

Personalized Mobile Digital Memory Book Application for Alzheimer's Disease Patient Single Person-Centered Approach

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Abstract: The use of assistive technology with intervention of mobile technology to support the treatment of Alzheimer's disease patients have drawn a lot of attention among the researches over recent years. A number of applications were developed to help in improving the quality of life for people with AD. Studies showed that AD patients could benefit the integration of this technology with the therapies. This study describes the design and development of a personalized mobile digital memory book for a mild-stage Alzheimer's disease patient. A functional system called my-Mobal was installed on an android platform aimed to support non-pharmacological therapy for Alzheimer's patient. The development of my-Mobal involved planning, design, development, implementation and evaluation. From the observation, the participant appeared to be actively engaged during the sessions. Result showed encouraging outcomes and further study in this field is recommended.

Key words: Alzheimer's disease, assistive technology, mobile technology, observation, treatment, Malaysia

INTRODUCTION

Alzheimer's Disease (AD) is a type of brain impairment that gets worsen gradually. As stated by National Institute of Neurological Disorders and Stroke (NINDS), AD is related to age factor and it is an irreversible brain illness that progress over a period of years (NINDS Alzheimer's Disease Information page) (UM., 2008). AD can cause problems with memory, behavior and thinking skills. At its early stage, memory loss is mild but with late-stage Alzheimer's, individuals could lost the ability to carry on conversation and respond to the environment.

According to Alzheimer's Disease Facts and figure, it is estimated 5.3 million Americans of all ages have AD in 2015 where estimated that 5.1 million people age 65 and older. Report from Alzheimer's Society UK stated that 850,000 people will be suffering from dementia by 2015 and the numbering will increase to 2 million by the year 2051 (AS., 2016).

For Asia Pacific region statistic, it is estimated that people who is suffering from dementia is increased from

23 million in 2015 to 71 million by the year 2050 (Alzheimer's Disease International, 2014). In Malaysia itself, around 60,000 people affected by Alzheimer's and the number would be increased to 120,000 by the year 2020.

MATERIALS AND METHODS

Mobile systems for AD patients: Nowadays, there are many applications developed for Alzheimer Disease (AD) patients that can be operated on desktop, laptop and also mobile devices such as smartphone and iPad. The advances in mobile technology with the improvement in processing power, storage capacity, embedded sensor and network data rates have prepared the direction for interesting and inspiring applications (Zmily *et al.*, 2014).

In addition, the development of mobile devices and systems for tele-medicine, home monitoring and also social networking helps to improve quality of life for people who diagnosed with AD by maintaining their independence and continue living at home (Tung *et al.*, 2013). As stated by Tsolaki *et al.* (2014) that, the ICT

could help health professionals and caregivers to provide better support for AD patients with cognitive, functional and behavioral problems. A study on the impact of technology for people with dementia has been carried out with the findings indicated that the use of technology could reduce the cost for health care, ease caregivers stress and also help people with dementia to have better, safer and fulfilling lives (Linda *et al.*, 2010).

An application with computer-aided telephone system was designed for AD patients that are used to prevent loneliness among the patients (Perilli *et al.*, 2013). It allows patients with AD to make phone calls independently. The system has a positive impact on their self-dependency as well as increasing their motivation. They could make a call to their family members, friends and caregivers by providing a list of partners to contact with related photos.

Recently, more applications for people with AD are moving towards mobile application that takes the advantage of the mobile technology. This technology is applicable on Android OS and iOS. The rapid changes of mobile technology more than other innovation gave a big impact on the communities (Lambeek, 2009). This has led to many innovations of mobile application that were designed as an assistive technology for AD patients. People who diagnosed with AD could gain a lot of benefits from the technology by identifying their needs of the application, able to make changes in their life, motivates them and also can give an appropriate human support (Lindqvist *et al.*, 2013).

A mobile application called my Book that was installed on a smartphone has made it easy for AD patient to access the system at any of the patient's convenience time. The system provides reminder for the patient's daily activities as well as some memory games to stimulate the patient's cognitive function. My Book managed to improve the patient's communication and social interaction with the caretakers (Hashim *et al.*, 2015).

Another invention of mobile application was developed to help in reducing the risk for people with AD to go shopping for groceries alone and help decrease the difficulty for them to remember which groceries to buy (Skillen *et al.*, 2012). This application could notified the person with AD to do groceries shopping once a week, provides street directions to familiar places, link to GPS if they lost their way and will also lists the items to shop based on their favorite food. The application is personalized for each patient as well as keeping their personal information and health condition. CPVS system is another mobile application that was developed to aid people with mild Alzheimer's disease. It includes personal diaries, notepads and post-it notes (Donnelly *et al.*,

2010). Another application was designed to overcome the feeling of being dependent on others and being lonely. It contains shared diary that helps carrying out everyday tasks and meet me tool that help to manage meetings (Gollner *et al.*, 2011).

