A Chatbot to promote Students Mental Health through Emotion Recognition

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Abstract—**The objective of this paper is to develop a chatbot for students to promote their mental health through emotion recognition technique. Nowadays, students are facing a lot of mental health issues due to various reasons like pandemic lockdowns, peer pressure, social media bullying, academic stress, loneliness, sexual harassment, etc. Because of which students are unable to progress well in their life, both emotionally and academically. Due to the battle of life, the students are also unable to receive proper guidance from experienced and knowledgeable humans to solve their personal issues. Therefore, developing a human friendly chatbot that can help students get the right guidance for their issues at the right time is a much needed one. These kind of chatbots can play a vital role in reducing the number of suicides in the country due to depression and stress. The chatbot named Maxx helps students solve or prevent any mental health issue in their day-to-day life. Maxx converses with the student, understands his/her present emotional state/mental health issue (if any), identifies the cause of that emotion/mental health issue and provides the right guidance based on the reason identified. Maxx uses technologies like DialogFlow for Natural Language Processing (NLP), Flutter for app development and Google Cloud Platform (GCP) for data storage and security.**

Keywords—Text-based Emotion Recognition, DialogFlow, Rule-based Grammar Matching, Natural Language Processing, Intent Processing, Entity Extraction, Artificial Intelligence, Flutter, Google Cloud Platform, Python, Web Scraping

I. INTRODUCTION

A. Chatbots

Chatbots are software applications that converses with humans. It uses a technique called Natural Language Processing (NLP) for its working. NLP consists of two steps, Natural Language Understanding (NLU) and Natural Language Generation (NLG).

NLU helps in understanding the dialogue of the user (also called as an intent). NLU cleans the intents, i.e., it removes all the unwanted words and fetches only the powerful words (the most suitable words from which responses can be generated) from the intent. Then, it classifies these powerful words into entities (categories), which then can be processed and used for the response generation process. DialogFlow uses rule-based grammar matching algorithm for this process.

NLG helps in generating the right response for the given intent. Based on the entities provided, it chooses the best response from a variety of responses generated. Machine Learning (ML) algorithms are used to generate the most suitable response for the given intent. This response is then used, to reply as a dialogue to the user.

DialogFlow is a Natural Language Understanding platform that helps in building chatbots in a much efficient and powerful manner by using various ML algorithms based on the quality and size of the dataset.

B. Problem Statement

The number of suicides cases among students are increasing day-by-day. Most of the suicides are due to the mental health issue faced by them. More than that, mental health issues can thrive among other students as well who may look quite healthy through the eyes. A lack of awareness among mental health issue is also causing a major havoc in solving this crisis. Even parents are lagging behind, when it comes to awareness about their own child's mental health. The availability of qualified psychiatrists is quite less in our country, which in turn has led to lesser availability of required assistance for the students who face a mental health issue.

Since identifying a mental health issue requires periodic examining and assistance, many families are unable to afford regular check-ups with a psychiatrist even during a serious mental health issue. In these situations, chatbots can be of great help. Chatbots can converse with the student whenever they need and can record the various feelings and emotions felt by them and it can also identify and record the reasons behind their emotions. Continuous assistance from the chatbot to the student helps in preventing the condition to thrive for a long time. These recorded emotions and feelings can be of great help to the psychiatrist as well in identifying and healing the major mental health issue faced by the student.

C. Softwares Used

The softwares that are been used in **Maxx** and the reasons for choosing them are as follows:

a. DialogFlow

DialogFlow is a NLU platform, created by Google, that helps in building a chatbot, by performing effective NLU and NLG processes. It uses rule-based grammar matching algorithm and Machine Learning algorithms to understand the given intent and generate the right responses for the user. It also uses Google's dataset for better responses to the user.

b. Google Cloud Platform

The Google Cloud Platform acts as an effective server to process all the processes in run-time with a very high accuracy. Since, the intents are all about emotions and students' personal feelings, data encryption should be given

the highest importance. So, GCP is used to provide the right security to the data.

c. Flutter

Flutter is a software development kit developed by Google, to design and develop beautiful mobile and web applications for various OSs like Windows, MacOS, Linux, etc. Since its single code base feature is quite useful for both integration and working with DialogFlow, Flutter is chosen to create **Maxx**'s mobile application.

