AVIVA
(Automated Visual Interaction-Based Voice Assistant)

Capstone Project Report
End Semester Evaluation

Bachelor of Engineering

SUBMITTED BY

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November 2018

Abstract

With the advent of 21^{st} Century, Robots are taking over manufacturing industry. They are becoming more and more essential to every part of life. Robots are now on the verge to become a part of peoples life. There are plenty of bots in the area which work on hard coded rules but don't offer a realistic human like responses and they don't serve any purpose. The above problem can be solved using machine learning to make the responses more realistic. Through Natural Language Processing (NLP) based algorithms a response system can be generated which sound natural and realistic. Expert systems are used for specific domains and these offer advices to the user. Also, bots are being made to interact with the surroundings which has been made possible through IOT, which offer the bot a virtual personality and a human-like nature.

Declaration

We hereby declare that the design principles and working prototype model of the project entitled Aviva (Automated Visual Interaction-Based Voice Assistant) is an authentic record of our own work carried out in the Computer Science and Engineering Department, TIET, Patiala, under the guidance of Dr. Rajesh Kumar and Mr. Harpreet Singh during 7th semester (2018).

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Acknowledgement

We would like to express our thanks to our mentors Dr. Rajesh Kumar and Er. Harpreet Singh. He has been of great help in our venture, and an indispensable resource of technical knowledge. He is truly an amazing mentor to have.
We are also thankful to Dr. Maninder Singh, Head, Computer Science and Engineering Department, entire faculty and staff of Computer Science and Engineering Department, and also our friends who devoted their valuable time and helped us in all possible ways towards successful completion of this project. We thank all those who have contributed either directly or indirectly towards this project.
Lastly, we would also like to thank our families for their unyielding love and encouragement. They always wanted the best for us and we admire their determination and sacrifice.

Date: 17th November 2018

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List of Abbreviations

AVIVA	Automated Voice Interaction based Visual Assistant
STT	Speech to Text
TTS	Text to Speech
ACE	Artificial Conversational Entity
ML	Machine Learning
NLP	Natural Language Processing
AIML	Artificial Intelligence Markup Language
IOT	Internet of Things
SD	Secure Digital
NPC	Non Playable Character
CLI	Command Line Interface
SVM	Support Vector Machine
NLTK	Natural Language Toolkit
DOM	Data of Machine
RFID	Radio Frequency Identification
SDL	Specification and Description Language
HTTPS	Hyper Text Transfer Protocol Secure
VNC	Virtual Network Computing

Chapter 1

Introduction

A chatbot (also known as a talkbot, chatterbot, Bot, IM bot, interactive agent, or Artificial Conversational Entity ACE) is a computer program or an artificial intelligence which conducts a conversation via auditory or textual methods.

1.1 Project Overview

Chatbots programs are often designed to convincingly simulate how a human would behave as a conversational partner, thereby passing the Turing test. Chatbots have come a long way from simple scripted answer machines. Todays chatbots are intelligent enough to engage potential customers and ensure that human customer service and sales agents are not swamped with repetitive inquiries that waste time and resources. But thats not all they do. Businesses today use chatbots in very interesting ways that demonstrate full spectrum of the capabilities and capacities of chatbots. Chatbots can be used with almost all popular messaging apps. These bots can be given distinct personalities as well. Chatbots can understand written and spoken text and interpret its meaning. The bot can then look up relevant information and deliver it to the user. Most of the modern smartphone apps rely on chatbots to function.

1.1.1 Technical Terminology

i **Machine Learning** is a field of computer science that gives computers the ability to learn without being explicitly programmed. Machine learning is closely related to (and often overlaps with) computational statistics, which also focuses on prediction making through the use of computers. It has strong ties to mathematical optimization, which delivers methods, theory and application domains to the field. Machine learning is sometimes conflated with data mining, where the latter subfield focuses more on exploratory data analysis and is known as unsupervised learning. Machine learning can also be unsupervised and be used to learn and establish baseline behavioral profiles for various entities and then used to find meaningful anomalies [22].

ii **Natural Language Processing** is a field of computer science, artificial intelligence concerned with the interactions between computers and human (natural) languages, and, in particular, concerned with programming computers to fruitfully process large natural language data. Formerly, many language-processing

tasks typically involved the direct hand coding of rules, which is not in general robust to natural-language variation. The machine-learning paradigm calls instead for using statistical inference to automatically learn such rules through the analysis of large corpora of typical real-world examples [19].

iii **Digital Image Processing** is the use of computer algorithms to perform image processing on digital images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems [14].

iv **Internet of Things** is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these objects to connect and exchange data. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of hyperphysical systems, which also encompasses technologies such as smart grids, virtual power plants, smart homes, intelligent transportation and smart cities [4].

1.1.2 Problem Statement

Interacting with internet has many problems. The foremost problem is that the medium of communication is not precise. The other problem is lack of intuitive experience or UI is not personalized to the persons taste. This creates a negative affinity towards technology and internet in general.

1.1.3 Goal

To create an immersive experience to interact with the internet by providing information using the basic human evolutionary concept of communication. To create an intuitive experience while interacting with the internet.

1.1.4 Solution

In an attempt to solve the above problem and reach the goal A chat-bot has been developed to answer questions in precise form. Because it uses Natural Language Processing to answer questions it feels like as a natural process of communication.

1.2 Need Analysis

Needs analysis is defined as a formal process focus on how a product addresses the needs of a human. It is not an official business development tool, but is considered a valuable analytical technique to better gauge the marketability of a product or a service to a human consumer.

i **Lack of an intuitive and natural way to interact with the internet**: From the very beginning of journey of life, human beings find it natural to interact with voice than text. Internet is a landmark in mankinds history but there is a need to make Internet more than just a browser. We need to have more intuitive interactions, like a human-like experience, that not just fill your screen with multiple links but answers whats relevant. So, using voice as way to interact seems so natural and intuitive at the very first place for human beings. With the bot user can interact directly using its voice by asking the bot query and the bot responds by obtaining the response from machine learning model and outputting the response using a human like voice.

ii **Difficulty in handling queries related to programming**: Programming queries are most difficult to handle and most queries cant be resolved. To solve preliminary problems related to programming using chatbots seems to be lacking in most chatbots that are present on the market. With AVIVA this can be achieved as it can answer most basic queries related to programming.

iii **Lack of emotional interaction in getting details**: Usually when people fill information online on Google forms or any such platform they generally fill them without an intent to be serious about the subject in hand. The problem with forms is they are too robotic and stubborn for humans to interact with them. A bot can help on this by being a medium that can interact and store information and avoid being too inhuman by using voice as medium.

1.3 Research Gaps

Bots are available for several domains but they are not specific to programming as they are meant for general purpose. The commercially viable chatbots are more specific to productivity and play the role of conversational agents. So there is a lack of a chatbot that answers programming based technical questions.

This work is thus an attempt to explore the applicability of already existing technology in developing a bot that can efficiently answer programming related questions. The literature review has covered a number of selected papers that have focused specifically on Chatbot design techniques in the last decade. A comparison has been made between Chatbot design techniques in the selected studies and then with the Loebner Prize winning Chatbot techniques. From the survey, it can be said that the development and improvement of Chatbot design is not grow at a predictable rate due to the variety of methods and approaches used to design a Chatbot. The techniques of Chatbot design are still a matter for debate and no common approach has yet been identified. Researchers have so far worked in isolated environments with reluctance to divulge any improved techniques they have found, consequently, slowing down the improvements to

Chatbots. Moreover, the Chatbots designed for dialogue systems in the selected studies are, in general, limited to particular applications. General-purpose Chatbots need improvements by designing comprehensive knowledge bases.

The Loebner Prize Competition has been used to evaluate the ability of chatbots to fool people that they are speaking to humans. Comparing the dialogues generated from ALICE, which won the Loebner Prize with real human dialogues, shows that ALICE tries to use explicit dialogue-act linguistic expressions more than usual to re enforce the impression that users are speaking to human. The general conclusion is that developers should NOT adopt an evaluation methodology just because a standard has been established, such as the Loebner Prize evaluation methodology adopted by most chatbot developers. Instead, evaluation should be adapted to the application and to user needs. If the chatbot is meant to be adapted to provide a specific service for users, then the best evaluation is based on whether it achieves that service or task.

1.4 Problem Definition and Scope of the Project

In our everyday life, most people face many problems such as playing music, checking weather and other news. People want their queries to be answered in quicker and efficient way. Most often think that can anyone do this task on my behalf. To solve all these problems there is a solution which is Personalized AI (AVIVA). Here comes the concept of Chatbots. Computer programs which can have real conversations are known as chatbots. A chat interface allows chatbots to converse with users. Chatbots can be used with almost all popular messaging apps. These bots can be given distinct personalities as well. Chatbots can understand written and spoken text and interpret its meaning. The bot can then look up relevant information and deliver it to the user. Most modern smartphone apps rely on chatbots to function. A robot will be developed that integrates the features of chatbot and uses the advanced technical knowledge of Stack Overflow to answer complex queries related to programming. To add upon, the robot will be capable to communicate with the environment using IOT as the medium. This is going to help the robot use its facial recognition to personalize the room to the choice of the user. The bot will help the user develop a natural way to interact with the internet. It helps you treat internet not as technology but as some other person. The bot develops a personalized environment for the user. The end result is a robot that behaves just like a normal human being with abundant knowledge.

