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MOBILE APPLICATION DEVELOPMENT FOR SENIOR CITIZENS

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Abstract

Aged care is a significant issue which concerns all governments. In order to provide assistance and provide quality of life to senior citizens, enormous resources are invested by the government each year. A significant proportion of the investment is used to provide a range of services for senior citizens who stay at home. Since providing quality aged care is an ongoing and complex process, there is a desperate need to develop innovative solutions, which will benefit society at large. Although modern information technology products are changing the lifestyle of younger generations, they have much less impact on old people. This research therefore undertakes a novel study into the question of: What mobile applications can be developed on smartphone devices to improve senior citizens' quality of lives. By using a requirement framework developed from the literature, this study also explored the availability and suitability of current mobile applications which are available from IPhone Application shops, Nokia OVI stores and other sources in order to identify possible directions for future mobile application development for aged care purposes.

Keywords: Mobile application, health care

1.   INTRODUCTION

Aged care is a significant issue which concerns all governments. In order to provide assistance and improve the quality of life to senior citizens, enormous resources are invested. For example, according to the Department of Health and Ageing in Australia, the federal government has increased the total aged care budget to $7.7 billion from year 2006 to 2007. A significant proportion of these funds have been used to provide a range of services for senior citizens who stay at home.

> On 1st July 1998, the Family Service Minister of Australia, Warwick Smith, officially acknowledged that "Over the next 20 years, the proportion of Australians aged 65 years and older will grow from 12 per cent to more than 16 per cent. This means an increase from 2.2 million people in 1996 to about 3.5 million people by 2016."

Researchers argue that governments urgently need to invest in aged care and community services. For example, the Department of Health and Ageing has been investigating the use of Information and Communication Technologies through Clinical IT in Aged Care projects to improve the quality of service and efficiency through the use of information systems tools (Woodhead 2008). A national e-Health initiative is planned to enable result in the uploading of all medical records online.

However, through previous research relationships with aged care organisations such as Domiciliary Care SA, it has been suggested that better care should be provided to senior citizens who stay at home in order to keep them healthy for a longer period of time. Together with Domiciliary Care SA, the research team has reviewed a number commercial ICT tools which are current adopted by various aged care organisations such as:

- *Villa Maria (VIC)*: using Infor-organiser, Microsoft Office Share-Point Server (MOSS) and TM1/Calumo to manage client records and related documents
- *FerosCare aged care*: using a community gateway (Virtual Office, Wireless Technologies, Paperless Environments and In house Software/Applications) to manage aged care services
- *Royal District Nursing Service of SA (RDNS)*: using a Mobilising community health system for paperless client record management and work event management

It is found that the current use of ICT technology has a primary focus on improving the monitoring of aged care services. The users of these systems are often aged care service providers with a special focus on health-related issues. Although health is a major concern for senior citizens, they have also other 'quality of life' needs which could be met through innovative information management and technologies. For example, the US web-based email service (PawPaw Mail) has a special user interface for senior citizens.

When considering mobile devices, especially Smartphone devices, it is reasonable to suggest that while modern information technology products are changing the lifestyle of younger generations; they have much less impact on older people. In addition to the special mobile phone devices that are available to senior citizens for aged care purposes (which will be discussed in the later sections), the available mobile application of smartphone devices (such as IPhone, Windows Mobile Phone, etc) are very limited. This research therefore undertakes a novel study into the question of: What mobile applications can be developed on smart phone devices to improve senior citizens' quality of lives? In order to provide an answer to this question, this paper explores the mobile ICT needs for senior citizens and reviews the available mobile technologies in order to deliver a mobile application requirement framework specific to senior citizens. By using this framework, this paper investigates the current smartphone application repositories and identifies the gaps and possible areas of future development.

2. SMARTPHONES AND MOBILE APPLICATIONS FOR SENIOR CITIZENS

In many regions and countries such as Hong Kong and Japan, the mobile phone ownership rates have reached 100%+, which means that many people have at least one mobile phone. While the majority of users are from the younger generations, according to the study done by Massimi and Baecker (2008), in Britain over 60% of men and women age 60-64 own mobile phones. This percentage decreases for older age brackets; the same study reports 30% of men aged 80 or older own mobile phones, while somewhat less than 20% of women do. In other words, senior citizens represent a significant group of mobile phone users and demand special attention to the development of adequate hardware and software for their use.

