences between the users and the designer as the users are unable to understand the language of the designer. A good way to overcome this is through the use of prototypes. The researcher then made use of PICTIVE prototyping, as users were given low-fidelity office products such as colored pens and paper and were asked to sketch a design of a low-fidelity prototype. From the information gathered in the design sessions the researcher was able to come up with feature ideas to be incorporated into the system.

4.2.3 Feature Ideas

From the participatory design sessions the researcher was able to extract valuable information such as features to be included in the system. Many of the stakeholders expressed their concerns of existing file-sharing systems and gave their opinions on what they wish to see in future systems. The following paragraphs give an overview of the proposed features that were extracted from the design sessions.

The purpose of a file sharing system is to be able to efficiently exchange data between one or multiple clients. This data is comprised of digitally stored information such as audio, images, video, music, electronic books etc. The application should allow users to achieve synchronous and asynchronous transfer (see Section 3.5) of data in a simple, convenient and efficient manner that does not frustrate the user.

In order to consider the features to include in the application, the researcher had to first look at what people thought of existing file sharing systems. There were a number of criticisms that came out of the design sessions about existing file sharing systems. Among these were things such as difficulties of obtaining and browsing through files, lots of technical jargon especially regarding settings, the need to have a technological-savvy “contact” to introduce you to them as they are difficult to use and set up. A lot of the participants agreed that existing file sharing systems are not user friendly and therefore not intuitively designed. An interesting observation was that the participants were used to a browser “like” interface, as they seem to have come into contact with that on a daily basis through the use of the Windows operating system and Internet browsers. They felt that the interfaces of file sharing systems were far from this metaphor, thus making them too technical and complicated. There also seemed to be a lack of social space dedicated to their activities and were not sure for example if new files were added by their favorite users. Most of the participants had only encountered file sharing systems on the desktop and thus agreed access to such

systems are limited, they have never considered the power such a system could bring if it were available on their mobile devices.

Despite the heavy criticisms of existing file sharing systems, there seems to be an opportunity available, not only to improve on them but also import them to a mobile platform thus making them more accessible. The researcher was then able to gather information from the participants as to how they envision file-sharing systems should operate in the future and from this, ideas were extracted for features to include in a mobile file sharing system that include:

- A dedicated social space per user, allowing them to interact with other users on a personal level
- Have gadgets (widgets) for the application
- Simple, clear-cut interfaces
- Categorizing of content to make them easier to access and less tedious to transfer data
- Simple easy to understand setting that's aren't too technical
- Allow more people access to these systems to increase the amount of data available
- Standardization of a preferred application e.g. Google File Sharing
- The ability to auto-detect new files and allows users to decide weather or not to accept the files.
- The ability to be able to transfer files to a single user (Synchronous transfer).
- The ability to transfer files to multiple users at the same time (Asynchronous transfer)

4.2.4 Interface Sketch

From the features mentioned above a sketch was drawn by the researcher in order to provide the researcher with a basic idea of the flow of the system, which can be seen below in figure 17. From this basic low-fidelity prototype, the researcher was able to build upon the features of the system gathered from the low-fidelity prototypes created in the participatory design session by other users, which will be discussed in greater detail in Section 4.3.

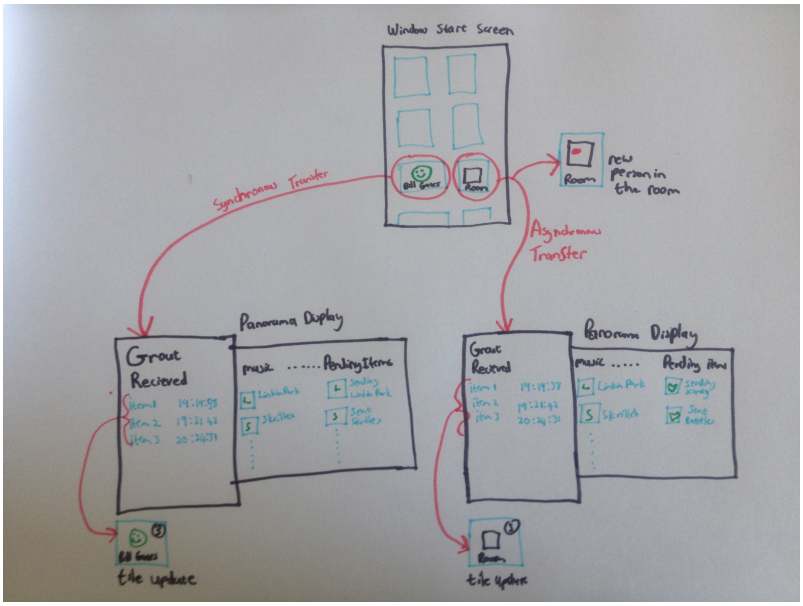

Figure 17 rough sketch of the system design

4.3 Paper Prototype

Paper prototyping is a widely used method in the user-centered design process and was used to help the researcher develop a system that met the users needs and expectations[17]. Apart from the information gathered from the Future Workshops and Ethnographic study in the participatory design sessions, participants were also asked to create a low-fidelity paper prototype of the system on large sheets of paper with colored pens. The researcher then took these low-fidelity prototypes and applied design principles and heuristics as mentioned in Section 3.4.2.1 and Section 3.4.2.2 The feedback was then analyzed to come up with a uniform design, which will be discussed in grater detail below.

4.3.1 Evaluations

There were a number of designs that were collected from the participatory design session, which can be seen in Appendix B. The researcher applied a formative evaluation technique as it provided valuable feedback. The researcher used the design principles and heuristics mentioned in Section 3.4.2.1 and Section 3.4.2.2 as a checklist to help assess the strengths and weaknesses of each design. The checklist was carried out as follows:

Design Principles

1. Affordance – If the interface has objects that are required to be tapped what indications are there that show these objects need to be tapped? How does the user interface show that scrolling needs to be performed? Does the design contain objects that users will know how to use without the need for additional instructions?
2. Mapping – Do all the objects in the design correctly depict or correlate to what will happen if they are interacted with?
3. Constraints – How does the design constrain the user from making errors? If input is required from the users, does the interface restrict the input that the user gives to the correct format? How does the design constrain the users choices between interfaces?
4. Metaphor Consistency – Does the interface relate to any other important interfaces, such as a Desktop or other mobile platforms?
5. Least Astonishment – Is there anything out of the ordinary with regards the interface? Does the interface flow clearly from screen to screen?

Design Heuristics

1. Visibility of system status – Does the design show the user which screen of the interface there in? Does the interface give feedback as to what is happening with regards to objects and other screens?
2. Match between system and real world – Does the design follow a real world convention, thus making information appear in a natural and logical order and does it use words and phrases that are familiar to the users?
3. User control and freedom – In the event of human error, does the design provide an emergency exit for the user from any of the interfaces within the design?
4. Consistency and standards – Does the design have a convention and is continuity across the whole design? Are the various screens in the interface consistent with one another?

5. Error prevention – How does the design prevent errors from occurring? Does the design eliminate error prone conditions or check them and present the users with a confirmation option before they commit to an action?
6. Recognition rather than recall – Does the design provide clear instructions for the use of the system such that the users don't need to remember anything?
7. Flexibility and efficiency of use – Does the interface provide accelerators for expert users?
8. Aesthetic and minimalist design – Does the design contain any irrelevant dialogues and is it aesthetically beautiful?
9. Help users recognize, diagnose and recover from errors – How are error messages portrayed in the design and do the use plain language?

4.3.2 Findings

A number of low-fidelity prototype designs of the system were collected from the participatory design sessions, which can be seen in Appendix B. The researcher's next step was to take each design and apply the checklist mentioned above in order to identify the strengths and weaknesses of each design and identify possible features that could be used in a uniform design. After much evaluating, the following were the findings of the low-fidelity designs.

Design Principles

1. Affordance – Most of the designs required the user to tap objects in order to proceed. There was some great affordance shown in some of designs as they had pictures on the clickable objects such as a picture of a "video recorder" for videos, "music note" for music, "magnifying glass" for searching etc. to give the user an a sense of what will happen if that object is pressed. Another good example of affordance was the scrolling bar included in one of the designs to show the user that there are more "tiles/users" to choose from. Some designs however involved dragging of elements; this was poorly depicted, as there are no signs to show that certain objects were drag able.
2. Mapping – There was good mapping in the designs as most designs included clickable objects such as buttons. These buttons generally contained an image that would map correctly to the next interface to be presented if that button was tapped.
3. Constraints – Most of the designs had a lot happening on one screen. It was vital for these designs to have some form of constraints so users don't produce any errors when using the various designs. The designs had clear indications on the various interfaces of what could be done. Some of the designs had clearly marked tap able objects, which constrained the users flow between interfaces. The designs didn't require any input from the users.
4. Metaphor Consistency – A lot of the designs included a drag able interface that was not very familiar with any other systems in use today. One of the designs however resembled a very interesting interface for selecting files. It was immediately apparent that it was similar to the interface used by iTunes to transfer data from a computer to an Apple device such as an iPhone and iPod. Another design included smaller icons on the screen to represent files, which resembled the app centric home screens of an android device.

5. Least Astonishment – The designs included straightforward objects to which users could know what would happen if they were pressed or tapped. There was nothing out of the ordinary with the designs.

Design Heuristics

1. Visibility of system status – Mostly all of the designs had poor visibility of system status when it came to informing the users which screen they were in, this the researcher believes is vital to a mobile application with multiple screens. A very nice idea came from one of the designs to include what percentage of the file has been transferred to the recipient, which could prove to be a vital piece of information in informing the users what is happening with regards to their file transfers.
2. Match between system and real world – The designs used good clear language that could theoretically be understood by many users. Most interfaces were divided into two halves on the same screen, but were made clear what each part of the interface was used for.
3. User control and freedom – The designs did not provide any objects which could aid the user in exiting an unwanted interface, however when asked about this most participants were under the assumption that the user could use the "back" button on the mobile device.
4. Consistency and standards – Some of the designs had a good convention and consistent interfaces throughout the design. However some designs didn't have consistent interfaces which could lead to users being confused or frustrated with the designs.
5. Error prevention – Most of the designs did not cater for error conditions it is however vitally important in a design. The researcher will also have to make use of confirmation messages before users commit an action, possibly before the sending of files.
6. Recognition rather than recall – A lot of the designs made use of good labeling to show what various parts of the interface were used for. This is very important but in some designs that included a search bar, no labeling was provided as to what the users will be searching. It is vitally important to give clear instructions in the design such that users don't have to recall what to do.
7. Flexibility and efficiency of use – Most of the designs included a simple enough interface such that accelerators weren't needed in the design.
8. Aesthetic and minimalist design – Some of designs provided nice pictures to go with the various tab able objects, however most of them did not make good use of screen space as they tried to fit a lot onto a single screen thus making the designs not appear aesthetically beautiful.
9. Help users recognize, diagnose and recover from errors – All of the designs didn't include any error messages and something the researcher will have to look into when designing the system

A lot was taken from designs collected in the participatory design sessions and from the findings mentioned above the researcher had a clear way forward for designing the system. Some of the more valuable findings included:

- Have consistent layout across all screens in the design
- Provide users with objects that could aid them when they reach an unwanted state

- Provide good clear pictures or texts on top of tap able objects to inform the user what will happen if those objects are tapped.
- Make efficient use of screen space, don't clutter a single screen with a lot of information
- Possibly provide a form of an accelerator for advanced users
- Make efficient use of labeling with objects on the interface
- Provide confirmation messages before users commit any action in the design
- Provide the users with feedback as to what screen there currently in and include a percentage of how far files have been transferred thus aiding in the visibility of the system status.