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1.5 Assumptions and Constraints

The basic assumptions and constraints are given below.

Table 1.1: Assumptions

S.No.	Assumptions
1	Python and its libraries would be the major programming approaches that would be used
2	The peripherals used must be compatible with Pi
3	User knows English language
4	Information related to the topics chatbot deals with is available on internet

Table 1.2: Constraints

S.No.	Constraints
1	Chatbot can answer limited topics only
2	The system will only support questions in standard English
3	The system needs always on good internet connection
4	The system will need always on power supply

1.6 Approved Objectives

The objectives that were approved by the panels are as follows :

i To create an intuitive experience using a bot.

ii To create an autonomous tagging-based Question and answer system.

iii To use facial recognition to create a personalized environment.

iv To create a use case focused IOT environment.

v To create multiple applications that evict the necessity of apps on phones.

1.7 Methodology Used

For building this project, we used the concept of Hardware-software Co-Design [5]. Firstly, we devise up our requirement analysis and then we do our behavioral model. Then applying partitioning method, we separate two parts into hardware and software. And then we do Requirement Analysis for both hardware and software. We apply our focus on then designing the both hardware and software components. We do integrated Modelling so that we get to know the hardware and software problems that we can face in the deployment stage.

1.7.1 Working Principle of Transistor

The design of a transistor allows it to function as an amplifier or a switch [31]. This is accomplished by using a small amount of electricity to control a gate on a much larger supply of electricity, much like turning a valve to control a supply of water.

Transistors are composed of three parts i.e. a base, a collector, and an emitter. The base is the gate controller device for the larger electrical supply. The collector is the larger electrical supply, and the emitter is the outlet for that supply. By sending varying levels of current from the base, the amount of current flowing through the gate from the collector may be regulated. In this way, a very small amount of current may be used to control a large amount of current, as in an amplifier. The same process is used to create the binary code for the digital processors but in this case a voltage threshold of five volts is needed to open the collector gate. In this way, the transistor is being used as a switch with a binary function: five volts ON, less than five volts OFF.

Semi-conductive materials are what make the transistor possible. Most people are familiar with electrically conductive and non-conductive materials. Metals are typically thought of as being conductive. Materials such as wood, plastics, glass and ceramics are non-conductive, or insulators. In the late 1940s a team of scientists working at Bell Labs in New Jersey, discovered how to take certain types of crystals and use them as electronic control devices by exploiting their semi-conductive properties. Most non-metallic crystalline structures would typically be considered insulators. But by forcing crystals of germanium or silicon to grow with impurities such as boron or phosphorus, the crystals gain entirely different electrical conductive properties. By sandwiching this material between two conductive plates (the emitter and the collector), a transistor is made. By applying current to the semi-conductive material (base), electrons gather until an effectual conduit is formed allowing electricity to pass the scientists that were responsible for the invention of the transistor were John Bardeen, Walter Brattain, and William Shockley. Their Patent was called: Three Electrode Circuit Element Utilizing Semi Conductive Materials [15].

There are two main types of transistors-junction transistors and field effect transistors. Each works in a different way. But the usefulness of any transistor comes from its ability to control a strong current with a weak voltage. For example, transistors in a public-address system amplify (strengthen) the weak voltage produced when a person speaks into a microphone. The electricity coming from the transistors is strong enough to operate a loudspeaker, which produces sounds much louder than the person's voice.

1.7.2 Working Principle of Camera

The camera is a device to capture an image on a desired medium. In the case of motion picture cameras, a series of individual pictures are captured and then presented in rapid succession to give the illusion of having captured motion. But this aside the basic principles between all cameras are the same.

The basic parts of a camera are: lens, iris, shutter, and the medium, and sometimes filter lens gathers light from the selected image and focuses the light on to the medium [34]. iris or diaphragm controls the amount of light that reaches the medium. This device can also be used to control the depth of field. Shutter is a door or gate that opens to allow selected light to reach the medium and closes after a user determined time. The shutter, like the iris, also controls the amount of light that reaches the medium, however

it has no effect of on the depth of field. Medium is the material or device where the light is transferred into a recorded image. With film cameras this is a film of acetate with layers of gelatin imprecated with silver halide particles. In the case of electronic image capturing devices the medium is a silicon-based chip usually a Charge Coupled Device (CCD) or a Complementary Metal Oxide Semiconductor (CMOS).

Filters typically are placed in front of the lens and are used to: control the amount of light, control the quality of light, and create special effects. Filters that control the amount of light are used in place of a shutter or iris when the shutter may be at a fixed speed like for a motion picture camera or when the iris is fixed in a position for a specifically desired depth of field of focus. Generally, for color mediums these filters are neutral density filters. Filters that control the quality of light may be colored filters to make a monochrome medium or in the case of black color filters are used to darken certain parts of an image. For example, a red filter is used to darken a blue sky in black and white photo image because the red filter reduces the amount of blue light passing through the lens to the medium resulting in less light from the sky reaching the medium. Special effects filters are used for a variety of reasons but none are fundamental to the basic principles of cameras, so they are outside of the scope of this project report.

1.7.3 Working Principle of Speaker

An audio signal source such as a microphone or recording produces an electrical ”image” of the sound. That is, it produces an electrical signal that has the same frequency and harmonic content, and a size that reflects the relative intensity of the sound as it changes. The job of the amplifier is to take that electrical image and make it larger – large enough in power to drive the coils of a loudspeaker. Having a ”high fidelity” amplifier means that one can make it larger without changing any of its properties. Any changes would be perceived as distortions of the sound since the human ear is amazingly sensitive to such changes. Once the amplifier has made the electrical image large enough, it applies it to the voice coils of the loudspeaker, making them vibrate with a pattern that follows the variations of the original signal. The voice coil is attached to and drives the cone of the loudspeaker, which in turn drives the air. This action on the air produces sound that more-or-less reproduces the sound pressure variations of the original signal.

1.7.4 Working Principle of Secure Digital Card (SD Card)

Flash works using an entirely different kind of transistor that stays switched on (or switched off) even when the power is turned off. A normal transistor has three connections (wires that control it) called the source, drain, and gate. Think of a transistor as a pipe through which electricity can flow as though it's water. One end of the pipe (where the water flows in) is called the sourcethink of that as a tap or faucet. The other end of the pipe is called the drainwhere the water drains out and flows away. In between the source and drain, blocking the pipe, there's a gate. When the gate is closed, the pipe is shut off, no electricity can flow and the transistor is off. In this state, the transistor stores a zero. When the gate is opened, electricity flows, the transistor is on, and it stores a one. But when the power is turned off, the transistor switches off too. The power supply when switched ON, there is no way of knowing whether it was on/off before, so this is the reason why its said to forget any information it stores.

A flash transistor is different because it has a second gate above the first one. When the gate opens, some electricity leaks up the first gate and stays there, in between the first gate and the second one, recording a number one. Even if the power is turned off, the electricity is still there between the two gates. That's how the transistor stores its information whether the power is on or off. The information can be erased by making the "trapped electricity" drain back down again.

1.7.5 Working Principle of Direct Control (DC) Motor

A motor is an electrical machine which converts electrical energy into mechanical energy. The principle of working of a DC motor is that "whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force". The direction of this force is given by Fleming's left-hand rule and its magnitude is given as in equation 1.1.

$$F = BIL \tag{1.1}$$

Where, B = magnetic flux density, I = current and L = length of the conductor within the magnetic field.

Fleming's Left-Hand Rule: If we stretch the first finger, second finger and thumb of our left hand to be perpendicular to each other AND direction of magnetic field is represented by the first finger, direction of the current is represented by second finger then the thumb represents the direction of the force experienced by the current carrying conductor. [2]

When armature windings are connected to a DC supply, current sets up in the winding. Magnetic field may be provided by field winding (electromagnetism) or by using permanent magnets, in this case, current carrying armature conductors experience force due to the magnetic field, according to the principle stated above. Commutator is made segmented to achieve unidirectional torque. Otherwise, the direction of force would have reversed every time when the direction of movement of conductor is reversed the magnetic field.

1.8 Summary of Project Outcomes

The summary of outcomes of the project are as follows :

i The bot will provide a more intuitive way to respond to user queries, more like talking to a friend.

ii The response from the bot almost tries to pass the Turing Test i.e. it imitates human responses.

iii The bot develops a personalized environment for the user.

iv The end result is a robot that behaves just like a normal human being with abundant knowledge.

