i-Mirror
A Smart Mirror With Artificial Intelligence

Bachelor of Engineering
In
Computer Science and Engineering

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Guide
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Dissertation submitted to
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in partial fulfillment of requirement for the award of
degree of

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Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Thesis on **"i-Mirror : A Smart Mirror With Artificial Intelligence"** is a bonafide work of **Ankita Singh, Bhavika Assudani, Isha Bahendwar, Nandini Jain, Ruchit Bhardwaj, Saburi Hindaria** submitted to the Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur in partial fulfilment of the award of a Bachelor of Engineering , in Computer Science and Engineering has been carried out at the Department of Computer Science and Engineering, Shri Ramdeobaba College of Engineering and Management, Nagpur during the academic year 2017-2018.

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DECLARATION

I, hereby declare that the thesis titled **"i-Mirror : A Smart Mirror With Artificial Intelligence"** submitted herein, has been carried out in the Department of Computer Science and Engineering of Shri Ramdeobaba College of Engineering & Management, Nagpur. The work is original and has not been submitted earlier as a whole or part for the award of any degree / diploma at this or any other institution / University.

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This thesis/dissertation/report entitled **"i-Mirror : A Smart Mirror With Artificial Intelligence"** by Ankita Singh, Bhavika Assudani, Isha Bahendwar, Nandini Jain, Ruchit Bhardwaj, Saburi Hindaria is approved for the degree of Bachelor of Engineering in Computer Science and Engineering.

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ABSTRACT

Artificial intelligence (AI) is one of the oldest and best known research fields in computer science which is aimed at giving intelligence in machines. In spite of enormous effort geared towards AI, its boundary and interference to other fields are yet undefined.

Life today is fast. We need to have information on the go. With everything getting smart and interactive, exchange of knowledge and information gets easier. But a lot of our time is whiled away doing the general chores and getting ready. Imagine a scenario when you come in front of your mirror to get dressed and your own personal AI is at your disposal for a series of tasks and updates that you demand from it.

Your customised newsfeed, weather updates, and a plethora of services in the go. The Smart Mirror aims to be your interactive assistant.

This project report starts with introducing our project need and objective. It covers the information about existing projects in this field. We later talk about all the technical terms and explain briefly about Artificial Intelligence, Natural Language Understanding, Speech Recognition, Speech to Text Conversion along with wit.ai which we used to train our bot. In the later part of the report, dataflow of the module is explained along with the knowledge base. The report then talks about the working of our project followed by results and conclusion.

i-Mirror is an approach to minimize and reduce human effort and intervention that is, it gives an insight into the ever expanding world of Artificial Intelligence and interaction as is.

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CHAPTER 1. INTRODUCTION

Not a day goes by when some of us don't ponder as to how Artificial Intelligence will one day take over the reigns on this world and overpower humanity. But do we actually understand Artificial Intelligence? A very few of us do. However, we are surrounded by technology these days most of which comes equipped with artificial intelligence. To put it into more simple terms, Artificial Intelligence (AI) is the intelligence displayed by machines in contrast to the Natural Intelligence displayed by humans.

We know that life today is fast. We need to have information on the go. With everything getting smart and interactive, exchange of knowledge and information gets easier. But a lot of our time is whiled away doing the general chores and getting ready. Imagine a scenario when you come in front of your mirror to get dressed and your own personal AI is at your disposal for a series of tasks and updates that you demand from it.

Your customised newsfeed, weather updates, and a plethora of services in the go. The Smart Mirror aims to be your interactive assistant.

1.1 OBJECTIVE

- To design and prototype a device that acts as a "Smart Mirror" by providing customizable information on the display.

- To act as a conventional mirror while also superimposing informational data, which can be customized by the user.

- To allow for touch free user interaction with inbuilt voice recognition feature.

- To provide the users with the ability to create a profile and customize the visual interface to display what specific data feeds they want.

1.2 NEED OF YOUR PROJECT

Time is precious and precious things need to be saved and taken care of. Our project aims to do just that. With i-Mirror, you will be able to get updated about various topics of your interest on the go i.e. while dressing up or grooming yourself. You would not need to devote time specifically for the purpose of getting yourself up to date with what concerns you.

1.3 FEATURES

- ***Easily Accessible Data*** : Data regarding news and weather and general questions is easily accessible and is just a question or command away.

- ***Control System :*** Your voice will be your control system. You will be able to ask questions to the mirror verbally and get answers for the same.

- ***Hands Free Control*** : The main purpose of the mirror was specifically aimed at providing hands free experience along with a good interactive session during the time you spend grooming yourself. Thus, i-Mirror provides a completely hands free control.

1.4 BENEFITS

- ***Interactive****:* The proposed "Smart Mirror" can interact with the user giving the user information and updates on some topics that are asked for

- ***Customizable****:* The feeds and updates given by the mirror are completely customizable and depend upon the person standing in front of the mirror.

- ***Multitasking****:* The artificial intelligence inbuilt in the "Smart Mirror" helps it to perform various operations such as providing updates and feeds on general topic along with doing the conventional job a normal mirror

- ***User Friendly***: The application is user friendly as it enables user to operate the mirror just like another computer or any smart device.

- ***State of the Art*** *:* This futuristic approach of the proposed "Smart Mirror" helps to contribute towards modernisation and the concept of a "Smart Homes".

CHAPTER 2. REVIEW OF LITERATURE

2.1 EXISTING SYSTEMS

Many AI Enabled assistants are present currently and have been developed by big companies such as Google's Assistant, Amazon's Alexa and Apple's Siri. But none of them gives you the functionality to inform you while you are getting ready for work or grooming yourself. Also, it might happen that what these assistants say might sometimes be not understood by some people. Our i-Mirror allows you to do just the same along with displaying the text on the mirror so that the user can read it if s/he is unable to understand what is being said by the assistant.

