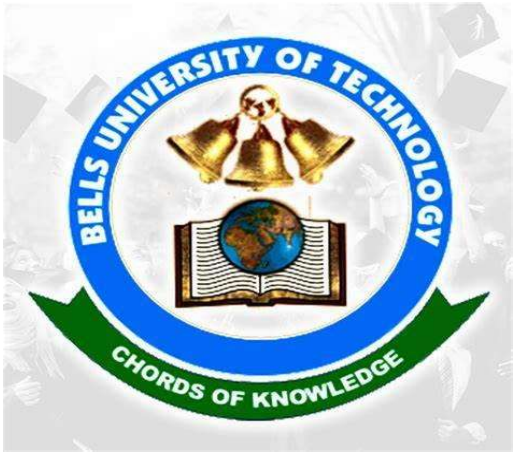
`

VOICE-CONTROLLED ROBOT “HOME AUTOMATION SYSTEM”

BY

MECHATRONICS ENGINEERING



COLLEGE OF ENGINEERING

BELLS UNIVERSITY OF TECHNOLOGY- NEW HORIZONS

Team Members:

Praise Egwuonwu

Goodnews Eke

Jesse Ekewuba

Samuel Chibuike Eberechi

Ebubechukwu Ekwuyasi

December, 2024

ROBOTICS 1

(ICT 215)

SUBMITTED TO

AYUBA MUHAMMAD

`

DECLARATION

We, the undersigned, hereby declare that the project titled [Voice-Controlled Robot Home Automation System] is our joint work specifically stipulated within [Robotics 1] under the guidance of [Mr. Ayuba Muhammad] at [Bells University of Technology-New Horizon]

We assert that:

1. The work submitted is original and has been performed by the members of this group.

2. Proper acknowledgment has been given to all sources of information, data, and references used in the project.

3. Each member has contributed meaningfully to the project's development, research, design, implementation, and presentation.

We agree to comply with the policies and regulations of the institution on issues related to plagiarism, ethical conduct, and academic integrity.

GROUP 7 MECHATRONICS MEMBERS

NAMES	MATRIC NUMBER	SIGNATURE
Egwuonwu Praise	2023/12408	
Eberechi Chibuike Samuel	2023/12552	
Eke Goodnews	2023/12389	
Ekewuba Jesse	2023/12303	

`

Ekwuyasi Ebubechukwu	2023/12427	

APPROVAL

This is to certify that the project titled **“[Voice-Controlled Robot Home Automation System]”** submitted by the members of Group 7 from the Mechatronics Engineering Department has been reviewed and approved as partial fulfillment of the requirements for **[Robotics 1]** under my supervision at **[Bells University of Technology].**

.....

AYUBA MUHAMMAD

Lecturer

`

ACKNOWLEDGEMENT

We sincerely thank **Mr. Ayuba Muhammad** for his guidance while working on the project titled "**Voice-Controlled Robot Home Automation System".** My sincere thanks to **Bells University of Technology** and the **Department of Mechatronics Engineering** for providing the necessary resources. I also wish to thank all group members and all friends and family for their unwavering support.

Thank you all for the assistance.

`

DEDICATION

This work is hereby dedicated to our families, whose relentless support and encouragement were the greatest motivation.

We hereby further dedicate this to our supervisor, **Mr. Ayuba Muhammad,** for making such sufficient guidance available, and to all the other people who inspired us throughout.

Lastly, we extend this to all future learners and innovators in the hope that this project may stand as a stepping stone toward their success.

`

TABLE OF CONTENTS

- DECLARATION---------- 2

- APPROVAL---------- 3

- ACKNOWLEDGMENT---------- 4

- DEDICATION---------- 5

- LIST OF FIGURES---------- 9

- ABSTRACT----------10

Chapter 1----------11-17

1.1 Background of the study----------11

1.2 Problem statement----------14

1.3 Objective of the study----------14

1.3.1 Main objective----------14

1.3.2 Specific objective----------15

1.4 Research questions----------15

1.5 Significance of the study----------16

1.6 Scope of the study----------17

`

1.6.1 Context of the scope----------17

1.6.2 Geographical scope----------17

1.6.3 Time scope----------17

Chapter 2----------18-25

2 Introduction----------18

2.1 Bluetooth HC-05----------19

2.1.1 Description of Pins----------21

2.1.2 Operational Modes---------- 23

2.1.3 The principle of a voice-controlled robot---24

2.2 How does Bluetooth HC-05 work? ----------25

Chapter 3----------26-53

3 Methodology----------26

3.1 Overview----------26

3.2 Block diagram----------27

3.3 System components----------30

3.3.1 Arduino Uno R3----------30

3.3.2 Bluetooth HC-05----------33

`

3.3.3 1kΩ Resistors----------34

3.3.4 2N2222 Transistors----------36

3.3.5 Servo motor----------37

3.3.6 Relay(x3) ----------38

3.3.7 1N4007 Silicon diode(x3) ----------38

3.3.8 Lamp model----------39

3.3.9 DC Motor model----------40

3.3.10 Yellow & Green LED models----------40

3.3.11 20V Voltage source----------41

3.3.12 Ground terminal----------42

3.4 Pseudocode for the program----------43-47

3.5 Code on Arduino IDE----------48-50

3.6 System connection and wiring in Proteus----------51

3.7 Appliance control----------52

3.8 3D View and PCB Layout for the voice-controlled home automation system----------53

Chapter 4----------54

`

4 Result of the System---------- 54

Chapter 5----------55-56

5 Conclusion----------55

5.1 Recommendation for the enhancement of the project-----55

5.2 References----------56.

LIST OF FIGURES

Figure No.	Title	Page No.
Figure 2.1	Diagram of Bluetooth HC-05	**21**
Figure 2.2	HC-05 Pinout Configuration	**22**
Figure 2.3	2D Diagram of HC-05	**24**
Figure 3.1	Block Diagram	**27**
Figure 3.2	Components Used	**31-42**
Figure 4.1	Output Results	**55-56**

`

ABSTRACT

This project, **"Voice-Controlled Robot Home Automation System,"** covers the development of a robot controlled by voice. The main goal is to create a hands-free, efficient way of controlling robotic movements and functionality for better usability in various applications such as automation, assistance, and exploration.

It uses **speech recognition technology** to interpret voice input, and then an interpreter such as Arduino interprets the results to tell the robot what to do. With **communication modules**, it accurately responds to commands.

This new approach shows how voice control integrated into robotics could improve user interaction, especially in the case of users with physical impairments or where operations need to be performed remotely.

`

CHAPTER ONE

1. INTRODUCTION

The increasing adoption of smart technologies has revolutionized modern living with home automation emerging as one of the most significant developments. Intelligent systems make it easier for people to control their routines while improving efficiency and convenience in households. This project titled **"Voice-controlled Robot Home Automation System"** aims to take automation a step further by integrating voice control and robotics into a dynamic and mobile platform. This project introduces an advanced smartphone robot that can move around the home and respond to voice commands. By using speech recognition technology, the robot can perform various tasks such as controlling appliances and navigation to specific locations and helping with minor household activities. The system is designed with a microcontroller (e.g., Arduino), motors to move parts sensors for obstacle detection, and a microphone that processes commands. The integration ensures the

`

robot is both functional and adaptable, catering to the specific needs of users including those with mobility impairments or limited technical skills. This project is designed as an intuitive way of doing home automation. The goal of the project is to create a more hands-free approach. This system not only enhances the user experience but also demonstrates the potential of emerging technologies in making our living spaces more appealing and effective by integrating robotic technology with voice control.