II. LITERATURE SURVEY

DialogFlow, not only supports human friendly bots but also supports commercially useful chatbot applications. Here are a few research papers that uses DialogFlow for building its chatbot applications as follows.

- DialogFlow is used to build a chatbot that helps the user in getting necessary information about the restaurants nearby using the Zomato API. It helps them in providing great satisfaction to the users round the clock. [5]

- Searching function plays an important role in any application that is been created nowadays and chatbots play an important role in providing the required data to the user. This paper talks about creating a college bot management system using DialogFlow that would in turn help students fetch all the required data easily. [2]

- Handy chatbots are used to teach people English language using DialogFlow's speech recognition feature. The author feels that advancement of technologies has huge impacts on how people learn a language. [1]

- A chatbot is developed to help students with their admission enquiry by providing them all the required details regarding the admissions. They use Rasa NLP and DialogFlow with a changing UI for the chatbot. [12]

- When every device has become smart, a chatbot that would help organize all the smart devices is the main idea behind DIY Smart Home Assistant chatbot. It helps the user make smart decisions regarding the same. [14]

- Since chatbots are experts in giving instant initial support to humans, this paper mainly focuses on giving humans the initial support during a calamity / natural disaster. This chatbot is named as Safeguard. [11]

- Since everyone has their own way of expression in a language, this paper focusses on finding the assertions in a sentence by providing the right specifications to the training system. They generated system Verilog assertions for this process in DialogFlow. [16]

Emotion recognition is quite a common culture when it comes to social media analysis. [10][15] Not only by using DialogFlow, but also there are many other ways in which emotion recognition based chatbots can be developed. A few ways can be by using algorithms like LSTM [3], Neural Network [9], etc.

Chatbots are used in various applications like university chatbot [7], transport enquiry bot [4], health care management bot [6][8][13], etc. So, DialogFlow is

a widely used platform to develop chatbots that deal with sensitive people like students, learners, disaster victims, etc., in an efficient manner.

III. METHODOLOGY

The aim of this paper is to develop a chatbot named **Maxx**, that converses with the students and provides the best advice possible to cure their mental health issues temporarily, if any. With the long-term implementation of the advises provided, it is possible to cure the mental health issues permanently too.

The steps that need to be followed for achieving the above-mentioned goal are as follows:

- Find the present emotional state of the student.

- Identify the reason behind the emotion or the mental health issue faced by the student.

- Generate the best response / advice that would help the student in curing the mental health issue.

- Store the emotion, reason and the advice provided, for future analysis and monitoring.
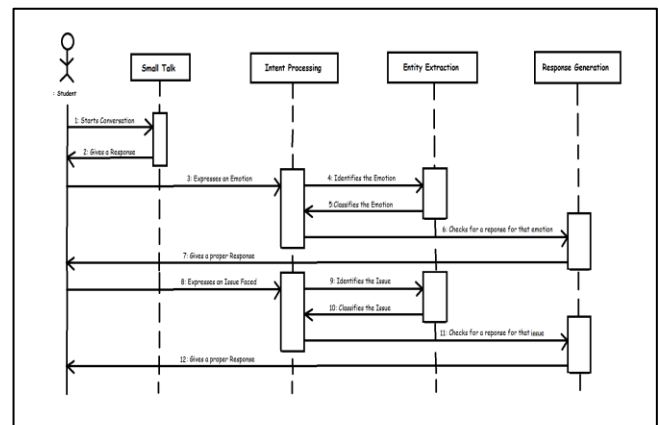

Fig. 1 Sequence Diagram of Maxx

For finding the emotion and for identifying the reason behind the emotion, we need to process the dialogue or input given by the user. This process is called Intent Processing. Once identified, we need to segregate them into emotions and their reasons. This process is called Entity Extraction. Once segregated, we need to find the matching response for the reason. This process is called Response Generation.

A. Algorithm Used

For maintaining a good mental health, it is necessary to:

- Understand the problem one faces.
- Know the right actions that would solve the issue.

Based on the above-mentioned necessities, a customized algorithm is created and used in **Maxx** chatbot. The basic logic of the algorithm is explained as follows:

- Identify the current emotion of the user and the issue faced by the user, if any.
- Check if it's a positive or negative emotion.
- If it's a positive emotion, continue a normal fun conversation.

