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Building a Chatbot for the Department of ECE using Flask

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Abstract: ***A Chatbot aims to make a conversation between both human and machine. The machine has been embedded with knowledge to identify the sentences and make a decision as the response to a question. The present technical project consists of developing a system for ECE Department enquiry using web based Chatbot. The ECE Department Chatbot has the capacity to make friendly conversations and gives the link for academic syllabus of different years as well. It also gives the faculty details such as their email address and mobile number.***
Implementation of the ECE Department Chatbot overcomes certain barriers of a website since it correctly understands the user's questions, asks clarifying questions if required and then retrains the system to give the response that the user intends to get. The heart of ChatBot technology lies in NaturalLanguage Processing or NLP.
The project uses Artificial Intelligence Mark-up Language (AIML) which is an XML based mark-up language meant to create artificial intelligence applications. AIML makes it possible to create human interfaceswhile keeping the implementation simple to program, easy to understand and highly maintainable.
Along with AIML it uses Flask, which is a web-framework similar to Django, but is more Pythonic. Implementation is done in Python using some of its software libraries.
Keywords: Artificial Intelligence Mark-up Language, Python, Natural Language Processing, Flask, XML.

I. INTRODUCTION

A computer program designed to simulate conversation with human users, especially over the internet is known as CHATBOT. The manner in which people communicate with businesses has been evolving at a rapid pace. For many years, in- person meetings and phone calls have been the dominant means of communication. Then, with the increase of the net, a large number of latest options became available, from email to social media, to mobile apps, to filling out a form on a website and waiting for a follow-up.Most recently, the increase of real-time messaging has led to a fundamental shift in how people wish to connect with businesses. Commonality in these communication channels, including online chat, is that they have mainly relied on humans to do the communications. But now that chatbots have arrived on the scene, this dynamic is getting down change. Many chatbots depend upon Artificial Intelligence (AI) in order to simulate how humans, communicate. More specifically, intelligent chatbots often rely on machine learning, which is when a program can automatically improve with experience, and also Natural Language Processing (NLP), which is when machine learning is applied to the problem of simulating human- produced text and language.The aim of a chatbot is to perform conversations which allows people to access the information via a light-weight messaging application. There are currently two distinct varieties of chatbot.

Rule-based chatbots:These essentially work as an interactive FAQ. Chatbots are programmed to identify certain terms and patterns from which they will respond with pre-set answers.

AI chatbot: These chatbots operate as an artificial brain, using sophisticated cognitive and natural language processing capabilities. It not only understands requests but also context, intent, emotion and it continuously gets smarter as it learns from conversations it has with users.

Although the primary chatbot, Eliza, was created in 1966 by the Massachusetts Institute of Technology to simulate a psychotherapist, emergence in day-to- day lives has only been in the last two years or so. They are rapidly becoming more worldly, but they are nowhere near to reacheing full potential.Even if the most successful give an illusion of simplicity on the front end, there are plenty of challenges to resolve to offer a seamless customer experience: analytics, flow optimization, error checking, integration to APIs, routing and escalation to live human conversation.

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II. LITERATURE REVIEW

Artificial intelligence (AI) sometimes called machine intelligence is intelligence demonstrated by machines, in contrast to the neural intelligence displayed by humans and other animals. In computer science, Artificial Intelligence research is defined as the study of "intelligent agents": any device that perceives its environment and takes actions that increases its chance of successfully achieving its goals. Commonly, the term "artificial intelligence" is applied when a machine mimics "cognitive" functions that humans associate with other human minds, such as "learning" and "problem solving".[1].

Machine learning (ML) is the investigation of algorithm and numerical models that a computer framework uses to logically enhance their execution performance on a particular undertaking task.

Machine learning algorithms manufacture a numerical model of test sample data which is also called as "training dataset", with the end goal to settle on predictions or decisions without being externally modified to execute the undertaking task. Machine learning calculations and algorithms are applied in the utilizations of email separating, recognition of network attackers, and personal compute vision, where it is very difficult to develop algorithms for such purposes.

