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Mobile Health Applications and Android Toolkit for Alzheimer Patients, Caregivers and Doctors

Gaurav Gupta[1], Ankit Gupta[1], Parimita Barura[2] and Varun Jaiswal[1]

[1]School of Electrical and Computer Science Engineering, Shoolini University, Solan (Himachal Pradesh), India
[2]Dr. Ram Mahomar Lohia Hospital and PRIMER (Post Graduate Institute of Medical Education and Research), New Delhi, India.

(Corresponding author: Varun Jaiswal)
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ABSTRACT: Alzheimer, a common form of dementia causes deterioration of cognitive abilities of an individual which results in difficulty in carrying out their routine activities. Research suggests that there is no cure for this deadly disease. However, the progression of the disease can be slowed down by improving the patient's quality of life, providing a solution for enhancing the cognitive abilities of the patient. One of the possible solution is to motivate the use of Smartphone by the patient. Smartphones play a crucial role for the family members of the Alzheimer patients as it helps the patients in carrying out their routine activities by providing time to time notifications about them. Furthermore, the smartphone also helps in assisting the caregiver to take proper care of the patient, such as retrieving the GPS locations of the patient, using Geotagging. Photographs can be used as a source of the medium in helping patients remember their family members. They are susceptible to music; therefore, the patient brain can be stimulated by playing their beloved tones. Smartphones tend to be a one-stop shop for providing all these facilities to the patients. This motivates the need to build relatively simple cross-platform mobile applications with interactive GUIs so as to enhance their cognitive abilities.

Keyword: Alzheimer, Android Mobile Applications, GPS, Computer Assisted Technology.

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INTRODUCTION

In an era where Alzheimer's and Dementia is increasing in adults (older as well as middle aged), alzheimer caregivers are searching for new and better solutions to overcome the same. One of the solution for this is the use of mobile devices to help Alzheimer patients. Today's research has shown that the use of computer assisted games which includes brain, memory, and solving problem help Alzheimer patients to stimulate their brain and also helps in reducing AD symptoms. One of the day care facility (in Spain), the use of the computer games, improved the reasoning power of AD patients.

Researchers in recent study found that when regular treatment is mixed with computer assisted toolkits which includes games as well as daily activity monitoring shows great improvement in AD patients (Olalla-Tárraga and Rodríguez, 2007).

Therapy which inlcudes brain games and stimulation (computer-based) are helping professionals such as healthcare, caregivers and also to AD patients.

New arcade for professionals working as caregivers, software developers, mobile application developer has been created due to the increasing use of internet by our older people. In starting age of mobile devices older people hasitate to use them due to small font, intricate menus and fear of using computing devices. Now developers are making mobile applications which are user friendly and easy to use by older people and adults suffering from alzheimer disease. Despite of this improvemnet in techology there is a scope of transition of these techologies into mobile tablets as well as other same devices. Research suggests that the use of smartphones or iPods helps in enhancing the cognitive abilities of the Alzheimer patients (Yamagata, *et al.* 2013). There is a vital need for the development of assistive technologies especially for the Dementia which is relatively correlated with dementia. This motivates the need to correctly identify the vital features of a mobile application that could assist the Alzheimer patients in a better way. This also helps in eradicating the mental and economic burden on caregivers as well as patients (Klimova, 2017).

To the best of our knowledge, a survey focussing on the vital factors and their identification in enhancing the quality of life for Alzheimer patients does not exist, presently. So, this is the first attempt to correctly identify features that can help to enhance the abilities of Alzheimer patients which results in a decline of Alzheimer's Progression.