4.3.3 Design

From the findings collected above, the next step was for the researcher to come up with a uniform design. What was a very interesting observation as can be seen in the figure 18 below, was that most participants from the participatory design sessions had never come into contact with Windows Phone and thus were not aware of the panorama and pivot interfaces available and therefore were not reflected in their designs.

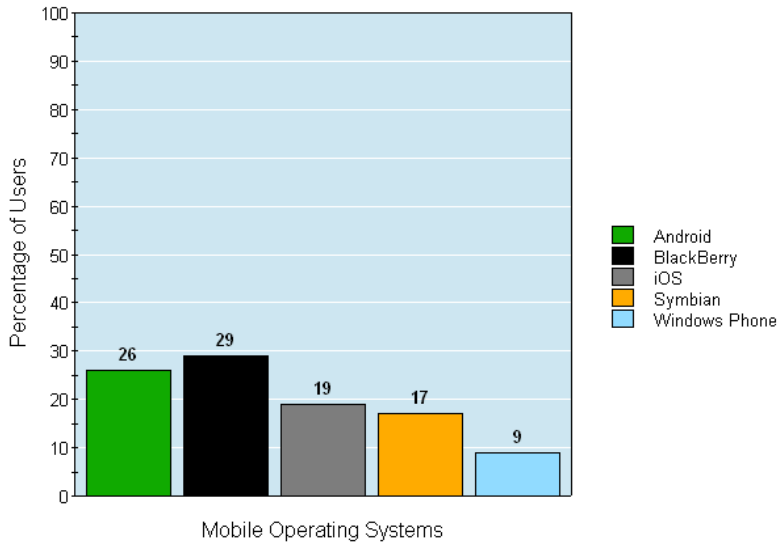

Figure 18 Bar Graph showing the Mobile Operating systems participants from the participatory design session were exposed to.

Despite this, these ideas could be made more consistent by mapping them to the Windows Phone interface (see Section 2.3.2), which would also help break up some of cluttered designs gathered from the design sessions. Below is a low-fidelity graphical representation of the system to be built using the data gathered from the design sessions and applying the design principles and heuristics as mentioned above. When it came to designing the low-fidelity prototype for the system the researcher made use of paper prototype sketches gathered from the participatory design sessions of which the original can be seen in Appendix C. From these low fidelity prototypes the researcher was able to establish what people wanted in the design of the system.

- A home screen which the user will be able to access all the other users in the system

- The ability to choose between synchronous and asynchronous transfer from the home screen.
- Make clickable objects clearly identifiable with some sort of text or image.
- Display valuable information within an interface that is easily accessible such as user information, and the status of files being sent.
- Categorize the users' files and allow the user to choose which files they wish to send to a particular person or people

From the above findings a computerized low fidelity prototype was created to show the major screens to be included in the design of the system that meet the users' needs.

- Home Screen

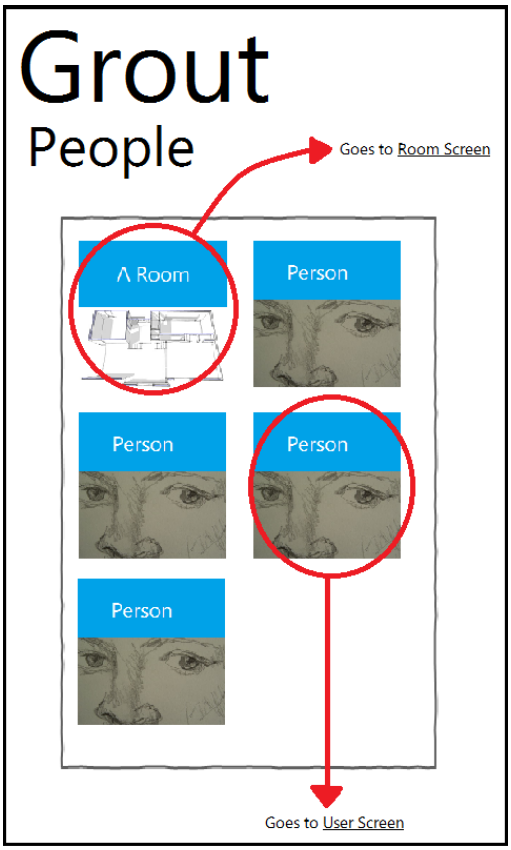

Figure 19 The Home Screen Paper Prototype

The home screen consists of a number of tiles each of them representing a specific person for synchronous transfer. These tiles are tap able by the user as illustrated above in order to move on to the desired screen. These tiles are dynamic and when a file is received from a particular person, that person's tile will automatically get updated to show that a file has been received. For asynchronous transfer "A Room" tile has been added to represent a room, when there are people in the room the tile will be updated to show that the room which user is in contains other users.

- User Screen

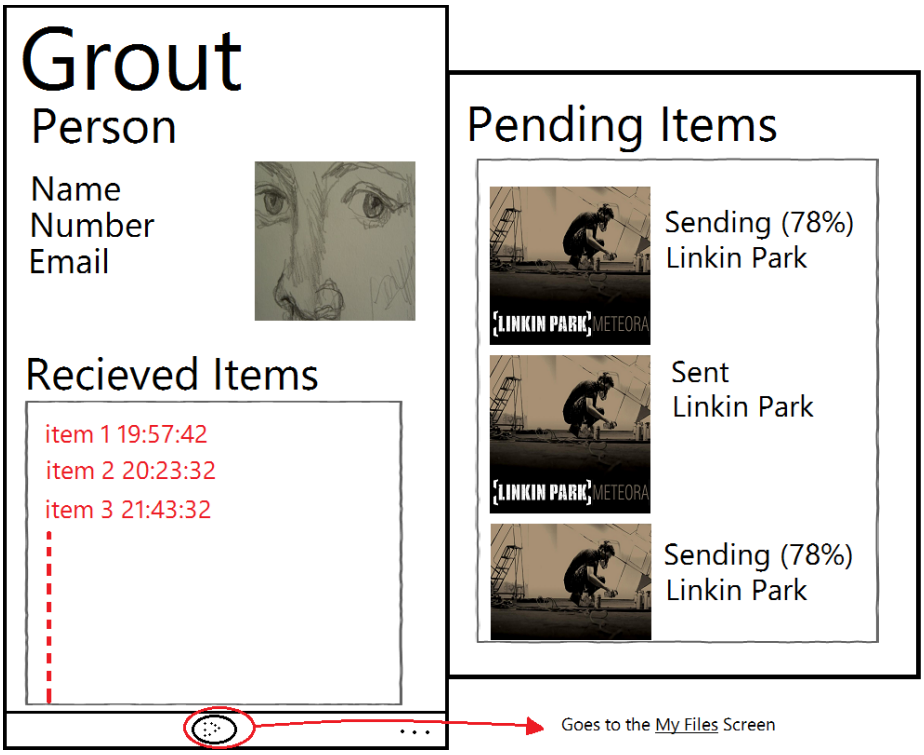

Figure 20 The User Screen Paper Prototype

When the user selects a person tile from the “home screen” they are then directed towards the “user screen". This particular interface makes use of the panorama interface (see Section 2.3.2). By using the panorama interface the design allow for information to be displayed across multiple screens and users may easily access other portions of the design without too much of a hassle. The “user screen” contains information about the particular person as well as the items received from that person. When the user scrolls their finger across they are presented with a screen showing them the pending items that are being sent to that particular user and how far they are until completion. The panorama interface provides great affordance, as users will see some of the lettering of the “Pending Items” screen thus informing them that they may scroll to the right. The user screen also contains an action bar at the bottom of the screen that contains a “send” icon. When the user taps this “send” icon object they will be navigated to the “My Files” interface where they may choose which files they wish to send to the recipient.

- Room Screen

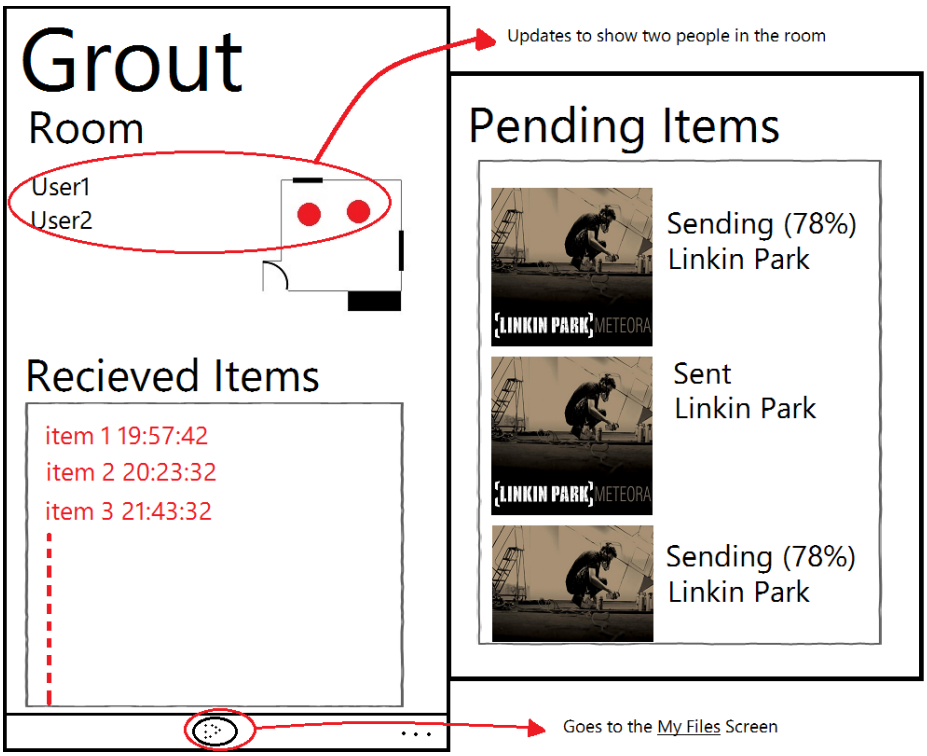

Figure 21 The Room Screen Paper Prototype

The "room" screen interface is almost exactly identical to the "user" screen interface and contains many of the features used in the "user" screen interface. This interface was designed to achieve asynchronous transfer (see Section 2.3.2). The whole idea behind the "room" interface is that when a user enters a room the application will automatically pick up other users in the same room. This information will automatically be displayed on the picture, which will also automatically update the "room" tile on the home screen as well as text fields will be updated showing which users are nearby. The user may then send files to nearby users in the same manner as they would send files when using the "user" screen interface thus achieving a consistency across the multiple screens.

