

**DEVELOPMENT OF HOME AUTOMATION SYSTEM USING VOICE  
COMMAND**

**BY**

**SHAHRIAR HOSSAIN**

**ID: 191-15-12996**

**AND**

**ASIFUR RAHMAN**

**ID: 191-15-12997**

This Report Presented in Partial Fulfillment of the Requirements for the  
Degree of Bachelor of Science in Computer Science and Engineering

Supervised By

**NISHAT SULTANA**

Lecturer

Department of CSE

Daffodil International University

Co-Supervised By

**ABU KAISAR MOHAMMAD MASUM**

Lecturer

Department of CSE

Daffodil International University



**DAFFODIL INTERNATIONAL UNIVERSITY**

**DHAKA, BANGLADESH**

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# APPROVAL

This project titled “**Development of Home Automation System Using Voice Command**”, submitted by Asifur Rahman, Id: 191-15-12997 & Shahriar Hossain, ID:191-15-12996 to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering (BSc) and approved as to its style and contents. The presentation has been held on 07 January 2023.

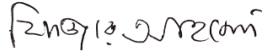
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Department of Computer Science and Engineering  
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Faculty of Science & Information Technology  
Daffodil International University

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**Dr. Md Sazzadur Rahman**  
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Institute of Information Technology  
Jahangirnagar University

**External Examiner**

## DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Nishat Sultana, Lecturer, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

### Supervised by:



**Nishat Sultana**  
**Lecturer**  
Department of CSE  
Daffodil International University

### Co-Supervised by:



**Abu Kaisar Mohammad Masum**  
**Lecturer**  
Department of CSE  
Daffodil International University

### Submitted by:



**Asifur Rahaman**  
ID: 191-15-12997  
Department of CSE  
Daffodil International University



**Shahriar Hossain**  
ID: 191-15-12996  
Department of CSE  
Daffodil International University

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## **ABSTRACT**

Home automation system has gained popularity nowadays. Considering this, we have developed a home automation system based on voice control. There are many advanced voice-controlled home automation systems like “Alexa” from Amazon, “Cortana” from Microsoft, and “Google Home” from Google available in the market but there is no machine learning approach based on machine learning which works on the CNN algorithm. This can greatly improve the convenience and efficiency of managing a home, as it allows users to control various devices and systems remotely and automate certain tasks. The accuracy of CNN is very high so we have worked on this algorithm to recognize voice commands. The system uses natural language processing techniques to interpret user inputs and perform corresponding actions on connected devices. Many algorithms work on speech recognition like VAD, SBN, PLP features, Deep neural networks, discrimination training, and WFST framework but we thought that CNN with ML will deliver more accurate results in this field. We have collected our voice dataset from the internet & processed using Python & ML. After everything, we got 81% accuracy of that dataset but we think that we can get more optimal results in the future if we can do proper use of this algorithm & ML.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

Higher-level technology developments are occurring, especially in the IoT, which may be easily integrated with home automation systems to improve daily life. Remote-controlled automation systems may be quite useful for patients who are bedridden and for those with physical limitations. Gesture-responsive systems are currently being created. These call for greater memory and quicker processing. A novel approach to home automation for patient aid is presented in this paper. Vocal commands are the only physical motions needed for this inexpensive, low-power technology to operate. An IoT-based portable automation system prototype is shown here [1]. There are programs for voice control, such as Blynk and Google Assistant. Control of the lights was part of the technological demonstration. Higher technical advancement, especially with regard to the Internet. It will discuss the current state of home automation technology, highlighting the limitations and challenges of existing systems. The introduction will then present the research question and objectives for the project, and explain how the proposed system aims to address these limitations and improve the user experience.

### 1.2 Objectives

An object-oriented approach could be used to build a home automation system that uses voice commands by defining various classes and objects to represent the different components of the system.

For example, you could define a Device class to represent the various devices that the system can control, such as lights, thermostats, and appliances. Each instance of the Device class would represent a specific device within the home and would have attributes such as its current state (on/off, temperature, etc.) and methods for controlling the device (a turn-on method for turning a light on). You could also define a Voice Control class to handle the voice recognition and command interpretation aspect of the system [6]. This class could

use machine learning algorithms and natural language processing techniques to classify vocal commands and determine their meaning. It could then use the appropriate Device objects to perform the requested actions. Overall, using an object-oriented approach can help to modularize and organize the code for a home automation system that uses voice commands, making it easier to add and modify features as needed.

### **1.3 Motivation**

Over the past few years, home automation has become more prevalent. Now everything is controlled by internet of things ever evolving technology, there have been smarter and more advanced solutions in the domain of home automation .so we are working this topic. home automation technology is very important every people.to enhance the standard of living, the appliances need to be wholly automated without any from whatsoever. This makes it possible for the user to communicate with the devices without any fuss since they learn from him and respond to his needs without him having to physically touch a button. The management of wired sensor systems is more challenging, and it also takes a lot of time to write the sensors at various locations. Another of the key benefits of automating household appliances is energy savings. hence, it's important to keep the consumer informed about how much power the controlled devices consume.

### **1.4 Expected Outcome**

- **Increased convenience:** With a voice-controlled home automation system, you can control various devices in your home with just your voice, making your home more convenient and easier to manage.
- **Improved accessibility:** Voice-controlled home automation systems can be especially useful for people with disabilities, elderly people, or those who have trouble using traditional home automation systems.
- **Increased energy efficiency:** A voice-controlled home automation system can be programmed to turn off lights, adjust temperature, and control other appliances when not in use, leading to increased energy efficiency and lower utility bills.

- **Increased security:** A voice-controlled home automation system can be integrated with security systems such as cameras, locks, and alarms, making it easier to monitor and secure your home.
- **Enhanced entertainment:** Voice-controlled home automation systems can be integrated with home entertainment systems such as smart TVs, sound systems, and gaming consoles, making it easier to control and enjoy your entertainment.
- **Cost savings:** With a voice-controlled home automation system, you can save money by reducing the need for manual intervention and manual adjustments to various devices in your home.

Overall, a voice-controlled home automation system can greatly improve the quality of life in a home, making it more convenient, efficient, and secure.

## **1.5 Project Management and Finance**

Project management and finance are critical components in the development of a home automation system using voice commands.

### **1.5.1 Project Management**

The project management plan should outline a clear scope, timelines, and budget for the project, as well as a detailed breakdown of the tasks and resources required to develop the system.

**Define the project scope:** The first step is to define the goals, objectives, and requirements of the project. This includes determining the devices and systems that will be integrated into the home automation system, as well as the voice command functionality that will be required.

