INTELLIBOT - Intelligent Voice Assisted Chatbot with Sentiment Analysis, COVID Dashboard and Offensive Text Detection

Abstract

Chatbot has become an essential crowd puller in the world today and is used in various domains and professions. With increasing technologies and advancements in AI, components of voice assistance have been gaining prolific importance when integrated with chatbots. INTELLIBOT is a smart bot that not only interacts with its users through an interactive and aesthetic platform but also had added features for customized experience. It makes use of speech to text and text to speech processing to listen to the user and speak back to them. This paper would give insights on the various applications of chatbots and existing systems along with the system we have proposed to overcome and curb the challenges posed by them through the INTELLIBOT framework. Further, the paper would elucidate the use of Naïve-Bayes algorithm and pattern matching algorithms for the same.

Keywords: Chatbots, pattern matching, Naïve Bayes, sentiment analysis, COVID Dashboard, offensive text detection, intelligent chatbot

1. Introduction

In the rapidly digitalizing generation, where almost every domain of profession and lifestyle are focusing on automation and interactive components, chatbots have been on the spotlight [1]. In general, a bot is very similar to a software application that mainly aims towards completing and executing tasks without much of a human interference. Chatbots are those bots which are capable of initiating and conversing with humans by speech, text or both by responding to the queries and clarifying doubts [2]. Many a times, chatbots are interchangeably used with conversational agents. However, the key point is that chatbots are much simpler and easier than conversational agents and they can be integrated with Application Programming Interfaces (APIs) to cater to the various needs of the user. Furthermore, it improves branding with less customer effort. Ever since 1990s, a large number of researches have been carried out with regards to conversational systems [3] including those of airline ticketing systems, travel programs, etc. And studies have shown that they have been performing at par with others in the field. ATIS and Communicator systems are designed to understand natural language requests and perform a variety of specific tasks for users, such as retrieving flight information and providing information to tourists. Their performance is excellent only within domains that have well-defined schemas [4]. Undisclosed chatbots are four times more productive than novice sales staff, and their ability reaches that of specialized consumer shopping employees. However, subjective human perception makes people consider disclosed chatbots less informed and emotionally intelligent. Thus, when customers discover during a conversation that they talk to a chatbot, they get upset and buy fewer products. Therefore, a method for delayed

disclosure of a chatbot was used. In [4], the so-called ‘‘uncanny valley theory’’ examines the uncomfortable feelings that a person is experiencing when he/she does not know if the interlocutor is a human or a computer program Personification and contact in people’s disclosures on sensitive topics, such as social stressors, have also been examined.

2. Literature Review

With evolving technologies and rapid advancements in numerous fields across the globe, chatbots have become an integral part of majority of applications because of the versatility and convenience it imparts in the domains it is being incorporated into. The very use of a chatbot is to introduce an environment of natural language to the user space with regards to the applications being used, be it entertainment, education, finance, health, etc. One of the very first chatbots that was brought to light was Eliza, which was capable of extracting the context of the user input sentences and generate a response as per the basic rules and guidelines laid out. This technique definitely did grab a lot of attention in the initial stages but on seeking deeper insights of the other features it offers, it was observed that Eliza couldn’t retain the history of the messages or conversations it had with its users [1][2]. Following this came, A.L.I.C.E., a chatbot developed from a novel technology termed as Artificial Intelligence Markup Language (AIML), which took an extensive amount of work and time for curation. A.L.I.C.E. works on the principles of pattern recognition, response template and built-in stimuli for engaging in natural conversations and chats with the users. Once the input is received from the user, the bot makes use of category matching techniques of patterns and further indulges in supervised learning approaches to create and store responses accordingly [3][4]. With progressing tech strategies and evolving algorithmic paradigms, chatbots have acquired mainstream representation with specifications with respect to the domain of usage and application. One of the other such chatbots is Jabberwacky which is generic in nature and the feature that makes it stand out is its ability to respond back to its users in a humorous and funny way and it keeps improvising its responses each time it learns something new from a recent conversation it had with one of its users. In simpler words, Jabberwacky is a generic conversation bot which doesn’t necessarily have an explicit domain of application and usually caters to generic chats and conversations [5]. The above mentioned chatbots are those which were developed in the initial stages of evolving chatbot technology. However, current chatbots are much more sophisticated and consist of intricate and complex strategical approaches for handling various aspects of a well curated chatbot. Few such technologies are so advanced that they often develop a goal driven mannerism. In fact, chatbots these days are inclusively connected with databases, application programming interfaces and application layers for efficient working and additional features [6]. One of the recent innovations in the field of chatbots is the development of a project which involves integrating Internet of Things (IoT) with Natural Language Processing (NLP) techniques for the aquacultural domain. This chatbot also consists of data retrieved from sensors and modular systems along with cloud computational frameworks to provide responses with accurate results in their field of application. This section, hence puts forward the various existing chatbot systems and architectures.

