Smartphone shared calendar application for elderly people
Abstract

In today's society, a smartphone has become an indispensable tool in people's daily lives and there are various apps on these mobile phone platforms, which provide great convenience for people's lives. Android system has became one of the mainstream operating system’s in the smartphone market, because of its high degree of openness, good user experience and low cost. Until the 24.9.2013, the Android mobile device has reached more than one billion units all over the world. Under the stimulus of such large usage, the Android apps emerge endlessly. From multimedia to social software, from games to browsers, all of the applications reflect the vast market potential and strong competitiveness and applicability of the Android system.

The calendar is an essential application for almost every smart mobile device. Calendar has been accompanied by the development of human civilization. After entering the information age, with the development of different kinds of smart mobile devices, calendar has also evolved from a paper calendar into computer software. It also gives the calendar more space to achieve more features. At present calendar applications are not used only for basic calendar features, but as a supportive tool for example creating alarms for timed events or memo features between other software. The combination of time and events in calendar software can improve one’s ability to manage daily life.

This thesis presents in detail, the development environment, the core architecture, main functions and the important algorithms for a calendar application for the elderly. It also shows the general process of development of mobile applications, and discusses the background, present situation and future development of the calendar application created for the Android platform. The developed calendar system is mainly oriented for the elderly. Therefore the purpose is to provide functional modules that can offer assistance for this aging population. In addition to the most basic functions, such as querying dates, it also includes recording, changing the font and sharing functions. This sharing functionality is the most important feature of the system module. Sharing means a calendar becomes networked communication software from the schedule management software. This paper concentrates on providing some valuable thinking of the design of software for elderly people.

Keywords
Android, calendar, elderly people, sharing, smart phone.

Supervisor
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Foreword

This thesis represents the end of my master's study, and also the end of my life in Finland. Frankly I have too many regrets, but don't know how to express.

At first, I want to talk about the project. From college, I have participated in many projects, but always as a manager. But in this project I’m a developer. It was a very interesting experience. About the application, in fact, I must say there are many places that need to be improved, but I think the value of the calendar application is not able to use as a business program, it is the train of thought for design the elderly software as a demo.

I want to thank Petri Pulli. From the course project 2, until now complete the thesis, Petri always help me in study and other aspects. I remember the first time of writing email to foreigner is writing to Petri, I really feel Petri is very kind. It hard to describe my feelings in English, and it’s not allowed to use Chinese, so that I only can say thank you very much.

I also want to thank Teemu Jääskeläinen as we have worked together for two years. In the past two years, Teemu gave me a lot of help. I enjoyed the time when we work together very much, and also want to say thank you Teemu's for friendship and patience. The handsome Finnish gentleman makes me feel the friendliness of Finnish people.

And I want to say thank you to Eeva Leinonen. I spelled your name correctly this time. I’m thank you for your enthusiasm. Eeva usually gives me help on time when I ask her for help.

At the last, I want to say thank you to all the people who helped me. Thank you very much, Thank you very much, Thank you very much, the important things need to say three times.

Wang Jizhe

Daqing, 11th November, 2014
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1. Introduction

With the advent of information age, the smart phone becomes more and more popular. Android system is one of the mainstream mobile operating systems, and its openness is also favored by more and more mobile device manufacturers. The broad freedom development environment has resulted in tens of thousand of apps developed for the platform.

A wide variety of apps bring changes to our life, at the same time, human society has been changing. There is a very significant situation is the aging of population. According to statistics, in the worldwide, the proportion of elderly population will increase from the 10.0% in 2000 to 21.4%. Some typical countries increases very quickly, such like Slovenia will increase 22.3% in 50 years, Japan will increase to 42.4% by 2050 (Pollack, M. E.,2005, p. 4). Improving physical health of the old people is a medical category, but we can provide the old people a more convenience life with information technology. So how to better serve the elderly?

1.1 The old people smartphone and calendar

On 14th of December, 1990, the general assembly of the United Nations passed a resolution, decided to make 1st of October be the international day of old persons begin from 1991. In today's world population aging has become a prominent social problem. For example, Jakovljevic, M., & Laaser, U. (2015) pointed out that: "The aging of developing nations occurs at a far greater speed. For increasing the proportion of people over 60 years from 7% to 14%, it will take China only 26 years, whereas the same process in France occurred over 115 years " (p. 3). In the future for a long time, the proportion of elderly population will increase at an average annual rate of 3.2%. With the improvement of people's health and life expectancy, the proportion of the elderly population will be larger and larger (Pollack, M. E.,2005, p. 2).

Nowadays, the mobile phone has become an indispensable tool for information interaction. With the continuous development of technology, demands of mobile phone users have tend to be more personalized and diversified, mobile phone consumer market is also subdivided again and again, according to the present situation of the world's population aging, the elderly smartphones also arise at the historic moment.

However, the popularity of elderly smart phones has to face a new challenge: although the design of the elderly smartphones has become increasingly perfect, there is a lack in software application that is designed for the elderly. The heterogeneity of the old people is very strong; they have their own peculiar physiological and psychological characteristics, which is mainly reflected in their ability of accepting things is gradually declining as the growth of the age (Hanson, V.
Limited by their physiological, psychological, living habits and etc., most elderly people are hard to use smartphone as flexible as young people, this will obviously affect the usage of smartphones in the elderly, and make it difficult for the elderly to have a good experience.

Using the calendar as an example, although calendar is a very useful app for the elderly, when I searched application store, I found there is a little calendar software which is designed according to the characteristics of the elderly. So when the old people use smartphone often appear some problems, for example, the font is too small to make the elderly see clearly, the tiny size makes icon manipulation also difficult, etc. While at the same time the function of the calendar has become increasingly diversified, but often do not have the function of the old people really need.

1.2 Project research purpose and meaning

As described above, today's society is facing more and more serious aging problems, however, with the continuous development of information technology, all kinds of intelligent equipment is constantly improved, the intelligent life will provide old people more and more convenience. This project aims to meet the needs of the elderly through developing mobile phone calendar app which is based on the Android platform, and helping the elderly to improve their quality of life. At the same time, in conjunction with the oldbird2.0 system which is a kind of smart navigation system specifically designed for old people, the calendar application can provide a quick and easy guardianship system to take care of the senior citizen for the family and the caretaker. It also can make the elderly be able to get help from family members or caretakers timely, and be used to do some simple communication.

For the elderly, in the physical, visual and perceptual recession, hearing ability weakened, language communication ability degradation and other functional decline; In the psychological sense, attachment to their families, elderly life at leisure, eager to get emotional comfort (Hanson, V. L., 2001; Ijsselsteijn, W., Nap, H. H., de Kort, Y., & Poels, K., 2007). So the app design for the elderly should be after fully considering the elderly physiological and psychological needs, thus design a software application which contains a variety of specific functions and meets the demand of the elderly use. An application which is developed by the core needs of the elderly, will effectively improve the elderly's using experience, and provide a better intelligent life.

For relatives, whether in the same framework of civilization or not, respecting and taking good care of the old people has always been the mainstream values of social morality. With the increasing aged population, each family appears more and more old people, and the family members are hard to give enough care for every old people by traditional methods. To solve the problem, this project will not only to research and analyze the special needs of old people, but also improve their ability of
self-care. And it will be connected to the PC program to help relatives to take care of the elderly.

For the caretakers, despite a lot of old persons’ caretakers are their relatives, still part of the old persons’ caretakers are full-time professionals. In the process of care, caretakers can not always be around the elderly, and many of the caretakers are not only taking care of only one person, they often have several persons to take care of. This project provides caretakers and the elderly a platform to have a real-time communication, and it can help caretakers grasp the situation of the elderly, so that to help the old people timely and effectively.

In addition, this project provides a rudiment of the elderly care system, which is based on the linkage between PC and mobile terminal, mobile terminal and mobile. The calendar application will realize efficient sharing and communication between the elderly, the elderly and family members, the elderly and the caretakers. At the same time through the analysis and research of many aspects of the elderly's habits, physical function level and etc. the calendar app will improve the human-machine interaction pattern and make the old people get a better user experience.