Machine learning is firmly identified with computational measurements, which circles around making predictions and decisions utilizing PCs. The investigation of numerical streamlining conveys techniques, hypothesis and application spaces to the field of machine learning. data mining is a field of concentrate inside machine learning, and spotlights on exploratory information or data investigation through unsupervised learning. There are various learning methodologies in machine learning such as supervised, unsupervised machine learning etc.[8].

Artificial neural networks (ANN) are registering frameworks ambiguously enlivened by the natural neural networks that comprise creature brains. The neural network itself isn't a calculation, yet rather a structure for some, extraordinary machine learning calculations and algorithm to cooperate and process complex information inputs. Such frameworks "learn" to perform assignments by thinking about precedents, for the most part without being modified with any undertaking explicit tenets. For instance, in picture acknowledgment or recognition they may figure out how to recognize pictures that contain dogs by examining precedent pictures that have been physically named as "dogs" or "no dogs" and utilizing the outcomes to differentiate felines in numerous pictures. They do this with no earlier information about dog, for instance, that they have hide, tails, bristles and dog like appearances. Rather, they consequently produce distinguishing attributes from the learning material that they need to process.[9]

III. METHODOLOGIES

This project uses concepts of machine learning and artificial intelligence such as neural networks, template-based method, appearance-based method and uses this methodology to meet the objective of the project which can be implemented with the help of the language python and various IDE's and tool such as TensorFlow. TensorFlow is used to store the large volume of dataset. Flask web framework is used to build the chatbot. Natural language understanding and Natural language processing are also used to understand natural languages.

A. Python

Python is an open-source programming language that was made to be anything but difficult to-peruse and it is incredibly powerful language. A Dutch developer named Guido van Rossum made Python in l99l. He named it after the network show Monty Python's Flying Circus.

Numerous Python models and instructional exercises incorporate jokes from the show.Python is also called as interpreted language. Main advantage of interpreted language is they need not get compiled to run the program. A program called an interpreter runs Python code on any sort of PC which implies that a developer can change the code and rapidly observe the outcomes which additionally implies Python is slower than other aggregated languages like C, since it isn't running machine code specifically.Python is a decent programming language for freshers.

It is very simple and high-level language which implies a software engineer, or the developer can concentrate on what to do rather than how to do it. Composing programs in Python takes less time than in some different languages. Python drew motivation from other programming languages like C, C++, Java, Perl etc.

Python has a simple to-peruse and simple to read syntax structure. A portion of Python's linguistic syntax originates from C, since that is the language that Python was written in. In any case, Python utilizes whitespace to delimit.Spaces or tabs are utilized to sort out code into gatherings. This is not quite the same as C. In C, there is a semicolon toward the finish of each line and wavy brackets ({}) are utilized to bunch code into one. Utilizing whitespace to delimit code makes Python a simple to-understand and read language.

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1) *Advantages*

a) It contains large number of third-party modules which can be used in the code that the developer is developing.
b) It is very easy to study and understand python.
c) Python is opensource software which makes it free for use, it can be installed in any of the computer and can be used.
d) Python has very vast set of APIs' whose functionalities can be used in the programs that the developer is developing.
e) Python is faster than all other programming languages like C, C++, JAVA etc.
f) Python has vast range of user-friendly data structures which can be used along with the code which is being written.

