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Mind pal: an Android App for Alzheimer's Patients

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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 solutions is to motivate the use of Smartphone by the patient. Smart phones 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. This project will be implemented by using android studio. This app will help patients with Alzheimer's disease to make them remember all the activities they performed during a day and also remind them of the medicines they need to take at different intervals of time. This app also has a to do-list to help the users add the tasks they want to perform during the day. The project will also consist of a chatbot which acts as a friend to the patient and assist them. Also, a navigation tracker for the care taker which will let them track the patient's location.*

Key Word: *Android Studio, Activity log, to-do list, medicine reminder, AI Chatbot, Navigation tracking, Profile page.*

I.INTRODUCTION

Alzheimer is a type of dementia that causes problems with thinking, remembering things, and even change in behavior. Our main aim of this project is to help Alzheimer's patients diagnosed with early and moderate level. The problem we are trying to solve is to give the patients a way to communicate, and share their experiences and memories. Our application will help patients add activity log, which logs all the activities performed by the patient, a to-do list and a medicine reminder, which will notify the patients about their prescribed medicines. The application will contain a conversational chatbot which will act as a friend to our patient. The AI bot will initiate conversations and talk to the patients. The patients can also initiate a conversation when lonely or to perform any other operations like ask about the weather, etc.The application will finally consist of a caretaker module which will provide personal information about the patient like medicines prescribed, other medical conditions, etc. This module will contain a navigation tracker which will track the patient's location and alert the caretaker if the patient has not responded for a long time. The caretaker module will also contain the emergency contacts of the near and dear of the patients which can be contacted during an emergency.

II.LITERATURE SURVEY

Living with Alzheimer's disease is not easy, for the person with the disease, his or her family and caregivers. With the advances in technology, new practices and innovative devices can now facilitate the care of Alzheimer's patients in order to provide them with quality care and a better living condition.

Following are the existing applications available to for the patients:

1. Intelli Doctor – AI based Medical Assistant (2019)
   Intelli Doctor is an Artificial Intelligence (AI) based personal medical assistant. In an attempt to provide smart healthcare and making it more accessible, this interactive application analyzes symptoms to diagnose, predict medical conditions, generates treatments and suggestions based on the inputs provided by the user. It incorporates various fitness activities tracked and other factors like their age, gender, location, past medical records, and calories intake to perform a more accurate analysis. It performs accurate comprehensive diagnosis, which also serves as a pre-screening device for Doctors.
2. Alzimio: A mobile App with Geofencing, Activity-recognition and Safety Features for Dementia Patients(2017) This work develops the Alzimio mobile app, to provide safety functions to these patients; including safe-zone geofencing, activity-based alarms, take-me-home, navigate to nearest friend, and check-on-me. Alzimio is able to achieve over 95% accuracy in less than 30 sec in most scenarios. The optimal threshold was found to be 65, to achieve best accuracy and delay. The phone was able to last throughout the day in their tests, which is very promising.
3. PERSONAL ASSISTANCE FORALZHEIMER'S PATIENT (2020)
   This application includes face recognition, wandering and fainting detection, assistance to find a way home, reminders to daily chores and past life, organizing, and planning jobs. This can be implemented by using the sensors and GPS in smart phones to sense the actions of the patients.

Through the literature analysed we found that there is a range of mobile applications aimed at people with dementia and their carers, whether family or institutional. Of the apps analysed a minority of them deal with apps that are primarily aimed at people with dementia and serve as assistive technology while the bulk of them are aimed at caregivers' use, namely as professional support, emotional support, practical support and other forms of support. Both types of apps make an important contribution to improving the quality of care and life of people with dementia and their carers (especially family carers), but we would point out that the apps are extremely different from each other and in this respect difficult to compare.

1. We see a need for a comprehensive app that supports both the person with dementia and their carers, and is a complex mix of all forms of support, from emotional, informational to practical. Such an app linking the person with dementia and the carer would allow the carer to be physically separated from the person for a certain period of time and, in case of a problem, to be informed that the person needs help.
2. For people with dementia, we highlight in particular the lack of practical applications in terms of reminders of important times and dates, timetable planners, menu planners, item finding, communication support and similar services that could potentially extend the time of independent living at home.
3. We highlight the lack of an app that would enable people with dementia to talk and communicate with different people, perhaps volunteers or chatbots. Such an app would reduce the feeling of loneliness for people with dementia and strengthen their sense of belonging to society.