LITERATURE REVIEW

In an era where Alzheimer's and dementia in older adults are increasing, caregivers are researching new solutions to mediate the crisis. Tablets and iPads, which are prevalent, can be utilized with dementia patients in portraying favorite music and family photographs via apps developed in close partnership with geriatric facilities (Kleinberger *et al.* 2007). New research has proven that the use of brain, memory, and solving problem games help stimulate the brain and reduce symptoms of AD. Research conducted in one of the daycare facility in spain for elder people that the use of games shows positive and much more improved sign of mental stability in AD patients. The cognitive benefits were also extended to 24 week (Feldman *et al.,* 2001).
Nowadays games are becoming more popular as computer-assisted therapy, which has given new hope for caregivers, healthcare professionals and patients respectively. Research and therapy programs from around the world and the U.S. have created a new market for healthcare professionals and software developers. There is a increased use of technology amog the older people such as use of internet, smart phones, ipads etc. Previously, older adults and people with disabilities often struggled to cope with the demand integration of Information Technology (IT) in their daily lives. For many older adults complex menus, small fonts, and the fear of a breaking the computer, unwanted feedback from a device or the Internet caused many to avoid these technologies all together. New assistive technologies and web accessible features have improved the usability and accessibility of the Internet and computer devices. Unfortunately, despite these improvements, these technologies have yet to fully transition into mobile tablet computers.

Phases of Alzheimer's disease: **Early stage:** In the early phases of Alzheimer's, a man may work freely. He or she may in any case drive, work and be a piece of social exercises. Irrespective of this, one may feel that he/she is having memory gaps, for e.g., superintending natural words or the area of average articles (Vogel *et al.,* 2006).

Problems include:

- Memory misfortune that upsets day by day life.
- Challenges in arranging or taking care of issues.
- Confusion with time or place.
- Decreased or misguided thinking.

Moderate stage: Moderate Alzheimer's is regularly the longest stage and can keep going for a long time. As the sickness advances, the individual with Alzheimer's will require a more noteworthy level of care.

Problems include:

- Absent mindedness of occasions or about one's very own history.
- Disarray about where they are or what day it is.
- Changes in rest examples, for example, dozing amid the day and getting to be noticeably fretful around evening time.
- An expanded danger of meandering and getting to be noticeably lost.

Severe stage: In the last phase of this ailment, people lose the capacity to react to their condition, to bear on a discussion and, in the end, to control development. They may in any case say words or expressions, however imparting torment ends up noticeably troublesome. As memory and subjective aptitudes keep on worsening, identity changes may happen and people require broad help with every day exercises.
Problems include:

- Require full-time, day and night help with day by day individual care.
- Lose familiarity with late encounters and also of their environment. Experience changes in physical capacities, including the capacity to walk, sit and, inevitably, swallow.
- Have expanding trouble conveying.

EXISTING SYSTEMS

The features of the existing apps that has been reviewed are one the same in almost all the avaialable alzheimer app (Pirani *et al.,* 2016).

Carezone. This android based mobile application is one of the prevalently used application with an overall user rating of 4.4 on a 5 point scale which possesses the features like medication management, Trackers for monitoring the health vitals and progress over time**,** Contacts, Sharing, Journal,Calendar, To-do List, Photo & Files and list.

Tweri Alzheimer Medical App. This application was built by the company named TWERI, possess an overall user rating of 4.1 on 5 point scale. This app consists of a Safety limits feature which generates alert for the caregivers in the form of an email. Besides this patient can also press a button which does the same alerting the caregiver of the patient's geographical location loss.

Alzheimer & Dementia. This application is offered by Borm Bruckmeier Publishing LLC**.** It is exclusively built for phones with an overall user rating of 4.1 focusing on the needs of caregivers for handling Alzheimer patients.

This application provides immediate tips and advice for handling the critical situations of and free access to caregivers resources and training materials for Alzheimer's with a rating system to rate the tip or advice.

CURAAP. This application is offered by EI Techie. It is exclusively built for an android phone with an overall user rating of 3.9 focusing on needs of caregivers for handling conversation between caregiver and Alzheimer patient.

Alzheimer Assistant. This app is created by Hans Menkveld with an overall user rating of 4.5. This application provides a handy overview of text and videos about familiar situations. It also allows for sharing the experiences of the caregivers in handling the patients suffering from Alzheimer's or Dementia under different critical or non-critical situations.