Many commercial vendors are becoming aware of the importance of the senior market and indeed there are a number of commercial solutions provided for senior citizens. For example, the following phone is specially designed for senior citizens with considerations of a senior-friendly user-interface (big button, simple operations), alarm features and emergency contact.

Figure 1: Senior citizen mobile phone, source: http://www.koool.com.au

While meeting specific needs (call, messaging and SOS emergency contact), these mobile phones generally lack features (as compared to the popular mobile phones available in the market) and are very expensive. For example, the above phone is advertised at AUD $150, but isn't capable of installing any additional software.

Regarding generic mobile phones, Massimi and Baecker (2008) indicate that many senior citizens use their mobile phones as memory aids by using built-in applications such as calendars and personal alarms. However, it is also noted that many users are frustrated with the impersonal nature of technology (e.g. the inability to customise the built-in calendar for different events with different colour-coding schemes).

When the 3G technology reached the market, video conferencing was used as a selling point for senior citizens who want to keep in touch with their friends and relatives for social interaction. However, O'Hara, Black and Lipson (2006) find that there are social and practical barriers to use of video telephony. Senior citizens' concerns relate to privacy and a reduced ability to control presentation of the self with video. Also it can be expensive and difficult to set up. In many cases, the senior users need to change their current mobile phone in order to use video calls.

Perhaps it is easy to argue that senior citizens generally do not need sophisticated features on their mobile phones and the ability to install third-party software is not relevant for this target market. It must be pointed out that the next generation of senior citizens (in the coming 5~10 years), and a proportion of current senior citizen users, are indeed fluent mobile phone users who are familiar with devices such as BlackBerry, Iphones, etc. Consequently, in contrast to the approach of cutting features and making special devices, the approach of developing mobile applications on popular Smartphone platforms by providing a well-designed user-interface and utilising all the features that mobile technology provides, is considered to be more beneficial and cost-effective in order to meet a range of senior citizens' requirements in the long-term. For example, by using the IPhone built-in Gravity sensor, it is not difficult to develop a SOS application to detect when the senior citizen falls. Additionally, the latter approach also provides flexibility and extendibility to constantly meet the new demands.

Thus, instead of focusing on special mobile devices, this paper tries to take the perspective of identifying how to develop mobile applications for the popular Smartphone platforms to meet the senior citizens' needs (as discussed in the next section).

3. MOBILE APPLICATION NEEDS OF SENIOR CITIZENS

A number of researchers have studied the current mobile usage of senior citizens. It is found that senior citizens are demanding a range of features other than basic calling. For example, Kurniawan's (2008) study with senior citizens suggests that the required hardware and software features can be categorised into:

1. Memory aids: appointments, reminders, address book with photos, personal Information (e.g. insurance numbers) and an alarm are considered to be very useful. In addition to standardised menus, the demand for personalised menus and design was mentioned to aid old people with reduced cognition.

2. Visual aids: backlight, large text, bold colour, colour scheme and big buttons are rated as high priority features. Especially, dual user interface output and input are preferred (e.g. blinking screen and ringtone for incoming calls).

3. Haptic aids: although it is not necessary to provide ruggedized devices, a rubber grip and easy-to-hold phones are useful to avoid damage.

4. Features to minimise user error: keypad auto-lock, extra confirmation dialog and noticeable reminders (when battery is low) are desirable.

5. Safety features: features such as panic button and speed-dial are considered essential for senior citizens when using mobile phones.

Lorenz and Oppermann (2008) have placed a special focus on many desirable features of the mobile application interface for senior citizens. For example,

- the font size should be between 36pt and 48ppt
- one-level navigation instead of using menu structures
- arrange the buttons at the bottom of the interface, so the input-hand will not hide the screen
- colour-neutral displays for visual impaired users
- redundant user guidance by colour-coding and blinking boxes
- slow animation speed

It is noted that the above-mentioned features mostly relate to the user-experience with mobile devices and some of these can only be implemented by hardware manufacturers. Nevertheless, when developing mobile applications, these are essential design criteria to keep in mind. However, in order to deliver a popular application, the mobile application itself must be able to meet the specific need of senior citizens in their daily life in the form (or both) of:

1. Physical needs: monitoring health conditions (e.g. blood pressure, etc).
2. Non-physical needs: for example, social needs: How to use mobile technology to interact with others, regardless of physical distance in the most convenient ways.

