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Mobile Application for Dementia and Alzheimer Patients

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Abstract

Dementia is an incessant neurodegenerative disease that to a degree influences millions of people around the world. Alzheimer's disease is a major reason for dementia, a term for the decline of memory and cognition, severe enough to impact everyday human performance. According to various studies, Alzheimer's disease has been found to account for 60 to 80% of dementia cases. Alzheimer's disease consists of 7 stages with different indicators. As the stage progresses, the patient's condition worsens over time and the dependency on the caregivers also increase. In this work, an Android application to provide a virtual guide for people with dementia and make tasks easier for caregivers is developed. This application will provide several features such as Family and Relationship information, Location Tracking using the Android location provider API, medication and exercise reminders with the alarm manager class, memory quizzes, and music therapy using Convolutional Neural Networks (CNN). The novelty of this application is the connection with volunteers in the vicinity using a spatial index for emergency assistance in situations where the nurse cannot physically attend to the patients. The aim of the application is to provide an integrated solution for counseling in all aspects of life in every stage of dementia.

Keywords: Dementia, Alzheimer, Caretaker, Mobile Application.

1. Introduction

Dementia is used to define any brain-related issues that negatively impact memory for human beings. It is caused by alterations in the human brain. Globally, there were about 46.8 million dementia patients as of 2015, and by 2050, that number is expected to rise to 131.5

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million [1]. Dementia disorders are chronic, progressive and incurable, it requires to coordinate care addresses the different aspects of the disease. People with Dementia struggle with a decline in thinking, social and behavioral abilities. Moreover, the loss of memory leads to functional disability causing difficulties in performing the daily activities

There are currently no reliable medicines available to reduce the progression of Alzheimer's disease or other forms of dementias. As a result, healthcare professionals concentrate on offering non-pharmacological interventions like counselling and music and remembrance therapy [2]. PWD become dependent on their caregivers or family members. Inexperienced caretakers may experience negative psychological, financial implications as a result of providing care for people with dementia, which can be a difficult task [3]. Caretakers also find it hard to track the patient's behaviors regularly and also increasing the need for assistive technology.

A study [4] was conducted on the existing mHealth applications and out of 678 apps, a total of 38 mobile apps met the requirements and were included in review. In general, several characteristics of dementia that have been discovered in research publications were targeted by the commercial apps that were considered for the shortlist. This extensive study determined the feasibility of using mobile Health-based applications for dementia, including AD individuals and their caretakers, despite the limited amount of research that was available. These apps have the capability to incorporate a variety of strategies and resources to dementia community care. The use of assistive information technology has the ability to postpone institutionalisation by relieving some of the responsibilities of caretakers while simultaneously regaining some of the care recipient's independence [5]. Thus, the aim of the proposed work is suggest a user-friendly application which creates stability by providing assistance to caregivers in managing the daily life activities of the patients and also helping the patient become autonomous. The application also enables both PWD and caretakers to handle smoothly in emergency situations.

The mobile application put forth aims to aid dementia patients and their caretakers by trying to make the patients more independent by providing features to help and manage ADLs effectively in a structured manner via refreshing the patient's memories. It also focuses on reducing the burden of the caretakers for monitoring constantly, as well as to avoid hazardous

situations by tracking the location of the patient and alerting them in case of emergencies. This application allows caretakers to handle tasks remotely instead of constantly supervising the patient and even seeking help during adverse conditions.

2. Literature Survey

H. E. Adardour [6], et al., proposed an IoT Geolocation prototype embedded with NodeMCU ESP8266. A GPS module and a portable Wifi modem as a dorsal belt are used for location tracking. The local data is analyzed and sent it to a mobile application integrated with Blynk/ ThingSpeak for marking the patient's location. It utilizes a Karman Filter Estimator for tracing and estimating the path of the patient, but it takes long time for localization.

Beenish Chaudhry and Joy Smith [7] proposed a mobile application to help a dementia- affected older adults in their day-to-day tasks and reduce the need for constant surveillance. Their application provides features such as a daily schedule and medication reminders, a photo book consisting of necessary details of family and friends, and a game module for improving the memory of the patient with the help of jigsaw puzzles. These features are implemented in Android Studio using the Intent and Image View classes.