2.2 OVERVIEW ON AI PROJECTS

The primary goals of AI projects include the application of expert knowledge, environmental perception, manipulating physical objects and natural language processing.

The approaches used to accomplish these goals include computational intelligence, machine learning, statistical methods and traditional symbolism. The tools that computer scientists use to implement these approaches include mathematical logic, search optimization and other methods based in a particular field of study. In addition to computer science, AI draws on other fields such as linguistics, mathematics, neuroscience, philosophy and psychology.

AI project is based on the concept that human intelligence can be described sufficiently precisely that a machine can simulate it. The question "What is artificial intelligence?" raises strong debate on the nature of the human mind and the ethics of endowing machines with human-like intelligence, which have been explored since antiquity.

The algorithms for difficult problems require great computing resources, especially processing speed and memory. These requirements typically experience exponential growth, meaning that many AI problems require more computing resources than are currently available. Increasing the efficiency of algorithms is therefore a high priority in AI project.

Many problems that AI machines are expected to solve require extensive knowledge of the physical world, making knowledge representation an essential element of AI project.

2.3 TECHNOLOGIES USED

1) Raspberry Pi

The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries. The original model became far more popular than anticipated, selling outside its target market for uses such as robotics. It does not include peripherals (such as keyboards, mice and cases). However, some accessories have been included in several official and unofficial bundles. It is a tiny credit card size computer. Just add a keyboard, mouse, display, power supply, micro SD card with installed Linux Distribution and you'll have a fully fledged computer that can run applications from word processors and spreadsheets to games.
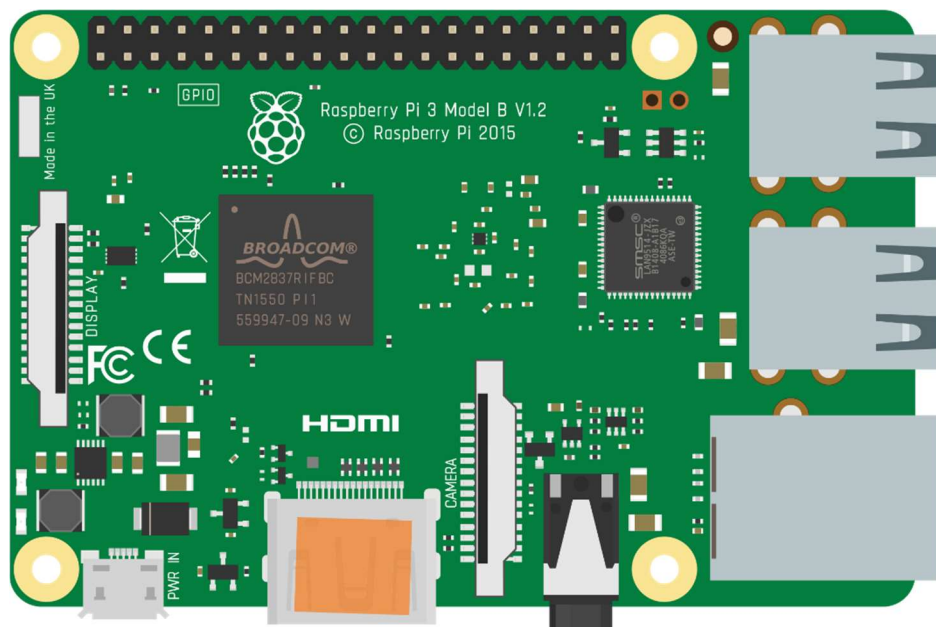

Figure 1 : Raspberry Pi Model 3 Version B

2) Python

Python is an interpreted high-level programming language for general-purpose programming. Created by Guido van Rossum and first released in 1991, Python has a design philosophy that emphasizes code readability, notably using significant whitespace. It provides constructs that enable clear programming on both small and large scales.

Python features a dynamic type system and automatic memory management. It supports multiple programming paradigms, including object-oriented, imperative, functional and procedural, and has a large and comprehensive standard library.

Python interpreters are available for many operating systems. CPython, the reference implementation of Python, is open source software and has a community-based development model, as do nearly all of its variant implementations.

3) Google Speech API

Google Cloud Speech API enables developers to convert audio to text by applying powerful neural network models in an easy to use API. The API recognizes over 80 languages and variants, to support your global user base. You can transcribe the text of users dictating to an application's microphone, enable command-and-control through voice, or transcribe audio files, among many other use cases. Recognize audio uploaded in the request, and integrate with your audio storage on Google Cloud Storage, by using the same technology Google uses to power its own products.

4) Wit.ai

Wit.ai makes it easy for developers to build applications and devices that you can talk or text to. It empowers developers with an open and extensible natural language platform. Wit.ai learns human language from every interaction, and leverages the community: what's learned is shared across developers. Wit.ai API is completely free for public and private instances with no limitations on request rate. It provides a nice combination of both voice recognition and machine learning for developers.

Wit.ai has two elements to it that you set within your app –

1)   Intents

2)   Entities.

Actions are separated to use as a combined operations. It has pre-build entities like temperature, number, URLs, emails, etc. It doesn't have interaction module to directly communicate with other messenger APIs (like Facebook Messenger), but it has web service API to hook services. Wit.ai API is available for developers to use with iOS, Android, Windows Phone, Raspberry Pi, Python, C and Rust. It also JavaScript plugin for front-end developers

5) Dark Sky API

Dark Sky is a service that provides an API key which allows us to get information regarding weather, temperature, humidity wind speed along with a detailed analysis of each and every one of them.

