CHATBOT

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JSS ACADEMY OF TECHNICAL EDUCATION
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Project Report
On

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Dr. A.P.J. Abdul Kalam Technical University, Lucknow

July, 2020-21

DECLARATION

We hereby declare that this submission is our own work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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CERTIFICATE

This is to certify that Project Report entitled "**Chatbot**" which is submitted by **Devanshu Srivastava, Om Rastogi and Shubham Tiwari** in partial fulfillment of the requirement for the award of B. Tech degree in Electronics and Communication Engineering of **Dr. A.P.J. Abdul Kalam Technical University, Lucknow** is a record of the candidate own work carried out by him under my supervision. The matter embodied in this thesis is original and has not been submitted for the award of any other degree.

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ABSTRACT

User interfaces for software applications can come in a variety of formats nowadays, ranging from command-line, graphical, web application, and even voice. While the most popular user interfaces includes the graphical and web-based applications, occasionally the need arises for an alternative interface too. Whether due to multi-threaded complexity, concurrent connectivity, or details surrounding execution of the service, a chat bot based interface may suit the need of the user.

Chat bots typically provide a text-based user interface (UI), allowing the user to type commands and receive text as well as text to speech response quickly. Chat bots are usually stateful services, remembering previous in order to provide functionality within their database. When chat bot technology is integrated with popular web services it can be utilized securely by an even larger audience to cater to.

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LIST OF SYMBOLS

&	And
$	Dollars- a currency
%	Percentage
?	Question mark
<	Less than
>	Greater than

LIST OF ABBREVIATIONS

AIML	Artificial Intelligence Markup Language
AI	Artificial Intelligence
R&D	Research and Development
UI	User Interface
API	Application Programming Interface
NLP	Natural Language Processing
NLTK	Natural Languages Toolkit
IoT	Internet of Things
BERT	Bidirectional Encoder Representations
GPT	Generative Pre-trained Transformer
ANN	Artificial Neural Networks

CHAPTER 1

INTRODUCTION

1.1 Literature Survey

Digitalization, the surge of mobile and internet connected devices has revolutionized the way people interact with one another and communicate with businesses entities. Millennial are accepting and supporting new technology into the routine of their everyday life, this is becoming more and more prevalent as technology companies are streamlining Artificial Intelligence (AI) into the products that they offer to us, such as; Google Assistant, Google Home and Amazon Alexa. The new and upcoming generations are expected to be critical of this fact and game changing customers for businesses. They demand effortless experiences, answers within seconds, not minutes and more intelligent self-service options to the users.

The Chatbots eventually evolved way back in the year 1966 when Joseph Weizenbaum made a natural language conversational program that featured a dialog between a user and a computer program through coding. With this great

breakthrough came the new age chatbot technology that has taken an enormous leap throughout the decades of time.

Traditional Chatbots	**Current Chatbots**	**Future Chatbots**
Automation Based	Task level Automation	Service Level Automation
System Driven	Driven by back and forth communication	Communication at multiple levels
Minimal Functionality	Maintains system Context	Ability to maintain task, system and people context
Only System context was maintained	Both Task content as well as system context is maintained	Introduction to Master Chatbots and eventually a Chatbot Operating System(OS) as well

Table 1: Table depicting evolution of chatbots.

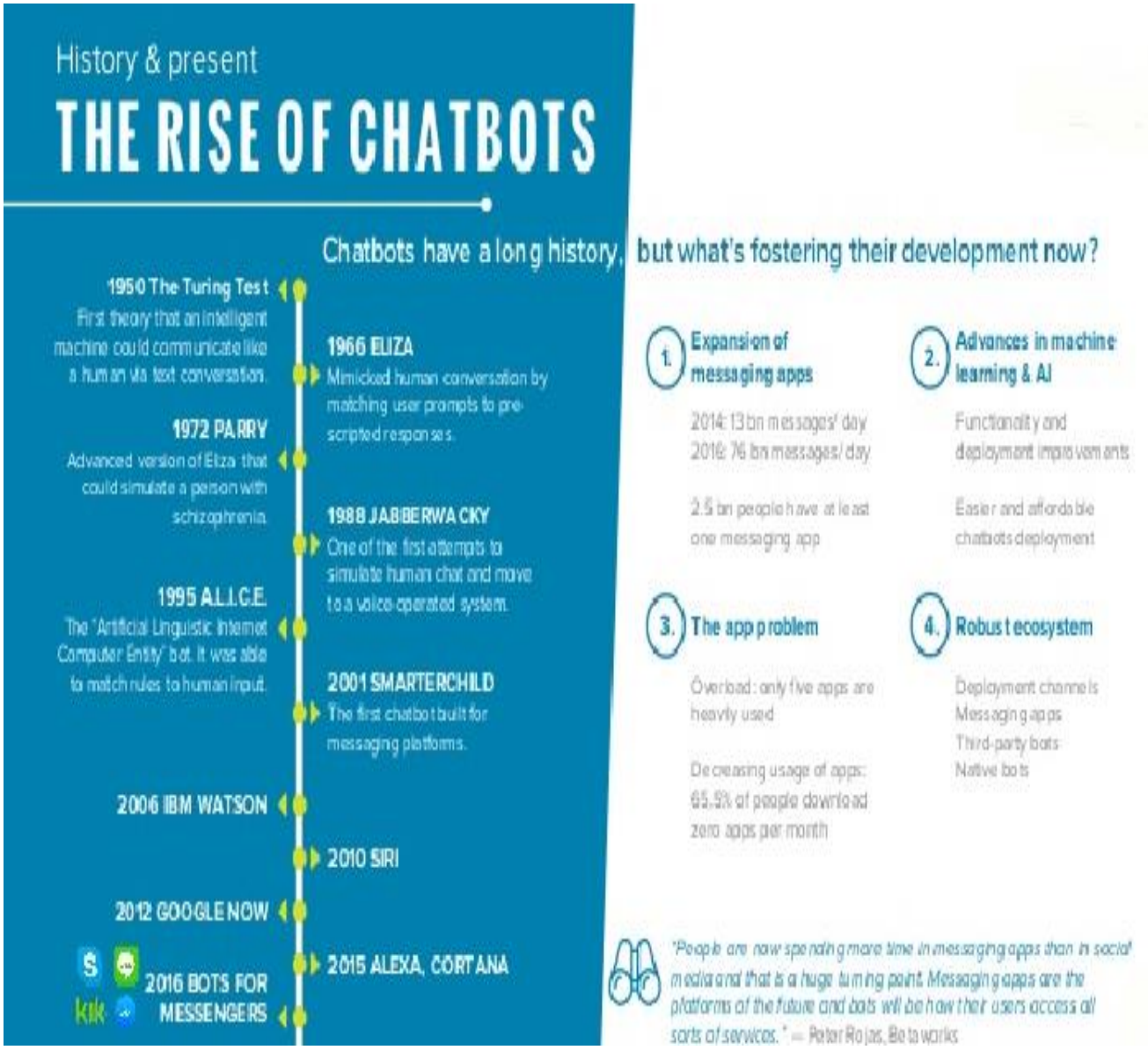


Fig 1. Rise of chatbots

1.2 Introduction of Project

Speech is one of the most powerful forms of communication between humans; hence, it is the researchers' ambition in the human computer interaction research field to improve speech interaction process between the humans and the computer in order to simulate human-human speech interaction. Speech interaction with modern networked computing devices has received increasing interest in the past few years with increased contributions from Google, Android and IOS. Because they are more natural than graphic-based interfaces, spoken dialogue systems are beginning to form the primary interaction method with a machine itself. Therefore, speech interaction will play a significant role in humanizing machines in the near coming future.

Much research work has focused on improving recognition rates of the human voice and the technology for the same is now approaching viability for speech based human computer interaction. Speech Interaction splits into more than one area including: speech recognition, speech parsing, NLP (Natural Language Processing), keyword identification, Chabot design/personality, artificial intelligence, etc. depending on the use. Chatbot is a computer program that has the

ability to hold a conversation occurred with human using Natural Language Speech.

Chatbot (also known as a talkbot, chatterbox, Bot, IM bot or Artificial Conversational Entity) is a computer program that mimics human conversations in its natural format including text or spoken language using artificial intelligence techniques such as Natural Language Processing (NLP), image and video processing, and audio analysis and designed through front end systems like HTML, CSS and JavaScript.

Chat bot can run on local computers and phones, though most of the time it is accessed entirely through the internet. Chat bot is typically perceived as engaging software entity which humans can talk with. It can be interesting, inspiring and intriguing that it appears everywhere, from old ancient HTML pages to modern advanced social networking websites, and from standard computers to fashionable smart mobile devices. Chat bots talk in almost every major language of the world. Their language (Natural Language Processing, NLP) skills vary from extremely poor to very clever intelligent, helpful and funny and all sorts of emotions. The same counts for their graphic design, sometimes it feels like a cartoonish character drawn by a child, and on the other hand there are photo-realistic 3D animated

characters available, which are hard to distinguish from human's vision. And they are all referred to as "chat bots" in a general sense.

1.3 Chatbots in Industries:

Most businesses and organizations understand the potential benefits of machine learning and artificial intelligence to have a positive change on how they perform business processes. Artificial intelligence has progressed to allow the development of more sophisticated chatbots within industries. Organizations are focusing on specific areas of user engagement that take up a lot of time but can be replaced through the use of a chat bot model. Chatbots can understand what the customer needs from a single text instead of the customer having to follow a process of multiple steps to follow.

Chatbots are used to automate customer service and reduce manual tedious tasks performed by employees so they can spend their time more productively on higher priority tasks that need their time. Establishments that regularly deal with its customers have discovered the potential that the chatbots possess as a channel to distribute more efficient and immediate information to customers in comparison to a customer service representative regarding queries and issues demanded by the user.