- My Files Screen

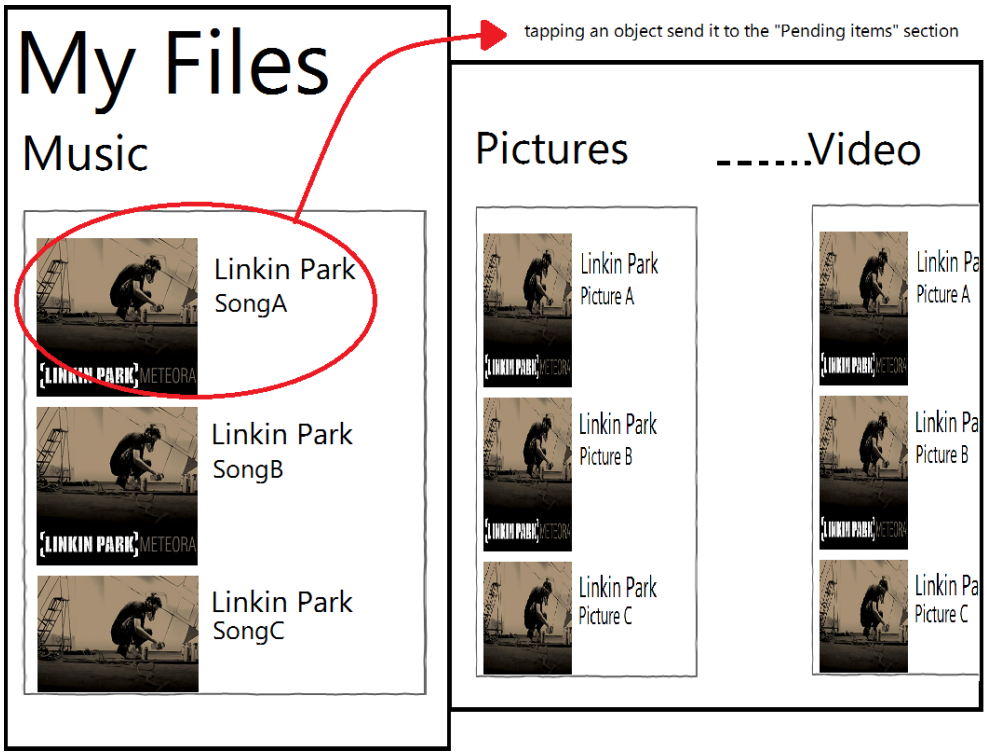

Figure 22 My files screen paper prototype

As mentioned above when a user taps on the send icon they will be directed to the "My Files" screen. This interface makes user of Windows Pivot interface (see Section 2.3.2). This interface was used in order to split the users files into categories and list each item available on the users phone under the categories. These were Music, Pictures, Documents and Video. The user may easily scroll through the interface and locate a particular files they wish to send. Once the user has located a specific file may tap it and a confirmation message will appear asking them if they wish to send the file. If they agree the files automatically get sent to the "Pending Items" interface on the "user" or "room" screen.

5. High Fidelity prototype Iterations

5.1 Introduction

This chapter looks at the high fidelity prototype developed from the design in chapter 4. One of the main areas of focus that the high fidelity prototype was intended to answer was whether or not users will be able to adjust to the new Windows Phone interface and efficiently navigate through an application without much frustration (see Section 1.2). The answer to these questions is discussed in the system design section of this chapter. Following that a communicative interaction method was followed in order to evaluate the high fidelity prototype. The findings of the evaluation are then discussed in detail as well as the recommended changes to be made for the final system.

5.2 Horizontal prototype

Software prototyping occurs in software development and is used to simulate a few aspects of the final product. There are two types of prototypes, namely: Vertical and Horizontal prototypes. For the application being developed the researcher will focus on producing a Horizontal prototype as it deals with the user interface. The purpose of a Horizontal prototype is to provide a broad view of the entire system, focusing on user interaction rather than functionality[26]. By producing a horizontal prototype the researcher may gain valuable feedback and be provided with possible areas of improvement for the system. In order to implement the uniform low fidelity prototype (see Section 4.3.3), the researcher had to familiarize himself with the development platform and language used for Windows Phone development, which will be discussed in greater detail below.

5.2.1 Development Platform

As discussed extensively throughout this paper, the operating system used to develop the file sharing system is Windows Phone. Windows Phone offers a variety of design opportunities (see Section 2.3.2) to make an application that not only works well, but is also appealing and attractive.

There are two main components of a Windows Phone application namely Silverlight which forms the crux of Microsoft's development platform and the C# programming language. The primary tools used for developing a Windows Phone 7 application are Visual Studio 2010 and Microsoft Expression Blend. In theory you could make an entire application within Microsoft Blend but you would still need to integrate it with Visual Studio to program functionality using C#. This integration was very clever on Microsoft's part as it meant that every .NET developer could become a Windows Phone Developer[21].

With the added benefit of the researcher not having to learn much new, as he was already familiar with the .NET framework, the decision was made to start developing the application using Visual Studio 2010. In order for development to begin Visual Studio required that the Windows Phone SDK be downloaded and installed. Once this was done, a Windows Phone application could be created easily as any other application using Visual Studio. The interfaces were designed using Silverlight, which uses XAML (Extensible Application Markup Language). A bit of functionality

of the interface was then encoded using C#. Visual Studio allows you to easily integrate these two languages when developing an application. Visual Studio then allows one to compile and run the application on an emulator or straight to any Windows Phone device that is connected. The system was developed and tested on a number of Windows Phone devices namely, the Nokia Lumnia 900, Nokia Lumnia 610 and the Nokia Lumnia 800. This was done to make sure that the interface looked good and wasn't cluttered as all the devices had different size screens.

5.2.2 System design

As illustrated in Section 4.3.3 with the low fidelity prototype there will be four main interfaces represented in the high fidelity horizontal prototype.

- Home Screen

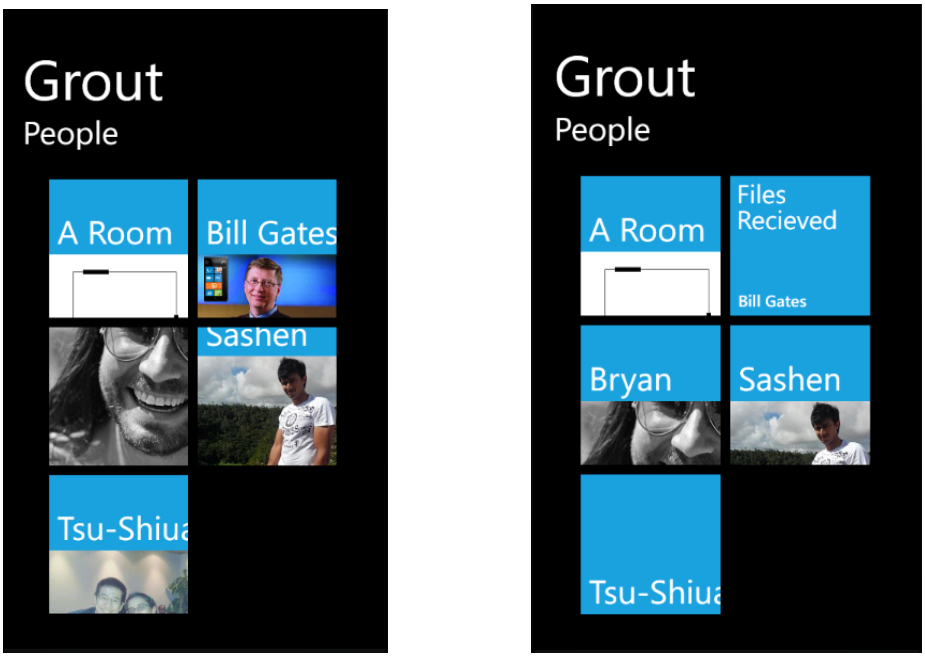

Figure 23 High Fidelity prototype home screen

The "home screen" is the first screen the user is presented with. As mentioned above in Section 4.3.3, this interface is made up of tiles, which are tap able, by the user in order to bring up the "user interface". Within this interface the researcher wanted to address the research question with regards to co-presence. By representing each tile a specific person, the researcher wanted to create an environment whereby the user of the system will feel that they could accomplish their communicative and creative goals as easily and efficiently as if they were physically co-present.

- User Screen

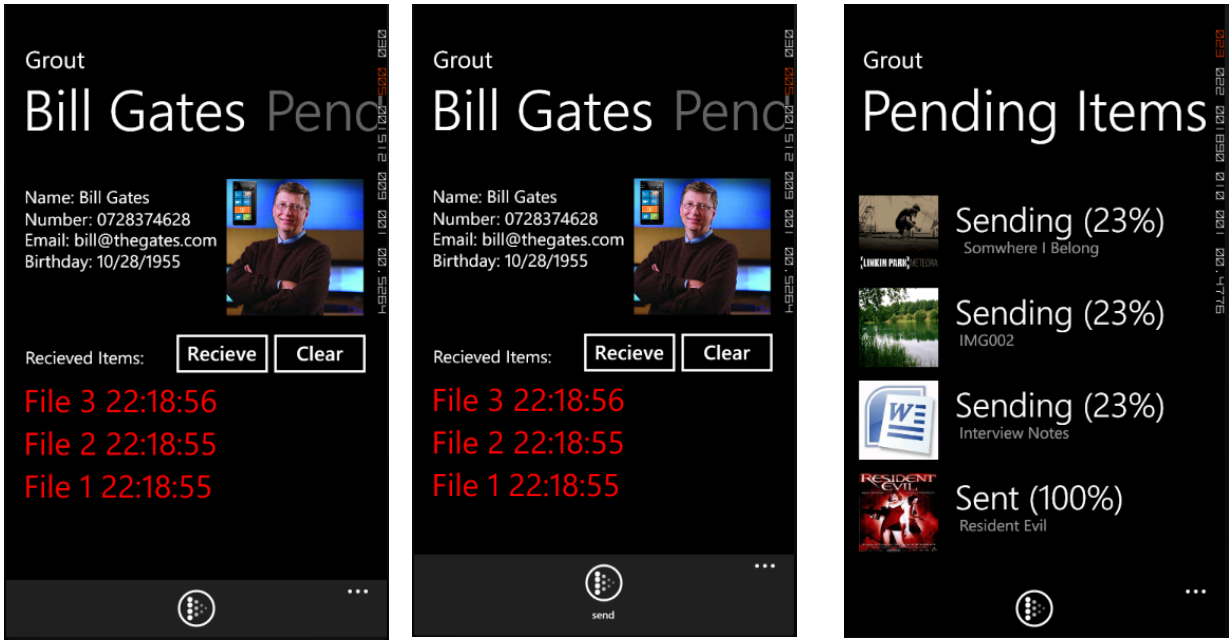

Figure 24 High Fidelity prototype user screen

Once the user clicks on a specific tile, if it is not the "room" tile they are then navigated to the "user" screen. By addressing the research question of whether or not users are able to adjust to the new Windows Phone interface and efficiently navigate through an application without much frustration. The researcher used the panoramic interface which shows great affordance as the users may figure out that they need to scroll to the left in order to bring up the Pending items screen as some of the lettering is cut off. A dummy "Receive" button was added to simulate when files were received.