1.1 Background of the study

Through continuous development since many years ago, home automation has been incorporated into modern life. Nowadays, we have a system to manage daily chores more comfortably-like switching lights and heaters and even switching on/off appliances with just a click or tap. Most traditional home automation systems are based on physical controls, mobile applications, or remote devices that may be problematic for a person with poor mobility or persons uncomfortable with technological systems. This has driven interest in voice-controlled home automation systems, expected to bring much greater intuitiveness and accessibility.

`

Voice recognition technology, which is a branch of artificial intelligence, has played a pivotal role in this transformation. We've all heard of voice assistants like Amazon's Alexa, Google Assistant, and Apple's Siri. These devices have shown us how powerful voice interfaces can be in managing our daily tasks—whether it's turning on lights, setting alarms, or even checking the weather. Building on this, the idea of integrating voice control into robotics opens up exciting possibilities for home automation. By adding mobility to the equation, a robot can not only respond to voice commands but also move around the house and interact with appliances more flexibly.

Just think about having a robot that can self-manifest itself, switch off the lights upon your instructions, adjust the thermostat, or deliver an object across the room for you without stretching your arm and lifting your finger. This might get materialized by a voice-controlled home automation robot. It employs speech recognition technology, while a collection of motors and sensors does all it can to execute the command and navigate across the house. Unlike the traditional and less-than-mobile wall-bound kind of system, this robot will grant a level of mobility and flexibility in the home to respond to commands and interact with other devices and objects.

`

That is what, apart from the above, maybe more exciting: servicing not only those who are too busy or tech-advanced users but also people who cannot use traditional devices due to one or another physical disability. Giving a voice to them releases them from a lot of trouble and helps them feel more independent. Be it turning the light off, opening the door, or even appliance operation voice-controlled robot adds convenience to all that.

This work tries to look at how this technology adds to the developing world of smart homes and assistive technologies in system design and development. This work aims to add some weight to the thought that voice-controlled robots may well be part of the future of home automation to make living spaces smarter, connected, and more accessible.

1.2 Problem Statement

While home automation systems have made life easier, most of them still depend on physical controls or apps, which may be a problem for persons with any kind of mobility issues or non-technical users. Most of these also are fixed and therefore not able to adapt to natural interactions that take place at home.

A voice-controlled robot easily solves these issues in a simple, hands-free manner. The integration of voice commands, makes

`

home automation both easier to interact with and flexible-thus, a solution for everyone.

1.3 Objectives of the Study

1.3.1 Main objectives:

The main objective of this project is to develop a mobile, voice-controlled robot for home automation tasks through spoken commands. The idea is to make life easier in general, and especially for people with some kind of mobility problem, using a hands-free, user-friendly system. Therefore, real-time voice recognition together with robotic mobility will enable the introduction of a certain degree of flexibility and dynamism into home automation systems.

1.3.2 Specific objectives

1. To design and build a mobile robot that can respond accurately to voice commands for performing basic home automation tasks.
2. To integrate speech recognition technology with a microcontroller for real-time processing of voice inputs.
3. To enable the robot to navigate autonomously within a home environment using sensors for obstacle detection and avoidance.

`

4. To demonstrate the robot's ability to control household appliances and assist with tasks, enhancing convenience and accessibility.
5. Ensure system compatibility with common smart home devices for seamless automation control.

1.4 Research question

1. How will speech recognition technology be integrated so that the voice commands will be processed right by the robot and carried out promptly?
2. What hardware components and design considerations are needed to enable the robot to successfully carry out simple home automation tasks?
3. How will the voice-controlled interaction of the robot with home electric appliances be effective and predictable?
4. What are some considerations that can be taken to make this voice-controlled robot user-friendly for a person with limited mobility or technical knowledge?

1. 5 Significance of the study

This study is focused on the design of a voice-controlled robot for the simplification and accessibility of home automation. Integrating voice commands with a mobile robot constitutes a hands-free,

`

convenient solution for people with mobility issues and for everybody in general. Here is where the adaptability and real-time performance make home automation flexible and user-friendly. Summarily, the project may fall under a group of assistive technologies that could enable users to be more independent in managing their environment and creating conducive living conditions.

1.6 Scope of the Study

1.6.1 Context of the Scope

This project focuses on developing an innovative robotic voice control system for home automation, effectively managing light, and appliance control. By integrating advanced voice recognition technology, we aim to create a user-friendly prototype that enhances accessibility for individuals with limited mobility.

1.6.2 Geographical scope

This project is designed and intended to be used under home conditions, typically interacting with common indoor spaces, such as living rooms, kitchens, and bedrooms. It does not refer to a specific location but is designed for adaptability in homes worldwide.

1.6.3 Time scope

`

The project will be completed in (6) months, covering design, development, testing, and final adjustments, but can be completed before (6) months.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Voice control in home automation has seen rapid advancements due to improvements in speech recognition, artificial intelligence (AI), and robotics. Voice assistants like Amazon Alexa, Google Assistant, and Apple Siri have revolutionized how people manage daily tasks at home, providing hands-free control of lights, appliances, and other smart devices. These systems have made everyday living more convenient, particularly for users with mobility issues or limited technical knowledge.

`

Research has explored various voice-controlled solutions, focusing on integration with fixed smart devices. However, the application of voice recognition for controlling stationary robots in home automation is less explored. Most studies have concentrated on individual devices or automation networks, but few have investigated how a stationary robot can act as a central hub for voice-controlled tasks in the home.

This review examines existing technologies in voice recognition, robotics, and smart home automation to highlight their potential for creating more efficient and accessible systems. Understanding how voice control can be integrated into stationary robots, and how these robots can interact with other smart home systems, is crucial for this project. The literature also explores the design principles and challenges in creating user-friendly, voice-driven automation systems.

By examining these studies, this review aims to provide a comprehensive foundation for the development of a voice-controlled robot that simplifies home automation and enhances accessibility.

2.1 BLUETOOTH HC-05

`

Before going into building this voice-controlled robot for home automation, it is important to understand how a Bluetooth device works (**Bluetooth HC-05**). The HC-05 Bluetooth module is among the most popular wireless communication modules in general electronics and IoT projects. It is a Bluetooth 2.0 technology with an Enhanced Data Rate. It offers a simple means of establishing communication between microcontrollers, i.e., Arduino, and other Bluetooth devices such as smartphones and computers.

