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A Helping System for Dementia Patients

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Abstract: In the 21st Century, everyone is running on the trade mill of life. In this cut-throat competition, Dementia/Alzheimer's can be a dishevelled consequence of such stressful life. Alzheimer's is the most common type of dementia. The system focuses on prime aspects of diseases affecting a massive amount of the population today i.e., Dementia and building an android application that could ease the everyday life of a person affected by dementia disease. With the help of this application, we have tried to fill the gap between patients and caregivers. The idea behind implementing it on "Android" is that it is a widely accepted open-source operating system.

Using the Firebase cloud and MySQL ROOM database to store data and the ML dependencies to validate the person face system is designed. This application has several basic functions like "Personal Information", "GPS Navigator", "Doctor Involvement", "Emergency Button", "To-Do List", and "Notification/Reminders". In the future improvement of medical professionals like scientists and researchers can be possible.

Keywords: dementia, android, reminder, dependency.

I. INTRODUCTION

Dementia affects millions of people worldwide. Caring costs for Dementia patients are $85,775 per year expected to reach $379 billion to $511 billion. Dementia is a collection of symptoms that affect memory, calculation and social abilities. Memory loss is a common symptom of dementia. Dementia is a global impairment of intellect, memory and personality but without impairment of consciousness. Not everyone is fortunate enough to remember everything and everyone. Some people tend to forget the smallest of things. This illness can be cured in the initial stages. These mobile applications for dementia patients can play a crucial role in improving their quality of life and cognitive function. These apps can help keep memories alive by allowing patients to revisit past events, people, and places. Engaging and stimulating activities such as games and puzzles can also help keep the mind active and engaged, potentially slowing down the progression of the disease. Communication is also a key aspect, and a mobile application can help patients stay connected with loved ones, even if they are physically apart. Additionally apps can help monitor symptoms and provide valuable insights for doctors and caregivers, ensuring the patient receives the best possible care. Mobile application for dementia patients can help to improve overall quality of life and provide peace of mind for their loved ones.

Dementia is a syndrome in which there is deterioration in cognitive function beyond what might be expected from the usual consequences of biological ageing. Although dementia mainly affects older people, it is not an inevitable consequence of ageing. Worldwide, 55 million people all over the world face the dementia problem and of this total number, 60% are living in low and middle-income countries.

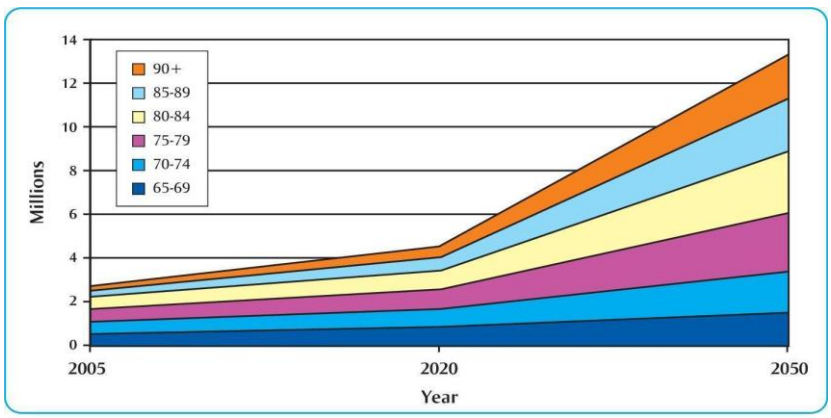

Figure 1.1 Dementia Statistics According to age

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As per the study, it is predicted that the number of older people in the population is going to increase rapidly mostly in all countries. According to the study, the number is expected to grow to 78 million in the upcoming 10 years and by 2050 the number may also reach 139 million. And it is expected to grow at a high rate in the upcoming years.

Overall study on this shows that people can reduce their risk of cognitive decline and dementia by being physically active, not smoking, avoiding harmful use of alcohol, controlling their weight, eating a healthy diet, and maintaining healthy blood pressure, cholesterol and blood sugar levels.

Additional risk factor may include various factors like depression, social isolation, low educational attainment, cognitive inactivity and air pollution. Dementia has very significant social and economic implications in terms of direct medical and social care costs, and the costs of informal care. In 2019, the estimated total global societal cost of dementia was US$ 1.3 trillion. These costs are expected to surpass US$ 2.8 trillion by 2030 as the number of people living with dementia and care costs increase. And this cost is going to increase to 10 trillion by 2050 which is a huge number.

