2022 IEEE International Conference on Distributed Computing and Electrical Circuits and Electronics (ICDCECE)

# An Efficient Deep Learning Based Chatbot for GRIET

Ashlin Deepa R N
*Computer Science Engineering*
*Gokaraju Rangaraju Institute of Engineering and Technology*
Hyderabad, India
rndeepa.pradeep@gmail.com

Sai Sravya Thumati
*Computer Science Engineering*
*Gokaraju Rangaraju Institute of Engineering and Technology*
Hyderabad, India
saisravyat99@gmail.com

Sandhya Reyya
*Computer Science Engineering*
*Gokaraju Rangaraju Institute of Engineering and Technology*
Hyderabad, India
sandhya.chandrika01@gmail.com

2022 IEEE International Conference on Distributed Computing and Electrical Circuits and Electronics (ICDCECE) | 978-1-6654-8316-2/22/$31.00 ©2022 IEEE | DOI: 10.1109/ICDCECE53908.2022.9792978

***Abstract*—This work aims to develop a chatbot that can provide required information about the educational institute, GRIET. At present, there is no chatbot system available for the institute's website. The entire website needs to be scrolled in order to get the required data. The proposed chatbot, GrietBot, helps in easy access of information for the user's query. The chatbot model exploits algorithms in order to process user queries and retrieve appropriate information efficiently. Various text preprocessing techniques and deep learning techniques are used to provide the state of art model in developing the first chatbot for GRIET. This chatbot helps access the information faster without the user's physical presence in this pandemic.**

***Keywords—Chatbot, text preprocessing, natural language processing, deep learning, deep neural network.***

## I. INTRODUCTION

In this pandemic situation, users expect all their queries to be answered without time consumption and physical presence. But the users are still facing the challenge of finding the right information at the right time. A chatbot is an application that gives answers to human beings in a natural way (the way we interact with one another) [11], [12].

GRIET (Gokaraju Rangaraju Institute of Engineering and Technology [1]) is located in Hyderabad, the capital city of Telangana state in India, is accredited with NAAC A++ grade which is one of the topmost colleges in the state. People always want to know more about the college either to get admission or inquiry. To make all the information available easily and to reduce in-person contact in this pandemic, a chatbot, GrietBot is proposed in this project. GrietBot is going to be the first chatbot for the GRIET college.

College inquiry system "GrietBot" will help in fast, standard, and righteous information retrieval to enhance the college website's user experience. After receiving the users' queries, the chatbot understands and responds accordingly [4]. In this process of developing the first chatbot for GRIET, GrietBot, various existing chatbots are studied and are discussed in the following section.

## II. RELATED WORK

Chatbots use different logic based on their usage in the market. Different domains of chatbots are goal-based, knowledge-based, service-based, and response generated-base [2]. The model that responds to the user queries based on keyword matching comes under context-centric natural language processing (NLP) [3]. The process starts by tokenizing, sentence detection, and POS tagging and stem the extracted words after extracting the subject-verb predicate. The response is given based on the relevance score and the threshold value.

The Adobot approach [4] is to provide the technical support only for What- and How- questions. These What- and How- questions improve the accuracy of user queries by processing knowledge at the semantic level. This serves as the semantic framework for the analysis of user inputs and generates responses accordingly.

There is also a model which makes use of AIML (Artificial Intelligence Markup Language) files to store the question and answers pair [5]. When the user converses with the chatbot, if the input query is matched to patterns, the corresponding response is returned to the user. Otherwise, the keywords are extracted from the query and a response is given based on the similarity between the user query and the patterns.

In the model [6] the user query is pre-processed for removing links, images, Twitter ID, punctuations, numbers, emojis, non-English words and replacing abbreviations with their long forms. Feature extraction is performed using the Bag-of-words and LSTM (Long Short-Term Memory) which can store past important information and forget the information that is not useful. GRU (Gated Recurrent Units) is similar to LSTM but trains faster and more efficiently. CNN (Convolutional Neural Network) can identify required pattpatternsthe sentences regardless of their position. These models are built where LSTM outperforms the rest of the models.