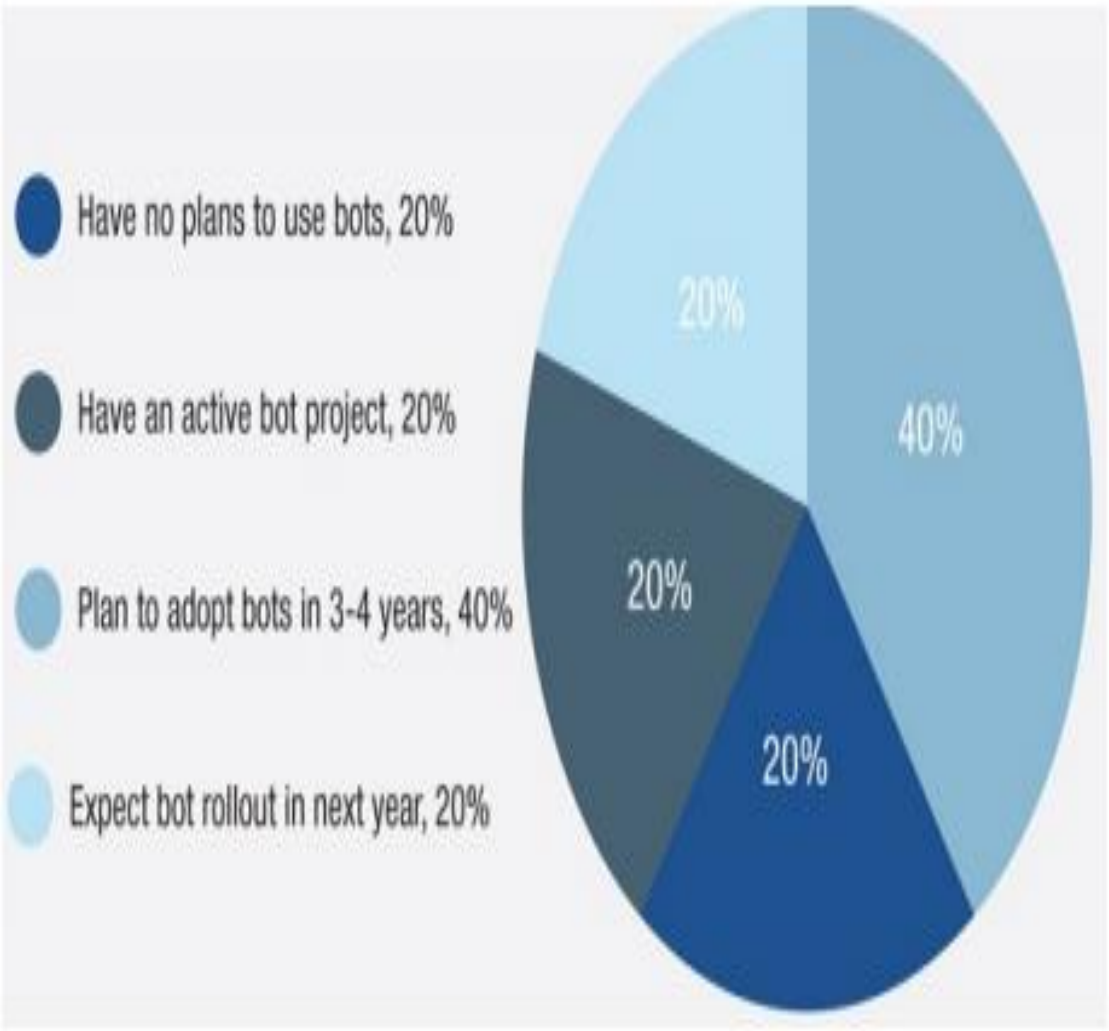


Fig 2: . Interest in chatbots within the Industry

1.4 Types of Chatbots

There are two categories of chatbots: one that works by following a series of rules, and another that uses artificial intelligence to process its data.

1.4.1 Rule-based chatbots

A rule-based bot can only comprehend a limited range of choices that it has been programmed with it initially. Predefined rules define the basic course of the chatbot's conversation. Rule-based chatbots are easier to build as they use a simple true-false algorithm to understand user queries and provide relevant answers quickly.

1.4.2 AI-based chatbots

This bot is equipped with an artificial brain with it, also known as artificial intelligence. It is trained using machine-learning algorithms and can understand open-ended queries thrown at it. Not only does it comprehend orders, but it also understands the language of the user. As the chatbot learns from the interactions it has with users, it continues to improve gradually. The AI chatbot identifies the language, context, and intent, which then reacts accordingly to user.

CHAPTER 2
COLLEGE MANAGEMENT SYSTEM

Chat-bot for college management system project will be developed using artificial intelligence algorithms that will analyze user’s queries. This system will be a web application which will provide answers to the analyzed queries of the user which the user demands. Users will just have to select the category for queries and then ask the query to the chatbot that will be used for answering it. Artificial intelligence will be used to answer and fulfill the user's queries. The user will get the appropriate answers to their queries asked. The answers will be given using the artificial intelligence algorithms used. Users won't have to go personally to the college for enquiry purposes.

The Users has to register to the system and has to login to the system user. After login user can access the various helping pages associated with it. There will be various helping pages through which the user can chat by asking queries related to college related work and activities. The system will reply to the user with the help of effective graphical user interface (GUI) as frontend. The user can query about the college-related activities with the help of this web application effectively. College-related activities such as annual fests like Zealicon, sports day like Mythri,

Intake and other cultural activities. It will help the students/user to be updated about the college activities happening within the premises.

Student information Chatbot for student information Chatbot project will be developed using artificial intelligence algorithms that will analyze user's queries and give results accordingly. This framework will be a web application which will give answers to the asked questions by the client. Clients will simply need to choose the class for questions and afterward ask the inquiry to the bot that will be utilized for noting it to produce results. Artificial intelligence will be used to answer the user's queries and demands. Chatbots work nonstop and give a conversational way to deal with the trading of data between the understudies and your educators, which makes it incredibly easy to understand and the least response time is taken. The user will get the appropriate answers to queries demanded. The appropriate responses will be given utilizing the man-made consciousness calculations effectively. Clients won't need to go actually to the college for request granting.

2.1 Problem Domain

In this modern era of technology, people don't want to waste time to go college and ask for information tasks like placement, result, time table, and student information. In traditional ways which are generally time consuming. For that they

have in college different departments, but they still need Chatbot for student related information. They need to follow some sets of guidelines and go through each process to get the appropriate answer. It would be much more time saving if user won't have to manually enter the data for information. If the student gets the data with just one keystroke, it will definitely be more efficient and time saving for them.

Students in college have to face some kind of problems regarding information of the college related activities. Examples of some of the problems faced by them are as follows:

- This can be trouble in finding a class and schedule changes.
- Burden for students to get Information of whole staffs and faculties
- Lack of Information about recently held programs and seminars in college
- Consumes time of students to know whole information of students and their attendance currently
- Need to visit person to person for required information transfer.

Fig 3: Our college website in which we are deploying our chatbot

2.2 Student Information Chatbot as a solution

In a college with hues numbers of student and a lot of teachers there can be possibilities of lack of communication between them. Student has to face certain problems to get the information of the activities as that can be time consuming to go and visit the administration by themselves physically.

As this student information Chatbot has all the necessary information for all the students wherein the students can a have this Chatbot so that they can gain the time privilege. They do not need to visit administration personally.

All enquires can be done in this chat bot system about placements, notices, time schedules, information of teachers, attendance, examination, assignment deadline, etc.

If the user gives any statement that is not in the database of the our Chatbot, it would politely ask the user to enter some other related keywords which might be in the database of our Chatbot to which it can detect it. This situation occurs because this is a Rule- based Chatbot wherein the database of our Chatbot is provided manually by our team and there are some chances that the entered keyword is not in the database that we provided to our Chatbot..

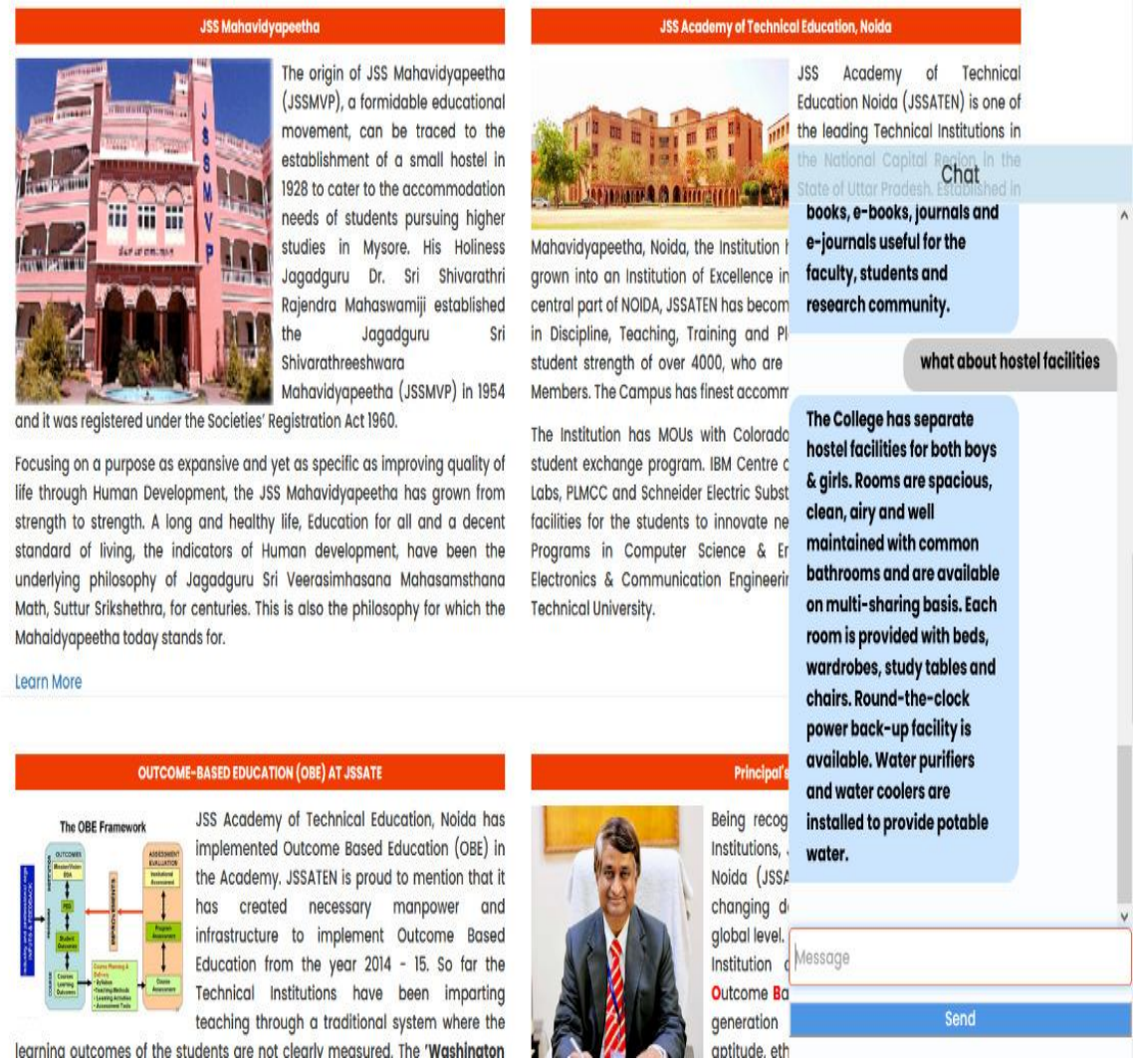
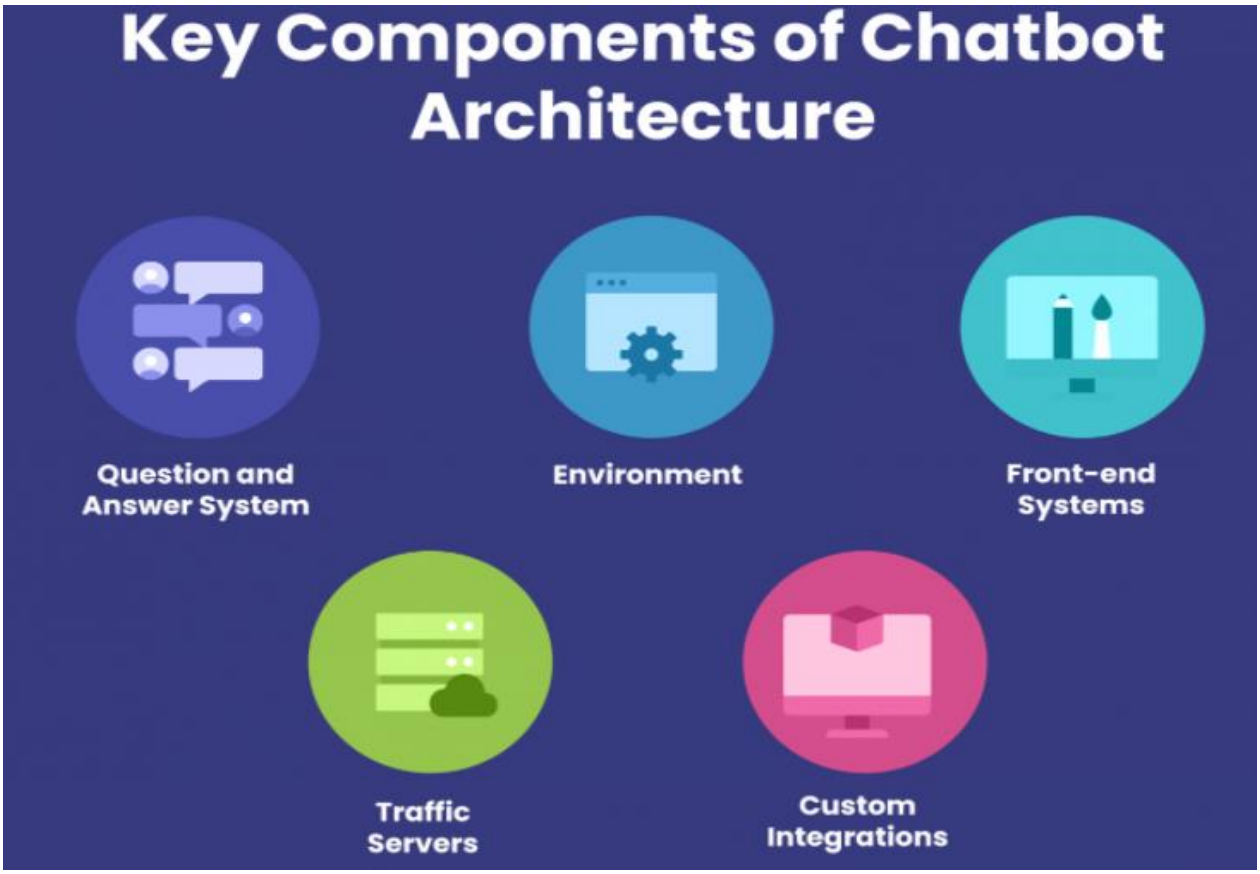