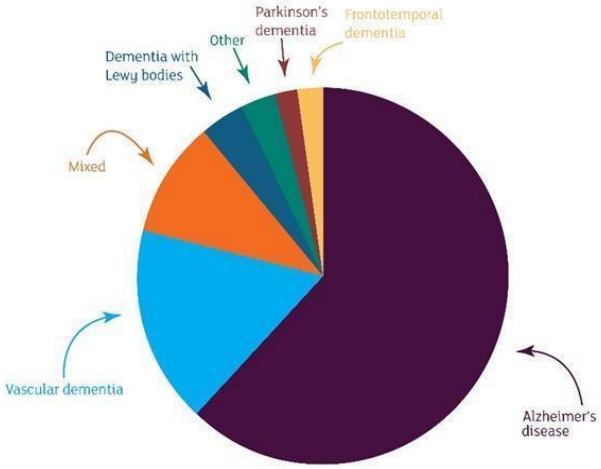

Figure 1.2 Dementia Statistics according to type

This application will make such patients less dependent on others and help them complete their day-to-day activities without needing others. An application For Dementia Patients using Cloud and ML. This study analyzed mobile apps for dementia care. To create mindful co-design techniques that will allow persons with dementia to voice their needs and issues with social participation during the design process.

Conceptual and Technical development of tangible mindful design solutions, both personal and environmental. Utilize new technology like Cloud, ML, and Android.

1. Alzheimer's Disease: It shrinks the brain and eventually causes brain cells to die, which affects and destroys the brain. In this type, People forget recent conversations or occurrences, misplace stuff, forget the names of places and objects, struggle to find the proper term, and ask repeating inquiries.
2. Vascular Dementia: It is a general term problem with reasoning, planning, judgment, memory and other thought processes caused by brain damage from impaired blood flow to your brain. In this type, people have a lot of confusion, trouble paying attention and concentrating, a reduced ability to organize thoughts or actions, a decline in the ability to analyze a situation, develop an effective plan and communicate that plan to others, and slowed thinking.
3. Dementia with Lewy Bodies (DLB): It is one of the most frequent kinds of dementia and is also known as Lewy body dementia. This kind of dementia involves a gradual deterioration in mental functioning. People with it also may have visual hallucinations. It has the symptoms like slow movement, stiff limbs, uncontrollable shaking and shuffling when walking.
4. Parkinson's Disease Dementia: This kind of dementia affects roughly 50% to 80% of people with Parkinson's disease, a nervous system condition. This disorder can impair cognitive function, causing forgetfulness and difficulty concentrating. Symptoms include problems in memory, focus, and judgement, difficulty processing visual information, and garbled speech.
5. Mixed Dementia: It is a combination of two types of dementia. The most common combination is Alzheimer's disease and vascular dementia. In this type, people forget about recent conversations or events, misplace items, forget the names

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of places and objects, have trouble thinking of the right word, ask questions repetitively, have Confusion, Trouble paying attention and concentrating, reduced ability to organize thoughts or actions.
6. Frontotemporal Dementia (FTD): Frontotemporal dementia (FTD) or frontotemporal degeneration is an illness characterized by progressive nerve cell loss in the frontal lobes of the brain.

As a result, there is a problem with behaviour and/or major personality changes, such as cursing, theft, a decline in personal cleanliness practices, socially unacceptable, impulsive, or repeated behaviour, and impaired judgement.
Stages of Dementia Disorder:

1.No Cognitive Decline – It has no Symptoms. The time period for it is also unknown.
2. Very Mild Cognitive Decline – It has symptoms related to memory problems. The time period for this is around 1 to 2 years.
3. Mild Cognitive Decline - It has symptoms which can be more noticeable to friends and family. The time period for this is around 2 to 7 years.
4. Moderate Cognitive Decline - The symptoms of Cognitive decline are apparent, and we should consult a healthcare professional as early as possible. The average duration for this is around 2 years.
5. Moderately Severe Cognitive Decline - The symptoms are memory loss regarding personal details. The average duration for this is around 1.5 years.
6. Severe Cognitive Decline - The symptoms are one may require help for daily activities. The average duration for this is around 2.5 years.
7. Very Severe Cognitive Decline - The symptoms are one may experience severe motor and communication impairment and may lose the ability to speak. The average duration for this is around 1.5 to 2.5 years.
This system has a storage facility for photos and videos using Cloud [Firebase]. The Firebase Realtime Database is cloud-hosted. Data is stored as JSON and synchronized to every connected client in real time. For the comfort of the patients, firebase is the suitable database to collect the required data. Firebase provides authentication for login and registration purposes it will use in the proposed system to authenticate the user as per the norms.