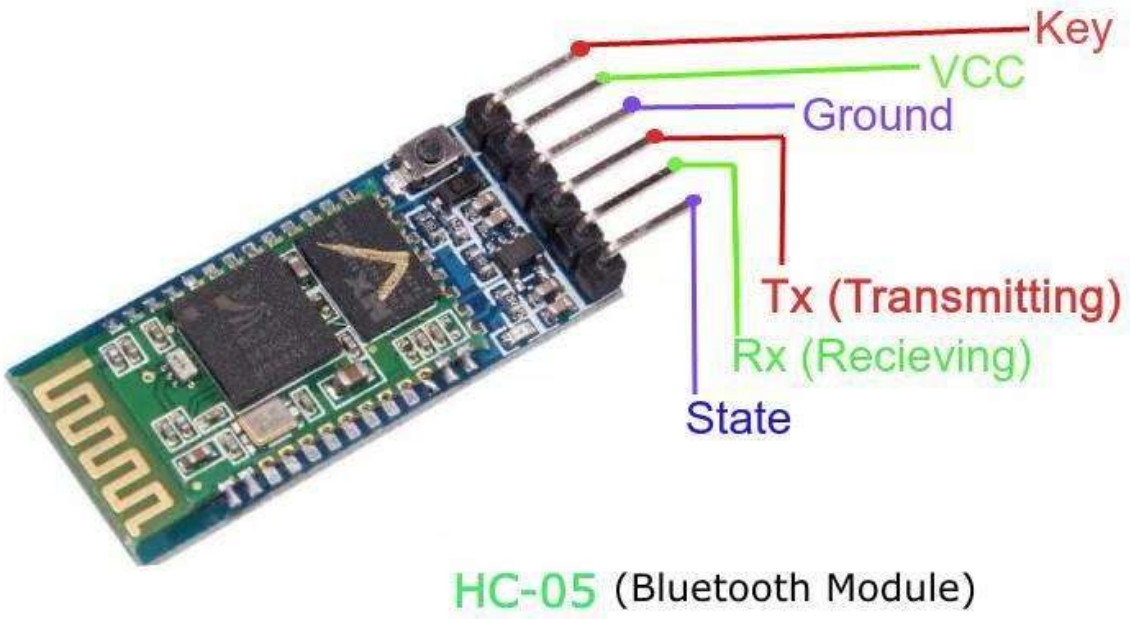
Bluetooth technology was invented in the year **1994** when **Ericsson** created it as a replacement for serial cables for wireless communication in short range. This went on to become the de facto standard for mobile phones, computers, and wearables. The HC-05 module was among such low-priced, easy-to-use devices aimed at hobbyists, students, and engineers who wanted to add Bluetooth to their projects. Because of its simplicity ease of use and low price, it has been one of the most popular products in the DIY electronics world.

What is unique about the HC-05 is the potential to operate in master and slave modes. In slave mode, it is discoverable and initiates connections to other devices, but in master mode, it initiates the connections. This renders it a suitable choice for

`

various applications that range from wireless data transmission and robotics to home automation. This module uses a UART interface method for communication; the default value of the baud rate is 9600. The transmission distance in the air is about 10 meters. Operating voltage: 3.3V to 6V.

One of the features of the HC-05 is the setting through AT commands. These allow the naming of the module, setting the baud rate, and the operating mode such that the module can be applied for several uses. This module is usually useful in wireless data communication, controlling a device remotely, and also networking in different IoT projects.



HC-05 (Bluetooth Module)

`

Figure 2.1

2.1.1 Description of Pins

- *Enable/Key* - This pin is used to set the Data Mode or AT command mode (set high).
- *VCC* - This is connected to a +5V power supply.
- *Ground* - Connected to the ground of the powering system.
- *Tx (Transmitter)* - This pin transmits the received data Serially.
- *Rx (Receiver)* - Used for broadcasting data serially over Bluetooth.
- *State* -Used to check if the Bluetooth is working properly.

`

HC-05 Pinout Configuration

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

Figure 2.2

2.1.2 Operational Modes

`

The HC-05 Bluetooth Module can operate in two modes: Data Mode and Command Mode.

Command Mode

During this mode, the Bluetooth module can be addressed using AT Commands for configuring various settings and parameters of the Module, such as obtaining the firmware version, Baud Rate modification, and module name modification. It can be used for configuring it as a master or slave.

One of the facts regarding the HC-05 Module is that it can be set as Master or Slave in a communication pair. To choose any one of the modes, command mode has to be enabled and appropriate AT Commands have to be sent.

Data Mode

Moving to the Data Mode, in this mode, the module is employed for communication with another Bluetooth device i.e. in this mode, the data transfer occurs.

`

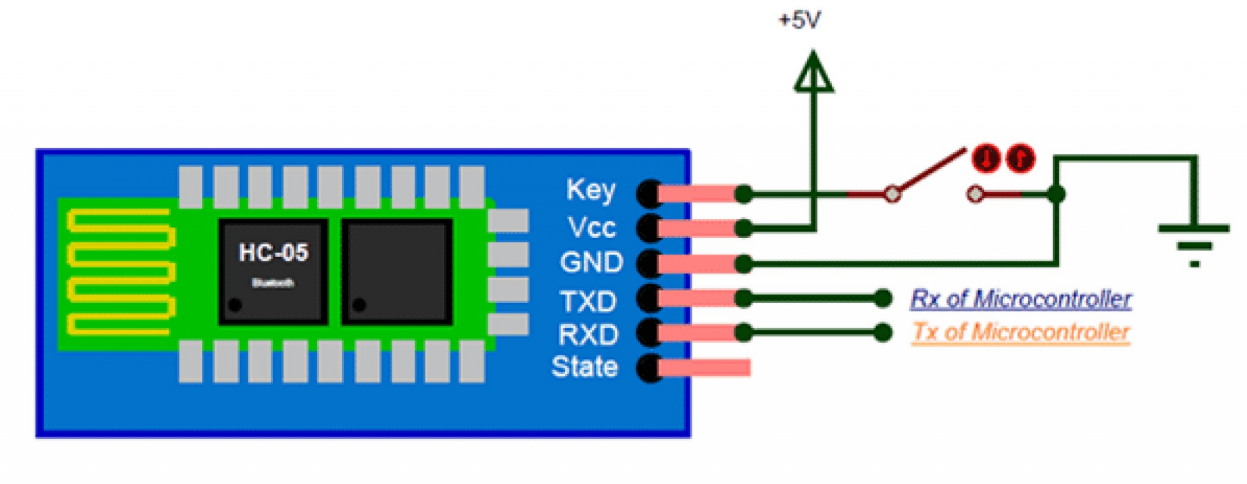


Figure 2.3

2.1.3. The principle of a voice-controlled robot

The principle of a voice-controlled robot home automation system is the transformation of words into electrical signals to control devices or appliances in your home. The system embodies speech recognition, decision-making mechanisms through microcontrollers, and control mechanisms of devices for complete functionality without human involvement. In simple terms, here is how this operates:

Speech Input: The user speaks a voice command into a microphone or smart device, which picks up the uttered command.

Speech Recognition: The system operates the voice command through offline modules or cloud services, further converting it into a text or digital signal.

`

Decision Making: A microcontroller interprets the command, compares it with pre-programmed commands, and decides what to do.

Device Control: The microcontroller triggers the relays or actuators to switch on/off the connected appliances and sends the feedback if required.

2.2 How Does Bluetooth HC-05 Work?

The HC-05 Bluetooth module is a wireless device based on the Bluetooth 2.0 wireless protocol. The module will work with any power supply ranging from 3.3V to 6V and operates in two modes: scanning for devices in master mode and waiting for devices to connect in slave mode. Its PIN is "1234" by default; pairing requires this number. It communicates via UART: to its TX and RX pins for transmission of data to/from paired devices. The module also supports AT command mode to configure settings like name, baud rate, mode, etc. After connection, you can start using it in both directions for that simple seamless wireless communication bridge as a transparent data link.

`

CHAPTER 3

METHODOLOGY

3.0 System Design and Architecture

This section presents the design and architecture of the voice-controlled robot automation system aimed at simplifying home automation. The system integrates hardware and software components to enable users to control home appliances using voice commands, offering a more convenient and hands-free experience.

3.1 Overview

The voice-controlled robot serves as the main control unit for home automation. Household appliances are connected to the robot via Bluetooth which allows users to control them using their phones or any Bluetooth-enabled device to give commands to the robot. After the robot receives a command, it carries out the task as stated in the command, such as turning lights on/off, adjusting room temperature, opening and closing curtains, and communicating with other devices.