1.9 Novelty of Work

A chat bot that answers programming related questions and can handle interview questions is the novelty of this project. The basic idea behind the project was to expand the boundaries of the domain of chat-bot and to create a base for further development of more complex and specialized chat-bots. The chat-bot is a scalable both upwards and downwards.

Chapter 2

Requirement Analysis

This chapter discusses the core philosophy behind the project. This part plays an important role from feasibility to design of the project. This part lays the road-map for the project.

2.1 Background

In 1950, Alan Turing's famous article "Computing Machinery and Intelligence" was published, which proposed what is now called the Turing test as a criterion of intelligence. This criterion depends on the ability of a computer program to impersonate a human in a real-time written conversation with a human judge, sufficiently well that the judge is unable to distinguish reliablyon the basis of the conversational content alone-between the program and a real human.

2.1.1 History of Chatbot

The notoriety of Turing's proposed test stimulated great interest in Joseph Weizenbaum's program ELIZA, published in 1966, which seemed to be able to fool users into believing that they were conversing with a real human. Elizas key method of operation (copied by chatbot designers ever since) involves the recognition of cue words or phrases in the input, and the output of corresponding pre-prepared or pre-programmed responses that can move the conversation forward in an apparently meaningful way (e.g. by responding to any input that contains the word 'MOTHER' with 'TELL ME MORE ABOUT YOUR FAMILY'). Thus, an illusion of understanding is generated, even though the processing involved has been merely superficial. ELIZA showed that such an illusion is surprisingly easy to generate, because human judges are so ready to give the benefit of the doubt when conversational responses are capable of being interpreted as "intelligent. Interface designers have come to appreciate that humans' readiness to interpret computer output as genuinely conversationaleven when it is actually based on rather simple pattern-matchingcan be exploited for useful purposes.

The Turing test (Fig 2.1), developed by Alan Turing in 1950, is a test of a machine's ability to exhibit intelligent behavior equivalent to, or indistinguishable from, that of a human. Turing proposed that a human evaluator would judge natural language conversations between a human and a machine designed to generate human-like responses. The evaluator would be aware that one of the two partners in conversation is a machine,

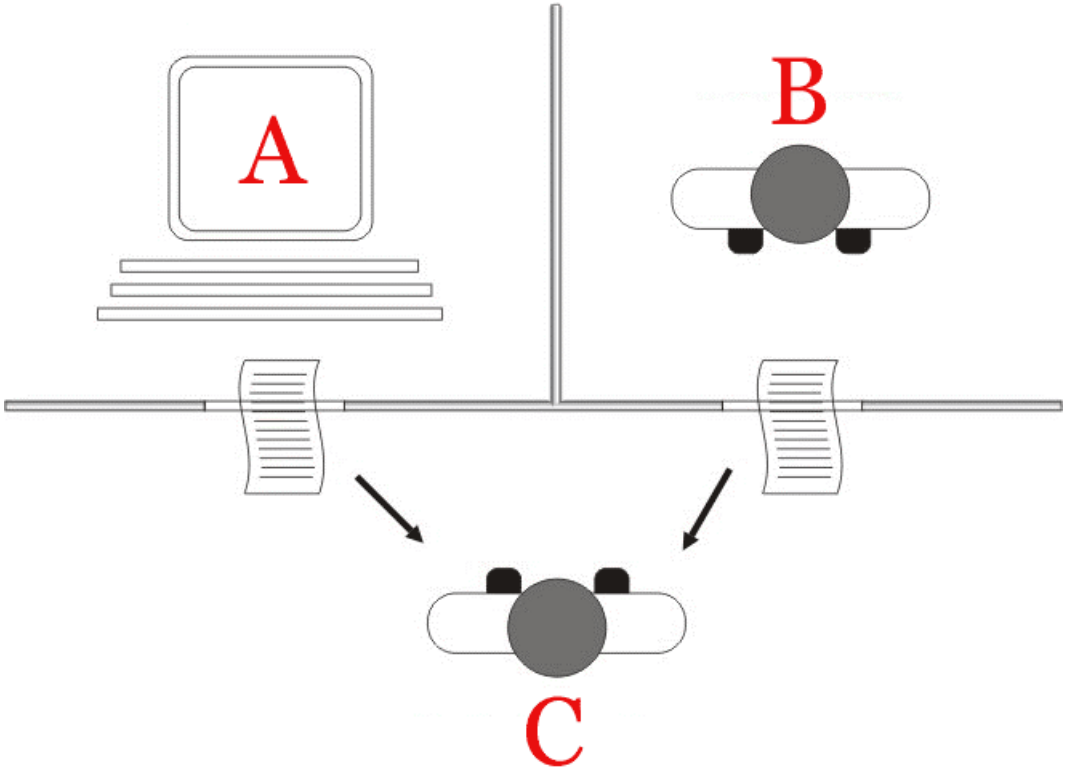

Figure 2.1: The ”standard interpretation” of the Turing test

and all participants would be separated from one another. The conversation would be limited to a text-only channel such as a computer keyboard and screen so the result would not depend on the machine's ability to render words as speech. If the evaluator cannot reliably tell the machine from the human, the machine is said to have passed the test.

2.1.2 Research Findings for Existing Literature

Table 2.1: Research Papers

S.No	Roll Number	Name	Paper Title	Tools/ Technology	Findings	Citation
1	101503154	Pahulmeet Singh	How Do You Want Your Chatbot? An Exploratory Wizard-of-Oz Study with Young, Urban Indians	AIML, Turing Test	users wanted a chatbot like Maya, who could add value to their life while being a friend. But they also wanted preferred traits of Ada and Evi infused into Maya.	[30]
2	101503154	Pahulmeet Singh	Toward an Ontology-Based Chatbot Endowed with Natural Language Processing and Generation	Natural Language Processing, Natural Language Generation, Semantic Web	improve the recognition by using well-known and efficient algorithms in order to gain more precision, to spot complex and ambiguous resources, and to be able to diversify given answers.	[10]
3	101503154	Pahulmeet Singh	A Chatbot as a Novel Corpus Visualization Tool	AIML, Natural Language Processing, Natural Language Generation, Semantic Web, Turing Test	possible to use the chatbot tool as a visualization process of a dialogue corpus, and to model different chatbot personalities.	[27]

4	101503154	Pahulmeet Singh	RMRSBot Using Linguistic Information to Enrich a Chatbot	NPC, AIML	To reduce the costs of the manual development, AIML authors use simple regular expression operators, what in turn leads to the problem of being overly permissive.	[16]
5	101503154	Pahulmeet Singh	Creating a Conversational Interface Using Chatbot Technology	Artificial Intelligence Markup Language (AIML), Pattern matching, Command line interface (CLI)	chatbot technology in which pattern matching is used to interpret the users input and templates are used to provide the systems output	[21]
6	101503154	Pahulmeet Singh	Implementation of ALICE chatbot as domain specific knowledge bot	ALICE bot,AIML, Web Crawler	A chatbot is one of the easiest way to fetch information from a system without having to think for proper keywords to look up in a search engine or browse several web pages to collect information	[23]
7	101510061	Ravijit Singh Ramana	Extracting Chatbot Knowledge from Online Discussion Forums?	SVM classifier	SVM ranks the pair of input and response efficiently well	[13]
8	101510061	Ravijit Singh Ramana	Computing Machinery and Intelligence	Turing Test	Differentiation of Machine and Human being.	[32]

9	101510061	Ravijit Singh Ramana	Survey on Chatbot Design Techniques in Speech	NLP, NLTK, SQL.	The techniques of Chatbot design are still a matter for debate and no common approach has yet been identified.	[2]
10	101510061	Ravijit Singh Ramana	An Investigation of Chatbot Technology in Distance Education	Freudbot, AIML	Psychological advantage which benefit the student performance	[12]
11	101510061	Ravijit Singh Ramana	Using dialogue corpora to train a chatbot	Dialogue Diversity Corpus, AIML	No standards in mark-up and annotation practices	[26]
12	101510061	Ravijit Singh Ramana	TensorFlow: A System for Large-Scale Machine Learning	Parameter Server Systems	Deep neural networks have achieved breakthrough performance on computer vision tasks such as recognizing objects in photographs	[1]
13	101510065	Rishabh Bassi	A Web-based Platform for Collection of Human-Chatbot Interactions	evaluation; annotations; crowd source.	Webchat, the first crowd-source initiative to collect and annotate human chatbot interactions	[18]
14	101510065	Rishabh Bassi	AI BASED CHATBOT	AIML, DOM	Technology like computer algebra systems, multimedia presentations or chatbots can serve as amplifiers but not replace a good guide	[11]

