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Alzheimer patients, Human-Computer Interaction, Usability, Intuitive interfaces, User-friendly

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ABSTRACT

Nowadays, computer systems play a very important role in the health care context. However, many of these systems are also becoming increasingly complex. In particular, the design of these systems should be compatible with Alzheimer's situation, as the condition of Alzheimer patients is growing worse, especially with the poor understanding of the disease, lack of support language difficulties, and memory loss. These systems should meet the various needs of such patients. In this paper, we are focusing on evaluating Alzheimer's assistance systems. Usually, in designing those systems, the human-computer interaction (HCI) is left behind. Thus, we demonstrate several aspects to improve Alzheimer's patient ability to interact with these systems. Moreover, we discussed the key factors that affect the success or failure of those systems taking into consideration criterion such as bringing down health care costs, learning ability, usability, dependability, readability, and facilitate automating. In the end, the paper illustrates using charts, and tables to show the impact of applying HCI when designing an interface to achieve user-friendly, intuitive interfaces, and higher usability of the systems.

Keywords— Alzheimer patients, Human-Computer Interaction, Usability, Intuitive interfaces, User-friendly

1. INTRODUCTION

Since the number of people diagnosed with Alzheimer's is increasing, according to the national Alzheimer's disease association estimates the prevalence worldwide of the disease is around 44 million patients, in 2016. As populations are growing, this number will increase to almost 80 million in 2040 [1]. Therefore, recent advances in technology have provided significant improvements in human daily life. Especially within health systems, the rapid expansion of mobile Information and Communications Technologies (ICT) creates a range of new opportunities to deliver new forms of interactive health services

to patients, clinicians, and caregivers. However, the more the increasing of mass production, the more advanced digital prototyping, and quality control methods are required. Thus, the design and implementation of an Alzheimer patient's assistance systems were investigated. Each use of these utilities requires us, as humans, to interact with these systems. This interaction requires a mode to implement successful communication. Alzheimer's assistance systems assist this category of our society who suffer from losing part or all their memory to perform the basic everyday activities such as: reminding the patient to take the correct medicines on time, eating meals, drinking water, closing windows and door, joining their events, etc. Also, they have been improved and qualified healthcare services to provide special services to help the patients manage their life. The importance of those systems came from Alzheimer's patient's needs to be self - reliant, especially for those who live alone.

2. RELATED WORK

Maglogiannis et al. [2] developed a multimodal electronic reminder system that supports the use of smart devices and utilizes the Pebble smartwatch. The system employs cloud technology and allows for other types of users with a supportive role in the patient's health care. Patient compliance is measured automatically with the method of self-reporting.

Chaiwongsai, Preecha, and Intem [3] they suggested an automated patient appointment reminder for cross-platform mobile application. The patients can receive appointment notification before the appointment date, be able to postpone or cancel the appointment easily when they cannot come to see the doctor or the patient get better. In addition, the doctors and patients can observe their appointment via a mobile application. The application performance is evaluated by user satisfaction scores. The application can work on the window, Android, and iOS platforms.

A mobile phone and Cloud-based smart application have been developed by Mohammed, Ibrahim, and Cavus [4] to improve patient adherence, particularly for older people with disabilities. The novelty of the developed application is the use of a Cloud service to provide two-way communication in the form of feedback between the older patients with disabilities and the doctors so that the medication adherence of the patients can be monitored.

Wang et al. [5] developed a reminder application based on Bluetooth. The accurate and real-time implementation of medical orders will be directly related to the patient's health. It could remind nurses to deal with the nursery content of patients real-time and ensure the accuracy of medical advice and real-time implementation by using text messages to remind nurses and adding reminder alarm kit to the drug box. Forgetfulness is a major difficulty in Patients who do not take their drugs with the exact dosage on time. Mohammed, Ahmed, and Salih [6] developed a Dose Reminder System, is a simple device designed for home use, it can be easily programmed by the caregiver and used by the elderly.

Rokhman and Saifuddin [7] developed a reminder system which works based on the venue location and activity time. The system notifies the user when the user was in the location and provide notifications when a note was detected approaching the deadline.

Pirani et al. [8] developed an application to provide various functionalities for the person affected by Alzheimer's disease such as tracking movements of the patient, providing medicine and food timing notifications, daily routine tracker and quiz to increase cognitive functioning of the patient.

Chen and Soh [9] developed a cooking assistance system for patients with Alzheimer's disease using reinforcement learning, it is reminder system help them in cooking tasks by divide into subtasks with notifying the user in each time need to add component.