B. *Tensorflow*

TensorFlow is a free programming library for dataflow programming over a scope of tasks. It is an emblematic math library, and is likewise utilized for machine learning applications, for example, neural systems. It is utilized for both research and generation at Google. TensorFlow was created by the Google Brain group for inner Google utilize. It was discharged under the Apache 2.0 Open-source permit on November 9, 2015, so that it can be accessed by anyone in the globe. Beginning in 2011, Google Brain fabricated Disbelief as a restrictive machine learning framework dependent on profound learning neural systems. Its utilization developed quickly crosswise over differing Alphabet organizations in both research and business applications. Google doled out different PC researchers, and computer scientists including Jeff Dean, to streamline and refactor the codebase of Disbelief into a quicker, more powerful application- review library, which wound up TensorFlow. In 2009, the group, driven by Geoffrey Hinton, had executed summed up backpropagation and different enhancements which permitted age of neural systems with generously higher exactness, for example a 25% decrease in mistakes in speech recognition and acknowledgment. TensorFlow is Google Brain's second-age development framework Adaptation of version 1.0.0 was discharged on February 11, 20l7. While the reference usage keeps running on single gadgets, TensorFlow can keep running on different CPUs and GPUs (with discretionary CUDA and SYCL expansions for universally useful figuring on illustrations preparing units and graphic processing units). TensorFlow is accessible on 64-bit Linux, macOS, Windows, and versatile figuring stages and smartphone platforms including Android and iOS. Its adaptable engineering architecture takes into account the simple arrangement of calculation over an assortment of platforms (CPUs, GPUs, TPUs), and from work areas to bunches of servers to versatile smartphones and edge gadgets.

TensorFlow calculations are communicated as stateful dataflow charts. The name TensorFlow gets from the tasks that such neural systems perform on multidimensional information exhibits. These arrays are called to as "tensors". In June 2016, Dean expressed that 1,500 stores on GitHub referenced TensorFlow, of which just 5 were from Google.

In May 2016, Google reported its Tensor handling unit named Tensor Processing Unit (TPU), an application-explicit coordinated circuit (an equipment chip) manufactured explicitly for machine learning and customized for TensorFlow. TPU is a programmable AI quickening agent intended to give high throughput of low-exactness arithmetic (e.g., 8-bit), and situated toward utilizing or running models instead of preparing and training them. Google reported they had been running TPUs inside their server farms for over a year and had discovered them to convey a request of greatness better-streamlined execution per watt for machine learning.

C. *AIML*

AIML stands for Artificial Intelligence Modelling Language. AIML is an XML based markup language meant to create artificial intelligent applications. AIML makes it possible to create human interfaces while keeping the implementation simple to program, easy to understand and highly maintainable.

1) *Elements of AIML:* AIML contains several elements. The most important of these are described further as follows.
2) *Categories:* Categories in AIML form the fundamental unit of knowledge. A category consists of at least two further elements: the pattern and template elements. When this category is loaded, an AIML bot will respond to the input with the response.
3) *Patterns:* A pattern is a string of characters intended to match one or more user inputs. A literal pattern will match only one input. But patterns may also contain wildcards, which match one or more words. A pattern will match an infinite number of inputs. The AIML pattern syntax is a very simple pattern language, substantially less complex than regular expressions and as such less than level 3 in the Chomsky hierarchy. To compensate for the simple pattern matching capabilities, AIML interpreters can provide preprocessing functions to expand abbreviations, remove misspellings, etc. The AIML syntax itself is at least as complex as finite state machines and as such at least of level 3 in the Chomsky hierarchy. This is because a state correlates to one topic. To implement that behavior, the topic should have a "*" Pattern to make sure, that the state is not left accidentally. A state transit is implemented with the <think><set name="topic">state2</set></think> tag. This way, the bot will be able to remember the topic talked about or even user privileges, which are gained during the chat.

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4) *Templates:* A template specifies the response to a matched pattern. A template may be as simple as some literal text. A template may use variables which will substitute the bot's name into the sentence, or which will substitute the user's age (if known) into the sentence. Template elements include basic text formatting, conditional response (if-then/else), and random responses.Templates may also redirect to other patterns, using an element called SRAI (Symbolic Reduction in Artificial Intelligence). This can be used to implement synonymy. Templates can contain other types of content, which may be processed by whatever user interface the bot is talking through. So, for example, a template may use HTML tags for formatting, which can be ignored by clients that don't support HTML.

