

Development of Artificial Intelligence based Chatbot using Deep Neural Network

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No matter how well-known colleges are, there will always be concerns that people have during the application process and even after they have been accepted. The college hosts a variety of events, ranging from departmental activities to club activities. Not everyone is likely aware of all events. Chatbot bridges gap between people and information. The world is becoming more automated, and people expect services to become more automated as well. A chatbot is software that responds to user questions and provides information from a knowledge base. The purpose of this project is to create a chatbot for VNRVJIET that will answer queries raised about fests, departmental activities, events, clubs, infrastructure, placement data, admission procedure, and others. The proposed methodology consists of a chatbot built using Deep Neural Networks and speech recognition capabilities. The information is delivered in both speech and text modes using the proposed methodology. Data is collected and formatted in JSON format initially. The prepared data is pre-processed and then the bag of words algorithm is applied to it. The bag of words algorithm is most influential method for object categorization. The key aspect of using this algorithm is for converting the word vector to a numerical data set for machine to do a deeper analysis. A deep neural network is created using tensor flow API, and the speech recognition function is defined for the input query and output response. Finally, chatbot function is defined and utilized for generating responses for any given query.

Keywords: Bag of words, Deep Neural Networks, Batch gradient descent algorithm, NLP, JSON.

1 Introduction

A text-based user interface is commonly used by chatbots, enabling the user to type commands and get text and textual content-to-speech responses. Chatbots are often stateful systems that remember prior commands to deliver functionality. When chatbot technology is connected with major web services, an even bigger audience can use it safely. A chatbot is a user-interactive agent that uses simple language to converse with users. Several chatbot applications, such as Customer Service, contact centers, and so on, employ AI terminology to converse with the user. One of the primary aims of chatbots is to resemble an intelligent human and make it difficult for the recipient of the discussion to understand the significance of collaborating with various architecture and capabilities for his or her use. Chatbots employ machine learning to achieve artificial intelligence, allowing them to understand the user's query and offer a suitable response. To converse or engage with the user, the chatbot is built using the help of Jupiter notebook using Natural Language Processing (NLP).

The proposed system could be an internet application that responds to the question posed via way of means of the user. Students only need to ask a question through the chatbot. Students can chat in any format they want; there is no set format that the user must adhere to. The replies to the user's request are relevant. The technology allows the user to query any college-related activities. To ask in person, the user does not need to travel to campus. The system will analyze the question and reply to the user. The system responds to the question as though the person replied. The system responds with an efficient graphical user interface, which implies that a real person speaks to the user.

This application allows the user to inquire about college-related activities online. The user can search for college-related events such as placements, admissions, club information, departmental achievements and activities, and other cultural activities. This system keeps students up to date on college activities.

2 Motivation

Throughout our courses, we as students require different forms of information about our college. Acquiring this information might be time-consuming and inconvenient. Getting information about our departments or placements, for instance, is a time-consuming process that requires us to visit the administrative building, identify the appropriate window, and then search for information. If required, update it with accurate information and send it to the relevant person. All of this is unnecessarily long, frantic, and inconvenient. We live in a computer science era, where everything is automated and simple tasks are easy to accomplish. So, why go through such a long and pointless process only to receive this basic information? We, as information technology students, are constantly excited to solve problems in our community by applying the technology we've learned and figuring out how to put it to use in real life. We considered using an intelligent chatbot to give this information at this point. Consider an application in which all you have to do is type in a query. If you wish to check a student's attendance, simply enter the query, and it will return the percentage of attendance. There's no need to go through a time-consuming and stressful treatment. If you want to know how to fill out a university exam form, our bot will walk you through the procedures. It can also help a student who is preparing to start college with a dilemma. He or she may want to inquire about several universities' tuition structures and entrance procedures. It can be a lengthy procedure in today's world, but our chatbot can complete it for you in seconds. All you have to do is request it a question. This is a much better way to communicate with students and respond to them.

3 Related works

This project is normally focused on colleges and the synchronization of all the sparse and various data regarding ordinary university schedules. Generally, students face issues in getting correct notifications at the correct time, some important updates such as campus interviews, training and placement events, admission details, and unique announcements. Smart Campus tries to bridge this gap between students, instructors, and college administrators. Therefore in the real world scenario, such as college campus, the statistics in the structure of notices, oral communication, can be directly communicated through the android gadgets and can be made handy for the students, teachers without delay, and the maintenance of application will be less difficult in later future because of the use of architectural MVC which separates the important works in the improvement of software such as records management, mobile user interface display and others which will be the controller to make sure for speedy and efficient maintenance of the application.