Wang et al. [10] developed an application for smartphones to remind and help patients to take the correct medicines on time and record the intake schedules for later review by healthcare professionals. It designed with a friendly user interface to help its users to recognize the proper medicines and obtain the correct instructions of taking these drugs.

Ghorbel et al. [11] developed a smart reminder called MEMO_Calendring to allow the users to be autonomous in organizing their daily lives wherever they are. The MEMO_Calendring reminding automatically provides patient-friendly user interfaces, supports natural language inputs, and supports multilingualism.

Assistance Systems for Alzheimer patients have already been used to help Alzheimer patients. In this work, we are considering mental models, in order to support the patient and healthcare practitioners to easily manage their daily life activities.

3. PROPOSED WORK

The proposed system is an Alzheimer assistance system that gives Alzheimer patients the ability to have a small memory which can help them easily remember all tasks of everyday life and make them as independent as possible. Also, it may contribute to the prevention of the progression of the disease rapidly. A major goal of this work is to evaluate mental models of user interface interaction of Alzheimer's assistance systems

under the umbrella of HCI. Therefore, we have communicated and collaborated with specialists of Alzheimer disease from Saudi Alzheimer's Disease Association and King Saud Medical City to get suggestions about the provided services. The specialist's advice was taken into consideration while designing the interfaces.

3.1 Comparison of Alzheimer's Systems

Systems for Alzheimer's patients may be similar or different in function provided but all have the same goal is to work as a helper (assistant) for that category. In this paper, we tried to summarize some of the systems that provide similar functions that we have proposed. Tracking daily activity of patients with application that design for smart home [12], used for tracking home activity in addition to notify helper when patient leave home so that track focus on home only, environment-aware system have section special area to helpers that allow them to help their patients at any time and place they need help by wearable device [12], but with Toolkit application[7], the tracking and GPS used in a different way, it focuses on the way back to home to user from any place to patient. One of our proposed systems is on phone uses tracking to tell the helper where the patient is now and can receive a daily list of where the patient goes. Another system works as management to daily life by reminding the patient to food time, medication time, events and other of daily life activities like [5,8,11,12], one of our proposed system are supported each of those activities with pictures that help patients to improve memory. In some systems, the doctor can notify and track the dosage of medication [1]. In our proposed system the doctor will be able to give the medication for the patient with time and dose, and he can see the name of the helper and communication information to connect with him/her if he needs any help, and we will provide communication information with the doctor. Also, we will provide a new feature given to patients to the private part, they can record notes by using her/his voice, and they only can listen.

3.2 System Architecture

The system should be developed using simple, basic, and low-cost components in order to meet the planned system objective which is being available for who needs it, resultantly, we were inclined to design the system as a phone application, so it is convenient for a wide part of society.

The interaction between each human role (patients, doctors or assistant) is the most important of this system. As a result, the developed application consists of three parts: An Alzheimer's patient interface, the doctor's interface, and the assistant's interface, where an Android or IOS type mobile phone is used. The proposed architecture helps adapt to different environments, this architecture also allows easily extendable when new functions needed. The functional diagram of the overall application is shown in figure 1. The task for each interface is described in the next section.

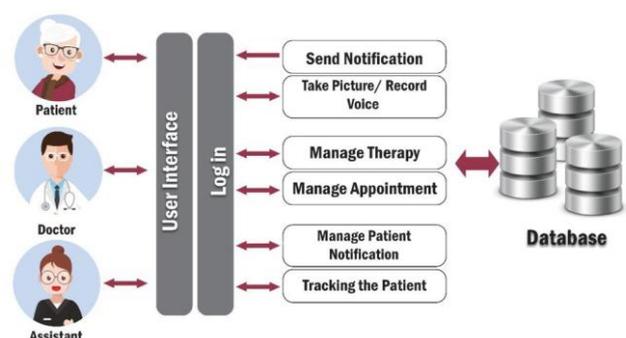


Fig. 1: Overview of system architecture

3.3 System Interfaces

Because the interface really plays the role of a bridge in communication between humans and computers it should be valuable. Therefore, we have integrated HCI activities into design processes, by taking into consideration the important design principles of human-computer interaction such as the principle of humanity, the principle of Safety and stability, and the principle of flexibility, thus we strived for consistency by using identical terminology in prompts, menus, and help screens.

In addition, the interface design should provide necessary and effective functions, since that as the frequency of use increases, the user will desire to reduce the number of interactions and to increase the pace of interaction. In response to this, we tried to adapt the interface to occupy the time of users as little as possible, through designing interface design should provide necessary, and effective functions to meet the reasonable needs of users, as it will show in the next figures.