1.3 The content and organizational structure

The main purpose of this paper is to expound the corresponding research and development process of smartphone calendar designed for the elderly and the analysis conclusion. At the completion of development, the calendar application has been carried on corresponding test and improved in some aspects on the basis of some typical scenarios. The calendar application is used for improving the quality of the elderly's smart lives, and also be expected to provide a prototype and an case for subsequent similar application project which is designed for the elderly

In this paper, the main structure is divided into three parts. The first part’s main purpose is to introduce the project background, the involved theory, the purpose of this paper and the significance of this project. The second part includes the design and development process. The third part is discussion, and at first it described two scenarios. Based on the scenarios, the sixth chapter make an analyzation and discussion about this project.

The first chapter content mainly includes: an introduction of the project research environment, the research purpose and meaning, it is a brief background of this thesis.

The " theory and background " chapter covers the relevant theory and the background, including an aging population situation, a brief introduction about the Android system, and oldbird system.

The second part is chapter 3 and chapter 4, this part described the calendar system design and development process.
The third chapter contains the demand analysis and functional analysis for special psychological and physiology of the elderly; and the fourth chapter presents a part of core code, the chapter provide a briefly introduction about how to realize the functions.

The third part contains chapter 5 and chapter 6. Chapter 5 described the bustrip scenario and the old bird scenario. Through the two scenarios, this chapter also analyses how to improve the calendar application. Chapter 6 criticizes the project and discuses about what new does the project bring as knowledge for others to use.

The last chapter is summary section, this paragraph makes a conclusion about the the project.
2. Theory and background

In today's world, aging population has become a prominent social problem. To cause the attention of the international community to the problem of population aging, on the 14th of December, 1990, the general assembly of the United Nations passed a resolution, decided to make October 1st be the international day of old persons begin from 1991..

The following chapters will answer the questions of 1) what is the global situation of ageing now? 2) What are the implications for human life? 3) how will the international community deal with?

2.1 The aging of the population

2.1.1 The standard of aging population

According to the United Nations aging population classification standard which is determined by <the Aging of Populations and Its Economic and Social Implications>, when the population proportion of people aged 65 and older exceeds 7% in a country or an area, it means the country or area can be referred as an aging society. In 1982, the world congress about aging population at Vienna, also provide a new standard. If the proportion of people Aged 60 and over the age of 60 is more than 10%, it means the country or area can be referred as an aging society(United Nations. Dept. of Economic and Social Affairs, 1956).

2.1.2 The situation of aging population in global environment

On 9th of September 2015, the HelpAge international (2015)published the <Global Age Watch Index 2015: insight report>.

The reported said that the global population of aged 60 and above is about 901 million, almost 12.3% of the world's total population. The proportion will reach 16.5% by 2030. In global environment, the number of people over the age of 60 is more than the number of children under the age of five now, by 2050, the population over the age of 60 will be more than the population under the age of 15(HelpAge international, 2015, p. 6).

According to The Second World Assembly on Ageing, in the 20th century, there was a great changes had taken place in life expectancy. The average life expectancy extended for 20 years to 66 years old and it is expected to extend for another 10 years from 1950 to 2050. In the 21st century, the rapid growth of the population means that the population over the age of 60 will increase from about 600 million in 2000 to nearly 2 billions in 2050, experts predict the elderly population accounts for the global population will increase from 10% in 1998 to 15% in 2025. In developing countries,
The growth is the largest and fastest, over the next 50 years, these country's aging population will grow for four times. In Asia and Latin America, the elderly population will increase from 8% in 1998 to 15% in 2025, but in Africa, during the same period, the proportion is expected to increase from 5% to only 6%, but by 2050, this proportion will be doubled. In Europe and North America, during the period of 1998 to 2025, the proportion will be increased from 20% to 28% and from 16% to 26% (U.N., 2002b). The changes of the global population have a profound impact on all aspects of individual, community, national, and international relationship. Every aspect of human, such as social, economic, political, cultural, psychological and spiritual, will change a lot.


Population aging phenomenon is unprecedented in human history, we cannot find similar situation in before history. By 2050, the number of elderly people in the world will be more than the number of young people, it is the first time in human history.

Population ageing has profound influence, it has important consequences and effects for all aspects of human life. In the field of economy, population aging affect the economic growth, savings, investment, consumption, labor market, pension, and tax deeply. At the social level, the aging population will have a widespread and profound influence on the health and medical care, family composition, and living arrangements.

Population ageing is enduring. In the 20th century, the proportion of elderly people continue to grow, this phenomenon in the 21st century is expected to continue. For example, the proportion of elderly in 1950 was 8%, in 2000 was 10%, forecast to reach 21% in 2050 (figure 2.1).

![Figure 2.1 The proportion of people over 60 years old 1950-2050](image-url)
Other key results of this report include the following:

1) By and large, the aging of the population trend is irreversible, the rejuvenation of population is impossible to happen again.

2) The increase of aging population is the result of population reproduction rate and mortality rate from high to low.

2.1.3 The trends of aging population

The current world is undergoing significant changes in the demographic transition. As the increasing of the population average life expectancy continuously, it can be expected that in the middle of this century, the proportion of old people and young people in glob will be the same. In fact, in several developed countries, the elderly population has exceeded the number of children, and the birth rate has fallen below the replacement level ("International Strategy for Action on Ageing", 2001). This means the aging of population trend appears three features:

- The speed of aging of population is faster and faster.
- The aging of population center gradually shifts from developed countries to developing countries.
- The number of the oldest old (over 80 years old) in the elderly population expands unceasingly.

2.1.4 The situation of caretaker

According to the "World population ageing: 1950-2050"(Nations. U., 2002a), the world's median age was 26 years old. The youngest country is Yemen, its median age is 15 years old, the oldest country is Japan, and the median age of Japan is 41 years old. By 2050, the median age is expected to increase to 36. At that time, the oldest nation in the expected is Spanish, the median age will be 55.

So we can see there is a very terrible problem, who is the caretaker for the old people? As above said, the median age of Spanish will be 55, it means almost half of Spanish is elderly people. In this situation, maybe we need to make old people take care of older people, and this problem also exists in other population aging countries.

Potential support ratio(PSR) means that each 65 years old or older people can have how many people who are between 15 and 64 years old to support them. The impact of aging population can be seen from the PSR. Now the PSR is declining and it will keep this tendency for a long time. Between 1950 and 2000, PSR decreased from 12 to 9. By the middle of the 21st century, PSR is expected to fall to 4 that means every 65 years or older people just have 4 supporters (figure 2.2). PSR has a significant
impact to social welfare, especially under the traditional system of retirement benefits (Nations. U., 2002a).

Figure 2.2 The PSR ratio showing the decline of people aged 15-64 available to assist people over the age of 65.

Estabrooks, C. A., Squires, J. E., Carleton, H. L., Cummings, G. G., & Norton, P. G. (2015) had researched the long-term care problem about elderly people. The elderly's health deteriorated with the increase of age, they usually got one or more chronic disease, so that the demand for long-term care is increasing (p. 2). The elderly can be divided into three categories based on their health:

- Disabled elderly, that is completely lose the ability to care for themselves.
- Partial disability, lost parts of self-care ability, but can do some life behavior.
- Independent self-care, have completely independent living ability.

For Disabled elderly, whether completely or partial disability, they require long-term care. Especially the completely disabled elderly, they usually need the professional nursing services. Considering about the situation of the decline of PSR, the societies have to face the pressure of the service resource scarcity.

2.2 The introduction about Android and research method

2.2.1 Action research method

In the process of development, the main research method had been used is action research. We need to constantly analyze the behavior of the elderly and design their
use context, and base on the analysis results the demand design, because the core principle of the application is to make it satisfy the elderly’s life situation. At the same time, in the process of design, the project uses a participatory design approach, calendar application users participate the process of functional design, and continue to make design recommendations based on individual needs.

It is an iterative design process, the main way is through each month holding development conference, at the meeting everyone will play different roles and make requests according to their own conditions. In the process of constantly updating demands, we extract two important core requirements. The first one is quick to share function, we taking into account the actual needs of the elderly in the design process. The range of the sharing function from the original only working between the calendar and calendar, calendar and oldbird expanded into can directly import scheduling into other instant messaging applications through the calendar system, which makes the system easier to use. The second is the voice function, although the function is not in the original design, considering the elderly people’s visual acuity and body control ability, voice input and output will greatly improve the user experience of the elderly people, so in the development process, the voice input and output is added to the calendar application.

