

Using Personalized Mobile Technology to Enhance Reminiscence and Cognitive Function for Alzheimer's Disease Patient

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Abstract: The use of mobile technology has been increased rapidly in the past decade. It has been used widely for many purposes and in many different areas. The usage is not only for the purpose of communication, but also for other functions such as in education, healthcare, finance and entertainment industry. This technology is portable and easy to access from any locations. This project is about designing and developing a personalized digital assistant application for an Alzheimer's patient by using mobile and touch screen technologies. The application is aimed to enhance reminiscence and cognitive function of the patient. A prototype is designed to cater the need of the patient, a 63 years old woman who is still new to mobile technology. The patient has difficulties to remember her family members and confuse with her meal times. Findings from this study indicated a good satisfaction level from using the prototype and positive reaction for repetitive use.

Keywords: Alzheimer's Disease, Cognitive Function, Mobile technology, Multimedia, Personalization, Reminiscence.

1. Introduction

Alzheimer's disease is a brain disease that is incurable and gradually destroys the memory, thinking and communication skills. Alzheimer's is the common type of dementia. Dementia is a common explanation for symptoms like memory, communication and thinking.

As mentioned by Hashim et al. (2013), the changes in behaviour and personality will occur as the disease becoming more critical. It also causes declining in cognitive abilities that will affect decision-making skills, communication skills and memory impairment. As reported by Alzheimer's Association, it is estimated 5.2 million people in America have Alzheimer's Disease (AD) in 2014, which includes about 200,000 who are younger than 65 years old with early symptoms. It also officially the sixth (6th) leading cause of death in the United States. According to Alzheimer's Disease Foundation (Malaysia), in Malaysia itself, it is estimated that 50,000 people are diagnosed with the disease. As most of the relatives think it is part of growing old, not many of them seek for medical opinion. In another report from Utusan Online dated back in year 2008, there are about 60,000 people in Malaysia affected by AD. The number will be increasing to 120,000 by the year 2020.

Until now there is no cure for this disease, but there are some treatments that can be used to slow it down. Research in this area is still continues in order to find the cure for the disease. Trouble in remembering and changes in behaviour can be an early sign of AD. Some of the symptoms of AD are memory loss, changes in mood and behaviour, changes in personality, loss of initiative, difficulty to carry out familiar tasks, troublesome with language, confusion with time and place, and misplace things.

Memories are important for human being. The loss of memory could cause changes in personality and behaviour. The most common early stage of AD is difficulty to remember newly

learned information. As the disease advances, it brings to a more severe symptom where patient will suffer from a more serious memory loss, difficult to speak, walk and swallow (Alzheimer's Association, n.d.). People who are suffering from AD have difficulties in going through their daily life. The need of external memory aids can assist them to compensate with their memories issues. These external aids can be alarms, diaries, notebooks, whiteboards and timers (Clare, 2002). Supports from the caretakers, family and friends are also essential for AD patient.

Many have been carried out in order to enhance the ability to memorize among the AD patients. Pharmacological and non-pharmacological are two types of treatments available when dealing with AD patients. Pharmacological treatment may refer to treatment by using drugs. Some of the mainly used drugs are donepezil hydrochloride (Aricept), rivastigmine (Exelon) and galantamine (Reminly)(Alzheimer's Society, 2014). Drugs that are used to treat AD do come with side effects. Some of them are nausea, vomiting, diarrhea and headache (webMD, n.d.).

Non-pharmacological treatment is another type of treatment used in slowing down the progress of the disease. Non-pharmacological treatments include therapies such as reminiscence therapy, art therapy, cognitive stimulation therapy, etc. Reminiscence is about remembering the past experience. People who suffer from AD usually have issue with the loss of short-term memory and later with long-term memory. According to Kennard (2009), reminiscence includes discussing memories with family, friends and caretakers. In reminiscence therapy, discussion on past activities and experiences are discussed with another person or in group of people. External aid such as photo, video, music was usually used to evoke the memories of the patients. As reported by Sarne-Fleischmann et al. (2010), reminiscence therapy is one of the most usable non pharmacological treatment for Alzheimer's and the elderly. Mulvenna et al. (2009) mentioned that in reminiscence therapy, various activities and tools are being used in order to stimulate cognitive, feelings and memories.

