

Mental Health Determination using Natural Language Processing and Emotional Recognition

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Abstract : This paper describes a system where a user can interact with the chat-bot just like a human and share his/her thoughts on various issues, and can open up his/her problems that determine a guy's mental status and also help them to get good help and can prove to be a life-saving solution. The chat-bot may take the help of human replies using Questionnaires and MCQ questions to find emotions hidden, and classify them and store the data to provide a fitting report to the user. The report can guide the user about if they need to find a balance in their personalities, and if critical, seek medical attention via a professional that is a psychiatrist. The system is used to show the visualization of Mental health weekly reports and help users to overcome the solution.

Keywords - Chat-bot, mental status, emotions, life-saving, classify, report, personalities, critical, medical attention, visualization.

I. INTRODUCTION

In real life, people are so obsessed with technology that they do not get time to be with themselves or understand their own feelings and/or problems they face. It's not anyone's fault, but, of course, a rise in technology had to ripple out an effect on daily lives of an average person. This seems to be a good thing in terms of work efficiency but a hindrance in terms of human's mental state and it's stability.

Mental health has always been a critical issue if not taken care of periodically. It's a state which looks after a human's overall behavior and stimulus with environment, and also gives power to get going at a task for a long time. If not taken care of, it disrupts the whole human cycle of functioning and may even lead to physical and mental strain, self-doubts, weakening of the person as a whole, etc.

To solve this problem, we can use the technology itself to connect to humans who are so attached to devices (like smartphones) and provide them a comfort into their own comfort zone, and their own time, to help them relax and know more about themselves and find out about their own personalities. Even a dire need of someone expert in the field of psychology can be completed if required, through our project.

The main objective of the proposed paper is to use the Artificial Intelligence to achieve the following goals:

- Developing an on-demand mental health check-up app gives a daily check on behavioral patterns and personality development options to users to become a better person each day.
- With an on-demand check-up, users can create a path which leads to a healthier lifestyle and a good, ethical routine for life with lesser downsides.
- This app included a feature in which the user can check his/her report, conditions (if any), get mental health exercises to calm down.
- A check on medical news and breakthroughs helps provide motivation to live a good tomorrow.

II. LITERATURE SURVEY

Emotion is one appearance of people behaviour and it is an important performance in human computer interaction (HCI). In the paper by Khodijah Hulliyah, Normi Sham Awang Abu Bakar and Amelia Ritahani Ismail [1] in 2017 on Emotion Recognition and Brain Mapping for Sentiment Analysis which provides the overview of past and recent research on emotion detection as well as some approaches and techniques used and shows the linked between both sentiment analysis and emotion recognition. Charvi Jain, Kshitij Sawant, Mohammed Rehman and Rajesh Kumar [2] showed us a way to detect faces from any given image, extract facial features (eyes and lips) and classify them into 6 emotions (happy, fear, anger, disgust, neutral, sadness) eventually characterized through a Support Vector Machine(SVM), refined using Grid Search.

Boxuan Zhong [3] and his team proposes a temporal information preserving multi-modal emotion recognition framework based on physiological and facial expression data streams. The performance of each component is evaluated and compared individually and after data fusion. The experiments tries to show that TIPF significantly improves the emotion recognition performance when physiological signals are used and the best performance is achieved when fusing facial expressions and physiological data.

Inappropriate diagnosis of mental health illnesses leads to wrong treatment and causes irreversible deterioration in the client's mental health status including hospitalization and/or premature death. About 12 million patients are misdiagnosed annually in US. The paper by G. Azar, C. Gloster, N. El-Bathy, S. Yu, R. H. Neela and I. Alothman [4] introduces a semi-automated system that aids in preliminary diagnosis of the psychological disorder patient. This is accomplished based on matching description of a patient's mental health status with the mental illnesses. The study constructs the semi-automated system based on an integration of the technology of genetic algorithm, classification data mining and machine learning.