Action research

It is a loop learning process. The process can be divided into two iteration. The first iteration has 4 parts as follow:

1) Define the problem, we should have a clearly thought about what problem should be solved in this project. In the initial stage, we hope to simplify operation, so the elderly can share their schedule with others, including their caretakers who use software in computers conveniently and quickly, and it make it easier for caretakers to help the elderly timely and effectively.

2) Design the action, we have design the situation of elderly people using the calendar application. It includes the elderly users communicate with each others through the application, and the old people who want to go shopping get help from their caretakers by sharing their schedule.

3) Observe and analysis the action, we found the similar scenarios in the real world and observed the action what elderly people had done. After that, we gather data on their behavior, and analyze why they have these behaviors, and how we can help them through the calendar system when they have these behaviors.

4) Implementation and extrapolate usable knowledge. Through analyzing the behavior, we get more detailed requirements of the elderly users, and then we can develop corresponding functions according to these requirements. At the same time, we also summarize some characteristics of these requirements, and design solutions for them.
Figure 2.3 The process of the action research in the calendar application project.

The second iteration is a process of improvement. Through the bus trip scenario, we found the new requirements to improve the calendar system. It will be described in the below paragraph.

2.2.2 Android System architecture

Android uses the hierarchical system architecture, the official standard architecture as shown in the figure below (figure 2.4). Android is divided into four main functional layers from bottom to up, which respectively are Linux Kernel, Libraries and Android Runtime, Application Framework and the Applications (Wang, C., Duan, W., Ma, J., & Wang, C. 2010; Liuge, 2014).
Linux kernel

Android is based on Linux operating system kernel. The android implements the core functions with the aid of the Linux kernel service, such as wireless communication, hardware device drivers, process and memory management, network protocol stack, power management and so on. The version before the Android4.0 is based on kernel 2.6 series. The version of 4.0 and after 4.0 use the Linux3 X kernel (Liuge, 2014).

Libraries and Android Runtime

The libraries and android runtime are located above the Linux kernel layer. They are used to support the application framework and provide service for the individual components of the Android system (Liuge, 2014):
Libraries

Most system libraries written by C/C+++, the android developers can use the function libraries through the Android application framework. The description of main system libraries as follow:

**Table 2.1** the main libraries of android

<table>
<thead>
<tr>
<th>The name of libraries</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Manager</td>
<td>When to perform multiple applications, manage the display of subsystem.</td>
</tr>
<tr>
<td>Media Framework</td>
<td>Based on Packet Video Open Core multimedia library, support there cord and playback of a variety of audio and video formats,</td>
</tr>
<tr>
<td>SQLite</td>
<td>Small local relational database.</td>
</tr>
<tr>
<td>OpenGL</td>
<td>ES</td>
</tr>
<tr>
<td>FreeType</td>
<td>Used to display a bitmap and vector fonts</td>
</tr>
<tr>
<td>WebKit</td>
<td>Web browser software engine</td>
</tr>
<tr>
<td>SGL</td>
<td>2 d graphics engine</td>
</tr>
<tr>
<td>SSL</td>
<td>Secure socket layer, is a security protocol to provide security and data integrity for network communication.</td>
</tr>
</tbody>
</table>

In addition to the main system libraries which are enumerated above, Android Native Development Kit (NDK) is also very important. The NDK provides the interface for developers so that the developers can directly use the Android system resources, and code by C or C++ language. Therefore, third-party applications cannot rely on Dalvik virtual machine. In fact, the NDK provides a series of tool for coding by C or C++, so that the developers can quickly develop C or C++ dynamic library. The NDK also can automatically package the dynamic libraries and the Java application into application package files, this file is apk..

Runtime

Android runtime includes the core libraries and the Dalvik virtual machine.

Core libraries: the core libraries provides the majority functions of Java 5 se API, and provides the core API of the Android, such as Android.OS, android.net, Android.media, etc.

Dalvik virtual machine is based on the apache Java virtual machine, and it was improved to adapt to the low memory, low processor speed of mobile devices. Dalvik virtual machine depends on the Linux kernel, it can realize the process isolation and
thread debugging management, security and exception management, recycling and other important function.

Application framework

Application framework provides all of the class and libraries which are needed for developing Android applications, so that the developer can undertake rapid application development, they also can realize personalized design through inheritance(Wang, C., Duan, W., Ma, J., & Wang, C. 2010; Liuge, 2014).

Table 2.2 the library of application framework

<table>
<thead>
<tr>
<th>The name of library</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity Manager</td>
<td>Manage all of the application program’s life cycle and provide interactive interface for all program window</td>
</tr>
<tr>
<td>Window Manager</td>
<td>To manage all open the window program</td>
</tr>
<tr>
<td>Content Provider</td>
<td>Provide the function for accessing the data from an application to another application, or to realize the data sharing between applications</td>
</tr>
<tr>
<td>View System</td>
<td>Create the basic components of application</td>
</tr>
<tr>
<td>Notification Manager</td>
<td>Make the application be able to shows a custom message in the status bar.</td>
</tr>
<tr>
<td>Package Manager</td>
<td>To supervise and control the application.</td>
</tr>
<tr>
<td>Resource Manager</td>
<td>Provide the resources to supply application uses.</td>
</tr>
<tr>
<td>Location Manager</td>
<td>To provide location services.</td>
</tr>
<tr>
<td>Telephony Manager</td>
<td>Manage all mobile equipment function</td>
</tr>
</tbody>
</table>

Applications

The application level of the Android platform includes all kinds of applications. Some applications have direct interaction with users, and some applications are the service programs which run in the background. Most of the applications are coded by the Java language.(Liuge, 2014) In fact, we can find a various of applications on smartphone, such as SMS messages, telephone dial-up, image browser, games, maps, a web browser program, and other applications.

2.2.3 The four major components of Android

The four components of android development are: Activity, used for function; Service, the background Service, it does not provide interface; BroadcastReceiver, used to receive broadcast; Content Provider, support in multiple applications store and read data, it is equivalent to the database. According to the <what is the four major components of android?> (Liang Hongyong, 2012), There is a brief introduction of the four major components as follow:

Activity
As Liang Hongyong (2012) said: "In Android, the Activity is the root of all the programs, all of the process is running in the Activity, the Activity is the most frequently component and also is one of the most basic module of Android. If comparing mobile phone to a browser, then the Activity is equivalent to a web page. Some controls can be added in the midst of the activity, such as Button and Check box."

Generally, an Android application is composed of more than one Activity. And the multiple activities can skip among each other.

Services

Services cannot run by themselves, they only run in background, and also can interact with other components. The Service is a program that can run for a long time, but it has no user interface. For example, we can listen to music through the music player during using other application. The music can be played in background because of the control of services. The Services can be used in many applications and occasions, such as download, recording the geographic information, etc. In a word, the services usually hide themselves (Liang Hongyong, 2012).

BroadcastReceiver

In Android, Broadcast is a widely used mechanism for transfer the information between applications. The BroadcastReceiver is a component for accepting, filtering and responding the broadcast which is send out. Developers can use BroadcastReceiver to make an application response to an external event. This is very interesting, for example, when a telephone call comes in the external event, the system can use the BroadcastReceiver for processing (Liang Hongyong, 2012).

Content Provider

Content provider is the solution of the third-party application data accessing which is provided by android. In Android, the protection of data is very tight, in addition to putting the data in the SD card, the database and file of an application are not allowed to direct access. Of course, android won’t make each application as a prison, it provides a door for each application. That is content Provider. If an application wants to provide data, it can encapsulate into a Content Provider through deriving a Content Provider class, each Content Provider with an uri as a separate identity (Liang Hongyong, 2012).