Mobile technology has been used for many purposes due to its affordability, portability and accessibility. Mobile smartphone technology might have the ability to help AD patients as it offers various functions that could meet their needs Armstrong et al. (2009).

2. Development of the Personalized Digital Assistant Application

ADDIE model has been used to develop the application. There are five stages involved in the development. The first stage is the analysis phase. During this phase, the issue, objectives, goals and target audience were identified. The scope and its significance also have been determined. For this research, the researcher has interviewed a lady from Kuala Berang, Terengganu. The patient has a hard time to remember her family members and also her meal times. Therefore, the application will be developed according to the patient's need.

Second stage involved with design phase. Tools and materials that were used in the system have been identified. Structure diagram, system's flowchart and storyboard were designed and later it will be used in the development stage. Multimedia elements were decided to use in the application. Third stage features development stage. All the materials that was collected and designed in the second stage were put together. As the system developed, it has been reviewed and revised a few times. It is important to get feedback from the patient and her caretakers. Fourth stage is implementation phase. This stage prepared the patient to test the application. Patient and her caretakers were explained on how to use the application. The fifth stage involved with evaluation phase. The evaluation phase consists of 2 parts: formative and summative evaluation. Feedback from the user was very useful to improve the application.

2.1 The Patient

The application was developed for an AD patient, Puan Zainab bt Zainal from Kuala Berang, Terengganu. She lives with her caretakers, who are also her daughters. In order to get to

know more about Puan Zainab, we have interviewed her caretakers, Puan Mekasri bt Ghani and Puan Norisah by Ghani. Puan Zainab is in the mild stage of the Alzheimer's disease. According to her daughters, as the disease progress, Puan Zainab has difficulties to recognize her family members and remembering their names. She also starts to forget her meal times more often. The picture below shows the patient using the application.



Fig.1 Puan Zainab is using the application with the help from her caretaker.

2.2 Description of the Personalized Digital Assistant Application

The application is designed and developed according to the need of the user. The personalized digital assistant application consists of four sections. It contains the information about the patient, her family, her meal times and games. Navigation from one section to another is done by touching the buttons on the screen. The touch screen technology that is used in the application has made it easier for the user to navigate through the application. As reported by Armstrong et al. (2009) with the ideal size of the smartphone, user feels more comfortable holding and operates the devices.

The application has two levels where the first level contains buttons that allows user to go to the next level and the second level provides the information needed. The navigation between levels was done hierarchically and bi-directional. The language used in the application is Malay language (Bahasa Malaysia). The reason is the patient is familiar with the language and that she could understand the instructions throughout the application. The production of the application also used a few multimedia software such as Adobe Photoshop to edit pictures and create contents (buttons and background), Adobe Flash CS6 to create the application and Audacity to edit the sound. The application was installed on a smartphone with Android's operating system.

2.3 The Development Process of the Personalized Digital Assistant Application

An iterative design style was used to develop the Personalized Digital Assistant application. Based on the information in the analysis phase, a conceptual design of the application was drafted. Simplicity and ease of use needs to be considered and carefully thought when designing application for the older adults. The application needs to be as user-friendly as possible, while other features such as user's age and her knowledge in using mobile technology needs to be taken into consideration in order to develop a successful application. Storyboard was created to define the application's interface. Multimedia elements of text, sound, animation and graphics were added into the application in order to enhance the reminiscence and stimulate the cognitive function of the user.