According to that, we designed the system to contain three types of users, doctor, assistant, and Alzheimer's patient as shown in Fig.2. The first one has integrated background services that activate notifications for the Alzheimer's patient and assistant users. Each of these users has their own page and different functions as shown below:



Fig. 2: A System interface

3.3.1 Alzheimer's Patient: For Alzheimer's patient page, at the header part, as shown in Fig.3 there are a user type and options. The options contain patient information and sign out. While the centre of the page contains five buttons: Appointments, Drugs, Meals and Water, Family and Friends, Events and Sound Notes List. In the Patient Information page, there are two sections of information. The first section for personal information contains the name of the patient, his age, ID, and his address. Also, at the bottom, there is the name and number of the relative assistant. The second section for medical information, it contains the history of the disease, name of the hospital, number of his record, name, and number of his doctor. The first button in the centre of the page is the Appointments page, the patient will be alerted when a new appointment is updated by the doctor. The next is Drugs page, it contains the name and time of each drug and its amount of dose. Alzheimer's patient almost forgets to eat and drink water and this increases the deterioration of his health. Therefore, the system contains Meals and Water Page which helps the patient to remember to eat and drink water at the specified time that set by an assistant. Due the Alzheimer's patients forget a lot of things, especially

their relatives whether family or friends. Therefore, the patient can add pictures of his family and close friends also, mention their relationship to him which helps the patient to remember them easily. Finally, the Events and Sound Notes page are consisting of the voice notes recorded by the patient and special events that take it by camera related to patient life.

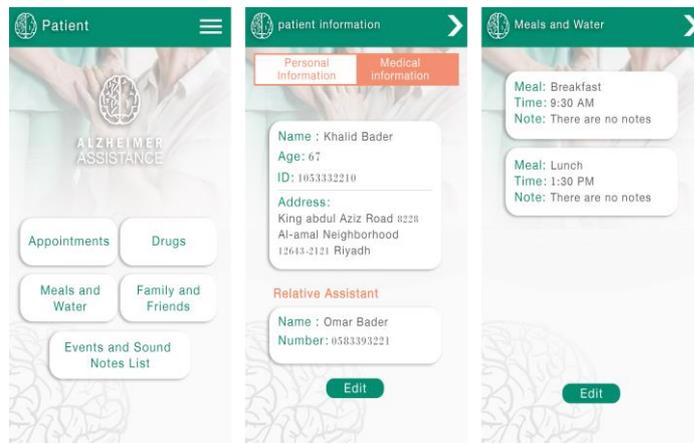


Fig. 3: Alzheimer's patient pages

3.3.2 Doctor: As shown in figure 4, the doctor is responsible for more than the patient. In the centre of the page, there is a list of patient's names that are being treated, and "add" button to add more patients. When clicking on each name there is patient details will appear. Each patient has two buttons, for prescriptions and appointments. The prescriptions page has the name of drugs, amount of dose and time of dose that can patient or assistant know it by alert tone. For appointment page, the doctor can make an appointment for the patient or manage it. As for the personal information of the doctor which consists of his name, number, ID, speciality and the name of the hospital where he works, it's in the options which set on the header page with a sign out option. The header page shows the user type also.

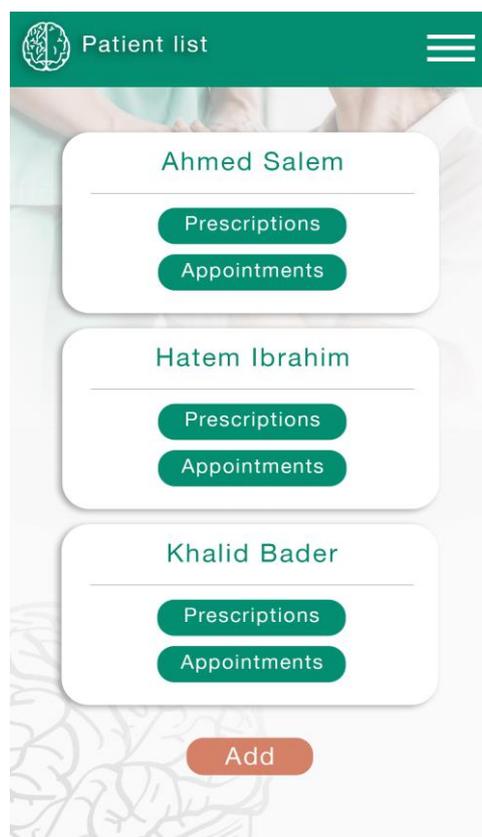


Fig. 4: Doctor Interface

3.3.3 Assistant: The assistant is the helper and closer responsible for the patient, all alerts of drugs and foods that show in the patient page should also be shown on the assistant page. As shown in Fig.5, the main page of the assistant consists of three buttons, the first one is patient information, and it has details of the patient for whom he is responsible. This button has all the personal and medical information of the patient. The second button is an alarm page, it's for drugs and foods or water that the patient should take on the time and appointment that updated by the doctor. Assistant can set time alarm for food and water to alert in the patient page and his page. The third button is to track the patient, this page has the current location of the patient which updates automatically. An assistant should have personal information like name, number, and relatives of the patient which will be linked in the patient personal information page. Also, sign out option like other users, those two options in the options button at the header part, placed next to the user type that shown in this part.