**Assemble the team:** Once the project scope has been defined, the next step is to assemble a team of professionals with the necessary skills and expertise, such as software developers, electrical engineers, and project managers.

**Develop a project plan:** A detailed project plan should be created, including the timeline, budget, and resources required to complete the project. This plan should include milestones and deadlines to ensure that the project stays on track.

**Conduct market research:** It is important to research the available technologies and products that can be used to build a home automation system using voice command. This will help determine the best options for the project, as well as any potential limitations or challenges.

**Design and development:** Once the team and resources have been assembled and the project plan has been developed, the next step is to design and develop the home automation system. This may involve creating custom software, integrating various devices and systems, and testing the voice command functionality.

### **1.5.2 Finance**

A detailed financial plan should be developed to outline the costs associated with the project, including costs for research and development, software development, hardware, and testing. The financial plan should also consider as the expected revenue from sales of the system, as well as any ongoing costs associated with maintenance and support.

A budget should be established and regularly monitored to ensure that the project stays within budget and that any variances are identified and addressed in a timely manner.

Funding for the project can come from a variety of sources, such as venture capital, crowdfunding, or government grants, and it is important to consider the pros and cons of each source before deciding.

Overall, effective project management and finance are essential for the successful development of a home automation system using voice commands. By creating a detailed project management plan and financial plan, and regularly monitoring progress and costs, the project can be completed on time and within budget, with a greater chance of success.

## **CHAPTER 2**

### **BACKGROUND**

#### **2.1 Preliminaries/Terminologies**

A home automation system using voice commands can be controlled through the use of a virtual assistant, such as Amazon's Alexa, Apple's Siri, or Google Assistant. These systems can be programmed to perform a variety of tasks in the home, such as adjusting the thermostat, turning off the lights, or setting an alarm, simply by speaking to the virtual assistant. Some home automation systems are also integrated with smart home devices, such as smart lights or smart plugs, which can be controlled through voice commands as well. This type of automation system can be particularly convenient for individuals who may have difficulty with physical tasks or for those who want a more hands-free way to control their home. Some examples of these types of systems include those that are gesture-responsive or can be controlled through voice assistants like Blynk or Google Assistant. These systems often rely on advanced memory and processing capabilities to function effectively [6]. The development of an IoT-based portable automation system prototype, as described in the paper you mentioned, is an example of this type of technology in action. Such a system can potentially be used to control various aspects of a home, such as lights, through vocal commands, making it more convenient and accessible for those who may have difficulty with physical tasks.

#### **2.2 Related Work**

There has been a significant amount of research in the field of home automation systems in recent years. Some examples of related work include:

Smart home systems that use machine learning algorithms to optimize energy consumption and improve comfort levels in the home. These systems may use data from sensors and other sources to learn about the occupants' preferences and habits, and adjust the home's settings accordingly. The use of natural language processing techniques to enable voice control of home automation systems. This can allow users to issue vocal commands to

control various aspects of the home, such as turning off the lights or adjusting the thermostat. The use of sensor networks and other types of hardware to gather data about the home environment and trigger certain actions, such as turning on the lights when someone enters a room.

The development of mobile apps and web interfaces for home automation systems, which allow users to remotely control and monitor their home from their smartphone or computer. Overall, much of the related work in the field of home automation systems has focused on improving the convenience, efficiency, and intelligence of these systems through the use of advanced technologies like machine learning.

### **2.3 Competitive Studies**

There have been a number of comparative studies conducted on home automation systems to evaluate their performance and features. These studies often compare different types of home automation systems based on factors such as their cost, ease of use, reliability, and the range of features they offer. A study that compared different types of smart home systems based on their energy efficiency, cost, and usability. This study found that systems that use machine learning algorithms to optimize energy consumption were generally more effective and cost-effective than those that did not. A study that compared the reliability and security of different home automation systems [7]. This study found that some systems were more prone to security vulnerabilities or malfunctions than others, and recommended that users carefully research and compare the different options before making a purchase. A study that compared the user experience of different home automation systems, including their ease of use, user interface, and the range of features they offer. This study found that systems with more intuitive interfaces and a wider range of features were generally preferred by users.

### **2.4 Challenges**

There are several challenges that can be encountered when building and implementing a home automation system. Some of these challenges include:

- **Compatibility:** Ensuring that the different devices and systems within the home are compatible with each other and can work together seamlessly can be a challenge.
- **Security:** Home automation systems can be vulnerable to hacking or other types of cyber-attacks, which can compromise the security of the home and its occupants. Ensuring the security of the system and its connected devices is therefore an important concern.
- **Integration:** Integrating the various devices and systems within the home into a cohesive whole can be challenging, especially if the devices use different protocols or technologies.
- **Cost:** Implementing a home automation system can be expensive, as it may require the purchase of multiple devices and the installation of various types of hardware. Overall, building and implementing a home automation system can be a complex and challenging task, but the benefits it can provide, such as improved convenience and efficiency, can make it well worth the effort by speaking to a virtual assistant or using a smartphone app.

## 2.5 The Scope of the Problem

when it comes to developing a home automation system using voice commands can be broken down into several key areas:

**Natural Language Processing (NLP):** One of the biggest challenges in developing a home automation system using voice commands is understanding and interpreting the user's command. This requires advanced NLP techniques to accurately process and interpret the user's spoken language, considering different accents, dialects, and speaking styles. **Machine Learning:** Another challenge is designing the system to learn and adapt to the specific vocabulary and phrasing used by individual users. This requires the use of machine learning techniques such as reinforcement learning to improve the system's ability to understand and respond to user commands.

**Device and service integration:** Another challenge is to make the system compatible with a wide range of devices and services, including those from different manufacturers. This requires the use of open architecture and open API's to facilitate integration with third-party devices and services.

**User interface and usability:** Another challenge is to design a user-friendly interface that is easy for users to navigate and control. This requires careful consideration of the interface design and user testing to ensure that the system is intuitive and easy to use.

**Security and privacy:** A significant challenge is to protect user data and the connected devices from hacking or unauthorized access. This requires incorporating encryption, secure authentication, and other security features to protect user's data and devices.

**Scalability and maintenance:** The system should be able to handle a large number of connected devices and services, and be able to evolve over time to keep up with the latest technologies and developments. This requires regular software updates, good documentation, and customer support.

By addressing these challenges, a home automation system using voice commands can be developed that is accurate, user-friendly, compatible with a wide range of devices and services, and secure, making it a reliable and sustainable solution for controlling smart devices in the home.



