Preface: The Rise of Mobile Computing in a Future Ambient Intelligent World

INTRODUCTION

Mobile Computing is growing at an extraordinary rate with no signs of decline in the near future (Pettey & Goasduff, 2011). This growth is tempting software developers away from traditional application development to the newer world of mobile application developing (Hakoama & Hakoyama, 2011). For instance, there has been a huge rise in the popularity of smartphones and tablets in recent years, providing health information for users to live a much healthier lives. Mobile applications exist to assist users in eating healthier foods and exercising more regularly. This should it is hoped reduce the overall number of patients admitted to hospital each year with common ailments such as heart disease, obesity and diabetes. Health organisations are beginning to realise how important and beneficial it is to be interacting with patients through mobile applications. Due to the nature of networked mobile devices, information to and from the physician is spread rapidly. Mobile Ambient Intelligent Applications could monitor pain thresholds in out-patients so as to radically identify suffering patients (Curran, 2011).

Developers have an obligation to understand what it is that users want their mobile device to do - and do it well. In many ways, that is the ambition of ambient intelligence - providing that superior mode of achieving ideal actions on behalf of the user. One of the new aspects of modern life is the integration of social networks into everyday life. Part of the rise of social networks is the ubiquity of the mobile. Information is now everywhere at anytime. This has led to acceleration of knowledge. As the speed of mobile devices and the constant development of new technologies become available, more devices are being released with different sets of features to provide for a range of user needs. This has created a fragmented development community, as the wide range of platforms and devices available mean that development cannot be too focused on a single set-up if it is to reach a wide audience or make money. This too applies to the future of ambient intelligence. What follows next is a brief foray into the merger of mobile and ambient intelligence.

SMART PHONES AND TABLETS

One option that has to be made before the decision of whether to use a particular brand of tablet or phone is which operating system to adopt for the product. There are a number of operating systems which can be considered, but the major players for now are Microsoft with Windows Phone 7, Apple with iOS, and Google with Android.

Android was developed by a consortium of small firms known as the Open Handset Alliance which was directed by Google who then acquired the initial developer after the software’s completion. Appli-
Applications are developed using the Java programming language, a high level object-oriented programming language primarily through the use of the Android software development kit. The Windows Phone 7 platform provides integration with other popular services such as Windows Live, Xbox Live and Zune. Application development centres on Microsoft’s Silverlight application framework and XNA development tools. Finally, iOS is the mobile platform developed by Apple. Originally known as iPhone OS, the platform has been implemented to Apple’s other mobile products such as the iPad and iPod touch to help standardise their product range and to increase application compatibility between devices. The applications are developed in the Objective-C object-oriented programming language and the software development kit does not support installation on third-party hardware.

The iPad still leads the way as the gold standard of tablets but there are a number of contenders snapping at its heel. In fact, the 7” tablet market is becoming a quite competitive marketplace. With roughly half the screen area of 10-inch tablets like the iPad, 7-inch tablets offer a smaller, more convenient size. Their paperback-like dimensions also make them a natural fit for e-books. Samsung offer another Android-powered tablet, the successor of the original Galaxy Tab - the first one to run Android 4.0 Ice Cream Sandwich. The Galaxy Tab 2.0 runs Android 4.0 which is supposed to be more responsive. Amazon have released the 7” Kindle Fire that ships with a customized version of Google’s Gingerbread and combined with Amazon content. In terms of exact dimensions, Both tablets have also a dual core processor with more RAM memory for the Galaxy Tab 2 with 1GB instead of 512MB for the Kindle Fire. The Samsung Galaxy Tab 2 has a lower capacity battery than Kindle Fire with a 4,000mAh in comparison with Kindle Fire 4,400. The Kindle Fire does not include a camera but the the Galaxy Tab 2 includes a rear 3 megapixel camera with a frontal VGA camera.

*Figure 1. Samsung Galaxy Tab, Kindle Fire, and Acer Iconia 7”*
The Acer Iconia Tab A100 comes with Android Honeycomb OS. It has both a standard micro USB connection and a micro USB port along with a micro HDMI port. This allows the tablet to be connected to an HDTV. It comes with a 1024-by-600 touch-screen LCD. Many expect Apple to compete in this space as well. There is something just ‘right’ about holding a 7” tablet as opposed to their much smaller or larger competitors. I for one find myself reaching for my Kindle Fire rather than my 10” iPad. I also recommend 7” for clinical trials of mobile health applications. I just feel that the patients are more inclined to interact with them if they are easier to carry and appear to be more durable than the larger tablets (where the screen seems more exposed and thus weaker).