Wai Kit Chenga [8], et al., developed a 3D customizable electronic shoe with data mining and fitted with GPS and RFID technology for providing outdoor and indoor location tracking functionality respectively. The designing of the shoe involved data collection from 3D and footprint scanning, categorization of elderly subjects and regression analysis. The caretakers are able to view the location data via a web-based application and it can additionally specify a geo-fence for enabling smart alert systems.

Rania Chokri and Wasna Hanini [9] proposed a collar-worn IoT prototype capable of performing facial recognition via CNN, which classifies known and unknown faces for better usage in the future and it uses steganography, a encryption technique to hide the identity of the person. This method was introduced since the previous models had privacy problems. Their model provides the capability to securely track the person with AD via GPS, incorporating an intelligent alert mail system involving S/MIME and Google voice assistance.

Kalpana Devi S [10], et al., developed an android application for providing personal assistance to patients. The application utilizes Deep learning and machine learning algorithms for face recognition to improve the memory of the patient regarding acquaintances, and

fainting detection along with GPS and Google Maps for detecting wandering behavior and alerting the caretakers in case of emergencies. Conventional sensors like accelerometers and gyroscopes were used for fall detection. The basic Reminder activities were also implemented by extending Built-in classes to manage day-to-day activities.

Amrita Dewani [11], et al., proposed the idea of creating a Technology- oriented solution for Assisting Caretakers and Dementia Patients with Mild Cognitive Impairment. The application provides assistance in daily routine activities, medication dosage guidelines, pills reminders, quiz games for reminiscing about patient's memory, location tracking and audio/video call feature. It includes a GPS location tracking system, firebase functions for SDK, Java Rest Services (Retrofit API) and Android Studio for application development.

Greeshma and Deeksha Bharadwaj [12] presented an IoT prototype which focused on tracking, monitoring and acting as a safety system for dementia patients. The Arduino-based kit consists of a GPS tracker to find the location of patients, a DHT11 sensor to check the temperature, SW-420 vibration sensor to detect the motion of the wearable system. Wifi Module, GSM and Node MCU connect the IoT prototype with the Blynk application.

K. İleri [13], et al., developed an Arduino-based wearable tracking system consisting of an Arduino Neo-6m GPS and a SIM800L Mini GSM/GPRS module to track the location of a person with AD and send the latitude and longitude data via a web server to an android application. Their application is built with Java and is embedded with Google maps for effective and accurate patient tracking with the help of location markers.

Manasi H. Kasliwal and Dr Hemprasad Y. Patil [14] presented an IoT prototype for family members or caretakers of dementia-affected elderly people. The purpose of the prototype is to find the real-time location of the patient on the caretaker's mobile application. Their prototype used Arduino Uno, GPS RoyalTek REB-4216 modem and GSM SIM900 module to track the location of the patient. The android app is developed in Android Studio. It is an official IDE for Android platform development and it is an Intellij-based platform.

Sarita [15], et al., developed a mobile application that mainly engaged in making users understand dementia and provide information regarding it. The application focused on features such as remainders, and workout & food counselling along with games. These

features are executed using the Android Studio classes such as Alarm Manager, Intent class and Image classes.

Kazi Shahrukh Omar [16], et al., presented an IoT-based intelligent assistive tool for Alzheimer's patients comprising different features to help the patients be independent in taking care of their daily activities. The prototype consists of a GPS-Wifi tracking system to reduce the risk of wandering, a heart rate monitor which notifies the caretaker in case of irregular heartbeat, important objects for daily usage are tracked by attaching them with trackers and lastly smart medicine box. These tasks are implemented by using Arduino to connect the different modules used for each feature. The smart pill box provides medicine at a specific time but no alerts are provided in case of any errors.

Muhammad Wasim. Raad [17], et al., proposed a prototype for consisting a Sirit RFID reader embedded in wearable anklets or bracelets and an external antenna system to localize the movements of older adults affected with Dementia. The positioning of the tags in various positions was compared for the most accurate results. An android application using Google maps is developed in support of their prototype for detection and alerting of wandering behavior.

Sarath Rathnayake [18], et al., conducted extensive surveys and interviews with family caregivers and therapists to acquire content requirements for developing a practical and simple-to-use assistive mhealth application. The application includes several features to provide an overview of dementia care and manage the patient's daily life activities and the caregiver's well-being. The application was implemented with Java and HTML, along with firebase connectivity.