U

`

3.2 Block Diagram

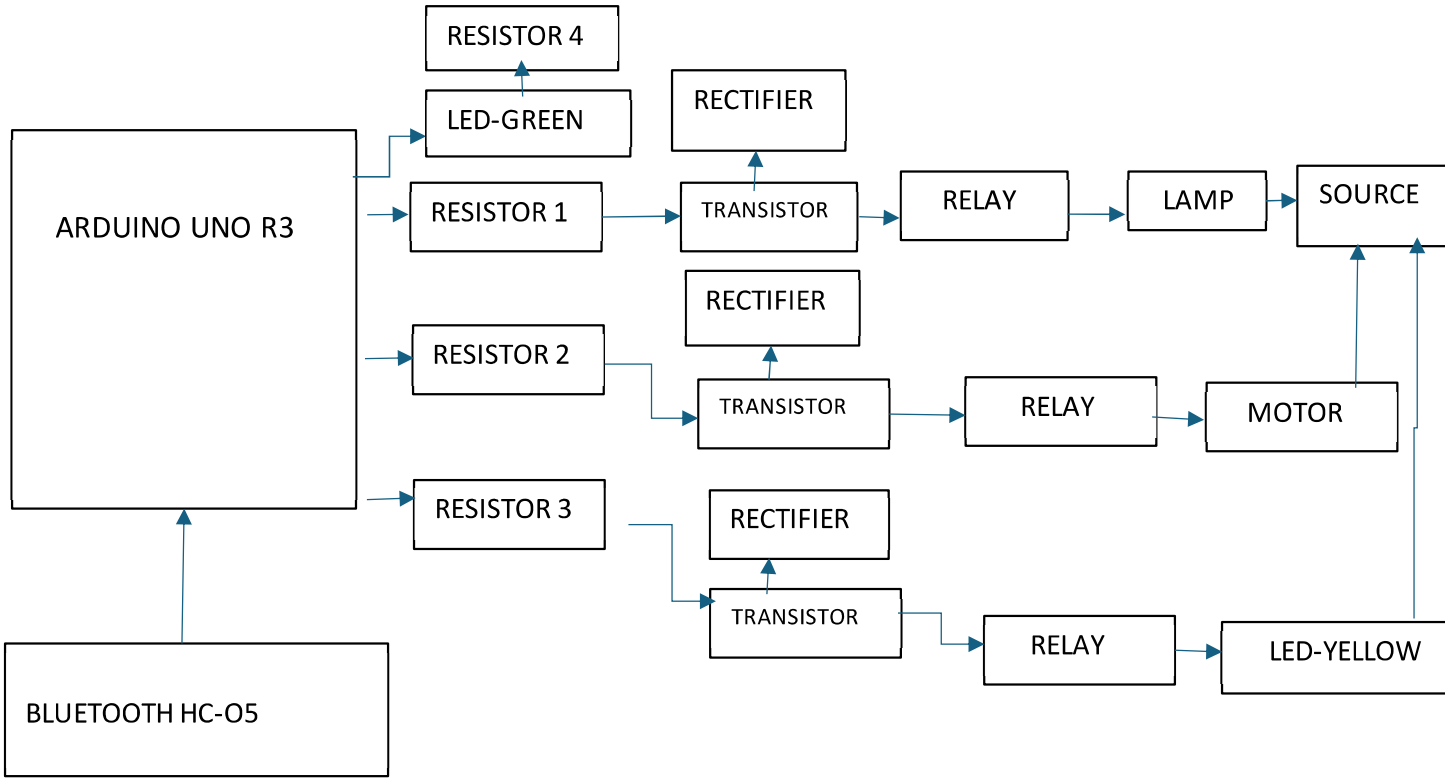


Figure 3.1

`

CIRCUIT DESIGN OF VOICE-CONTROLLED ROBOT HOME AUTOMATION SYSTEM

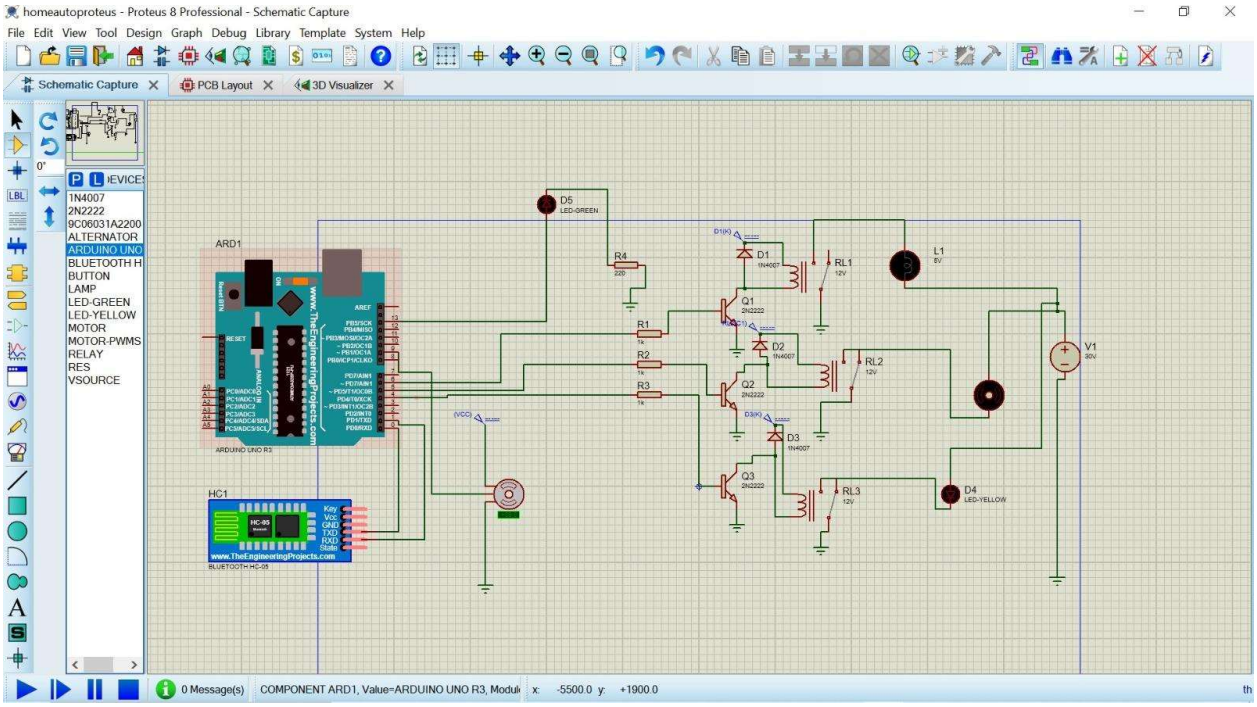


Figure 3.2

FLOWCHART OF VOICE-CONTROLLED ROBOT HOME AUTOMATION SYSTEM

`

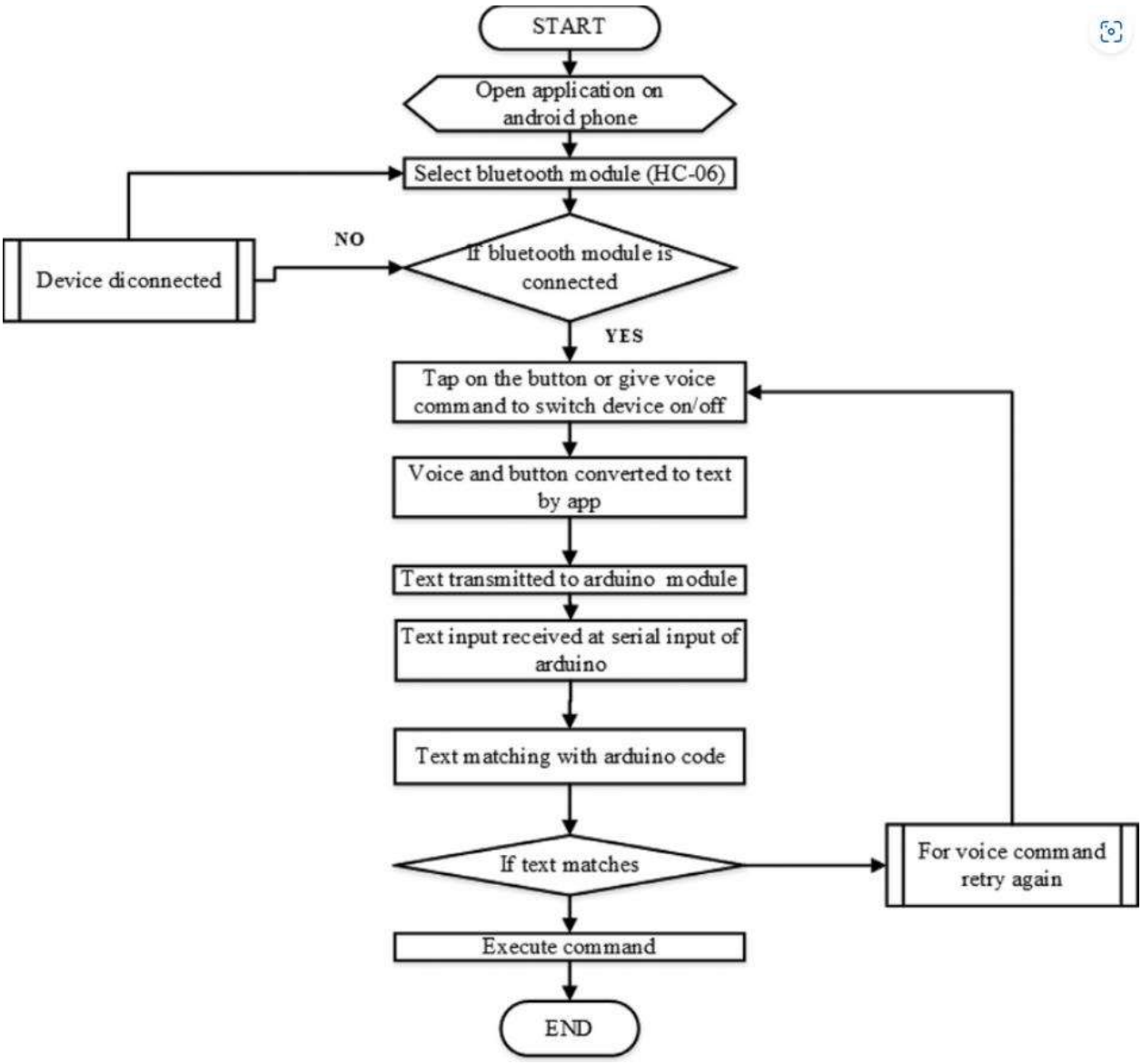


Figure 3.3

Above is the flowchart for a voice-controlled robot home automation system. It visually outlines the process, from capturing the voice command to triggering actions like controlling appliances or moving a robot.

3.3 SYSTEM COMPONENTS

3.3.1 ARDUINO UNO R3

`

The Arduino Uno is a well-established open-source microcontroller board that was designed by Arduino.cc, with the Microchip ATmega328P microcontroller as it's the heart of it. From the time it was introduced to the market in 2010, the one has been the most used microcontroller board out there by newcomers and old.

The Oracle has 6 pulse width modulations this is a very cool (PWM) output that is programmable out of 14 that are digital, the rest are also digital. The board is also equipped with 6 analog read ports, enabling the user to measure physical quantities by the utilization of onboard modules such as sensors. 16 MHz ceramic resonator for the microcontroller was chosen to ensure a constant speed of operation. The board has 5 analog pins (the rest of the digital pins are PWM), a USB connection for easy download of the program memory, and a reset button so you can make it run at full speed again.