Fig 4: Student Information Chatbot as a solution

CHAPTER 3
CHATBOT ARCHITECTURE

Chatbot architecture is the spine of the chatbot. The type of architecture for your chatbot depends on various factors like use-case, domain, chatbot type, etc. However, the basic conversation flow remains the same. Before proceeding to the solution, the theoretical concepts behind the solutions are first examined to the fullest. We will start by studying the field of Natural Language Processing (NLP) and proceed by examining the techniques used in this project in a comprehensive manner.



3.1 Question and Answer System (Q&A)

As the name suggests, the Q&A system is responsible for answering the customers' frequently asked questions. The question is interpreted by the Q&A system, which then replies with appropriate responses from the knowledge base it possess. It consists of the following elements:

3.1.1 Manual Training:

Manual training entails the domain specialist compiling a list of commonly asked user questions and mapping out the answers from them. It enables the chatbot to identify the most relevant questions' answers rapidly.

3.1.2 Automated Training

Automated training entails sending business documents to the chatbot, such as policy documents and other Q&A type documents, and instructing it to train itself accordingly. From these documents, the engine generates a list of questions and responses. The chatbot would then be able to respond with confidence.

3.2 Environment

The environment of the Chatbot is made primarily by Natural Language Processing (NLP) implemented via its Application Programming Interface (API) which is called Natural Language Toolkit (NLTK).

3.2(a) Natural Language Processing (NLP)

The environment is mainly responsible for contextualizing users' messages using natural language processing (NLP) into different contexts. The NLP Engine is the central and most important component of the chatbot architecture. It interprets what users are saying at any given time and turns it into organized inputs that the system can process at a time. The NLP engine uses advanced machine learning algorithms to determine the user's intent and then match it to the chatbot's supported intents list of the database.

Natural Language Processing (NLP) is a field derived from Artificial Intelligence (AI) and linguistics and deals with the generation and comprehension of natural human languages by computer or other artificial agents involved.

Given this definition of NLP, it is easy to see potential uses for this technology. Its usefulness in processing natural language constructs means that it can for the basis of flexible, ambiguous or complex human- computer interaction, such as machine translation or information extraction, rather than more restricted or simpler forms of interaction which include clicking or entering values into the fields. There are numerous problems or issues in dealing with general language as a whole.

NLP Engine has two components which are as follows:

- **Intent Classifier:** An intent classifier maps between what a user asks and the type of action performed by the software accordingly. It helps identify the action the chatbot needs to perform on the user's input done. For instance, the intent of "Where is JSS" and "JSS location"? and "How to reach JSS" is the same. All of these user's texts trigger a single command giving users options for reaching the location of JSS.

- **Entity Extractor**: The entity extractor is responsible for identifying keywords from the user's query that helps determine what the user is demanding for. An entity represents keywords from the user's query picked up by the chatbot to understand what the user demands. It is a concept in our chatbot.

An NLP engine can also be extended to include feedback mechanism and policy learning for better overall learning of the NLP engine which are as follows:

- **Feedback Mechanism:**

  This includes the feedback for the chatbot which is provided by the users. This part of learning can be incorporated into the chatbot itself to answer it. Here, the user rates the interaction with the Chatbot at the end of the conversation. It encourages the bot to learn from its mistakes and improve in future interactions in coming future needs.

- **Policy Learning:**

  Policy learning is a broad framework wherein the bot is trained to create a network of happy paths in the conversation flow that increase overall end-user satisfaction occurred with the chatbot

Different types of disambiguation that are occurred in NLP are as follows:

- Word sense disambiguation
- Syntactic disambiguation
- Irregular input detection

3.2.1 Word sense disambiguation

Word sense disambiguation is a problem caused by words having more than one meaning. Hence each instance or token of any word may have different meaning from the other instances. This one-to-many relationship between words and meanings becomes many one- to-one relationships between word instances and its corresponding meanings. To select an appropriate meaning for each word instance, we employed a statistical method to solve.

3.2.2 Syntactic Disambiguation

Natural languages have ambiguous grammar structures. Hence while processing; one must be wary not only of different grammar structures but also of different uses for each grammar structure used. Context can be used to solve this problem along with the syntax and semantics.

Project focuses mainly on providing a more robust input interface for demanders. Syntactic processes used therefore focused on the identification and comprehension of semantics used rather than syntax.

3.2.3 Irregular Input Detection

Natural language lacks basic structure unlike machine and programming languages. This can be compounded by errors in input. These errors need to be detected and fixed before other forms of natural language processing are applied to it.

This project dealt with this issue by asking for further clarification rather than attempting to use time consuming and imperfect algorithms.

3.2 (b) Steps involved in Natural Language Processing (NLP)

- **Sentiment Analysis:** With this, the algorithm tries to interpret the sentiment of the user's query by reading into the entities, themes, and topics of the users.

- **Tokenization:** The NLP divides a string of words into pieces or tokens. These tokens are linguistically symbolic or are differently helpful for the application purposes

- **Named Entity Recognition:** The chatbot program model looks for categories of words, like the name of the product, the user's name or address, whichever data is required by the user.

- **Normalization:** The chatbot program model processes the text to find common spelling mistakes or typographical errors in the user's intent. It gives a more human-like effect of the chatbot to the users comparatively.

- **Dependency Parsing:** The chatbot looks for the objects and subjects-verbs, nouns and common phrases in the user's text to find dependent and related terms those users might be trying to convey to the chatbot.

Like most applications, the chatbot is also connected to the database of its own. The knowledge base or the database of information is used to feed the chatbot with the information required to give a suitable response to the user demands.

The information about whether or not your chatbot could match the users' questions is captured in the database of the chatbot. NLP helps translate human language into a combination of patterns and text that can be mapped in real-time to find appropriate responses aptly in a quick manner.

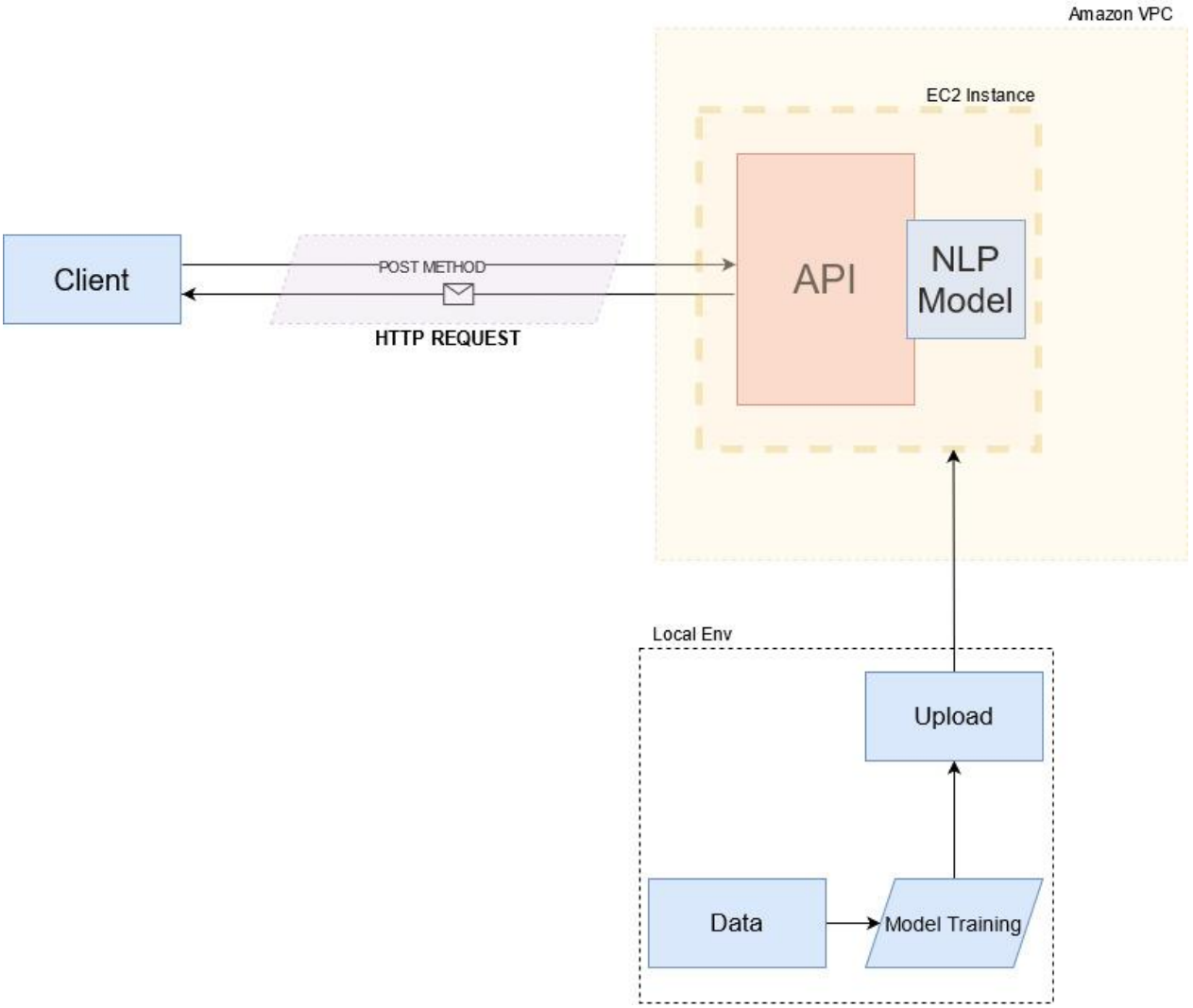


Fig. 5: NLP model

3.2 (c) Natural Language Toolkits (NLTK)

Chatbots are not a thing of the present, one of the foremost of this kind is ELIZA, which was created in the early 1960s. In order to build a conversational engine successfully which serves all the purposes, it should take care of the following things:

- Understand who is the target audience
- Understand the Natural Language of the communication.
- Understand what the user demands
- Provide responses that can answer what the user demands

We can create a simple chat assistant or chatbot using Python's NLTK library.