2.4 WHY ARTIFICIAL INTELLIGENCE?

- **AI automates repetitive learning and discovery through data.** But AI is different from hardware-driven, robotic automation. Instead of automating manual tasks, AI performs frequent, high-volume, computerized tasks reliably and without fatigue. For this type of automation, human inquiry is still essential to set up the system and ask the right questions.

- **AI adds intelligence to existing products**. In most cases, AI will not be sold as an individual application. Rather, products you already use will be improved with AI capabilities, much like Siri was added as a feature to a new generation of Apple products. Automation, conversational platforms, bots and smart machines can be combined with large amounts of data to improve many technologies at home and in the workplace, from security intelligence to investment analysis.

- **AI adapts through progressive learning algorithms to let the data do the programming**. AI finds structure and regularities in data so that the algorithm acquires a skill: The algorithm becomes a classifier or a predicator. So, just as the algorithm can teach itself how to play chess, it can teach itself what product to recommend next online. And the models adapt when given new data. Back propagation is an AI technique that allows the model to adjust, through training and added data, when the first answer is not quite right.

- **AI analyzes more and deeper data using neural networks that have many hidden layers**. Building a fraud detection system with five hidden layers was almost impossible a few years ago. All that has changed with incredible computer power and big data. You need lots of data to train deep learning models because they learn directly from the data. The more data you can feed them, the more accurate they become.

- **AI achieves incredible accuracy though deep neural networks – which was previously impossible**. For example, your interactions with Alexa, Google Search and Google Photos are all based on deep learning – and they keep getting more accurate the more we use them. In the medical field, AI techniques from deep learning, image classification and object recognition can now be used to find cancer on MRIs with the same accuracy as highly trained radiologists.

- AI gets the most out of data. When algorithms are self-learning, the data itself can become intellectual property. The answers are in the data; you just have to apply AI to get them out. Since the role of the data is now more important than ever before, it can create a competitive advantage. If you have the best data in a competitive industry, even if everyone is applying similar techniques, the best data will win.

CHAPTER 3. SYSTEM ARCHITECTURE AND COMPONENTS

3.1 KNOWLEDGE BASE

A knowledge base (KB) is a technology used to store complex structured and unstructured information used by a computer system. The initial use of the term was in connection with expert systems which were the first knowledge-based systems.

The original use of the term knowledge-base was to describe one of the two sub-systems of a knowledge-based system. A knowledge-based system consists of a knowledge-base that represents facts about the world and an inference engine that can reason about those facts and use rules and other forms of logic to deduce new facts or highlight inconsistencies.

The knowledge base in our project is small describing 6 entities and various permutations and combinations of how the question can be asked, These include weather type, map type, status type, user status, wit/datetime, wit/location. Each entity houses various questions that can be asked regarding it. A snapshot of the knowledge base is given below.

Figure 2 : Knowledge Base Overview
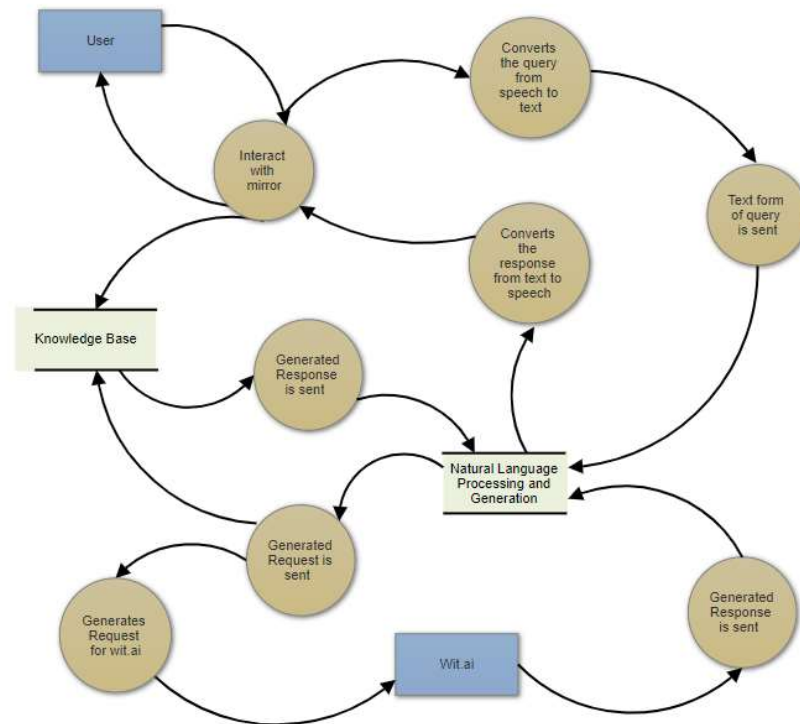
3.2 METHODOLOGY

Figure 3 : Methodology

The module consists of the following actors : User, Knowledge Base, Natural Language Generation, natural Language Processing and Wit.ai

3.3 MODULES

- *BOT Module*

The main module which interacts with every other module and communicates between then by sending the required data and collecting results is the BOT module. The major tasks of the communication process between the user and mirror are handled by it. Some of them are taking the input form user via speech recognition module and send it to the NLG module, so that we mirror can convert user commands in the form of text which can be handled in the whole process in an efficient way. This command is then sent to the knowledge base and answer to the query is obtained in the form of a JSON object. This object is further processed and presented to the user in the form of speech. In this way, the conversation goes on.

- ***Knowledge Base***

The knowledge base is a type of database maintained by any artificially intelligent machine. It learns from its experience and uses it to answer the questions. The knowledge base of this mirror contains of information about the mirror (specific) and the process by which any query can be sent to wit.ai and information can be obtained from it. The response obtained for any query is then decodes into a set of information and sent to NLG and converted into speech from text.