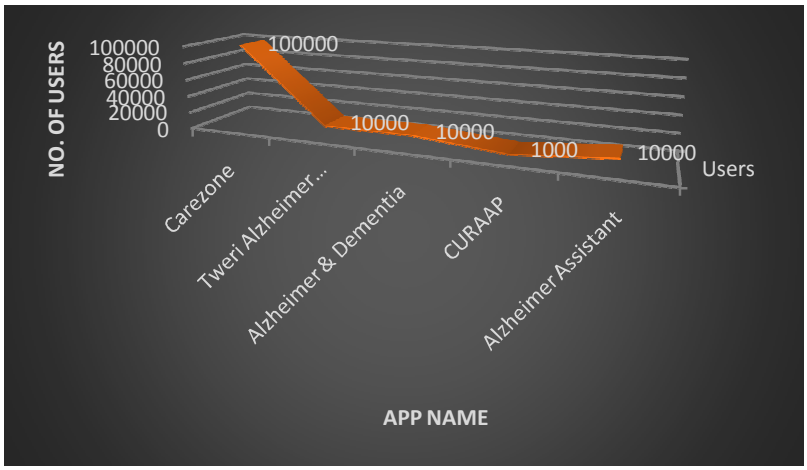


Fig. 1. Graph depicting the userbase of the selected mobile applications.

Fig. 1. depicts the statistics of the selected mobile applications based on a number of users which clearly indicates the prevalence of CareZone with an overall user base of more than 10,00,000 users while other applications are being used a relatively smaller group of people. It can be further noticed that, out of the remaining 4 applications, three are being used by a same number of users i.e. 10,000 with CURAAP having the lesser number of users.

Although, every application (Weir *et al.* 2014) possess the features mentioned in the above section, none of them have features like doctors dairy, games, SOS, daily scheduling.

FEATURES FOR ALZHEIMER ASSISTING MOBILE APPLICATION

A mobile application is a software which is created for its usage on mobile devices like Smartphones, Tablets etc. These devices are much more prevalent, to be used as an assistive technology for a variety of disorders like dementia (Stoyanov *et al.,* 2015), HIV (Banos *et al.,* 2015), etc. Development of application as an assistive technology is a major category in the field of mHealth (Elfaki and Alotaibi, 2018). The heart of these applications are the features that it supports. Hence, selecting the appropriate features, especially for the applications focussing on disorders treatment or diagnosis requires extensive research and understanding the need of patients suffering from a disorder. As an instance, Alzheimer patients suffer from memory loss due to a weak connection between neurons, so that application built for these patients will require a well-defined notification system that can alert the patients to carry out their routine activities (Årsand *et al.,* 2012). This survey focuses on recognition of application features that can help the patients to carry out daily activities as well as enhancing their quality of life. This study deals with the collection of over 60 androids supported prevalent mobile applications. Further, each application is thoroughly reviewed to extract important characteristics of every application.