## **CHAPTER 3**

### **RESEARCH METHODOLOGY**

#### **3.1 Research Subject and Instrumentation**

Voice recognition technology has been rapidly advancing in recent years, with increasing applications in various fields such as home automation, smart devices, and virtual assistants. This technology allows users to control various devices and appliances in their home using voice commands, providing convenience and ease of use. One of the main advantages of voice recognition in home automation is its ease of use.

Some benefits of home automation using voice recognition include increased convenience, improved accessibility for individuals with disabilities, and the potential for energy savings. For example, a user can control the lights, thermostat, and other devices in their home without having to physically interact with them. Additionally, voice recognition technology can be integrated with other smart home devices, such as security systems and cameras, to provide a more comprehensive and integrated experience. However, there are also some limitations to home automation using voice recognition. One major limitation is the need for a reliable internet connection, as the technology relies on cloud-based servers for processing voice commands [18].

Additionally, some users may find the technology difficult to set up and configure, and there may be issues with voice recognition accuracy in certain environments.

Home automation using voice recognition is an emerging technology with a lot of potential for improving the convenience, accessibility, and energy efficiency of homes. However, more research is needed to address the limitations and improve the overall user experience. One of the main advantages of voice recognition in home automation is its ease of use.

Users can simply speak commands to control various devices in their homes, eliminating the need for physical buttons or touchscreens. This can be particularly useful for individuals with disabilities or mobility issues, as it allows them to control devices without

the need for physical dexterity. Another advantage of voice recognition in home automation is its integration with other smart devices [7]. Many smart home devices, such as thermostats, lighting, and security systems, can be controlled through voice commands, allowing users to control multiple devices with a single command. This can also be integrated with virtual assistants, such as Amazon Alexa or Google Home, making it even more convenient for users.

However, there are also some limitations of voice recognition in home automation. One of the main limitations is the accuracy of the technology, as it may not always recognize commands correctly, leading to confusion and frustration for users. Additionally, privacy concerns have been raised regarding the use of voice recognition technology in home automation, as the technology records and stores voice commands, raising concerns about data privacy and security.

The D.C. fan and LED lights are controlled using a voice command "on/off" and the device is designed to operate in two modes, namely manual mode and voice control mode. In manual mode, the user can control the fan and lights using physical buttons or a mobile application. In voice control mode, the user can control the fan and lights using voice commands. The device uses a microphone and a voice recognition module to recognize the voice commands. The device also includes a security feature where it can only be controlled by authorized users. This can be achieved by setting up a password or using biometric authentication. The device also has a built-in speaker, which can provide feedback to the user, such as "Fan turned on" or "Light turned off. "In conclusion, the proposed home automation system using voice recognition technology allows for convenient and easy control of D.C. fans and LED lights [11]. It uses a wireless ad-hoc connection to establish communication between the front-end device and the home server, and the microcontroller implements the commands. The device also includes security features and provides feedback to the user. Further research and development can be done to improve the accuracy of the technology and to add more devices to the system. Machine

learning is a subfield of artificial intelligence that involves the use of algorithms and statistical models to enable machines to learn and improve from data. This technology has been increasingly integrated into home automation systems, allowing for more advanced and personalized control of devices. One application of machine learning in home automation is in the use of natural language processing (NLP) to improve the accuracy of voice recognition technology. NLP allows the system to understand and respond to natural language commands, rather than requiring users to use specific pre-programmed phrases [4].

**Collect and preprocess data:** Collect a large dataset of voice commands from multiple users. The data should include a variety of voices, accents, and speaking styles. Preprocess the data by removing noise, normalizing the volume, and segmenting the commands into individual words or phrases [2].

**Train the model:** Use the preprocessed data to train a machine learning model, such as a deep neural network or a recurrent neural network. The model should be trained to recognize the voice commands and predict the corresponding actions.

**Test the model:** Test the model using a separate dataset of voice commands. Evaluate the model's performance using metrics such as accuracy and F1 score. Adjust the model's parameters and retrain as necessary to improve performance.

**Integrate the model into the home automation system:** Once the model is trained and tested, integrate it into the home automation system. The system should be able to receive voice commands, send them to the model for recognition, and execute the corresponding actions.

**Continuously monitor and improve:** Continuously monitor the system's performance and collect feedback from users. Use this data to continuously improve the model's performance and adjust as necessary

This can improve the user experience, making it more intuitive and natural for users to interact with the system. Another application of machine learning in home automation is in the use of predictive algorithms to learn user behavior and preferences. This can enable the system to automatically adjust settings and make recommendations based on past actions, without the need for explicit user input. For example, the system can learn a user's preferred temperature settings and adjust the thermostat accordingly. There are five groups of voice commands, each containing up to seven commands [8]. Access, Safety, Fan, and Lighting are the command groups. Light and practical. The group name must be stated by the user, followed by the command, for the registration to be successful [10].

The Access group commands are used for controlling access to the home automation system, such as setting up a password or enabling biometric authentication. Examples of commands in this group include "Set password," "Enable biometric authentication," and "Disable biometric authentication."

The Safety group commands are used for controlling safety features, such as setting up an alarm or activating a security camera. Examples of commands in this group include "Activate alarm," "Deactivate alarm," and "View security camera."

The Fan group commands are used for controlling the D.C. fan, such as turning it on or off and adjusting the speed. Examples of commands in this group include "Turn on fan," "Turn off fan," and "Set fan speed to high."

The Light group commands are used for controlling the LED lights, such as turning them on or off and adjusting the brightness. Examples of commands in this group include "Turn on lights," "Turn off lights," and "Set brightness to 50%." The Utility group commands are used for controlling other utility features, such as setting the temperature or controlling the air conditioning. Examples of commands in this group include "Set temperature to 72 degrees," "Activate air conditioning," and "Deactivate air conditioning."

By dividing the commands into groups, it makes it easier for the user to navigate and find the specific command they are looking for. This also allows for a more organized and efficient system, as the commands are grouped according to their function. The use of voices from both male and female users ensures that the system can recognize commands from users of both genders, regardless of their age or accent. This is important, as different people may have different speaking styles, which can affect the accuracy of the voice recognition system [19].

Additionally, by using voices from users of different ages and backgrounds, the system can be trained to recognize commands from a wide range of users, including people with different accents, dialects, and speaking styles. This can improve the accuracy of the system and make it more accessible to a wider range of users.

Moreover, the use of different voices from different distances from the microphone can enhance the system to recognize the commands regardless of where the speaker is located. The system can be trained to recognize commands from speakers at different distances from the microphone, which can be useful in situations where the user is not directly in front of the microphone.