- Room Screen

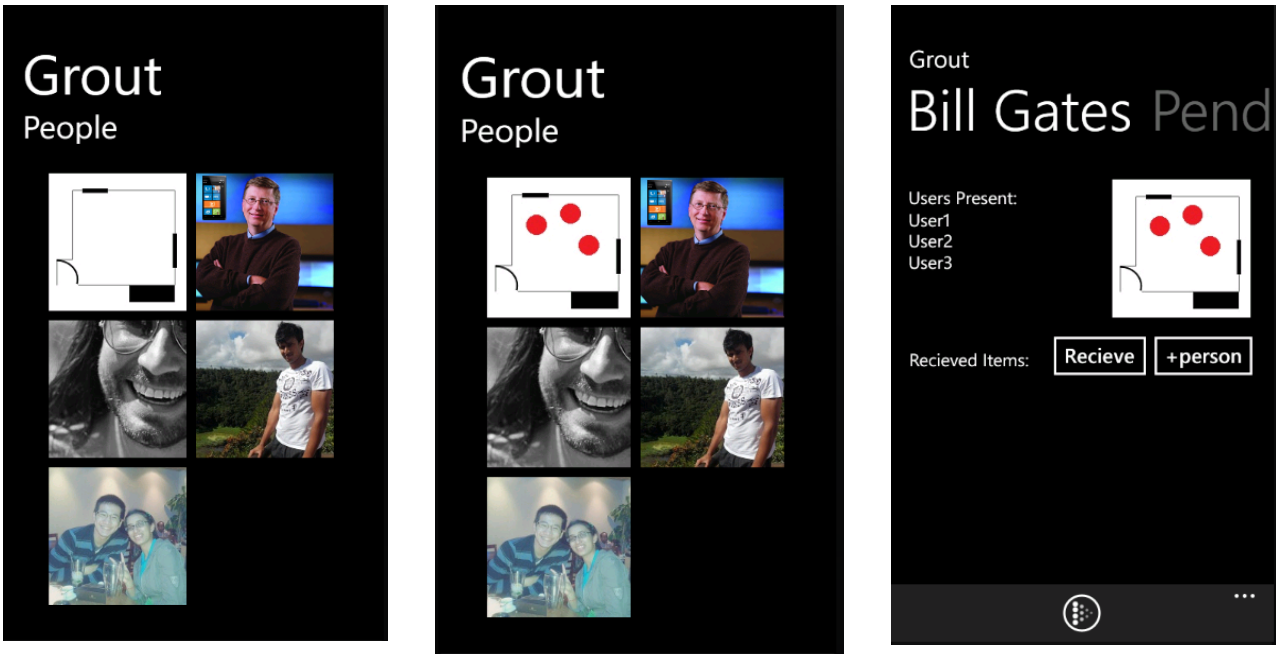

Figure 25 High Fidelity Prototype room screen

The "Room Screen" wasn't much different from the "user screen". The question to be addressed here was whether or not synchronous and asynchronous transfer could be represented in the same application. By introducing a room tile as the first tile of the application, users are always made aware of surrounding users, represented by the red dots. By placing this tile as the first tile on the "home screen" it can peacefully coincide with the other tiles so as not to cause much confusion for the user. Thus when the user opens the application they can immediately associate the first tile with asynchronous transfer and the rest of the tiles with synchronous transfer.

Dummy buttons were added to simulate the receiving of files as well as for picking up new nearby users. As can be seen in figure 25 above when a new user is picked up, the HubTile on the home screen automatically gets updated to show there are nearby users.

- My Files Screen

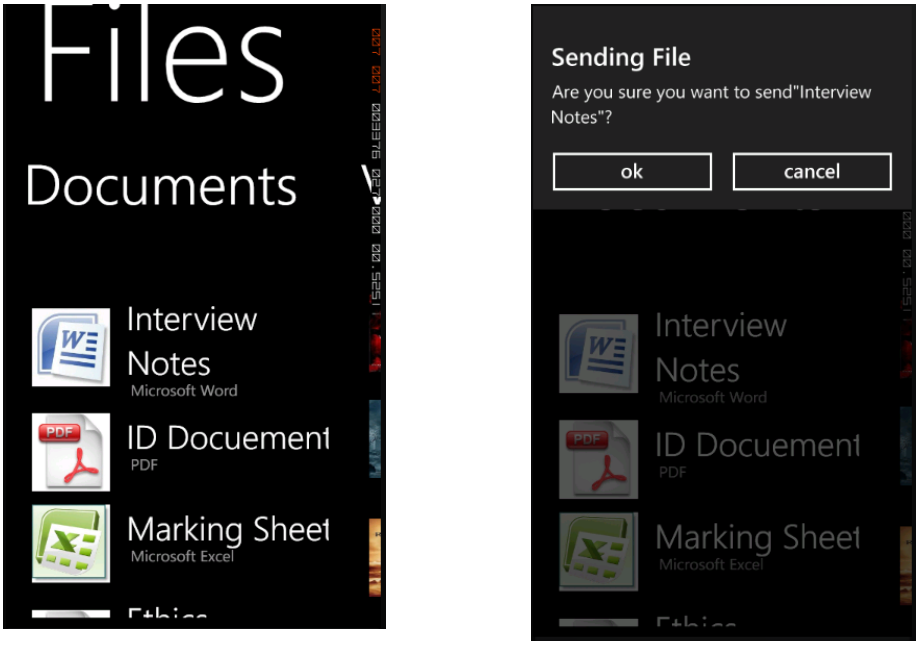

Figure 26 High Fidelity Prototype My Files Screen

There are four types of files that are to be considered in the design of this system namely:

- Music
- Documents
- Pictures
- Videos

Each one of these file types will have a dedicated screen on the "my files" interface. As seen in Figure 26 above when the user wishes to send a particular file, the user has to tap on that file and a confirmation message will come up with regards to sending that file. If the user accepts then the file will automatically be sent to the "Pending Items" screen.

5.2.3 System Design difficulties

There were some challenges faced in implementing the interfaces discussed in Section 5.2.2 above, which will be discussed in greater detail below.

- Home Screen
  For this particular interface a Windows Phone object known as a Listbox was used to store each individual tile. These specific tiles are known as HubTiles. HubTiles come with a set of built in properties, which allow them to be modified in a number of ways. From the initial design when the user received a particular file from another user, the researcher wanted to show a count in the top right hand corner of tile, representing how many new files have been received, much like the count shown on iOS and Android devices when a message has been received. Unfortunately HubTiles don't support this

property and as an alternative the researcher made use of the “title” and “comment” property to show a file has been received, as can be seen in figure 23 above.

- User and Room Screen
  One of the difficulties in implementing this interface was the “send” icon in the action bar at the bottom of the screen. For users familiar to the Windows Phone interface they will know that they need to tap the 3 dots in the bottom right corner in order to bring up the menu to find out what the button is used for, however this might be unfamiliar to those who have never used Windows Phone before. Another issue was the icon selected for the send button. There are very limited icons available to choose from within the SDK folder that comes with, when you download the Windows Phone SDK. In order to access other icons you will need to pay $99[4]. This could impact the design as users will not normally associate the icon chosen with a “send” icon.

5.3 Evaluation and Findings

A formative evaluation was conducted for the horizontal prototype in order to test the flow of the system. In particular, attention was paid towards how users handled navigation and use of the system. Usability testing was done on the Nokia Lumnia 610. The expected outcomes of the evaluation were to uncover any navigational problems and identify some of the key interaction problems in the user interface[29] and how it could be further improved.

The following section gives more detail on the test subjects, permissions and consents, methodologies used and the exact structure of the evaluations. This will then be followed by the findings and the results of the evaluation in Section 5.3.5

5.3.1 Test subjects

The navigation testing was performed on the same set of users who were present in the participatory design session. The test subjects were all from the University of Cape Town and consisted of students from the Computer Science and Information Systems departments. A total of 12 undergraduate students were available for the testing. These students were chosen again as they had been provided with sufficient information in the participatory design session about the system and thus had a greater understanding of what was trying to be built. Furthermore, coming from ICT related backgrounds these participants would have been exposed to a variety of mobile technologies throughout their university career and therefore could give a accurate criticism in comparison to other mobile technologies they have been exposed to. The test subjects were each given with a coke and packet of chips for their participation, which they were able to consume during the evaluation.

5.3.2 Permission and consent

In order to carry out the evaluations and participatory design session’s ethical clearance was required to be obtained from the Ethics Research Committee of the Faculty of Science from the University of Cape Town. This procedure took a total of two weeks, as two separate consent forms were required to be approved. One of the

forms was required to approve the ethical principle of the study whilst the other was required to gain access to the students.

The test subjects were first approached and asked if they were willing to participate in the evaluations. If they agreed they were then explained what these evaluations would entail and would be informed that it was the system that was being assessed and not themselves and any comments or suggestions they make would remain anonymous. Participants were then told that they were free to leave at any time during the evaluation. Participants were given a coke and a packet of chips in order to reward them for participating in the evaluation.

5.3.3 Methodology

The evaluation methodology used was known as constructive evaluation. Constructive evaluation is a methodology used whereby subjects are given a set of tasks to complete about a specific system and forced to talk out aloud in a situation where they would normally be silent[22]. This then allows the evaluator to listen and record the subject's thoughts. By having 2 subjects talk to one another, it helps circumvent the problem of understanding what any given user is thinking [22]. The subjects interact constructively with one another and not only explain what they are thinking but also why they think it, as they verbalize their thoughts. For this project the most important stakeholder is the end-user. It is vital that the end-user know how to use and navigate through the system other wise system would not serve its purpose and thus not be effective, thus it was important to assess weather test subjects were able to use and understand the system.

5.3.4 Structure of evaluation

By using the constructive evaluation methodology as explained above in Section 5.3.3. The evaluation required subjects to team up in pairs. The purpose of the evaluation was then explained to the subjects. Some of the test subjects had never interacted with Windows Phone before and were therefore informed on the tiling, panorama and pivot interfaces respectively.

Test subjects were then handed out a Windows Phone device with the application installed and a task list to complete in their pairs, in order to gain an understanding as to weather the test subjects understood the application. The task list was set up to test the navigation and usability of the system, in particular the researcher wanted to see if subjects could adapt to the pivot and panorama Windows Phone interfaces as well as see if subjects could grasp the concept of representing synchronous and asynchronous transfer within the same application. Test subjects were asked to talk out aloud to one another what they were experiencing when accomplishing these tasks. This was then recorded using a sound recorder, which could then later be analyzed in greater detail by the researcher. There was no time limit specified for the tasks however, all the tasks were required to be done. In total 9 tasks were set for the users in order to test the navigation and usability of the system and in particular paying close attention to synchronous and asynchronous transfer, the task list and rational for each task was as follows:

1. Choose Bill Gates (specific user on the system).
   The purpose of this task was to ensure that users knew what to do in order to move on to the next screen and thus be able to complete the next task.

2. Accept an incoming file.
   This task was set up to test weather the method chosen for accepting new files was easily understandable.

3. Reject an incoming file.
   Like task two the task was set up to test weather the method chosen for rejecting new files was easily understandable.

4. Navigate to the “My Files Screen”.
   This task tested navigation of the interface.

5. Send a music and document file to Bill Gates (specific user on the system).
   This task tested the system usability to ensure that the sending of files was apparent to the users for synchronous transfer.

6. Identify the status of the file/files being transferred.
   This task was set to check how easy it would have been to check the status of the files being sent.