MOBILE APPLICATION DESIGN

Human Computer Interaction (HCI) is the relationship between people and computer systems and applications (Ayob et al., 2009). Usability is a measurement of how ‘easy’ a product is to use. Sometimes the most important aspect underlying adoption of a product is the user interface. Apple understands this and hence their success in recent years. An interesting study (Baillie & Morton, 2009) tested two separate designs developed. One did not adhere to HCI principles but the second was developed by following HCI standards. The findings revealed that building an application without adherence to HCI can come at a cost. This ultimate cost is that a product can perform more efficiently if it is designed to be more user-friendly. The need for good HCI is critical for future Ambient Intelligent Mobile systems development.

For each new device released on the market, many people will not have the time or patience to learn new techniques. Instead, techniques should be implemented across multiple devices to enhance the aspect of “ubi-input” (Wobbrock, 2006). Producing techniques that are consistent across numerous models can help satisfy the vast majority of users. Physical, visual, aural and cognitive disabilities all affect the user’s ability to operate devices which require exact movements and co-ordination. Despite the assistance given to disabled users of desktop applications in the form of assistive technologies such as Braille displays and alternative keyboards, making mobile devices accessible is more of a challenge. As the traditional desktop computer is controlled by the keyboard and mouse, emulating these actions with accessible hardware/software is extremely difficult on a mobile device as the majority of interaction is carried out using only the fingers.

Mobile design guidelines give developers a useful template to follow during the development of user interfaces and there exists Shneiderman’s 8 Golden Rules which offer a concise summary of the key principles of interface design (Dix, 2004). These include the need to strive for consistency so that terminology, sequences and arrangements such as font size, colour and the various styles are consistent across the interface. Users should be able to perform familiar actions more efficiently by the use of certain key sequences using hotkeys as shortcuts. Feedback should be offered for any action that requires it, especially where an error has occurred and users should be informed when they have successfully completed a task or transaction perhaps through the use of prompts. There should be attempts to prevent errors by the user, but when this does occur, measures should be in place to provide recovery and it should be easy to reverse action as this encourages the user to explore the system without anxiety and with the ability to the point of entry or a previous state with which he is familiar. Finally the user should feel that he is in control of the system and that it will respond to his actions and displays and menus should be kept as simple as possible to avoid clutter and any unnecessary overload of the memory capability.

These rules do not apply to every project but they do provide a foundation which interface designers can build on. They should be implemented where possible as they will not have a detrimental effect.
on any system. Adherence to these guidelines will help ensure that an interface is produced which will meet its requirements in terms of necessity and usability. The above rules have been laid down for a number of years, no corresponding rules exist for mobile devices. There is a good argument for compiling similar rules to combat the weaknesses in the design of interfaces on mobile devices. A number of modifications have been suggested to the remaining guidelines to render them more suitable when applied to the design of mobile interfaces.

Consistency is particularly important in relation to mobile devices and their integration with desktop machines. A user may find it necessary to transfer documents from a home computer to a PDA and read them while travelling to work. A difference in interface design, coupled with the inevitable environmental distractions, will make the task of the user even more difficult. Certain buttons and links may not be easily identified and this can lead to further difficulties. Therefore, it makes good sense that mobile interfaces should resemble exactly that of a desktop computer. Whilst the need to prevent and correct errors on both types of interface is necessary, it is more critical on mobile devices due to the time taken by the requirement of scrolling, zooming and other functions. The physical design of the mobile device can be problematic where the device is small and buttons are placed in close proximity to each other. Care should be taken to ensure that simple operations do not initiate unplanned events which might adversely affect transactions such as online-banking. Reversal of actions allows a useful degree of flexibility for the user, and whilst it is quite difficult to install on mobile devices, it remains a necessary function. Short-term memory capacity is limited on all interfaces and this is a particular concern on mobile devices. Also, the user may be distracted by other activities and interaction with the device may not have his full attention. The use of audio input and output would go some way to solving this problem.

**NEAR FIELD COMMUNICATION**

Near Field Communication (NFC) is a technology that enables a device to communicate with another at a maximum distance of around 20cm or less. Currently, mobile phone manufacturers, financial organisations and mobile network providers are attempting to apply this technology to Smartphones and other handheld devices because of the opportunity to enable the consumer to use commercial services more easily. As more phone manufacturers start to include NFC chips in their mobiles, the need for applications will increase. Already marketers are looking at the possibilities of using the NFC interface alongside their traditional marketing methods such as posters. Information could also be passed to the NFC device, allowing the user to gain more information about a product or service, so this would be an efficient means of advertising. For example, it would be possible to transmit a URL to the target device so that the user would then be able to navigate to a website to get further information about a product or service in which they are interested. This is where having NFC enabled on a smartphone could prove to be very useful for consumers, enabling them to find out the best price for a product before committing to the purchase. There are many uses for NFC. They can also be used to transfer tokens at airports, which would eliminate the need for boarding cards. The passenger would check-in using their mobile and then re-confirm by swiping their phone again at the departure gate. There is also the possibility of them being able to store biometric information, which is becoming more widely developed for security.