D. Flask

Flask is a micro web application framework written in Python. It's developed by Armin Ronacher, who leads an multinational group of Python enthusiasts named Pocco. Flask is based upon the Werkzeug WSGI toolkit and Jinja2 template engine. Both are Pocco projects. Web Application Framework or simply Web Framework represents a set of libraries and modules that allows a web application developer to write applications without having to bother about low-level details like protocols, thread management etc. It's classified as a micro framework because it doesn't require particular tools or libraries. It has no database abstraction layer, form validation, or the other components where pre-existing third-party libraries provide common functions. However, Flask supports extensions that help to append application features as if they were implemented in Flask itself. Extensions exist for object-relational mappers, form validation, upload handling, various open authentication technologies and a number of other common framework related tools. Flask provides simplicity, flexibility and fine-grained control. It's a compact and light-weight python web framework that provides useful tools and features that make creating web applications in Python easier. It gives developers flexibility and is a more accessible framework for new developers since a web application can be built quickly using only one Python file. Besides, Flask is also extensible and doesn't force a specific directory structure or require complicated boilerplate code before getting started. Best feature of the flask is that it's lightweight, open source and offers minimal coding for developing an application.

1) Advantages of using Flask

a) Higher flexibility
b) Higher compatibility with latest technologies
c) High scalability for easy applications
d) Higher framework performance
e) Easier to use for smooth cases
f) Smaller size of the code base
g) Easy to make a fast prototype
h) Routing URL is straightforward
i) Easy to develop and maintain applications
j) Database integration is effortless
k) Small core and smiply extensible
l) Minimal yet powerful platform

E. Natural Language Understanding

It has 3 specific concepts:

1) *Entities:* Entity basically represents a concept in the Chatbot. For example, the syllabus of different years.
2) *Intents:* It's basically the action chatbot should perform when the user says something. For example, intent can trigger the same thing if the user types "Who is the HOD?" or "Who is the Head of ECE Department?", all these user's text show trigger solo command giving users the information about the Head of the Department.
3) *Context:* When a NLU algorithm analyzes a sentence, it doesn't have the history of the user conversation. It means that if it receives a reply to a question, it has just asked, it'll not remember the question. For differentiating the phases during the chat conversation, it's state should be stored. It can be flags. With context, one can easily relate intents without knowing what the previous question was.

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F. Natural Language Processing

Natural Language processing (NLP) Chatbot takes some combination of steps to convert the customer's text or speech into structured data that's used to select the related answer. Some of the Natural Language Processing steps are:

1) *Sentiment Analysis:* Tries to learn if the user is having an honest experience or if after after some point the chat should be forwarded to the human.
2) *Tokenization:* The NLP divides a string of words into pieces or tokens that are linguistically symbolic or are differently useful for the application.
3) *Named Entity Recognition:* The chatbot program model looks for categories of words, for example, name of the product, the user's name or address, whichever data is required.
4) *Normalization:* The Chatbot program model processes the text in an effort to seek out common spelling mistakes or typographical errors that might the user intent to convey. This offers more human like effect of the Chatbot to the users.
5) *Dependency Parsing:* The Chatbot searches for the objects and subjects- verbs, nouns, and common phrases in the user's text to discover dependent and common phrases that users might be trying to convey.

As most of the Applications, the Chatbot is also connected to the Database. The database of information is utilized to feed the chatbot with the information needed to give an appropriate response to the user. Data of user's activities and whether or not the chatbot was able to match their questions, is captured in the data store. NLP translates human language into information with a mix of patterns and text that can be mapped in the real time to find applicable responses.There are NLP services and applications programming interfaces that are used to build the chatbots and make it possible for all kinds of businesses, small, medium and large scale. The main point here is that Smart Bots have the potential to assist increase customer base by improving the customer support services and as a result boosts the sales as well as profits.

G. System Architecture

The model learns the actions formulated on the training data provided unlike a conventional state machine-based architecture that's based on coding all the possible if-else conditions for every possible state of the conversation. Fig 1.1 shows the architecture of the chatbot.