15	101510065	Rishabh Bassi	Commercial Chatbot: Performance Evaluation, Usability Metrics and Quality Standards of Embodied	SPSS and other statistical metrics	emphasizes the importance of a multidimensional evaluation of any commercial chatbot deployment.	[17]
16	101510065	Rishabh Bassi	Review of integrated applications with AIML based chatbot	Artificial Intelligence Markup Language (AIML)	great business field to manage customer using machine intelligence with more flexible and efficient ways	[25]
17	101510065	Rishabh Bassi	Chatbot Evaluation and Database Expansion via Crowdsourcing	Python, TickTock, SQL	feasible to use the crowd sourcing platform for system evaluation	[35]
18	101510065	Rishabh Bassi	Methods for chatbot detection in distributed text-based communications	NLTK, SPSS.	there is no surefire strategy to distinguish with absolute certainty whether a communicator is a person or a computer	[20]
19	101510068	Rohan Piplani	Internet of Things (IoT): A vision, architectural elements, and future directions	RFID, Cloud Computing.	a framework enabled by a scalable cloud to provide the capacity to utilize the IoT	[9]
20	101510068	Rohan Piplani	Securing IoT for smart home system	Logic Gates Networking	Entering device ID, pre-shared secret key and AP name by hand as a safety measure	[24]
21	101510068	Rohan Piplani	Different measurements metrics to evaluate a chatbot system	glass box, black box	Evaluation should be adapted to the application and to user needs.	[29]

22	101510068	Rohan Piplani	ALICE Chatbot: Trials and Outputs	AIML; corpus; machine learning	Chatbots as tools to practice different languages, to visualize corpus, and to provide answers for questions.	[3]
23	101510068	Rohan Piplani	A Survey of Chabot Systems through a Loebner Prize Competition	AIML, SQL	no game changing breakthrough in the chatbot technologies	[6]
24	101510068	Rohan Piplani	A Corpus-based approach to generalizing a chatbot system	corpus, machine learning	successful automation of production of chatbots	[28]

2.1.3 The Problem Identified

The major problem in almost all bots is lack of natural human like voice and responses.as most bots are unable to pass the Turing test. For even a casual user will often expose its mechanistic aspects in short conversations. These mechanical aspects of the bot always hold them back. Another problem that has been identified is lack of chat-bots that have the ability to answer technical questions and lack of corpora for the same. The biggest problem is lack of properly annotated corpora for chatbot.

2.1.4 Survey of Tools and Technologies Used

Raspberry pi: To make the bot portable we had to use a CPU which is small in size to make it handy,

i **Mic**: To convert the analog voice to digital which can feed to our model for predicting the answer

ii **Speaker**: To tell the answer to a query which was asked.

iii **Camera**: For taking pictures to recognize objects.

iv **Google Cloud Services**: Since raspberry does not have much computational powers so we had to rely on virtual computers for computation of such powerful models.

v **Python**: To make a TTS and STT engine and also the machine learning model.

vi **Flask/Django**: For making a localhost server on which face recognition model will run and it will produce a json type output.

vii **Ngrok**: Its a tunneling software and it will return the json file to the google cloud so that it can be used by our STT engine running on google cloud to speak the output.

2.2 Standards

A technical standard is an established norm or requirement in regard to technical systems. It is usually a formal document that establishes uniform engineering or technical criteria, methods, processes, and practices.

2.2.1 IEEE Standards

The Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA) is an organization within IEEE that develops global standards in a broad range of industries, including: power and energy, biomedical and health care, information technology and robotics, telecommunication and home automation, transportation, nanotechnology, information assurance, and many more.

2.2.1.1 IEEE 802.11

It is a set of media access control (MAC) and physical layer (PHY) specifications for implementing wireless local area network (WLAN) computer communication, They are the world's most widely used wireless computer networking standards, used in most home and office networks to allow laptops, printers, and smartphones to talk to each other and access the Internet without connecting wires. The 802.11n standard has a maximum raw data rate of 11 Mbit/s, and uses the same media access method defined in the original standard. This standard uses DSSS modulation. Devices using 802.11n experience interference from other products operating in the 2.4 GHz band.

2.2.1.2 IEEE P7006 : Standard for Personal Data Artificial Intelligence (AI) Agent

This standard describes the technical elements required when developing AI ethically and also keeping a human involved in all decision making. This will ensure that personal data use remains transparent even when an AI agent is being used. In order to enable ethics-based AI, individuals will require the means to influence and determine the values, rules and inputs that guide the development of personalized algorithms and Artificial Intelligence. They will need an agent that can negotiate their individual rights and agency in a system of shared social norms, ethics and human rights that also foresee and helps the individual mitigate ethical implications of data processing. This approach will enable individuals to safely organize and share their personal information at a machine-readable level and enable a personalized AI to act as a proxy for machine-to-machine decisions.

2.2.1.3 IEEE 802.15.1 : Standard for Bluetooth Devices

The lower transport layers (L2CAP, LMP, Baseband, and radio) of the Bluetooth wireless technology are defined. Bluetooth is an industry specification for short-range RF-

based connectivity for portable personal devices. The IEEE has reviewed and provided a standard adaptation of the Bluetooth Specification v1.1 Foundation MAC (L2CAP, LMP, and Baseband) and PHY (Radio). Also specified is a clause on SAPs which includes an LLC/MAC interface for the ISO/IEC 8802-2 LLC. Also specified is a normative annex which provides a Protocol Implementation Conformance Statement (PICS) proforma. Also specified is an informative high level behavioral ITU-T Z.100 Specification and description language (SDL) model for an integrated Bluetooth MAC Sublayer.

2.2.1.4 SAE CRB 1-2016 - Managing the Development of Artificial Intelligence Software

A necessary prerequisite to moving expert systems into widespread use is to reduce the methodologies for expert system development closer to the more generally accepted software engineering techniques. It describes an alternative software life cycle model for expert system development. For these systems, a developmental cycle is articulated, and each phase of the cycle described. This is followed by the management controls necessary to track system development, recommendations, and areas requiring future study. The focus of the earlier life-cycle phases should be on refining system requirements, not on development. The concept exploration and demonstration/validation phases should be moderately unconstrained with system requirements. The intent of this report is to serve as a baseline for the tailoring and development of expert system software.

2.2.1.5 INCITS/ISO/IEC 2382-28:1995[R2011] Information Processing Systems

Standardization work is in now underway to support AI and its applications. The newly formed international standardization committee on artificial intelligence (AI) International Organization for Standardization / International Electrotechnical Commission (ISO/IEC) Joint Technical Committee (JTC) 1, Information Technology, Subcommittee (SC) 42 is intended to serve as the focus for ISO/IEC JTC 1s standardization program on AI as well as provide underlying support to other committees

2.3 Software Requirement Specifications

A software requirements specification (SRS) is a description of a software system to be developed. It is modeled after business requirements specification (CONOPS), also known as a stakeholder requirements specification (StRS). The software requirements specification lays out functional and non-functional requirements, and it may include a set of use cases that describe user interactions that the software must provide.

2.3.1 Introduction

A chatbot (sometimes referred to as a chatterbot) is a computer program that attempts to simulate the conversation or ”chatter” of a human being via text or voice interactions. A user can ask a chatbot a question or make a command, and the chatbot responds or performs the requested action.

2.3.1.1 Purpose

Computer programs which can have real conversations are known as chatbots. A chat interface allows chatbots to converse with users. Chatbots can be used with almost all popular messaging apps. These bots can be given distinct personalities as well. Chatbots can understand written and spoken text and interpret its meaning. The bot can then look up relevant information and deliver it to the user. Most modern smartphone apps rely on chatbots to function. A robot will be developed that integrates the features of chatbot and uses the advanced technical knowledge of Stack Overflow to answer complex queries related to programming. To add upon, the robot will be capable to communicate with the environment using IOT as the medium. The robot shall use object detection and object detection to personalize the experience for different users, which feels like the bot has its own personality [7]

2.3.1.2 Product Scope

The bot would try to bridge the gap between non-living entity (INTERNET) and the living entity (USER), by being more intuitive and intelligent in its responses which would make user think of the Internet as a living entity. The bot develops a personalized environment for the user. The end result is a robot that behaves just like a normal human being with abundant knowledge.

2.3.2 Overall Description

The project has been developed as a basic structure to create a generic or a specialized chat-bot. It has a use case as a programming query resolver chat-bot.

2.3.2.1 Product Functions

It is a very basic chatbot that performs all the tasks any chatbot should perform. While the stand out function is its ability to answer technical questions related to programming. It also implements machine learning and IoT.

2.3.2.2 Operating Environment

The only requirement for operation of the bot is a stable internet connection to retrieve information from website/database.

2.3.2.3 Design and Implementaions Constraints

Creating a chatbot able to answer every single question is not possible to implement with current technology and within the duration of the project, so the system will be able to answer questions about limited topics. The system will only support questions in standard English language.

2.3.2.4 Assumptions and Dependencies

Most project development will be done using Python. Jasper an open source platform for developing always-on, voice-controlled applications will be used. All the hardware devices to be connected to the Pi should support it.