Developed a chatbot by using knowledge in database. The proposed system has Online Enquiry and Online Chatbot System which is developed using various programming languages on a user-friendly graphical interface to send and receive response for the queries. Mainly it uses SQL (Structured Query Language) for pattern matching which is been stored in program [1]. Proposed a college enquiry chatbot system that has been built by using Artificial Intelligence algorithms. The bot analyses query of a user and understands user messages. The system has modules like an Online chatbot, Online Noticeboards, etc [2]. Methodology have designed using AIML (Artificial Intelligence Mark-up Language) to make a response to queries. AIML is employed to make or customize an ALICE bot that could be a chat-bot application supported ALICE free code [3]. Projected and have built chatbot on android application. The proposed methodology consists of developing an expert System for college enquiry desk using an android based chatbot, through Artificial Intelligence technology virtual assistance (Human-machine conversation), transmitting natural language to a server [4].

Proposed an artificial chatbot using NLP (Natural Language Processing) which can be done in two ways the first via written text and the second is via verbal or voice communication. Written communication is much easier than verbal communication. This paper introduces an interest in some emerging capabilities for evolving speed understanding and processing in virtual human dialogue systems [5]. Authors have developed a web-based site. It has three modules - Front end, ChatBot and Back end is admin login. And the response generated is in text format [6]. Projected a chatterbot based on AIML (Artificial Intelligent Markup Language) structure for training the model and uses Microsoft voice synthesizer for providing speech recognition system and natural language processing [7]. In the proposed work several hybrid models that combine different classification techniques, namely, Markov models, artificial neural networks (ANNs), and the All-Kth-Markov model are used to resolve prediction using Dempster's rule. Such fusion boosts the accuracy of ANN, particularly, when dealing with a large number of classes [8]. Projected and examines the potential use of dialog-based ALICE bots in disseminating terrorism information to the general public. The proposed system has utilized feedback to test the chatbot accuracy and customer satisfaction [9].

Authors have implemented an iterative model to build a chatbot. The proposed systems consist of modules along with login credentials [10]. Proposed work have coined a programming language for natural language processing, ELIZA which is operated within the MAC time-sharing system and makes certain natural conversation between man and computer possible. Input sentences are analyzed on the basis of decomposition rules which are triggered by key words appearing in the input text. Responses are generated by reassembly rules associated with selected decomposition rules [11]. Projected a chatbot system with 2 different modules namely, an admin module and user module. The proposed system used porter-stemming algorithms during pre-processing [12]. The proposed system was implemented using a database extracted from the raw input text that is needed for the online access of the addresses. They have built a dialogue flow for finding addresses in the

context [13]. Planned and investigated the implementation of ALICE Chabot system as an application named as college enquiry chat bot. A keywords-based human-computer dialog system makes it possible that the user could chat with the machine in natural language [14].

4 Proposed Methodology

The proposed methodology flow is as follows. Initially, the data relevant to the requirement is collected and prepared, then the collected data is pre-processed. A bag of words algorithm is applied and the resulting vector is used for training the deep neural network and optimization is done based on batch gradient descent. After the model is built, for the given input the output response is generated.

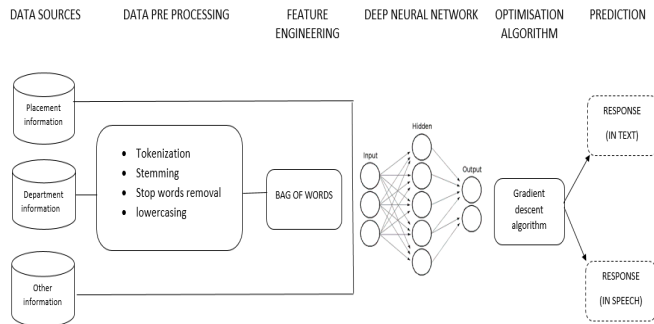


Fig. 1. Workflow of the proposed method

4.1 Dataset Collection

Data is prepared in JSON format as it provides the flexibility to represent the data. We gathered information on VNRVJIET's admission procedure, numerous departments, training and placement details, various clubs, faculty and principal details, information about each department, course details, syllabus books, and so on as part of our data gathering. We started by generating a list of tags that users' searches may fall under. Patterns would have to be specified for each of the tags we generate. Essentially, this describes the many methods in which a user may ask our chatbot a question. The chatbot would then utilize these patterns as training data to figure out what someone was asking for.