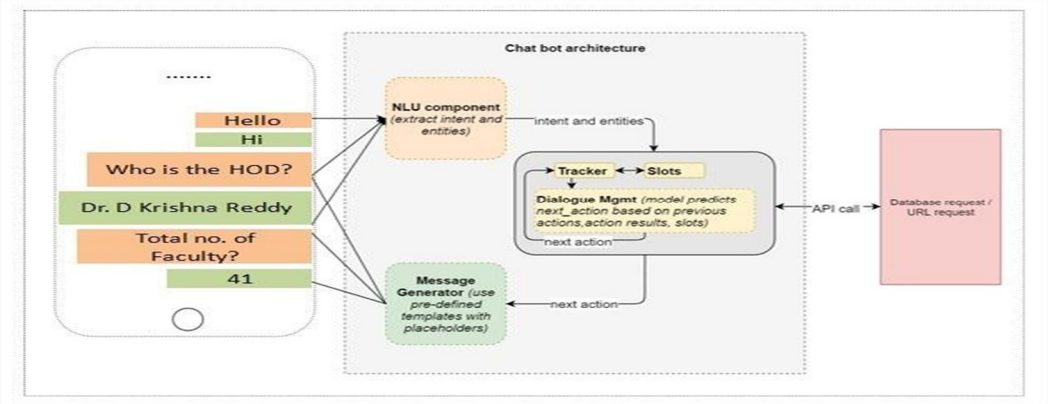

Fig 1.1 System Architecture

Things needed to determine an appropriate response at any given moment of the conversational flow are as follows.

1) One should need to know the user's intent. They are called intents. Few examples of intents are HOD intent, faculty intent etc.
2) One should know the specific intents in the request called as entities.

For example- the answers to the questions like when? where? how many? etc., that correspond to extracting the information from the user request about number, details respectively. Here number, details are the entities.

a) NLU Component: It constitutes:

- A supervised intent classification model that is trained on varieties of sentences as input and intents as target. Typically, a linear SVM will be enough as an intent classification model.
- Entity extraction model—This can be a pre-trained model like Spacy or Stanford NLP library or it can be trained using some probabilistic models like CRF (conditional random fields).

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Since this is a conversational AI bot, track of the conversations happened thus far should be kept predicting an appropriate response. For this purpose, a dictionary object is needed that can be persisted with information about the current intent, current entities, persisted information that user would have provided to bot's previous questions, bot's previous action, results of the API call. This information will constitute input X, the feature vector. The target y, that the dialogue model is going to be trained upon will be 'next action'. The next action can simply be a one-hot encoded vector corresponding to each action that is defined in the training data.

Getting the information regarding the intent and entities is straight forward as seen from the NLU component. Getting the remaining values (information that user would have provided to bot's previous questions, bot's previous action, results of the API call etc.,) is little bit tricky and here is where the dialogue manager component takes over. These feature values will need to be extracted from the training data that the user will define in the form of sample conversations between the user and the bot. These sample conversations should be prepared in such a fashion that they capture most of the possible conversational flows while pretending to be both a user and a bot.

By extracting all the required feature values from the sample conversations in the required format, an AI model like LSTM followed by SoftMax to predict the next action can be trained. Referring to the figure 3.1, this is what the 'dialogue management' component does. As the model should be context aware and look back into the conversational history to predict the next action. This is akin to a time-series model and hence can be best captured in the memory state of the LSTM model. The amount of conversational history to look back can be a configurable hyper- parameter to the model.

The predicted value of the next action can be something like

- Respond to the user with an appropriate message.
- Retrieve some data from a database (if there are any)
- Make an API call and get some results matching the intent.

If it happens to be an API call / data retrieval, then the control flow handle will remain within the 'dialogue management' component that will further use/persist this information to predict the next action, once again. The dialogue manager will update its current state based on this action and the retrieved results to make the next prediction. Once the next action corresponds to responding to the user, then the 'message generator' component takes over.

b) *Message Generator Component:* It consists of several user defined templates which are nothing but sentences with some placeholders, that map to the action names. So, depending on the action predicted by the dialogue manager, the respective template message is invoked. If the template requires some placeholder values to be filled up, those values are also passed by the dialogue manager to the generator. Then the appropriate message is displayed to the user and the bot goes into a wait mode listening for the user input.