Here is a general methodology that could be followed to build a home automation system that uses voice commands:

- Identify the specific devices and actions that the system should be able to control. This could include things like lights, thermostats, appliances, and security systems.
- Define the range of vocal commands that the system should be able to recognize and interpret. This could involve identifying common phrases or keywords that users might use to control the various devices and systems within the home.
- Collect and label a dataset of voice input examples that the system will be trained on. This dataset should include a variety of different vocal commands or phrases

that the system should be able to recognize, spoken by different people in different contexts.

- Preprocess the collected data by converting it into a format that can be used by the machine learning model. This may involve converting the audio data into a spectrogram or other suitable representation.
- Train a machine learning model on the dataset to classify the vocal commands and determine their meaning. There are a variety of models that can be used for this purpose, such as hidden Markov models, support vector machines, or recurrent neural networks.
- Integrate the trained model into a system that accepts voice input and uses the model to classify the input and perform the appropriate action. This could involve using APIs or other means of communication to interact with the various.

### **3.2 Working Procedure**

Here is a general outline of the working procedure for a home automation system that uses voice commands:

- a. The user speaks a vocal command to the system, either through a virtual assistant or a smartphone app.
- b. The system captures and processes the audio input, using natural language processing techniques and machine learning algorithms to classify the vocal command and determine its meaning.
- c. The system determines the appropriate action to take based on the classified vocal command, such as turning on a light or adjusting the thermostat.
- d. The system sends a command to the appropriate device or system to perform the requested action.
- e. The device or system carries out the requested action and provides feedback to the user if necessary.

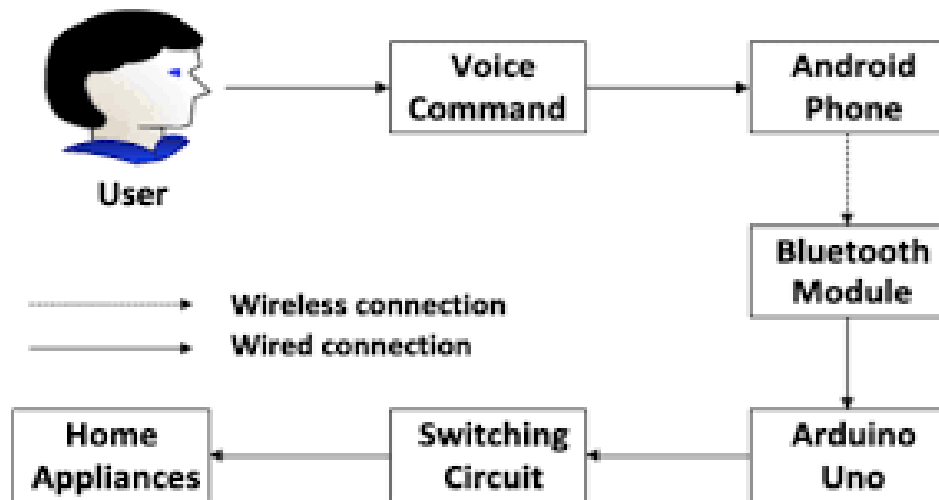


Figure 3.2.1: Home automation based on Voice recognition. [23]

### 3.3 Software Requirement

Specification for a home automation system that uses voice commands would outline the functional and non-functional requirements for the system, as well as any constraints or assumptions that need to be taken into consideration during the development process. Here are some examples of what an SRS for a home automation system that uses voice commands might include:

#### Functional Requirements:

- The system should be able to recognize and interpret a range of vocal commands, such as "turn off the lights" or "set the thermostat"
- The system should be able to control various devices within the home, such as lights, appliances, and thermostats.
- The system should be able to provide feedback to the user when a vocal command has been recognized and executed.

### **Non-Functional Requirements:**

- The system should be reliable and consistently recognize vocal commands with a high degree of accuracy.
- The system should be easy to use and have an intuitive interface.
- The system should be secure and protect against hacking or other cyber-attacks.
- The system should be energy efficient and minimize its power consumption.

### **Constraints:**

- The system must be compatible with a range of different devices and protocols.
- The system must be able to operate within the constraints of the home's existing infrastructure and hardware.

### **Assumptions:**

- The system will be accessed through a smartphone app or voice assistant.
- The system will have internet connectivity.
- The system will be installed and configured by a technician or user with technical expertise.

### **3.4 Data Pre-processing**

Preprocessing is an important step in building a home automation system that uses voice commands, as it involves converting the collected audio data into a format that can be used by the machine learning model. This can involve a variety of different tasks, such as:

- **Noise reduction:** Removing background noise or other distractions from the audio data can improve the performance of the machine learning model.
- **Feature extraction:** Extracting relevant features from the audio data, such as spectral characteristics or pitch, can help the model better understand the content of the audio.
- **Data normalization:** Normalizing the data to have a consistent scale can help the model converge faster and improve its accuracy.



- **Data augmentation:** Generating additional training data by augmenting the existing data can help the model generalize better to new examples.

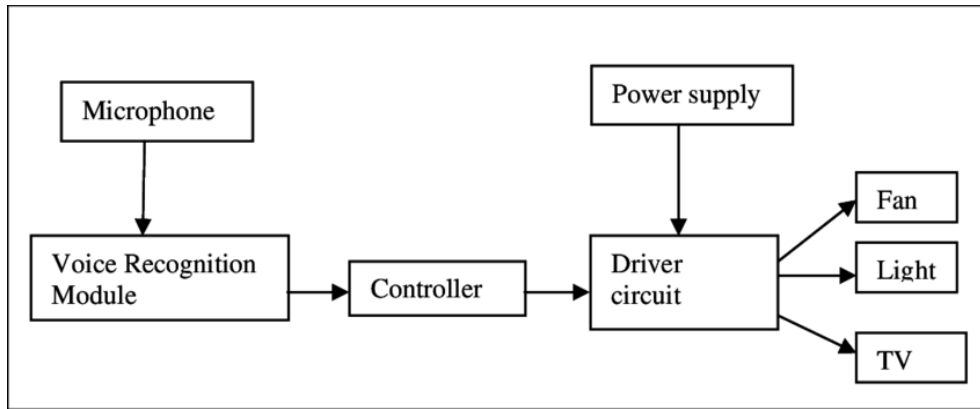


Figure 3.4.1: Block diagram of voice-controlled home appliances. [24]

### 3.5 Existing Techniques

There are several existing techniques for home automation using voice recognition, including:

- Speech Recognition:** This is a technique where the system converts spoken words into text, allowing the system to understand and respond to natural language commands. This can be done using software such as Google Voice Recognition or Amazon Alexa.
- Natural language Processing (NLP):** This technique involves using machine learning algorithms to understand and respond to natural language commands, allowing for more intuitive and natural interaction with the system.
- Voice Biometrics:** This technique uses voice recognition to identify and authenticate users, allowing only authorized users to control devices. This can be done using software such as Voiced.
- Smart Speakers:** These devices, such as Amazon Echo or Google Home, allow users to control various devices in their homes using voice commands. They also integrate

with other smart devices, such as lighting and thermostats, to provide a more comprehensive home automation experience.