2.3 the introduction of oldbird system

The old bird system is a Unity 3D project. It includes some 3D model of birds, the Stockmann market, and the elderly people’s house (RajeekaPonrasa, TeemuJääskeläinen, HannuRaappana, 2014). These models formed a simply the
elderly living environment. This system is mainly used for monitoring the elderly people, so that the caretaker can provide the service at any time. This system includes the information box features. The information box contains some personal information about elderly users, such like age, living status, and medical information. The oldbird system also has caregivers communication tool. This tool can send message and take a call to the calendar application, and the calendar application also can share the schedule to the oldbird system. This combination makes the caretaker can timely understand the elderly needs and give them help.
3. Requirements analysis and general design

The heterogeneity of older population is a very strong, they have their own peculiar physiological, psychological and mental characteristics, their ability to accept things are as the growth of the age gradually decline. Although people often use positive words to praise the elderly, such like "smart", "amiable", "rich experience" and etc., when people talking about some older people, they usually use "weak", "old", "sickly" to describe (Jana, M., 2011, p. 2). As Rueda, M. C. A., & Ferreira, M. R. (2012) said: "The above explanations acquire relevance in advanced old age, or what is called the fourth age, a stage that is characterized by the appearance of physical or mental diseases that bring about incapacity, deterioration and lack of social functionality (Ludi, 2005; Solís, 1999). All this, in turn, causes old people to become physically dependent on the care of others for carrying out of the basic activities in daily life." (p. 3).

3.1. Requirements Analysis

3.1.1 Requirement description

From the perspective of users, the requirements of this calendar app can be divided into two aspects

• Old users, they are main users of this calendar app. The design should provide the special service on the basis of their requirements.

• Caretakers, they need to be able to get the information that is relevant to the elders, to take care of them on time.

From the perspective of the aging, requirements are as follows:

• Basic requirements: all of the basic functions of calendar system, such as query date.

• Special requirements: the function is designed for the characteristics of elder people, such as voice input.

The basic requirements:

From our mobile phone we can find out that the calendar program should have four basic functions:

• Query requirements. That is querying the date. This is the most fundamental requirement of calendar. The calendar application includes a variety of patterns, such as day model, week model, and month model.
• Recording requirements. From the days of using paper calendars, calendar is used to query demand. People tend to record under the corresponding date, in order to achieve the purpose of noting.

• Remind requirements. People often expect to make the schedule through recording on the calendar. However, people usually forget to check the calendar after using it to record. For calendar software, the system can distinguish whether it or not it reaches the preset time nodes according to the system time. If necessary, it can give the user a corresponding prompt before the time nodes. With this function, the users can still accomplish their plan even they forgot to check the calendar.

Positioning date requirements. The calendar software is different from paper calendar. Calendar application often contains a large amount of data, even hundreds of years. But people often want to look for a specific date. So the calendar application should be able to locate to a certain date quickly.

The special requirements:

As previously mentioned, the special requirement is based on the characteristics of the elderly. The following part will analyze the special needs of old people from two aspects, psychology and physiology (Deponte, A., 2007; Geraldine Moane., 2012; Goodpaster, B. H., Carlson, C. L., Visser, M. ,, Kelley, D. E., Scherzinger, A. ,, & Harris, T. B., et al., 2001).

The physiological characteristics of old people:

On the vision,

the elderly need higher brightness to identify things;

their close vision loss is serious; they can't put up with strong light;

they are sensitive of colour reduced.

In terms of hearing,

their auditory acuity decreased;

the elderly are not sensitive to high frequency sound.

In terms of the nervous system,

the most obvious is the decrease in the memory and learning ability, for the second performance, unresponsive,

the resilience of the environment reduced, etc.

In terms of motor nerve,
bone calcium loss,
muscle strength drops,
action is slow,
and the elderly can't hold the items for a long time.

So when designing a software for the elderly, these special physiological characteristics should be fully considered.

The psychological characteristics of old people are characterized by negative emotions, including low self-esteem, loneliness, fear, depression and so on. With the passage of time, the physiological function and brain function of the elderly become more and more recession analyzing from the psychology perspective. At the same time, their social roles also have a big change, which lead to producing some different features inevitably of the elderly’s psychology(Pikhartova, J., Bowling, A., & Victor, C., 2015).

- Inferiority complex, the decay of their body and a variety of diseases make the elderly people doubt the value of their own and effect on self-denial.
- Loneliness, the elderly people usually feel nothing to do, and emotional needs are not being met, thus produce empty lonely, etc.
- The feelings of lose, the transformation of social role makes the elderly marginalized in the social activities, resulting in a loss.
- Depression, there are difficulties in life so that the elderly people feel sad and anxious, etc

With the development of information technology, more and more app make people's life get great convenience. For the elderly, although like to use high-tech products, but the difficulties which is encountered in the process of using apps make them get "high-tech anxiety"(Goldberg, B, 1998).

According to <Study using behavior analysis of the old cell phone design>(Zhang Zhenmeng, 2011),the lower level of intelligence of the interface, the easier for the elderly to accept. The main reason is the reducing of learning ability of old people makes them hard to learn how to use complex interface. This situation affects the life of old people seriously, especially using smart devices. Therefore, to design a software for the elderly, we should avoid complex operation process, provide a simple and easy interface, reduce the study burden of the elderly, thus improve the user experience. By observing the habit of using a smartphone in our daily life (Table 3.1).we can come to the conclusion that the following differences, provide some references for designing the elderly software.
Table 3.1 the differences of using situation between elderly and young people

<table>
<thead>
<tr>
<th>The activities</th>
<th>Young people</th>
<th>Elderly people</th>
</tr>
</thead>
<tbody>
<tr>
<td>The phone rang</td>
<td>directly see who is calling</td>
<td>Need help to see</td>
</tr>
<tr>
<td>Answering the phone</td>
<td>Direct answer</td>
<td>Sometimes error, press the hang up button</td>
</tr>
<tr>
<td>Hang up phone</td>
<td>Direct hang up</td>
<td>Need to confirm many times</td>
</tr>
<tr>
<td>Send message</td>
<td>fast input</td>
<td>Input is very slow</td>
</tr>
<tr>
<td>Using application</td>
<td>Use all kinds of app quickly</td>
<td>Only can use simple app, at the same time, using an app tend to use only a few simple functions</td>
</tr>
<tr>
<td>The interface of smartphone</td>
<td>Cluttered</td>
<td>Only a few common app, and fixed position.</td>
</tr>
</tbody>
</table>

From what has been discussed above, we can see the special requirements of elderly can be summarized as these elements, see clearly, simple operation, easy to learn, easy to use.

The requirements of Caretaker:

Through the observation of the Caretakers, caretaker can be divided into two categories:

Full time caretaker, this kind of caretaker has very obvious one characteristic is that they spend a lot of energy and time to take care of the elderly, so they can fast effective corresponding the needs of elderly and help for the elderly. So their requirement for Realtime is higher.

Family caretaker, this kind of caretaker is often with the elderly have genetic relationship, but they are not professional for the care of the elderly. So they will only understand the demand of the elderly in a certain period of time, and take care. Their main requirement is able to accurately understand the plan of old people, and in the corresponding time node to be prompt.

3.1.2 The using range of calendar system

First, we need to focus on the purpose of the system and the applicable scope. This calendar program is designed by the requirements of the old people to improve the elderly intelligent life experience. So in the design of the present stage, the system is based on the scope of basic functions of calendar program, including chronicle, query the date and the function which is the elderly need. About the demand of other function for the elderly, such as entertainment, health monitoring, etc., does not belong to the scope of application of the system.
Second, since the system contacts with oldbird 2.0 system, so this application can be real-time data exchange with oldbird 2.0 system through webserver.

3.1.3 The requirement acquirement of function

In the process of capture requirements, we should consider every possible case as much as possible, because each requirement has a corresponding cases exist. Then according to the requirements by the above description, we can analyze the following cases:

First of all, these use cases can be divided into two groups, the first set of use cases is basic:

• The query date, the user can query the date of the day, such as date, week, etc.

• The orientation date, user can locate to a specific date.

• Establish a schedule, it used for the new schedule. Set the date of establish schedule.

• Edit the schedule, you can edit the schedule, include start time, participants, the end of the time, location, specific events and remind time. After editing, the schedule must be saved.

• Save the schedule, to save after editing schedule, only does this step can make the editor to take effect.

The second group of special cases:

• Share schedule, select a schedule and share all of the information of the schedule to PC or other client.

• Optimize the interface, make the interface more clearly, so that the old people who has the poor eyesight can see clearly.

• Optimize the interaction pattern, provide different interaction patterns, make old people use more efficient.

• Simplify the operation, using one step can connect multiple functions, multiple applications.