III. SYSTEM ARCHITECTURE

Chat-bot architecture is the heart of mental health determination app development. Based on the usability and context of business operations the architecture involved in building a chat-bot changes dramatically. So, based on client requirements we need to alter different elements; but the basic communication flow remains the same. Also, there needs to be a learning of how to choose the right chat-bot architecture and various aspects of the Conversational Chat-bot. The technical block diagram of the app has been depicted in Fig. 1.

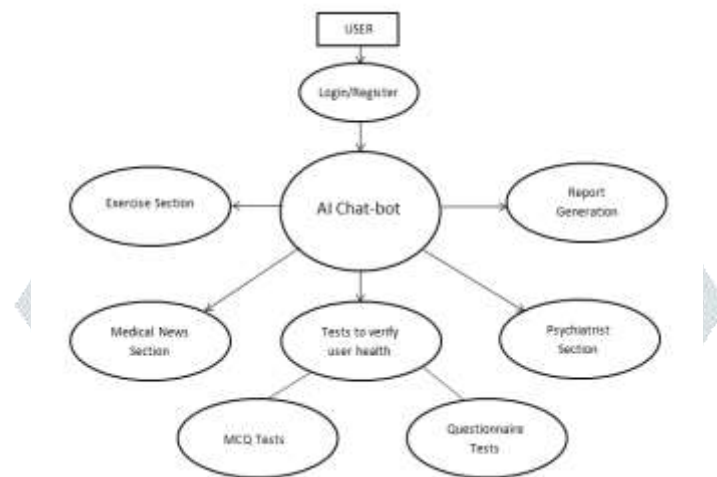


Fig. 1: Technical Block Diagram

3.1 AI Chat-bot

The AI Chat-bot is the main feature of this project. The Chat-bot is a piece in this app which will work as how a human thinks and speaks, and interact with the user in a very peculiar and straightforward-yet-vague manner about his life, current situations and daily social life and thinking [6]. The user's input will be the main source of data to be analyzed by the AI for further analysis[9]. The chat-bot may present it's questions[13] and the user may be asked to answer in one of the two forms:

- a. Question-Answer
- b. MCQ format.

3.2 Mental Health Report Section

The inputs are the most important aspect of this overall project as the report of a user's mental health will be generated based on how they answer and what exactly they answer on a particular question[10]. A weekly report is expected from our side to the user to make them see what and how they are spending their daily lives and what are their emotions on a daily basis. A monthly report also will be provided after day 30, to see how was their monthly mental health condition, and (if) there is some critical condition in mental state of the user.

3.3 Psychiatrist Info Section

If suppose our system detects some critical health condition in user's mental state, we are dedicated to support them and so we can actually help them seek a professional person using our app. We also plan to provide them our complete report (with each responses if possible) so that this process of seeking help and getting better gets really smooth than it should be.

3.4 Medical News Section

A medical news section is to be kept as a tab within the app. This information is taken from various sites and shows the user, new developments in the field of medical science. We believe this can provide a ray of little hope & happiness into the minds of troubled users.

3.5 Exercise Section

Exercises related to mental stability are very crucial if you are taking the time to interact with their emotions. That's why a daily exercise section is very necessary for the user, so they can follow it up and get some stress out from their day

IV. SOFTWARE USED

4.1 Flutter

Flutter is a cross-platform UI toolkit that is designed to allow code reuse across operating systems such as iOS and Android, while also allowing applications to interface directly with underlying platform services. The goal is to enable developers to deliver high-performance apps that feel natural on different platforms, embracing differences where they exist while sharing as much code as possible[12].

During development, Flutter apps run in a VM that offers stateful hot reload of changes without needing a full recompile. For release, Flutter apps are compiled directly to machine code, whether Intel x64 or ARM instructions, or to JavaScript if targeting the web. The framework is open source, with a permissive BSD license, and has a thriving ecosystem of third-party packages that supplement the core library functionality.