III.PROBLEM STATEMENT

The current market does not have an application which can cater to all the needs of an Alzheimer's patient. There are apps which provide Todo List or there are apps which provide medicine reminder but none of them provide all the features in a single application. Only a few apps have a chatbot integrated but not the other features.

Therefore, we created an app which has all the features. These features are Activity Log, To do List, Medicine Reminder, Chatbot and Navigation Tracking. The Activity Log keeps the record of all the activities that the patient performed during the day. The Todo List will help the patient to show them all the activities they need to do during the day. The Medicine reminder will remind the patient about the medicines they need to take throughout the day by notifications. The Intelligent Chatbot will act as a friend for the patient and will have conversations with the user and give them information about various things. The Navigation Tracker will let the caretaker know where the patient is and let them track their location.

IV.METHODOLOGY

Following are all the different components and algorithms used in the project:

1. Recycler View

Recycler View is a View Group added to the android studio as a successor of the Grid View and List View. It is an improvement on both of them and can be found in the latest v-7 support packages. It has been created to make possible construction of any lists with XML layouts as an item which can be customized vastly while improving on the efficiency of List Views and Grid Views. This improvement is achieved by recycling the views which are out of the visibility of the user. For example, if a user scrolled down to a position where items 4 and 5 are visible; items 1, 2, and 3 would be cleared from the memory to reduce memory consumption. To implement a basic Recycler View three sub-parts are needed to be constructed which offer the users the degree of control they require in making varying designs of their choice.

A. The Card Layout: The card layout is an XML layout which will be treated as an item for the list created by the Recycler View.
B. The View Holder: The View Holder is a java class that stores the reference to the card layout views that have to be dynamically modified during the execution of the program by a list of data obtained either by online databases or added in some other way.
C. The Data Class: The Data class is a custom java class that acts as a structure for holding the information for every item of the Recycler View.

2. Natural Language Processing

Natural language processing (NLP) is the ability of a computer program to understand human language as it is spoken and written, referred to as natural language. It is a component of artificial intelligence.

NLP is of particular importance for chatbots because this technique determines how the bot will understand and interpret the text input. The goal of an ideal chatbot would be to converse with the user in such a way that the user is completely unaware that they are talking with a machine. This algorithm attempts to learn through machine learning and an abundance of conversational data, the intricacies of human language. NLP helps the bot understand text data, comprehend grammar, sentiment and intent. This is primarily due to the wide range of functionalities offered by NLP such as text summarizations, word vectorization, topic modelling, PoS tagging, n-gram and sentiment polarity analysis. The various Natural Language Processing Algorithms we used are:

- MITIE: This is an all inclusive library meaning that it has NLP library for entity extraction as well as ML library for intent classification built into it.
- spaCy + sklearn: spaCy is a NLP library which only does entity extraction. sklearn is used with spaCy to add ML capabilities for intent classification.

- MITIE + sklearn: This uses best of both the worlds. This uses good entity recognition available in MITIE along with fast and good intent classification in sklearn.
  All these algorithms are built-in the DIET Classifier. to computational linguistics to statistical natural language processing.

3. RASA

Rasa Open Source is an open source conversational AI platform that allows you to understand and hold conversations, and connect to messaging channels and third party systems through a set of APIs. It supplies the building blocks for creating virtual (digital) assistants or chatbots. Rasa NLU and Rasa Core are the two modules that make up RASA. Rasa NLU examines the user's input, classifies the intent, and extracts the entities. Rasa core takes the user's input and generates a response accordingly using various pipelines. Rasa is an effective and time-efficient tool to build complex chatbots and works out of the box in dialogue management. It is transparent and customizable in terms of development.