- e. **Remote Control:** This technique allows users to control their devices remotely, using a mobile application or web-based interface. This allows users to control their devices from anywhere, as long as they have internet access.
- f. **Voice-enabled Devices:** This technique allows users to control devices using voice commands, using specialized devices or software such as Amazon Echo Dot or Google Home Mini.
- g. **Cloud Computing:** Cloud computing is a technique used to store and process data remotely, allowing for real-time monitoring and control of the home automation system from anywhere. This can be particularly useful for users who want to control their home automation system from a remote location.
- h. **Internet of Things (IoT):** IoT is a network of connected devices that can communicate with each other and share data. Home automation systems using voice command can be integrated with IoT devices, such as smart home devices, to provide a seamless and integrated home automation experience.

These are some of the key existing techniques used in the development of home automation systems using voice command. By leveraging these techniques, home automation systems can provide users with a convenient, efficient, and secure solution for controlling and monitoring their homes.

## **CHAPTER 4**

### **IMPLEMENTATION AND TESTING**

#### **4.1 Experimental Setup**

Here is an example of how you could use machine learning to build a home automation system that accepts voice commands:

First, you will need to collect and label a dataset of voice input examples that the system will be trained on. This dataset should include a variety of different vocal commands or phrases that the system should be able to recognize, such as "turn off the lights". Preprocess the collected data by converting it into a format that can be used by the machine learning model. This may involve converting the audio data into a spectrogram or other suitable representation. Split the dataset into training and test sets, and use the training set to train a machine learning model. There are a variety of models that can be used for this purpose, such as hidden Markov models support vector machines or recurrent neural networks [14]. Evaluate the model's performance on the test set to ensure that it is able to accurately recognize the vocal commands or phrases. Once the model has been trained and tested, you can use it to classify new audio data and determine whether it contains the keywords of interest.

#### **4.2 Implementation of Interaction**

Here are some steps you could follow to implement an interaction system for a home automation system that uses voice commands:

First, you will need to design the interaction system and define the range of vocal commands that the system will be able to recognize. This could involve identifying the specific devices and actions that the system should be able to control, as well as any additional functionality that the system should provide.

Next, you will need to implement the voice recognition component of the system. This could involve using machine learning techniques and natural language processing

algorithms to classify vocal commands and determine their meaning. Once the voice recognition component is in place, you can implement the logic for controlling the various devices and performing the actions requested by the user. This could involve using APIs or other means of communication to interact with the devices and carry out the desired actions. Test the interaction system to ensure that it is functioning correctly and is able to accurately recognize and respond to vocal commands [9]. Integrate the interaction system into the overall home automation system, including any additional features or functionality that the system provides.

Deploy the system and ensure that it is properly configured and working correctly within the home environment.

### 4.3 Feature Generation

Feature generation is a technique that can be used to improve the performance of a home automation system that uses voice commands. It involves extracting relevant features from the collected audio data that can help the machine learning model better understand the content of the audio and make more accurate predictions.

```
| 1 DATASET_PATH = 'data/mini_speech_commands'
| 2
| 3 data_dir = pathlib.Path(DATASET_PATH)
| 4 if not data_dir.exists():
| 5     tf.keras.utils.get_file(
| 6         'mini_speech_commands.zip',
| 7         origin="http://storage.googleapis.com/download.tensorflow.org/data/mini_speech_commands.zip",
| 8         extract=True,
| 9         cache_dir='.', cache_subdir='data')
```

```
Commands: ['left' 'stop' 'no' 'down' 'right' 'up' 'go' 'yes']
```

Figure 4.3.1: Data pre-processing commands.

```

1 import os
2 import pathlib
3
4 import matplotlib.pyplot as plt
5 import numpy as np
6 import seaborn as sns
7 import tensorflow as tf
8
9 from tensorflow.keras import layers
10 from tensorflow.keras import models
11 from IPython import display
12
13 # Set the seed value for experiment reproducibility.
14 seed = 42
15 tf.random.set_seed(seed)
16 np.random.seed(seed)

```

Figure 4.3.2: Data pre-processing algorithms.

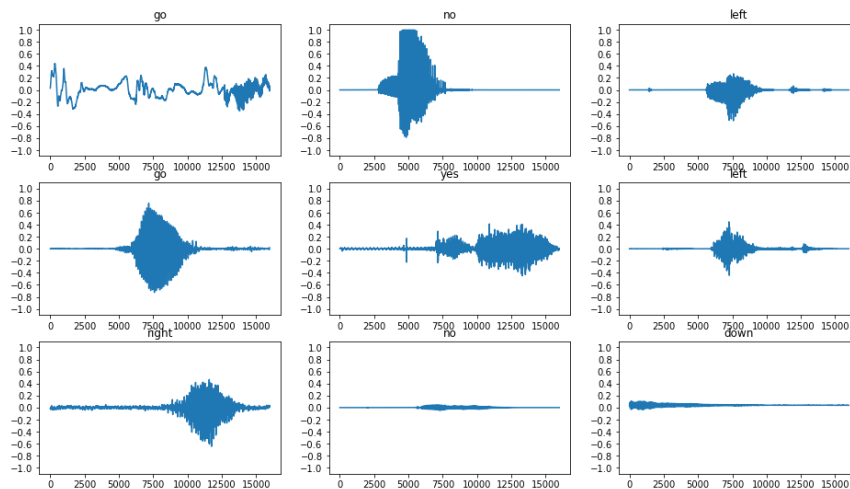


Figure 4.3.3: Audio Spectrograms.

▶ Label: no  
 Waveform shape: (16000,)  
 Spectrogram shape: (124, 129, 1)  
 Audio playback

▶ 0:00 / 0:01 ————— 🔊 ⋮

Label: left  
 Waveform shape: (16000,)  
 Spectrogram shape: (124, 129, 1)  
 Audio playback

▶ 0:00 / 0:01 ————— 🔊 ⋮

Label: go  
 Waveform shape: (16000,)  
 Spectrogram shape: (124, 129, 1)  
 Audio playback

▶ 0:00 / 0:01 ————— 🔊 ⋮

Label: yes  
 Waveform shape: (16000,)  
 Spectrogram shape: (124, 129, 1)  
 Audio playback

▶ 0:00 / 0:01 ————— 🔊 ⋮

Label: left  
 Waveform shape: (16000,)  
 Spectrogram shape: (124, 129, 1)  
 Audio playback

▶ 0:00 / 0:01 ————— 🔊 ⋮

Figure 4.3.4: Audio data input.