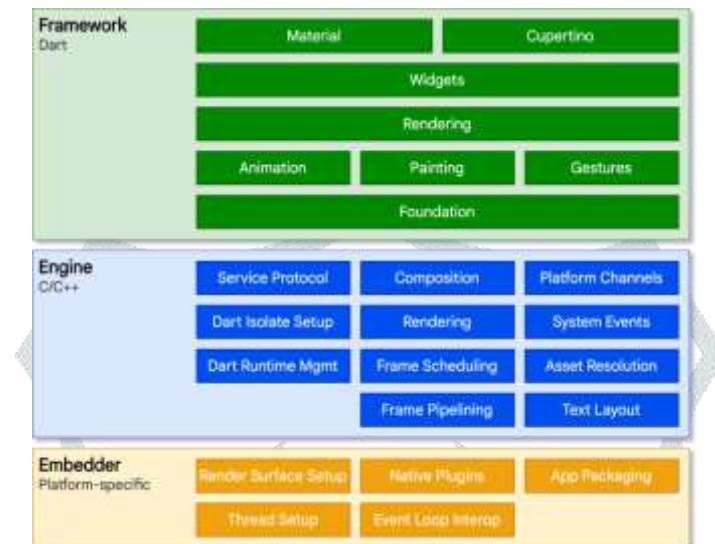


Fig. 2: Flutter Architecture

4.2 Visual Studio Code

Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs, as well as websites, web apps, web services and mobile apps. Visual Studio uses Microsoft software development platforms such as Windows API, Windows Forms, Windows Presentation Foundation, Windows Store and Microsoft Silverlight. It can produce both native code and managed code.

4.3 Firebase (Cloud)

Firebase is a Backend-as-a-Service (Baas). It provides developers with a variety of tools and services to help them develop quality apps, grow their user base, and earn profit. It is built on Google's infrastructure[17]. Firebase is categorized as a NoSQL database program, which stores data in JSON-like documents.

V. IBM WATSON TONE ANALYZER

The IBM Watson® Tone Analyzer service uses linguistic analysis to detect emotional and language tones in written text[11]. The AI can analyze tones at both the document and sentence levels and can break down the tone of each sentence and its severity. One can use the service to understand how your written communications are perceived and then to improve the tone of your communications. One can use this to learn the tone of their user's communications and to provide them with correct response, or use it for further trainings, etc.

The Tone Analyzer is used to map user's response and detect joy, fear, sadness, anger, analytical, confident and tentative *tones* found in text. These responses are crucial to get emotions and to find out if the user's mental health is at a good level or not by averaging the data and recording it in the app.

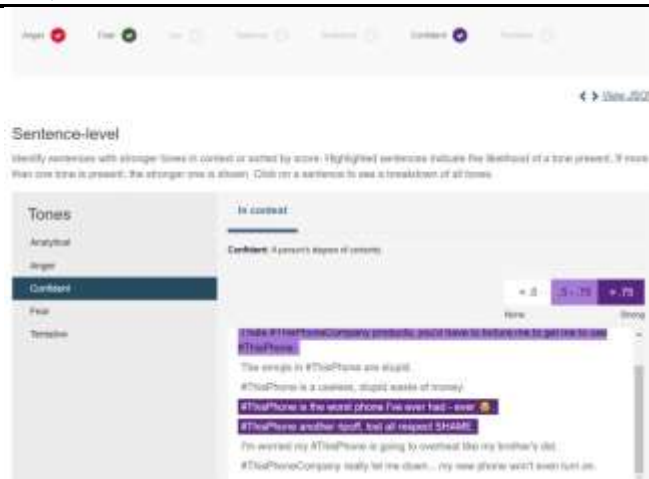


Fig. 3: IBM Watson Tone Analyser

VI. IMPLEMENTATION OF PROPOSED SYSTEM

The creation of a mobile app involves a required set of milestones, which are as follows:

6.1 Creation of Chat-bot

The very first step of the whole project is to create a chat-bot with Flutter which is in working condition.