2.3.3 Other Nonfunctional Requirements

In systems engineering and requirements engineering, a non-functional requirement (NFR) is a requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviors. They are contrasted with functional requirements that define specific behavior or functions. The plan for implementing functional requirements is detailed in the system design. The plan for implementing non-functional requirements is detailed in the system architecture, because they are usually architecturally significant requirements.

2.3.3.1 Performance Requirements

A stable internet connection with speed of more than 512kbps is required to access the websites and database for the answers. For faster response time higher internet speed might help.

2.3.3.2 Security Requirements

A secure Hyper Text Transfer Protocol Secure(HTTPS) for internet access. Secure Shell (SSH) port for programming the code on Raspberry Pi 3B ensures adequate security level.

2.3.3.3 Operability

The only requirement for operation of the bot is a stable internet connection to retrieve information from website/database.

2.3.4 Functional Requirements

In software engineering and systems engineering, a functional requirement defines a function of a system or its component, where a function is described as a specification of behavior between outputs and inputs.

2.3.4.1 Visualization

The Pi camera will suffice this need. It serves the need of an input to the image processing machine learning model.

2.3.4.2 Raspberry Pi

It would contain all the machine learning models, data and APIs, in addition to the peripherals like camera, microphone, and speaker. It will hence, perform various calculations needed.

2.3.4.3 Microphone/Speaker

They would serve as input/output respectively for the chatbot. Input would initiate the query process and output would be the response from the bot after computations.

2.3.4.4 Machine Learning Models

These models would serve as the brain to the bot. The models must be trained to answer regular questions and answers as well as technical queries. Also, object detection [33] would help the bot to interact with the surroundings. This would act as the input to the bot to use its actuators accordingly. They would hence do the main computations required.

2.4 Cost Analysis

All costs are maximum in their areas and taken into account considering best for the project.

Table 2.2: Cost Analysis

Requirements	Quantity	Cost
Raspberry Pi 3B (supplied by TIET)	1	3500
Generic USB microphone	1	500
Camera Board Module	1	1000
Power Source	1	1000
USB speaker	1	1000
Memory Card	1	-
Chassis	1	500
DC Motor	2	500
Arduino	1	-

Total Cost = Rs. 8000 approx.

Chapter 3

Methodology Used

Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge. Typically, it encompasses concepts such as paradigm, theoretical model, phases and quantitative or qualitative techniques.

3.1 Investigative Techniques

The investigative techniques used in the project are as follows.

Table 3.1: Investigative Techniques

S.No	Investigative Projects Techniques	Investigative Techniques Description	Investigative Projects Examples
1	Experimental	An organized investigation that includes a control group and is designed to test the hypothesis, includes independent and dependent variables	Deep Learning in model training and Convolution neural nets for object recognition.

3.2 Proposed Solution

Following the major outline(Fig 3.1) of the project, the model firsts asks user for a query and then using NLP, speech is converted to text which in raw form is given to our ML model. Output text is generated which is again converted to speech and returned to end user.

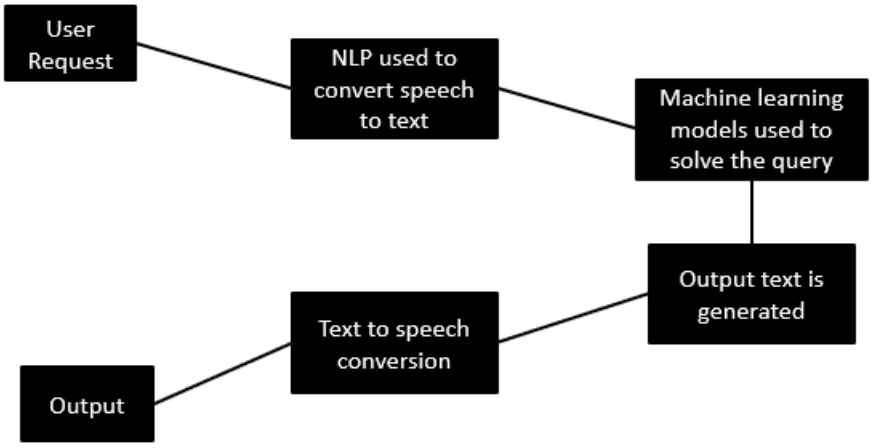

Figure 3.1: Simplified Flow

Now talking about the detailed flow(Fig 3.2) of NLP phase which gets user query as an input and converts it into text.Firstly a catch phase is used such as ”Hey AVIVA” to activate the bot. Then it starts listening to user.Using stt it converts the audio to text which is sent to machine learning model.

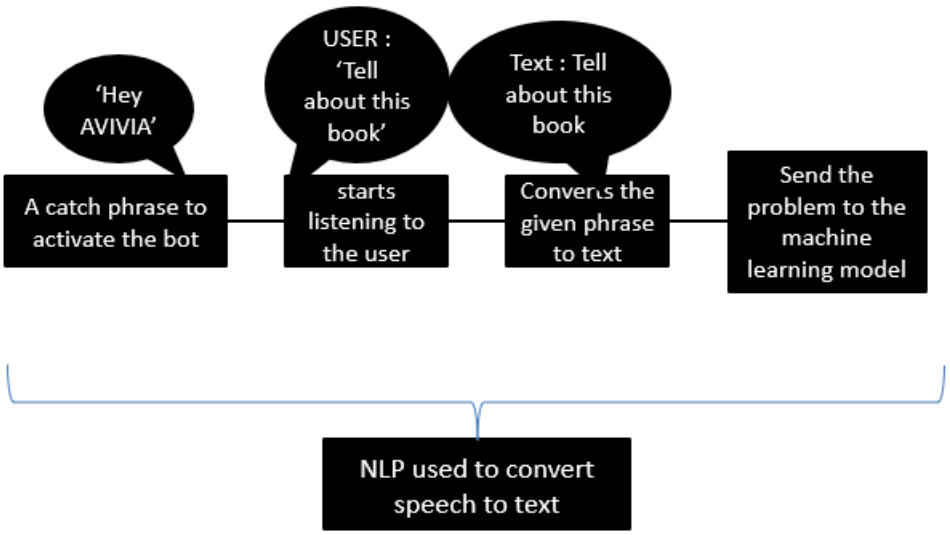

Figure 3.2: Detailed Flow NLP

The diagram in Fig 3.3 gives a great detail about the machine learning models used in our systems. Firstly raw data is converted into text from which we extract POS and tags and then these kwywords are fetched to our model which finally generates the result in the form of speakable form.

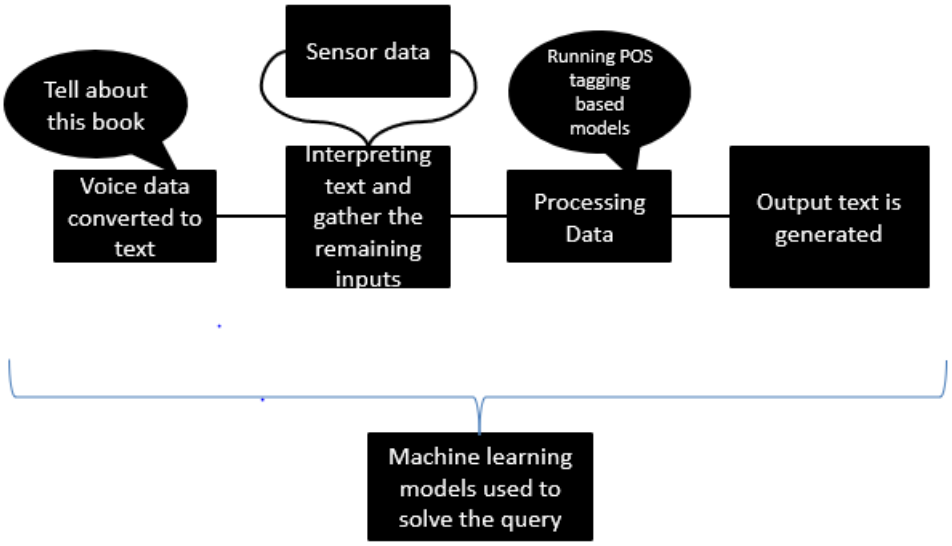

Figure 3.3: Detailed Flow ML

The diagram in Fig 3.4 gives a great detail about TTS system used. Text to Speech takes place through the standard python library called as pyaudio. It converts the given text to speakable phrase whose output is available through the speaker.