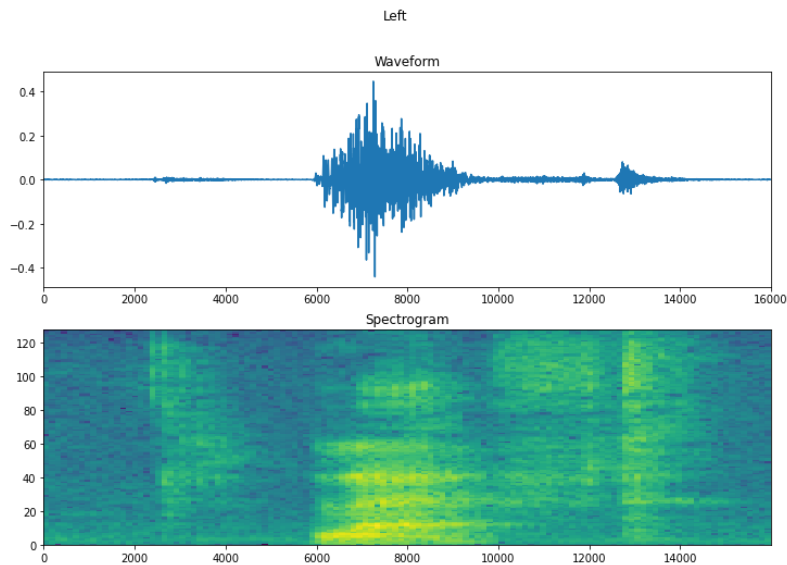


Figure 4.3.5: Audio waveform & Spectrogram.

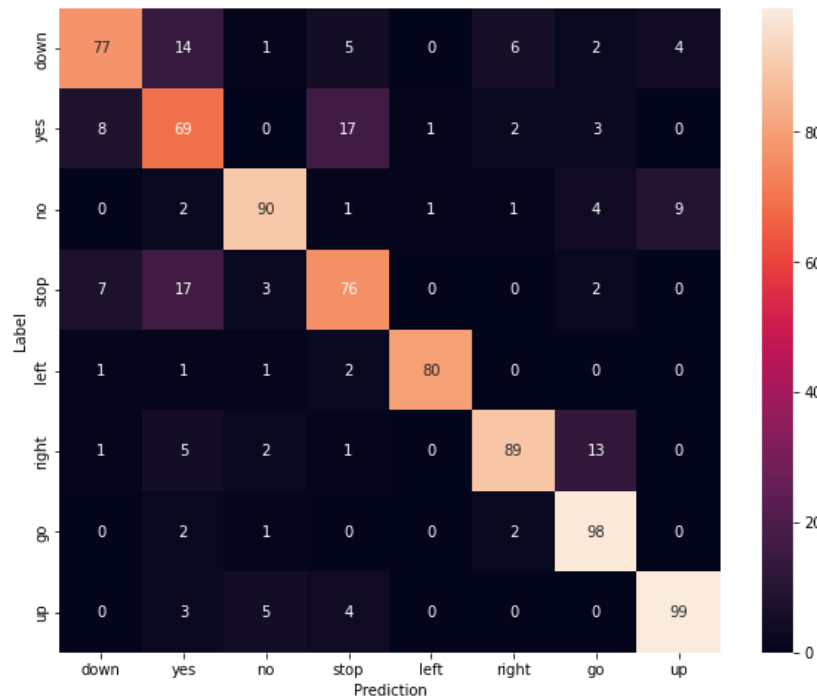


Figure 4.3.6: Data prediction.

```

Epoch 1/6
100/100 [=====] - 26s 254ms/step - loss: 1.7577 - accuracy: 0.3634 - val_loss: 1.3390 - val_accuracy: 0.5990
Epoch 2/6
100/100 [=====] - 32s 324ms/step - loss: 1.1818 - accuracy: 0.5922 - val_loss: 0.8933 - val_accuracy: 0.7539
Epoch 3/6
100/100 [=====] - 23s 233ms/step - loss: 0.8820 - accuracy: 0.6858 - val_loss: 0.7240 - val_accuracy: 0.7799
Epoch 4/6
100/100 [=====] - 24s 238ms/step - loss: 0.7266 - accuracy: 0.7409 - val_loss: 0.6552 - val_accuracy: 0.7969
Epoch 5/6
100/100 [=====] - 24s 237ms/step - loss: 0.6113 - accuracy: 0.7884 - val_loss: 0.5848 - val_accuracy: 0.8307
Epoch 6/6
100/100 [=====] - 24s 237ms/step - loss: 0.5411 - accuracy: 0.8152 - val_loss: 0.5211 - val_accuracy: 0.8411

```

Figure 4.3.7: Epoch.

There are a variety of different features that can be generated from audio data, such as spectral characteristics, pitch, and volume. The specific features that are generated will depend on the specific requirements of the home automation system and the characteristics of the collected data. Feature generation can be performed as part of the preprocessing step

when building the home automation system. It can help the model learn more effectively from the data and improve its accuracy in recognizing vocal commands.

Overall, feature generation is a useful technique for improving the performance of a home automation system that uses voice commands and can help the system better understand and respond to user input.

#### 4.4 Result

The results of a home automation system that uses voice commands will depend on a variety of factors, including the accuracy of the machine learning model, the complexity of the system, and the user's expectations and needs.