Location tracking module to assist patients. This location tracking works by using the Google GPS dependencies which support android applications to get the device's longitude and latitude coordinates which will help the guardian to track the patient. A to-do list is used to schedule the regular tasks for the patient, and medicine reminders by data and time reminders can be set. The patient's medical history can be handled by the doctor module so the progress of the patient can be tracked. Appointments also get scheduled by the system which will be displayed on the Guardian and patient dashboard. Storing pre-recorded video content for rechecking the identity of patients and their family members/friends. Biometric/ face validation module for patients to validate family and friends. This proposed system analyzed mobile apps for dementia care. This system's goal is to provide mindful co-design techniques that allow persons with dementia to communicate their needs and issues with social participation during the design process.

II. RELATED WORK

Sundar C [1] implemented a mobile application to provide comfort for dementia or Alzheimer's patients, caretakers and doctors. Patient's medical history is tracked as also the personal information of patients related to their family and friends. Using Google Maps, they implemented location tracking functionality to trace the patient's location by the Guardian side. The authors implemented location tracking functionality if patients wander beyond a certain limit, then notify the guardian. This model triggers the patient for the medicine reminder. Bear in mind family, and friends' photos and pre-recorded videos can be stored in the application. When family/friends are not around, this facility helps the patients. There is also a term for an emergency call when a patient need help. The model has modules such as login/registration for caretakers and patients where they used Firebase Authentication services.

Musani Aqsa [2] proposed a system with 2 applications one for the patient and another for the caretaker. They analyzed the symptoms of dementia patients where they studied disturbance in brain functioning including memory, calculations, language, judgement and learning capacity. Dementia patients go from the 7 stages of dementia Very Severe Cognitive Decline, Severe Cognitive Decline, Moderate Cognitive Decline, Mild Cognitive Decline, Moderately Severe Cognitive Decline, Very Mild Cognitive Decline, and No Cognitive Decline. Dementia affects many aspects of humans as social behaviour and emotional control. So, the author designed a model with game functionality to check the regular progress report by mental ability. This proposed system also includes GPS tracking by the caretaker side to track the patient's location. The system helps to follow the schedule of tasks and medicine schedule by reminders. Quiz game is introduced to identify family members and friends, and to stimulate brain functionality games are helpful.

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Huansheng Ning[3] presented a paper about the SGDC and they talk about the stages of Serious Games for Dementia Care (SGDC). Generally, treatment of this disease mainly depends on therapies which are based on drugs which do not have the results we want, so the paper talks about how SGDC is the method which can be one therapy which will contribute to bringing improvement in dementia patients. As Serious games, they are going to use in the treatment of dementia patients so these games will not be for the purpose of entertainment. At the early stage of Huarongdao, Jigsaw these kinds of traditional board games were used for dementia care. The basic goal of this paper is to provide help to researchers in developing more effective and appropriate SGDC. According to the WHO, dementia patients have three stages and for that different serious games have developed according to the need of that stages like first stage patients have normal problems like less thinking abilities or memory-related issues which will be difficult to recognize so that Fitt&Hick game and memory games etc. second stage patients suffer from the same problems as like first stage patients with the additional problem of physical disorder and for that Point-and-Click game and Executive timed target game is developed for patients as per the review done in this paper. And third stage patients have a bad condition, they generally have the problem of complete loss of memory. For using serious games for treating dementia patients, the basic requirement is that patients should have the ability to understand the rules of playing that game. But in this stage patients will not be able to understand rules. So, serious games are not suitable for this stage. This paper also has done a review of the assessment model which has therapeutic effectiveness. It means checking whether those serious games are effective for doing therapy on dementia patients or not. This paper is proposing the model with some future scope including adding therapies like reminiscence therapy and music therapy which will be also helpful for dementia care.

We are referring to this paper for knowing more about dementia patients. We are getting how we can take care of dementia patients and what problems they exactly face. As mentioned earlier that this paper aims to help researchers to design SDGC. The conclusion of this paper is for providing effective and appropriate treatment which will do dementia care well than medical treatment based on medicines. This treatment is going to provide through serious games. But this proposed system which is presented in this paper involves serious games which cover all the symptoms of dementia patients and this proposed system also has the involvement of multiple patients like patients and professionals etc. which is an additional feature compared to present serious games. This paper aims to guide researchers in developing and designing serious games which will contribute to treatments for dementia patients.