H. Dataflow Diagram

A Data-flow diagram (DFD) shown in Fig 1.2, is a way of representing a flow of a data of a process or a system usually an information system. The DFD also provides information about the outputs and inputs of each and every entity and the process itself. A data-flow diagram has no control flow, there aren't any decision rules and no loops. Specific operations based on the data is often represented by a flowchart.

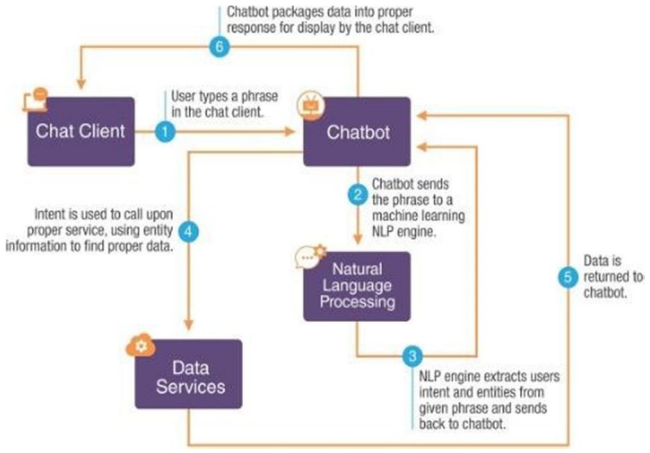

Fig 1.2 Dataflow Diagram

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I. Use Case Diagram

A use case diagram in the Unified Modelling Language (UML) is a type of conduct diagram characterized by and made from a use-case analysis. As shown in Fig 1.3, its intention is to display a graphical outline of the usefulness given by a framework regarding performers, their goals which are represented as use cases and any conditions between those use cases. Use case diagrams are formally incorporated into two demonstrating dialects characterized by the OMG: the unified displaying language and also the frameworks displaying language.

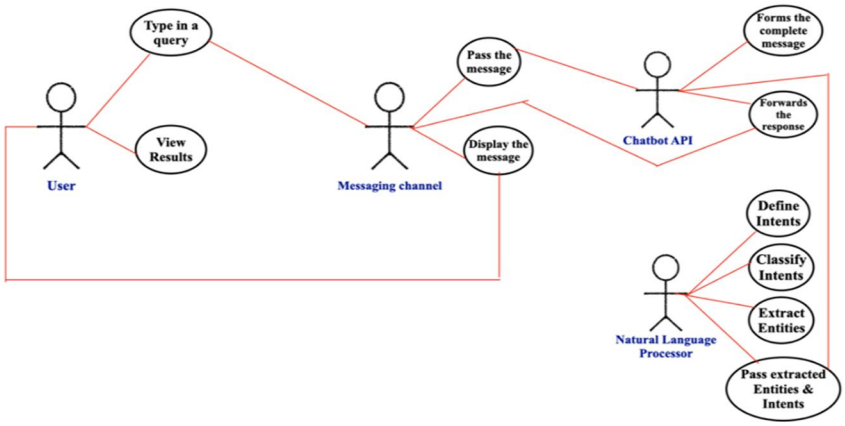

Fig 1.3 Use case diagram of the process

IV. RESULTS

The following figure, Fig 1.4, shows how the bot looks and how it welcomes. The URL of the chatbot can also be seen in the Fig 1.4

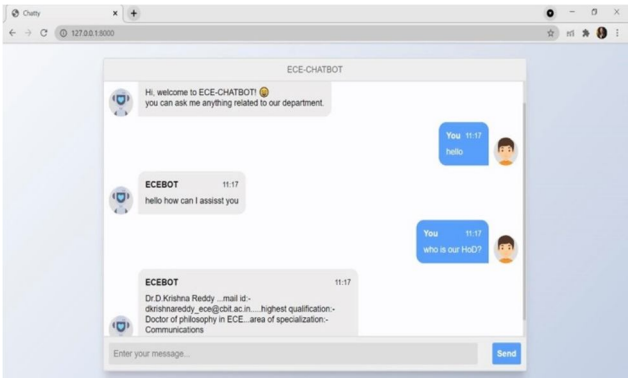

Fig 1.4 Welcome conversation

The syllabus pdfs are also included in the bot which can be seen in the following figures: Fig 1.5 and Fig 1.6.