6.2 Setting up Firebase

To run a chat-bot, we require an AI to set and follow up with questions. For that purpose, we need to set up Firebase, which actually drives the chat-bot with questions appropriate[5][13].

6.3 Creation of back-end Dataset for questions

The questions which are to be asked to a user aren't readily available in the market as a dataset. So we need to create a dataset from scratch to actually send it to chat-bot via Firebase.

6.4 Setting up a Database for user

Each user will need a separate space of database for their own data. To ensure that we need to set up a database at a secure location from where their reports and other data can be stored and retrieved whenever needed.

6.5 Using Tone Analyzer to generate emotions from user input

To ensure that whatever user has given as input has a meaning and an emotion to it, the data must be passed to an NLP(Natural Language Processor)[9], IBM Watson's Tone Analyzer, via its API which then checks the data for all types of emotions and classifies them using classification algorithms like Logistic Regression[15][16] and returns the emotion value present in the sentence.

6.6 Mental Health Report Generation

After accumulating data an average of answers will be carried out and then a report will be generated showing them a chart of what happened and what emotions were highlighted the most and which were the least used[5]. This report will be crucial in the next stages of personality development and mental care.

After all these steps are taken care of, the app is expected to run to provide the necessary output to the user. The flow of the app is explained in fig. 4.

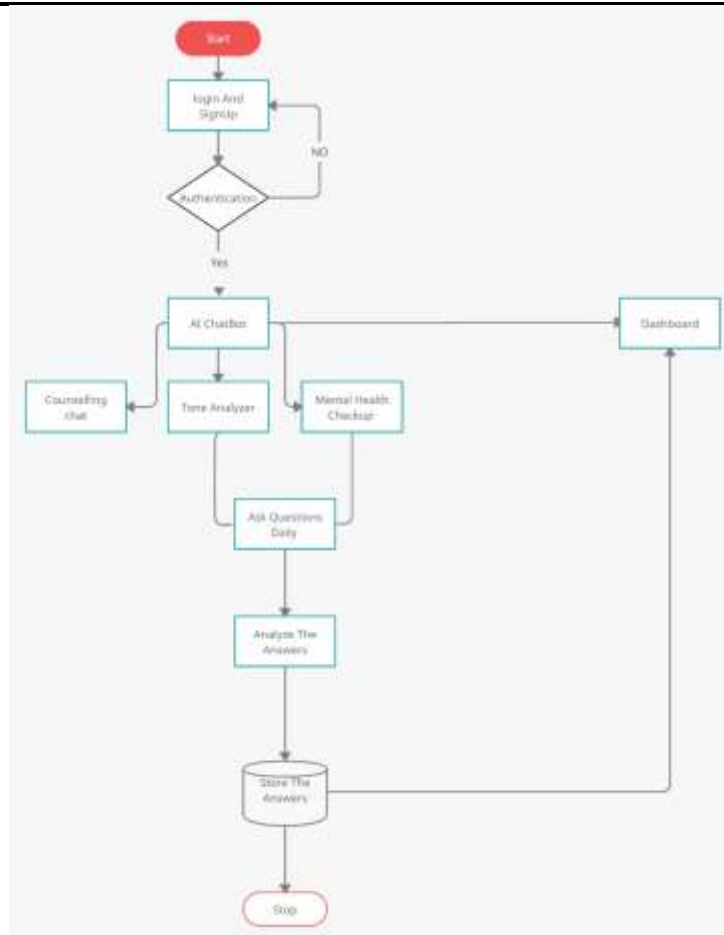


Fig. 4: Flow-Chart

VII. RESULTS OF IMPLEMENTATION

Experimental Results have been obtained after the successful implementation of the app. Fig. 5 shows the dashboard of the application developed using Flutter and Firebase. The dashboard shows the previous and current reports of the user in a pie chart with color code, ordered descending as per the dates. Green indicates a good state, dark green means the user needs to cope up with their mental health, and red means it’s not good, they must seek professional care. It also has a logout button on the top-right.