Given the potential benefits of mobile application in treating AD patients has motivated the development of a personalized mobile digital memory book called my-Mobal. This study discusses the design and development of the application that could assist in enhancing reminiscence and stimulating cognitive function of the patients.

RESULTS AND DISCUSSION

The development of my-Mobal: In this study, we provide the design and development of my-Mobal application. It went through a few key phases in order to ensure successfulness and quality of the application. Those are planning, design, development, implementation and evaluation.

The participant: At the time of the study, the participating patient was a 74 years old female. She was diagnosed with AD and with a standard assessment by a clinical psychologist confirmed her to be in the mild stages of the disease. She has moved from Johor Baharu to Shah Alam to be with her caretakers.

The design of my-Mobal: my-Mobal is a mobile application that was developed specifically for an AD patient. Therefore, the contents and its requirements were designed and arranged especially for that patient. During this phase, we also sketched use case diagram that showed the scenario of the application.

The application is structured around three essential events: daily activities, reminiscences therapy and cognitive stimulation therapy. Daily activities described the activities of the patient. These include taking her daily medicine, meal times and watching her favorite TV programs. The second event contained pictures of the patient's and her family members whilst the third event involved with a few cognitive stimulation games.

From the use case diagram in Fig. 1, we developed a structure chart as in Fig. 2. The structure chart in Fig. 2 displayed the breakdown of the system to its lowest manageable level. There are two modules after the splash screen, analysis and contents. It started with reminder of daily activities. The list of activities is accompanied with an alarm for important event such as prayer time. This function acts as an alert to assist the patient/user to perform the said activity.

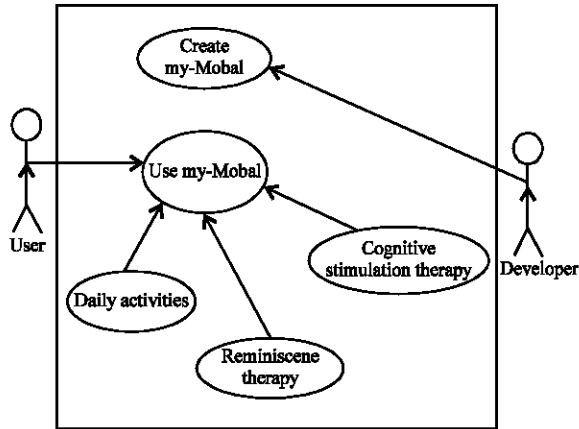


Fig. 1: Use diagram

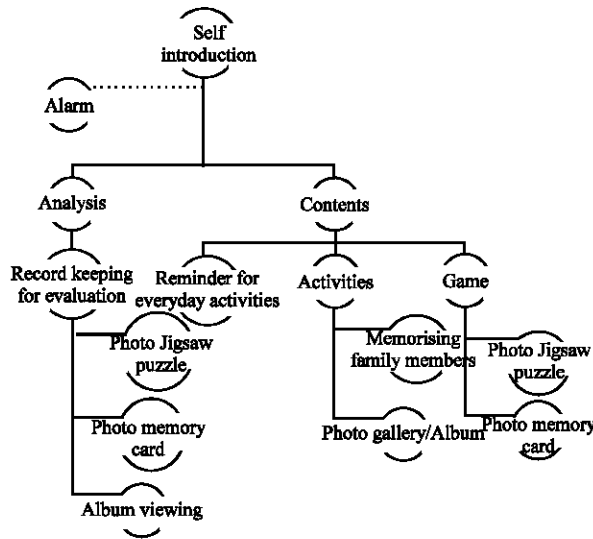


Fig. 2: my-Mobal's structure chart

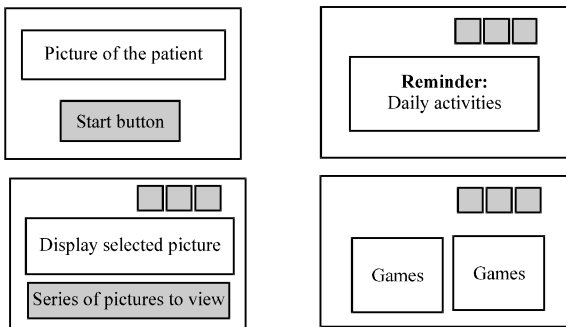


Fig. 3: Storyboard for my-Mobal

Storyboards for my-Mobal were designed after determined on the flow of the system as shown in Fig. 3. The system began with the introduction of the

application. The introduction displayed patient's brief information with her photo. To proceed with the application, the patient needs to press on enter button. The application started with the date, time and reminder of the patient's activities for that day. After going through the activities, the patient can proceed to the next event, either viewing the photos or playing interactive games.

my-Mobal applies the principles of user interface design such as visibility, minimalism, consistency and forgiveness (Marc, 2007). Menu buttons were placed on each page, so that, the user could navigate the application easily. The concept of forgiveness made the application to be an error-free system, so that, the user feels confident using it. Minimalism provides a simple yet informative layout. Consistency gave a standard layout, so that, the user feels comfortable using the application. Visibility allows user to find the function easily on the application.