- ***NLG Module***

NLG module mainly consists of vocabulary, grammar and expressions for the generation of sentences. It is responsible for the generation of natural language sentences form information and vice versa. It is further used by google speech recognition for converting text to speech and speech to text in order to communication with users like humans.

- ***Speech Recognition Module***

Speech recognition module is responsible for the conversion of speech obtained by user command to text and process it further. It also converts response to any user query from text to speech. It uses mike and speakers as its tools to do so.

- ***Backend (Wit.ai)***

Training

The training of this engine goes around Stories (domain specific use cases). The tool learns conversation flows from the examples of user input and chatbot responses. As any other NLP engine, it allows to understand user input after certain training, identify Intent, extract Entities, and predict what your bot should do based on the current Context and user query.

You can train your model via web interface. The system validates every sentence against an existing model and suggests to highlight the pre-built Entities, if any. Of course, you can define your own Entities/Parameters and set possible values for all of them. Standard Parameters include location, temperature, date and time, age, URLs, emails, reminders, distance, etc.

As any other NLP engine, its functionality allows to train the model around a specific user Intent. Apart from that, bot and app developers can benefit from using pre-built models.

Among the list of pre-built Agents you will find many common ones, such as "Navigation", "Hotel Booking", "Small Talk", "Translator", "Weather", "News", etc.

If your chatbot is supposed to be fully unique in terms of dialogs, you don't need most of these agents. However, you can still import "Small Talk" module with common topics like "hello," "goodbye," "emotions," or "courtesy," and make your bot polite.

If you want to train your model manually, you can either put your phrases via web UI or import the model from .txt or .zip file. Then you'll go through the typical for NLP engines process: define Intents, Entities and programming Actions that bots should do.

Features

It is worth to mention that Dialogflow supports voice interfaces. It allows you to build the Agent that understands text and voice without additional efforts. Later, when you test your Agent you can test both text and vocal dialogs.

Platform supports about 50 different languages and is completely free of charge. At the moment, the platform supports 15 natural languages. Though we can expect the number of natural languages, pre-built models, and integrations to grow over time.

Personal impression

The platform is well-documented and has a friendly user interface. Considering the number of pre-built agents, it is really easy to start building a chatbot that fits many platforms at once. Moreover, it's a good engine to build simple or middle level chatbots or virtual assistants with voice interface.

Algorithms Used

- For Chunking, Named Entity Extraction, POS Tagging:- CRF++, HMM
- Word Alignment in Machine translation :- Maxent
- Spell Checker:- Edit Distance, Soundex
- Parsing:- CKY algorithm and other chart parsing algorithms
- Document Classification:- SVM, Navie bayes
- Anaphora Resolution:- Hobbs Algo, Lippin and Leass algo, Centering Theory
- Topic Modeling and keyword extraction:- LDA, LSI

CHAPTER 4. SYSTEM DESCRIPTION

4.1 WORKING OF THE PROJECT

For the iMirror to start, two directories, MagicMirror and AI-Smart- Mirror, which have been created are used. 'npm start' command runs or executes the file in the MagicMirror directory with an extension .json. Then in the AI-Smart- Mirror directory we activate the virtual environment created for python named 'hhsmartmirror' using- source hhsmartmirror/bin/activate. After the activation of the virtual environment we execute a python file, name bot.py, after the 'npm start' command have been executed.

When this file is executed, it runs a pre-set audio lines and a gif of a face is displayed. The AI part begins when the launch phrase. 'Ok Mirror', is said by the user which in turn activates the iMirror.

The user can ask any query to the mirror after activating it using the launch phrase. We created a knowledge base containing queries regarding holidays, snow white, user status, insult, greeting, user name, maps, weather, news, personal status, meaning of life, appearance, joke, appreciation. These fields are called as Trait Values.

Whenever a user asks a query on the above-mentioned topics, the query is taken as input in audio form. That audio is then recognised and broken down using Google Speech recognition(GSR). The GSR converts the audio into text, which is then passed to wit.ai. Wit.ai deals with machine reading comprehension and divides the input query into Intents like weather, holidays, etc. and Entities like today, next few, etc. The answer to the query is then fetched from the knowledgebase where the file knowledge.py is used. When the AI has a definitive answer for the input query, it is computed a constructed into a grammatically correct sentence. This job is done by Natural Language Generation which creates sentences like "You look beautiful today!". A file named nlg.py has all the components to this part of our project. This data or sentence is then converted into speech using Google's text- to-speech converter. The output is then played for the user using speakers. This is how one cycle of question and answer takes place. This procedure is repeated till the time user wants to keep asking questions.

4.2 PROJECT FLOW

- ***Google Speech Recognition***

Speech-to-Text enables developers to convert audio to text by applying powerful neural network models in an easy to use API. The API recognizes the language and variants, to support your global user base, and then passes the data to Wit.ai which is the NLU of our project. It processes real-time streaming audio, using Google's machine learning technology.

- ***Natural Language Understanding (NLU)***

NLU is a subtopic of natural language processing in artificial intelligence that deals with machine reading comprehension. Its applications are in the field of news-gathering, text categorization, voice-activation, archiving, and large-scale content-analysis, hence, it is used by the iMirror.

Wit is a natural language interface for applications capable of turning sentences into structured data. Wit.ai extracts the intents and entities from the text passed to it by the GSR.

For example, 'holiday' would be an intent and 'next few' would the entity for that intent. Wit.ai uses or searches the knowledgebase for answers after extracting intents from the text which was input as audio.