Fig 5: Dashboard with Report display

Fig. 6 shows the Chat-bot system taking user’s permission to take reports for today or just chat casually with the bot.



Fig 6: App asking user for report or chat function

Fig. 7 shows the chat-bot function of asking the user for their responses on certain questions in the form of MCQs.



Fig. 7: MCQ tests

Fig. 8 shows the chat-bot function of asking the user for their responses on certain questions in the form of Questionnaires. These functions are meant to generate report for the user, and the questions asked are unique each day. Fig. 9 shows the emotion detection on an answer using tone analyzer function.



Fig. 8: Tone Analyzer Questionnaire tests

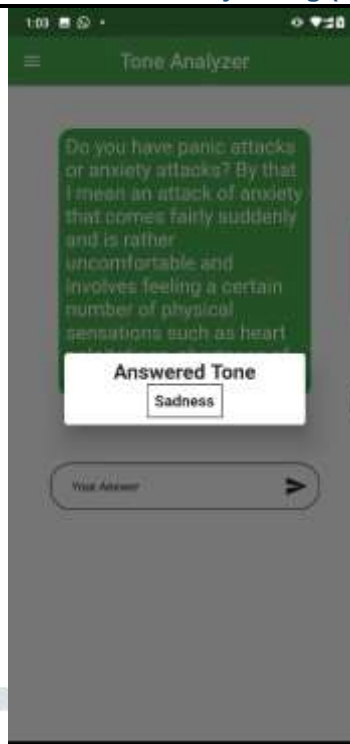


Fig. 9: Emotion Detection on Tone Analyzer

Fig. 10 shows chat-bot which is used for relief or de-stressing the mind of the user which enables itself to act like a human, where the user can be care-free to share their feelings whenever needed.

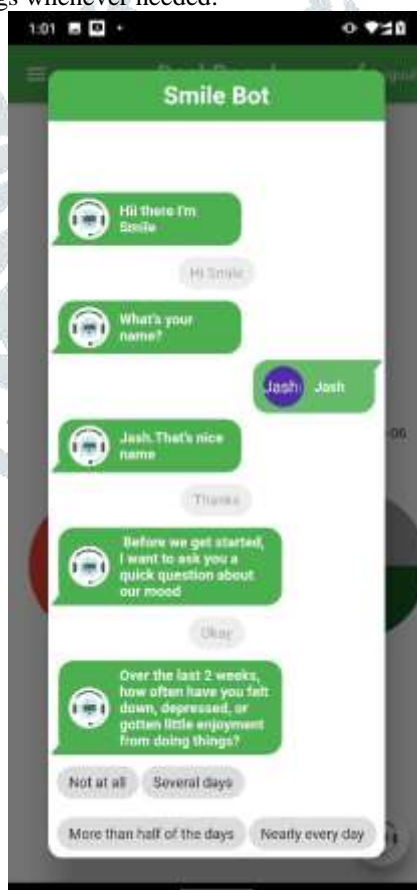


Fig. 10: Emotion Detection on Tone Analyzer

Fig. 11 shows a hamburger menu[17] or a menu with three lines, located at the top-left. It is used to select the different sections made in the app.

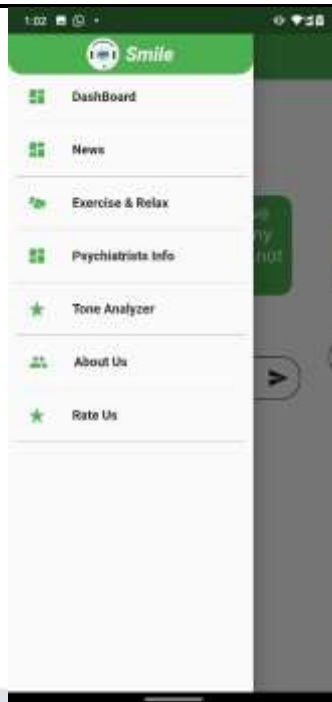


Fig.11: Hamburger Menu

Fig. 12 presents the medical news section for the user to check out, it takes information from well-known sites and displays them here. Most of the news are taken on a positive impact so that good atmosphere can be created in the mind of the user. It also answers them the question “How is the world doing?”

