

# Mobile application design of healthcare for the elderly

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**Abstract-** The purpose of this paper is to propose a healthcare mobile service platform for the elderly based on their healthcare characteristics and conditions, and to design a mobile application that can implement the proposed model. The application provides the elderly with dietary prescriptions customized for their health conditions and also allows them to receive medical feedback from doctors. Moreover, the user interface was designed based on consideration for their declining cognitive ability with deteriorating vision and their limited ability to understand complex instructional procedures. With the current trend of increase in number of patients with chronic illness, the mobile service model and the application proposed in this paper is expected to provide better healthcare services for the elderly who are in need of healthcare services.

**Keywords-** elderly, mobile health, healthcare, platform service

## 1. Introduction

One of the more important social issues in major developed countries of the world today is the phenomenon of population aging [1]. Population aging greatly affects a wide range of social issues, including public health, economy, welfare, culture [2], etc. The situation is true for the United States and Europe, and Korea is not an exception. The chronic illnesses of the elderly not only limit their physical activities but also accompany both mental and physical pain, thus becoming a major reason for drastic decline in quality of life [3]. In addition, an increase in healthcare costs increases the financial burden to both individual citizens and the society as a whole [4]. Therefore, a person should start making preparations for healthcare in old age before entering old age. For example, regular health checkups, diet management and continuous exercises greatly help to prevent and cure chronic illnesses with high disease incidence [5]. In particular, statistics show that the key to a long life of 100 years or longer rests on maintaining disciplined dietary habits, placing a critical importance to dietary prescriptions and management in terms of maintaining good health [6][7]

With recent developments of mobile health services that apply IT technology to healthcare management, along with research and development for customized services in healthcare management, dietary prescription and exercise management are rapidly expanding [7]. However, most services today are generic mobile-based healthcare management solutions targeted at middle-aged people; services customized for the elderly with chronic illness are lacking.

With the mobile device market saturated, companies are trying to stay profitable by either engaging in price

competition or exploring an untapped market [5]. They see the children and the elderly as an untapped segment in the market in which mobile device services have not yet penetrated. Therefore, it is expected that there will be various applications developed for and introduced to this market segment. Likewise, mobile healthcare platform service model for the so-called silver generation that focuses on the elderly seems quite promising [8].

The purpose of this paper is to propose a mobile platform service model for the silver generation based on their health characteristics and conditions and design a mobile application accordingly. The most important part of mobile service design is analyzing and deriving UI/UX optimized for the age characteristics and creating an input/output interface that reflects them. The idea is to develop an enhanced interface format and menu design with high readability by taking into account the limited ability of the elderly to use mobile devices and understand complex instructional procedures, along with their declining cognitive ability resulting from deteriorating vision. The proposed model should allow them to regularly monitor their health conditions and disease status, based on which dietary prescriptions can also be produced. In addition, the model should offer a regular cyber health checkup to enable constant healthcare monitoring.

Finally, the mobile application was designed using the hybrid-app method based on PhoneGap framework so that the application can run on various mobile platforms including iPhones and Android phones [9].

## 2. Related works

### 2.1. Mobile healthcare service

Mobile healthcare services refers not only to services that use mobile devices to monitor or search healthcare information but general services that use mobile devices to facilitate communication between doctors and patients [10]. In some mobile applications where patients manage their own health records, the medical device automatically transmits the measured health records to mobile devices [10]. However, in most cases, patients directly input their healthcare data via Q&A format. Samsung Electronics recently developed and rolled out SAMI, a cloud service platform for healthcare service [11]. Apple and Google have also introduced their versions, Healthkit and Googlefit [12][13]. These companies are trying to provide mobile and web-based healthcare services to general populace.

However, most services are designed for people who are familiar with using mobile devices and therefore are generally not suitable for the silver generation, who are generally not comfortable with using mobile devices. Moreover, with development in customization technology

that provides services specifically customized for individual user characteristics and taste, it is becoming increasingly more difficult for the silver generation to use existing mobile applications as they are.