A survey in UK university concludes many factors affect the students to use chatbots [7]. Performance expectancy, effort expectancy, and habit are the three main factors that increase the interest to use a chatbot. UTAUT2 (Unified Theory of Acceptance and Use ofTechnology 2) is the model used for the survey. In [8], different functions are designed to take the input, get the response, clean the text from the chatbot using java. It is a simple and user-friendly chatbot that uses pattern matching [16], which is the challenging research area in various real time applications and the flexibility of changing the functioning is more for admin. Models using Seq2Seq, LSTM chatbots are more interactive and natural [9].

In this model, the Attention mechanism focuses on the important content. It always tries to answer with the best and most accurate response. Another chatbot that is built using Facebook messenger API uses the python backend [10]. This includes the WIT.AI library which contains a pre-trained neural network to respond to the user's query. The delivery of the user's input from the interface to the server is carried by a webhook.

TABLE I. VARIOUS CHATBOTS MENTIONED IN THE LITERATURE

| Sl.No. | Authors | Objective | Techniques | Advantages | Disadvantages | Tools | year |
|---|---|---|---|---|---|---|---|
| 1. | Dahiya [8] | A simple and user-friendly chatbot | pattern matching | The input and output can be customized according to the user | More data is needed for good accuracy | Eclipse | 2017 |
| 2. | Kumar Shivam, Khan Saud, et.al., [10] | A chatbot is developed to provide appropriate answers | Pattern Matching | all the queries of the organization are answered | No means of keeping track of the previous data | Facebook Messenger API, Webhook, wit.AI, AIML | 2018 |
| 3. | Sagar Pawar, Omkar Rane, [13] | To help the students to stay updated with their college activities | Bigram | New queries are stored, and they are added by the admin | Questions are predefined | Jupyter | 2018 |
| 4. | Namratha Bhartiya, Namrata Jangid, Sheetal Jannu [14] | Solving user queries related to university | Neural networks | Efficient and faster query solution | Less robustness | Flask, Spyder | 2019 |
| 5. | Lavanya Susanna, Pratyusha, Swathi, Sai Praadeep[15] | Reduces paperwork, manpower, and time for any individual. To develop an algorithm that will want to | Pattern matching | This system aids the students to be updated with college-related activities | The response will be slow if too many users try to access | Codeigniter,xampp | 2020 |
| 6. | Moeerh Aleedy, Hadil Sahiba, et.al.,[6] | Implementation of a chatbot using different models | LSTM, GRU, CNN | LSTM and GRU models tend to generate more informative and valuable references | CNN is not more interactive when we compare it with LSTM and GRU models. | Jupyter | 2019 |
| 7. | Vishal Aggarwal, Anjali Jain, et.al.,[9] | To create a chatbot that is capable of dialogue according to the query | Attention mechanism | Learns to focus on specific parts of inputs while decoding | The greedy decoder is used. The quality of the final output sequences is not so optimal | java kit | 2019 |

After analyzing the literature mentioned above in TABLE I., we are going to build the first chatbot for GRIET to provide an efficient college inquiry system.

## III. METHODOLOGY

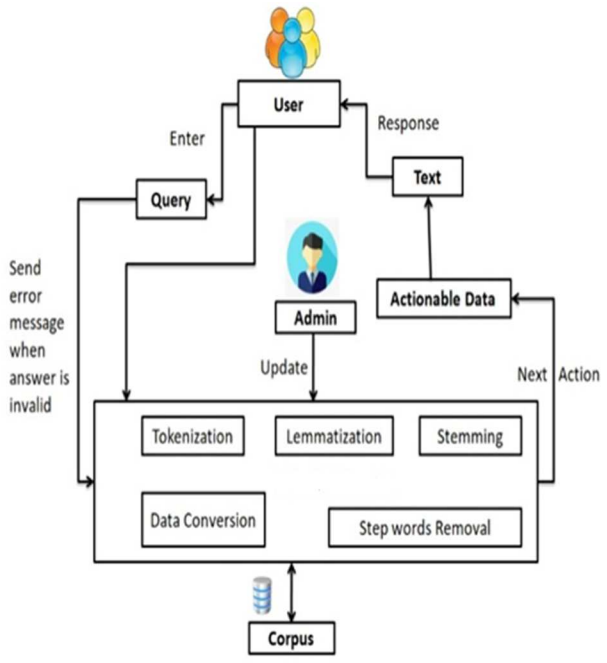


Fig. 1. The flow of the proposed System Architecture

The motive is to build a chatbot for our college Gokaraju Rangaraju Institute of Engineering and Technology which would be named as GrietBot. The main purpose of building the chatbot (GrietBot) is to provide the flexibility to the anonymous person to know the details of the college. The advantage of the GrietBot is that it doesn't require the physical presence of the person in the college and responds within no time. Fig. 1. shows the system architecture of the GrietBot. This GrietBot is going to be the first-ever chatbot for our college. The process starts when the user enters the query and submits it to the GrietBot. The query is processed by the proposed chatbot system and the corresponding information is displayed as a response.