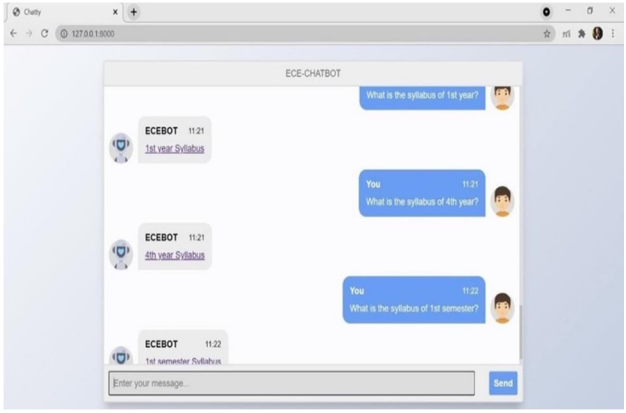

Fig 1.5 Syllabus conversation

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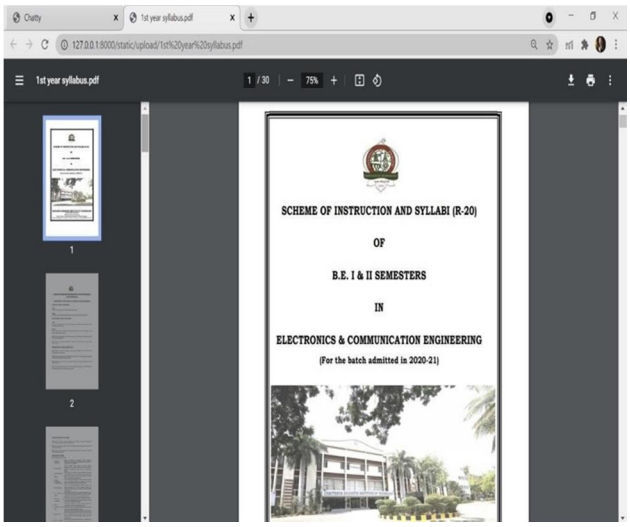

Fig 1.6 Syllabus PDF

V. CONCLUSION

Department Chatbot is useful in guiding students with correct and most updated sources of information. It is advantageous for applicants for queries such as academic matters. Students can get the information at their fingertips instead of visiting college office. It improves efficiency by taking up tasks that humans are not essential.

Chatbots are poised to ease the frustrations by providing the real-time, on-demand approach that users seek. While chatbots can't replace phone or email when it involves providing in-depth answers to technical questions, chatbots are poised to become the new apps. They are poised to ease the frustrations by providing real-time, on-demand approach that users seek.

The top four potential benefits of chatbots are:

A. Quick answers to simple questions
B. Getting 24-hour service
C. Quick answers to complex questions
D. Getting detailed answers

However, the system was partially successful in adding empathy since scope of the queries is vast and therefore the system requires more rigorous data to handle all the questions which are out of script. Nevertheless, active learning helps to enhance the bot performance for handling off-script queries. By using chatbots together with online chat, it can deliver a level of real-time service that's unable to achieve using either technology on its own.

Ultimately, chatbots are a technology which will help bridge the gaps between business communication channels, which can help deliver a far better, speedier online experience to consumers.

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AUTHORS PROFILE

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Sarayu Jupudi is pursuing her Bachelor of Engineering (B.E) 4th year in the field of Electronics and Communications Engineering(ECE). Her research interests lie in the area of Natural Language Processing(NLP), Artificial Intelligence, Python Programming.This interests made her build a College department Chatbot.

K.Sreeja is pursuing Bachelor of Engineering in Electronics and Communications Engineering from Chaitanya Bharathi Institute of Technology, Hyderabad. Her area of interest is Artificial Intelligence which was a driving force in building a Chatbot for the ECE Department of CBIT.