In particular, healthcare service tends to play a more important role in old age. It is because the elderly need more diverse healthcare services thanks to physical changes such as aging, declining ability in tasting and smelling, disorder in digestive and metabolic activities, decline in body function due to chronic illness, ignorance about balanced diet, decline in appetite due to use of medical drugs, disorder in digestive function, social alienation, etc [14]

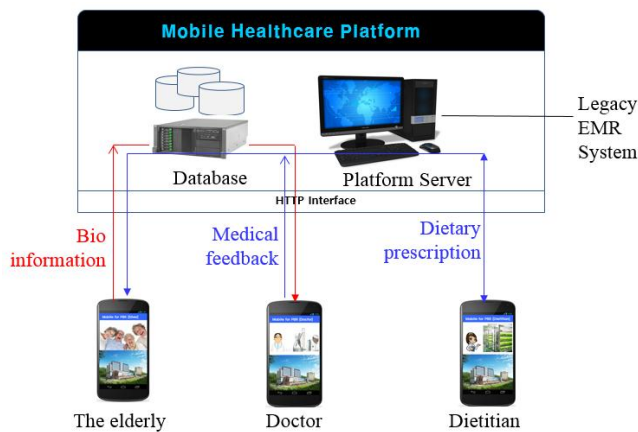


Fig 1. Mobile healthcare service

Therefore, a mobile healthcare service for the silver generation as shown in Figure 1 above is proposed [14]. When user inputs his own bio-information into a mobile device, the doctor checks the information, writes a note on the patient's health condition and transmits the data to the dietitian and the user. Then, the dietitian produces an appropriate dietary prescription and recipes based on the information received. In this process, there is a need to create a mobile environment and services that are easy and convenient for elderly user to use.

**2.2. Requirements of mobile user interface for the elderly**

For the silver generation to easily understand mobile device functions, the size of the letters and the shape of the pictures in the interface are crucial. Therefore, it is necessary to use intuitive icons in the interface that anyone can understand without going through learning process. Also, the letters should have a big size font. Moreover, since the elderly often have a poor ability to distinguish colors and often cannot distinguish colors in the same group, use of high-contrast colors is recommended. The elderly also have a declining vision and gradually loses ability to focus on an object at near distance. An average elderly person aged 60 years old can only take in 1/3 of light they used to in their 20s. Therefore, they tend to like bright colors. Therefore, use of bright colors and the font with high readability is recommended in designing the interface. The suitable font size is from 20pt to 25pt. For readability, less than 10 characters should be used per line [14].

The process of finding a menu option should not be complicated. Therefore, it should take no more than 3 steps to find a menu option and intuitive descriptions such as pictures and graphs should be used. Also, a grid system should be used so that the contents can be aligned. In addition, a flat design reflecting extensibility, usability and the trend in UI design should be used.

**2.3. Requirements of mobile application function for the elderly**

First, the basic features of the application should include, as shown in Table 1 below, a subscription function, sign-in/sign-out function, and user authentication function to update account information [14]. Second, it is necessary to have a function where the user can measure and input his bio-information every day at a specified time of the day. In general, there are two methods: a method that links to a medical device and a method that inputs measured data via Q&A format. In this paper, a method that receives input via Q&A form and transmits the data to the platform server will be used.

Table 1. Use cases for healthcare

use cases	description
Subscription	subscribe health service for the elderly
Sign in / sign out	sign in the service or sign out
Update account	update of an account information
Bio information	entering and transfer glucose, weight, blood pressure querying my bio information from the platform
Medical feedback	inquiry daily medical notes from doctor enable or disable healthy alarm from the doctor
Dietary prescription	inquiry weekly and daily dietary table enable or disable daily push service from the platform
Settings	account configuration service configuration network configuration

The application has a medical feedback function that allows user to query medical notes from doctors and an alarm function that alerts user if health problems are discovered. Moreover, it has dietary prescription function that recommends appropriate diet program based on user's disease and health condition. Such functions are implemented in the application according to UI/UX guideline customized for the elderly.