4. DIET (Dual Intent and Entity Transformer)

DIET is a multi-task transformer architecture that handles both intent classification and entity recognition together. The Dual Intent and Entity Transformer (DIET) model for natural language processing (NLP) is implemented in RASA, which is an open-source implementation. It provides the ability to plug and play various pre-trained embeddings like BERT, GloVe, ConveRT, and so on. DIET is different because it:

a) Is a modular architecture that fits into a typical software development workflow
b) Parallels large-scale pre-trained language models in accuracy and performance
c) Improves upon current state of the art and is 6X faster to train

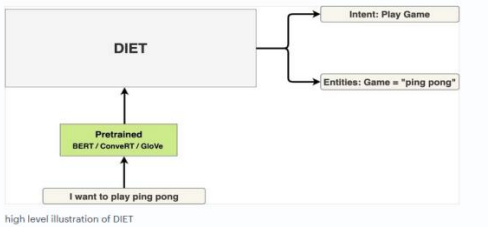

Fig 1. High Level Illustration of DIET

5. Conversation-Driven Development (CDD)

Conversation-Driven Development (CDD) is the process of listening to your users and using those insights to improve your AI assistant. It is the overarching best practice approach for chatbot development.

Developing great AI assistants is challenging because users will always say something you didn't anticipate. The principle behind CDD is that in every conversation users are telling you—in their own words—exactly what they want. By practicing CDD at every stage of bot development, you orient your assistant towards real user language and behavior.

CDD includes the following actions:

- Share your assistant with users as soon as possible
- Review conversations on a regular basis
- Annotate messages and use them as NLU training data
- Test that your assistant always behaves as you expect
- Track when your assistant fails and measure its performance over time
- Fix how your assistant handles unsuccessful conversations

6. GPT-2

GPT-2 is a large transformer-based language model with 1.5 billion parameters, trained on a dataset of 8 million web pages. GPT-2 is trained with a simple objective: predict the next word, given all of the previous words within some text. The diversity of the dataset causes this simple goal to contain naturally occurring demonstrations of many tasks across diverse domains. GPT-2 is a direct scale-up of GPT, with more than 10X the parameters and trained on more than 10X the amount of data. Generative Pre-trained Transformer 2 (GPT-2) is an open-source artificial intelligence created by Open AI in February 2019. GPT-2 translates text, answers questions, summarizes passages, and generates text output on a level that, while sometimes indistinguishable from that of humans, can become repetitive or nonsensical when generating long passages. It is a general-purpose learner; it was not specifically trained to do any of these tasks, and its ability to perform them is an extension of its general ability to accurately synthesize the next item in an arbitrary sequence.

7. Google Maps API

Google Maps API is a powerful tool that allows developers to integrate Google Maps data and functionality into their own applications. The API provides a range of features, including mapping and geolocation services, routing and directions, as well as location-based search and recommendations. Developers can use this data to create custom maps, overlay data on top of Google Maps, and build their own location-based applications. The API is easy to use and provides comprehensive documentation, along with code samples and SDKs for various platforms. Developers can also customize the appearance and functionality of their maps using JavaScript and other programming languages. Overall, the Google Maps API is a versatile and reliable platform for developers to create location-based applications and services.

8. Geo coder Plug in

The geo coder plug in is a powerful tool used to convert human-readable addresses into geographic coordinates, also known as geo coding. It uses data from various sources such as Google Maps, Bing Maps, and Open Street Map to accurately match the address to the corresponding coordinates. The plug in works by sending a request to the geo coding service with the provided address information. The service then responds with a JSON object containing the latitude and longitude of the address. This information can then be used to display the location on a map or for other location-based functionality. The geo coder plug in is widely used in web and mobile applications to provide location-based services such as routing, location-based search, and real-time tracking. Overall, the geo coder plug in is a valuable tool for developers looking to integrate geo coding functionality into their applications with ease.

V.SYSTEM FLOWCHART

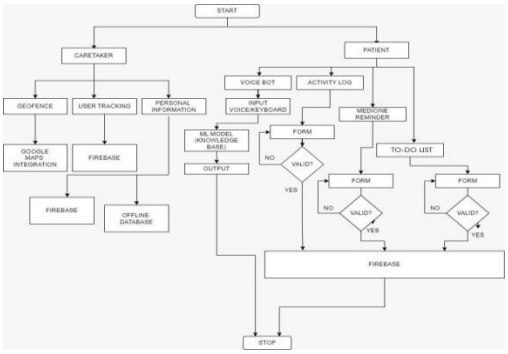

Fig. 3 System Flowchart

VI.IMPLEMENTATION DETAILS

6.1 Activity Log

The activity log page contains a button to add a new activity and a list that shows the activities performed by the user. When the user clicks on the Add Activity button they will be directed to a new page and will be requested to input the name of the activity performed and the date and time at which that particular activity was executed. Due to the tendency of Alzheimer's patients to forget what they did in the past, this feature will allow them to remember all the activities as well as things they did in the past. The user will then click the add button and then will get redirected to the home page where they can see the activity being shown to them in a list order. The user need not input the date and time of the activity as the app allows then to input the current date and time by default making the user interface a lot easier to use.