During the design stage, storyboards were created so that it would be easier to visualize how the application would look like and if the arrangement was suitable for the user. Then, the

storyboard was presented to the caretakers and the user so that they could give some ideas and feedback on it. The storyboards below showed some interface that was used in the application. It is necessary to keep the application as simple as possible with clean design. During the development phase, all contents were arranged as according to the storyboard. Sound was also added into the application to make it more interesting. Some contents were using audio to give some simple explanation such as the name of the family member that the user was viewing, and etc. Adobe Flash Professional was used to compile and create the application, while Adobe AIR was used to deliver the application on an Android's mobile devices.



Fig. 2 Main Page

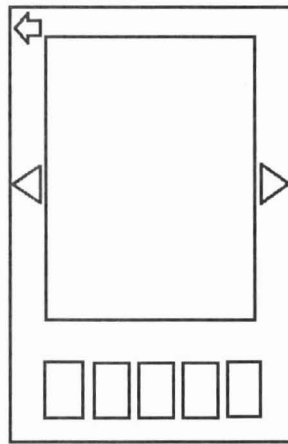


Fig. 3 Gallery Page

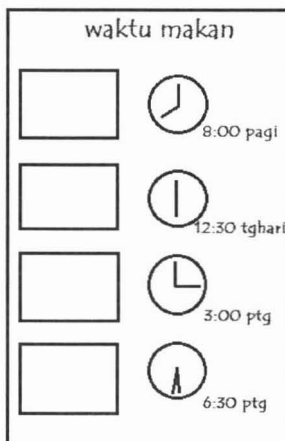


Fig. 4 Mealtime Page



Fig. 5 Sample buttons used in the application

The application was introduced to the patient during the fifth stage. The patient went through eight sessions within four weeks and was carefully observed by her caretakers. The sessions were done twice a week. The first session was carried out by the researcher and it lasted for almost one hour. During this session the patient together with the presence of her caretakers were given the explanation on how the application works. The system is designed to be an error free application in order to avoid the patient feeling uncomfortable and uneasy. The communication with the caretakers and the patient was made available most of the time so that we could give support whenever they have issues with the application. Interviews were carried out before and after the development of the application in order to get feedback from the user.

2.4 The Development of the Jigsaw Puzzle Games

As part of stimulating the cognitive function of the user, a jigsaw puzzle game was included in the application. The family member's pictures were used as the jigsaw puzzle game to make the game more interesting for the user while helping the user to enhance her reminiscence. Figures 6, 7, 8 and 9 showed some screenshots on the development of the jigsaw puzzle game.

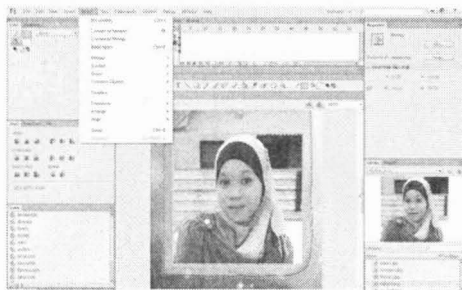


Fig. 6 Cutting the picture to a few sections



Fig. 7 Making puzzle shapes

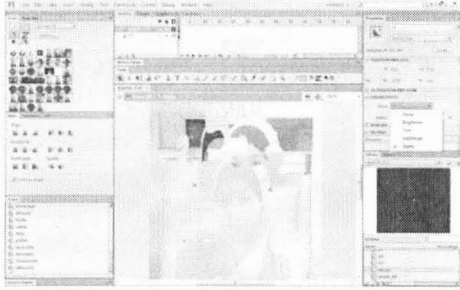


Fig. 8 Applying effects

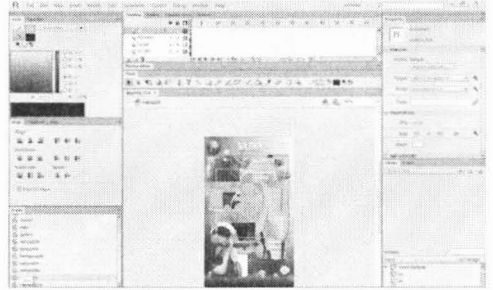


Fig. 9 Finishing the puzzle

2.5 The Screenshots

Below are some samples of the screenshots from the Personalized Digital Assistant Application.