NFC devices can be used in conjunction with image display devices like digital photo frames for displaying images very quickly. All the user needs to do is touch the photo frame with the image ready to be sent, then the connection is established and the image is sent over Bluetooth. NFC is backward
compatible with RFID; therefore it is perfectly feasible to use an NFC enabled device as an RFID key. This can be used with traditional RFID access control systems as a replacement for the key fobs and cards currently used. Wireless car keys using NFC are being developed by BMW with personalised settings stored into each key. They have developed an NFC car key system which will link into the cars current navigation system which already allows for hotel reservation, and train ticket booking. Using NFC the tickets and reservations can now be stored on the NFC card which can then in turn be used to gain access to the hotel room or validate the ticket with the conductor. Applications for smartphones are starting to appear that allow the user to create their own NFC tags, an application that was developed and is being distributed for free is NXP TagWriter for the Android smartphone. The application uses the NFC enabled phone to send a signal to write contact details, URLs and SMS messages onto an NFC enabled tag which can be on items like business cards up to posters.

Microsoft’s Windows 8 operating system (OS) includes built-in NFC functionality which enables Windows 8 PCs, laptops or tablets to support NFC RFID readers. To date there have only been a limited range of mobile phones that are NFC-compatible. These act as 13.56 MHz passive NFC readers and writers interrogating tags and capturing data. They then can ship this data wirelessly when within range of those tags. The use of Near Field Communication will grow as NFC support in Windows 8 should spur the new community of developers and end-product manufacturers to create new applications. NFC’s use in personal devices which may now include tablets and laptops, as well as mobile phones should enable brick-and-mortar stores to link their products with the Internet.

Google Wallet (http://www.google.com/wallet) is an Android app that makes your phone your wallet. It is primarily aimed at the payments market as it stores virtual versions of your existing plastic cards on your phone. It works however by people tapping their phone to pay and redeem offers using near field communication (NFC). It is just being rolled out around the world. Google Wallet has been designed for an open commerce ecosystem. It aims to eventually hold many cards people keep in their leather wallet today. Because Google Wallet is a mobile app, it will be able to do more than a regular wallet ever could, like storing thousands of payment cards and Google Offers but without the bulk. Google hope that eventually our loyalty cards, gift cards, receipts, boarding passes, tickets, even our keys will be seamlessly synced to our Google Wallet. Every offer and loyalty point will be redeemed automatically with a single tap via NFC. The vast majority of phones however do not support NFC but Google believe that NFC will grow in popularity, and for the time being this is really a first step. Google also intend to enable older mobiles to use a more limited version of the NFC application through NFC stickers that you can place on the back of a phone.

Google are a little vague to date on this but it seems the plan is that users will be able to obtain special NFC stickers with a single credit card associated with them. Purchases made using the sticker will be relayed to the Android Wallet application on a device via the cloud. Google says it is willing to partner with everyone to help broaden support for Google Wallet and we can expect to see other operating system implementations of this technology. Google Wallet is now released on the Nexus S 4G by Google. It is possible that there may be real opportunities in the ambient intelligence arena to use the NFC on the Google phones to provide added value and services. The obvious feature is knowing the location of people.

Devices using NFC are expected to operate in environments with varying security, some with a high level of security and others that do not need any security. the technology is ‘inherently secure’ because of the small transmission distance however the best solution to these security issues is to have a layered security model with a minimum requirement of authentication before the start of communication. De-
velopers can then add higher levels of security according to their application needs. This is not required by the ISO standard but will be essential for making money from the technology. So there is much room for research into these areas in secure ambient intelligent Near Field Communications.

**MOBILE HEALTH**

Mobile Healthcare the provision of medical applications on mobile devices to improve the health of patients. In recent years, through advances made in healthcare, people are expected to live long active lives. People are becoming more knowledgeable in how to have a better quality of life. How we get this information to help us live longer has changed. As a society in the twenty first century we are forever searching for new information. Information has become more readily available and through mobile devices, patient’s views are always in close proximately to new information.