Shakila Basheer [4] talk about Alzheimer's disease which is a progressive stage of dementia. Dementia disease is generally faced by aged persons whose symptoms are like loss of some cognitive abilities and loss of memory. But Alzheimer's is the next stage of dementia disease where the human can die because of cell connections of the brain and even degeneration of cells themselves and die which results in complete memory loss and problems related to mental functions. Alzheimer patients also will have a less life span of a few years which again depends upon different factors. But this disease can be identifiable at an early stage so that we can take appropriate treatment to treat Alzheimer's disease.

Mainly this paper is focusing on the early detection of Alzheimer's disease so that it will be helpful for patients to get recover. The proposed model is using more efficient modified capsule networks rather than using CNN because modified capsule networks resolve problems of CNN like an absence of function pooling, and spatial information.

As per the review of this paper, CNN is used by most of the other models. But the proposed system has advantages in that it is using capsule networks which use for handling problems related to hierarchical modelling and offers advantages related to accuracy and good computation as compared to CNN. The proposed model is also using the PCA kernel method to build a simpler model so that we can use this model in hospitals. This model is using classification techniques by feeding images to the system using CNN and CapNet in the image retrieval type of system. And it works by taking some images as a sample and even extracting some images after that next step it performs is pre-processing of those images. Once it is done then the model does the feature extraction of that images and finally, it trains that particular model and built that model. In this model data preparation happened by taking the database from the OASIS dataset which involves numerous PET images as well as MRI images of patients suffering from Alzheimer's disease.

This method also uses the latest capsule network, which takes input data and then it generates the parent vector by taking into consideration of different features. The CNN and activation function gets the data and gives a transformation vector. In this, the feature extraction is done by using KPCA before the data is passed on. In CNN a Squash is used which is a special activation function. The output of the Squash function tells how data is routed. The analysis is done on the OASIS MRI longitudinal dataset by using this we can predict early dementia. For the analysis of this data, different Python libraries are used. In this paper, we studied longitudinal MRI images which consist of neuroimaging test images. This model makes use of the capsule network technique to differentiate the dementia group.

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Zhengyan Sheng [5] implemented a Convolutional Neural Network (CNN) to differentiate dementia patients from Healthy Patients. The method uses eye tracking and simultaneous speech for recognition of the subject. The authors developed two models, first, regional picture recognition and automatic speech recognition to extract the features related to eye-tracking and speech. In next step, a neural network combines these two models for identifying patients with dementia. Patients in the early stage of dementia suffer from language disorders. To identifying dementia using speech, many datasets of speech are designed for dementia diseases analysis. Dementia can also be detected based on eye-tracking features. Many datasets have been designed for dementia detection using eye-tracking. Earlier the methods used single-model data to detect dementia patients but the use of a multi-model Convolution neural network has proved to be a better choice. The dataset was made by the records taken from the patients of Shanghai Tongji Hospital. All patients suffered different levels of dementia and were subjected to a physical examination and cognitive function test. The dataset has Chinese Speech and eye-tracking recordings from the subjects during a picture description task. In the task, the subjects were asked to describe the picture of 'Cookie Theft' as much as possible. Doctors provided them tips while describing the pictures. The description of the patients and tips from the doctors were recorded by a microphone. The eye movement of every patient was tracked and had attributes such as the position of sight, the state of eye movement, duration of the state, size of the pupil, etc.

Suriya Murgan [6] created (DEMNET) i.e. DEMentia NETwork to find stages of dementia disease by using MRI. It is a CNN i.e. Convolutional Neural Network used to generate a structure which can be used to locate particular characteristics of Alzheimer's illness by using MRI (Magnetic Resonance Imaging). The network considers four stages of dementia and results in significant probability that results from the structure of the patient's brain. The four stages are: i) Mild Cognitive Impairment ii) Mild Dementia iii) Moderate Dementia iv) Severe Dementia. The model uses a CNN to take out differentiating features. The model is assessed by training it on the dataset of the MRI from Kaggle. This dataset has 6400 MR Images of four classes Mild Demented (MID), Moderate Demented (MOD), Non-Demented (ND) and Very Mild Demented (VMD). This dataset consists image of 176*208 size. Those images are again resized into size 176*176. This dataset is a class imbalance as the number of images for every class is unequal. The Synthetic Minority Oversampling Technique (SMOTE technique) is applied to that dataset which increased the total number of images to 12800 with each class having 3200 images. This dataset is split into 10% for validation**,** 10% for testing and 80% for training set from 12800.