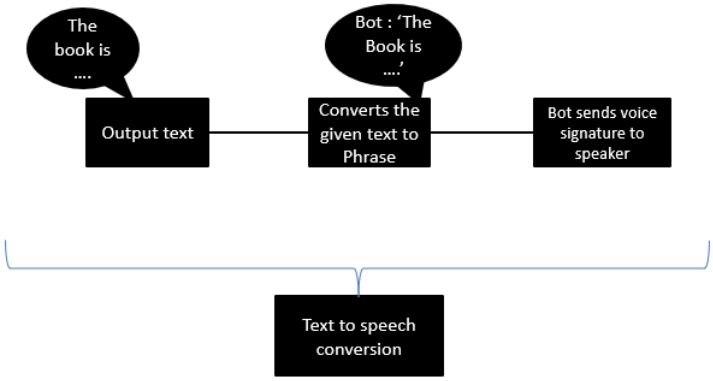

Figure 3.4: Detailed Flow TTS

3.3 Work Breakdown Structure

Dividing complex projects to simpler and manageable tasks is the process identified as Some important goals are as follows:Giving visibility to important work efforts. Giving visibility to risky work efforts. Illustrate the correlation between the activities and deliverables. Show clear ownership by task leaders. The efficiency of a work breakdown structure can determine the success of a project. The WBS provides the foundation for

all project management work, including, planning, Therefore, WBS [8] is a critical step in the process of project management as shown in Figure 3.5

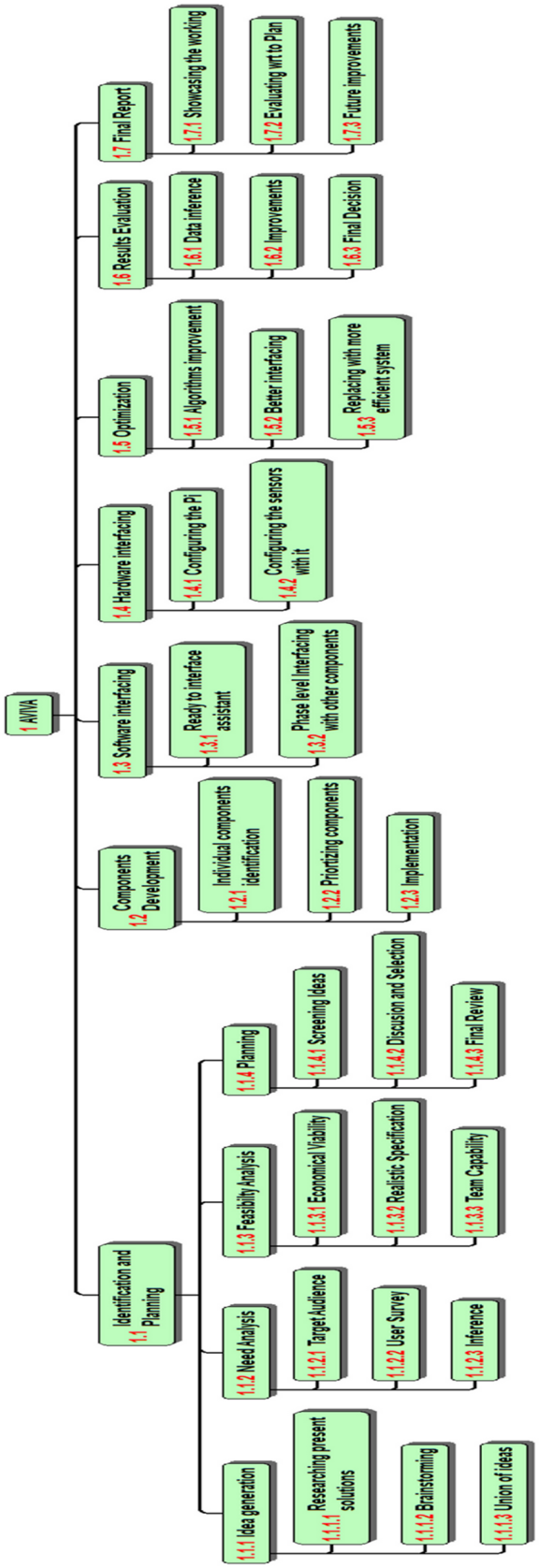

Figure 3.5: Work breakdown structure

3.4 Tools and Techniques Used

i Raspbian Os

ii RTexttools

iii R

iv Python

v RStudio

vi Creatly online platform

vii Latex

viii Vnc Viewer

ix Putty

x GTTS

xi Google Trans

xii Py Audio

xiii DialogFlow

Chapter 4

Design Specifications

This chapter discusses the design philosophy behind the project that is theoretical part of the project.

4.1 System Architecture

System Architecture(Fig 4.1) represents the complete process and steps in a nutshell. Firstly, user sends a request to the bot in the form of query in response to which some nlp operations will come into picture and keywords will be extracted and fead into machine learning model. The output keywords will be fed into language generator which will frame a proper phrase and spoken by the bot through the speaker.

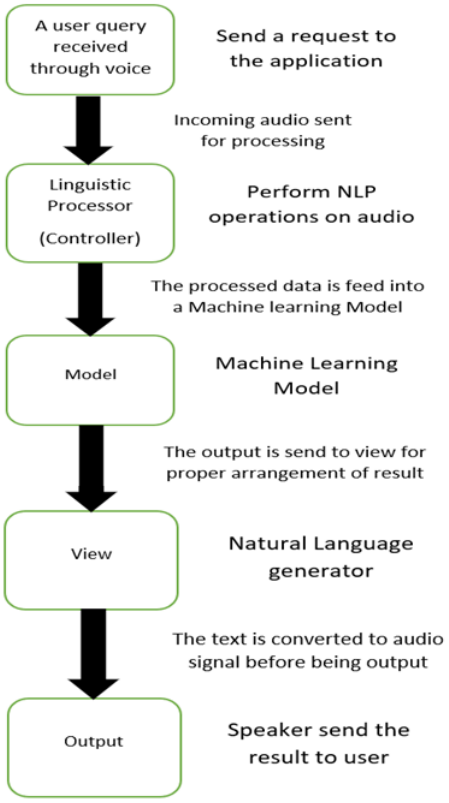

Figure 4.1: Model View Classification

4.2 Design Level Diagrams

The various design diagrams are drawn and explained in the below paragraphs.

4.2.1 Component Diagram

It represents the interconnection of components in our chatbot. Components used are Raspberry pi, Arduino, Mic, speaker chassis etc. Fig 4.2 shows various components and their interconnections as discussed.

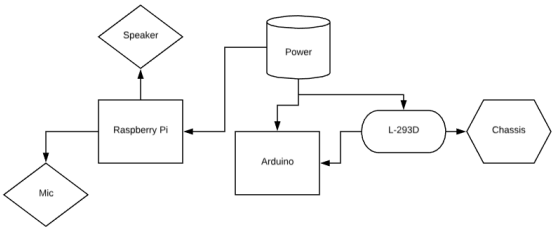

Figure 4.2: Component Diagram

4.2.2 Data Model

It represents the flow of data through the different components. Each component receives some input data which get processed according to nlp rules or machine learning model and then it passes on the data to the next stage. Fig 4.3 provides a great insight into this concept.

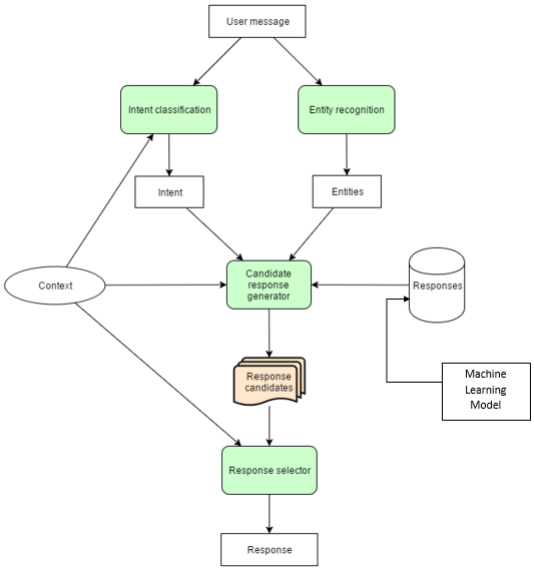

Figure 4.3: Data Model

4.2.3 User Interface Diagrams

Use case diagrams are usually referred to as behavior diagrams used to describe a set of actions (use cases) that some system or systems (subject) should or can perform in collaboration with one or more external users of the system (actors). Below is the use-case diagram (Fig 4.4) and Use case template(Table 4.1 and Table 4.2) for the project.