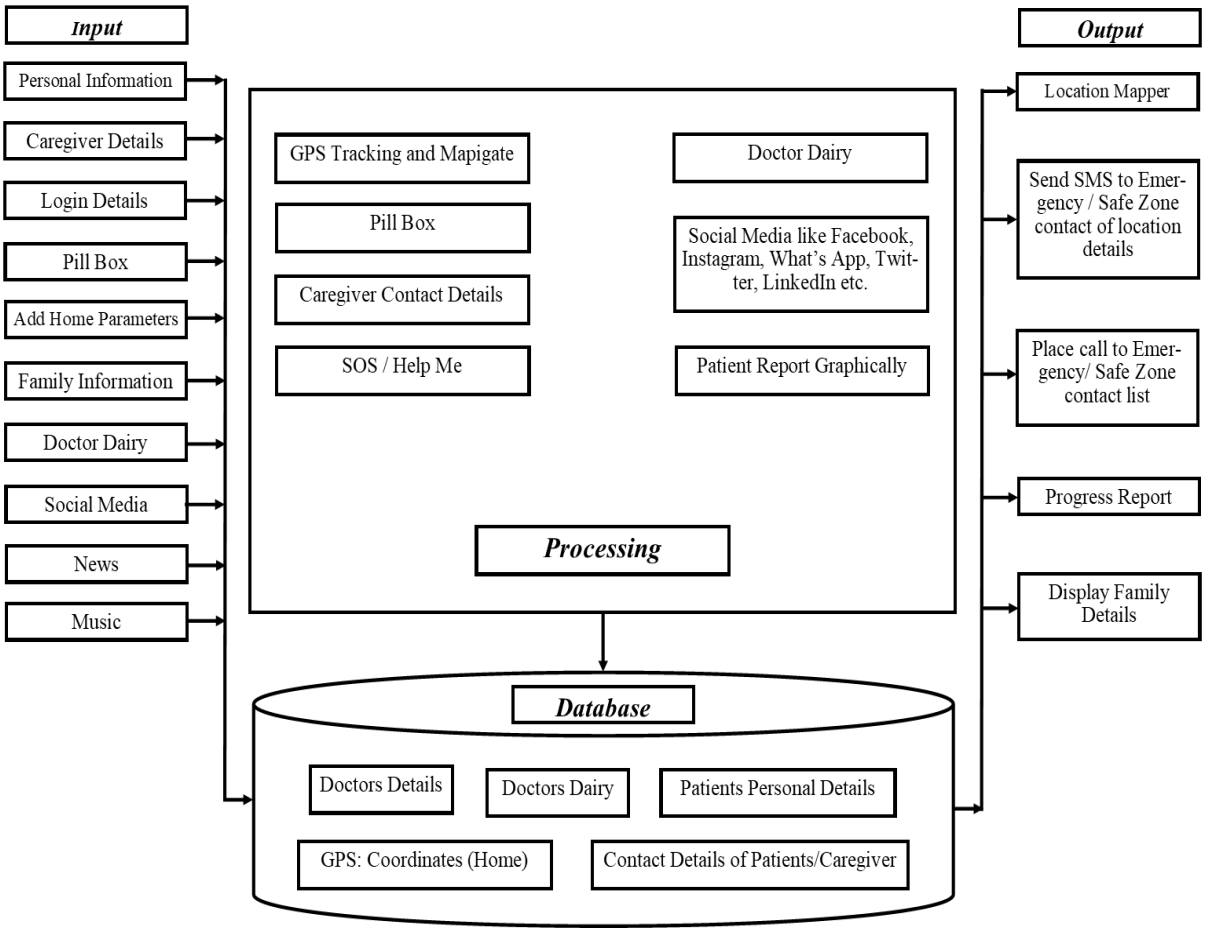


Fig. 2. Alzheimer Monitoring System Block Diagram.

Keeping in mind the difficulties faced by Alzheimer patients, following are the features which are incorporated in a mobile application, predominantly.

Personal Information (Patient and Caregiver): At the very beginning caregivers has to register patient with following mentioned credentials shown in figure 3.