7. Navigate back towards the “home screen”.
   This task was set purely to test the navigation of the system and if users were able to leave an unwanted state within the application.

8. Identify the number of nearby users in the room.
   This task was set up to test if it was apparent to the subjects how many users were nearby for asynchronous transfer.

9. Send a music and document file to all nearby users.
   Like task 5, this task tested the system usability to ensure that the sending of files was apparent to the users for asynchronous transfer.

After completion of the task list the test subjects were then asked if there was anything in the application that they found confusing, and if there was anything else they would to be added to the system.

5.3.5 Outcomes from the tasks

By applying the task list mentioned above (see Section 5.3.4) the researcher was able to draw useful conclusions about the application. In total there were 6 evaluations done whereby subjects worked in pairs to complete each task and communicated to one another how they would tackle each task. For each task subjects were assessed in their ability to complete the task and these were graded as unclear, partially clear and clear. The results were then analyzed as a total percentage of the 6 evaluations across all the grades. The results obtained from the evaluations were surprising and will be discussed in greater detail below.

1. The first task required subjects to choose a specific user on the system. Subjects were handed a Windows Phone device and were presented with the home screen. The results for task one were as follows:

- Unclear 0 %
- Partially Clear 16 %
- Clear 84 %

In general everyone understood how to choose a specific user in the system. However, in one of the evaluations the subjects weren't used to the Windows Phone tiling interface and only once the tile's image had moved down to show the name "Bill Gates" for that specific tile, were the subjects able to identify which user to choose.

2. Task two required users to accept a file received from a specific user. Once the subjects were on the "Bill Gates" user screen, the application was set up such that 3 new files were received and were highlighted in red. The results were as follows

- Unclear 0 %
- Partially Clear 16 %
- Clear 84 %

Most of the subjects recognized that in order to accept the incoming file they had to tap that particular file. The user was then greeted with a message box asking if they would accept the file. One of the subject pairs found this a little confusing at first as they had both agreed that there was no clear instructions displayed on the screen that told them what to do. However, both of them soon realized that tapping the received item could be the only option and were then able to complete the task by accepting the new file.

3. Task three was similar to task two, except it required subjects to reject the incoming file rather than accepting it. The results were as follows:

- Unclear 0 %
- Partially Clear 0 %
- Clear 100 %

Having learnt from the previous task the group that had struggled a bit was able to apply what they learned from the previous task and use it in this task. All the subjects were then able to complete this task without a problem.

4. Task four required the users navigate to the My Files screen in order to send files. There was a lot of confusion with this task and the results were as follows:

- Unclear 17 %
- Partially Clear 67 %
- Clear 16 %

Only one of the groups was able to effectively complete this task without any problems and this was because they both were currently using Windows Phone as

their primary mobile device. For the other groups, there was much discussion as to how to actually send a file. Their first difficulty was navigating to the send screen. The actual send button was placed at the bottom of the screen and in order to realize that this was a send button, subjects had to tap the three dots on the action bar to bring up the name for the button. The action bar was new to the subjects as they have never seen it before and therefore didn't know how it worked. Most Subjects both agreed that the image used to represent the send button didn't relate to an image they would associate with sending. One of the groups found it very unclear, as they had made the assumption that everything beneath the received items was used for receiving and therefore never considered looking below this part of the screen.

5. Task five required users to send a music and document file to "Bill Gates". The results for the task was as follows:

- Unclear 0 %
- Partially Clear 0 %
- Clear 100 %

Subjects handled this task exceptionally well. All the subjects knew that they had to tap the item they wished to send. Subjects had no problem sending both files. Once the music file had been sent participants then communicated with one another and was easily able to establish that the interface required the subject to scroll to the left to access the documents. This was due to the some of the text being cut off at the top of the panoramic interface, which showed great affordance.

6. Task 6 required users to check the status of the items they had just sent. This task caused a lot of problems for the subjects and the results were as follows:

- Unclear 84 %
- Partially Clear 16 %
- Clear 0 %

This task caused a lot of confusion. As soon as the subjects clicked send, a lot of them complained that there was no status returned to show that the files are being transferred. Most of them stayed on the same screen and flipped through the panoramic interface in confusion; whilst others were holding their finger down on the file they had sent hoping another interface would appear. After a while the subjects soon agreed with each other that they had to go back to the previous screen. Once on the user screen some of the subjects were still unclear to do. After looking very hard at the user screen they then saw that they could scroll to the left to bring up the pending items screen.

7. Task 7 required users to navigate back to the home screen. The results as follows:

- Unclear 0 %
- Partially Clear 0 %
- Clear 100 %

This task was completed the fastest. All the users made use of the back button on the Windows Phone device. This was good as it showed that the researcher doesn't need to include any back buttons for the user

8. Task 8 required the user to identify the number of users in the room. The application was set up such that the tiling room icon contained 3 dots thus representing 3 nearby users. The results of the task were as follows.

- Unclear 0 %
- Partially Clear 33 %
- Clear 67 %

Most of the subjects were able to identify that there were three users straight away. However for some of the subjects it was partially unclear, this was due to the tiles being dynamic and moving. When this happens the tile icon goes out of focus making it difficult to count the dots.

9. The final task required subjects to send a music and document file to all nearby users. The results for the task were as follows:

- Unclear 0 %
- Partially Clear 0 %
- Clear 100 %

Having learnt how to send files from task 4 and 5 users were able to easily send the files to the nearby users. This showed consistency in the design, as users were not confused once they knew how to send the files.

5.3.6 List of required changes

Following on from the evaluations, there were a number of changes that needed to be made for the final application. The test subjects themselves recommended most of the changes whilst some changes were identified from the results of the evaluations. The summary of the required design changes is as follows:

- Small instructions on the home screen informing first time users what they can do.
- Make the room tile static instead of dynamic so users will always be able to identify the number of nearby users.
- Instead of dots to represent the nearby users, stick figures would be more appropriate.
- If a file is received by another user, that users tiles background colour should change to make it more apparent that a file has been received.
- Within the room interface, an option should be given to choose which nearby users you wish to send files to instead of sending files to all nearby users.
- Use a different image for the send icon that users can relate with on more familiar level.

- On the “My Files” interface it was recommended to have a send button. Users would then choose single or multiple files they wish to send. Once they had chosen their files, they would then tap the send button, which would immediately navigate them to, the pending items screen.
- Another recommendation to the “My Files” interface was to remove the pending items screen and when a user chooses a file to be sent, that file’s information on the “My Files” interface will automatically be updated to represent the percentage of the file being transferred.
- A search button was recommended when selecting a users tile on the home screen.
- Introduce a more dedicated social space per user. The recommendation here was to allow the user to interact with other users on a more personal level by allowing the user of the application to be able to email and write on other user’s Facebook walls within the application.

6. Final Iteration

6.1 Introduction

The chapter will look at the changes made to the system as a result of the formative evaluation conducted in Chapter 5.

6.2 Development changes made

The evaluations conducted for the high fidelity prototype were very useful (see Section 5.3.5). From the findings of these evaluations, it appeared there was a lot of work yet to be done on the system in terms of navigation and usability. Each one of the changes (see Section 5.3.6) was then assessed according to the design principles and heurists (see Section 3.4.2.1 and 3.4.2.2) to see if they made the system more efficient. Each significant change will be discussed below.

6.2.1 Recommended changes not implemented

A lot of people struggled with being able to identify the status of the files being transferred. There were two valuable recommendations to help solve this issue. After considering both of them, the decision was made not to implement the recommendation that suggested adding a send button to the "My Files" interface and allowing users to choose which files they wish to send. The decision to not implement this change was largely due to the problems uncovered about the pending items screen. According to Nielsen's design heuristic on the visibility of system status, the system should always keep users informed about what's going on via appropriate feedback within a reasonable time frame. Once users clicked send, there items would automatically be transferred to the pending items screen but users will still be on the "My Files" interface, thus not providing the user with an immediate response regarding the status of their files being transferred.

6.2.2 Recommended changes implemented

There were a number of developmental changes made from the original high fidelity prototype, which will be discussed, in greater detail below according to the various interfaces affected.

- Home Screen
    1. The first change made was to include text on the home screen to inform the users what to do. Aesthetic and minimalist design was considered as the text to represent this change was chosen very carefully such that irrelevant information would not flood the screen thus making the interface less aesthetic.

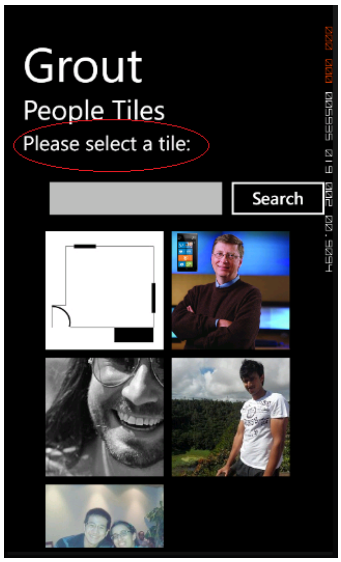

Figure 27 Home screen showing added text

2. A search button was introduced to make it more convenient for the user to access a specific tile they wanted.

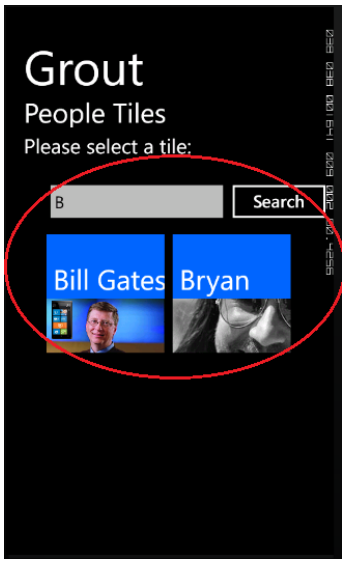

Figure 28 Home screen showing searching capability

3. The red dots on the tiling interface were changed to little stick men. This improved the standards of the interface, as people would normally associate nearby users with stick men rather than red dots.

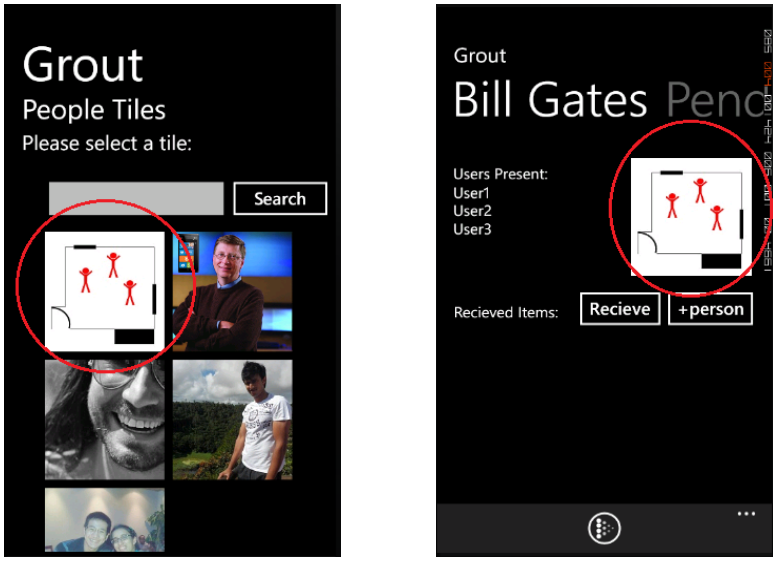

Figure 29 Red dots changed to stick men

4. When a file was received the background colour of the user's tile was changed to red to make it more apparent that a file has been received. This affected the visibility of system status as appropriate feedback was provided to the user with regards to incoming files.