Such needs can be demonstrated from the published studies on the design and use of mobile applications for health care (in particular, aged care) worldwide. Some of these studies are summarised below.

McGree-Lennon (2008) suggests that the design of any home-care system (especially for senior citizens) must consider its very nature, which involves a number of direct users and other stakeholders all of whom are inter-related, but are likely to be separated from the physical distances. This makes mobile communication technology ideal for interaction as the majority of users are possibly on the move during the day. Especially when the direct user is a senior citizen, health indicators such as blood pressure sensors, heart beat sensors and other related indicators are thought essential in any health care system. However, with the increase of user ages, and changes to individual health conditions,, the system must be flexible enough to allow additional features to suit individual needs.

In the study of the use of mobile information systems in long-term care facilities in Australia, a number of researchers such as Chau and Turner (2006), Yu, Li and Gagnon (2009) point out that the introduction of mobile ICT solutions is currently focusing on the improvement of health information management and service delivery, the result of which is directly related to the quality of life of an increasing proportion of the ageing population. In contrast, Camarainha-Matos and Vieira (1999), Hameed (2003), Lapinsky (2007) suggest that senior citizens' needs should not be neglected. Some key needs are listed below:

- *Health Monitoring needs:* Due to the limitation of aged care resources, remote care services have become increasingly popular. Senior citizens often require special health vigilance, including monitoring of their physical and emotional conditions and the fulfilment of some medication agenda. Thus, it is necessary to adopt remote monitoring/vigilance of the elderly persons' health state, in order to improve the quality of the offered services.
- *Personal Information needs:* Most senior citizens spend most of their time at home with an occasionally visit for a short period. It is necessarily to provide advice / help located at their homes and at the places they visit, in some form of personal information maintenance, which includes medication and food constraints, personal interests and preferences,
- *Social Needs*: It is very common that a senior citizen's relatives are engaged in jobs outside their homes and their friends are unable to visit on a daily basis. However, in general, relatives and friends want to offer help or keep in touch with each other. Thus, video conferencing and remote monitoring facilities would be useful.
- *Leisure and Sales needs:* Personal leisure (entertainment) is important for senior citizens in what constitutes their free time occupation. Obtaining books, hiring videos, ordering meals and groceries, playing games etc, allows the users to stay healthy mentally. ICT technologies will enrich the users' experience even if they are unable to go out regularly.
- *Safety and privacy needs:* This is considered as the most critical aspect for senior citizens. The user's activity must be monitored by using presence sensors, image sensors, etc, and be analysed with consideration to different scenarios.

4.   PRELIMINARY RESEARCH FRAMEWORK AND RESEARCH DESIGN

Summarised from the literature, a framework for mobile application development on Smartphones for senior citizens has developed as shown in figure 2.
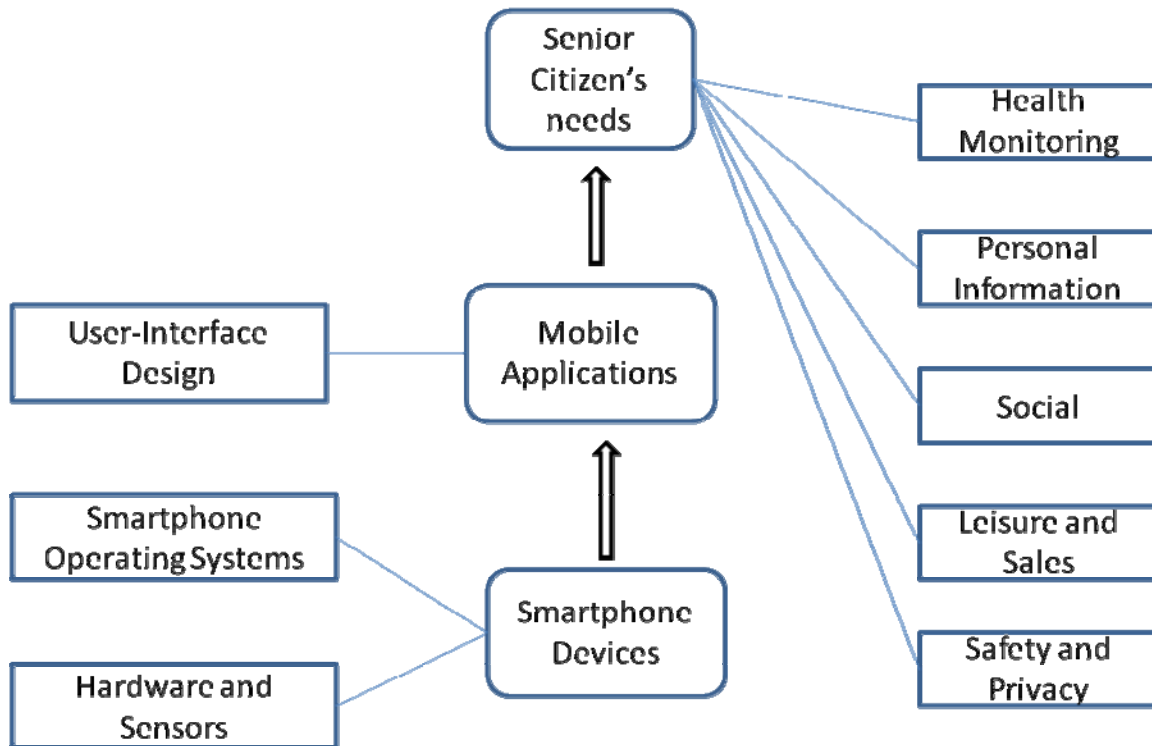