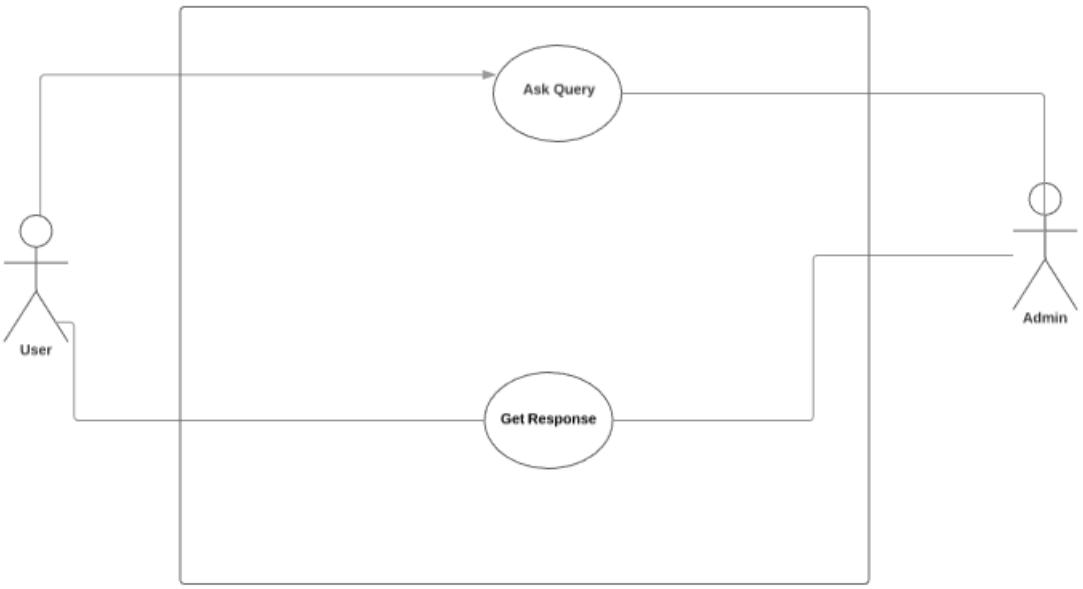

Figure 4.4: Use Case Diagram

Table 4.1: Use Case Template : User

Use Case Field	**Description**
Use Case Title	Ask Query
Use Case Id	1.0
Actors	Application user, Admin
Description	This process allows the user to ask query from the chatbot (Aviva).
Preconditions	The asked question should be feasible.
Task Sequences	The user should first ask question.
Post Conditions	Query is converted to text for further processing

Table 4.2: Use Case Template : Admin

Use Case Field	**Description**
Use Case Title	Get Response
Use Case Id	2.0
Actors	Application user, Admin
Description	This process allows the user to hear the results of the analysis performed on the query.
Preconditions	The user needs to ask a valid query from the chatbot.
Task Sequences	The analysis of query using ML and NLP.
Post Conditions	The user is provided with the results of the analysis.

4.3 Snapshots of Working Prototype Model

Below is the snapshot(Fig 4.5) of the given project.

Figure 4.5: Protoype

Chapter 5

Implementation and Experimental Results

An experiment is a procedure carried out to support, refute, or validate a hypothesis. Experiments provide insight into cause-and-effect by demonstrating what outcome occurs when a particular factor is manipulated. Experiments vary greatly in goal and scale, but always rely on repeatable procedure and logical analysis of the results. There also exists natural experimental studies.

5.1 Experimental Setup

A chatbot is a computer program, which conducts a conversation in natural language via auditory or textual methods, understands the intent of the user, and sends a response based on business rules and data of the organization.
AVIVA, being an intelligent chatbot, needs to answer questions related to programming languages. The chatbot needs to answer most commonly asked questions to Python, C++, Java, C and other basic questions. The major objective, being able to answer these questions instead of providing links to queries so this was done by creating a database and making the chatbot train on this database. Now after training, we need to keep track of where we are heading with our approach. So, to keep in check with the progress and results so far, the hardware and software was embedded into one setup and experimentation was done to test the bot on certain questions and to evaluate our work so far. Our expected end result is a bot that tries to handle small talk and, more primarily, the programming questions. In addition to this, the bot is equipped with a camera to act more intelligent around humans and recognize objects.

Apparatus required: Raspberry Pi, Wi-Fi, laptop, speakers, microphone, USB, Pi camera

Procedure: The Raspberry Pi is connected with a charging point. The speakers and microphone are connected to the connection points provided on the Pi, along with the Pi camera. The connections are pretty simple. The laptop is connected with the Pi through puTTy. The raspberry Pi has a Wi-Fi module in-built.

5.2 Expermimental Analysis

Below are explained the experimental analysis

5.2.1 Data

After testing stackoverflow dataset we realized that we have to make our custom dataset. So we build our own dataset using intent and response. We took help from geeksforgeeks, indiabix and other programming sites.

5.2.2 Performance Parameters

The parameters for a chatbot can be almost same as a humans. An example being able to understand your questions and how quick and accurate the responses are, also if the chatbot is able to answer or not at all.

i **Comprehension capabilities:** The chatbot must be efficient enough to understand and comprehend the queries of the user and even understand the user even its not grammatically correct. The bot must be smart enough to answer a question even though its asked in various ways.

ii **Speed:** The chatbot must be quick enough to handle queries and must not take forever to answer as that would make typing a better option.

iii **Scalability:** The chatbot must be scalable to different topics and work regardless of the environment

iv **Accuracy:** It is a major aspect for a chatbot, as this what the bot is all about as to how close it is to fulfill its objective of answering to queries.

5.3 Testing Process

Testing is a process rather than a single activity.Testing must be planned and it requires discipline to act upon it.The quality and effectiveness of software testing are primarily determined by the quality of the test processes used.

5.3.1 Test Plan

The test plan was designed in a way, so that we stayed in close agreement to our objectives and performance parameters.

5.3.1.1 Features to be tested

i **Small Talk:** Being a chatbot, it must answer basic questions to have an intuitive experience so that the bot feels more alive.

ii **Programming Questions**: AVIVA must handle programming questions well and try to answer most of these question on which it is trained which is the major objective of our project.

iii **Object Detection** : The bot needs to be aware of its surroundings and must be able to identify objects near it when asked.

5.3.1.2 Test Strategy

We prepared two datasets one for different programming languages and one for small talk. We tested the time time taken and tested the bot on various phrases and expressions to test the comprehension capabilities of chatbots.

5.3.1.3 Test Techniques

We divided the chatbot into three classes.The first beginner class was small talk which tested the questions about the bot and second was programming questions which was related to medium class.

5.3.2 Test Cases

The test cases were divided basically in factions, namely, small talk, programming questions and identifying objects. We tried to question the bot on various topics like C, C++, Python and have some normal chatbot questions but asked some questions in different ways to check the comprehension property of the bot.

5.3.3 Test Results

The test results were profound as the bot started to answer queries and handle small talk. It was able to identify objects when asked to and answer programming questions with precision. The bot was able to comprehend the meaning of the question and answer it. The speed was a factor which depended on the connection, which is an issue depending on the environment. Another being the noise which interrupted its functioning.

5.4 Results and Discussions

The chatbot as expected begins to answer questions related to various programming languages and also handle small talk. Not only this, it is able to detect certain objects around it. The main objective being the bot be able to answer questions instead of providing links. The results are in close agreement as to what we had expected. The chatbot answers questions related to C, C++, Java, Python, JavaScript and more basic questions. Its quite simple with the bot, as more data is provided, more intelligent it becomes. So, depending on the need, the bot can be trained in further detail and depth in a particular language.

5.5 Inferences Drawn

Based on the experimentations, we inferred that the bots can be trained on any language we want and thus, if we need it to have in-depth knowledge of a specific language or topic, we can do that with ease. The database can be increased as and when required and the bot becomes efficient enough to understand the query (in any sort the question

is asked), and it answers appropriately. This makes our project robust and user-friendly, and gives us an insight that if we want the bot to help beginners in coding and programming, it has the potential to do so, and it would be a big help for them. It can make various apps in our devices obsolete as the bot would be able to anwer questions as an expert so the user doesnt has to type in every query.

5.6 Validation of Objectives

i The project was completed in close agreement with our specified objectives and we tried to stick to them as close as possible.

ii As specified, we were able to create an intuitive experience with our bot, the way it handles queries and small talk.

iii The bot is able to answer programming questions properly and is able to recognize objects around it.

iv The bot, being equipped with the knowledge of various programming languages and small talk, can make some apps in our phones obsolete in which we try to search for questions by typing and getting the same results.

Chapter 6

Conclusions and Future Direction

The conclusion and future direction of the project has been discussed in detail in the following subsections.

6.1 Conclusions

A chatbot is a conversational agent that interacts with users using natural language. This report overviewed AVIVA chatbot in terms of the progress done in development of full-fledged chatbot. The advent of modern chatbot with the Turing test is the benchmark for a quality chatbot. The recent rise of machine learning and their usage in chatbots plays an essential role in a well-developed chatbot. The modern chatbots are all inspired from human beings so computer vision plays an all-important role. The existing system cleverbot is the present benchmark for chat bot performance. The problem with most modern chatbots lies in their mechanistic and short conversations. The present progress made in the development of AVIVA is that it is a finished project. The machine learning model has been tuned and trained and its deployment is done. Object reorganisation has been developed and its interfacing on Raspberry pi is done. We have ironed out most errors out of the system. The development of the chatbot was done with the philosophy

6.2 Environmental, Economic and Social Benefits

The chatbot, we are trying to build would be tangible i.e. a bot on wheels which gives a physical essence to an entity. The ability of the bot to respond more intuitively and intelligently would make interactions more human-like and feel less boring as the internet. The bot would be configured for object and face detection and act according to the surrounding. Thus, the bot would have a virtual personality. Since, the bot would be an expert system so it would provide more relevant to the point answers rather than popping up numerous links. The vast knowledge of the system would be a boost up to increase the knowledge-base of the user as well. Since, asking questions by talking and getting responses in the same way is considered a better approach than typing and getting links.

