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Developing Mobile Support System for Dynamic Integrated Community-Based Screening

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Abstract. Screening evaluations can effectively detect unrecognized health problems in individuals. Current integrated community-based multiple screening manually fill out handwritten forms. The motivation of the system developed in this study is to provide a method for participants to quickly fill out community health screening questionnaire prior to participating in the screening event. This study is divided into two stages: 1. System development and design compatible with the needs of elderly users, planning and creation of system architecture based on the requirements of the community-based integrated screening questionnaire; 2. System evaluation: provide the created App to users for evaluation of user satisfaction. The system prototype design includes the use of "3+1 hierarchical grid interface design", incorporating all the questions in the community screening survey and the details on interface design takes note of the needs of elderly users, the questionnaire used is a 5-point Likert scale. Assessment results: overall score of 4.12±0.31 leaning towards "Agree" with perceived usefulness having the highest score (4.32±0.17), second being reliability (4.17 ± 0.1), followed in order by satisfaction (4.14 ± 0.0), perceived ease of use (4.07 ± 0.21), learnability (4.0 ± 0.07), and acceptance (3.79 ± 0.81). Based on these results, the participants held a positive attitude towards the system.

Keywords: community-based multiple screening, mobile health, Interface Design, Elderly user

Introduction

For many years the government has invested large amounts of resources into disease screening and prevention. Since 1999 Professor Chen Hsiu-Hsi promoted community-based cancer and chronic illness screening project in Keelung, Taiwan and successfully developed a community-based integrated multiple disease screening model. Prevention and screening of diseases are not longer done individually. The successful experience of implementing the community-based integrated screening was extended to other cities' health bureaus. Each city added new screening items as needed and the number

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of items integrated have also increased. But the contents of each individual questionnaire and the screening process have not received integration. With limited number of computer equipment at the scene of community screening, when too many people arrive at the same time, it causes congestion problems. Therefore, it is hoped that with easy to carry mobile equipment, this problem can be solved by providing community people with a mobile support system that they can use to fill out forms prior to reaching the location for screening.

Purpose: Design a dynamic elderly-oriented mobile accessory system prototype for community-based integrated screening. This provides the public with a convenient method to fill out integrated questionnaire on a mobile phone, in order to achieve rapid clearance once they arrive to the screening location. And use this prototype as reference for development of systems oriented to the needs of the elderly.

1. Literature Review

Since most of the participants in this study are over the age of 50, the detailed design of the interface should to take into account needs of elderly users. Older users have pre-established use habits based on previous related life experiences and are affected by these in addition to the degree of concentration during use and inferred tips within user interface. For the elderly who are less familiar with information technology products, the lack of experience causes them to try wrong methods and are easily lost within functional structures, thus relying greatly upon “restore” or “back” keys. In addition, they require further explanation of touch screen functions on mobile devices such as flipping through menu pages with finger swipes and zooming by sliding fingers apart or together. Elderly users are also more prone to error in handwritten input or touch selection, and easily confused by function icons in the interface(Tzu-Lo Wong, Chia-Yin Huang, Chun-Di Chen,2010). This study employs the following interface design principles for elderly users in the development of the system interface: single-hand operation of smart phone utilizing the thumb for input, enlarged font size, increased contrast between text and background, concept visualization and simplification, clear feedback system, two-tiered menu, supplemented with larger buttons, light background with dark font color, providing enough input assistance functions. The “3+1 hierarchical grid interface design” proposed by Dr. Chang and Kuo’s “monopoly” interface design principle were employed in the organization of the system’s questionnaire structure.

2. Methods

Research framework: In this study a dynamic community-based integrated screening mobile auxiliary system was created on the Android platform taking into account the needs of elderly users. Through purposive sampling users were selected and user satisfaction assessed. This system was designed for mobile equipment. Users fill out community health screening questionnaires upon smart phones and through GPRS network protocol upload the information through a webpage into the database. The system architecture is seen in Figure 1.