To build the model, the first thing to have, is the data specific to our college GRIET. As there is no existing chatbot for our college website, there is no available dataset for the development of chatbot (GrietBot). In this regard, the data is collected manually from the various websites of the college griet.ac.in, csi.griet.ac.in, cse.griet.ac.in, ece.griet.ac.in, eee.griet.ac.in, it.griet.ac.in, me.griet.ac.in, hse.griet.ac.in, griet.newtonclassroom.com, grietsdc.in/moodle, accgriet.com. The data is stored in excel format in <keyword, description, link> format.

After analyzing the drawback of that excel format data that is not multiple patterns can be mapped to the tag at the same time. So, the excel data is converted to the json format containing the pattern, tag and response. The pattern is a list of words that may appear in the query raised by the GrietBot user. Each pattern is associated with a single tag and corresponding response. The json format helps in storing data in key-value pairs in which the key represents the tag that uniquely identifies the intent of the query, and the values represent the list of words in various patterns of the query. Sample pattern-tag-response is given in the following TABLE II. The patterns to tag matching are of n:1 cardinality. The data in the json format undergoes various preprocessing techniques like tokenization, stemming or lemmatization, stopwords removal, etc.

TABLE II. PATTERN-TAG-RESPONSE MATCHING

| Pattern | Tag | Response |
|---|---|---|
| "y. vijayalatha",<br>"PROFESSOR IN GRIET"<br>"DEAN GPAAC" | y_vijayalatha | An academician with more than 22 years of teaching and research experience, Dr.Y. Vijayalata, Professor in CSE and Dean GPAAC, completed PH.D. from JNTU Hyderabad. She earned M.Tech. in Computer Science from BITS, Ranchi. Dr.Y. Vijayalatha's area of research includes Image Processing, Cloud Computing, and Big-Data Analytics. |
| "ashlin deepa r.n",<br>"ASHLIN DEEPA",<br>"DEEPA"<br>"ASSOCIATE PROFESSOR OF COMPUTER SCIENCE",<br>"ASSOCIATE PROFESSOR IN CSE" | ashlin_deepa_r_n | Associate Professor of Computer Science and Engineering, Ashlin Deepa, completed her M. Tech from AKCE Madurai and Ph.D. from JNTU Hyderabad. She has over 12 years of academic and research experience. She earned a Bachelor of Engineering in Computer Science and Engineering from VIT, Vellore. |
| "Transport" | Transport | College operates 34 vehicles to provide bus facility to students from Hyder Nagar, Kukatpally and Hi-Tech city MMTS station. Additional Route Bus Services available from different corners of the city on demand basis. It is recommended …etc., |

For example, if the user's query includes the pattern "ashlin deepa r.n", the corresponding tag 'ashlin_deepa_r_n' is returned by the model. The chatbot displays the corresponding response to the query. The database contains various patterns for each tag which makes the proposed model unfailing for various types of external user queries. The GrietBot is case insensitive which provides flexibility to the user during the online inquiry.

The preprocessed data is passed to the proposed model for the training. The list of words in each pattern is mapped to a unique tag which acts as the keyword to retrieve the corresponding response. The pattern-tag data is trained using the proposed model. The response corresponding to each tag becomes the output generated for the user's query in the chatbot. Fig. 2. describes the model architecture used for developing GrietBot.