NLTK (Natural Language Toolkit) is the go-to API for NLP (Natural Language Processing) with Python. In order to deal with and manipulate the text resulting from speech recognition and speech to text conversion, specific toolkits are needed to organize the text into sentences then split them into words, to facilitate semantic and meaning extraction.

The Natural Language Toolkits (NLTK) are a combined set of modules, tutorials and exercises which are open source and cover Natural Language Processing symbolically and statistically. NLTK was developed allowing computational linguistics with three educational applications in mind: projects, assignments and demonstrations. NLTK is used to split words in a string of text and separate the text into parts of speech by tagging word labels according to their positions and functions in the sentence. The resulting tagged words are eventually processed to

extract the meaning and produce a response in the manner in which it is required. Different grammar rules are used to categorize the tagged words in the text into groups or phrases relating to their neighbors and positions. This type of grouping is called chunking into phrases, such as noun phrases and verb phrases.

3.2(d) Python

Python is an interpreted high-level general-purpose programming language whose design philosophy emphasizes code readability with its notable use of significant indentation. Its language constructs it as well as its object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects depending on the needs.

Python is an interpreted, object-oriented, high-level programming language with dynamic syntax and semantics. Its high-level built in data structures, combined with dynamic typing and dynamic binding; make it very attractive for Rapid Application Development, as well as for use as a scripting language to connect existing components together to make it a single one. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program cost and maintenance. Python supports some modules and packages, which encourages program modularity and code reusability. The Python interpreter and the extensive standard library are available in source or binary form without payment for all major platforms, and can be freely distributed.

Often, programmers fall in love with Python because of the increased productivity that it provides. Since there is no compilation step, the edit-test-debug cycle is incredibly quicker. Debugging Python programs is easy: a bug or bad input will

never cause a segmentation error in it. Instead, when the interpreter discovers an error, it raises an exception of that error. When the program doesn't catch the exception, the interpreter prints no error. A debugger allows inspection of local and global variables, evaluation of arbitrary expressions, setting breakpoints, stepping through the code a line at a time, and so on. The debug is written in Python itself, testifying to Python's introspective power. On the contrary, often the quickest way to debug a program is to add a few print statements to the source: the fast edit-test-debug cycle makes this simple approach very effective.

3.3 Front-End Systems

Front-end systems are the ones where users interact with the chatbot. These are client facing systems such as – Facebook Messenger, WhatsApp Business, Slack, Google Hangouts, your website or mobile app, etc. It is basically the front end system only that provides us with the User Interface (UI) which the end user is able to see. It provides us with the UI through which the user can interface and can get the desired output. Designing of the Chatbot on the external surface to which the users can see and interact with is only done by the Front end systems.

The Front End Systems are designed using application of HTML, CSS and JavaScript. The detailed descriptions of each one of them are as follows:

3.3.1 HTML

The HyperText Markup Language or HTML is the standard markup language for documents designed to be displayed in a web browser and web page. It can be assisted by technologies such as Cascading Style Sheets (CSS) and some scripting

languages such as JavaScript. HTML can embed programs written in a scripting language such as JavaScript, which affects the behavior and content of web pages in it. Inclusion of CSS defines the look and layout of content of web page. Web browsers receive HTML documents from a web server or from local storage and render the documents into multimedia web pages to display. HTML describes the structure of a web page semantically and originally for the look and appearance of the document. A web widget on a sample HTML page is as follows:

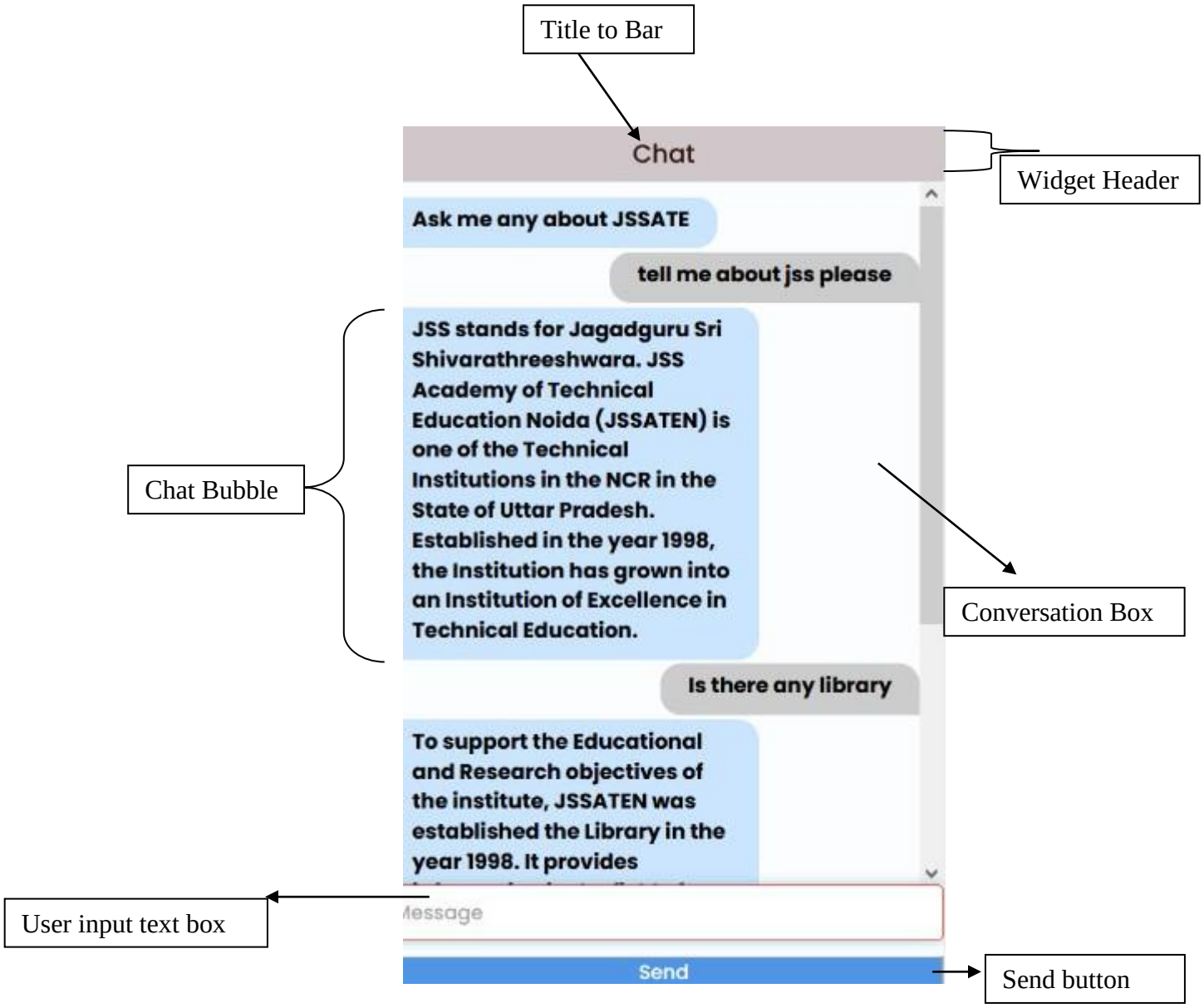


Fig 6. A web widget on a sample HTML page

3.3.2 Cascading Style Sheets (CSS):

Cascading Style Sheets, also referred to as CSS, is a simply designed language intended to simplify the process of making web pages presentable and readable. CSS allows you to apply styles to web pages and websites. More importantly, CSS enables you to do this independent of the HTML that makes up each web page for editing..

It provides powerful control over the presentation of an HTML created document. A CSS comprises style rules that are interpreted by the browser and then applied to the corresponding elements in document prepared. A style rule set consists of a selector and declaration block along with it..

To manage chatbot UI we used CSS predominantly. When Chatbot is clicked its view is changed to flex view and when it’s unclicked then its view is changed to none resulting into toggling of chatbot. The position of the chatbot is kept fixed using fixed property of CSS. Also it is positioned in the right left corner of the page so that it can be integrated in the future as per the needs. As the number of messages in Chatbot increases the property of overflow is used so that we get a scrollable chat in a fixed size screen. Font families used are Arial, Helvetica, sans-serif. Styling our chatbot is completed with this.

3.3.3 JavaScript

JavaScript is a dynamic programming language that's used for web development, in web applications, for game development, and lots more. It allows you to implement dynamic features on web pages that cannot be done with only HTML and CSS. We used JavaScript in chatbot to interact with users, that are to read messages, direct messages and get proper response from the server for those messages. We implemented REST API to interact with the server. POST method is used to send data to the server. Data from the input is received using value. Closing and opening of chatbots on clicks is also done using JavaScript. We dynamically set CSS of display to none and flex, thus it helps to toggle.

3.3.4 Web Socket

Websockets allows a server and a client to exchange messages in a bidirectional manner. Due to their bidirectional nature, they're very suitable for the kind of application we're developing — conversation between a client and a server (i.e. our chatbot).

WebSocket is bidirectional and a full-duplex protocol that is used in the same scenario of client-server communication. Unlike HTTP, it begins from **ws:// or wss://**. It is a stateful protocol, which means the connection between server and client will keep alive until it is terminated by either party (client or server). After closing the connection by either of the client and server, the connection is terminated from both the ends.

Let’s take an example of client-server communication, there is client which is a web browser and a server, whenever we initiate the connection between client and server, the client-server made the handshaking and decide to create a new connection and this connection will keep alive until terminated by any of the server or client. When the connection is established and alive the communication takes place using the same connection channel until it is terminated by anyone.

This is how after client-server handshaking, the client-server decide for a new connection to keep it alive, this new connection will be called as WebSocket. Once the communication link is establishment and the connection are opened, message exchange will take place in bidirectional mode until connection persists between client and server. If anyone of them (client-server) dies or decides to close the connection, the connection is closed by both of the party. The way in which socket works it slightly different from how HTTP works, the status code 101 denotes the switching protocol which is used in WebSocket.