3. Types of Chatbots

Chatbots are of various types and are developed based on the application, use, and necessity. One of the first types of chatbots is the rule based chatbot wherein the communication and interaction with users is based on a predefined collection of rules. This type of chatbot doesn't have much of Artificial Intelligence (AI) involved and hence utilizing such rule-based bots for vast, broad, boundless conversations might not yield accurate responses and results. The next type of chatbot is the menu/button based chatbot, which is quite evidently prevalent in numerous application domains currently [7]. The core data structure used here is that of the decision tree hierarchy which are displayed as buttons for users to chat and interact with the bot. It's often compared to the automated menus which are mainly observed on smart phones and related gadgets. The main use of this menu/button based chatbot is in handling FAQs and support queries and responses. One of the other types of bots is keyword recognition based chatbot which has the potential to respond to the user as per the request and needs of the user, ensuring a user-centric performance. It surely is gaining a lot of popularity off late and has been considered as a mixed combination of menu based and keyword-based type of chatbot [8][9][10]. Following this, is the contextual chatbot which are surely the most advanced when compared to the above-mentioned types of chatbots, as they make use of Machine Learning (ML) and AI for learning from every new conversation they engage in and also to retain the memory of the previous conversations and chats. This makes the context based chatbots smarter in terms of being able to improvise their responses to the users based on the experiences they gain and from the chats they retain in their memory. Another classification of chatbots is the support chatbot which is majorly used in overcoming a problem or query localized to a certain domain. Apart from this, it also demands the chatbot to be well aware of the contextual background, especially in cases where they might have to explain the entire procedure or business process to the users. Some of the main use cases of the support type chatbots include customer centric service bots, e-commerce bot along with recommendation systems, bots for ordering food, and bots which cater to answering FAQs [11]. Another interesting category of bots is the skills chatbot type which is much simpler when compared to support based chatbots from the awareness aspect. This chatbot is mainly utilized in situation where an action is to executed for a particular command or request that is given to the bot. Then, there are assistant bots which are very commonly used in smart phones for personal assistants like Siri, Bixby, Google Assistant, etc. Transactional bots, information gathering bots, conversation chatbots, etc. are all some of the other types of bots which are currently existing [12]. The key observation to be made here is that there are so many varieties of chatbots such that a particular type of chatbot can be easily adapted to a specific application domain with added features, benefits and characteristics which can be specially curated and attached to the curated chatbot [13]. However, most of the existing chatbot systems have a few disadvantages which restrict their varied and extensive use to a certain extent. Some of these chatbots may not be able to extract the exact essence of what the user is intending to say and might respond back in unexpected ways. Further, some of the chatbots lack a responsive, dynamic and aesthetic user interface presence despite the accuracy in results obtained.

4. Proposed Architecture of Chatbot

Based on the research and analyses of surveys on chatbots, it was observed that majority of the chatbots were specific to a particular domain. In other words, if a chatbot was developed for the health sector, it could only be relatively trained for the health sector and similarly if a chatbot was curated for the educational sector, its utility remains within the boundaries of the educational field. This surely hampers the versatility of the chatbot and urges users to work with many chatbots to get an idea of the chatter bots and to clear their queries in different fields. To overcome this curb and to highlight the versatility and uniqueness of the chatbot, INTELLIBOT is proposed. Like a few other chatbots, INTELLIBOT is an intelligent and smart chatbot which makes extensive use of AI and ML algorithms and concepts for improved behavior with increasing experience and conversations with users. Most importantly, INTELLIBOT has been curated in such a way that it can also cater to the needs and queries of the blind. This is incorporated by using the very important essence of Natural Language Processing (NLP), i.e speech to text conversion and text to speech conversion. This ensure that, if the user wishes to convey his/her query to the chatbot, they just need to put out the words clearly and INTELLIBOT would grab the essence or context of the said sentence, would apply the necessary pre-processing techniques and would then pick out the respective response and show it to the user. Along with displaying the response, it would also speak out the response which the user can hear and get his/her doubt or query cleared. One of the other aspects and characteristic features of INTELLIBOT is that it isn't restricted to a specific domain of application. It can take up the roles of chatbots in different domains and act accordingly. If the user wishes to have a random generic chat with the bot, INTELLIBOT can take up that role too. But asper the current scenario, there are three pressing issues to be addressed and taken care of which include COVID related queries, offensive text detection and sentiment analysis and INTELLIBOT can embrace and respond to queries related to all these fields as well. This surely is one of the striking features of INTELLIBOT and takes it way ahead than the existing bots in the world.