- If it's a negative emotion, then search for the issue/reason that caused the identified negative emotion to the user.
- If unavailable, send a response message that would fetch the issue faced by the user.
- When the issue is identified, provide the right advice as a response to the user and continue to a have an optimistic conversation.

The algorithm used in **Maxx** chatbot is explained as follows:

- Step 1: Listen to the user.
- Step 2: Read msg.
- Step 3: Identify the issue faced by the user (if any).
- Step 4: Read issue.
- Step 5: if (issue == null) Identify the emotion of msg.
- Step 6: Read emotion.
- Step 7: if (emotion == "positive emotion") continue normal conversation
- Step 8: if (emotion == "negative emotion") generate an interrogative reply about the user's negative emotional state.
- Step 9: Go to step 1.
- Step 10: if (issue != null) generate an advice / solution as a reply to the user

The algorithm involves three complex functions:

- Identifying the issue / emotion
- Generating the right reply
- Continuing a normal conversation

All the above steps are performed by rule-based grammar matching and ML matching algorithms with custom parameters. These algorithms are built-in features of DialogFlow. These features are wisely been used in various parts of the algorithm to serve the objective of this paper.

For **Maxx** chatbot to work smoothly, we would need two types of datasets.

- Dataset for positive emotional state (normal conversation)
- Dataset for negative emotional state (interrogative reply / response)
- Dataset for issues faced (Advices / solutions for the issues faced by the user)

Dataset for positive emotional state is taken from the built-in feature of DialogFlow called as "Small Talk". Small talk is a very powerful tool as it is formulated by using Google's humongous datasets and powerful algorithms for its working.

Datasets for negative emotional state and dataset for issues faced are custom datasets. These custom datasets are created using python web scraping technique. The official government websites and UN websites that have the correct ways to solve any kind of emotional issue or a normal issue are scraped, for generating the right reply to the user.

B. Intent Processing

The chatbot **Maxx**, mainly focuses on providing the right advice to the students. So, it is highly important to identify the mental health issue faced by them or the symptoms that would lead them to have one. The intent processing procedure takes care of this.

Intents are dialogues delivered by the student. Therefore, the inputs are generally called as intents. Before identifying the mental health issue faced by the student, it is important to clean the intent. Cleaning includes removing unwanted words and segregating and saving only the powerful words. Powerful words are the words which are predicted to have the features that are needed, i.e., here mental health issue.

Most of the time, the mental health issue won't be directly available in the intent. So, it is highly needed to predict the mental health issue from various other criterias present in the intents. The criterias that we could use to identify the mental health issues are:

- Emotion
- Reason for the Emotion

Emotions are the assets of humans. It is the highly reliable criteria that we could use to identify the mental health issue. But emotions are divided into two types:

- Positive Emotion
- Negative Emotion

Negative emotions are the ones that we need to deal the most. Once the student is expressing a negative emotion, then we need to raise responses accordingly so that the student would reply stating the reason for their emotion. A few negative emotions can be sad, fear, crying, etc.

Positive emotions are highly important too as it would help in providing the right personalized advice for the student when they are showing negative emotions. A few positive emotions can be happy, neutral, over-joyed, etc.

a. Finding the Emotion

Inorder to identify the emotions we need to feed DialogFlow with a lot of example intents from which it can learn how to predict the emotions expressed by the student. When it comes to the algorithm, DialogFlow uses built-in Machine Learning algorithms based on the training data given. So, the power of the chatbot depends upon the amount of the training data provided to the DialogFlow.

So, based on the data provided, it considers words like happy, sad, cry, afraid, etc., as emotions expressed by the student. These words are the powerful words that would help us identify and segregate the emotion of the student.

b. Identifying the Reason

Inorder to identify the reason that caused that emotion, we need to first generate a response that would ask

the student to know why the student is feeling that emotion, then based on their new dialogue/intent we need to identify the reason for the emotion.

So, we need to feed DialogFlow with a lot of example intents from which it can learn how to predict the reasons that caused that emotion, expressed by the student.

When it comes to the algorithm, DialogFlow uses built-in Machine Learning algorithms based on the training data given. So, the power of the chatbot depends upon the amount of the training data provided to the DialogFlow.

So, based on the data provided, it considers words like academic stress, depressed, not satisfied in life, etc., as the mental health issue or reason causing those emotions expressed by the student. These words are the powerful words that would help us identify the right advice to the students.