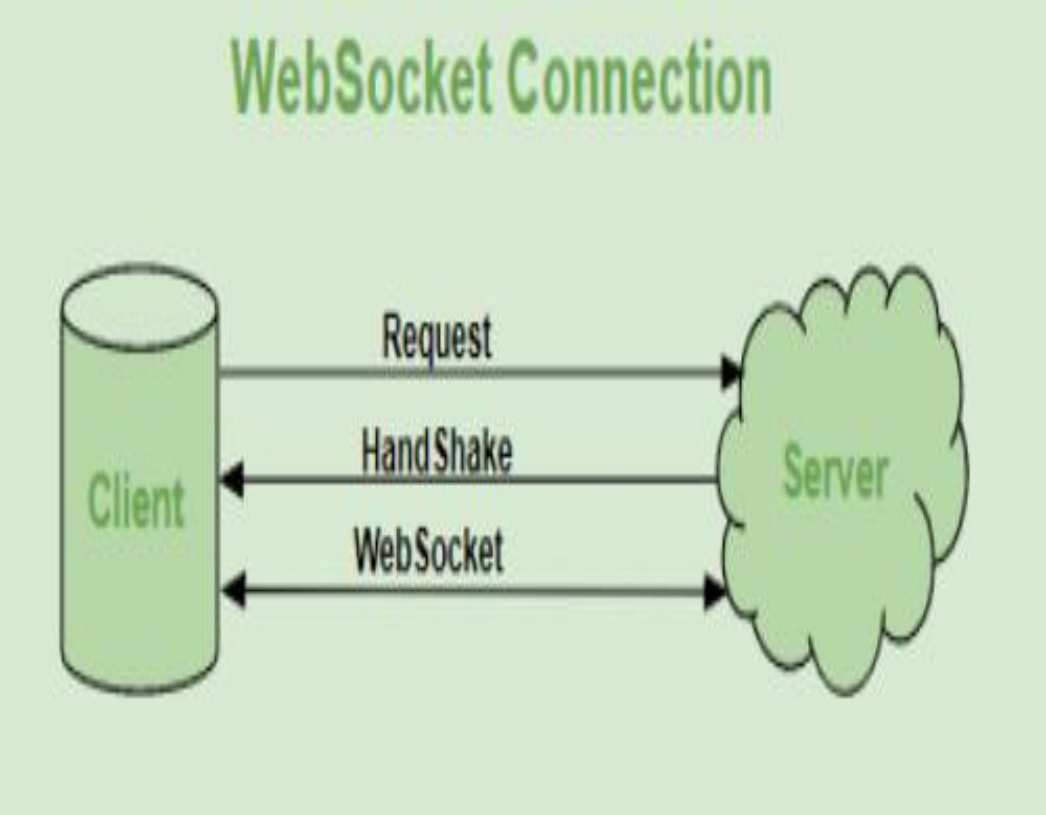


Fig 7: WebSocket Connection

Real-time web application uses a web socket to show the data at the client end, which is continuously being sent by the backend server to frontend. In WebSocket, data is continuously pushed or transmitted into the same connection which is already open, that is why web socket is faster and improves the application performance and speed.

This is how after client-server handshaking, the client and server will decide for a new connection to keep it alive, this new connection will be known as WebSocket.

3.4 Node Server / Traffic Server

It is the server that deals with user traffic requests and routes them to the proper components. The response from internal components is often routed via the traffic server to the front-end systems. It helps in efficient management of the traffic at the server. Due to this only, node server is managed carefully leading to forming of a server providing quick and efficient output from the Chatbot..

3.5 Custom Integration

With custom integrations, the chatbot can be integrated with your existing backend systems like CRM, database, payment apps, calendar, and many such tools, to enhance the capabilities of the chatbot. It is the final stage wherein the work done in previous all stages is successfully integrated to produce a self sustained and a working model of our Chatbot.

CHAPTER 4
CHATBOT STRATEGIES

To give suitable answers to keywords or phrases extracted from speech and to keep conversation between user and administrator continuous, there is a need to build a dialogue system (programme) called a Chatbot (Chatter-Bot). Chatbots can assist in human computer interaction and they have the ability to examine and influence the behavior of the user by asking questions and responding to the user's questions effectively. The Chatbot is a computer programme that mimics intelligent conversation by its database. The input to this programme is natural language text, and the application should give an answer that is the best intelligent response to the input sentence that user demands. This process is repeated as the conversation continues and the response is either text or speech whatever it needs.

Building a Chatbot needs highly professional programming skills and experienced developers. There is a complicated development platform behind any Chatbot which will only be as good as its knowledge base which maps a user’s words into the most appropriate response which is demanded by user. The bot developer also builds the knowledge base as well. However, there are some platforms which provide a learning environment as well. Writing a perfect Chatbot is very difficult because it needs a very large database and must give reasonable answers to all interactions that we demand. There are a number of approaches to create a knowledge base for a Chatbot and include writing by hand and learning from a experience. Learning here means saving new phrases and then using them later to give appropriate answers for similar phrases as asked by users.

Designing a Chatbot software package requires the identification of the constituent parts through which it is made. A Chatbot can be divided into three parts: Responder, Classifier and Graphmaster (as shown in Figure), which are described as follows:

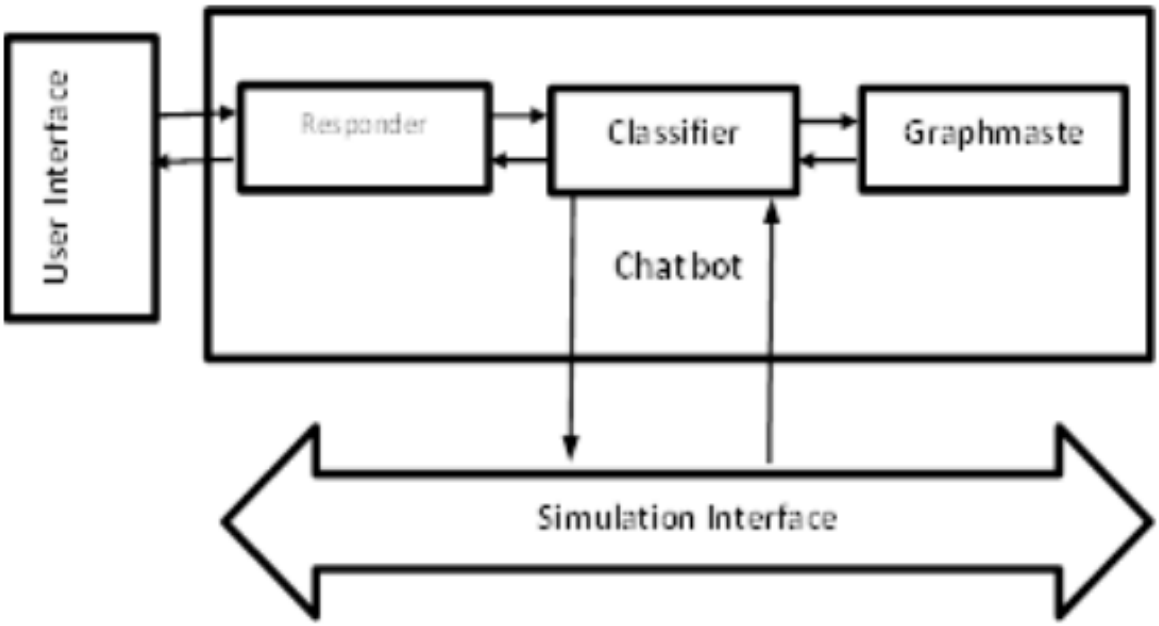


Fig 8:. Components of Chatbot

4.1 Responder

It is the part that plays the role of interfacing role between the chatbot's main routines and the user. The tasks of the responder are as follows:

- Transferring the data from the user to the Classifier unit
- Controlling the input and output operations.

4.2 Classifier :

It is the part between the Responder and the Graphmaster units. The functions of this layer are as follows:

- Filtering and normalizing the inputs
- Segmenting the input entered by the user into logical components
- Transferring the normalized sentence into the Graphmaster unit
- Processing the output from the Graphmaster unit
- Handling the instructions of the database syntax (e.g. AIML).

4.3 Graphmaster:

Graphmaster is the part which is used extensively for pattern matching, operations. The tasks performed by this layer are as follows:

- Organizing the brain’s contents
- Storage of data
- Holding the pattern matching algorithms.

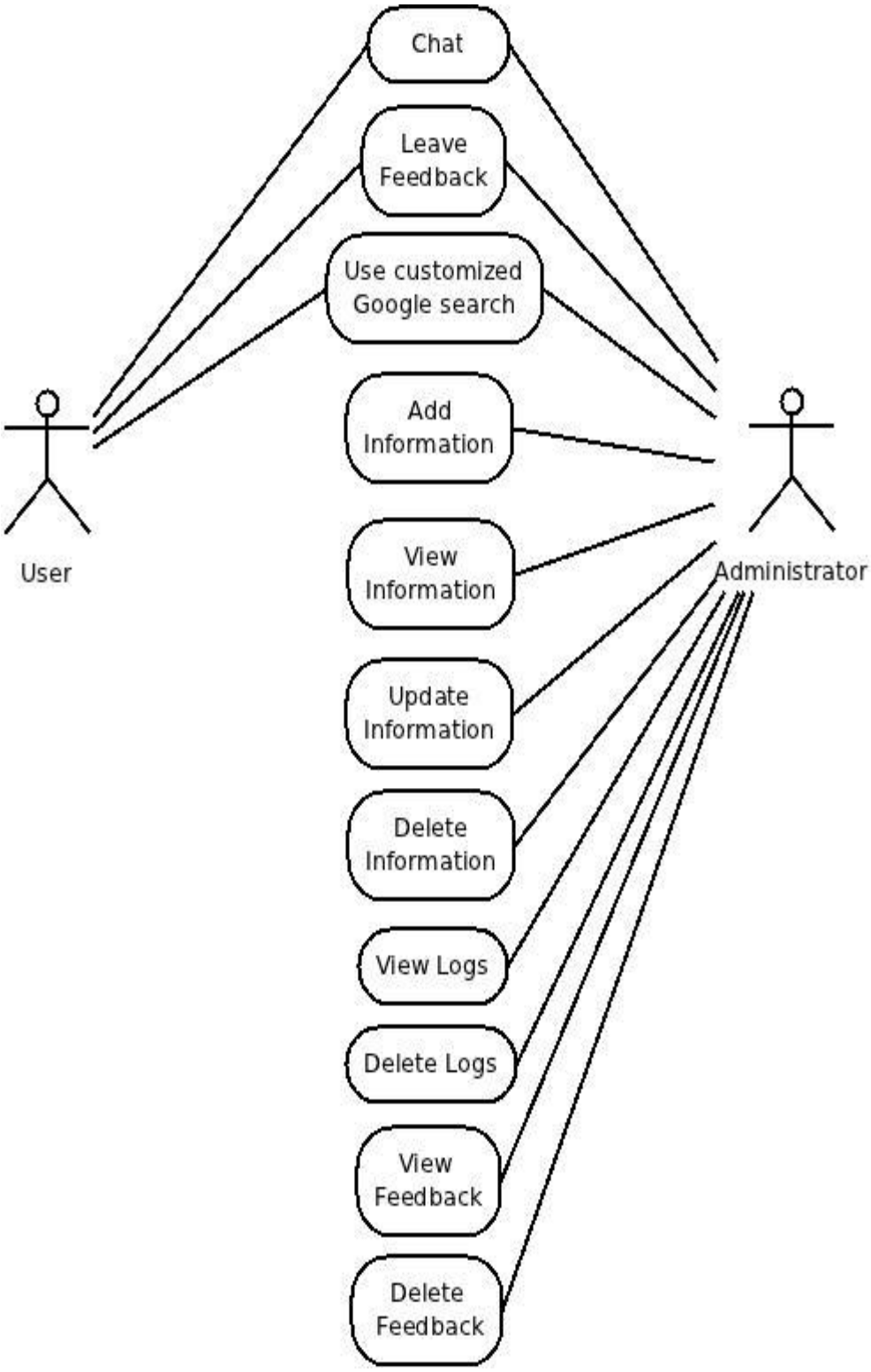
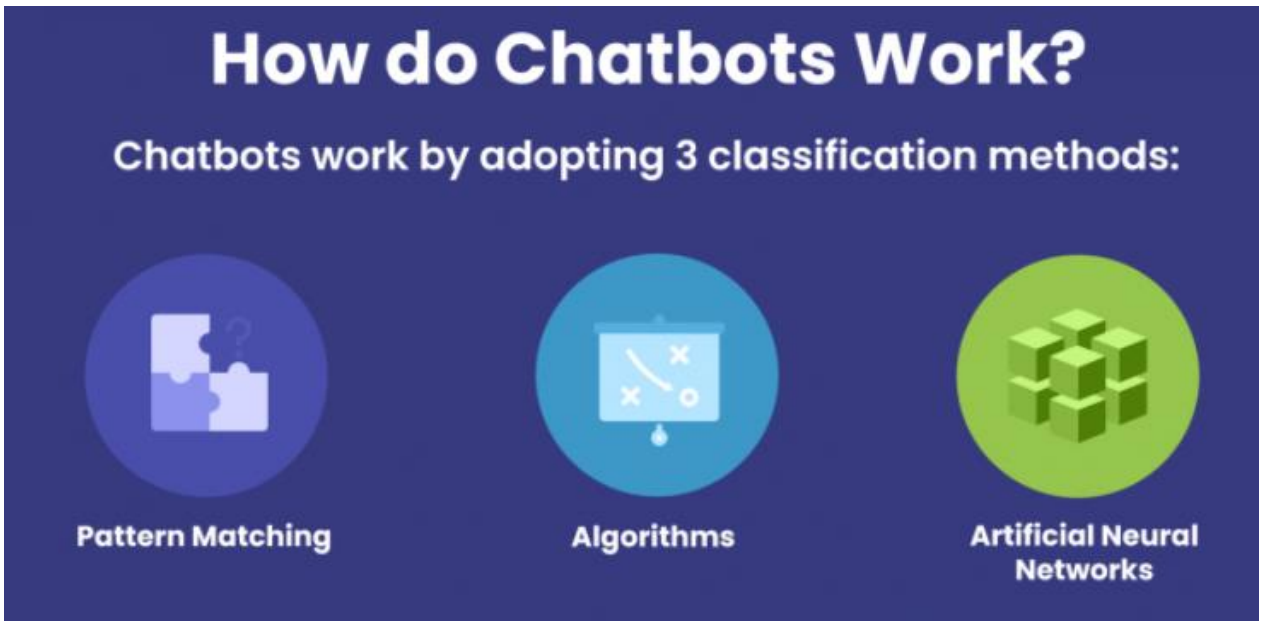