- ***Knowledge Base (knowedge.py)***

It is the job of the knowledgebase which is included in the knowledge.py file of our project to search for the answer of the query asked to it by the user after NLU has broken it down into intents and entities. knowlegdge.py file makes use of various links and keys in order to fetch the right answer of the user's question. For example, it uses darksky.net key in order to get the weather-related information. The correct answer to the query is then forwarded to the NLG in order to give a correct output.

- ***Natural Language Generation (NLG)***

Natural language generation (NLG) is the natural language processing task of generating natural language from a machine representation system such as a knowledge base or a logical form. It could be said an NLG system is like a translator that converts data into a natural language representation.

The nlg.py file is the vocabulary or grammar part of the project. It contains all the language related information like greetings, adverbs, salutations, etc. It forms a grammatically correct sentence using the information passed to it by the knowledgebase, i.e., it forms sentence including the answer to the query in a form to be understood by the user.
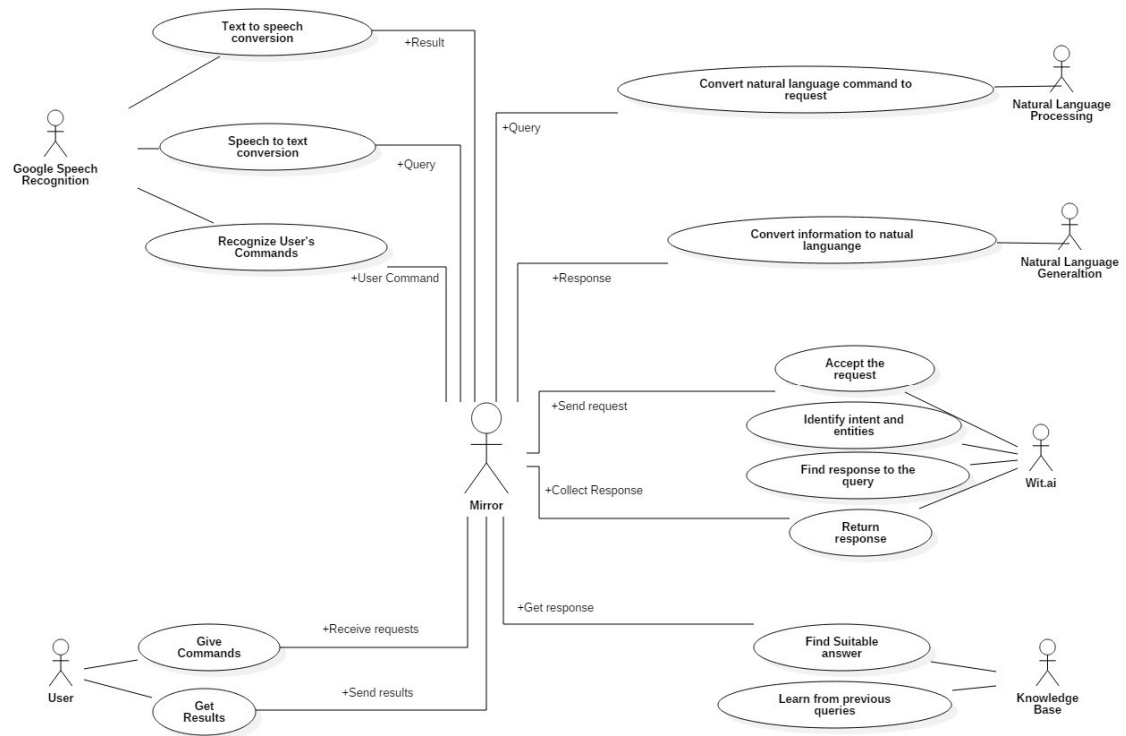
4.3 USE CASE DIAGRAM