Fig. 1 portrays the architecture of the system used to develop INTELLIBOT. Initially, the user turns on the chatbot application and on being intimidated to speak his/her query or comment, the user speaks. The contextual meaning and logic of the speech is extracted from the spoken words by the bot using the speech to text conversion module. Fig. 2 elaborates on the process used for speech to text conversion [14]. Once the input speech is obtained, speech analysis is done by the bot which is preprocessed using the necessary models which are imported from the library. The module from python library called *speech_recognition* is used for extracting the essence of the text and using the *Recognizer.recognize_google(audio)* the speech is finally converted to the right textual sense [15]. Once this is done, the next step is for the BOT to parse through the converted text and perform some sort of analysis and preprocessing to understand the exact sense of the speech given by the user. On completing this step, the bot uses the Naïve Bayes algorithm for parsing through the set of predefined pattern-matching based keywords and questions to identify what response needs to be given to the user. There are four possible domains of applications INTELLIBOT offers. The user can chat with the bot from a generic perspective and engage in some humorous and interesting talks. One of the other possible options is to get details related to COVID statistics using the in-built COVID dashboard INTELLIBOT offers. Or, the user can

assess the offensiveness of a particular text/comment using the offensive text detection module which is embedded with the bot. And finally, the user can also assess the sentiment of a particular text or comment through the sentiment analysis bot which INTELLIBOT has. The modules apart from the generic/customized text response is carried out on a platform called AIPlayground, which is and AI and ML powered framework used for curating such interactive chatbots. After the response for the query shared by the user has been created, the text should now be converted back to speech. Fig. 3 elaborates on the procedure involved for the same. The generated text response is preprocessed once again and undergoes Unicode conversion followed by segmentation and concatenation of words and syllables. Following which, the prosody and smoothening technique is applied and finally the text is converted back to speech and is given out to the speaker as a response.