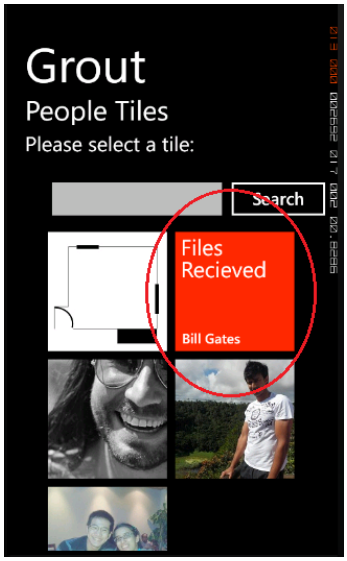

Figure 30 Tile changing colour when a file is received

- Room and User Screen
  1. One of the suggestions was to introduce a greater dedicated social space per user. On a particular user screen, the main user of the system is able to send other users an email or an SMS. This addition affects the idea of co-presence, which will be discussed below in the greater detail in Section 7.

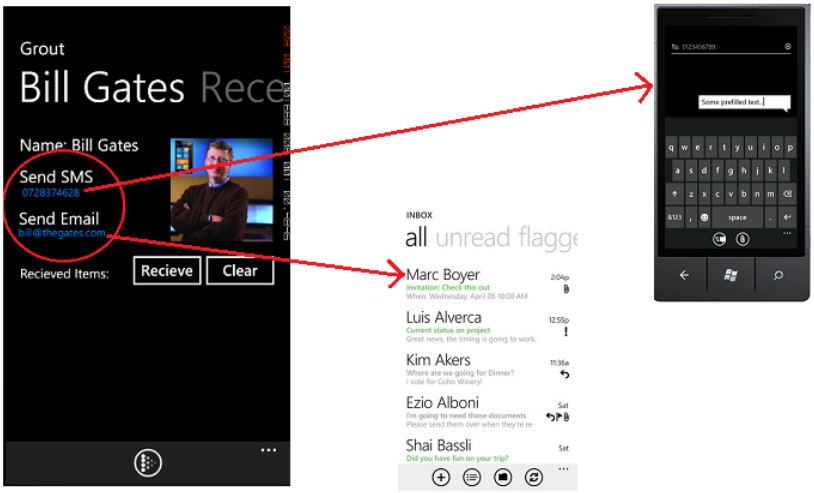

Figure 31 User screen showing added social space

2. The send icon image was replaced. This impacted the affordance and standards of the interface as users could associate the new image with the sending of files.

- My Files Screen
  1. The pending items screen from the "User Screen" was removed. In its place, in order to identify the status of the files being sent, the user will have to access the "My Files" screen. Once the user selects the file they wish to send, the files information on the screen will change to represent the status of the file being transferred. This helps improve on Nielsen's design heuristic on the visibility of system status, as immediate feedback is then given to the user on the status of the file being transferred.

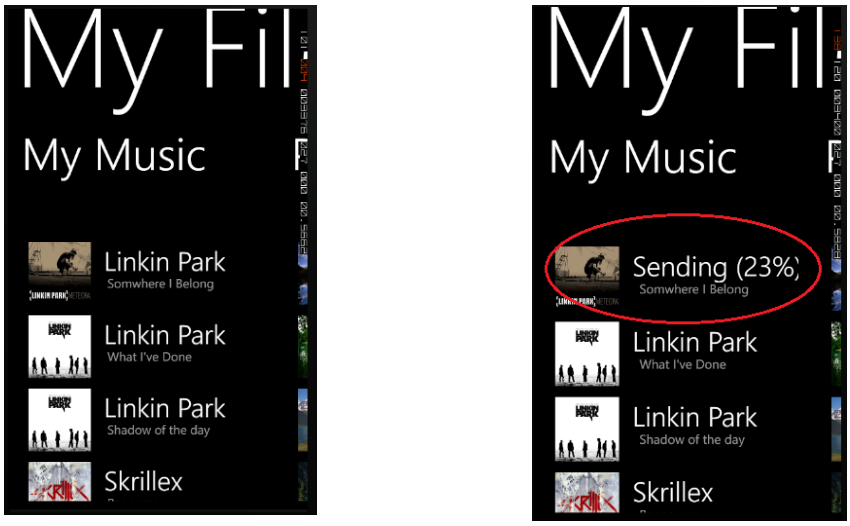

Figure 32 My Files screen showing update of files being transferred

6.3 Problems arose that are beyond the system

Working with Windows Phone from a design perspective was a good experience However, the one major piece of functionality that was apparent in the low fidelity prototypes was the ability to drag tiles. Currently the API for Windows Phone doesn't support this feature and thus could not be implemented. If the API did support this feature it could open up new design possibilities that could further improve on the navigation and usability of the system.

7. Conclusions

The research questions posed at the beginning at this report were aimed at creating a mobile file sharing application that effectively makes use of the Windows Phone interface. The system was required to effectively represent a level of co-presence and be designed for synchronous and asynchronous transfer.

In order to develop the proposed system a user-centered design methodology was followed and specific methods were used such as participatory design, design guides and constructive interaction. By using the user-centered design approach, users were included as early as possible as co-designers in the development of the system. By including users as co-designers in the design process the researcher was able to identify and pay attention towards users needs and what they expected out of the system.

By adopting this approach a number of low fidelity prototypes were gathered from the participatory design sessions. From the designs the researcher was able to apply the design principles and heuristics in order to evaluate each design. After evaluating each design the researcher could then assess what the users wanted and come up with a uniform design. A low fidelity prototype was created based on this uniform design and was then translated into a high fidelity horizontal prototype.

Once the high fidelity prototype was created it was then vital to include the users to evaluate the system in order to gain vital input for improving the interface. An evaluation technique known as constructive interaction was thus carried out. The same test subjects that were available from the participatory design sessions were chosen to evaluate the high fidelity prototype. This evaluation was conducted in pairs and test subjects were given a set of tasks to complete to test the systems usability and navigation. The results from the evaluation were surprising. A number of navigational issues were uncovered, especially when trying to choose files to send. Different mobile operating systems use different action bars to represent information to the user. The subjects of the system were unable to effectively make use of the action bar used for Windows Phone, which gave information on how to navigate to the send screen. Only once subjects found out how it worked, were they able to effectively navigate to the screen to allow them to send files.

From the evaluations of the high fidelity prototype, there were a number of changes that needed to be implemented to the system. Minor changes were made to all the screens to enhance their user friendliness and make them easier to navigate.

7.1 Research questions addressed

Throughout this project a number of research questions were addressed in order to illustrate the problems of existing file sharing systems and how they could be successfully imported onto a mobile platform.

One of the questions addressed was how can the concept of co-presence be effectively incorporated into the design of a mobile file sharing system. This concept involves designing the system such that it has the same communicative efficacy as face-to-face interaction. In order to address this question the researcher was able to create a dedicated social space for every user of the system through the use of Windows

Phone tiles. When questioned about this concept during the evaluation of the high fidelity prototype, users were aware that they were dealing with a specific user once they had chosen a specific tile, which effectively represented a level of co-presence. A number of suggestions were made to further expand on this social space, which included adding the ability to email or SMS a specific person from within the application.

The next question addressed was whether or not a desktop file sharing system interface could successfully be imported onto a mobile platform. One of the major challenges to overcome for this question was screen size. From some of the low fidelity prototypes gathered from the participatory design sessions, it was clear that users were putting a lot of information onto a single screen thus affecting the aesthetics of the design. In order to overcome this issue the researcher made effective use of the panorama and pivot interfaces provided by the Windows Phone platform in order to break up the information onto different screens. By using these interfaces the researcher was able to provide the full functionality of a desktop file sharing system onto a mobile device.

The panorama and pivot interfaces are unique to the Windows Phone platform. These interfaces are very powerful as it allows information to be displayed in an effective way on a small screen. Due to its uniqueness, the next question to be addressed was whether or not users who have never interacted with the Windows Phone platform would be able to effectively use and navigate through an application. From the evaluations of the high fidelity prototype there were mixed reactions. Some people found it very easy to adjust to the new interfaces as they included great affordance; so users were able to figure out what to do. However, some struggled to get to grasp with the interface, particular those users who had BlackBerry devices. Despite this, once they were shown how the interface worked, users were easily able to navigate through the application without much frustration.

The importance of a file sharing system is the ability to transfer files to other people. For the purpose of this project it was vital that the researcher included two types of transfer methods within the same application, namely synchronous and asynchronous transfer. Synchronous transfer was represented by the specific tiles within the application representing each person; when a person tile was chosen files could then be transferred to that particular person. Asynchronous transfer was represented by the "room" tile; this tile showed the number of nearby users and when chosen, user would be able to send files to all nearby users. During the evaluations users were clearly able to distinguish between the two types of transfer methods, as by default the asynchronous tile was the first tile represented on the home screen.

7.2 Future Work

There are still a number of improvements that could be made to enhance the design and usability of the system. From the low fidelity prototypes a lot of users wanted the ability to drag object, something they felt that would make sending of files a lot easier. Due to the limited API of Windows Phone 7, this was not possible to implement. The HubTiles used to represent the tiles had a limited set of properties and weren't as customizable as one would have hoped. With the recent announcement of Windows 8, this may all change thus allowing greater design opportunities for

applications on the Windows Phone platform. With the announcement that Windows 8 (Windows desktop operating system) is going to include a tiling interface[34], this opens up a whole new opportunity to extend this system not only to transfer files between mobile devices, but between desktop computers as well.

Much of this report has relied heavily on the design heuristics and principles in order to create an intuitive and free flowing interface. By closely following these guides the report offers people various avenues in designing an application for the ever increasingly popular Windows Phone platform. As discussed people may look more into the tiling objects and numerous interface, Windows Phone has to offer to exploit various concepts such as of co-presence, in order to create a useful and meaningful application in which people can use in their everyday lives.

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Appendix A: Ethnographic and Future Workshop study used for the participatory design sessions

Information, data and drawings embodied in this document are kept strictly confidential and intended solely for the use of the individual carrying out the experiment.

Please indicate which mobile Operating Systems you have come into contact with:

- ☐ Android
- ☐ BlackBerry
- ☐ iOS (Apple)
- ☐ Sony Erricson
- ☐ SymbianOS
- ☐ Windows Phone
- ☐ other

Please specify: _____

Consider the following:

We live in a world today full of wonderful electrical gadgets and technological advancements. With all these technological advancements there develops a need to gain information in effective and easy manner, weather it be for study purposes, gaining an edge over competitors in business or wanting that cooking recipe; information is what drives us. A popular way of gaining information in today's world is through the use of the Internet. We often access the Internet through the use of a computer or a mobile device. Accessing the Internet through a mobile device can be considered costly, especially if you're not on the correct data plan with your mobile provider.