Kanmuru Vikranth Reddy [19], et al., proposed a mobile application for dementia patients where included some features such as face recognition to identify family members and close ones using OpenCV by cross-verifying the image of a person with the data provided to the application by the caretaker. A simple chatbot feature is also added which provides responses for basic queries in common, conversational answers. The implementation of an android application is done by using Android Studio along with Agora API for the features used.

Daniel Rodrigues [20], et al., proposed a smartwatch-based system to handle wandering behavior and fall detection of people affected by Alzheimer's. GPS-based

Location services are used to pin the location of the patient and geofencing is used to specify a safety zone outside of which invokes an alert. An accelerometer is used for fall detection where a fall is recognised if the value reaches either minimum or maximum peak of acceleration and triggers a warning in either case. The application was made to simplify user interaction and maximize functionality.

Unais Sait [21], et al., proposed a wearable smartwatch integrated with RFID, Bluetooth module along with image processing for object identification and face recognition enabling patient identification. GPS modules are used to identify the location of the patient and the data is sent via GSM to the application were installed in the caretaker's smartphone for tracking. The application also includes an alarm and notification system to manage the patient's daily routine. The patient is guided to understand the equipment via voice commands and has the ability to provide feedback via the smartphone. Smartwatch also includes a music recommendation feature for improving patient relaxation especially useful after panic situations.

K.S. Savita [22], et al., proposed a mobile application which helps people affected by earlier stages of dementia. The application was developed considering feedback from a broad range of participants. The data are collected and analyzed through multiple interview sessions as well as through partial observations from real experiences. Features such as reminders and photo albums are implemented using in-built classes in Android studio. Another important feature developed was that of object identification which used image processing to identify objects and describe their functionality for future reference.

Deepali K. Shende and Mr Sidheshwar Madrewar [23] proposed a smart-phone based monitoring system for people with Dementia worn as a belt which includes tracking the path of the patients for detecting signs of wandering via real-time images from the smartphone camera of the user's path and GPS. The data collected from the user is constantly updated on the cloud for regular monitoring of the caretaker. Fall detection is achieved by using a wearable 3-axial accelerometer which notifies the caretaker of the patient location along with the Google Maps link via Gmail if the sensor reading crosses the threshold.

Sherine Susanna J and Sivakumar R [24] developed an IoT prototype of an elderly monitoring system comprising remainders and fall detection. Their prototype included

temperature and Pyroelectric Infrared sensors for temperature and fall detection. Gas alert and water level monitoring were also done using the DAQ assistant and NI LABVIEW software, along with .NET controls.

Sundar C [25], et al., proposed a mobile application to aid dementia- affected people and their family by decreasing the burden of taking care of the patients. Their application mainly focuses on locating patients via Google Maps, so the risk of wandering is avoided. Reminder for daily tasks by using Android Studio classes. Flutter framework is used for the development of Android Studio.

Paper	Reminder	Location Tracker	Memory Stash	Detail
RefineMind: A Mobile App for People with Dementia and Their Caregivers [7]	Yes	No	Yes	Yes
Personal Assistance for Alzheimer's Patient [10]	Yes	Yes	No	No
DemCure: A Technology-oriented solution for Assisting Caretakers and Dementia Patients with Mild Cognitive Impairment [11]	Yes	Yes	Yes	No
Co-design of an mHealth application for family caregivers of people with dementia to address functional disability care needs [18]	Yes	No	No	Yes
Mobile Application for Alzheimer's Patients [19]	No	No	Yes	Yes
Memhans: an Assistive Device for Dementia Patients [21]	Yes	Yes	No	No
Help me! MyDem application for early-stage dementia patients [22]	Yes	No	Yes	No

DemeAssist-Dementia Assist Mobile Application [25]	Yes	Yes	Yes	Yes

3. Module Description

The application is used by different categories of users, where each and every user use the application for their own requirements. Based on this the modules available and the interaction with application differs. All the modules within the application with their description are provided below.

A. Reminder

This module is simple but it is an important feature for dementia-affected patients. Caretakers can set task reminders with the necessary description, timing of the reminder and repetition settings for each task and on completion of the task the patient can provide confirmation giving a solid feedback system which helps the caretaker in viewing patient progress. The reminder history list can be viewed by both caretakers and patients in the application. These remainders include activities like exercise and medicine intake.