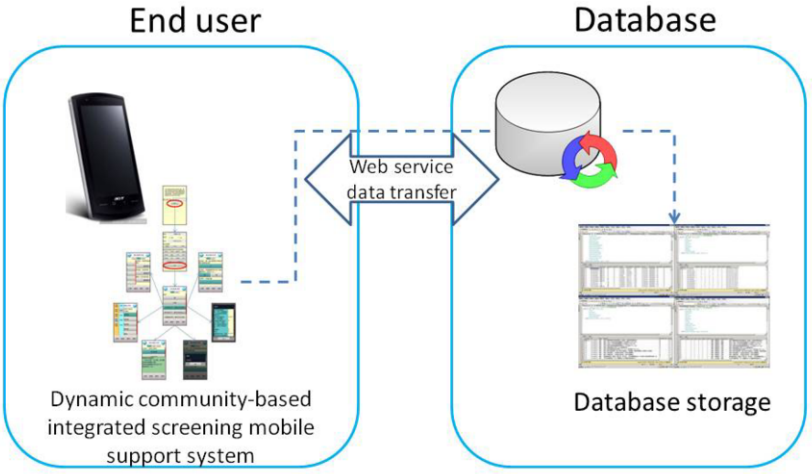

Figure 1 System architecture

System design development tool: The Android platform was selected for system development for the smart phone. The Eclipse Foundation's Eclipse 3.7.2 version, loaded with Android Java SDK version 8 extension ADT package, was used for system creation. The data is uploaded through internet into the database and is not saved in the local device. The development language is JAVA and XML. Since programs designed in the Android system cannot directly connect to remote database, a web service was created with Visual Studio C# program. The web service utilizes C# language and SQL syntax for logic processing. The information input and output from the service end is linked to the database through the web service.

System assessment: This study employs a self structured questionnaire based on Technology Acceptance model for mobile service (TAMM) structure theory proposed by Kaasinen (2008) and the questionnaire in Ming-Chuan Kuo's iBaby newborn health record system for mothers to record newborn health after discharge. The questionnaire used a 5-point Likert scale and is divided into three parts, part one is basic information. The second part contains questions on the system's perceived usefulness, perceived ease of use, learnability, reliability, acceptance and user satisfaction. The last part is overall recommendations. The participants were selected based on purposive sampling among people 50 years or older in a health promotion center in Taipei. The requirements include those over 50 years old who meet the basic requirements for all questionnaires, are able to communicate verbally, and are willing to participate in the study. User satisfaction is gathered after they have utilized the App on a real machine and completed the questionnaire.

3. Results

After design, the application can be easily operated with one hand by the user. The most commonly used functions are designed to be within sliding range of the thumb. But the layout arrangement also facilitates two-handed users. The questionnaire pages layout uses font size designed for ease of reading for the elderly. The main function

area located at the bottom of the screen contains questionnaire content information: "classification", "progress", "save", "search" as seen in Figure 2. After implementation, the system was streamlined, adopting unidirectional progress, in order of system entry to complete operation. The system function organization chart is seen in Figure 3. Different labels are used for login layer, layer A: basic information, layer B: core questionnaire, layer C: assistance tools, layer D: instructions. The different levels are numbered in order to explain the location of each layer's image in the system.

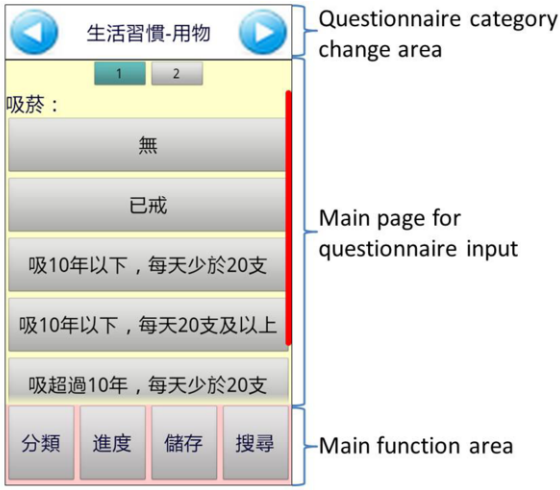

Figure 2 Page function diagram

This study includes 21valid participants. In the basic demographics of this study's survey showed that age 71 and above was the most often selected (42.85%), with a male to female ration of 38.1% : 61.9%. Educational level is mainly middle school (33.33%), and average income is below 30000 (85.7%). Nearly half of the participants have been to a community screening for more than 5 times (47.6%), with semi-annual (33.33%) and annual visits (33.33%) being most common. The most often used features in the smart phone are dialing or taking phone calls (85.7%), followed by receiving text messages (38.1%), with camera function being third (33.33%).

On the questions about perceived usefulness, perceived ease of use, learnability, reliability, acceptance and user satisfaction after use of the system, overall score was highest in perceived usefulness (4.32±0.17), second being reliability (4.17 ± 0.1), followed in order by satisfaction (4.14 ± 0.0), perceived ease of use (4.07 ± 0.21), learnability (4.0 ± 0.07), and acceptance (3.79 ± 0.81). The overall score is 4.12 ± 0.31, with most of the participants select "strongly agree" and "agree". The contents are described below. In perceived usefulness the participants found that the system can save time and help answer questions more quickly. The system's font, color and buttons are helpful in identification and input. In perceived ease of use, the users found that the system was easy to ease. For learnability, the participants believe that the system operation and function were easy to learn and master. The users found the system to be reliable as it avoids missing required fields and the questionnaire information will not lost. For acceptability, the participants think that the system is worth promotion, but

only 28.56% of the users are willing to use the program if it requires payment. In satisfaction, the participants were willing to recommend the system to friend and family and believe that system is convenient and functions as expected.