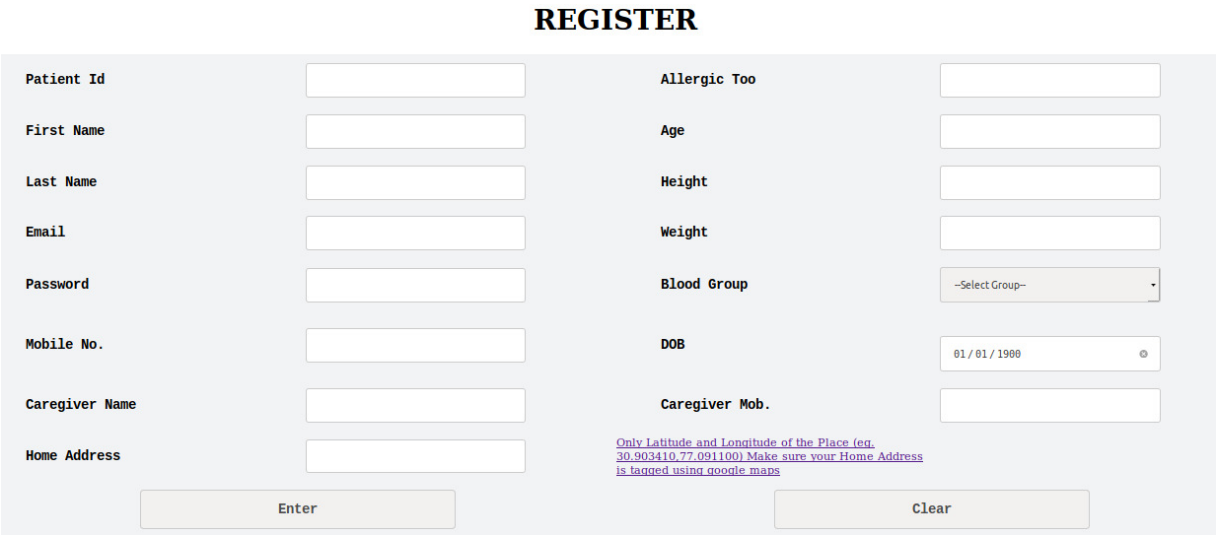


Fig. 3. Patient Registration.

Learning & Care Giving: This feature includes basic information about the diagnosis and cares that an Alzheimer patient requires (González-Salvador *et al.*, 1999; Tierney *et al.*, 1996). Alzheimer is a kind of dementia which possesses different stages. Each stage requires a separate protocol for taking care of the patient (Grol, *et al.*, (2007).

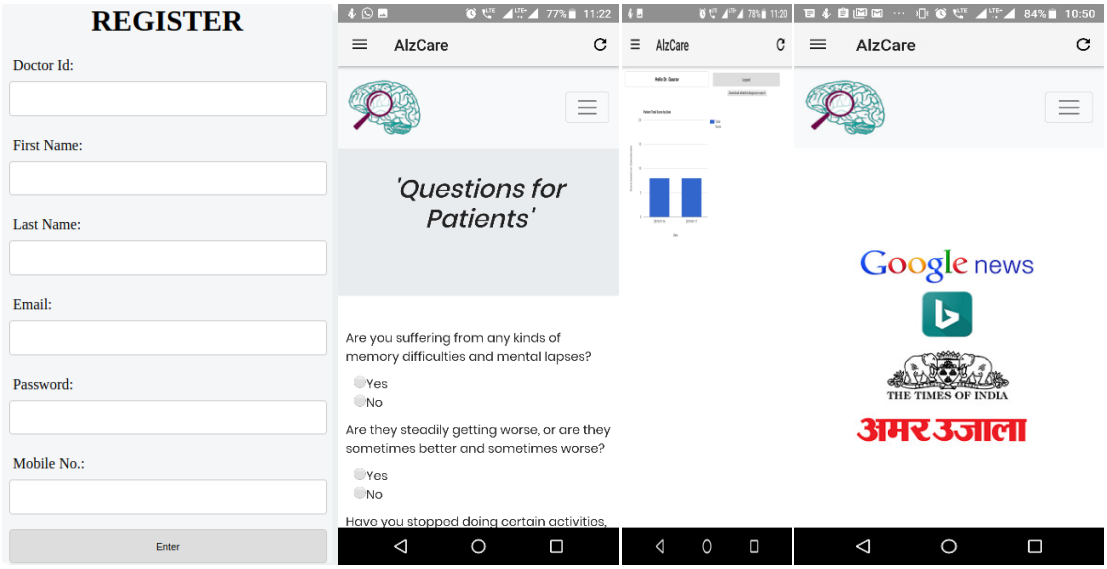
Thus, it is important for the caregiver to correctly identify the stage and take appropriate measure for proper handling of the patient.