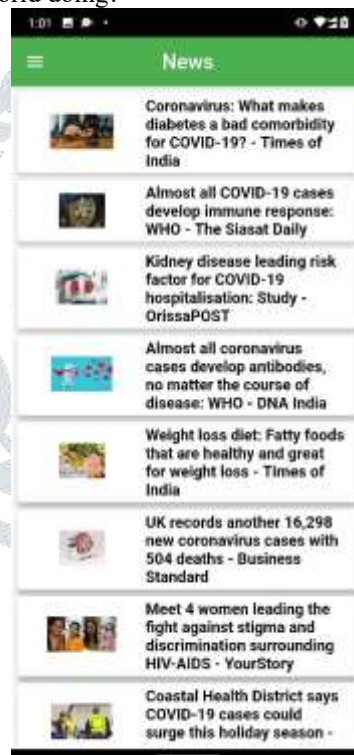


Fig. 12: Medical News Section

The user also have access to the exercise section which uses an animation of a timed circle, which indicates them at what intervals to breathe in & breathe out, as shown in fig. 13

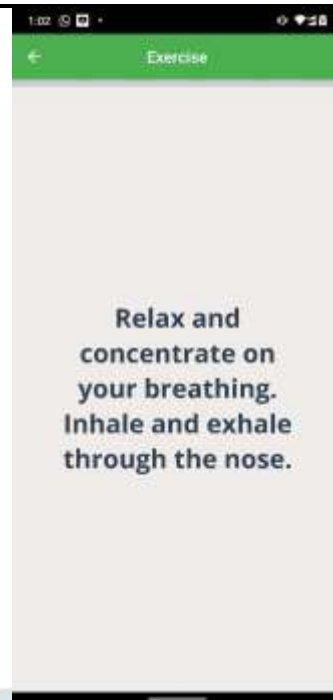


Fig. 13: Medical News Section

We also have a psychiatrists section available for the user, incase their health reports come out in the red spot for several days. They can contact them through the information provided by the app and can seek out their consultation and medical attention, if needed. Fig. 13 shows the info tab.



Fig. 13: Medical News Section

VIII. CONCLUSION

The basic ideas which were intended to be implemented in the project i.e. Mental Health Determination app consisting various operations like chat bot, report generation, medical news section, psychiatrists section etc. was carried out successfully. Humans can be stressed-free and can open up easily as there is no human interaction unless and until the Human wants to. Machine Learning & AI are the backbone of this idea as they are used to find out accurately the condition of the human. The working of each and every module has been reasoned out with utter carefulness and they have been placed in such a way that they contribute towards getting the best results from the system. Hence, a working project is successfully designed and implemented giving the desired outputs.

IX. FUTURE SCOPE

We can keep on increasing Dataset of new questions for detailed learning about user's day-to-day emotions. Implementation of modules like facial recognition and voice recognition in the chat-bot can really improve the efficiency and the capabilities of the app in a way that it can change the world of technology. Not only for personal use, this app can be modified for organizations to find out about the mental state of their own employees and determine the workload process and also their status. Even medical experts in this field can use this system to interact with patients and fill out their personal question tabs and the report generated by this app can be much beneficial to professionals to interact with patients. The use of data warehouse for bringing all the data together and translating it into a singular, structured data can be difficult, but if we achieve that feat, then we can even hope to add even more techniques that can be used to process the data, thus increasing accuracy of the app.

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