Instant communication, can be connected to other instant messaging software, and use it to communicate.

3.2 The preliminary design of the system
In the entire design process, the user as the center is the most important design principles. At the same time, we used the method of participatory design (PD). In the monthly thesis supervision meeting, we constantly put forward amendments to design. Finally, under the condition of considering the characteristics of the elderly, with the above requirements description and the requirements of relevant cases, the function design and their corresponding relationship are listed as follows.

**Table 3.2** the design of function

<table>
<thead>
<tr>
<th>Use case</th>
<th>User requirements</th>
<th>Function</th>
<th>Functional description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query date</td>
<td>Query requirements</td>
<td>The basic function of date</td>
<td>Query and select date</td>
</tr>
<tr>
<td>Locate date</td>
<td>Select date requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Build schedule</td>
<td>Recording requirements</td>
<td>The basic function of schedule</td>
<td>Provide the management function of schedule for users.</td>
</tr>
<tr>
<td>Edit schedule</td>
<td>Recording requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Remind requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Save schedule</td>
<td>Recording requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharing schedule</td>
<td>The psychological requirements, Caretaker requirements</td>
<td>Sharing the schedule</td>
<td>Make the schedule be able to share with PC, and other users.</td>
</tr>
<tr>
<td>Optimized interface</td>
<td>The physiological requirements</td>
<td>Change the front size</td>
<td>Can change the size of word</td>
</tr>
<tr>
<td>Instant communication</td>
<td>The psychological requirements, Caretaker requirements</td>
<td>Contact with other application</td>
<td>Contact with other application, such as Facebook, wechat, etc.</td>
</tr>
<tr>
<td>Simplified operation</td>
<td>The physiological requirements</td>
<td>Voice input and output</td>
<td>Voice input to record, via voice output make the elderly without reading can also be used.</td>
</tr>
</tbody>
</table>

3.2.1 The module design

After completing the function design, the system could be decomposed into various modules, so that it can be correspond to the function. Since Android system has a user-defined calendar control, so we can put the basic function of the calendar into basic module, moreover sharing the schedule with external app can be classified into sharing modules, the function of changing the font and voice control can be put into the smart help module.
3.2.2 The structural design

Considering with the using habits and the adaptive capacity of elderly users, we hope to provide a simple interface for elderly users. Compared with some of the calendar application on the market at present, we decided to simplify the traditional interface. The new interface is much similar with traditional one, but the new one put the schedule model and date model into one page, so that the users can check their schedule without other options. The using process of the calendar system is very easy to learn.

The first step is enter the calendar interface, this interface is the main interface of the whole calendar system, its main feature is query the date and schedule; We can choose the corresponding date in the calendar interface, and add new agenda. After editing the agenda, the users can choose whether to share the schedule. At the same time in the calendar interface, we can also choose to change the font size, or select a specific date, etc. The specific process as follows.

- **Query**, the user can query the date and the agenda in the main calendar interface, at the same time the user could make one day schedule by querying a specific date.

- **Record**, enter the main interface, if you want to create a new schedule, you first need to select a date, and select the new schedule. New schedule contained time, place, characters, events, and so on factors. The next step is editing it. When after editing the basic information, the editor need to choose whether to remind, if you need to remind, if it is need, the editor also need to set reminders. At this time, the edition of schedule is completed. After editing the new schedule, the user can
choose whether to share the schedule. If not, the interface will be back to the main interface.

- Contact, this part is divided into two sub-processes, the first process is instant messaging, users can contact with other people through other external app. The second process is sharing schedule, the first step needs to determine whether there is a schedule which have been shared, if not, choose a new agenda, and then share it, if you have, directly open the agenda.

![Flow diagram of the calendar application.](image-url)

**Figure 3.2** The flow diagram of the calendar application.
The use case

In accordance with the above use case analysis we can get a use case diagram (figure 3.3):

This use case mainly described the function of calendar application, and the interaction between calendar application and oldbird2.0 system. In this use case, there are two kinds of users, one is the elderly calendar users, the other one is the oldbird users. The different users will use the different function, and they also have the different using purpose.

Based on the above design, the calendar users can use the application to check the date and record schedule. The recording schedule function not only includes the basic recording function as normal calendar, but also added a new function which is sharing the schedule. This function makes the calendar can be contacted with oldbird2.0 system. The users can share their schedule directly to their caretaker through the sharing function, and if they want, they also can take an instant messaging.
Figure 3.3 The use case diagram of the calendar application.
4. The implementation of the system

This section proposed to design the four core functions for the functions that calendar system should have and related problem solutions according to the requirements analysis and general design which are mentioned in Chapter 3. After introduced each function, from the perspective of technology, this section provides the core code and implementation details of each function. And do the analysis and improvement for these functions.

4.1 The basic function

This part is the basis of calendar program, the main function is to build a calendar control. In the control, calendar program can realize the basic functions, such as query date, select a date, etc.

The versions after the Android 3.0 all provide a calendar control, but the requirements of each calendar program is not the same, therefore, in order to facilitate the follow-up development work, this calendar application chose to use a custom calendar control.

This custom calendar control is an open source control, it is from the open source community (XiaosaiSoAi, 2013). The main function is implementing the drawing of calendar and selecting date.

At the same time, this part also provide the code about implementing voice output, but this code is not as the focus in this section, related contents will be introduced in the following paragraphs in detail.

The open source control provides two main help. The first help is providing a completed drawings of the calendar, we can use those drawings to realize the main structure of calendar interface. Because this control interface contains the main elements of the above design of the calendar system, there is only need to make a little change for this part of the code. The interface follows the control’s basic style. And this part will not provide the source code, but can provide the mapped rendering in blow.

Another function of the open source control is providing the activities. Such as query a month, select date, etc. The following will provide some core code to tell how to realize the above functions.

The following code is the main implementation of the function about querying another month in the calendar interface, the ya [0] said year, ya [1] said month.

```java
String[] ya = calendarView.getYearAndMonth().split("-");
calendarCenter.setText(ya[0] + "-" + ya[1]);
```
The main function of code given in the following is to set up controls to monitor, you can catch click on each day.

In be used actually, people often have two needs in the selected date, the first is to choose the continuous date, so this procedure by setting three date type variables to achieve this requirement. At first, there need a start date (selectedStartDate) and an end date (selectedEndDate), the core code as follow:

```java
calendarView.setOnItemClickListener(new OnItemClickListener() {

    @Override
    public void onItemClick(Date selectedStartDate, Date selectedEndDate, Date downDate) {
        if (calendarView.isSelectMore()) {
            String text = format.format(selectedStartDate) + "to" + format.format(selectedEndDate);
            speak(text);
            Toast.makeText(getApplicationContext(), text,
```
And then, the second requirements is selecting singled date:

```java
else {
    mCurTime = format.format(downDate);
    speak("select "+getDateString(downDate));
    Toast.makeText(getApplicationContext(), mCurTime,
    Toast.LENGTH_SHORT).show();
}
Log.e("MainActivity", "OnItemClickmCurTime is " + mCurTime);
if (mCurTime != null&&mCurTime.contains("-")) {
    String[] timeStrs = mCurTime.split("-");
    String dayStr = timeStrs[timeStrs.length - 1];
    int day = Integer.parseInt(dayStr);
    calculateCalendar();
}
```

The resulting effect of this part is presented in Figure 4.1:

![Calendar Interface](image1)

![Select Date Interface](image2)

**Figure 4.1** left: The interface of calendar. Right: the interface of select date

4.2 Changing the font size for elderly users

About the design of changing the font type, the original idea is based on how to solve the problem of vision loss in the elderly. First of all, from the research on the physiological characteristics of old people, I found that without the influence of eye disease, the vision of the elderly compared to the young’s although had been decreased, they still be able to see things clearly. Another point is because of the habits
with eyes, the elderly people usually cannot look at the smartphone screen for a long time. For the poor eyesight elderly users, its main disease is characterized by presbyopia, it means that they can feel light but difficult to identify the tiny objects, in life, this part of the elderly are often wear glasses to see things clearly (DeLoss, D. J., Watanabe, T., & Andersen, G. J, 2015., p. 2).

Considering to the two situations presented above, in order to ensure the two kinds of elderly people are able to see clearly, the calendar application chooses to change the font size to adapt to the requirement of old people under different visual conditions in the design.