Almost everyone at some point in their life will need some type of health treatment. Whether this health treatment is from a general practitioner, surgeon or any other medical expert we want to be cared or have someone else cared for in the best possible way. Unfortunately there are current threats to the healthcare system which could reduce the quality of healthcare people will receive in the future. Since the United Kingdom fell into recession officially in January 2009, the government has been cutting funds from education, transport and various other services (Monaghan, 2009). Unfortunately the healthcare sector has also had to find ways to reduce its spending in order to save money. To save money organisations such as the NHS have been forced to cut jobs from all areas of the health sector. More than 50,000 doctors, nurses, midwives and other NHS staff are due to lose their jobs due to the most comprehensive survey of health cuts since the government came to power (Prince, 2011). With fewer nurses on wards due to these cuts, the return to long waiting lists and a rise in cancelled operations will result. Patient care will be an early casualty he warns.

Now more than ever it is important that methods can be put in place to save money for the health sector while still maintaining the highest quality of healthcare for patients. In the UK the population is predicted to increase to 70 million by the year 2027 (Travis, 2011). The number aged over 85 is expected to more than double over the next 25 years from 1.4 million in 2010 to 1.9 million by 2020 increasing to 3.5 million by 2035. The number of people aged 90 and above is set to triple, while the number of people aged 95 and above is expected to quadruple both by the year 2035. At a time where the health sector is trying to cut down on spending, there should be an emphasis on expanding the health sector for the forecasted increase in the number of older aged people and the types of healthcare treatment that they will need. Many Healthcare services are therefore faced with the problem of reducing spending while increasing resources in the next 20 years to cope with more patients. Methods must therefore be found and implemented into the health arena and mHealth applications could be beneficial to the current and future issues that affect health care.

Mobile Ambient Intelligent Applications (MAIA) are extremely relevant in this world and can benefit both healthcare professionals and the public. With the current recession in the UK and across the world, the health arena has been forced to cut down spending in order to save money. MAIA can help reduce costs in the long run for any health trust. Ultimately however it is the users of MAIA who can determine whether or not the health arena can use such innovative systems to their and the physicians advantage (Curran, 2012).
CONCLUSION

Mobile devices are becoming more prevalent as our main source of information and applications are becoming the gateway to which we can access it. The mobile device industry is very much fragmented, which leaves developers making many difficult decisions in order to maximize their applications success and availability. The large corporations that control the market places do not agree on many standards and protocols, which is making the divide within the mobile device ecosystem larger.

Security is becoming the main concern for the large mobile device providers as more and more people are using mobile devices this is becoming a new market for hackers and cyber criminals. Many developers leave their applications vulnerable and many do not patch their application, which puts the users of the application at great risk of malicious intent. One of the main aspects that is cropping up amongst the mobile apps community is personalisation and user centeredness. This can be achieved by analysing the user’s behaviour and preferences and identifying areas where the applications can prompt the user with a suggestion based on these, or by automatically providing information that they may want and minimizing text entry (e.g. drop down boxes). This kind of approach, as mentioned earlier, is strongly becoming characteristic of mobile applications, and this can help bypass several of the limitations of the device and its user interface if implemented correctly in the development stages. This design approach should be strongly emphasised in future application development as it will lead to more functional, user friendly applications. As apps are implicitly characteristic of compactness, ease of use, speed and functionality, it is important that the final product is able to deliver on these ideals if it is to be successful. It is important to the user that the application carries out exactly what is asked of it, with the minimum of fuss, and even just one annoying bug that impairs the app’s functionality, even slightly, could turn the user off the product completely, seeking an application which does it better. This is why testing is crucial and any bugs which may visibly affect the running of the core functionality should be top-priority and stamped out immediately.

Healthcare is a multi-billion dollar industry and a vital service within society. There has been a shift in emphasis for patients, from attending hospitals and local doctor’s surgeries to looking at self-monitoring and health awareness. With more health trusts attempting to embrace technology, patients are taking more control of their health. In the past the patients visited the doctor when they felt sick or unwell or had a medical problem. The doctor then provided the patient with advise, diagnosis and medication and in some cases referred them to a consultant. When the patient returned home the only person they could talk to was a relation or a neighbour. In cases where a patient had a rare condition then they would have felt extremely isolated as no one they knew would be going through the same situation.

Mobile Ambient Intelligent Applications could provide patients with support from multiple areas. This may revolutionise the healthcare sector. Control is now in the hands of the patient. This is largely down to what is known as content control. Anyone can now publish, read and review medical information due to the internet. This has shifted the medical expert from the centre of the health arena to the patient (Ayob at al., 2009).

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REFERENCES


ENDNOTE

1 http://www.nhs.uk/aboutNHSChoices/aboutnhschoices/NHSChoicesmobile/Pages/NHSChoices-mobile.aspx