Consider the following scenario:
There exists a remote African village in Uganda about 2 hours driving distance from Kampala (Capital of Uganda). Not many people travel to this village as it far from the main road and the dirt roads to get there are difficult to traverse especially during the rainy season. Most people in the village spend most of their days in the garden and picking beans. Most of the children often carry water to their homes from a nearby creek and play soccer with a very dirty warn ball. There are no TV's and Radios, however people do have access to mobile phones. Education plays a huge role in the village and although there is a school in the village, textbooks from this school are often outdated. One of the villagers, Ben however does manage to travel to Kampala as often as he cans and tries to bring back new textbooks, newspapers and food supplies. Distribution of these resources back into his community is often difficult due to the large number of people living in the village.

Information and money is scarce resource in the village. Given the fact that most people in the village have access to mobile phones. Consider a mobile application, which allows information to be transferred from one mobile device to another through Bluetooth, cutting out the data charges. Information may be given to a single person (synchronous transfer) or a group of people (asynchronous transfer) at any given moment in time. This application will allow people in the village to gain access to vital information brought back to Kampala on Ben's phone all at the same time.

Briefly answer the following:

Give a brief critic of existing file sharing systems in use today.

……...

……...

……...

……...

……...

How do you envision these file sharing systems should operate in the future?

……...

……...

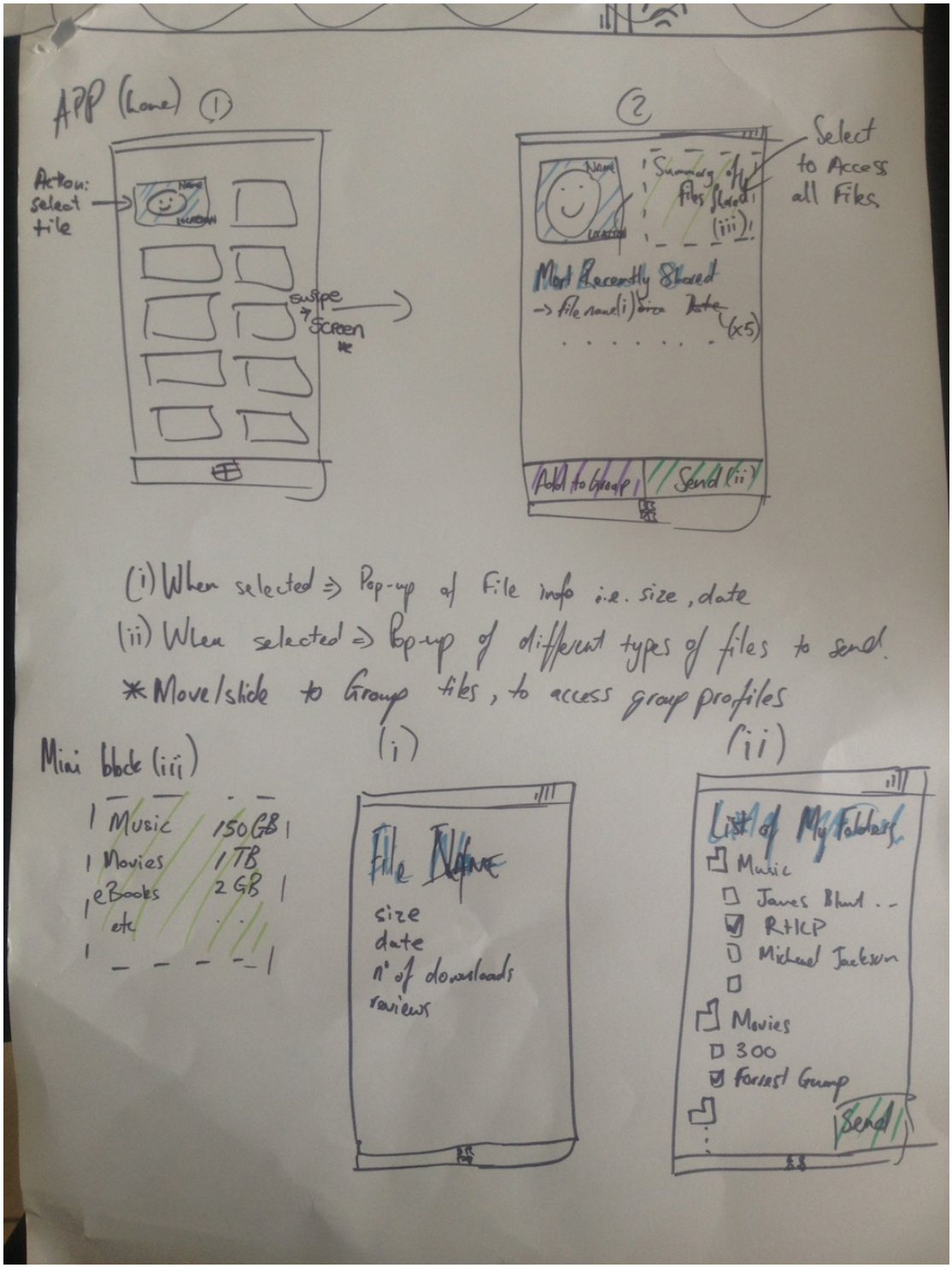
……...

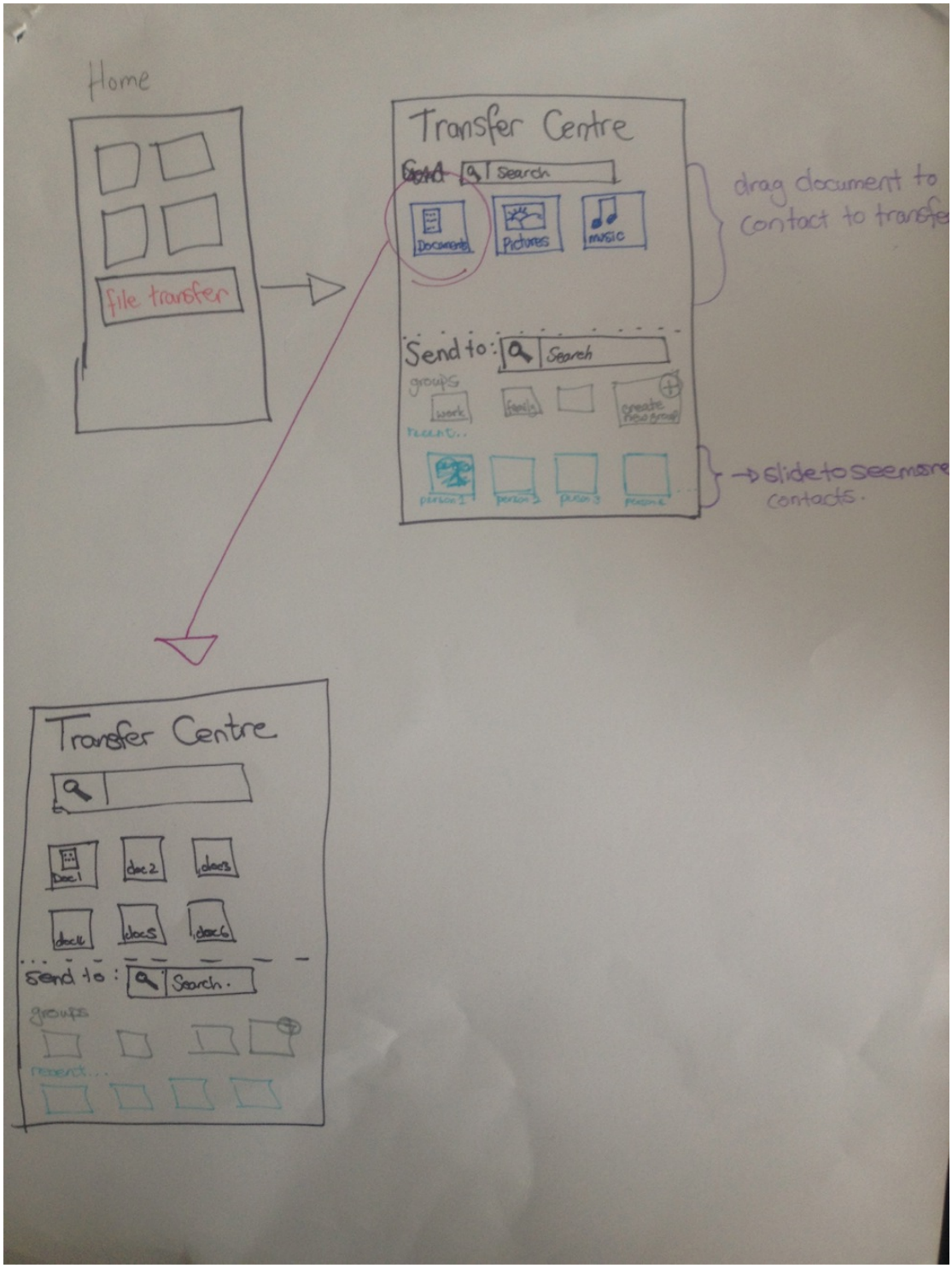
……...

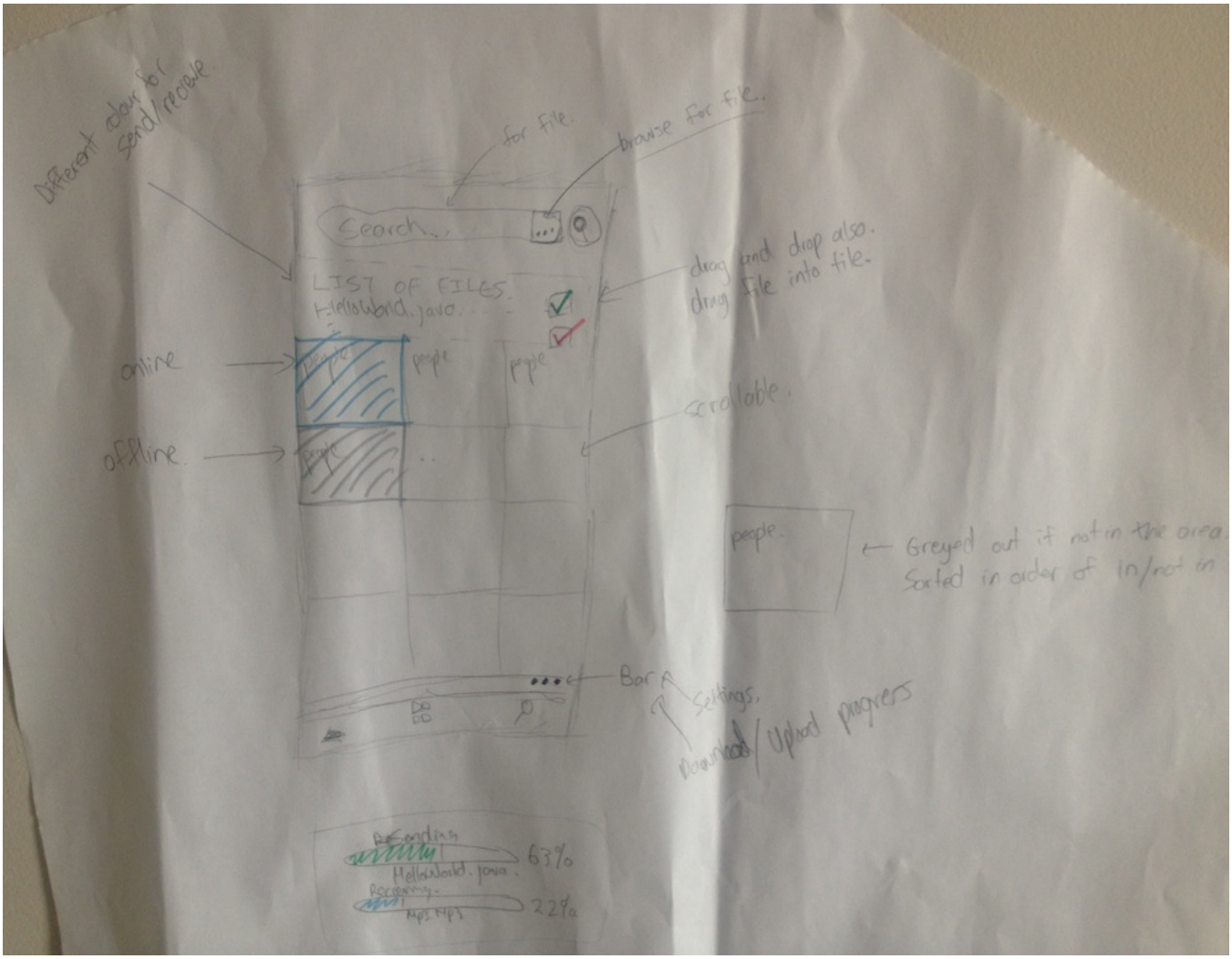
……...