When designing the function, the calendar has a full consideration about the different requirements of the two kinds of the elderly, so that it is designed to have enlarged and reduced font types to meet their requirements.

The calendar application is based on the viewpoint of simplified operation, so that it won’t use several font sizes. Instead we chose just three simple font sizes, so that old users can easily choose the models which they need.

- Large size is designed for the elderly who are poor eyesight. By enlarging font size, they can see the screen clearly without wearing glasses.

- Medium size is the normal size, it conforms to the requirements for the using of most of the elderly.

- Small size is designed for the good eyesight elderly users. The font change to narrowed, so that the application is able to display more information on the screen, it will improve the reading efficiency, and reduce the time of looking at the screen.

```java
public boolean onOptionsItemSelected(MenuItem item) {
    int id = item.getItemId();
    speak(item.getTitle().toString());
    switch (id) {
        case R.id.action_add:
            showTimerDialog(0);
            return true;
        case R.id.action_size:
            String title = "Font size";
            String[] items = new String[]{
                "Small", "Normal", "Large"
            };
            break;
    }
    return false;
}
```

About the font size setting, calendar application adopted 18,22,30 three size to respectively corresponding to the three kinds of specifications, the choice of the three types is through some surveys and an eye doctor's advice. Through these three size,
the function can make the most of old people use a calendar easily according to their own requirements.

```java
DialogInterface.OnClickListener clickListener = new DialogInterface.OnClickListener() {
    @Override
    public void onClick(DialogInterface dialog, int which) {

        switch (which) {
        case 0:
            mCurFontSize = 18;
            speak("set current font size small");
            break;
        case 1:
            mCurFontSize = 22;
            speak("set current font size normal");
            break;
        case 2:
            mCurFontSize = 30;
            speak("set current font size large");
            break;
        }

    }

    The resulting effect of this part is presented in Figure 4.2:

    Theses figures present the different effects with different font sizes.
```
Figure 4.2  a) The interface of select font size; b) The effect of large size; c) The effect of small size; d) The effect of normal size.

4.3 The sharing function

Schedule management is putting the daily affairs in the date, and making effective records. It will provide convenient for daily affairs management. The most important
function of schedule management is recording, reminding, and sharing the users’ agenda with others. For older people, because of their own characteristics, such as memory loss, not good at complex operation and so on. The accurate, timely warnings and easy operation are the lowest demand for schedule management functions. At the same time, when the elderly users use the schedule management function, they often need to tell their family or caretakers about their schedule. For this requirement, the calendar application need the function of sharing schedule, so that there is no need to share the schedule through the message, email, etc. it becomes simple and efficient.

The current schedule management is mainly concerned with web services, PC client, mobile client. The sharing schedule of calendar application implements the sharing between the PC client (oldbird 2.0) and the mobile client (calendar system), the mobile phones client and the mobile phone client.

4.3.1 Data information table

Before the sharing schedule, the calendar application must make sure what need to be shared at first. At first, people need to know the four major factor: what, when, where and who, and the time factor should include when to start and when to end. So the calendar has determine the Starttime, Endtime, Location, Name, Action and Calendartime(date). Through these elements, the users will know when to go to where to do what things with who, but some people need the reminder services, so we set the Remindtime to implement the services. For the system, there also need an ID to distinguish each schedule. Eventually we determine the containing element is as follows:

<table>
<thead>
<tr>
<th>Type</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strs[0]</td>
<td>ID</td>
</tr>
<tr>
<td>Strs[1]</td>
<td>Starttime</td>
</tr>
<tr>
<td>Strs[2]</td>
<td>Endtime</td>
</tr>
<tr>
<td>Strs[3]</td>
<td>Calendartime</td>
</tr>
<tr>
<td>Strs[4]</td>
<td>Location</td>
</tr>
<tr>
<td>Strs[5]</td>
<td>Name</td>
</tr>
<tr>
<td>Strs[6]</td>
<td>Action</td>
</tr>
<tr>
<td>Strs[7]</td>
<td>Remindtime</td>
</tr>
</tbody>
</table>

4.3.2 The Algorithm of sharing schedule

The sharing schedule method is to send POST data.

In Android, the system provides the standard Java interface HttpURLConnection and Apache interface HttpClient, to support HTTP programming client.
In the process of sharing schedule, it need the following three parts: the server side, sending POST, and manage the response result (Primpap, 2010).

The first part, the server side. Calendar system and oldbird 2.0 systems use the same webserver to realize data exchange. First determine the webserver.

RL = "http://obdb.esy.es/db.php"
hash = "zbh564s4anyxd"

In the webserver, the code used to realize the function as follows:

```plaintext
// Gets all data
ob_hash:zbh564s4anyxd ob_function:GetAll

// Gets all the events for one person
ob_hash:zbh564s4anyxd ob_function:GetEventForBird
ob_param1:personname

// From left to right: start_time, end_time, date, location, person, activity, reminder. Separate with spaces.
ob_hash:zbh564s4anyxd ob_function:PutEvent ob_param1:"00:01:00 00:02:00 2015-02-25 testlocmarjatta trafficking 10"

// Changes a field with a value, according to the id in database
ob_hash:zbh564s4anyxd ob_function:ChangeEvent ob_param1:personID ob_param2:field ob_param3:value
```

The second part is sending a POST request to the server, through the discussion with Teemu Jäskeläinen, we decided to use the method as follow:

- Encapsulated schedule information into request body, this is by calling `getRequestData()` method.
- Set The parameters of `HttpURLConnection`, and then use the `HttpURLConnection.GetOutputStream()` method to get the output stream `outputStream`, reuse `outputStream`. `Write()` method for sending the request body content to the server.
- Judged the Server response code, through `HttpURLConnection.GetInputStream()` method to get the server's response input stream, and then call `dealResponseResult()` method to manage the server's response.

The last part, manage the response result, the most important of this part is to accept messages from Oldbird 2.0 system schedule.

The resulting effect of this part is presented in Figure 4.3 and 4.4:
From the Figure 4.3, we can see the process of setting up the schedule. After choosing the start time and end time, the users can set up the detail information. The remind time means how many minutes the user need to be reminded before the events. After all steps, the user should choose whether to share.
The Figure 4.4 shows the events from oldbird system, we can see the basic information in the front page.

4.4 The voice input and output for the calendar application

In order to provide better interaction experience, after selection size, the system will be carried out in the voice prompt. The voice prompt can inform the choice of size, so that the elderly users who even cannot see the normal size also can choose the larger size.

Liberating or freeing the hands is the purpose of this function. Considering the vision of old people is worse than the vision when they were young, we design the function of speech output, this function can make the elderly be able to easily use the calendar application even they could not see large size front. At the same time also can make the users who don't want to read the text, choose another interaction patterns.

The voice input function. The voice can be converted into a text. This feature allows the user to edit the schedule without manual input text. As stated above, a lot of old people began to appear the high-tech anxiety with the growth of their age. So that they became more and more easily to make mistakes when they use the smart phone. Through speech input, the calendar system can simplify the complexity of the type operation, it will improve the efficiency and the user experience for elderly users.

In order to facilitate elderly users to learn how to use the voice function, the calendar system sets the voice speech function to automatically play. It means if the users open the schedule, the system will speech the information of schedule. The usage of voice input function is similar with normal usage, holding down the voice button to input text.

4.4.1 The implementation of voice input and output

This calendar application adopts text-to-speak provided by the Android classes to achieve voice input and output functionality. First, we need to know the TTS class supports only six languages: US English, Canada French, German, Japanese, Italian and Chinese. respectively (Android - Text To Speech Tutorial, n.d.).

So at first before using TTS to input, the calendar application should determine whether the languages is one of six languages.

```java
public void onInit(int status) {
    if (status == TextToSpeech.SUCCESS) {
        int result = textToSpeech.setLanguage(Locale.US);
        if (result == TextToSpeech.LANG_MISSING_DATA ||
            result == TextToSpeech.LANG_NOT_SUPPORTED) {
            Log.e("error", "This Language is not supported");
        } else {
```

Log.e("success", "success");
}

else
Log.e("error", "Initialization Failed!");
}
});

In order to support such a large amount of data, the TTS engine uses the preloading method for resource optimization, extracting the corresponding resources from library through a series of parameters information, and loading into the current system.

