Improving Cognitive Impairment Among Dementia Users Using Mobile Application: An Initial Study

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ABSTRACT

Computers such as mobile applications could play an important part in improving the quality of life for people with dementia: for information seeking, communication and leisure. Computers and the Internet offer special tools that could help people to maintain and learn new skills, develop hobbies and communicate with others in new ways. However, the design of interfaces often acts as a barrier to people with cognitive difficulties. Besides, mobile applications have been developed as tools in the diagnosis of dementia and the potential for using computers for activities in care settings is being recognized. However, very little research has been done into what people with dementia themselves need from computer interface design. Cognitive impairment includes the lacking ability to remember things, disorientation in remembering the current location and the struggle to find the correct word. People with dementia are often involved in this impairment. With that being said, this project proposes the use of a mobile application to help in improving their cognitive issues. Thus, this paper presents an initial study to tackle this problem, features and functionality of a mobile application specifically for dementia users are identified which contributes to the development of a diary application. Identifying and gathering features from previous studies is the initial method by hopes that may improve the dementia application for future development.

Keywords: Memory Loss, Features, Diary, Dementia.

1. INTRODUCTION

The human-computer interaction (HCI) is described as the interaction between humans and computers. This interaction is mainly done at the user interface. It is understood by developers, especially HCI designers that it is wise to design interfaces that are usable and more accepting of people's requirements and needs [1]. HCI is considered as cognitive as

it heavily involves in problem-solving, navigation, reduce user waiting time [2] as well as language processing [3]. For interaction with an interface to be successful, users must be able to navigate through it effectively to complete the task at hand [4]. Not only that, but the overall functionality of the interface has to be usable too.

Now, it is undeniable that people interact with technologies and the internet every day. They utilize these for communication, information searching and also entertainment. In a world where computing is pretty much everywhere now, all users are catered for when designing an application with good features and functionality. However, that applies to most people. Most people who are without difficulties and disabilities. Now, what if our attention goes to the people with disadvantages. The way they interact would be different or rather, it would be a lot difficult for them to understand and utilize the interfaces when compared to most people. Research suggests that people with dementia are keen to utilize the latest technology even though they find it difficult to follow or understand the way to use any mobile application [5].

Dementia is a degenerative brain condition in which it is not a natural part of the aging process [6]. People with dementia

typically have problems with language impairments, memory loss and mood changes. According to the Alzheimer's Disease Foundation Malaysia [7], there are about 127,000 people in Malaysia with dementia. This number is projected to be 261,000 by 2030 and will continue to increase to 590,000 people in 2050. Dementia is indeed a progressing and weakening disease. Memory decline is the most noticeable initial symptom of dementia and people with dementia struggle to remember recent events. If this memory degradation continues, their long-term memory would be affected. They would forget familiar things or even knowledge learned [8]. This further affects their cognitive ability. As mentioned, there are numerous kinds of applications nowadays but only a few of these are specifically aimed at people with dementia. There are hardly any applications that have been designed with the particular viewing requirements of people with dementia in mind [9].

Designing an application with features and functions that is easy for people with dementia to utilize is rather difficult as it involves the balance of accessible and usable features and functions to improve their user experience [10]. Many people with dementia find that technology can help them in their daily life. It could allow them to stay independent and keep doing many of the same things they have done before. Keeping track of daily activities, appointments or things that needed to be done is useful and effective for people with dementia (Alzheimer's Society of UK). So, for them to keep track of everything, a notebook or a diary is utilized. Sometimes, it could even be post-it-notes. However, in the case of post-it-notes and diary books, it is often that they would forget where they put them. Thus, to aid them in coping with memory loss, a diary application with easy-to-understand features and functions would be very helpful.

This paper presents an initial study aim to improve cognitive impairment among dementia users using mobile application specifically for identified which contributes to the development of a diary application.

2. RELATED WORK

Dementia is known to be a progressive neurodegenerative disorder caused by many different diseases, the most common being Alzheimer's disease [11]. People with dementia typically have problems with language, memory, visuospatial processing, lack of problem-solving ability as well as mood changes. People with dementia are a rapidly growing demographic. In the next 10 years, the number of people with dementia in Malaysia is expected to reach a total of 260,000 (Alzheimer's Disease Foundation Malaysia). In a world that is increasingly dependent on technology and computing, this large group of people is becoming isolated technologically, due to the ill-suited design of interfaces.

It has also been shown that people with dementia can learn new skills and computers may be an ideal medium for this if interfaces are designed well [12]. Computer interfaces can andshould be designed in a way that maximizes their accessibility and enables people with dementia to benefit from this. Based on Ancient et al. [6], designing interfaces should consider three possible areas where dementia will have an impact on. They are cognitive impairments, motor impairments and visual impairments. They have found that, people with dementia struggle with understanding the pinch-zoom functionality of touch screen applications. This involves motor impairments where people with dementia may have slower movements. So, it is wise to take in the consideration of increasing the response time of people with dementia. Say, for example, an interface that expects a response within a specific length of time such as 'time-outs' when completing an online form.