**3. Design of the mobile application for the elderly**

**3.1. Use case and sequence diagrams for the application**

In designing a mobile application for the elderly, the use case diagram contains 4 actors and 6 use cases as shown in Figure 2. First, user must subscribe to the service to obtain user rights. If the platform server approves the subscription request, the user can use 4 services. Also, the user must sign in to query medical feedback. In addition, in Figure 2, the user can read medical feedback from the doctor and the

dietitian can also read the feedback to create a dietary prescription, which is provided to the user.

The mobile application proposed in this paper is installed by downloading it from the Play Store of the App Store. The platform server must first approve the subscription request.

Figure 3 illustrates the subscription request approval process. When the user sends a subscription request via the subscription guide window, the subscription request is sent to the platform server via the server interface. The user input his name and date of birth on the mobile device while the telephone number is obtained from the mobile device API. The user data is then sent to the platform server, which receives and approves the request and data. Finally, it returns the results to inform the user. If the request is not processed normally, such as an unsubscribed user, it returns an error code.

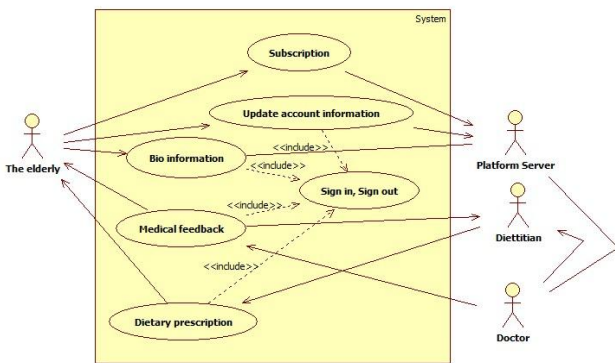


Fig 2. Use case diagram of the mobile application for the elderly

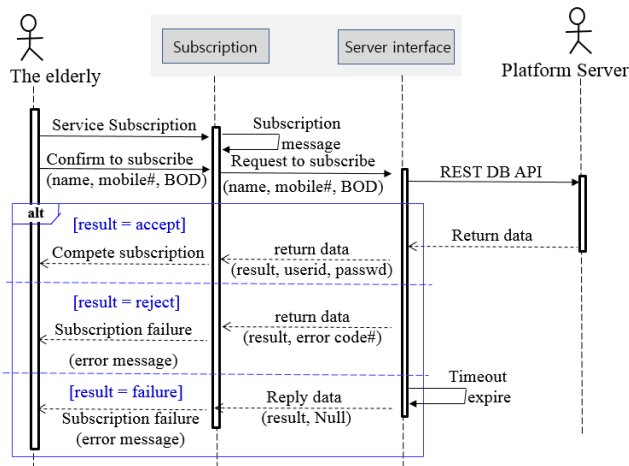


Fig 3. Sequence diagram of the subscription

Bio-information is a function that transmits health information measured by the user to the platform server via mobile application. In Figure 4, the application accepts input and sends the user's blood pressure, blood sugar and weight information to the platform server.

The doctor can regularly check a user's bio-information and may write a medical note to convey health information the user must know or to provide healthcare instructions. When the medical note is recorded and transmitted, it should be immediately delivered to the user. In

Figure 5, there is a function that allows the user to query their doctor's medical notes. The user must pick a date for the medical note to access its contents. The application retrieves the medical note from the platform server for the date chosen. The medical note is also made available to the dietitian so that she can provide dietary prescriptions depending on the user's health conditions