Fig. 2. JSON Data Format

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The dataset includes 35 documents, 35 classes, and 127 stemmed words that assist in answering the user's question.

4.2 Data Pre-Processing

Data preprocessing is a method of preparing the raw statistics and making them appropriate for a computing device model. When performing any action on data, it is necessary to clean it and format it, which enhances the accuracy and efficiency of a machine learning model. It includes the following steps:

Tokenization: Tokenization divides the raw text into words and phrases, which are referred to as tokens.

Lowercasing: Converting a word to lower case.

Stop word Removal: To remove stop words from a phrase, break your text into words, and then remove the word if it appears in the NLTK list of stop words.

Lemmatization: It is the process of merging common words to reduce the number of words to a single word.

4.3 Feature Engineering

Bag of Words is basically a word representation of a document in vector format that involves identifying the vocabulary of familiar words and then counting the number of times familiar words appeared. It starts with the data collection, then vocabulary formation and lastly formation of document vector. After the pre-processing of data is being done, the bag of words model is built. It uses frequency as a feature for the training model. It involves 3 steps:

Step 1) Pre-processing:

For building a BoW model, we need to pre-process the data that is being fed into the model. Before the stage, we have already done processing the JSON data. We pre-processed and converted the text to lowercase, removed the stop words (!,.,?) and wordless letters (like a)

Step 2) Identifying the keywords:

Now, after the pre-processing of data is being done. We now identify the keywords, which hold a very important feature or meaning. For example: In the sentence, "They have a laboratory beside show & tell" the words (laboratory and show & tell) are the keywords. To identify these, first of all, we declare a variable as a dictionary to preserve these words i.e bag of words. Then we do tokenization for every sentence present in the data to words. After that, for every phrase of the sentence, we test against the bag of words and see if it exists there. If in case it does, we increase the count by 1 and if it doesn't match, we add it to our bag of words (dictionary) and set its count as 1.

Step 3) Building the BoW model:

This is the final step and here we build the bag of words model. In this step, we assemble a vector, which would inform us whether a phrase in every sentence is a conventional word or not. If a word in a sentence is the most occurring or frequent word, we set it as 1, else we set it as zero.

5 Building and Training the neural network model

The data related to VNRVJIET College is very diverse. Therefore, there is a need for a neural network which uses many layers of nodes to derive high end functionalities. Therefore, deep neural networks (DNN) fit the best in this use case scenario. The neural network is also very efficient even if the inflow of data is exponentially increasing. The college has numerous day to day activities which in turn lead to huge data which the neural network can accommodate.

The bag of words model has converted the textual data to a document vector containing 0's and 1's. The length of the vector will be equal to vocabulary size. We initialize 1 when a word from the cur-

rent pattern is found in the given position X (pattern converted into array [0,1,0,1,0, 1,...,0]), Y (training data) (intents converted to an array [0,0,1,0,0,0,0], there will be only single 1 for intents array as it responds to the match found). Layers of interconnected nodes make up a Neural Network. In Neural Networks, there are two key components. The Neuron and the Network are their names. A neuron is a data-storage node. The network is a mathematical relationship between nodes that is achieved through the use of functions. Different Layers are also present in the network.

The Input Data Layer, Multiple Intermediate Hidden Data Layers, and Output Data Layers are the three layers. We have constructed a deep neural network. The DNN is constructed with 2 hidden layers for mapping comforts.

Optimization function: When you train a model you try to solve the optimization problem. While you are trying to optimize the weights. Each connection between the neuron has an arbitrary weight assigned to it. During the training, these weights will be constantly updated and attempted to reach optimal values. In terms of how they are being optimized it depends on the optimization algorithm. In our project, we have considered the optimization algorithm to be GD (Gradient Descent).

The no of epochs we used for our model is 1200. We have obtained it from trial and error method-ology where we tested for a wide number of ranges and this range was giving desirable results.