Fig.9: Roles of user and network administrator

CHAPTER 5
WORKING OF CHATBOT

There are three classification models that chatbots adapt to work. These are as follows:



5.1 Pattern Matching

Chatbots use pattern matching to classify the text and produce a suitable response for the customers need. A standard structure of these patterns is called as "Artificial Intelligence Markup Language" (AIML). It is one of the core techniques that are used in common conversational Chatbot designing.

The purpose of the AIML language is to simplify the job of conversational modeling, in association to a “stimulus-response” process. It is also a mark-up language which based on XML and depends on tags which are the identifiers that make snippets of codes to send commands into the Chatbot. The data object class is defined in AIML as an AIML object, and the responsibility of these objects is modeling the conversational patterns and objects. This means that each AIML object is the language tag which associates with a language command.
The most important objects among the AIML objects are category, pattern, and template. The category tag performs the task of defining the knowledge unit of the conversation. The pattern tag identifies the input from the user and the task of template tag is to respond to the specific user input which user demands.

5.2 Algorithms

A unique pattern must be available in the database to provide a suitable response for each kind of question asked by user. A hierarchy is created with lots of combinations of patterns of questions. Algorithms are used to reduce the number of classifiers and create a more manageable structure to present.
Computer scientists call it a “Reductionist” approach- to give a simplified solution; it reduces the problem of searching time complexity.

5.3 Artificial Neural Networks

Neural Networks are a way of calculating the output from the input using weighted connections, which are computed from repeated iterations while training the data is being done. Each step through the training data amends the weights resulting in the output with accuracy which is commendable.

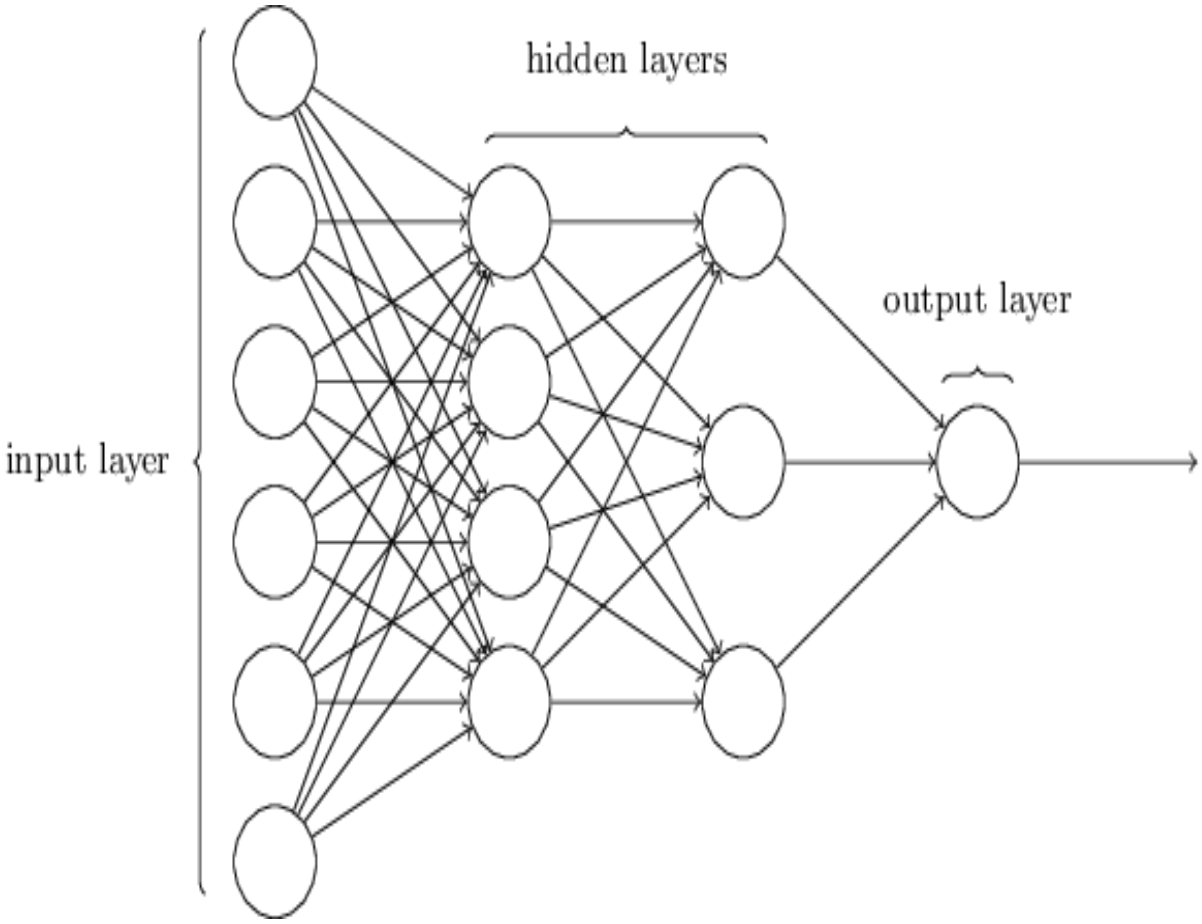


Fig 10:. Neural Network Architecture

Each sentence is broken into individual words, and each and every word is then used as an input for the neural networks. The weighted connections are then calculated by different iterations through the training data a number of times, whenever improving the weights to form it accurate.

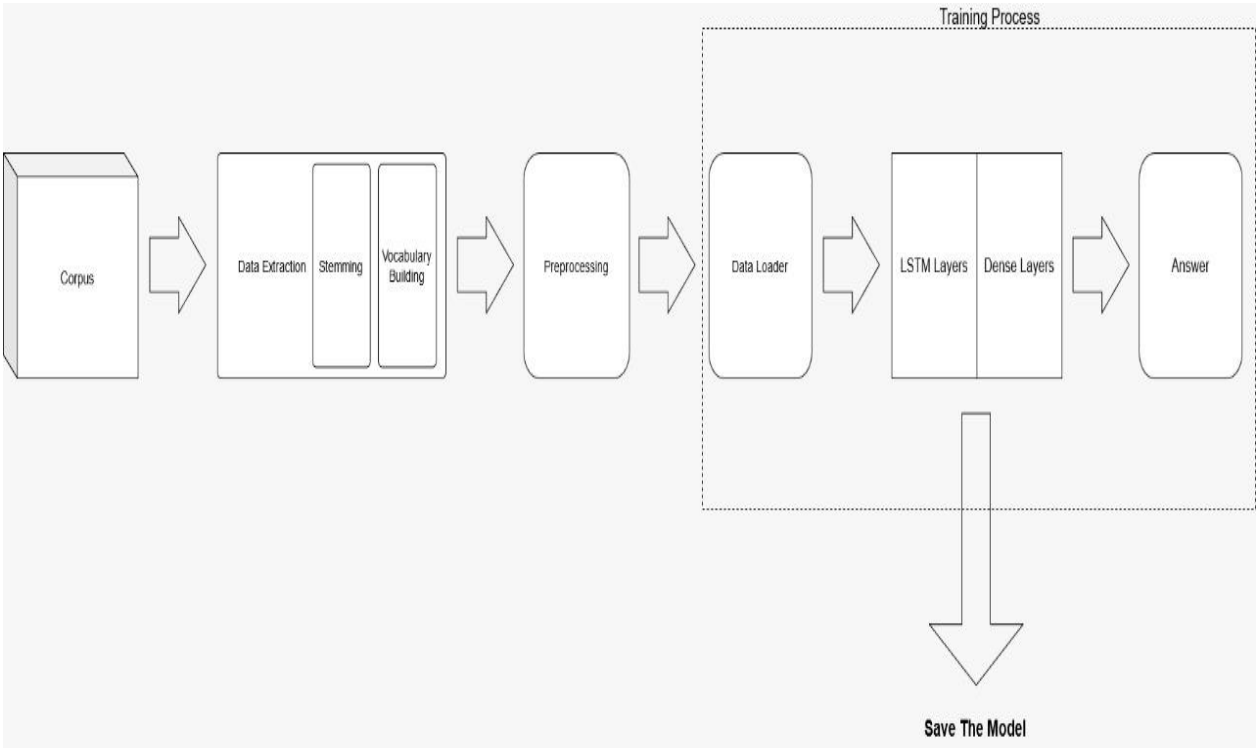


Fig. 11 Training Process

The trained data of a neural network is a comparable algorithm with more and less code which is developed. When there is a comparably small sample, where the training sentences may have, for example, 200 different words and 20 classes that would generate a matrix of 200×20. But this matrix size increases by n times more gradually and can cause a massive number of errors after some time. In this kind of scenario, processing speed should be considerably high to avoid errors. The waterfall model is implemented which comprise of various intermediate steps which must be carried out to implement a working model of a Chatbot which after the technical advancements can be industrially deployed leading to serve the roles of both the user as well as the administrator. The stages in the waterfall model

include various steps which includes requirements of the objective for which we are trying to make our project, analysis is done for the requirements that we have made, design is done for the project which is tried and tested to get the model which has least error, coding of the model is done which is required, the coded version of the project is tested and is then debugged, and finally acceptance of the project that we have made that we can industrially deploy in order to serve the needs of the users. Chatbot which after the technical advancements can be industrially deployed leading to serve the roles of both the user as well as the administrator.