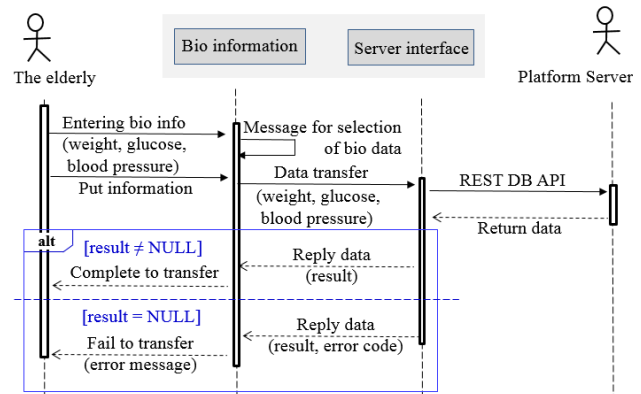


Fig 4. Sequence diagram of entering bio information

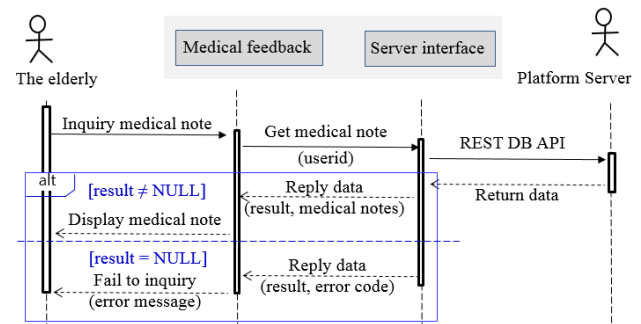


Fig 5. Sequence diagram of the medical feedback

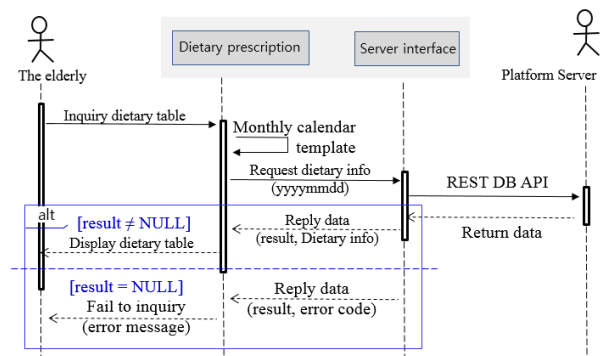


Figure 6. Sequence diagram of dietary prescription

The user can query dietary prescriptions. A date (in yyymmdd format) must be selected to query dietary prescription information, as shown in Figure 6. When the application requests a dietary prescription for the selected date to the platform sever, it is displayed in the screen unless the result is NULL. If the result is NULL, it is because either the wrong date was selected or the dietary prescription was not created, in which case a suitable message is displayed.

The most important part of the mobile application proposed in this paper is UI/UX interface. Designing an appropriate input/output environment for the elderly determines the effectiveness of the services provided. User interface based on such consideration is defined as follows.

### 3.2. UI/UX design

As shown in Figure 7 (b), user interface is defined in terms of bio-information, medical feedback, dietary prescription and settings. The initial screen (a) is an interface that provides a sign-in function. The design should also include a function that allows unsubscribed user to subscribe to the service. If the bio-information is selected, the user can input his weight, blood pressure and blood sugar level via a Q&A format. The design should also include a screen that allows the user to input detailed health records based on the type of bio-information.

Figure 7 (c) shows this for the case of blood pressure. It accepts SBP (systolic blood pressure) and DBP (diastolic blood pressure). Here, in case the user finds it difficult to use mobile device, the design offers Voice menu to allow the user to enter input via voice.

Figure 7 (d) shows the user querying and reading the doctor's note. The doctor should regularly monitor the user's bio-information and, should there be noteworthy conditions or a case that requires a cautionary message, they must record their opinions on the note to help user can independently manage their health.

The design must also follow Figure 7 (e) and (f). The user must be allowed to access weekly dietary prescriptions and access dietary information prescribed for morning, lunch and dinner for the specific date selected. The settings function must provide information about the server network, service access information and activating/deactivating of various alarms.