When it comes to the power source for the Arduino Uno, it can be powered through a USB connection or by an external power source like a 9V battery. The programming of the board is done via the very simple Arduino IDE (Integrated Development Environment). A Type B USB cable is used to establish a connection between your computer and the board.

`

The cut-down-size version is called the Arduino Uno because it has a built-in bootloader on the ATmega328P microcontroller. This particular feature makes it possible for you to upload code to your device via the USB connection without having to use any external hardware programmers. This is especially useful when it comes to programming boards quickly and just trying things out.

Figure 3.4

Arduino Uno Pinout Overview

Digital Pins

`

- **Pins 0-13**: General-purpose digital input/output (I/O) pins.
- **PWM Pins**: Pins **3**, **5**, **6**, **9**, **10**, and **11** support **Pulse Width Modulation (PWM)** output for more precise control.

Analog Pins

- **Pins A0-A5**: Analog input pins that can also function as digital I/O pins when needed.

Power Pins

- **Vin**: Input pin for an external power source.
- **5V**: Regulated **5V** output.
- **3.3V**: Regulated **3.3V** output.
- **GND**: Ground pins to complete circuits.

Communication Ports

- **Serial (UART)**: Pins **0 (RX)** and **1 (TX)** are used for serial communication.
- **I2C**: Pins **A4 (SDA)** and **A5 (SCL)** handle **I2C communication** for connecting multiple devices.
- **SPI**: Pins **10 (SS)**, **11 (MOSI)**, **12 (MISO)**, and **13 (SCK)** are used for **SPI communication**.