6.3 Reflections

The project helped the team learn a lot about social interaction skills. It helped team adhere to a strict plan and importance of communication in a team. On the technical side of things, the team developed a keen interest into IOT and furthered their understanding of object recognition. It also gave the members a taste of latex. Many more valuable advices which cannot be all named some intuitive other forced helped the group become better and more responsible developers.

6.4 Future Work

The project setups a base for further development. A base has been setup that is scalable in nature and adaptable to suit the needs of any type of chatbot. There is work to be done to implement IOT in a better way. Multi-User support can also be developed to make it more human. Proper dataset development for the chatbot can also be done.

Chapter 7

Project Metrics

Project metrics is discussed in detail in the following subsection. There are no defined maximums and minimums so everything is relative.

7.1 Challenges Faced

The team faced a lot of challenges during the project development some emotional and some technical. Communication and Leadership were major problems faced on emotional front. On technical front, the team faced problems to run the models on pi. So a performance bottleneck was present. IOT implementation needed a lot of background and configuring it to the pi was another problem. On the whole the problems faced changed the course of project and gave the team invaluable lessons.

7.2 Relevant Subjects

Many subject played crucial roles in this project but the most important are listed here :

i Machine Learning

ii Engineering Drawing - 2

iii Engineering Drawing - 3

iv Image Processing

v Deep Learning

vi Embedded System

vii Computer Networking

7.3 Interdiscpilinary Knowledge Sharing

During the course of the project members had various group sessions to discuss the feasibility and utility of the idea. The sharing of knowledge between human psychology and utilitarian thoughts helped develop the bot as it is today. The principles management

as well ancient rules of stoic helped us stick together as a team. Sharing knowledge between computational image processing and machine learning made image detection a lot better. The joint strides in embedded system and computer networking helped bring life to the chatbot and helped solve the problem of performance bottleneck.

7.4 Peer Assessment Matrix

Here we presented a Matrix on the scale of 1 (min) to 5 (max) rating of contribution of each member.
S1 = Ravijit Singh Ramana
S2 = Rishabh Bassi
S3 = Rohan Piplani
S4 = Pahulmeet Singh

Table 7.1: Peer Assessment Matrix

Evaluation By/Evaluation Of	**S1**	**S2**	**S3**	**S4**
S1	5	5	5	5
S2	5	5	5	5
S3	5	5	5	5
S4	5	5	5	5

7.5 Role Playing and Work Schedule

Below are the roles of members:

i Documentation, Ideation and Image Processing : Ravijit Singh Ramana

ii Stack Overflow tagging, IOT and Chat Bot : Rohan Piplani

iii Stack Overflow tagging, IOT and Chat Bot : Rishabh Bassi

iv Image Processing and Chat Bot : Pahulmeet Singh

Figure(Fig 7.1) shows the work plan of our capstone project.

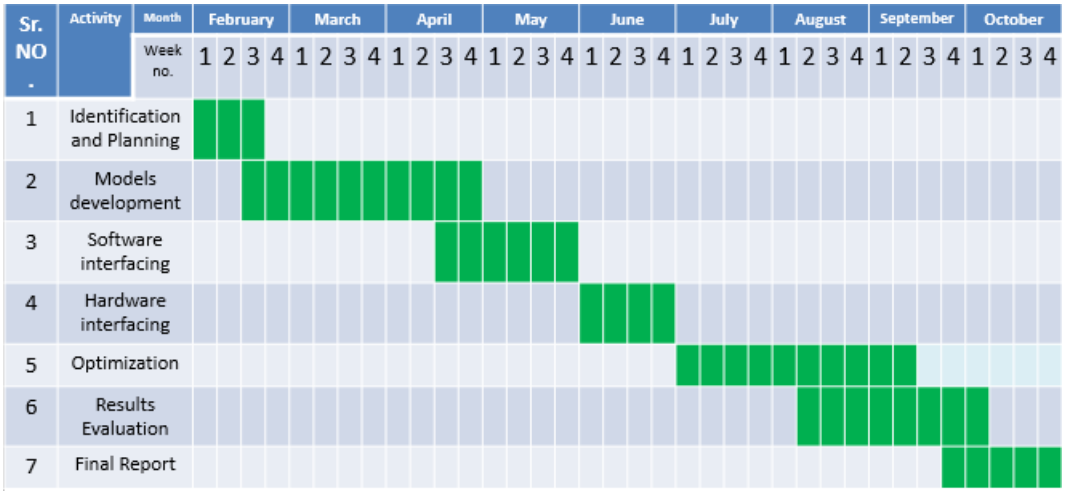

Figure 7.1: Work Plan

7.6 Student Outcomes Description and Performance Indicators (A-K Mapping)

A-K mapping for the project has been provided in a tabular form given below.

Table 7.2: A-K Mapping

S.No	Description	Outcome
A1	Applying mathematical concepts to obtain analytical and numerical solutions.	Used to train chatbot by computing the parameters for neural nets
A2	Applying basic principles of science towards solving engineering problems.	Developed idea to create a chatbot that could answer programming queries
A3	Applying engineering techniques for solving computing problems.	Developed method to improve accuracy of machine learning model used in the chatbot
B1	Identify the constraints, assumptions and models for the problems.	Used to contain the problem in a very definitive boundary
B2	Use appropriate methods, tools and techniques for data collection.	Used web scrapping and dataset normalization to improve model accuracy
C1	Design software system to address desired needs in different problem domains.	The project solves the problem endless web scrolling to get the result of programming queries
D1	Fulfill assigned responsibility in multidisciplinary teams.	Every member was assigned different roles and communicated information in bi-monthly discussion hours.
D2	Can play different roles as a team player.	Most of the time our team members helped each other if stuck on some problem
E1	Identify engineering problems.	Lack of structured base for chatbot development

E2	Develop appropriate models to formulate solutions.	The project team developed a machine learning model that was indigenous and maximized the performance of bot
E3	Use analytical and computational methods to obtain solutions.	The optimization of the model was done by using random values for parameters in various statistical models.
F1	Showcase professional responsibility while interacting with peers and professional communities.	Team conducted regular discussions with the assigned mentor in punctual manner
G2	Deliver well-organized and effective oral presentation.	Regular presentation to the panel to explain idea and the progress made were done by the team
H2	Examine economic tradeoffs in computing systems.	The team decided to rent an online server to run models as cost cutting mechanism for the project
I1	Able to explore and utilize resources to enhance self-learning.	Each member studied various online courses to implement new and effective technologies in the project
K1	Write code in different programming languages.	The members used python, R and matlab to d most of the coding. Some work was done in C++ and java as well.
K2	Apply different data structures and algorithmic techniques.	Various algorithms were used to optimize model parameters

7.7 Brief Analytical Assessment

i What sources of information did your group explore to arrive at the list of possible Project Problems? The group was aware to the understanding of the Capstone requirement and some of problems that needs to explore. We explored the literature mostly the Technical journals and Technical magazines from IEEE. The interfacing issues have been refreshed through textbooks/internet resources. However, the scope has been decided after consulting our supervisor.

ii What analytical, computational and/or experimental methods did your project group use to obtain solutions to the problems in the project? Constructing a simple and cost-effective Automated System was the most challenging task with face detection, voice recognition and web application compatibility. We have integrated various modules of time, weather, news, etc. into a single system.

iii Did the project demand demonstration of knowledge of fundamentals, scientific and/or engineering principles? If yes, how did you apply? In this technical project, we have used the principles of Machine learning and Digital Image Processing. Other skills used are Web Application Development. Design, architecture and documentation principles were taught in the subjects Software Engineering and Software Design and Construction.

iv How did your group shares responsibility and communicate the information of schedule with others in team to coordinate design and manufacturing dependen-

cies? Our team of 4 members divided the project into subtasks, each individual taking one subtask at a time. Slack a free online project management tool was used to assign tasks, deadlines and for other communication and coordination.

v What resources did you use to learn new materials not taught in class for the course of the project? We took various online tutorials, MOOCs on websites like Coursera, Udacity. Also various courses on Udemy for web application implementation were referenced, and read multiple papers and technical reports on IEEE and ResearchGate to learn new materials not taught in class.

vi Does the project make you appreciate the need to solve problems in real life using engineering and could the project development make you proficient with software development tools and environments? Our project addresses a real life problem using engineering. Working on this project has made us appreciate the need to solve real world problems and has motivated us to take up new problems in diverse fields. We were introduced to various new technologies during the course of this project like Machine Learning and various Python libraries. Working on these technologies has highly improved our proficiencies with these technologies.

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