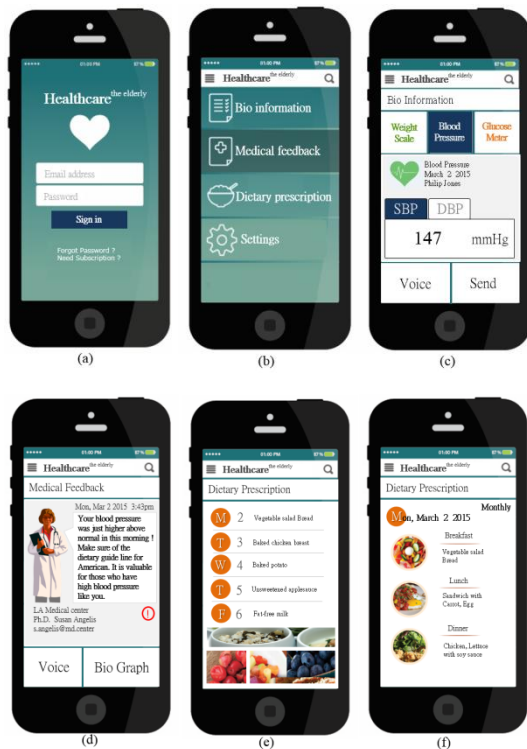


Figure 7. User interface of the mobile application

### 3.3. Database modeling

Figure 7 As shown in Figure 8, the ID, name, photo, phone number of the user and his doctor's name are define under senior table. Information about doctor and dietitian are defined under doctor and nutri table, respectively.

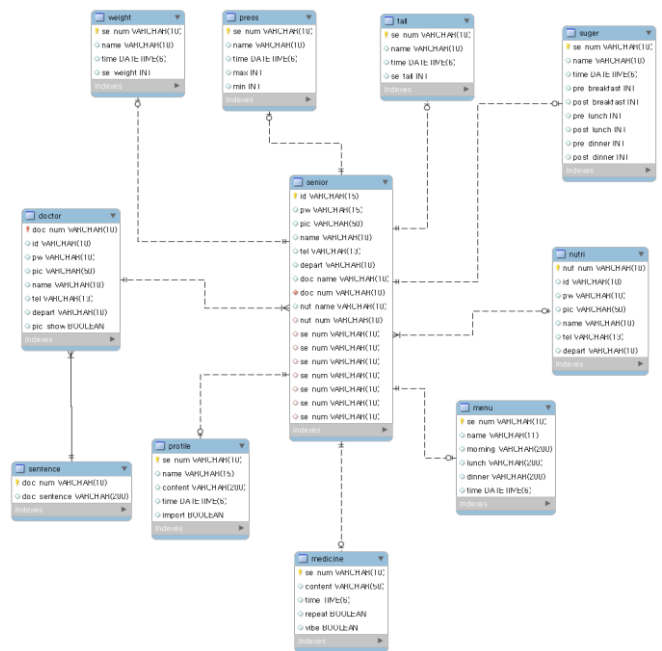


Fig 8. User interface of the mobile application

Bio-information is defined and stored under weight values, press and sugar table. Also, the doctor's medical feedback is stored under sentence table while dietary prescription information is stored under menu table.

As shown, a database is installed on the platform server and mobile applications and HTTP protocols are used to transmit data in JSON format. This way, the platform server becomes a database-linked web-based application.

## 5. Conclusions

In this paper, a mobile healthcare application system customized for the silver generation was proposed and designed, which is expected to expand the scope of increasingly popular mobile device-based healthcare management application. In particular, user convenience features were maximized to better service silver generation and the application was designed to provide a variety of convenient services such as doctor's feedback and dietary prescriptions optimized for healthcare service operation.

Given the current trend of increasing number of patients with chronic illnesses, the healthcare service for silver generation is expected to play an important role in the future. However, additional research is needed in terms of voice-based user interface technologies, which will make it even easier for the silver generation to use the services.

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