Figure 2: Development Framework of Mobile Applications on SmartPhones for Senior Citizens

Based on this framework, this research will investigate the current mobile applications and their ability in matching the senior citizens' specific needs. This research therefore consists of a number of stages:

Stage 1: Explore the current SmartPhone repositories to seek an understanding of to what extent, the existing mobile applications fulfil the needs of senior citizens. The specific focus has been placed on health monitoring needs. (Mobile applications such as Facebook updaters may fulfil the social needs, but whether such applications are suitable for senior citizens are arguable. Thus, mobile applications of other categories will be studied during Stage 2).

Stage 2: Conduct case studies with senior users by trying some carefully-chosen applications from each category of needs to seek an understanding of whether or not the current application design fulfils the needs of senior citizens. During this stage, it is expected to conduct usability studies with senior citizens covering both mobile hardware and software aspects. Especially, the case studies will be conducted in relation to real world scenarios such as remote health monitoring.

Stage 3: Develop prototype applications which utilise the SmartPhone features (e.g various sensors) to indicate the future directions of application development and develop guidelines for mobile application development specific for senior citizens.

The limitation of this research is also noted. While addressing the senior citizens' various needs (as shown in Figure 2), this study will not cover some related aspects such as cultural issues. Additionally,

this study does not aim to propose mobile software solutions for senior citizens. Instead, this study tries to provide generic guidelines to mobile hardware and software vendors on how to meet senior citizens needs better.

This paper will report stage 1 findings.

5.   STAGE 1 FINDINGS AND DISCUSSION

There are a number of Smartphone platforms that are available for developers, among which the IPhone, Symbian and Windows Mobile are the most popular platforms. Arguably, the new Google Android platform may become increasingly popular. However, since it is still relatively new, the number of available applications is still limited.

The following publicly available mobile application repositories are chosen for this study:

- IPhone: IPhone Application Store has an estimated 65000+ applications
- Symbian: Nokia OVI store and My-symbian software shop have an estimated 50000+ applications
- Windows Mobile: Microsoft Windows Mobile Catalogue and PocketGear have an estimated 50000+ applications

Although none of the repositories have provided accurate numbers of the applications that they host, they represent the most popular Smartphone applications repositories, and are often the first and only stop for Smartphone users who seek the applications.

The search for aged-friendly mobile applications has employed two methods: (1): The category search where categorises such as "health and fitness" are available; and (2): keywords and key phrases search including "health", "medical", "care", "senior", "aged care" and so on. The chosen application must be useful to senior citizens (e.g. MediMobile is a health care related application, which allows physicians to capture information. It is not chosen however because this application has little relevance for senior citizens use on a daily basis.).

The following table summaries the most popular, appropriate applications:

	Health Monitoring
IPhone	- Ojas Life Energy For a Healthy Heart: Listen to a collection of mantras and chants. - Camera for Heart: recording pulse, - Treadmill Tracker - BMI and Calorie Calculator for iPhone - App Store Inner Slim in 7 Days: Weight Loss and the Mind - Diet Watch - Ojas Blood Pressure - AlphaMind ?Alpha Brain Wave Entrainment - iGetFit PRO Calories Tracker - Run: tracking running exercises - Gym Buddy - Master Cleanse - Fitness & Healthy Weight
Symbian	Afridoctor: Africa 's first personal mobile health clinic.