Studied by Morris et al. [13] suggested that the language on the interface should not be complex and should avoid more abstract or metaphorical language. For instance, the customary use of ''home'' to signify a link to the home page might be confusing and difficult for them to understand. People with dementia may have difficulties in concentrating and giving attention to multiple tasks at one time [14]. Hence, when designing interfaces, the number of items on the page that requires attention is to be cut down. Also, people with dementia are often passive consumers of computer applications. Some of the developments have been done on memory aid applications and the use of computers for rehabilitation and reminiscence [15].

The technology could play an important part in improving the quality of life for people with dementia, be it for information seeking, communication and leisure. Technologies offer special tools that could help people to maintain and learn new skills, have hobbies and communicate with each other in new different ways. However, the designs, features and functions of applications often act as a barrier to people with cognitive difficulties [9]. There are only very few studies done in regards to the development of applications especially mobile applications that tackles the cognitive impairments of people with dementia. Table 1 gives a brief description of related works.

Table 1: Description of related works

SOURCE	TITLE	METHOD	FINDINGS	FOCUS
[6]	Issues with Designing Dementia-Friendly Interfaces	Existing literature and observation from a pilot study	-Motor impairments. which for example causes them to move slow. -Cognitive impairments. often struggle to recognize and find correct words -Visual impairments. Have problems with perception of colors, shapes and texts.	Focuses on an interface only but did not develop any system
[16]	Learning from People with Dementia to Improve Accessibility of Website Interfaces	Preliminary study, person-centered approach	- Scrolling difficulties - Clicking wrong links - Becoming worried or upset.	Focuses on website interfaces because they are flexible to design
[17]	Designing an Interface Usable by People with Dementia	Developed a multimedia conversation support system	- Participants with dementia are quite active in participating themselves with navigating through the system. - All participants enjoyed using the system	Develop a touchscreen-based interface system only
[8]	Affordance and Intuitive Interface Design for Elder Users with Dementia	Create and test user interfaces of microwave ovens	-Experience fluctuating attention and emotion - Difficulty in understanding instructions	Focuses on elderly users and creates interfaces and operating tasks only not a system/application.
[18]	Mobile App Development and Usability Research to Help Dementia and Alzheimer Patients	Google's voice recognition; provide the weather, and supply pill reminder alerts	-Buttons are placed too close to each other. -Colors are too bright.	- It focuses on elderly people with dementia. - Develop a mobile application that mainly tackles memory loss and mood changes.

Even so, there is research done by Ancient et al. [6] where they studied and analyzed the possible barriers that need to thoroughly considered when designing interfaces to make sure that they are accessible and usable by people with dementia. Based on their research, they found that when designing, three possible areas are to be considered and they are the cognitive, motor and visual impairments which are shown in Table 2. The researchers discovered that people with dementia may have slower movements. So, it is wise to take into consideration in increasing the response time of the application. Say, for example, an interface that expects a response within a specific length of time such as the time-out sessions of a certain application. It is also a fact that people with dementia may also have problems with interpreting colors and shapes. Hence, readability must be improved with the reduction of text density [19].

Table 2: Interface design considerations

Impairments	Cognitive impairments	Motor impairments	Visual impairments
Description	─ Reduced ability to remember items ─ Disorientation when trying to recall relative location in the system ─ Often struggle to find the correct word, enhancing the difficulty with terminology. ─Reduced capacity to formulate new memories - difficult to learn both new words and menu locations.	─ Have slower movements ─ May not be able to learn new complex motor skills, like pinch-zoom or scrolling on touch screens.	─ Difficulty in perceiving colors, shapes and texts. ─ Maximize readability with enough information to provide them an accurate reading.

Research by Savitch and Zaphris [16] focused on building the interface of a website. They studied the accessibility of website interfaces as they thought that website interfaces are easy to design. The researchers found several problems that these people with dementia have when using the website. The problems include scrolling difficulties and clicking the wrong links. They also analyzed how when people with dementia are using the website, their mood changes from being calm to being worried or upset. This tells that difficulty in understanding how to utilize through the website results in their mood and emotions being affected.

Alm et al. [17] did a study focusing on designing and developing a multimedia conversation support system where they base on the interface of the system only. This research has managed to get the attention of their dementia participants as they found that the participants enjoyed using the system. On the contrary, Chen et al. [8] where they discover that people with dementia experience mood changes

and have difficulty in comprehending instructions the interface designs the created. They created and tested several interfaces of microwave ovens and involved only elderly dementia users to try and use and operate the microwave ovens.

Also, there is one research that focuses on elderly people with dementia where they developed an application that consists of voice recognition, weather information and reminder alerts. It is a mobile application that tackles problems that people with dementia have such as memory loss and mood changes. The researchers found that the design of their application has some drawbacks. For example, the buttons are placed to close to eachother and the colors are too bright. Thus, buttons alignments and color themes are taken into considerations when designing and developing this Diary application.

3. DISCUSSION AND CONCLUSION

This paper aimed to review previous research done on the development application for people with dementia especially on the user interface design and features and found that most dementia preferred applications for memory used such as diary application. This diary application as said that could make the cognitive problems between dementia people better. Thus, some initial study lists the proposed interface design guideline for further development. Also, future works will look into details based on real experiments, whereby people with dementia must be identified using health questionnaires conducted. Then, involvement verified dementia people will be evaluated their effectiveness of using the application. Besides, future works in regards to this study may include developing another mobile application that improves cognitive and visual impairment instead of focusing on cognitive only.

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