The review paper by MD Rishad Ahmed [7] offers a thorough examination of pertinent neuroimaging modalities and related analysis approaches made available in past few years for dementia diagnosis. The recent reviews have addressed only particular imaging modality, which includes MRI, PET and a single type of dementia, like AD. For dementia diagnostics, they generally cover a wider range of imaging, machine learning and deep learning technologies so that specialists in this field can quickly determine its state of art. Additionally, they stress on significance of early dementia detection and also prediction so the patients can receive treatment and support as early as possible. This will help to slow the degenerative procedure and help the patient keep their quality the life for a longer time. Their review is broken down into multiple sections: (1) in the field of dementia diagnosis a discussion of the most recent neuroimaging techniques for important clinical applications (2) structured description of the techniques in machine learning, especially deep learning approaches for the early detection of dementia diseases.

To diagnose different types of dementia, that outlined the most contemporary neuroimaging techniques, including PET, MRI, and SPECT, as well as deep learning and machine learning technologies. They concluded that using MRI scans is promising to diagnose AD, significant advancement is required in diagnosing different types of dementia such as VD, PD, and FTD. This was based on the performance measurements across algorithms in the available literature. They also discovered that deep learning methods outperform traditional machine learning and imaging approaches in the analysis of brain images obtained using cutting-edge imaging techniques. As a result, the field is moving quickly toward providing early and accurate diagnoses of dementia in all of its forms. Further study is required to enhance categorization for diagnosis of dementia, particularly for earlier identification to enable treatment that can start sooner.

Shehroz S. Khan [8] detected agitation using unsupervised deep learning and by taking help of videos in people having dementia. Long Term Care (LTC) facilities have video surveillance systems, the team developed a computer vision algorithm for studying these videos to detect the problem of agitation in people those who are having dementia disease. As the symptoms of agitation are very rare so they can be considered an anomaly. They developed an unsupervised neural network which was trained approximately on 24 hours of recording of normal activities and further it was tested on 11 hours of video having both agitation episodes and normal activities. The dataset contained videos from 20 number of research participants in the Specialized Dementia Unit located at TRI, which is present in Toronto, Canada. Fifteen Cameras were installed in the public areas such as recreation, dining and hallways in the unit. Due to the privacy issues, the cameras were not installed in the washrooms and bedrooms of the participants. The recording was only done between

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7 and 23. The last dataset include the data of 17 participants, excluded due to a lack of agitation events. The data was collected form the total videos of 600 days. A total video data of 35 hours of the participant was considered and divided into testing and training data sets. The training data set has video data of approximately 24 hours, having normal events only. The test has video data of 11 hours which had agitation episodes. The test set was split into 30 seconds which were labelled as agitation (0) and (1) normal for evaluating the performance of developed model.

Spatial navigation [9] is the ability of finding and maintaining a route from one place to another place. Patients with dementia suffer problems in spatial navigation. The spatial navigation ability decreases with the stages of dementia for the patient and can be considered as a feature for diagnosis. Such people with dementia rely on navigation assistance devices for their daily activities. Léa Pillette and co-authors did a navigation systems systematic review for people with dementia. The review aims to provide a qualitative analysis of navigation system that were tested with people having dementia and also to provide guidance for the implementation, design, and evaluation of future navigation systems for patients with dementia. The main focus of the review was on i) navigation advice provided by the system ii) technology on which the device relies iii) experimental methodology that is used for testing the device. The review aims at providing solution to these questions:- 1) Which devices providing navigation for people with dementia disease have been tested and developed ? 2) Do they improve daily living and navigation abilities? 3) Which characteristics are beneficial? 4) How were the devices evaluated?