	• mobileCalorie Countdown • mobileProgress Proj-Data Gathering • mobileMens Fitness • Weight Loss Equations Calculator • eyesight chart • Health Tracker for Symbian • Health Calculator for Symbian: Calculates BMI, BSA, BFP, BMR, Max. Heart rate etc • The ACP Handbook of Women's Health • Mosby's PDA Dictionary of Medicine, Nursing, & Health Professions • Ascendo Fitness for Symbian • Fitness Tracker for Symbian • Medical Acronyms & Abbreviations Dictionary 2009 • KeepFit • eRem: Chronic Medication Usage Reminder • Infodev BP Tracker Pro for Symbian • Infodev Cholesterol Tracker Pro for Symbian • Diets S60 3rd Edition • First Aid Guide from MobileReference • Calorie Assistant • My Weight Monitor • BP Tracker for Symbian • Best Diets, Plans, Recipes and Nutrition Encyclopedia • FitnessAssistant (for Nokia 3650, 7650) • Diabetes Care Quick Study Guide from MobileReference • Practical Guide to the Care of the Medical Patient (ferriguide6) • Biorhythm for Nokia Mobiles
Windows Mobile	• MyPersonalDiet: Manage weight, fitness and health by defining, tracking and monitoring diet and nutrients. • My Last Cigarette: Quit smoking project management • emHealth: provided BMI calculator • Health & Diet Manager • FitnessPlus: Comprehensive and Powerful Diet and Exercise Tracking Tool • Blood Pressure Tracker Glucose: Measuring glucose level by keeping a daily log • Nutritional Foods • Calories Calculator • Immunizations & Vaccinations Calendar -SP 1.0 • Asthma Care Quick Study • Smart Healthy: check and diagnose your health measurements • 1st Aid & Emergencies • Handy Medical • Health Care • Headache and Migraine Care 4 • 900 Diabetic Recipes

The above findings show that health-care has been emerged as a popular area for mobile application development on various Smartphone environments. The close review of the software functionalities has suggested the followings issues:

1. Paper replacement Memory Aid: The majority of healths monitoring applications are delivered as paper replacement tools which allow the users to log their exercises, blood pressure, drug uses on mobile phones instead of paper. However, very few applications actually utilise the Smartphone hardware sensors to capture the data and record it automatically even though the capability exists. For example, one IPhone application uses the built-in Gravity sensor to serve as a pedometer.
2. Fitness: The fitness applications are mainly designed for the young generation with the specific focus on weight loss and diet management. It is difficult to find any specific scenario within these applications which are tailored for senior citizens. In other words, these program treats different age groups same (with an implicit intention of use by the young generation).
3. Lack of medical concern: The above list has included some medical-related applications. However, many of them are e-books and medical dictionaries. Given the limitation of reading mobile phone screens in small fonts, it is difficult to argue their value to serve senior citizens.
4. Standard-alone application: The majority of the above software are stand-alone with no capability to transmit the data and information (e.g. blood pressure logs) to third-parties (e.g. local clinics) for further analysis or early warning.
5. Lack of integration: The individual health monitor requires dynamic profiles with common indicators. Currently it is difficult to find one application which allows the users to track all his / her health readings. For example, the user is often required to use one application to record the heart-beat rate but open another application for recording the blood pressure readings.
6. Software-only solution: All the software is delivered as software-only solutions. This study hasn't shown any solutions that provide a Smartphone application with hardware accessories to extend the Smartphone functionalities (e.g. a blood pressure reader which can hook onto a Smartphone).

6.   CONCLUSION

Aged care is a significant issue which concerns all governments. Since providing quality aged care is an ongoing and complex process, there is a desperate need to develop innovative solutions, which will benefit society at large. Although modern information technology products are changing the lifestyle of younger generations, they have much less impact on older people. Instead of developing specific mobile hardware devices for senior citizens, with respect to the rapid advancement of Smartphone devices, this study undertakes a novel perspective of research into how to develop desirable mobile applications to improve senior citizens' quality of life.

Based on the literature, this paper has developed a mobile application development framework for senior citizens. Using this framework, the stage 1 study indicates deficiencies in meeting senior citizens' needs. The summary of findings may provide directions for future mobile application development on Smartphones. Stage 2 and 3 studies will be completed shortly, with a view to providing precise design guidelines.

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