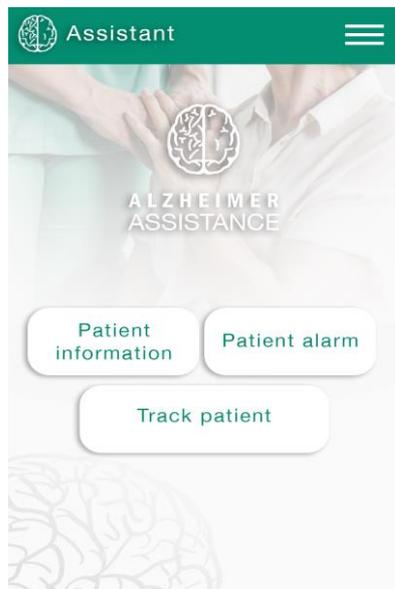


Fig. 5: Assistant interface

3.4 Evaluation of system interfaces

To evaluate the proposed system according to its idea and its interface design, we distributed an electronic questionnaire to two official organizations interested in Alzheimer's patients which are Saudi Alzheimer's Disease Association and King Saud Medical City. The total number of respondents is 30, (67.0%) of the respondents are doctors whereas (33.0%) of them are nurses. The following table shows a descriptive analysis of some variables, summary the descriptive statistic of the overall satisfaction such as perceived of usefulness, perceived ease of use, and attribute of usability.

Table 1: Descriptive Statistic

Items	HCI Domain	Description	Mean	Std. Devia Tion
1	Considering the conceptual model, feedback, and visibility to make the system clear, obvious, and substantial.	Alzheimer's Patients Assistance System will help Alzheimer's patients to remind what they may forget, such as eating their medications on time.	4.65	0.875

2	Considering the conceptual model, mapping, and consistency, the system will be understandable by the users in the manner intended.	The system will help the doctor and the assistance to take care of patients and save their effort and time.	3.96	1.093
3	Considering visibility to control the different operations are clearly visible.	Alzheimer's Patients Assistance System's contents such as pictures, icons, voice notes, and names can help patient to remember.	4.24	0.624
4	Considering feedback and visibility to allow the patient to continue with the activity.	The system will benefit patients in the stability of their health in the long term.	3.96	0.922
5	Considering the mental model, mapping, and consistency to enhance learnability and ease of use.	Interaction with the system is clear and understandable.	4.03	0.771
6	Considering conceptual models by building the interfaces based on the patient's perceptions.	It is easy to become skilful at using Alzheimer's Patients Assistance System.	4.10	0.731
7	Considering affordance, consistency, and visibility to make the system more intuitive and easier to use.	The system design is easy to operate the interface.	3.89	1.014
8	Considering cultural constraints as universally accepted conventions to make the system more reliable.	The use of a mobile reminder system is suitable for each community groups.	4.13	0.708

Table 1 demonstrates that the system was acceptable because most respondents' answers are agreeable. The evaluation proved that the system will benefit the target groups and could lead to dispensing with the home nursing service for Alzheimer's patients. This

4. CONCLUSION AND FUTURE WORK

Alzheimer's patients suffer from forgetfulness, and this problem causes deterioration in their health. Therefore, in this paper, we investigated the design and implementation of Alzheimer's

Patients Assistance Systems to help the patients to contribute to keeping their health in the long run. The proposed system includes many features such as describe the treatment by the doctor through the system, remind the time of medicine and food/water, also the possibility of tracking Alzheimer's patient in the map by the assistant, the possibility of record voices, keep the photo of patient's family and friends with a description to be remembered by the patient and other features. We distributed an electronic questionnaire to two official organizations. The results demonstrated that the system successfully designed to meet many essential requirements by providing user-friendly interfaces and applying some HCI practices to help them to remember easily. In addition, future work can focus on improving the services of the system to increase its effectiveness and usefulness by linking the system to more than one hospital. This will allow the doctors to communicate with the patient and describe the treatment easily. Also, when the patient has not taken prescribed medicines at the specified times, we suggest improving the system to directly send an automatic text message to notify the patient's family members.

5. ACKNOWLEDGEMENT

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