Pill Box: Alzheimer patients require timely doses of medicine in order to slow down the disease progression. It is, therefore, necessary that the patient should not forget to take the prescribed medicine (Hall, 2003).

- This module deals with the proper management of medicine schedule by providing medication names, dosing schedule, refill dates by generating timely notification alerts.

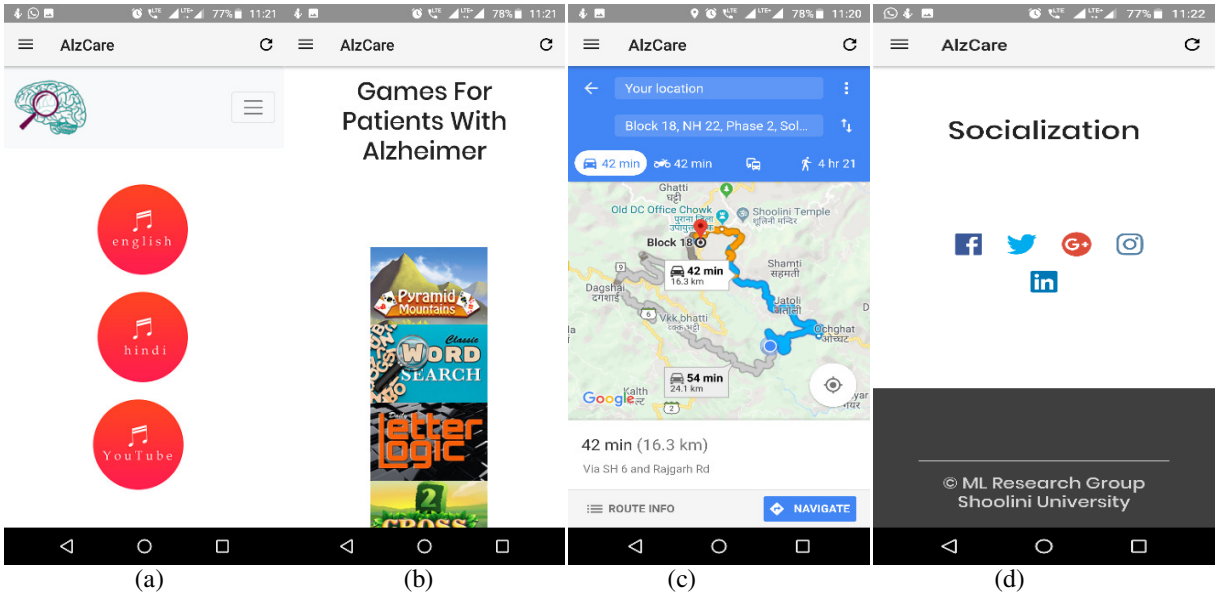
Doctor Dairy: This will act as a reporting system which is directly accessible to the clinician. In Doctor Diary, a set of Yes/No questions will be asked from patients and scored accordingly (Yu, 2005).

- The score will be then sent to doctors automatically which will be seen by the doctor. This enables the proactive analysis of critical situations that may arise due to the poor health condition of the patient.



(a) (b) (c) (d)

Fig. 4. (a) Doctors regstration (b) Doctor's dairy questions (c) Patient report in doctor's portal (d) News portal.



(a) (b) (c) (d)

Fig. 5. (a) Music Portal (b) Games for patient (c) GPS Navigation (d) Social Media.