ARDUINO UNO R3 PINOUT

`

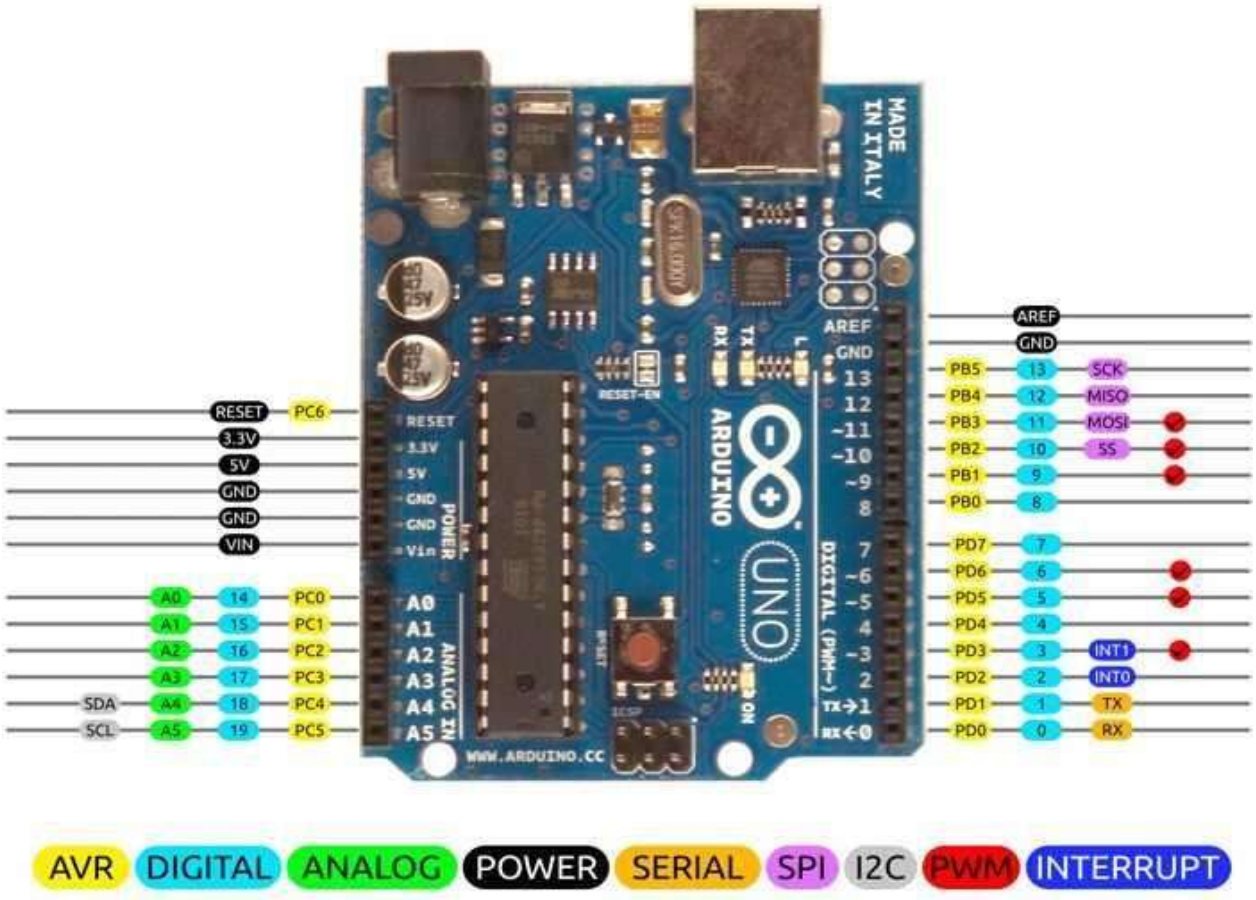


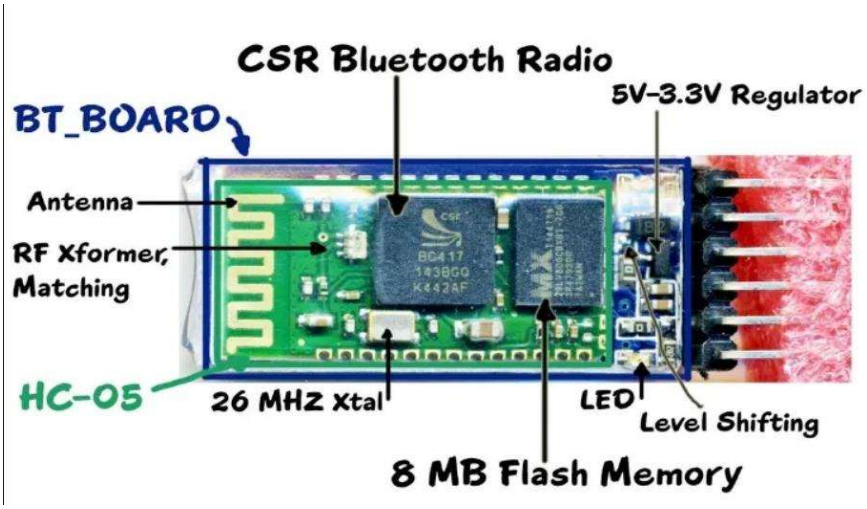
Figure 3.5

3.3.2 Bluetooth HC-05

The **HC-05 Bluetooth module** is a versatile and cost-effective Bluetooth transceiver that is made to exchange information between different devices through the wireless network. It supports both **Master** and **Slave** modes, allowing for usage across various fields such as robotics, home automation, and IoT projects. The module incorporates **Bluetooth 2.0+EDR** technology, which allows a distance of up to **10 meters**. The HC-05 works on a **3.3V power**

`

supply (despite this, some breakout boards operate with 5V) and, through a **UART (Serial) interface** with standard RX and TX pins, it communicates with microcontrollers such as Arduino. Pairing the HC-05 with smartphones, computers, or other Bluetooth-enabled devices is easy and the commands can be set by using **AT commands**. Through its simplicity and versatility, the HC-05 module is an ideal choice for wireless communication functionality in similar projects.



3.3.3 1kΩ Resistors (x3)

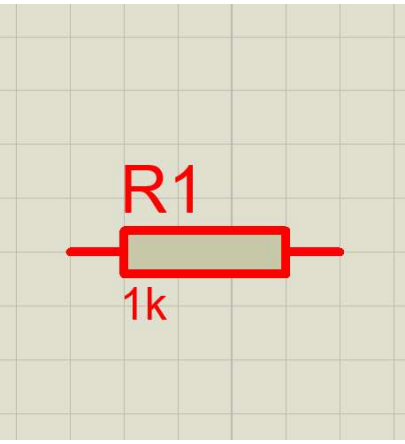
A **resistor** is a significant passive electronic component for controlling and regulating electrical current in a circuit. It works by providing resistance, in terms of **ohms (Ω)**, to restrict current and alter voltage values. It keeps elements like LEDs, sensors, and

`

microcontrollers safe and operational in its rated range, free of destructive current overload.

Resistors can be in many types, including **fixed resistors**, with a constant value of resistance, and **variable resistors (potentiometers)**, with variable values of resistance. The value of a resistor's resistance is generally displayed with a series of **color-coded bands**, and these bands even reveal information about its tolerance value and its value for power rating.

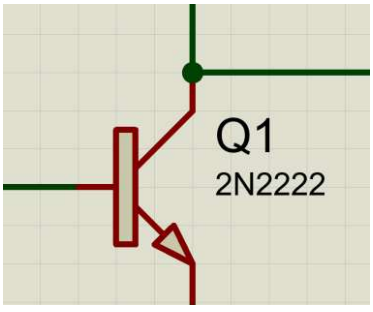
In this project, resistors have a basic role, in current restriction, voltage division, and safeguarding fragile parts. By its use, overall safety, efficiency, and proper working of the circuit are guaranteed. Resistors can be in almost any electronic device and therefore play a significant part in this project.



3.3.4 (2N2222 Transistor) Silicon NPN Low Power High-Frequency Bipolar Transistor (500mW, 200°C) (x3)

`

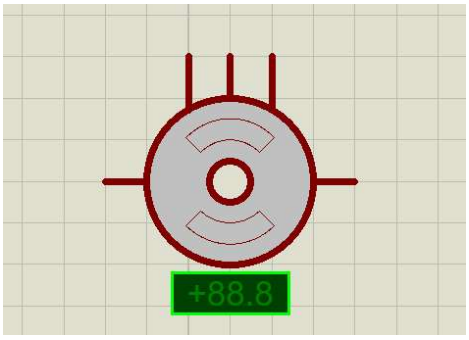
The Silicon NPN Low-Power High-Frequency Bipolar Transistor is a semiconductor device designed for use in high-frequency electronic signal amplification and switching applications. An NPN transistor comprises two layers of n-type semiconductor material separated by a layer of p-type material. This type of transistor finds wide applications because of its fast-switching time and the fact that even a very weak signal can be easily amplified. Some of the main characteristics of this transistor are: **Maximum Power Dissipation: 500mW**, hence making it suitable for low-power applications; **a maximum operating temperature of 200°C** provides great assurance in its performance under high-temperature conditions. It serves to amplify the signal in a project, drive loads, or as a switch in such circuits where high-frequency operation with low power dissipation becomes important. This transistor is tough and efficient; hence, it is one of the most significant pieces in modern electronic systems.