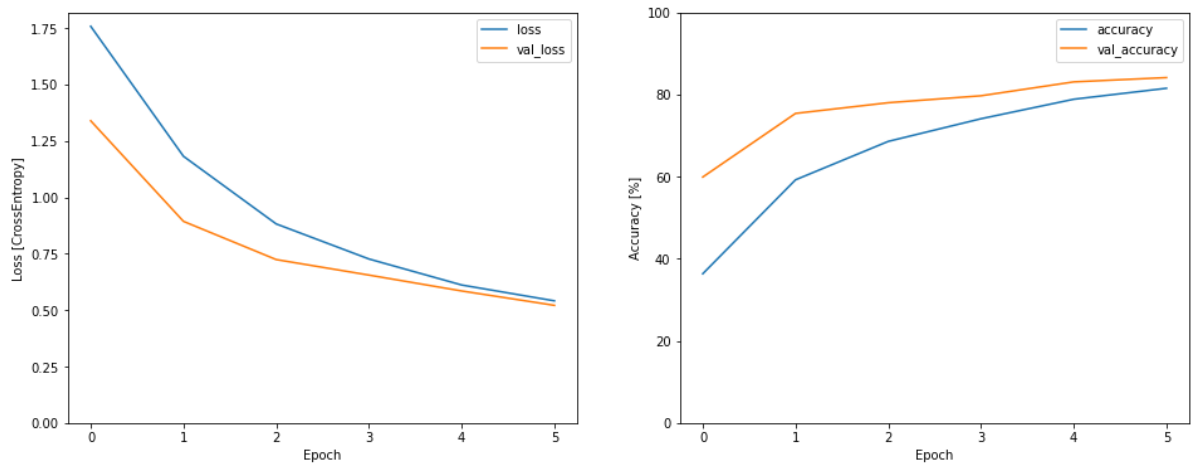


Figure 4.4.1: Epoch accuracy graph.



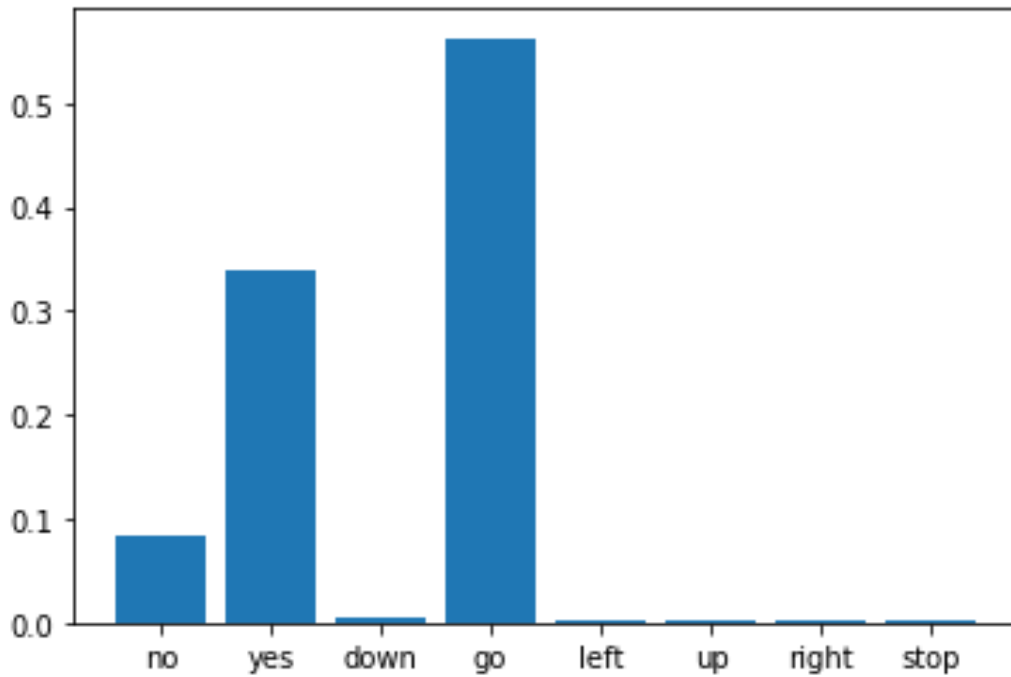


Figure 4.4.2: Command accuracy.

After successfully running the model for **6 epochs** we have got an accuracy of **81%**.

The goal of a home automation system that uses voice commands is to improve the convenience and efficiency of managing a home by allowing users to control various devices and systems remotely and automate certain tasks simply by speaking to a virtual assistant or using a smartphone app.

## CHAPTER 5

### IMPACT ON SOCIETY & SUSTAINABILITY

#### 5.1 Impact on Society

Home automation systems, which allow for remote control and monitoring of household appliances and systems, can have a number of positive impacts on society.

One potential benefit is increased energy efficiency and cost savings, as homeowners can use the automation system to monitor and adjust their energy usage. This can lead to a reduction in overall energy consumption, which can have a positive impact on the environment. Another benefit is improved communication and connectivity. Some automation systems allow for remote control and monitoring of the home, which can make it easier for homeowners to stay connected with their homes and make sure everything is running smoothly. This can be especially beneficial for people who travel frequently or are away from home for long periods of time. On the other hand, home automation systems can also have negative impacts on society [16]. One potential drawback is that they can be expensive to purchase and maintain, which can make them inaccessible to lower-income households. This can exacerbate social inequalities and create a digital divide. Home automation systems can also improve security and safety, as homeowners can remotely monitor their homes and receive alerts if there is suspicious activity. This can lead to a reduction in crime and an overall increase in community safety [21].

Additionally, home automation systems can improve the quality of life for people with disabilities, elderly people, and others who may have difficulty performing certain household tasks. For example, an automation system can be set up to control lighting, temperature, and appliances, allowing people with mobility issues to control these elements of their home without leaving their bed. Home automation systems can have a number of positive impacts on society, including increased energy efficiency, cost savings, improved security, and improved quality of life for certain groups of people [15]. Another potential drawback is that automation systems can create new forms of dependence. For example,

people may become reliant on the automation system to perform certain tasks and may have difficulty performing those tasks manually. This can reduce self-sufficiency and autonomy. y, if the technology fails, it could lead to a disruption in the daily routine. This can have a significant negative impact on the society, especially in the case of a widespread failure. They can improve convenience and comfort, improve communication and connectivity, but they can also be expensive and create new forms of dependence and can exacerbate social inequalities. It is important to consider these impacts and take appropriate measures to mitigate any negative effects.

## **5.2 Impact on Environment**

Home automation systems can have a positive impact on the environment in several ways. One of the main benefits is energy efficiency. Automation systems can be used to monitor and adjust energy usage in the home, such as turning off lights and appliances when they are not needed, or adjusting the temperature to minimize heating and cooling costs. This can lead to a reduction in overall energy consumption, and subsequently a reduction in greenhouse gas emissions. smart thermostats can learn a person's schedule and adjust the temperature accordingly, reducing energy consumption. Smart lighting systems can also be used to reduce energy consumption by turning lights off when they are not needed [15].