Figure 4 : Use Case Diagram

CHAPTER 5. RESULTS

SCREENSHOTS OF THE PROJECT

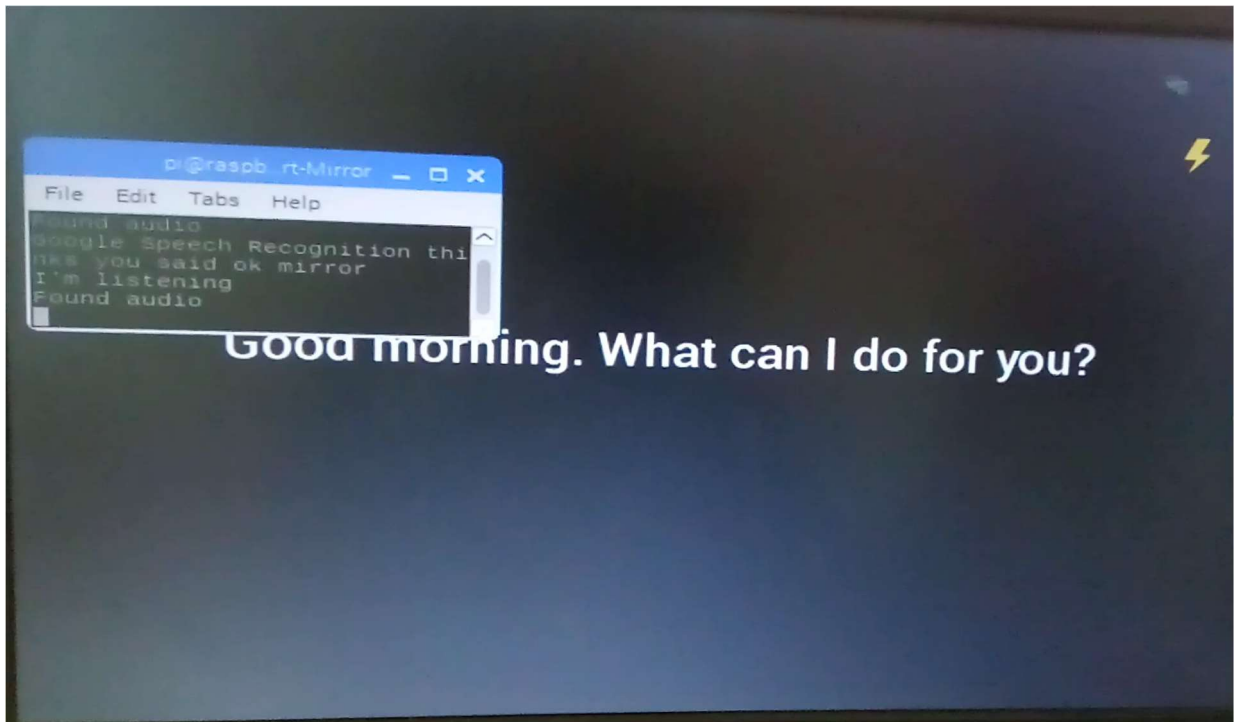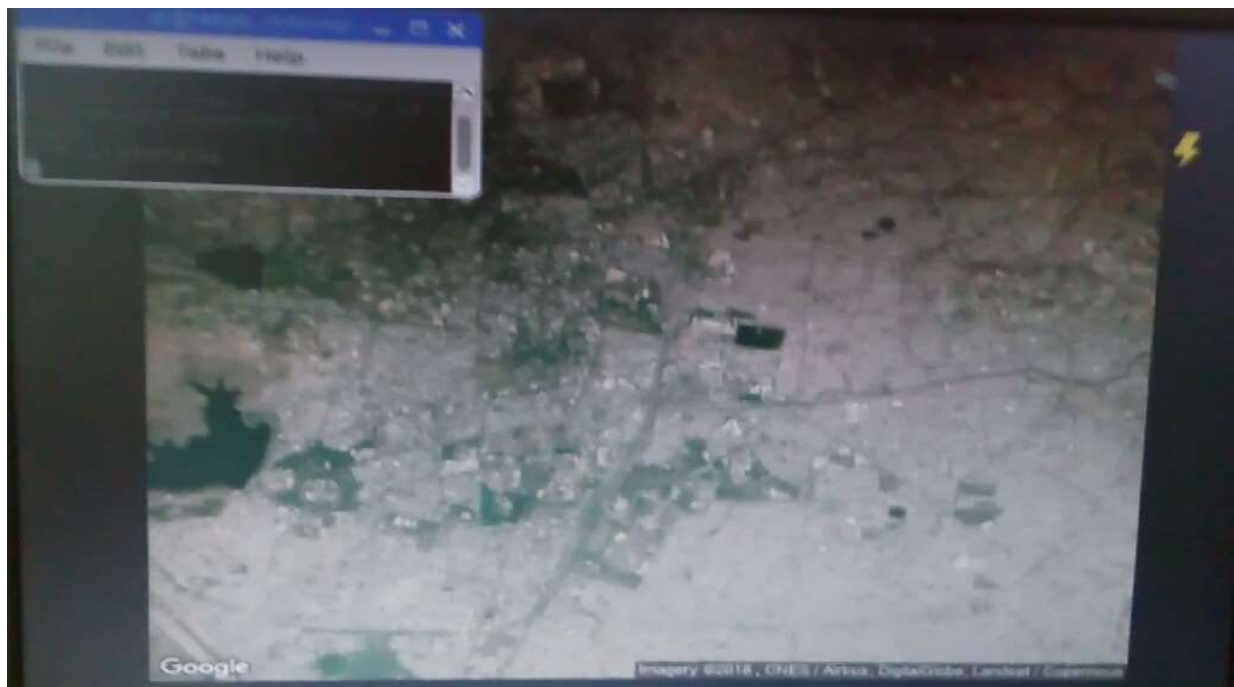
Figure 5 : Initialization