We achieved 93 percent accuracy on our model after training it for 1200 epochs.

```

11
12 # Define model and setup tensorboard
13 model = tflearn.DNN(net, tensorboard_dir='tflearn_logs')
14 # Start training (apply gradient descent algorithm)
15 model.fit(train_x, train_y, n_epoch=1200, batch_size=8, show_metric=True)#n_epoch is the number of times network sees the da
16 model.save('model.tflearn')
    
```

```

Training Step: 4799 | total loss: 0.90349 | time: 0.014s
| Adam | epoch: 1200 | loss: 0.90349 - acc: 0.9259 -- iter: 24/26
Training Step: 4800 | total loss: 0.81615 | time: 0.017s
| Adam | epoch: 1200 | loss: 0.81615 - acc: 0.9333 -- iter: 26/26
--
INFO:tensorflow:C:\Users\Dell\Desktop\major project\model.tflearn is not in all_model_checkpoint_paths. Manually adding it.
    
```

Fig. 3. Training Accuracy and Loss

5.1 Speech recognition

Speech recognition is one of the most common features that find its application almost everywhere. It makes the environment more user-friendly and eases the process of querying at the user's end. Our project has utilized the speech recognizer and pyttsx3 modules for building speech recognition functions.

a) Input from speech

The system's inbuilt microphone is used to take the speech input from the user and that input is converted to a wave file (audio file). That audio file is being analyzed by the speech recognizer module of python and generates the textual data out of the audio. Now that textual data is being sent for pre-processing and bag of words algorithm is applied. Finally sent to DNN model for the response.

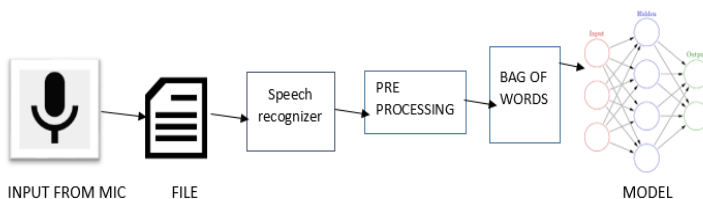


Fig. 4. Flowchart for Speech Recognition Input

b) Output as speech

The pyttsx3 initializes an engine that is responsible for loading speech, changing the pitch of the speech (voices female or male). After the engine is initialized, it is run and it gives you a simple speech output of the response that responds to the given query.



Fig. 5. Flowchart for Speech Recognition Output

6 Results and Discussions

It takes input words that are also pre-processed. The bag of words algorithm is applied and is matched with the document vector. If the result index is 90% matched it returns the response. Therefore, if the model found a 90% match from document vector it results in response pointing it.

The main purpose of this project is to create a chatbot for VNRVJIET College that will answer queries raised about fests, departmental activities, events, clubs, infrastructure, placement data, admission procedure, and other topics. Therefore, our chatbot responds to the queries related to all of them. Typically, this chatbot is made for the outsiders to know about VNRVJIET efficiently.

```

jupyter FINAL_CHATBOT Last Checkpoint: 16 hours ago (unsaved changes)
File Edit View Insert Cell Kernel Widgets Help Not Trusted Python 3
10 tag = labels[results_index]
11 #print(results[results_index])
12 if results[results_index] >= 0.9:
13     for tg in data["intents"]:
14         if tg["tag"] == tag:
15             responses = tg["responses"]
16             ms = random.choice(responses)
17             print("VNR-BOT : "+ms)
18             bot_speaking(ms)
19 else:
20     print("VNR-BOT : Sorry, I don't know how to answer that yet ")
21     bot_speaking("Sorry, I don't know how to answer that yet")
22 chat()
  
```

VNR-BOT:Hi! I am your personal bot. I am here to answer queries on VNRVJIET
 YOU : Hi!
 VNR-BOT : Hi there, how can I help?
 YOU : Placement highest package?
 VNR-BOT : 85 Global Companies (26 Core Companies) Recruited 955 Students from 2020 Graduating Batch.
 Amazon SDE Offers highest about 28.75 Lakhs per annum package.
 The highest salary package offered for one of the students from the passed-out batch was 43 LPA
 The average salary package offered was around 5 LPA-7 LPA while the least is 3.75 lpa.
 Visit <http://www.vnrvjiet.ac.in/placement.php>.
 YOU :