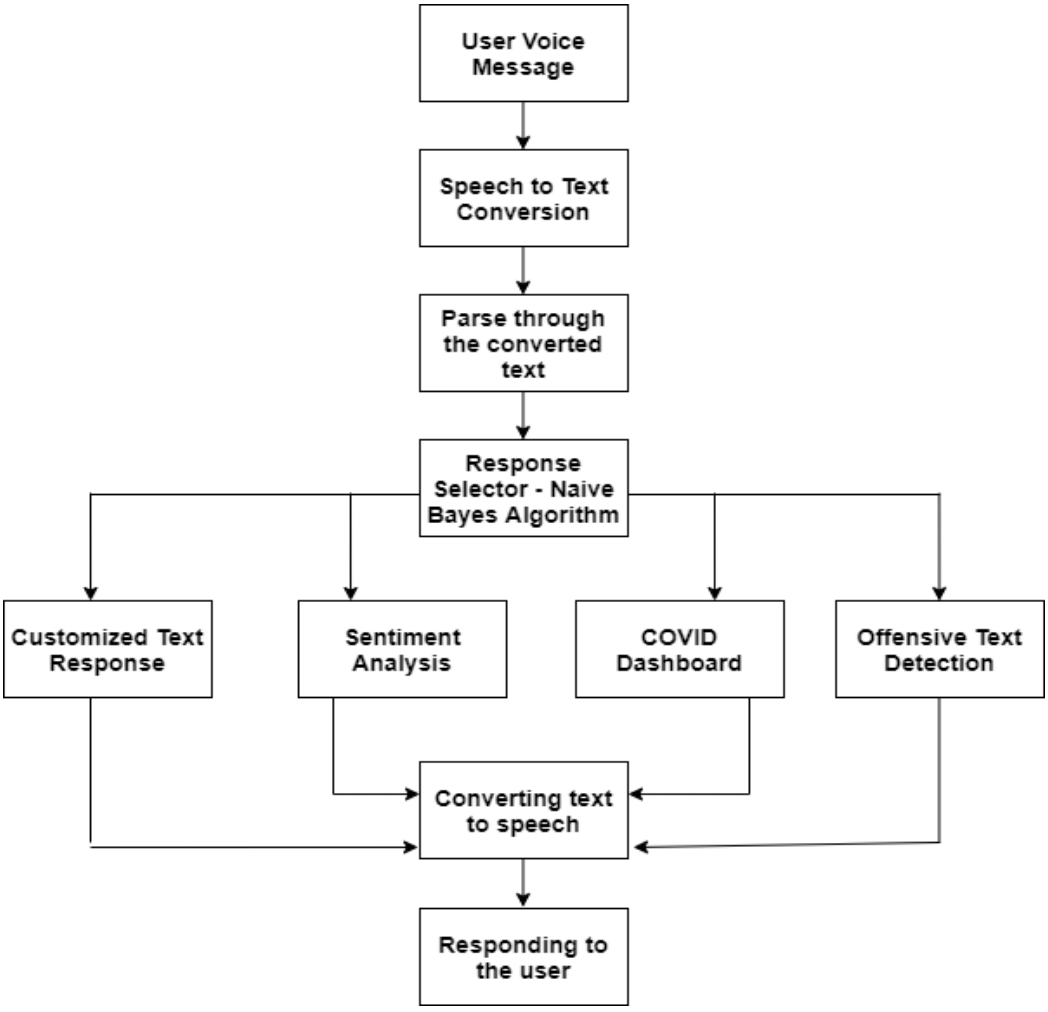


Fig. 1 Proposed system architecture of INTELLIBOT

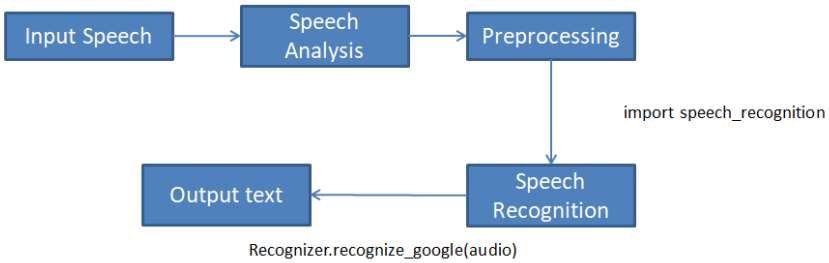


Fig. 2 Speech to Text conversion module

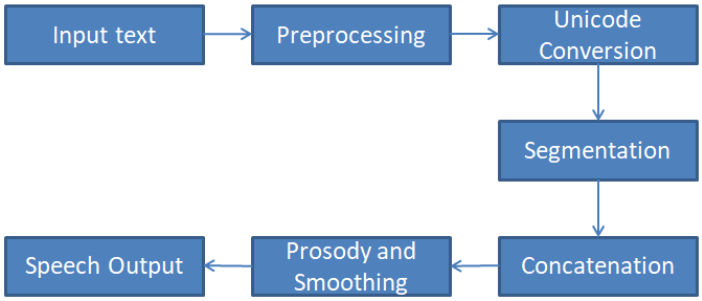
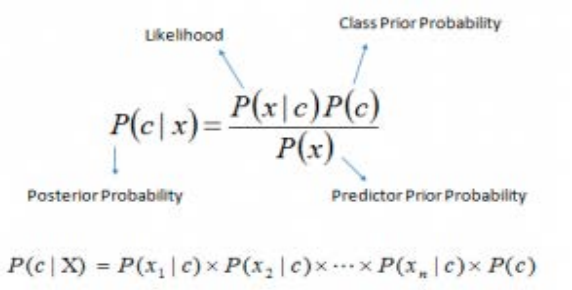


Fig. 3 Text to Speech conversion module

5. Implementation

Implementation of INTELIBOT has been carried out using the Python programming language for ease of construct, flexibility and dynamic framework related activities. In order to curate the core architecture and conceptual scene of the chatbot, the very first step is to implement the Naïve-Bayes algorithm as per the needs of INTELLIBOT. Firstly, all necessary libraries and packages are imported and installed including those of *speech_recognition*, *pyttsx3*, and *time*. Using the *Recognizer()* built-in function from speech_recognition library, the user defined function for turning on the input voice resource and extracting the speech given by the user is created. In case of any turbulent noises or extremely unclear speech input, the bot will prompt the user to reiterate the spoken words for better identification. The next main function is the *respond()* function which is user defined to incorporate the Naïve-Bayes algorithm for giving accurate results to the user. Naive Bayes model is easy to build and particularly useful for very large data sets [16]. Along with simplicity, Naive Bayes is known to outperform even highly sophisticated classification methods [17][18]. The formula used for curation of the probability of picking the necessary response is as follows:



wherein, P(c|x) is the posterior probability of getting a particular class c for a given attribute predictor x, P(c) is the initial or prior probability of the class, P(x|c) is the probability of the predictor attribute for a give class and P(x) is the prior probability of the predictor attribute. The dataset used for INTELLIBOT is a large Java Script Object Notation (JSON) file which contains the necessary classes and a set of possible responses as attributes in the form of key value pairs. The algorithm in the *respond()* function would compare and match the extracted words from the user's speech input and identify the suitable response from the dataset based on the probabilities calculated by the algorithm. Following this, the response is converted back to speech using the user defined *speak()* function. The function *speak()* makes use of the *pyttsx3* module to convert and transform the response back to audio and the converted speech is then thrown out to the user. The above explanation elucidates the generic working of INTELLIBOT and the integration of the algorithm and dataset used for curating the interactive experience. Moving on to the individual modules of INTELLIBOT which highlight the unique features and characteristics of the bot.

i. **Sentiment Analysis**

One of the major highlights of INTELLIBOT is the sentiment analysis bot which helps the users in identifying the sentiment category or emotional context of a particular text or speech input given. In order to develop this module, the AIPlayground framework has been used. AIPlayground is a Java Script based platform which allows its users to curate and train models using AI and ML and integrate it with their built-in chatbot called Lexy. As seen in Fig.4, in order to develop the sentiment analysis bot for INTELLIBOT, the very first step is to train the model for identifying the different classes of sentiments. Initially the different sentiments such as happy, sad and neutral are used as labels for the classes. Each of the classes are then integrated with a sufficient number of words, phrases, and sentences pertaining to the class from the dataset acquired from Kaggle. After the manual updation of the dataset, the model is trained for around 1500 epochs and tested for any glitches and mishaps. Finally, the model is imported to the code base using *fetch()* and is integrated with INTELLIBOT.

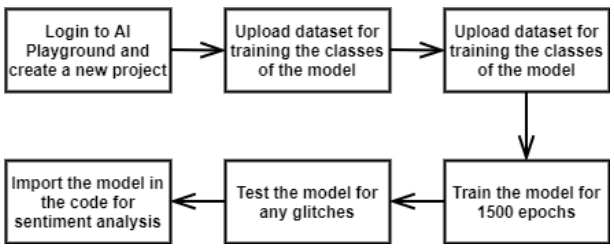


Fig. 4 Steps involved for sentiment analysis model.

ii. **COVID Dashboard**

Over the last year, one of the highly spoken about topic and issue across the globe is the outbreak of the global pandemic – COVID'19. It surely has had a negative toll on majority of the mundane lives and the data inflow in this field has been extremely huge and vast, such that it makes it nearly impossible to interpret the proper statistics with ease and conveniently. INTELLIBOT has been incorporated with a COVID Dashboard which extracts live COVID statistics from a reliable Application Programming Interface (API) and displays the necessary stats for the country. Once the user gives the speech/text input of the country whose details or statistics are needed, the bot would extract the data from the real time updated API and provide information including those of death rates, confirmed cases, positive cases, etc. for the particular country. This module has also been developed using the AI Playground platform. The workflow for this module can be observed in Fig. 5

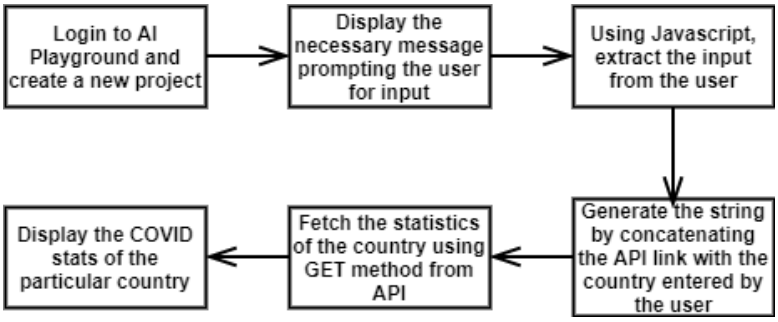


Fig. 5 Steps involved for COVID Dashboard module

iii. **Offensive Text Detection**

The next module of INTELLIBOT is the offensive text detection module. With the spike in the use of social media platforms in the society, there has been numerous cases of harassment and unethical events through posts and comments. We wanted to ensure that INTELLIBOT was close enough to reciprocate to human emotions and hence decided to incorporate the offensive text detection module. Using the AIPlayground platform, the model was trained by manually importing the dataset into the two classes of "offensive" and "not offensive". It was trained for 1500 epochs and tested. After developing the accurate model without any glitches, the next step was to integrate the model with the code for implementation. Whenever the user enters a text/speech which involves rude/harsh comments, the bot responds back by telling them that they were mean and if not, the bot would thank the user for being nice to it.