C. Entity Extraction

Categorizing is the best method that would help us to summarize or conclude at the earliest. Now, we are aware of the emotion and its reason, but we are still not aware of the type of emotion and the problem faced. So, we can need to categorize the emotions and the reason inorder to conclude the problem and provide a solution.

These categories are called as entities. In our case, for emotions we have two entities, negative emotion, and positive emotion. The reason for the emotion can have multiple entities like academic stress, relationship issue, loneliness, etc.

Inorder to segregate these powerful words into entities, we need to again feed the DialogFlow with the segregated entities training data, so that the ML algorithm trains and segregates the right emotions into the right entities.

So once, an intent is received, emotion is identified and segregated into entities, a response will be generated based on the entity created. That is, if intent has the word "Sad", it will be saved under the Negative Emotion entity. Now, since the negative emotion entity is updated for the latest intent, a new response will be generated and displayed to the student, asking for the reason for his sadness.

Note: If the intent has both the emotion and the reason for the emotion then, a response won't be generated. It will directly display the suitable advice for the issue faced.

Once the student replies, this new intent will be used to again find the emotion and the reason for the emotion. Once identified, it is segregated into the suitable entity. The latest updated entity of the reasons will decide the mental health issue faced by the student.

D. Response Generation

Once the segregation of the reasons is successful, we can decide on the issue of the student. The entity with the higher accuracy, i.e., the entity that has most of the powerful words from the intent, will be the mental health issue faced by the student.

So, now we need to provide the right advice to the issue. Each issue entity will be provided with unique sets of the training data of advice responses. After getting trained from these data, the chatbot generates a valuable response for the

entity and gives it as an output or dialogue. And that how a response will be generated.

But, if it was unable to identify the reason behind the emotion, then it will generate responses like "Why are you sad Today?", etc., from the training data that will be provided, till it gets the right reason for the emotion. Even after multiple tries, if it was unable to identify the issue, it will simply listen to the user and will save the conversation, so that it can used to identify the issue behind with the help of a psychiatrist manually, if requested by the student or their guardians.

IV. TESTING AND EVALUATION

After testing, it is concluded that **Maxx** is a good adviser, problem identifier, problem solver and listener. **Maxx** could correctly identify the emotion of the student and was also able to reply promptly in a much sensible and optimistic manner. The replies were quite polite and helped in solving the problem   faced by the student.

Fig. 2 Conversation with Maxx

The testing or experimentation of **Maxx** involves two cases. In the first case, **Maxx** converses with the user who show a positive emotion and in the second case, **Maxx** converses with a user who express a negative emotion. Each case was tested with unique 20 users or here, 20 students from a college.

In the positive emotional state case, **Maxx** performed well for 18 out of 20 times. Therefore, **Maxx**'s performance score will 90%. At the same time, for a negative emotional state case, **Maxx** performed well for 16 out of 20 times i.e., the performance score will be 80%.

The 90% score of **Maxx** was due to the listening capacity and optimistic character of **Maxx**. Since, humans tend to love people who listen to them, **Maxx** was able to satisfy the user's needs when they were in a happier emotional state by listening to them and giving them a happy and positive response.

At the same time, the 80% score of **Maxx** is due to the variety of problems available in the society and the various unique ways of expressing one's feelings by humans. Since **Maxx** is trained so far to give proper responses to issues like depression, stress, bullying, sexual harassment, loneliness, fights with friends, fear, anger, societal pressure, etc., when it encounters problems like ego, jealous, etc., it is unable to satisfy the user.

So, more datasets considering various other problems in the society with unique styles of expression of words can help in improvising **Maxx** in its working.

The core benefits of **Maxx** are not only about helping students with their mental health issue, but also the students' data is safe and used only in an ethical manner, this helps in increasing reliability on **Maxx** exponentially. It is also quite useful for psychiatrists to diagnose a student with a severe mental health issue.

V. Conclusion and Future Scope

Maxx chatbot can be implemented in college management systems and applications as it can interact well with the students and can also help report the teachers or parents during a severe mental health issue. It can help students to become mentally strong, as it provides the right and ethical advices at the right time. **Maxx** can become a good friend to the students in a short period of time.

We can train the chatbot with much more data to improvise on the mental health issues that are quite complex in nature. We can also add other features like calendars, reminders, web search, etc., to use it in a much efficient way.

Acknowledgment

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