Fig. 6. Result Function-1

By using deep neural networks for chatbot, we were able to achieve accurate results for single word query as well. Most of the users are handy towards the short words rather than using long sentences for queries. Our chatbot can easily retrieve the results for keywords specification as shown in the above fig 6. There are few hyperlinks linked in the dataset so that for more information about the particular query they can easily click the hyperlink and the website would be displayed as shown in the fig 7:

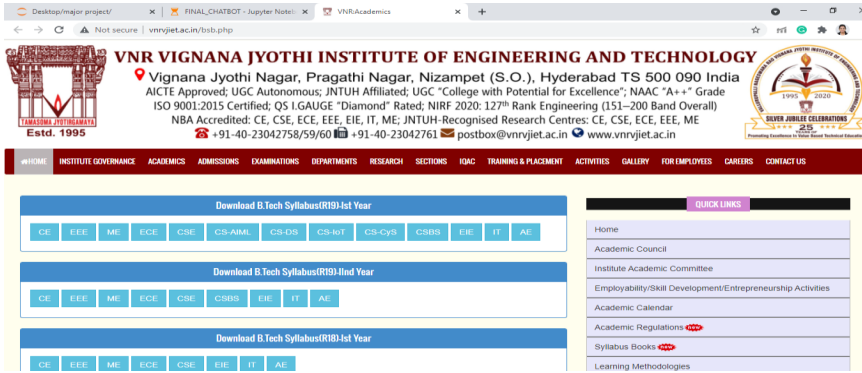


Fig. 7. Result URL Redirecting

Graphical User Interface (GUI)

The major purpose of using a GUI is to make users comfortable with the chatbot. The GUI provides all users the flexibility in using the environment.

Graphical User Interface (GUI) for this chatbot was developed using Python and Tkinter module. The Tkinter is the flexible and stable GUI toolkit with a simpler syntax. The user interface for a chatbot application is very simple and comprehensible as well.

The UI is designed for making it interactive and speech is automatically enabled for each response along with the output text. The user can give even single keyword and retrieve the responses as shown in the fig 8. These interactive conversations give a feel of conversing with our friends.

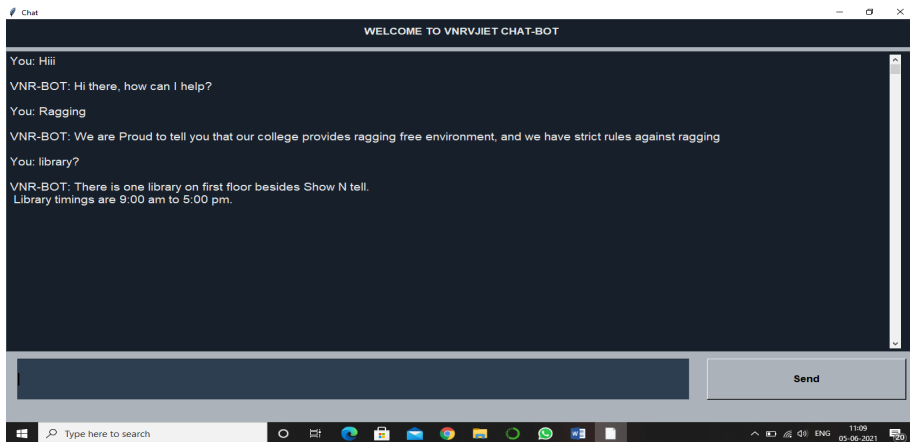


Fig. 8. Result-GUI Application

7 Conclusions and Future Work

The main objective of the college inquiry Chatbot project is to employ algorithms to read user questions and understand user messages. The internet offers a variety of methods to obtain information and has dramatically altered how people communicate. There is a need for technology that addresses the queries of users 24/7. One such technology is a chatbot. A chatbot is just a man-made program that easily connects with users to assist and solve their queries. The services that a chatbot

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can deliver are quite distinct and diverse as they could assist from daily essential queries to big industrial needs. Chatbots can reach a large range of audience and be more practical than humans.

We can incorporate speech-based inquiries and replies into our project in the future. The application may be integrated into the college's website. Sentiment analysis analyses the user's input text or speech to assist understand their feelings and state of mind. Chatbots can use this data to better prepare discussions and give the appropriate replies. There is room for more data to be added in the future, making the chatbot more authentic and accurate.

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