Dhulipala Teena Chowdary is pursuing her Bachelor of Engineering (B.E), 4th year, in field of Electronics and Communications Engineering, from Chaitanya Bharathi Institute of Technology, Gandipet, Hyderabad. Her research interests lie in the area of Artificial Intelligence and Machine Learning to build a chatbot. In recent times, she has focused on building a chatbot for ECE department.

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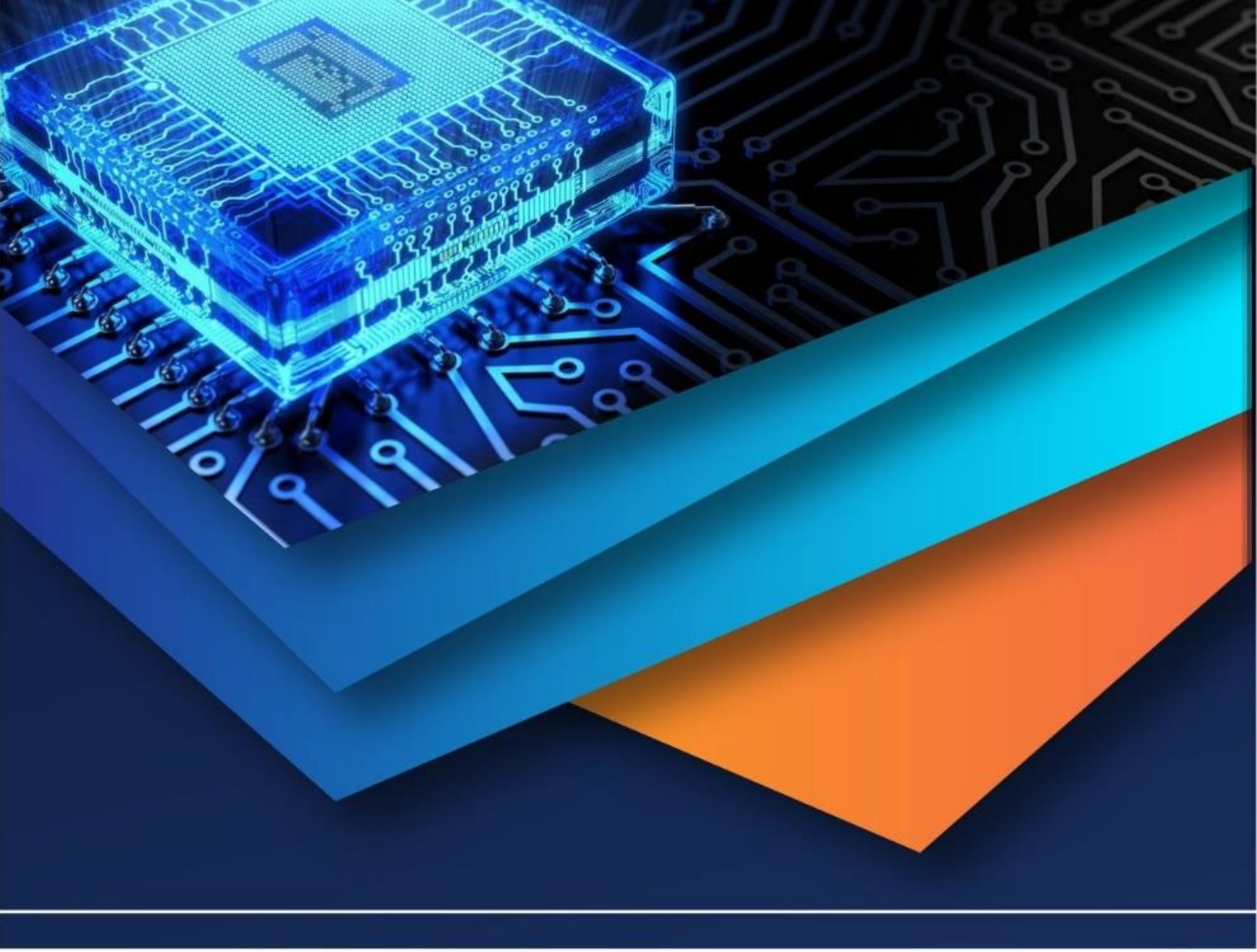

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