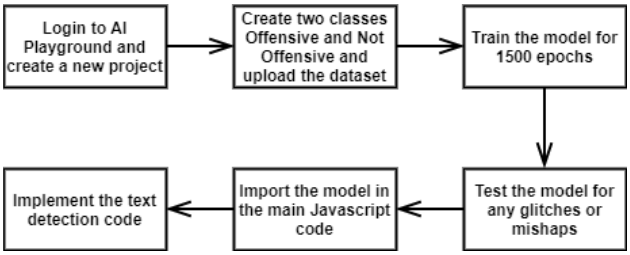


Fig. 6 Steps involved for Offensive Text Detection module

6. Results Obtained

The implementation of the above-mentioned modules and integration yields INTELLIBOT which is the intelligent voice assisted chat bot. Fig. 7 elucidates the snapshot of the implementation using the python code for implementing the Naïve Bayes algorithm and speech to text and text to speech conversion. Fig. 8 portrays the snapshot of the training of the model involved in the platform following which the testing can be seen on the right-hand side column. Fig. 9, 10, and 11 gives the snapshot of the implementations of offensive text detection, sentiment analysis, and COVID dashboard using the AI/ML powered platform. Further, the built-in chatbot feature integrated with AIPlayground is also compatible for detecting speech as well as text and gives the response in both was too.

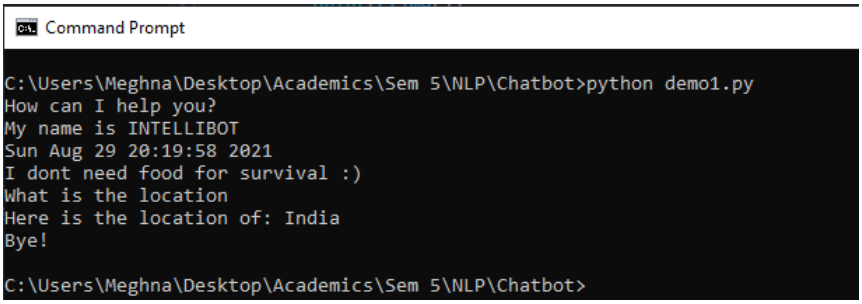


Fig. 7 Snapshot of implementing the Naïve Bayes algorithm for chatbot along with speech to text and text to speech