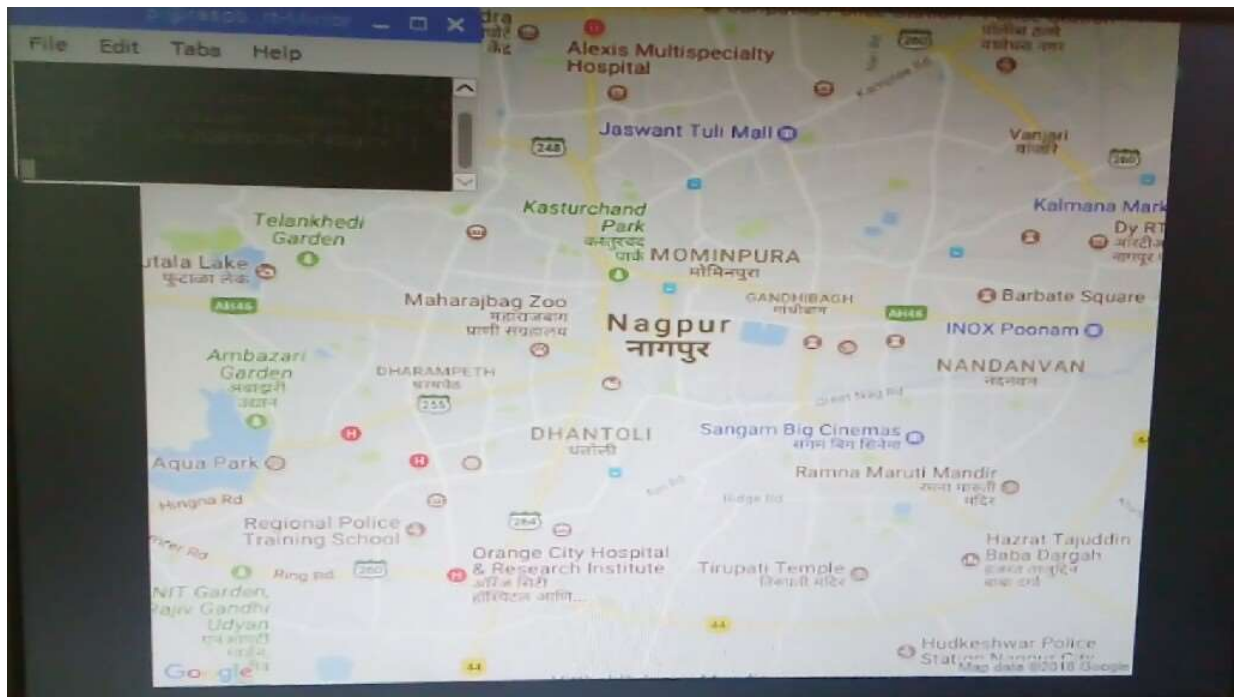Figure 6 : Terrain Map Of Nagpur
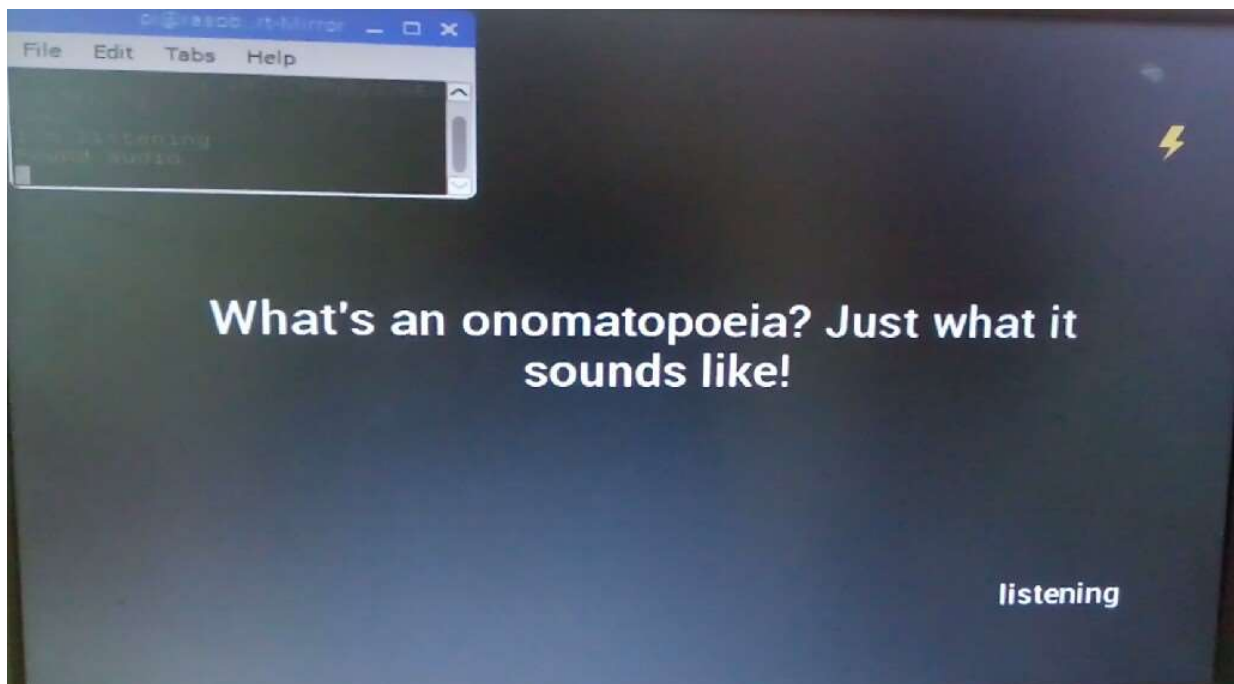
Figure 7 : Roadmap Of Nagpur