Additionally, home automation systems can also help to conserve water. For example, an automation system can be set up to monitor water usage, detect leaks, and shut off the water supply in case of a leak. This can help to reduce water waste and conserve resources. Home automation systems can also promote the use of renewable energy sources. For example, some home automation systems allow homeowners to monitor and control the use of solar panels and other renewable energy systems. This can help to increase the use of clean energy, and thus reduce the reliance on fossil fuels. Home automation systems can have a positive impact on the environment by increasing energy efficiency, conserving water, and promoting the use of renewable energy sources [16]. With the use of smart home devices,

it can also reduce the usage of plastic and other materials by controlling and monitoring the usage of the appliances.

### **5.3 Ethical Aspect**

Home automation systems raise a number of ethical concerns, particularly in regards to privacy and security. One concern is that automation systems can collect a large amount of personal data, such as information about a person's energy usage, home activities, and personal habits. This data can be used for targeted advertising and other purposes, which raises concerns about privacy and data security.

Another ethical concern is that automation systems can be used to monitor and control people's behavior. For example, some systems can be set to automatically lock doors or turn off lights if a person does not behave in a certain way [20]. This raises concerns about autonomy and the potential for abuse by those who control the system. Additionally, some systems may have potential security vulnerabilities, which can be exploited by hackers to gain access to personal information or control over the system. This raises concerns about the safety and security of the users. Another ethical concern is that automation systems can further widen the gap between rich and poor, as these systems tend to be more expensive and may only be affordable for higher-income households. This could lead to a digital divide and exacerbate social inequalities. Home automation systems can also raise ethical concerns regarding the protection of the environment, as it could potentially lead to an increase in energy consumption and waste if not programmed or set properly. Home automation systems raise several ethical concerns, particularly regarding privacy, security, autonomy, and social inequalities [16]. It is important to consider these concerns and take appropriate measures to address them when implementing and using these systems.

### **5.4 Sustainability Plan**

A sustainability plan for a home automation system using voice commands would involve several key components:

- 1. Energy efficiency:** The system should be designed to minimize energy consumption, particularly when it comes to the connected devices that it controls. This could involve incorporating energy-saving features such as automatic shut-off when a device is not in use, or adjusting the settings of devices based on the time of day or occupancy of the home.
- 2. Durability and longevity:** The system should be designed to last for a long time, with minimal maintenance required. This could involve using high-quality components that are built to last, and incorporating features that make it easy for users to troubleshoot and fix any issues that may arise.
- 3. Recyclability and environmental impact:** The system should be designed to be easily recyclable, and to minimize its environmental impact. This could involve using environmentally friendly materials and manufacturing processes, and providing clear instructions for how to properly dispose of the system at the end of its life.
- 4. Software updates:** Regular software updates should be provided to fix any bugs and to improve the system's performance over time. This will also ensure that the system remains compatible with any new devices and services that may be introduced in the future.
- 5. Security:** The system should be designed with security in mind, to protect user data and the connected devices from hacking or unauthorized access. This could involve incorporating encryption, secure authentication, and other security features to protect user's data and devices.

By following this sustainability plan, the home automation system using voice commands would be designed to be energy efficient, durable, recyclable, user-friendly, secure, and with regular updates, making it a sustainable solution for the future.

## **CHAPTER 6**

### **CONCLUSION & FUTURE SCOPE**

#### **6.1 Summary of The Study**

Home automation systems that use voice commands allow users to control various aspects of their home, such as the lights, thermostats, and appliances, simply by speaking to a virtual assistant or using a smartphone app. These systems use natural language processing (NLP) techniques and machine learning algorithms to interpret vocal commands and perform the appropriate actions. Building and implementing a home automation system that uses voice commands can be a complex and challenging task, as it requires the integration of various technologies and the development of machine learning algorithms to accurately interpret vocal commands. Home automation system using voice commands is to incorporate machine learning techniques to improve the system's ability to understand and respond to user commands. For example, the system could use reinforcement learning algorithms to learn and adapt to the specific vocabulary and phrasing used by individual users. Additionally, incorporating sentiment analysis would allow the system to understand the intent behind a user's command, allowing for more accurate and context-aware responses.

However, the resulting systems can greatly improve the convenience and efficiency of managing a home, as they allow users to control various devices and systems remotely and automate certain tasks.

Overall, research in the area of home automation systems that use voice commands has focused on improving the accuracy and usability of these systems, as well as developing new applications and capabilities.

#### **6.2 Conclusion**

In conclusion, home automation systems that use voice commands can provide a convenient and efficient way for users to control various aspects of their home, such as the

lights, thermostats, and appliances. These systems typically use natural language processing techniques and machine learning algorithms to interpret vocal commands and perform the appropriate actions. Several challenges can be encountered in the development and implementation of these systems, such as compatibility issues, security concerns, and the cost of implementing the system. However, with advances in technology and the increasing popularity of home automation systems, these challenges will likely be addressed and overcome in the future. There is also significant potential for further development in this field, with opportunities to expand the range of features and integrate with other technologies to provide a more seamless and convenient user experience. A speech recognition-based connected home system was created and put into use.

The potential to greatly improve the convenience and user-friendliness of controlling smart devices in the home. By utilizing natural language processing and machine learning techniques, the system can understand and respond to user commands in a more accurate and context-aware manner. Additionally, incorporating a mobile application and open architecture allows for easy remote access and control, as well as integration with third-party devices and services. It is also important to consider the sustainability of such a system. A sustainability plan that focuses on energy efficiency, durability, recyclability, user education and support, regular software updates, and security can help ensure that the system is not only useful, but also environmentally friendly and secure for the users.

### **6.3 Future Work**

Home automation is firstly outgoing in technology making home safer and better the place to live. These features help users to virtually monitor and control home like light, entertainment system, security, climate control, etc. the most common application of home automation is lighting control, lawn irrigation and main important security system, so we are working on new features our project and our project are updating regularly. Even children and old people can operate the light at night using voice command without their family's assistance. Adding variable control features to increase the system's adaptability,

including offering control instructions other than ON/OFF commands. As an illustration, "Raise Temperature," "Dim Lights," etc. • Using GSM or a mobile server integrated for remote operation. Must be working our home safely. Improving the accuracy and reliability of voice recognition: Machine learning techniques could be used to improve the accuracy of voice recognition algorithms, which would make it easier for home automation systems to correctly interpret vocal commands. Developing new natural language processing techniques: new techniques could be developed to allow home automation systems to understand more complex or nuanced vocal commands, such as those that involve multiple clauses or use colloquial language. Improving energy efficiency: Machine learning algorithms could be used to optimize energy consumption in the home, by learning about the occupants' preferences and habits and adjusting the home's settings accordingly. Improving energy efficiency: Machine learning algorithms could be used to optimize energy consumption in the home, by learning about the occupants' preferences and habits and adjusting the home's settings accordingly.



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## CHECK

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