In the following code uses two functions class of TTS:

• shutdown()

This method releases the resources used by the TextToSpeech engine.

• stop()

This method stop the speak

    public String getDateString(Date date){
        calendar.setTime(date);
        String m = calendar.getDisplayName(Calendar.DAY_OF_WEEK, Calendar.LONG, Locale.getDefault());
        return format.format(date) + " " + m;
    }

    @Override
    protected void onDestroy() {  
        super.onDestroy();
        if (textToSpeech != null) {
            textToSpeech.stop();
            textToSpeech.shutdown();
            textToSpeech = null;
        }
    }

To make the voice output function can be used to cover the entire process, the calendar application uses a lot of speak() in the source code. The following list is only a representative of the core code, its main function is to achieve the voice output of each element of the schedule, such like name, action, location, etc..
```java
public boolean onCreateOptionsMenu(Menu menu) {
    getMenuInflater().inflate(R.menu.menu_main, menu);
    return true;
}

public void speak(String text) {
    if (TextUtils.isEmpty(text)) return;
    textToSpeech.speak(text, TextToSpeech.QUEUE_FLUSH, null);
}

private void sendPostPutEvent() {
    SendPostPutEventAsyncTask sendPostPutEventAsyncTask =
    new SendPostPutEventAsyncTask();
    StringBuffer strBufer = new StringBuffer();
    strBufer.append(mStratTime).append(" ")
        .append(mEndTime).append(" ")
        .append(mCurTime).append(" ")
        .append(mLocation).append(" ")
        .append(mPerson).append(" ")
        .append(mAction).append(" ")
        .append(mRemindTime);
    Log.e("MainActivity", "sendPostPutEventstrBufer is " + strBufer.toString());
    speak("start time:"+mStratTime+" end time:"+mEndTime+" location:"+mLocation+" person:"+mPerson+" action:"+mAction+" remind time:" +mRemindTime);
    sendPostPutEventAsyncTask.execute("zbh564s4antyxd", "PutEvent", strBufer.toString());
}

This code embodies the implementation process of TTS in the calendar application.
```
5. The validation of the calendar application

After completing calendar application development, we choose to use calendar system in different scenarios to research its usage in these situations, so as to analyze current version of the calendar program can provide what kind of effective help for the elderly, and what needs to be improved.

5.1 The Bustrip scenario

This is a travel for old people, the elderly people will take a bus to travel. In the trip, they will visit a church, have a lunch, hold a party and so on. The scenarios can be divided into eight parts, according to the time sequence as follows:

- Starting the trip: Bus come to the first prescribed destination, and then the elderly get on the bus, and check the list. Then bus drives to the next prescribed destination, other old people who have been waiting there get on the car, and check list, and then the trip start.

- On the trip: in the process, event organizers do two jobs, one is telling the timetable and matters needing attention to the elderly passengers. The second thing is collecting the travel fee.

- Church: This is the first destination, here, the elderly tourists get off and walk to church, in the church they can hear related introduction, then visit the church. Return to the bus after the visit.

- Eating: Organizers lead the elderly tourists go to a restaurant. At first organizers introduce the restaurant, and take the charge of meals. Then organizers lead the tourists to the restaurant, after the meal, they give the tourists some free time, the older travelers can take advantage of these time to use toilets and visit around. Finally returned to the bus.

- On the trip and sightseeing: Organizers lead old tourists appreciate the scenery along the way, and introduce corresponding history to the visitors, etc.

- Old rectory: The same as the visit of church, the organizers will inform considerations, and the appointed time of returning to the bus. When the elderly people enter the old rectory, first of all, there will be a presentation to tell people the history of the place. At the end of the presentation, people will sing together and chat with each other, then it is free time, people can chat or visit the old rectory according to their own ideas. At the appointed time, return to the bus.

- Navettakahvila (coffee house): it is the same as the two places before, still inform considerations, the appointed time for return, and make a presentation, however, the difference is that visitors can drink coffee here to have a rest and buy some presents to give relatives.
5.2 The Oldbird scenario

Oldbird usage scenario is relatively simple. In this scenario, the Oldbird system developer play the role of a caretaker in the system. He provide the guide service for the calendar user. The sharing schedule function of calendar application is designed to effectively exchange the data with oldbird system, thus providing better service for the elderly users.

In this scenario, the scenario is set as an old person is going to go shopping. First through the mobile terminal, the elderly users create a schedule about going shopping, and share this schedule. After the schedule be shared, the caretaker who uses the oldbird system can get the schedule. When caretakers know the elderly’s plan, they can remind the elderly before the schedule time.

When the elderly people are ready to go to the mall, caretakers can help them choose suitable travel route by the oldbird system, and also can direct the way for elderly through the calendar system.

When older people arrive at the mall, they can go shopping by themselves. At this time if there is an emergency, elderly users may contact caretakers through instant messaging of the calendar system at any time.

At the appointed time, caretakers remind the elderly people to go back home, at the same time provide the guide service.

5.3 Analysing the scenarios to improve the calendar application

After the above scenario description and practical experience, I have found many functions to improve the calendar application, such like the personal information documents, voice control, GPS, etc.. At first I analyzed and discussed the bustrip scenario.

In the first scenario, the starting of the trip, the calendar program can be applied to provide old users with reminders service, the information of schedule such as location, time, and so on. The program can remind the elders not to miss the appointment time and not to forget the prescribed destination.

In the second scenario, the calendar system provides a lot of help. When organizers say that the schedule and the matters need attentions, they often need to announce it loudly, however there is not any guarantee that every one can hear them. Using the sharing schedule function, they can send the schedule, notice to every user's phone. It
can also make every old person be able to query information at any time without forcing people to announce loudly.

When the users visit the church, the reminder service of calendar application can also be helpful. Organizers need to make an appointment time with visitors for back to the bus after visiting. However, considering the characteristics of the elderly people’s memory, some old people forget possibly the agreed time. The organizers can set a schedule as remind service in advance, so that the application remind the elders to return to the bus within the prescribed time.

In dining situations, the use of calendar system is similar to the case visiting the church, mainly is to remind the elder tourist the time to return to the bus.

For sightseeing along the way, there is no requirement for the calendar system.

The process of the second and the third sightseeing spots are roughly the same as the first one. The use of the calendar system is still the reminder function. But in these two scenarios, the elder users need to chat. So in the calendar system, we can provide a way of communication for elder users through connecting to other instant messaging applications, so that they can communicate more easily.

In the final scene, the tourists ended the whole trip. They need to return to their home. In order to make the elders return home with more convenience and safe, the bus driver will stop at lots of sites along the road. What are the specific sites, the bus driver can inform all the tourists by sharing function. At the same time, the elders can also share schedules to inform the caretaker when they reach the prescribed destination.

Then according to the actual situation, I think the calendar can add a file system for each other, its aim is to build an introduction for each user. Other users can have a general impression to the user, so as to improve the efficiency of communication. The file system can be thought as an introduction, it includes name, age, gender, birthday, hobby, life experience and introduce yourself, and so on. These information is the public information. As a calendar system, we can also add schedule to the personal information, so that the users can open their schedule information to the specified user. What we need to pay attention to is that the elders information file is unlike Facebook and other social software. The main purpose is to make a brief introduction to the user, so that it doesn’t have abundant functions as social software. The main reason is that social software function is too rich. It will increase the complexity of the using software. In software design, it does not mean the more features is the better. On the contrary, for the characteristics of the elderly, the function of the software should be on the basis of concise and practical. If there are too many functions in the same software, the elderly user will be very difficult to learn how to use, thus reduce the user experience.
By the introduction of information file, I could add related important information in the file information, such as home address, social security number, phone number and other commonly used information. If old people forget these information, they can also get tips by querying the information files; another extension function is emergency medical records; information file will include, blood type, disease, medication, disease history, physical characteristics, first aid, etc. So if there's an emergency, such as seizures, elderly users can show disease file to obtain the effective treatment.

The function of the calendar application should be improved under the oldbird scenario. In the oldbird scenario, the main interaction of the calendar application and the oldbird system is that sharing the schedule with each other, thus providing need services. In the use of oldbird, we used oldbird system to simulate an old man went to shopping scene. Through the map interface, I found the old men usually need the positioning service. As an application has close relationship with oldbird system, I think the GPS function should be the main direction of future development.