3.3.5 Servo Motor

`

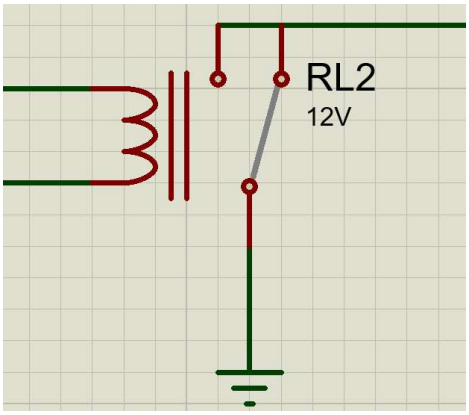
A servo motor is an actuator of precision for controlling angular or linear motion. It comprises a DC motor, a control circuit, and a position feedback system that works with PWM signals to set its position. It usually rotates within a 0° to 180° range with high accuracy. This servo motor will be used in the movement control of the project, like an opening or closing mechanism, in this case, it simulates an automatic door. Its **reliable and smooth operation** makes it perfect for automation and robotics applications.



3.3.6 Relays (x3)

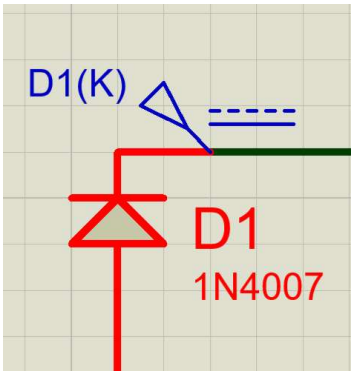
The **Relay RL2 12V** is an electromagnetic switch that operates on a **12V DC** supply to control high-power circuits using low-power signals. It consists of a coil, contacts, and a switching mechanism. When the coil is energized it creates a magnetic field that closes or opens contact contacts, opening or closing all contacts and leaving a current flowing through the connected circuit. This relay is commonly used in **automation motor control and power management** applications.

`



3.3.7 1N4007 Silicon Diodes (x3)

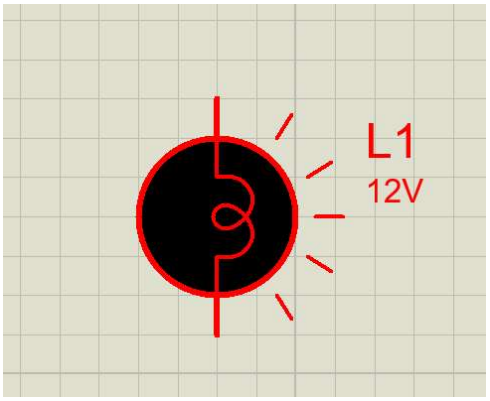
The **1N4007** is a general-purpose **silicon rectifier diode** designed for applications requiring **high voltage and current handling**. It is primarily used in *rectification circuits to convert **AC to DC** and can withstand a **maximum reverse voltage of 1000V** and "current up to 1A**. This diode has a **low forward voltage drop (typically 0.7V)** and is efficient in power regulation and protection circuits. In your circuit, the **1N4007** is placed across the relay coil as a **flyback diode** to protect the **2N2222 transistor** from voltage spikes when the relay is turned off. This prevents damage to sensitive components and ensures reliable operation.



3.3.8 Lamp Model

`

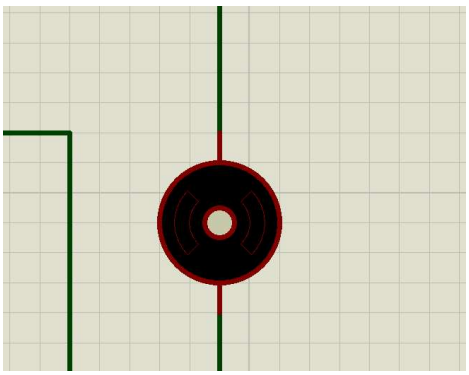
A **lamp model** represents a **light-emitting component** used for **illumination or signaling** in a circuit. It converts electrical energy into light and is controlled by switches, relays, or microcontroller devices. In this project, a lamp acts as an output device by indicating system status or automated responses, it simulates a real home lighting system.



3.3.9 DC Motor Model

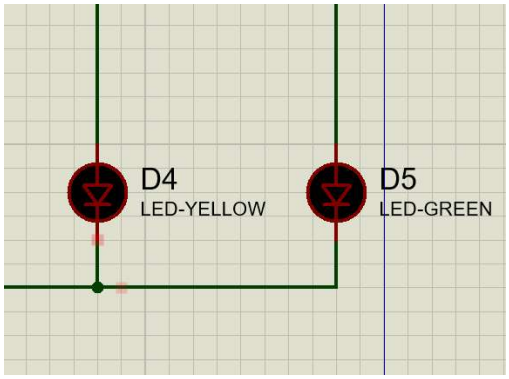
A **DC motor model** represents a **rotating electrical machine** that converts **DC electrical energy into mechanical motion**. It operates using a **magnetic field and a rotating coil**, generating torque to drive mechanical loads. In this project, the DC motor is used for **automation and motion control,** it represents a fan or other motorized appliances.

`



3.3.10 Yellow & Green LED Models

Light Emitting Diode (LED), serves as an indicator in a circuit or system. The yellow LED model simulates another home appliance, such as an indicator light. While the green LED serves as a feedback indicator to confirm a successful command execution.

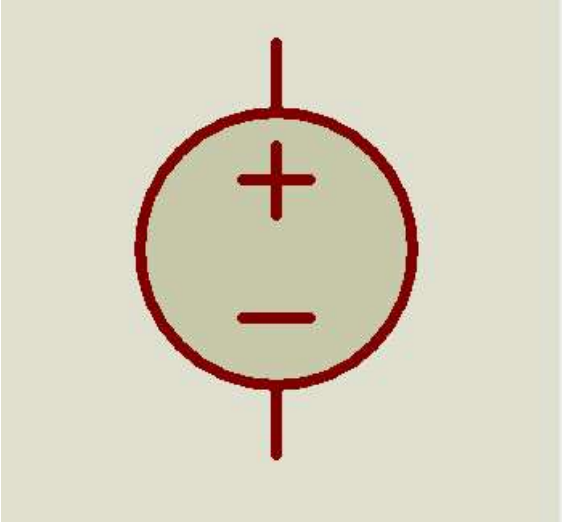


3.3.11 20V Voltage Source

The 20V voltage source provides a constant 20V output suitable for powering the motors, LEDs, and components that require this