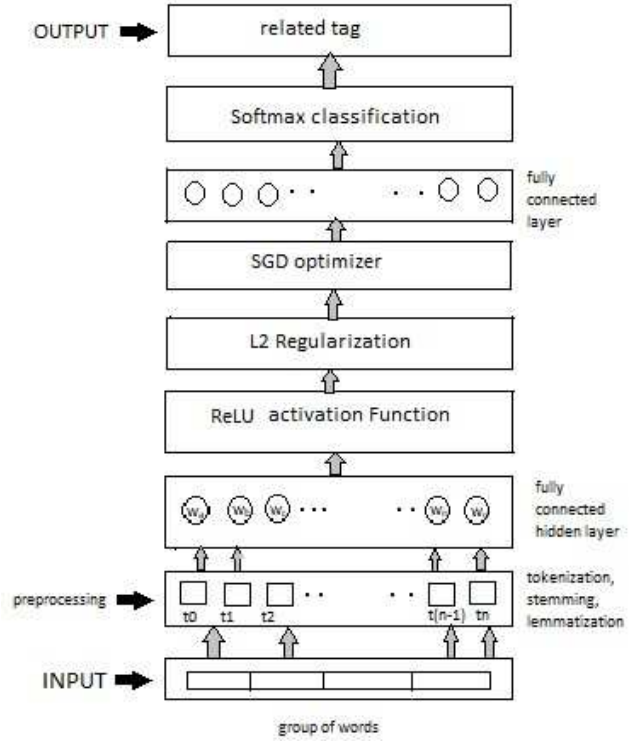


Fig. 2. Model Architecture

The proposed Deep Neural Network (DNN) architecture consists of a fully connected hidden layer having 100 neurons with activation function as ReLU (Rectified Linear Unit). The rectified linear activation function or ReLU for short is a linear function that will output the input directly if it is positive, otherwise, it will output zero. We made use of the L2 regularizer also known as Ridge Regression. Regularization prevents the model from overfitting by shrinking the coefficient estimates towards zero.

Optimizers help the model to prevent overfit and underfit. SGD (Stochastic Gradient Descent) optimizer is preferred over the Adam optimizer in the proposed model because Adam converges faster. SGD is an iterative method for optimizing an objective function with suitable smoothness properties such as differentiable or subdifferentiable. Adam's algorithm simply estimates moments and uses them to optimize a function by calculating an exponential weighted moving average of the gradient and then squares the calculated gradient. Also, SGD generalizes better leading to improved model performance. We noticed that as the batch size is increasing the accuracy is increasing whereas using the Adam optimizer there are fluctuations in the accuracy. The SoftMax activation function is applied on the fully connected output layer. SoftMax is mainly used to normalize neural networks output to fit between zero and one. It is used to represent the certainty "probability" in the network output.

The layout of the proposed GrietBot along with sample input query and output response is given in Fig. 3.

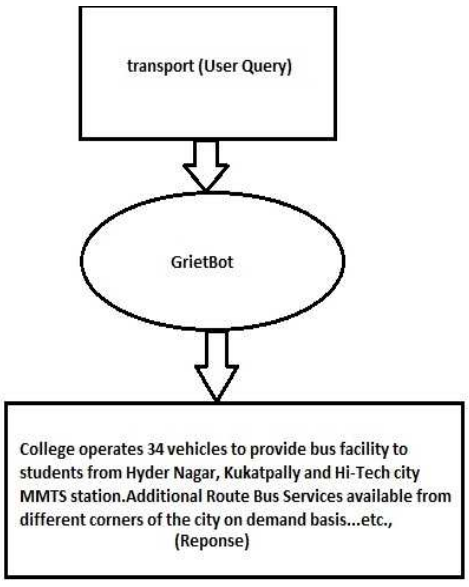


Fig. 3. GrietBot Layout

## IV. Result And Analysis

As chatbot data is not available for our college, the data of staff, administrative offices, students, library, student bodies, college ranking, college sports events, college technical and non-technical events, etc. are collected manually from the college website. The collected data is stored in excel and later the same is converted into the json format. The data is preprocessed using the libraries in nltk (Natural Language Toolkit). NLTK works with the human language data for symbolic and statistical Natural Language Processing (NLP).

The first step in preprocessing is to tokenize the user query. Tokenization separates the text in the query into smaller units (words). Lemmatization is chosen over stemming to obtain the root form of the word as the result of the stemming might not be correct always. All the words are converted into the lowercase to make the model case-insensitive. Stopwords such as "the", "a", "an", etc. are removed as they can be ignored in searching and retrieving query applications.