GPS: in the oldbird scenario, GPS positioning function provides oldbird system users with the real-time location of the elders, it can make the caretaker accurate provide the fastest service and the most optimal path for the elders. In the reality, the GPS function can not only provide the direction service, but also prevent the elders’ lost. What’s more, in the emergent cases, it can provide accurate location information for the relevant people.

Through GPS positioning service, we can make the two calendar users able to know the distance between each other. Another function is the reminder service. We can set up a marker on the map, when close to the mark, to remind users. For example, elders can mark their home. When the bus is close to the default address, the calendar will remind the user home.

There are two other functions. They can be used not only in the above two scenarios, but also in most cases with high frequency. They are voice control and instant messaging.

Voice control: the calendar application has realized the basic function of voice control, voice input and voice output. The two functions have been introduced. The future of voice control function should be intelligent. Nowadays, Apple's Siri can serve as a reference example. But, as a software design according to the elders, intelligent voice services should also be fully considering the characteristic of the elders, such as slurred speech, hearing loss and other factors, as well as improving the recognition accuracy. It should also use big data technologies to provide more accurate services to the elders. For example, when the old man said he wanted a meal, the intelligent voices should provide the restaurant is more accord with the characteristics of the old habits.
Instant messaging: in the current version of the calendar systems, instant messaging functions are realized by connecting to other communication software, this situation is based on two reasons: the first reason is that the server is not yet developed. As a result, server-side corresponding function cannot be achieved. The second reason is that the application is a demo, with the considering that IM is not a necessary function. But it’s very useful to improve the user experience. So the application has taken to borrow external programs. In the development of the future, I suggest that when the development of server-side is completed, we should develop its own instant messaging for calendar.
6. Result and discussion

Calendar application’s recording feature is very useful for elderly whose memory continue to decline, however, limited by the factor of the elderly’s learning ability, lifestyle and so on, the elderly often encounter difficulties during use, which reduces the effects of using calendar program to help the life of the old people. Therefore the purpose of this project is to design one calendar application which is convenient for the elderly for use and can provide elderly with better user experience.

As mentioned above, the action research has two iteration. The second iteration is from the "observe and analysis action" part. In the process of observation we found that the elderly users often can not accurately operate their own mobile phones, and many elderly people often find it difficult to see the screen information clearly. For these cases we carried out a second research action.

The second iteration is similar with the first one. We also design a scenario. It is about bus trip. This scenario has been described in above chapter. By observing and analyzing this scenario, we study the physiological characteristics and behavior habits of the elderly from the other point of view, and put forward the relevant solutions according to the results of the study.

1) Changing the font size make the elderly users see the font more easily.

2) Using the voice function, such like voice input and output, make the elderly users free their hands. It’s also a good way to simplify operation and provide better user experiences.

6.1 Limitation of the calendar project

As mentioned above, this article shows the program design and implementation process of calendar application according to the characteristics of the elderly people. Although this application is a demo, its significance provides design ideas and solutions for the characteristic of the old people. However, in the design and implementation stage, limited personal ability, this demo has still lots of deficiencies.

First of all, from the general design, although we have taken PD pattern, but there is a significant problem in the whole development process is that small sample size. In fact, in the design process, the users only include some of group members and my grandmother, so that although we have improved the design constantly during the whole process, but there are still some omissions, some of which also affect the subsequent design.

Secondly, from the functional perspective, there is a great omission which the system didn’t design the account model. In the original design, because of we only
considered the PC client and the smartphone, so we haven’t design the user ID, password and other parts which are related account properties, this led directly to cannot establish user information documents.

Another obvious deficiency is that the UI need to implement better colour and layout designs for the elderly in the future as the current ones where not satisfactory to all users. It is limited to personal aesthetic ability and design quality so that hard to improvement, but the UI design is related to the realization of certain ideas, this will be in the details below.

Above are the main deficiencies in the process of development.

### 6.2 The future of the research of the elderly software

Although this is a demo of the calendar application, but the design of the application provides three directions for the elderly software: identification, interaction patterns, simplification of the operation.

Identification method: in this project, the calendar is to change the font size. Its principle is by changing the font size, enable the elderly to read more clearly. I think of other ways to improve the efficiency of cognitive, it is the color identification, in the process of the operation, the old people do not need to be able to clearly see every word, they only need to distinguish the colors, each function has its own color, such as sharing schedule is yellow, the emergency call is black. This feature with voice input-output function can greatly reduce operating time, and make the elderly still can use when they cannot see clearly. Now the faced problem is the UI design, how to use the color reasonable, how to make it comfortable to use and easy to distinguish, how to make it easy to remember.

There is also some special situation need to be considered. For example, the color blindness, so we’d better avoid using red and green. In fact, the ISO/IEO(2014) has pointed: " The best colour combinations depend on the purpose of information, whether it is for guidance or a hazard warning, and the lighting conditions under which it is most likely to be viewed. For example, black on yellow or light grey are general purpose combinations which provide strong definition without too much glare, pastel shades on pastel backgrounds or red lettering or symbols on light grey are difficult to see and should normally be avoided. "

All of these problems mean the UI need to be improved, if there is a set of reasonable design, so the color design could become the new colour combinations for elderly software design.

Interaction patterns: depends on the TTS class, the development has achieved voice input and output, so as stated above, the voice control is the next research problem. The existing technology already has a lot of a mature voice control platform, such as
Apple's Siri, Baidu voice, etc. The Android system has natural advantages because it can directly use Google voice service. However, I think, in order to provide better services to the elderly, the system should develop a voice server for the elderly in the future development which is designed by elderly characteristics. So it can solve the problem of some physiological special in the elderly, such as slurred speech.

Simplified operation: based on the key technology of big data. If we don't just stand on the calendar application point of view, but standing on the perspective of the smartphone, we will find that it has a very significant difference between the old and the young. The elderly is difficult to deal with complex mobile phone operation. For smartphones, people in the use of smartphone, often use a number of applications. For young people, frequent switch of each application is an easy thing, but for many older people that's more complex operations. So in the future, the programs should solve the problem: how to use the technology of big data screening to help old people choose the function what they want to use, and these programs can be a link in a calendar program, for example, sharing the agenda will provide instant messaging app links.
7. Conclusion

The elders’ market has a rapid development and great market potential, and mobile application development is also the hot spot of research and development area. This thesis introduces the design and implementation of the elders’ calendar application. Through the application, I hope to provide reference and inspiration for the software design of the elderly software.

In this paper, the first chapter firstly introduces the aging of the population, as well as the present situation of the application software for the elderly. Then the chapter elaborated the research meaning and purpose in the project. Finally it presented the structure of this paper.

The first part of the second chapter describes the present situation and the trend of population aging, and introduces situation of the elderly service resources. The second part is the summary of the Android system, includes the architecture of Android system and the four components of the Android system.

The third chapter and the fourth chapter are the analysis, design and implementation of the elderly calendar application. First of all, the requirement description analyzes the characteristics of elders from the physiological and psychological point. It concludes the detailed requirements for the elderly calendar application. Then according to the result of requirement analysis, with the using of PD design patterns, the general design provides a software design based on the characteristics of elderly. Finally at the implementation stage, the fourth chapter uses some core code to explain how to realize the design purpose.

Chapter 5 is for scenario simulation. This chapter analyzed the effect of the calendar application through different scenarios. And according to the calendar system usage in these situations, the chapter provides the analysis and design of the functional requirements and changes in the future through the experience.

Chapter 6 is discussion part. In this chapter, the thesis introduces the research method of this project. Action research is the mainly method, it provides a lot of useful information for improving calendar application. This chapter also discusses the limitation and further work of this project. There are some design mistakes such like account information, so that some additional function which will be used in the future cannot be implemented.

The software for elderly users is much different from traditional software. The software for elderly should not only consider about the physiological characteristics, but also need to think about the elderly usually need more communication with other people. As this project, the calendar application can contact with many other devices, this function can provide timely service for elderly users. In addition to this, the
software also need to design some interaction model for elderly people, such like color control, it will be useful for elderly users to use application, and improve their smart lives.
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