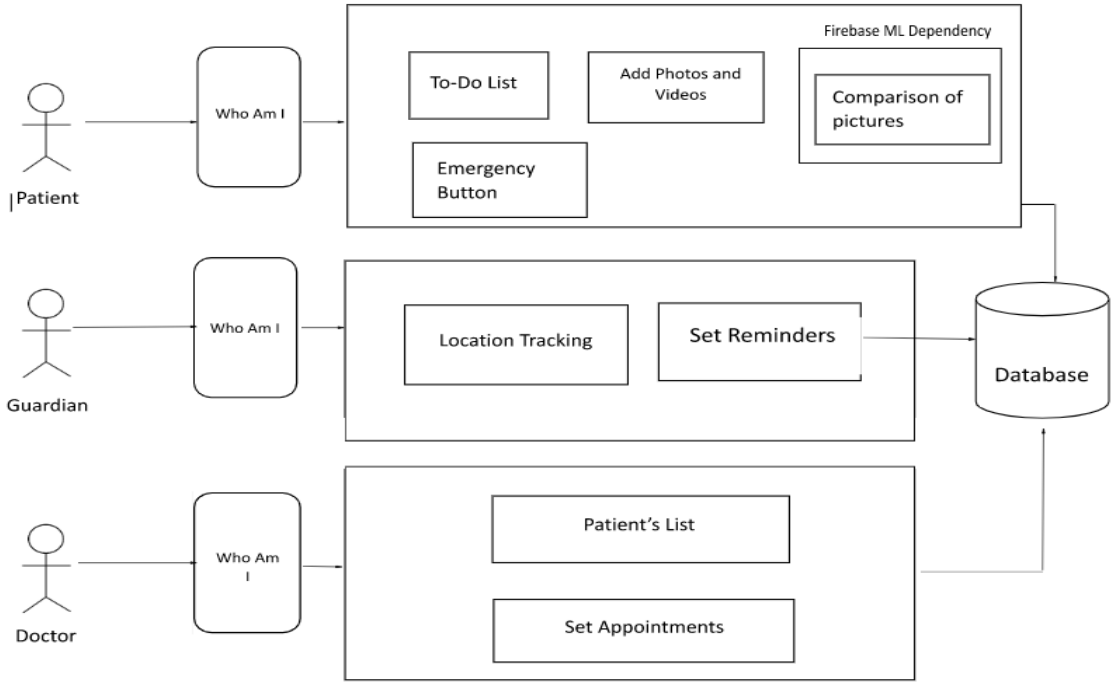

Figure 3.1 System Architecture

III. PROPOSED SYSTEM

This application helps dementia patients make their day-to-day life easy. It is composed of three main models Doctor, Guardian and Patient.

Currently, there are many different apps present in the market which has some features but not collectively. We have developed a system which draws all the beneficial features from these apps and added some features that are unique to our apps. We have proposed to integrate features like patient monitoring by the doctor and guardian at their end. Face recognition is also added so that the patient can point the mobile camera to any person add check the details about the person if present.

The first module has facilities like To-Do List, Add Photos and Videos, an Emergency Button, and a Comparison of Pictures.

i) To-Do List: The patient is allowed to keep track of day-to-day tasks.

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ii) Add Photos and Videos: It allows patients to store photos and videos of people, family members and any other places that the patient visits, which are helpful in future to recall the memories.
iii) Emergency Button: Patient can use the following functionality when in danger or is having a panic attack or any other difficulty, which will send an alert to its guardian.
iv) Comparison of Pictures: Patient can use this in case he cannot recognize the person. The functionality allows patients to get information about the person by comparing the person with images and videos captured by the patient earlier.

Second module has facilities like Location Tracking, Set Reminders.
i) Location Tracking: It allows the guardian to track the patient's location by using the device's GPS.
ii) Set Reminders: It allows the guardian to set reminders of the patient's daily tasks, such as taking medicines on time, or any other work to be done.

Third module has facilities for Patient Lists and Set Appointments.
i) Patient's List: It allows doctor access to the list of patients and manage their data.
ii) Set Appointments: It allows doctors to set appointments for every patient according to their schedule.
Comparison of Pictures is made by using Firebase ML Dependency.
The application data is stored using Firebase No-SQL Database.
Application does not make use of any dataset as the application gathers data in real-time.
Technologies used to create the application are Java, Android Studio, Firebase, and XML.

IV. CONCLUSION

This paper presented an innovative system that coupled with the mobile application, cloud and ML. Researchers have concluded that users who have dementia disorder can work in their comfort.This can be achieved by implementing various other features such as data storing, GPS tracking, Medicine and task reminders, Alert / Emergency buttons etc. Using Firebase ML (Machine Learning) dependency users can validate the images of family and friends for memory retention. This system plays a major role to keep patients independent. Additionally, system can be used with voice assistance in the future scope.

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