There are multiple variations in neural networks, algorithms as well as patterns matching the code. Complexity may also increase in some of the variations it has. But the elemental remains equivalent as the previous one and therefore the critical work is that of classification among its types.

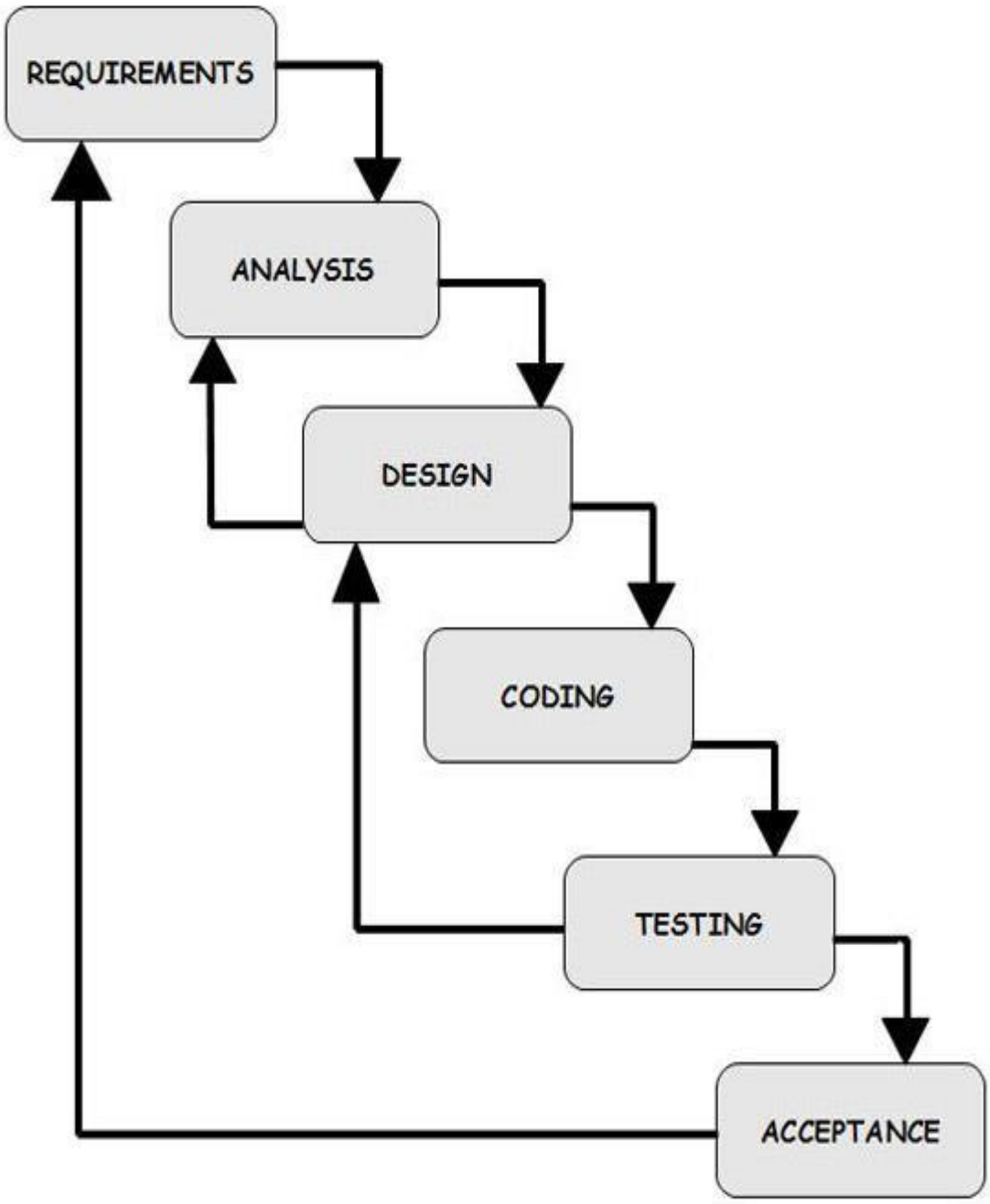


Fig 12. Waterfall model

CHAPTER 6
FUTURE ASPECTS

In today's fast paced world it is very important that we stay up- to- date with all the technological advancements occurring on a regular basis. For this we have to update ourselves and get acquainted with the same. In the similar fashion we have also tried to improve our project of chatbot with the advent of future technological advances. Hence we will try to continue this project in the future as well and try to deploy it in a greater domain of technology. For this we have several suggestions and enhancements that we wish to implement in our project in the near future:

1. In the present time our implemented model of Chatbot is according to the latest technology but we are guessing that it would not be able be cater the needs of the future generation due to advancement of science and technology in the Research and Technology (R&D) department. We will try to increase the robustness of our Chatbot model in order to ensure that it is in good condition in the coming future and we will be sure that it could serve the needs of many people

2. If the user provides any input that is not in the database of the Chatbot, it will ask the user to enter some other keyword till it gets the same

keyword in its database to which it can respond and provide an answer. In the coming future we will try to enhance its database and try to provide failover correction to our Chatbot service.

3. The working of Chatbot is done by the efficient use of the API system. NLTK is the go- to API of the NLP that we have used in our project. API provide a intermediary software that allows two applications to talk to each other. But in the coming future we will try extensively to make our Chatbot API secure.

4. Internet of Things (IoT) is the current specification of technology. Nowadays we can see lots of things around us connected to the world of internet and it could be accessed from any part of the globe if we have an internet connection with ourselves. In the similar fashion, we would also try to implement this technology of IoT in our project of Chatbot to make it more versatile which could be helpful for a lot of people. We will create a service- to- service Chatbot service by applying AI over IoT devices such as Bluetooth sensor (HC-05), Zigbee, Wifi Module and others, to answer the real-time queries that the user demands. These demands would not be necessary be stored in the database of our Chatbot, instead it would match the meaning what

the user is trying to say and give the desired response. We can thus use this Chatbot system to control different appliances from a remote location and can thus serve our requirements of e-learning, e-control, e-governance, etc as and when it would be demanded by the user.