Figure 8 : Joke

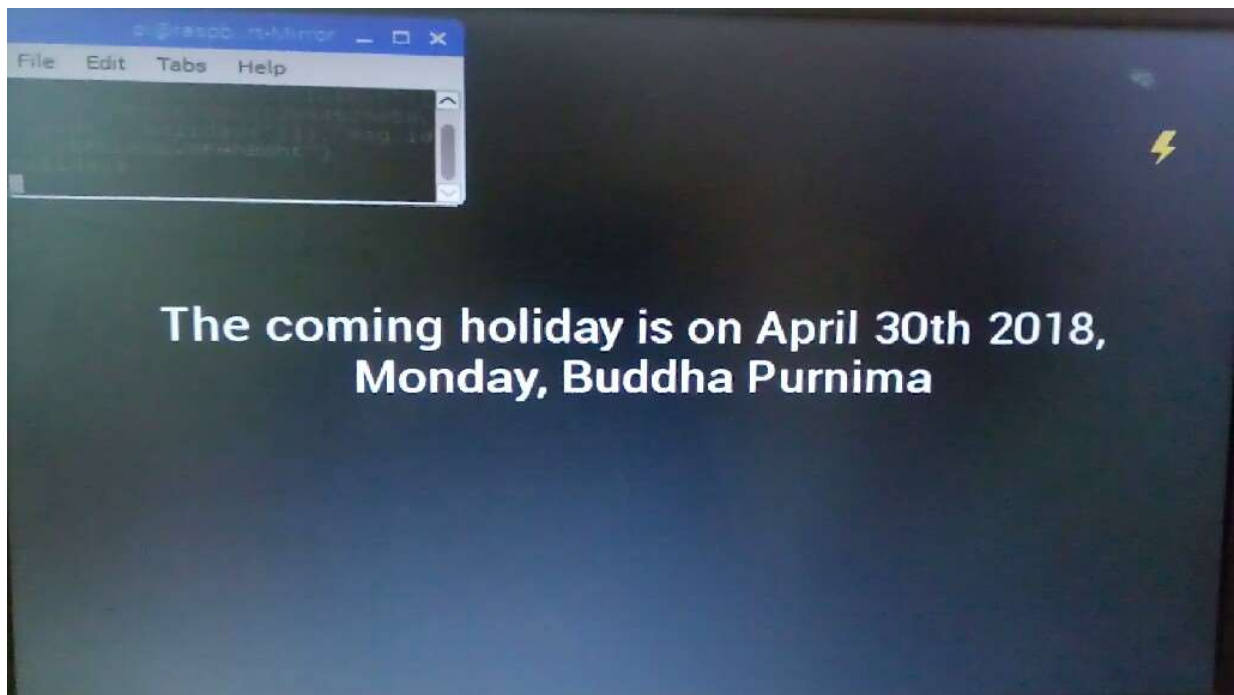Figure 9 : Weather Report

Figure 10 : News Headlines

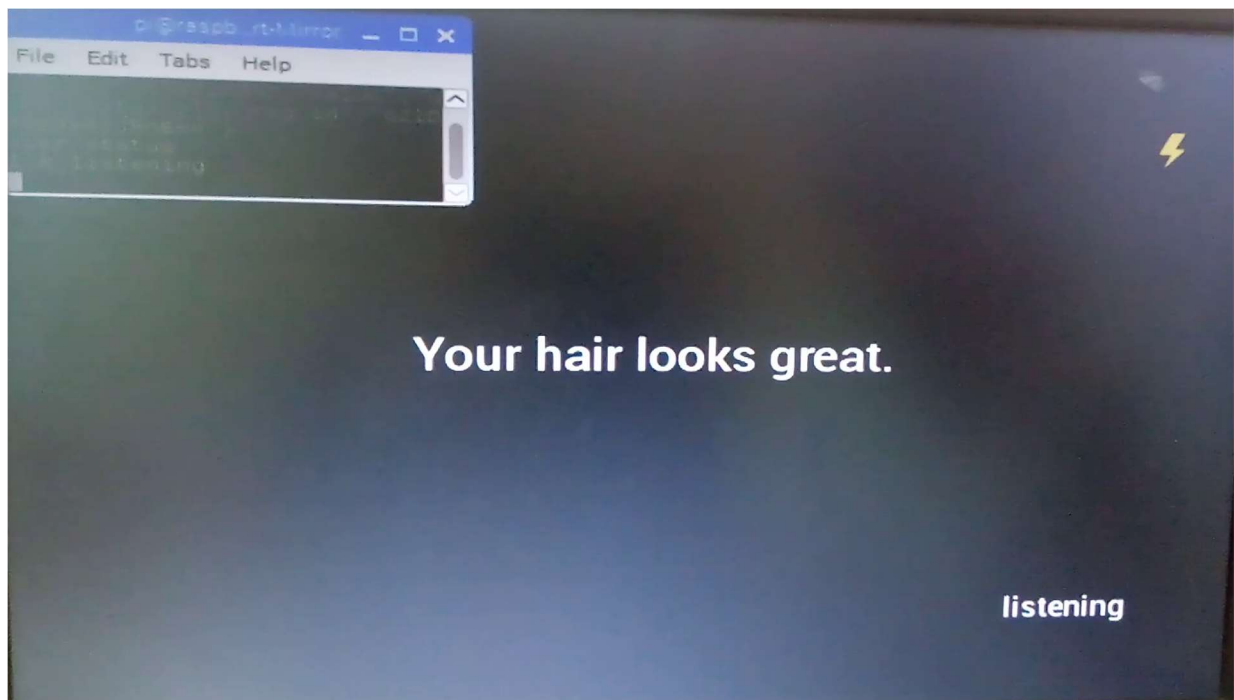Figure 11 : Details of the next Holiday

Figure 12 : Comment on Appearance

CHAPTER 6. CONCLUSION AND FUTURE WORK

6.1 FUTURE WORK

In our project we have created a Smart Mirror with a small knowledge base due to which our Smart Mirror can handle only a limited number of queries. As we have trained our mirror for small knowledge base similarly the mirror can be trained to handle a large number of queries by increasing the knowledge base gradually and we can use it as information retrieval/answering query system at many places where users can ask questions and this system can answer their queries.

Furthermore, we can include a degree of facial recognition to it which will allow the user to set up various profiles and customize the user interface accordingly. Since we have used Raspberry Pi for the accomplishment of this project, our options were limited due to the constraint in the processor specs. However, implementing it on a machine with a higher processing speed and capacity.

Expert Systems are an integral part of Artificial Intelligence. We can create an expert system specific to a certain knowledge base by training our bot to do an in depth analysis of the topic in question

6.2 CONCLUSION

Hence , in this way we have created a mirror which can interact with the user, answer his/her questions. This project would be used mainly to get daily news, weather reports, viewing locations through maps etc. by just standing in front of the mirror and interacting with it. Also, it would be an economically feasible solution as compared to other assistants present in the market as of now,

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  Key elements for human–robot joint action
  Sociable Robots and the Future of Social Relations: Proceedings of Robo-Philosophy, vol. 273

Hyperlinks

- Information about Raspberry Pi and Wit.ai

  https://www.raspberrypi.org/

  https://wit.ai/

- Tutorial files related to Knowledge Base creation and AI Creation
  https://www.zendesk.com/guide
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GUIDE APPROVAL

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Prof. V. Rathod

Project Guide