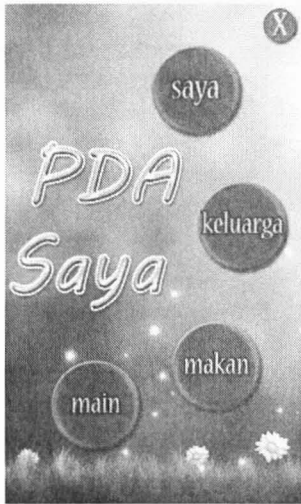


Fig. 10 Homepage Screen



Fig. 11 About the Patient Screen



Fig. 12 Family Tree Screen



Fig. 13 Mealtime Screen



Fig. 14 Games Screen



Fig. 15 Jigsaw Puzzle Game Screen

3. Findings

The application was developed personally for Puan Zainab, an Alzheimer's Disease patient who has difficulties to recognize her family members and remembering their names. She is also starting to forget her mealtime. We have carried out a close observation during the implementation stage. As the application was introduced to her for the first time, her reaction was not very positive. She was a bit stunt and worry when she was told that she would be using the application. She refused to hold the mobile phone, instead she just sit next to her caretakers and observed the application as her caretakers went through the application. After feeling a bit confident, she then slowly reached the mobile phone and started to touch the screen. The smartphone technology and the application were all very new to her.

The size of the buttons was big enough that it was easy for Puan Zainab to touch them on the screen. Her confident grew as she continuously exploring the application. The touch screen function together with the attractive design and the multimedia elements embedded in the application has made it more interesting and joyful for the patient to use. She went through the family tree page and felt joyful as she saw familiar pictures in it. She also found it interesting when she listened to the audio as she pressed on the photo of the family members. When she reached the game section, she was a bit confused on what she should do. The researcher and the caretakers showed her how to play with the game. After trying out the jigsaw puzzle game with the help from the caretakers, she started to enjoy the game. When she finished using the application, she put the mobile phone away and continues to use it when the caretakers were around to assist her. The mealtime's section was a bit puzzled for Puan Zainab as she did not understand its use. The system would alert the patient like an alarm clock when it is the time to have a meal. Every week the researcher would contact the caretakers to update on the patient's progress. According to Puan Norisah binti Ghani, who is one of the caretakers, after the second week using the application, the patient can already remember her and starts to call her name. It was a very emotional moment for the caretakers.

4. Conclusion

This paper described the design and implementation of a personalized digital assistant application that is used to enhance the reminiscence and cognitive function of a patient. The application used the collaboration of mobile technology, multimedia technology and the advancement of information technology to make the system more interesting and effective. Initial tests showed that the application was able to attract the user's attention and motivated her to use it more often. Although the reaction was not very positive during the first attempt, but the confidence was built as the patient getting more familiar with the application. We have trained the caretakers on how to use the application and had closely observed the therapy session without having to assist them. From the observation and the feedback we have received, the patient was motivated to participate with the therapy session without our presence. The result shows that the application was not only enhance her reminiscence and cognitive function, but it has also improved the communication between the patient and her caretakers. The application has encouraged her to communicate more with the caretakers and her family members.

The application can be improved for better results in the future. More contents could be included to enhance the patient's reminiscence such as photos related to her past for example her childhood friends, hometown, favourite singers and artists. Other games that could stimulate the cognitive function can be added in the application. Traditional games such as 'Congkak' would also be an ideal option for the application that could stimulate the cognitive function and enhance reminiscence of the patient's childhood. The application was a new experience to the patient, therefore more time is needed to ensure the effectiveness and capability of the application.

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