Fig. 4 Activity Log Section

6.2 To do List Section

The To do list page is used when the patient need to do some activity in the future but due to their disability they forget what they wanted to do. Thus, the user can add a todo list which will remind them every hour about the things they wish to do with a simple notification. This feature will help the user remember all the tasks they wanted to perform throughout the day. The user will get a notification every hour reminding them about checking the app and reminding them about the tasks they are going to do. The user can update or delete a particular task if they wish so.

Fig. 5 Todo List Section

6.3 Medicine Reminder Section

Almost all the Alzheimer's patients are under some medication which can help them in battling the disease. These can be different types of medicines with different doses during the day and can confuse the patient when to take the particular medicine and at which time. Therefore, to remind each and every medicine the patient will need to take during the day, this feature was implemented. The user will add a medicine with specific time on which they will get a reminder to take the medicine. The UI is created such that the user will be able to see the medicine name and time clearly and use the interface with ease. The user can set the timer at any time and they will get the notification of the medicine with the name of the medicine specified in the notification. Due to the condition of the patient, they might forget to take the medicine so this feature will help them remind their medication.

Fig. 6 Medicine Reminder Section

6.4 Profile Page

There may be time when the user may get lost due to their condition and can get into dangerous situations. As Alzheimer's Disease causes the patient to forget their memory, it can lead to the loss of important information such as contact number or name of their loved ones or caretakers. To help them in this situations, we have developed an profile page which will enable the user to add emergency contacts, caretaker name and phone number, pictures of the user, etc which the user can use when they are in an alarming situation to alert their caretaker and loved ones. The user can add as many contacts as possible in this section.

Fig. 7 Profile Page

6.5 Chat Bot

The main module of the application is a voice assisted chatbot created using RASA Framework and python programming language will act as a friend for the patient. Many patients suffering from Alzheimer's disease go through loneliness which is why this module is one of the most important features of the project. The chatbot will ask how the patient is doing, add activities, tell the weather, respond to specific moods, and will ask if they completed any tasks or activities. This will help the patient not feel lonely and have a friend with them at all times. The chatbot is trained using Open AI's GPT-2 Model which automatically generates texts and responds to user queries.

Fig. 8 Chat bot Section

6.6 Navigation Tracker

The Navigation Tracker in the Caretaker Module let's the caretaker know the location of the patient in real time. This

is extremely useful when the patient either gets lost while travelling or to just check in on the patient. The Navigation Tracker uses Google Maps API to send real time location from the patient's phone to the Caretaker's phone. If the caretaker cannot get the location of the patient then it can immediately contact the near and dear ones of the patient to let them know about the situation.

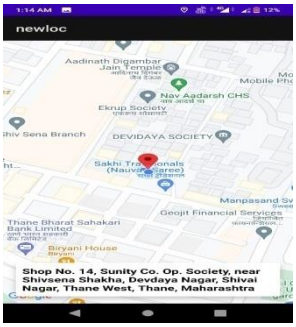

Fig. 9 Navigation Tracker Module

VII.CONCLUSION

The system created after extensive research during the literature survey includes the implementation of Activity Log section, Todo List section, Medicine Reminder section, Chatbot and Navigation Tracking which will help in aiding the Alzheimer's patient. Easy user interface has been designed keeping the user's convenience in mind.

VIII.FUTURE WORK

The current system we have built has a few limitations such as the latency is too high between the server where the chatbot trained model is situated and the android app and more which we will tackle in the future work of this project. In addition, we would like to try to:

- Load the trained model on a paid server for increased network speed.
- Add an online database for storing all the chat messages.
- Publish the application on Play Store.
- Support multiple languages.
- Add feature to include important documents like Aadhaar Card, Medical Certificate, etc (HIPAA Compliance).

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