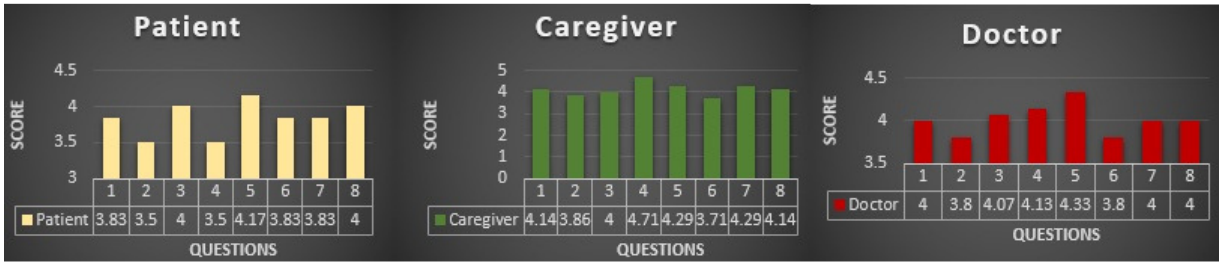
- **News:** This is one of the assistive features which has to be included to assist caregivers and getting up to date regarding the proper care. This feature will provide AD patients with up-to-date news about Alzheimer's research, treatments and other current developments.
- **Caregiver:** This feature includes the contact of the friends and family members which ensures a definite help from the family members in alarming situations. This also helps the patient to get connected with their trusted ones and also maintains social well being.
- **Music & Games:** Beloved music tunes help the Alzheimer patient to stimulate their brain. This is a music library which consists of the favorite music tunes of the patient. On the other hand, Games helps in the enhancement of their cognitive abilities. These games should be fairly simple and should not create frustration or anger to the Alzheimer associated patients.
- **Mapigate:** This feature enables thereal-time tracking of the patient. Alzheimer patient suffers from sudden memory loss, frequently. This creates a danger of forgetting the moving directions to a right path. So This feature shares the current location of an individual with the safe zone contacts and generates an alert, in case of wrong path selection.
- **Socialization:** This feature includes differnet social media platforms with which patients can interact with different people.

TESTING OF MOBILE APP

The mobile app testing is conducted with respect to the application and also in comparison with the existing systems conceded the following result (Zhang, and Adipat, 2005).

The survey of mobile app is conducted with the help of google form which includes the following questions

- *Usability and Evaluation*
  How easy is to use the App. [From 1 - 5] (in comparison to Carezone, Tweri Alzheimer Medical App, Alzheimer & Dementia, CURAAP, Alzheimer Assistant)?
  How good you will rate this mobile application based on efficacy and usability? [From 1 - 5]
- *Doctors Dairy (Report) and Mapigate (GPS) efficiency*
  How effective is the doctor's dairy? [From 1 - 5]
  How effective is the Location tracking for patient? [From 1 - 5]
- *Others Important Features*
  Games incorporated in the app is useful? [From 1 - 5]
  Socializations, News and other features of the app. [From 1 - 5]
- *Future Improvement and Approachability*
  Describe the factors which needs to be changed in coming versions?
  How supportive and easy is the user interface of the application [From 1 - 5]
  We have categorized our survey into three parts i.e. patient, caregiver and doctors.



(b) (c)

Fig. 6. Mobile AppTesting by (a) Patient's (b) Caregiver's (c) Doctor's.

CONCLUSION

Smartphones or Touch iPods is one of the propitious assistive technology benefitting both classes of individuals *viz.* the caregivers as well as the Alzheimer patients. Research suggests that playing the favorite music tunes helps in stimulating the brain of the patient while the photos help the caregivers and family for handling the situation of sudden memory loss by the patient. Hence there is a need to develop mobile applications which can benefit both or any of the two. Mobile Applications focusing on treatment or diagnosis of disorders needs to have certain set features which can help either help the patient or the caregivers. These features were collected on the basis of discussion by medical experts and the mobile applications used for this study.

Only 5 applications were found suitable based on the proposed set of features. Although the frequency of features in these applications ranges from 4 to 9, few features were lacking in every application. Those features are doctors dairy, games, SOS, daily scheduling. Thus, it can be concluded that a mobile application encompassing all the discussed features will act as a good support for the enhancement of cognitive abilities of the patient and also provides an insight to handle critical situations by caregivers.

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