B. Location Tracker

This module enables users to track the location of the patient via GPS and display the location details in Google maps along with location markers. Patients must allow the application to access their smartphone's GPS as a requirement to use this module. Caretakers and Volunteers use this feature for preventing wandering behavior and ensuring the safety of the patient. In case a patient is lost, home location details are shown to the patient and an alert is also sent to the caretaker with the patient's current location.

C. Volunteer Association

This module enables users to act as helpers when the caretakers need assistance in any task while taking care of the patients. The users can register themselves as volunteers who can assist the caretaker in need. During emergency situations, caretakers can search for volunteers based on their rating and the patient's locality then the caretaker can connect with the volunteer and send them the patient's current location and also necessary instructions for

providing help to the patients. The Volunteers can also send confirmation to the caretakers once the situation is handled. The caretaker can review and set ratings for the volunteer based on their experience.

D. Memory Stash

This module helps the patients recall the important memories and events that happened in their life. This acts as a storage module to save important details associated with the patient's life. The caretaker can easily modify and add required details of the patient's life to this module which the patient can access as required. The photos and videos of an event, family members and emergency contact details are stored in this module to refresh their memory.

E. Music Therapy

This module helps the patients to relax after panic situations. Camera permission should be provided as a requirement for this module. The module takes the live camera input for performing face expression recognition. This recognition is done with the help of CNN algorithm. A set of predetermined emotions are taken as a reference and music playlists are categorized and stored according to this set. Based on the detected emotion, the appropriate playlist is recommended to the user.

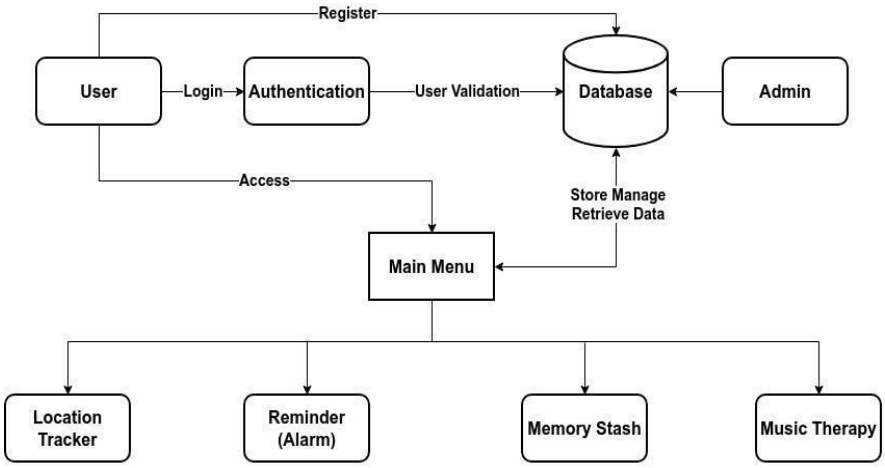

Figure 1. Flow Diagram

4. Challenges in the Existing System

In existing system, various applications have been developed to aid dementia patients in their day-to- day activities. There are different approaches and research-based applications have been proposed in the domain of dementia. But most of the applications are lacking in the important factors of connecting with the caretaker addressing the dependent nature of patients properly. This is the main concern in the existing system as mostly every application requires the assistance of a caretaker to constantly teach the patients and supervision is not reduced as much. This approach is ineffective as people affected by dementia have to relearn many common habits and continuous mental or emotional strain can make them easily agitated due to high sensitivity.

5. Conclusion and Future Work

A mobile application for Dementia and Alzheimer patients with various features such as location tracking, volunteer association and music therapy for the patients and caretakers is put forth in the work. The proposed work provides a cohesive and user-friendly application to take care of all daily life activities of dementia patients with effectively and assistance to the caretaker for enhancing the caretaker-patient coordination. Moreover, some features are included in the applications by using in-build classes. The music therapy feature is implemented by using face recognition via CNN. The novelty of this application is the connection with volunteers in the vicinity using a spatial index for emergency assistance in situations where the nurse cannot physically attend to the patients. The aim of the application is to provide an integrated solution for counselling in all aspects of life in all stages of dementia.

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