The description of my-Mobal: my-Mobal was developed using a few software. Adobe Flash CS6 was used to integrate all the media elements into one application with the help of ActionScript 3.0 to add the interactivity. Adobe Photoshop CS6 and Adobe Illustrator CS6 were used to edit photos as well as graphics. Most of the buttons were created using Adobe Flash CS6 to avoid the file getting bigger from the imported objects. All sound was recorded using iPhone and Adobe Sound Booth CS6 was used for editing purposes. Family members contributed their voices for the application, so that, it gave familiar feeling to the patient whenever the sound was played. The application was installed on Samsung Galaxy 4 10 inch tablet that running Android OS.

my-Mobal provides memorizing exercises that are used to enhance patient's ability to remember. For this exercise, 2 activities were developed in consideration to assist the patient to recognize their close family members and getting familiar with their faces. In order to recognize the close family members, the activity comes with close-up photos and information on the person.

The other memorizing exercise is by providing photo gallery or album where it allows the patient to browse through the photos with her caretakers. my-Mobal also included two games activities, Jigsaw puzzle and memory card. Both games were chose in order to help in stimulating the brain activities while playing. Photos of the family members were used, so that, it could support the patient to reminisce during this activity.

Besides the contents, the application was also embedded with a simple event logging toolkit that recorded the time spent by the patient on completing the activities. Frequency of viewing each photo will be documented as well as the time taken to complete the games. Both of the information may help the researchers



Fig. 4: Analysis on viewing photos frequencies



Fig. 7: Patient surrounded by family members



Fig. 5: Analysis on jigsaw puzzle games activities

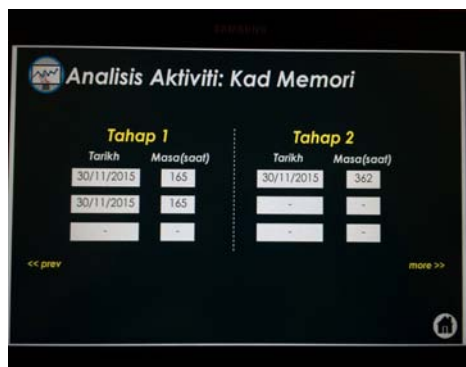


Fig. 6: Analysis on memory games activities

to make an analysis on the memory improvement on every day basis. Figure 4 showed the analysis for viewing the pictures that was performed by the patient. The analysis showed all the pictures in the application together with the dates and frequencies when those pictures were viewed. Figure 5 and 6 presented the activities of Jigsaw puzzle games and Fig. 6 was on flash card games (Fig. 7).

CONCLUSION

This study described the design and development of my-Mobal, a personalized mobile application that is used to enhance reminiscence and stimulate cognitive function for Alzheimer's disease patient. The exploratory case study using single-case study is also supported by another research by Massimi *et al.* (2008). Other AD patients could also use my-Mobal by adding their own personalized content into the system. my-Mobal's interface was designed to meet the need of the older adult. Thus, it can be customized towards the patient's requirements for their non-pharmacological therapy.

my-Mobal was installed on a tablet, thus, it has made the testing easier to be carried out. The mobility of the application gave an opportunity to the patient to use it anytime and anywhere she goes. Features such as simplicity, visibility and error-free gave motivation and self-assurance for the patient to use my-Mobal. Caretakers were also able to manage a few sessions without the presence of the researcher as the application was benefited those characteristics. Using the 10 inch tablet with touchscreen technology has made it easier for the patient to view the contents and navigate the system.

The arrangement of the contents where most photos with small group of people has helped the patient to recognize her family members easily. The interactivity element in the games sections made the activities more fun. Adding cheering sound to the games when the patient finishes every level has made the application more entertaining and enjoyable. The grandchildren involvement in the sessions gave positive effect to the patient, since, the contents are about her life and family.

my-Mobal has background sound which sometime was quite inconvenience. A volume button should be included so the patient could adjust the sound anytime they want. Family video content would give the advantage to make the application more interesting. Frequent use of the contents in the application shortens the battery life. To prevent rapid battery loss issue, the tablet should be fully charged before the session begins.

From the observation, the patient showed positive response and was motivated to use the application. It also enhanced communication with her family.

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