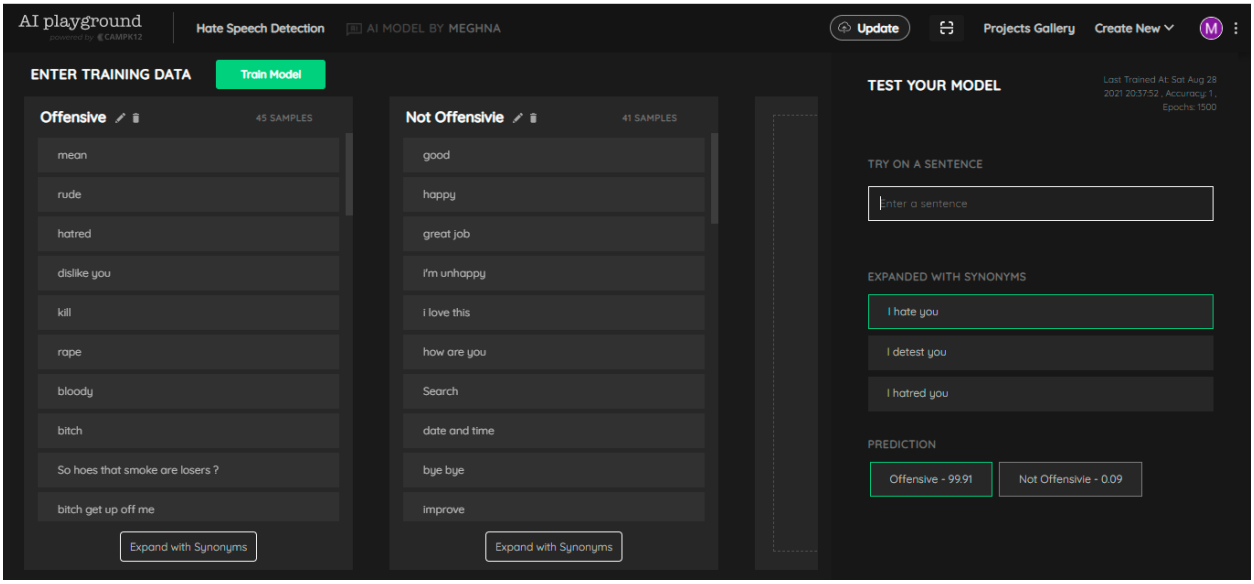


Fig. 8 Training the models in AIPlayground

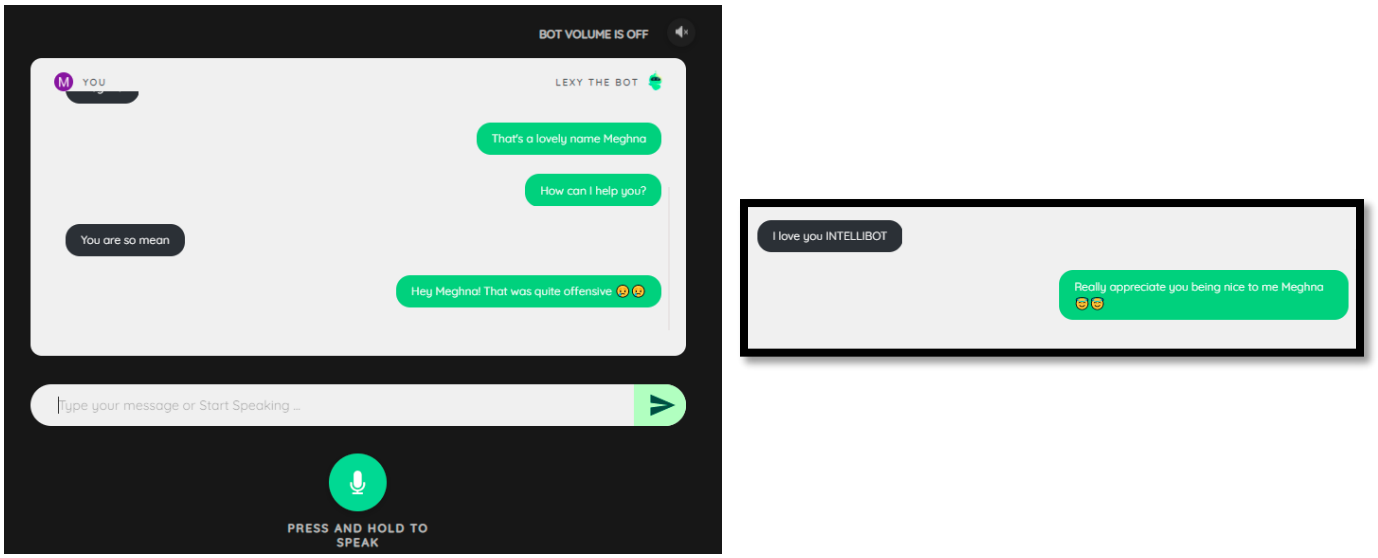


Fig. 9 Offensive Text detection Analysis

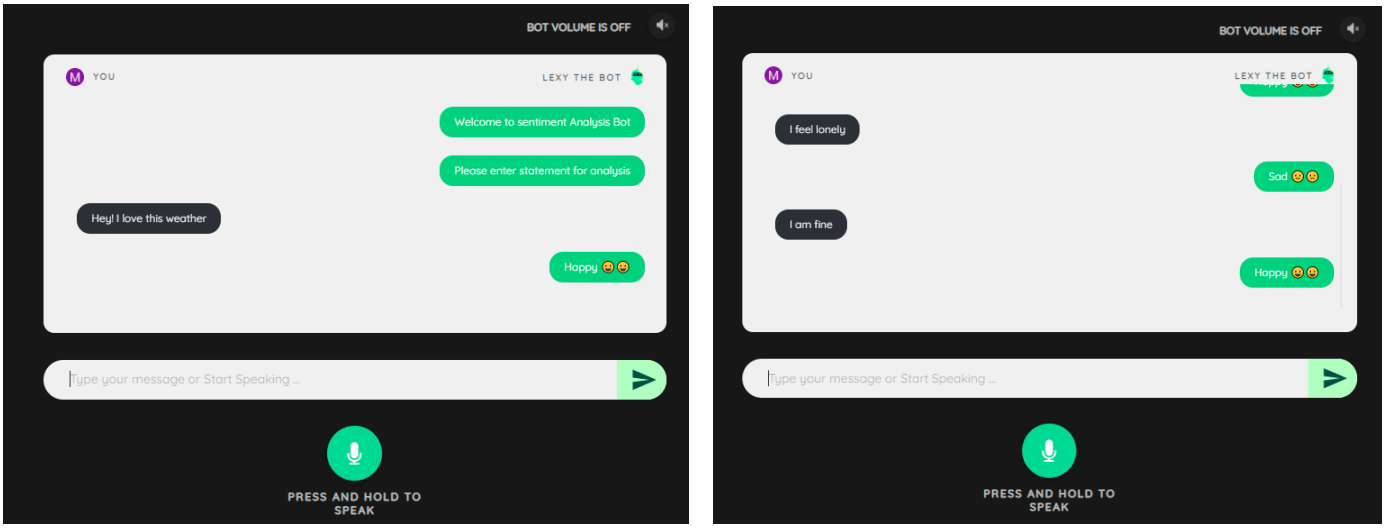


Fig. 10 Sentiment Analysis using AIPlayground

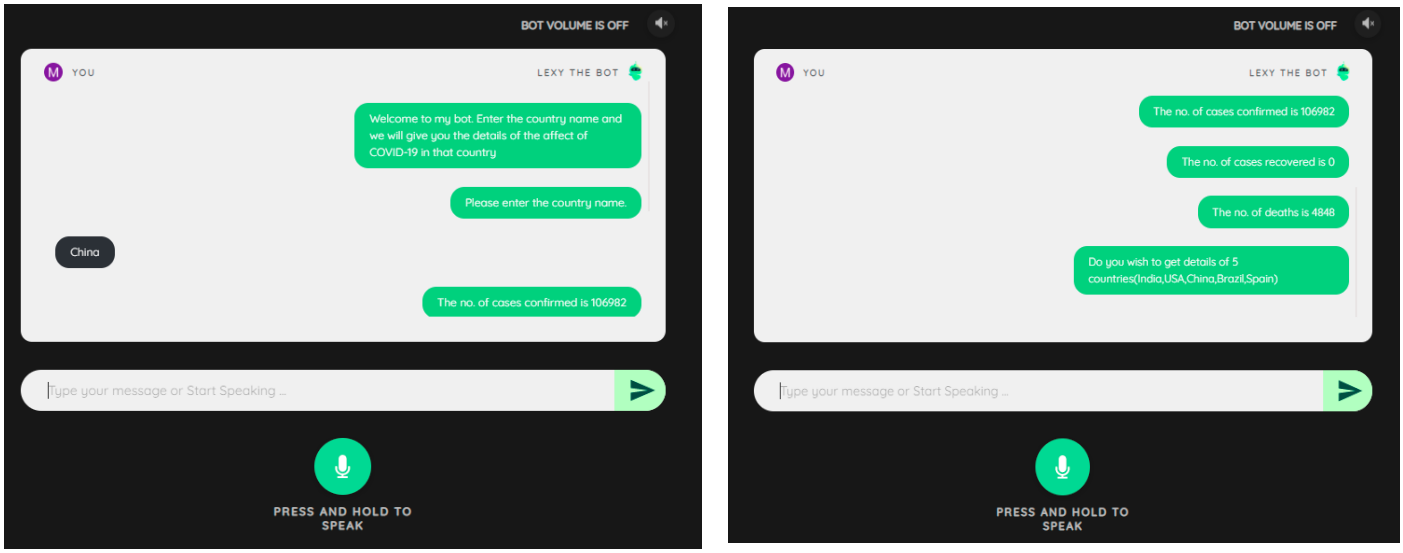


Fig. 11 COVID Dashboard using AIPlayground

7. Conclusion

On the whole, the implementation of INTELLIBOT has been beneficial in ensuring that people can clarify their queries and details pertaining to some of the varied and highly important domains within one work space. INTELLIBOT not only caters to people with vision and hearing abilities, but is friendly and smart enough to address the query needs of the visually impaired by using the speech to text and text to speech conversion. Further, the effective and efficient Naïve-Bayes algorithm ensures that the bot responds accurately without much deflectional and deviational responses. In order to integrate the modules of sentiment analysis, offensive text detection and COVID dashboard along with INTELLIBOT, an AI/ML based platform called AIPlayground has been used for implementing and training the model. In the current world where chatbots have been gaining predominance over various fields and domains, chatbot systems and architectures like INTELLIBOT have a sure chance of shining bright.

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