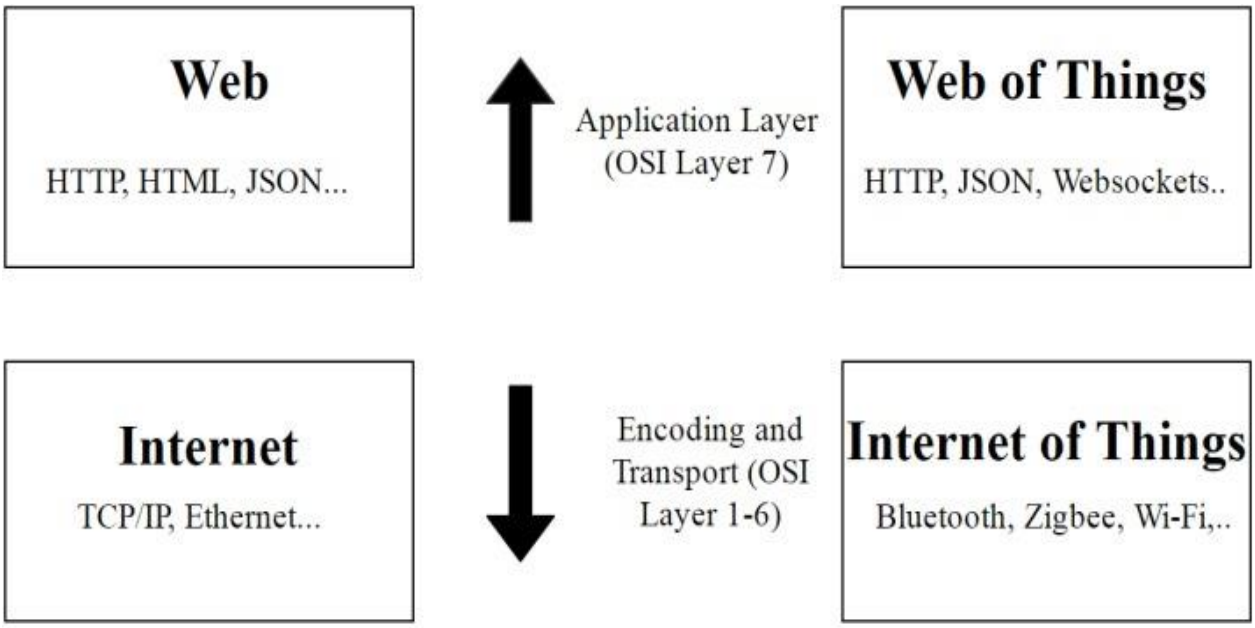


Fig 13: Web of Things

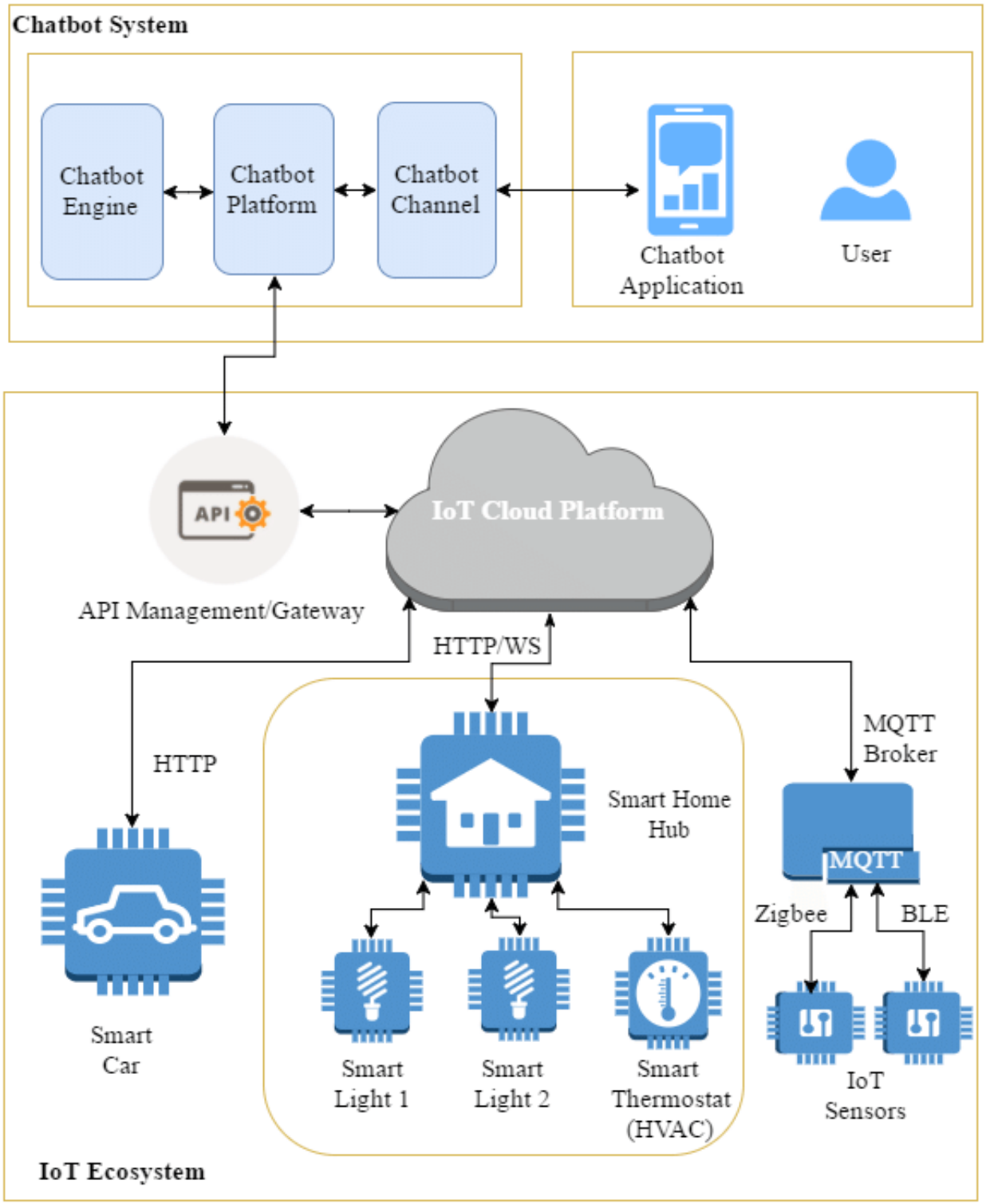


Fig 14: Proposed System Design of IoT- Chatbot System

5. We will try extensively to improve our NLP models that we have used in our project by using some word embeddings and advanced models like BERT and GPT . BERT which stands for Bidirectional Encoder Representations from Transformers is a neural network-based technique for natural language processing pre-training. It can be used to help Google better discern the context of words in search queries. Generative Pre-trained Transformer 3 (GPT-3) is an autoregressive language model that uses deep learning to produce human-like text. It is the third-generation language prediction model in the GPT-n series (and the successor to GPT-2) which is created by OpenAI, a San Francisco-based artificial intelligence research laboratory.

CHAPTER 7

CHATBOT: PROS AND CONS

7.1 Benefits of using a Chatbot

In today's fast paced world, the power of a Chatbot can be utilized for innumerable purposes.

Some of the important uses of the Chatbot are as follows:

As per a statistical report submitted by the HubSpot organisation, “approximately 21% of the customers believe that chatbots are the best and easiest way to initiate a conversation with any business”.

- Chatbots are becoming increasingly important due to their financial benefits that they possess.
- Chatbots provide a cost saving approach which is available to us 24X7.
- Chatbots provide individual connections to a limitless number of users at a broad scale.
- Chatbots automate routine functions at a greater level.
- Chatbots can be industrially deployed in regions where efficient use of manpower by industries is desired.
- Chatbots are used wherein we want our work to be done in a quick and efficient manner.
- Chatbots make it easy to have excellent customer service and a customized experience to all.
- Chatbots are social, allowing for a two-way dialogue with suggestions to follow.
- Chatbots are highly personalised keeping track of the data that we have given as an input to the Chatbot.
- Chatbots have endless patience. They will never react rudely and will always give the answer in a calm and efficient manner.

- With the help of chatbots, the companies can help in gaining deeper understanding of the customers by analysing the data entered by them and hence focus on the same domain to increase their sales and can earn lots of profits meeting the user's demands.

7.2 Limitations with a Chatbot

Nothing in the entire universe is perfectly efficient and serves all the purpose of the mankind to its fullest. Chatbot also stands at this role wherein due to increasing advancements in the field of science and technology, at some point of time there comes a point where it becomes fairly difficult to work with the chatbots which in a general manner serve the purpose of a variety of mankind. Some of the limitations that we feel which are associated with the Chatbot are as follows:

- **Domain Knowledge**:

  Broadly speaking, artificial intelligence in a true sense is still out of reach despite of the regular advancements in the research and development (R&D) of the various technologies in the world, it becomes difficult for any chatbot to completely fathom the conversational boundaries when it comes to conversing with a human due to immense domain of knowledge

that a human being possess in comparison to the knowledge that Chatbot possess which s ultimately provided by us, the human beings.

- **Personality**:

Not being able to respond correctly and fairly poor comprehension skills has been more than frequent errors of any chatbot, adding a personality to a chatbot is still a benchmark that seems far away. But we are more than hopeful with the existing innovations and progress-driven approaches.

CHAPTER 8
CONCLUSION

The main objectives of the project were to develop an algorithm that will be used to identify answers related to user demanded and submitted questions. We tried to develop a database were all the related data will be stored and to develop a web interface. The web interface developed had two parts, one for simple users and one for the network administrator.

A background research took place, which included an overview of the conversation procedure and any relevant chat bots available within the time framework. A database was developed, which stores information about questions, answers, keywords, logs as well as feedback messages. A usable system was designed, developed and deployed to the web server. It was also tried for a basic electronics model. Also after received feedback from the first deployment, extra requirements were introduced and implemented

APPENDIX

Other possible Applications of our ChatBot Model

1 - ChatBot in Educational Websites-

- Pandemic has led people to move more towards eLearning. It also made people realise how e-learning can be beneficial in the long term.

- However there are some drawbacks. In a class, the teacher can solve the doubts of all the students simultaneously. However it can cant be done for a website. Students are forced to search for answers on their own.

- The student may even end up searching for the wrong answer.

- Chatbot can be a good solution for this problem.

- With chatbot multiple students may ask the same questions multiple times. This will also help students to develop at their own pace.

- Students can also learn things at times they are comfortable with that are on their own schedule.

- The information may also be then updated regularly by the faculty.

The Idea –

- The idea is to design a website that will contain all the learning material on topics.

- It can then be integrated with a ChatBot similar to ours. So that it may not take much of the screen.

2- For emotional support

- Pandemic has forced people to stay at their homes.
- This gave more time to people for them.
- However it did not impact everyone positively. Many were open to negative thoughts, negative feelings.
- An urge was seen in people to talk and share their feelings with someone.
- However most of them found themselves alone.
- Chatbot can be used to tackle this problem

The idea-

- The idea is to use this chatbot and to make the replies from chatbot closely related to real humans.
- The chatbot can learn from past experiences. An algorithm to understand the emotion of the person can be used.
- Infact replies of people can be used by chatbot to bring more originality to chat.
- This way chatbot can reply as a human and thus it may solve the problem of loneliness.

3- Customer Support

- Almost all companies that provide services to people require customer support.
- Most of the time people end up asking similar questions or requesting the same things.
- This not only leaves people exhausted but it also drains money from the company.
- A solution can be chatbot. People may consult their issues. They can get updates on the company. They may ask for similar questions.
- Basic requests of customers can also be managed with this.
- Thus it will help company to save a lot of resources.

The Idea -

- The idea is to integrate a similar ChatBot of ours to the company website.
- The service must be available 24*7.
- The information in the chatbot must be regularly updated.

4 - Vacation Plannings-

- Tourism has gained a lot of popularity in recent times. People release their stress with vacations.
- Since everyone wants their vacation to be perfect. People pay for planning their vacations.
- However, these informations and reviews are already available on the internet for free.
- The requirement here is to aggregate that information and present it to the people.
- The chatbot here can be used as a tool to interact with people and provide them useful information.
- Later it can then collect feedback of the location and integrate it in its database.

The idea –

- The idea is to use a chatbot similar to ours and use data of people reviews.
- The data can be presented according to people's demands.
- This will save a lot of money for people and it will also provide people with better vacations.

5 - Help find transactions.

- Pandemic has made people rely on Online banking.
- This not only saves people time but it also takes minimum effort.
- This effort can be further minimized by using chatbot.
- Lot of times people have small queries which don't require authentication. For example to send account details to registered email, to get transaction details.
- Thus chatbots may be used to solve this problem.

The idea-

- The idea is to use a similar chatbot and integrate it on a net banking website.
- This will help companies to save lot of resources

Being associated with the branch of Electronics and communication engineering, we have also planned to develop a Chatbot which answers some basic questions of electronics upon the questions being demanded by the user. For this we have created a web page inbuilt with the Chatbot model answering the basic electronics questions demanded by the user. This we would have implemented extensively if we would have met in the college provided our inputs comprehensively. To this date it still remains as a point of interest for us in the coming future as when the pandemic will end.

List of sensors that can be used to implement IoT in our Chatbot are as follows:

1. **Ultrasonic Sensor (HC-SR04)**:

The ultrasonic sensor or ultrasonic transducer is one of the most popular sensors used in applications of IoT.

Working Principle: The transmitter transmits the ultrasonic waves in the air of forwarding direction, and when an object is there, it will reflect towards the receiver. The receiver (Photodiode) receives the ultrasonic waves**.**

Distance = Speed x Time

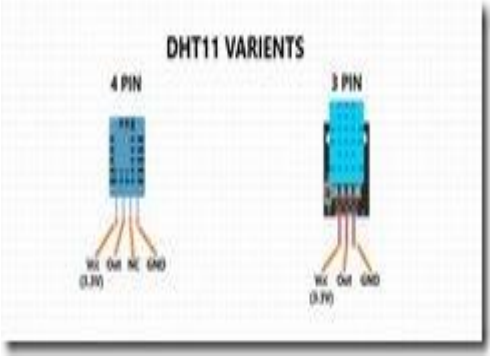
Now, we should know the speed and distance, then calculate the distance of the object.

VCC	5V power supply
Trig	Input pin
Echo	Output pin
GND	Ground pin

Table 2: Pin diagram of HC- SR04

2. Humidity and Temperature Sensor (DHT-11):

Humidity and temperature sensors are used to measure the moisture and temperature of the surrounding air. The different temperature sensors are designed based on the application with analog and digital output. Example LM35 and DHT11, DHT22. The automation application widely used the DHT11 sensor because of output in digital form. The digital data comes from the data pin in every 2 seconds**.**



VCC	Input voltage
NC	No Connection
Out	Output pin
GND	Ground pin

Table 3: Pin diagram of DHT-11

3. Bluetooth Sensor (HC-05)

HC-05 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data.

Pin Number	Pin Name	Description
1	Enable / Key	This pin is used to toggle between Data Mode (set low) and AT command mode (set high). By default it is in Data mode
2	VCC	Powers the module. Connect to +5V Supply voltage
3	Ground	Ground pin of module, connect to system ground.
4	TX – Transmitter	Transmits Serial Data. Everything received via Bluetooth will be given out by this pin as serial data.
5	RX – Receiver	Receive Serial Data. Every serial data given to this pin will be broadcasted via Bluetooth
6	State	The state pin is connected to on board LED, it can be used as a feedback to check if Bluetooth is working properly.
7	LED	Indicates the status of Module Blink once in 2 sec: Module has entered Command Mode Repeated Blinking: Waiting for connection in Data Mode Blink twice in 1 sec: Connection successful in Data Mode
8	Button	Used to control the Key/Enable pin to toggle between Data and command Mode

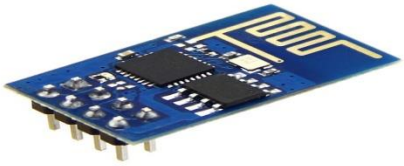
Table 4: Pin diagram of HC-05

4. Zigbee module:

Zigbee is a low-cost, low-power, wireless mesh network standard targeted at battery-powered devices in wireless control and monitoring applications. Zigbee delivers low-latency communication. Zigbee chips are typically integrated with radios and with microcontrollers.

5. ESP8266 module:

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all WiFi networking functions from another application processor.



6. NodeMCU:

NodeMCU is a low cost open source IoT platform which is an advanced version of ESP8266 module providing greater number of pins and frequency of output.

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