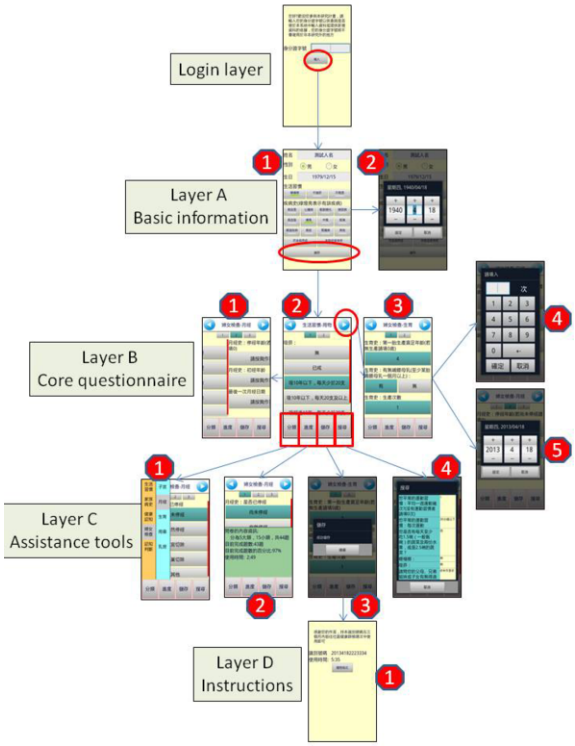

Figure 3 System architecture diagram

Based on the above results of the assessment questionnaire, it shows that the use of mobile technology in healthcare is an important need and is suitable for promotion. But the system has to be easy to use, to learn and to access.

4. Discussion

Based on the information in the questionnaire provided by the community-based integrated screening and the dynamic community-based integrated screening auxiliary mobile system has successfully employed the "3+1 hierarchical matrix design" principle which emphasizes that users only need to click twice to find the desired information, assisted with auxiliary input layer, the data has been classified and structured for a fluid transition. When compared to the computer version on differences in requirements, system structure, display of questionnaire information, the Android system on smart phones provides for mobility and does not limit time or location for use which makes it more convenient. On structural differences, the windows format can directly link with the database for reading or writing of information, while the

mobile application cannot directly connect to the database and requires referral from the Web service to complete this goal, so the mobile application is weaker in the area of confidentiality. The mobile system utilizes the "3+1 hierarchical grid interface design" principle, with the application of hidden layers and display of current location. It is specially designed with larger buttons, increased font size in layout to assist in information input so that even on a small screen smart phone it is still easy to input.

System assessment results show that most participants leaned towards "Fair", "Agree" and "strongly agree", with a total score of 4.12 ± 0.31. The lowest score was 2.86 for the statement "If a fee is charged for this application, I will still like to use it." This result is similar to previous research, when inquired about the willingness to use a paid program without a specified price, the users tend to disagree with paying for the service. In order of average scores the most satisfactory statements were: "The use of smart phone for input of health assessment is worth promoting", "When compared to the paper format, this method allows me to freely schedule a time to complete the questionnaire", "I feel this system can effectively select the more relevant questions for me", "I feel this system can save time and answer the questionnaire quicker", "I feel it is important that there this tool can be used anywhere", and "I think the font, color and buttons in this system are helpful in identification and input". Participants did not offer suggestions for improvement showing that this system has good usability and acceptance. The users have expectations of this system and it is worth promoting in community-based integrated screening.

5. Conclusion

The concept and system implementation proposed in this study provides an extension to the community-based integrated screening program, allowing for the services to begin outside of the actual screening location. In combination with the mobility and convenience of smart phones, the service provided meets user expectations. Currently the system does not provided encryption for information transfer, but security is an important issue, and it is hoped that future research will provide further confidentiality in information transfer to improve the information security and protect participant privacy in dynamic integrated community-based screening. For future application, population health information collected from a health promotion center through the use of this system can be utilized through data analysis to understand the habits, disease perception and believes, exercise history of the people living near the health promotion center. And with it further strengthen the implementation of health promotion policies or adjust the direction of health education, so that the concept of disease prevention in public health can have more concrete representative data and promote public health policies with better focus.

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