As there are no existing chatbots for GRIET, GrietBot is compared with itself based on the parameters used in the proposed model. Here, the proposed Deep Neural Network (DNN) model produced a training accuracy of 86% accuracy. To make the model perform well, a batch size of 8 is used and the model is trained for 150 epochs. L2 regularizer is used in the model. The optimizer used is SGD (Stochastic Gradient Descent). We noticed that as the batch size is increasing the accuracy is increasing with the SGD optimizer whereas there are fluctuations in the accuracy when the Adam optimizer is used. This can be observed in Fig. 4. and Fig. 5.

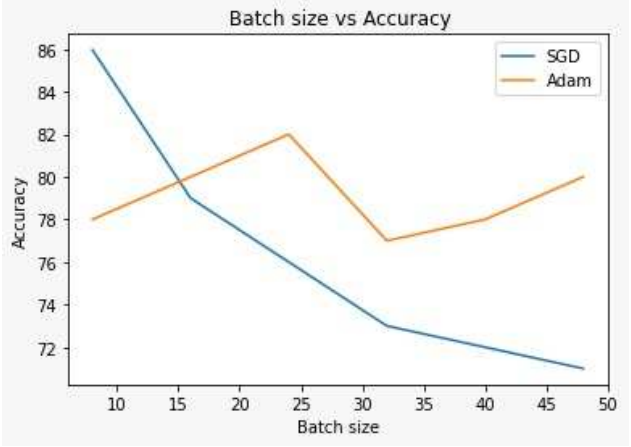


Fig. 4. Batch size vs Accuracy

Fig. 4. represents the accuracy variation with the batch size for 150 epochs. The accuracy is decreasing with the increase in the batch size while using the SGD optimizer. It is observed that the model performs well for batch size 8. And the accuracy is a bit fluctuating in the case of the Adam optimizer. This is the main reason for selecting the SGD optimizer in our model.

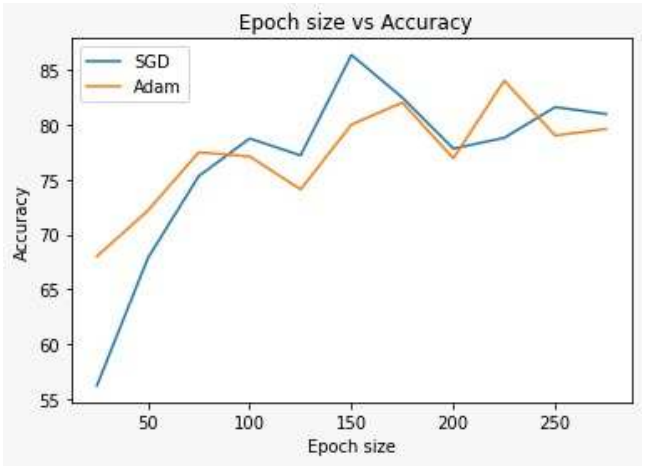


Fig. 5. Epochs vs Accuracy

Fig. 5. represents variation in the accuracy with the number of epochs for both the SGD optimizer and Adam optimizer. There is a pretty good accuracy obtained at 150 epochs using the SGD optimizer. TABLE III. shows the variation of model performance concerning the number of hidden layers used. The accuracy of the model decreases with an increase in the number of hidden layers.

TABLE III. Hidden Layers Vs Accuracy

| Hidden Layers | Accuracy (%) |
|---|---|
| 1 | 86 |
| 2 | 83 |
| 3 | 81 |
| 4 | 50 |

## V. Conclusion

As the usage of chatbots is becoming popular in our day-to-day lives, it is very advantageous for colleges and universities as well. We can find that from managing small requests such as college route maps to handling more complex tasks like course details, class schedules, etc., chatbots help in making students' life more easy, dynamic, and focus on their core duties. In this regard, GrietBot, the first chatbot for our college GRIET, is developed in this paper. The chatbot accepts the query from the user and the preprocessed query is passed as input to the proposed model. The response to the query is displayed as output. The transformation in the pattern matching is made with the help of an Artificial Intelligent agent and knowledgeable database. The proposed model produced an accuracy of 86% for GrietBot.

## VI. Future Work

The accuracy can be further improved by adapting various deep learning techniques. The future enhancement of the project is to enrich GrietBot by adding more features so that it will be a good online college inquiry system for GRIET.