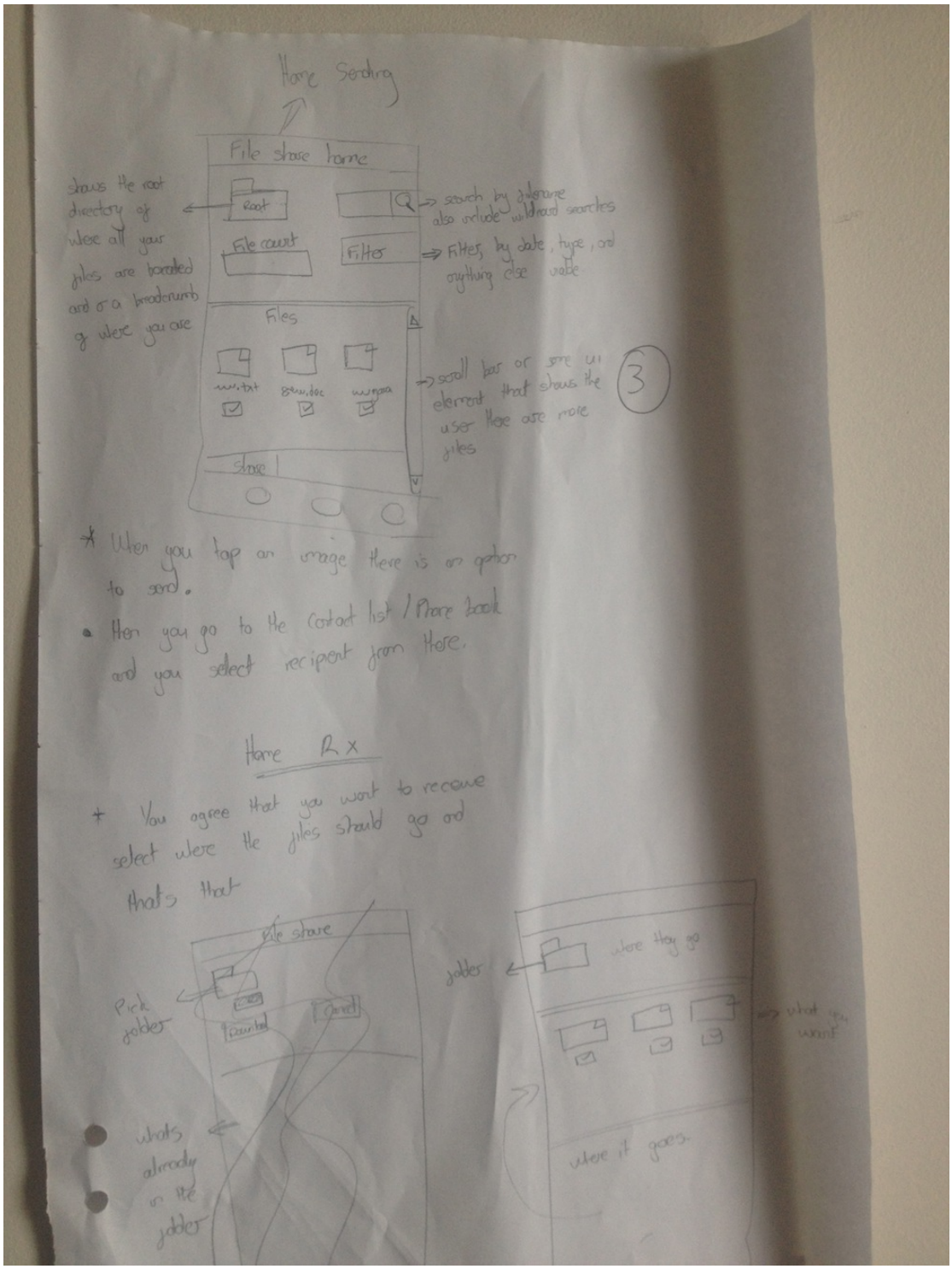
A brief demonstration of Windows Phone to follow…

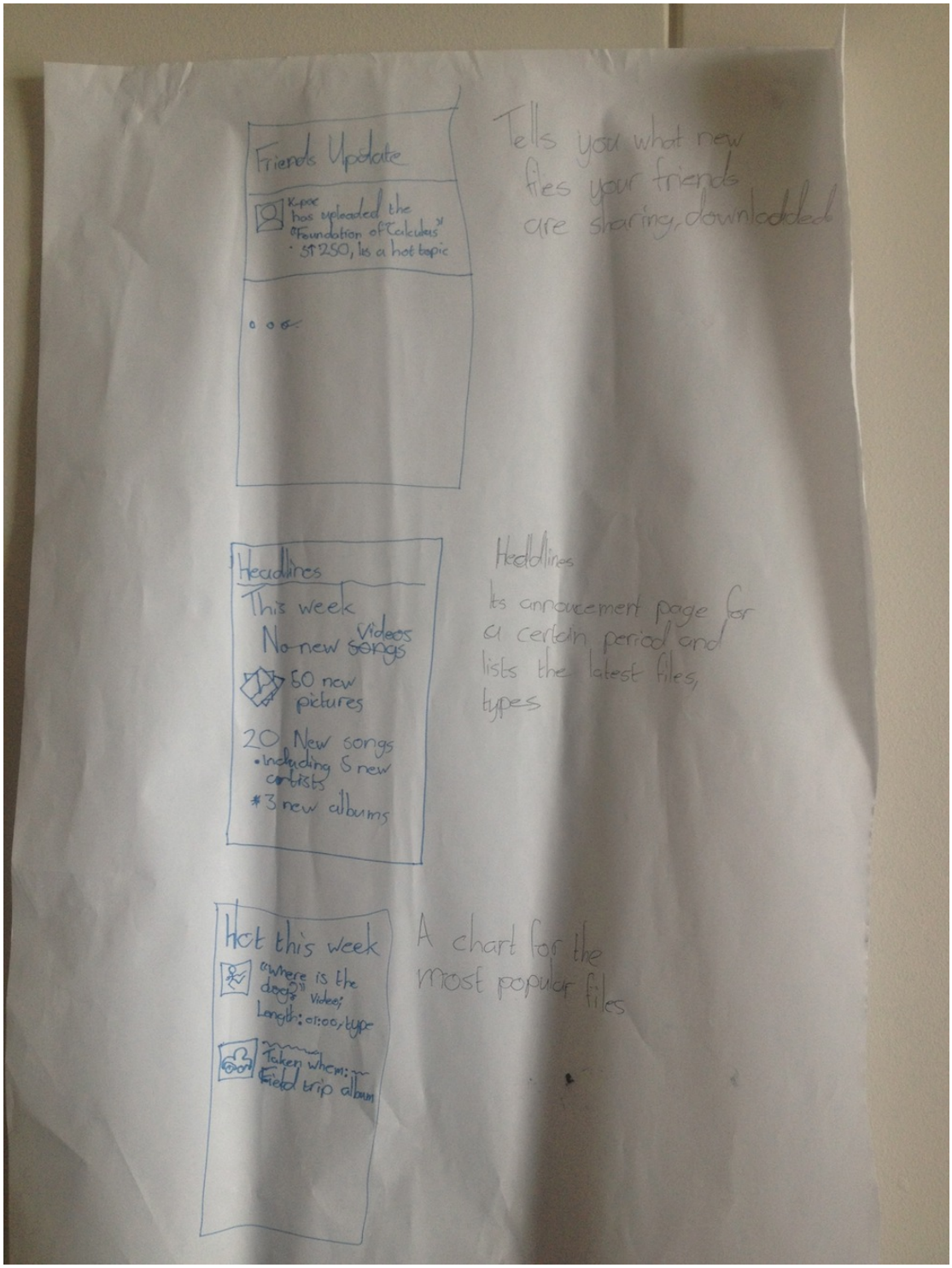
Appendix B: Low fidelity prototypes gathered from the participatory design sessions




Home
file transfer
Transfer Centre
Search
Documents
Pictures
music
drag document to contact to transfe
Send to:
Search
groups
work
family
create new group
recent..
person 1
person 2
person 3
person 4
→ slide to see more contacts.
Transfer Centre
doc 1
doc 2
doc 3
doc 4
doc 5
doc 6
Send to :
Search.
groups
recent...


Different class for send/recieve
for file.
browse for file.
Search...
LIST OF FILES.
HelloWorld.java.
drag and drop also.
drag file into file.
online
people
people
people
offline
people
scrollable.
people.
← Greyed out if not in the area.
Sorted in order of in/not in
Bar
Settings,
Download/Upload progress
Recording
63%
HelloWorld.java.
Recording.
Mp3 Mp3
22%


Home Sending
File share home
shows the root directory of where all your files are located and or a breadcrumb of where you are
Root
File count
Filter
=> search by filename also include wildcard searches
=> Filters by date, type, and anything else viable
Files
=> scroll bar or some UI element that shows the user there are more files
3
share
* When you tap an image there is an option to send.
• Then you go to the contact list / Phone book and you select recipient from there.
Home Rx
* You agree that you want to receive select where the files should go and thats that
File share
Pick folder
Cancel
thats already in the folder
folder
where they go
=> what you want
where it goes.


Friends Update
K-pop has uploaded the "Foundation of Calculus" - $1250, its a hot topic
Tells you what new files your friends are sharing, downloaded
Headlines
This week
No new videos songs
60 new pictures
20 New songs
• Including 5 new artists
#3 new albums
Headlines
Its announcement page for a certain period and lists the latest files, types
Hot this week
"Where is the dog?" Video
Length: 01:00, type
Taken when:
Field trip album
A chart for the most popular files

Appendix C: Low fidelity prototype of the uniform design