## References

[1] https://www.griet.ac.in

[2] Mohammad Nuruzzaman, and Omar Khadeer Hussain, "A Survey on Chatbot implementation in Customer Service Industry through Deep Neural Networks," IEEE 15th International Conference on e-Business Engineering (ICEBE), pp. 54-61, 2018.

[3] Tarun Lalwani, Shashank Bhalotia, Ashish Pal, Shreya Bisen, and Vasundhara Rathod, "Implementation of a Chatbot System using AI

and NLP," International Journal of Innovative Research in Computer Science & Technology (IJIRCST), pp. 26-30, vol. 6, May 2018.

[4] Luong Tran Hien, Ly Tran Thi Ly, Cuong Pham-Nguyen, Thang Le Dinh, Hong Tiet Gia, and Le Nguyen Hoai Nam, "Towards Chatbot-based Interactive What- and How- Question Answering Systems: the Adobot Approach," International Conference on Computing and Communication Technologies (RIVF), pp. 1-3, April 2020.

[5] Manisha Tamboli, G. Jeevan Ashish, Madhaw Ram Sahu, Aish Kumari Sahu, Md. Khaja Mohiddin, and Arpita Shukla, "Commercial Utilization of Chat-Bot Using Python," Annals of R.S.C.B., vol. 25, pp. 16505- 16513, April 2021.

[6] Moneerh Aleedy, Hadil Shaiba, and Marija Bezbradica, "Generating and Analyzing Chatbot Responses using Natural Language Processing," (IJACSA) International Journal of Advanced Computer Science and Applications, pp. 60-68, vol. 10, September 2019.

[7] Fatima Amer Jid Almahri, David Bell, Mohamad Merhi, "Understanding Student Acceptance and Use of Chatbots in the United Kingdom Universities: A Structural Equation Modelling Approach,"

IEEE International Conference on Information Management, pp. 284-288, March 2020.

[8] M. Dahiya, "A Tool of Conversation: Chatbot," International Journal of Computer Sciences and Engineering(IJCSE), vol. 5, pp. 158-161, May 2017.

[9] Vishal Aggarwal, Anjali Jain, Harsh Khatter, Kanika Gupta, "Evolution of Chatbots for Smart Assistance," International Journal of Innovative Technology and Exploring Engineering (IJITEE), vol. 8, pp. 77-83, August 2019.

[10] Kumar Shivam, Khan Saud, Manav Sharma, Saurav Vashishth, Sheetal Patil, "Chatbot for College Website", IJCAT - International Journal of Computing and Technology, vol. 5, pp. 74-77, June 2018.

[11] Sanglap Sarkar, M. Venkateshwar Rao, Baala Mithra SM, Subrahmanya VRK Rao, "NLP Algorithm Based Question and Answering System," Seventh International Conference on Computational Intelligence, Modelling and Simulation, pp. 75-79, 2015.

[12] Prathik Salve, Vishruta Patil, Vyankatesh Gaikwad, Prof. Girish Wadhwa "College Enquiry Chat Bot," International Journal on Recent and Innovation Trends in Computing and Communication, vol. 5 pp. 463-466, March 2017

[13] Sagar Pawar, Omkar Rane, Ojas Wankhade, Pradnya Mehta, "A Web Based College Enquiry Chatbot with Results", International Journal of Innovative Research in Science, Engineering and Technology, vol.7, pp. 3874-3880, September 2020

[14] Namrata Bhartiya, Namrata Jangid,Sheetal Jannu,Purvika Shakula, "Artificial Neural Network Based University Chatbot System", IEEE Bombay Section Signature Congerence, pp. 1-6, 2019

[15] Ms.Ch.Lavanya Susanna,R.Pratyusha,P.Swathi, P.Rishi Krishna,V.Sai Pradeep,"COLLEGE ENQUIRY CHATBOT", International Research Journal of Engineering and Technology(IRJET), vol. 7, pp. 784-788, March 2020

[16] Ashlin Deepa, R.N. and Rajeswara Rao, R., "A novel Nearest Interest Point classifier for offline Tamil Handwritten character recognition", Pattern Analysis and Applications, SPRINGER, vol. 23, pp. 199-212, 2020