`

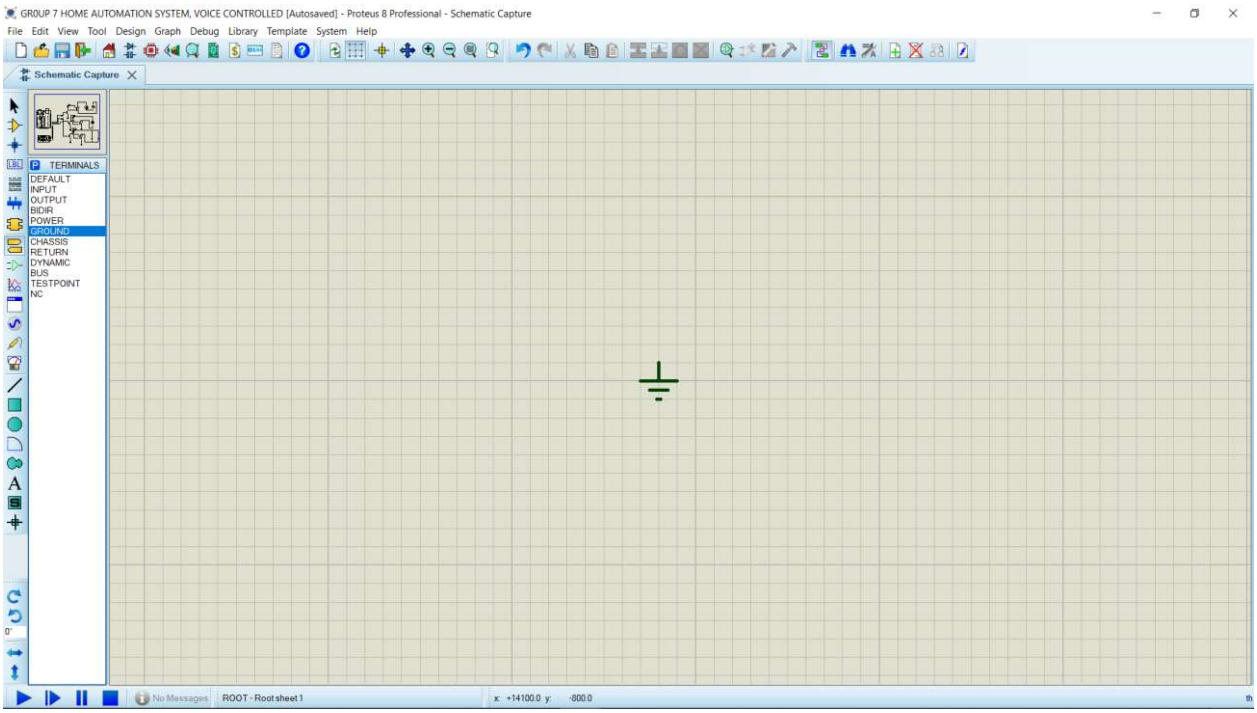
voltage. In this project, this is the main powerhouse that supplies voltages to the appliances in the simulation.



3.3.12 Ground Terminal

The ground terminal provides a return path for the electrical current, completing the circuit. Without a proper ground connection, the circuit won't function correctly. Ground serves as a reference point for all voltage measurements in the circuit. It ensures that all components operate at the correct voltage levels relative to the ground. It helps maintain consistent and reliable operation of the circuit, preventing issues like noise and voltage fluctuations.

`



3.4 PSEUDOCODE FOR THE PROGRAM

BEGIN

IMPORT Servo library

DECLARE Servo object myservo

DECLARE integer pos = 0

DECLARE string command = ""

DEFINE RELAY pins:

RELAY1_PIN = 6

`

RELAY2_PIN = 5

RELAY3_PIN = 4

SETUP:

ATTACH servo to pin 9

SET relay pins as OUTPUT

INITIALIZE all relays to OFF state

CONFIGURE built-in LED for feedback

INITIALIZE serial communication at 9600 baud

PRINT "System initialized. Waiting for Commands..."

MAIN LOOP:

IF serial data available THEN

READ command until newline

TRIM whitespace from command

CONVERT command to lowercase

PRINT received command for debugging

CASE OF command:

"lamp" ->

ACTIVATE RELAY1

TURN ON LED

PRINT confirmation

`

```
"offline one" ->
  DEACTIVATE RELAY1
  TURN OFF LED
  PRINT confirmation
"fun" ->
  ACTIVATE RELAY2
  TURN ON LED
  PRINT confirmation
"offline 2" ->
  DEACTIVATE RELAY2
  TURN OFF LED
  PRINT confirmation
"lights" ->
  ACTIVATE RELAY3
  TURN ON LED
  PRINT confirmation
"offline 3" ->
  DEACTIVATE RELAY3
  TURN OFF LED
  PRINT confirmation
```

`

"all on" ->

ACTIVATE ALL RELAYS

TURN ON LED

PRINT confirmation

"all off" ->

DEACTIVATE ALL RELAYS

TURN OFF LED

PRINT confirmation

"open door" ->

ROTATE servo from 0° to 180° gradually

DELAY 15ms per step

TURN ON LED

PRINT confirmation

"close door" ->

ROTATE servo from 180° to 0° gradually

DELAY 15ms per step

TURN OFF LED

PRINT confirmation

DEFAULT ->

IGNORE unknown command

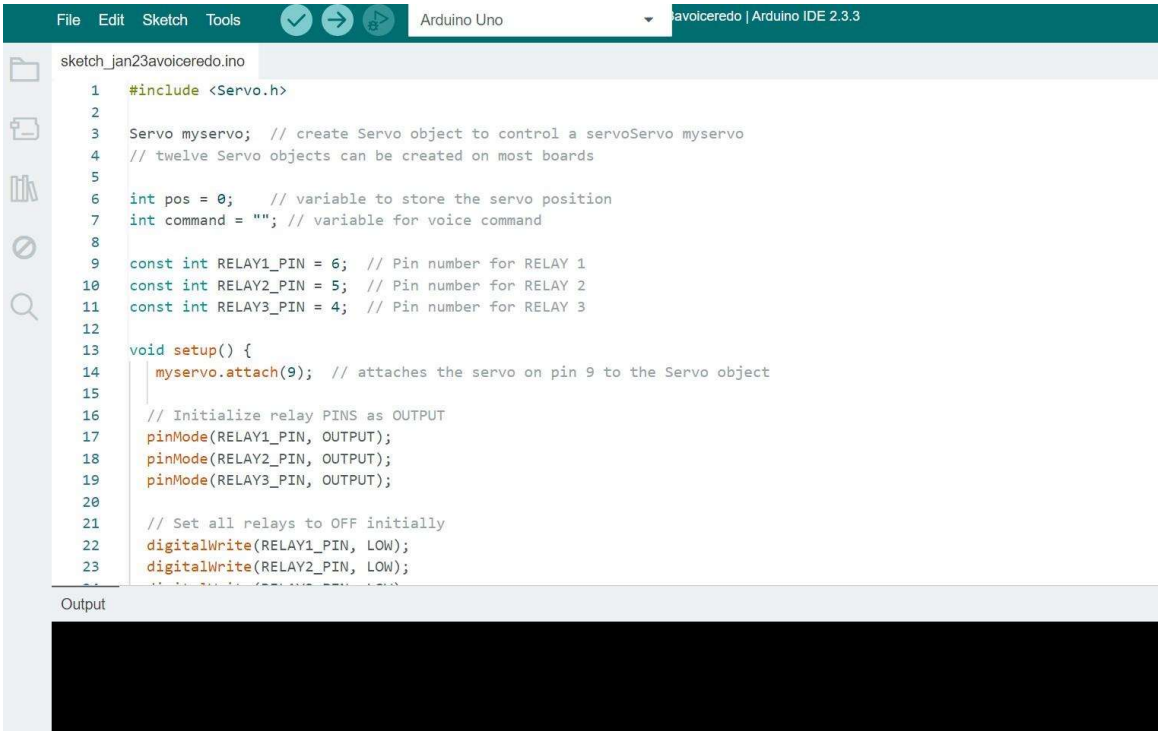
`

END CASE

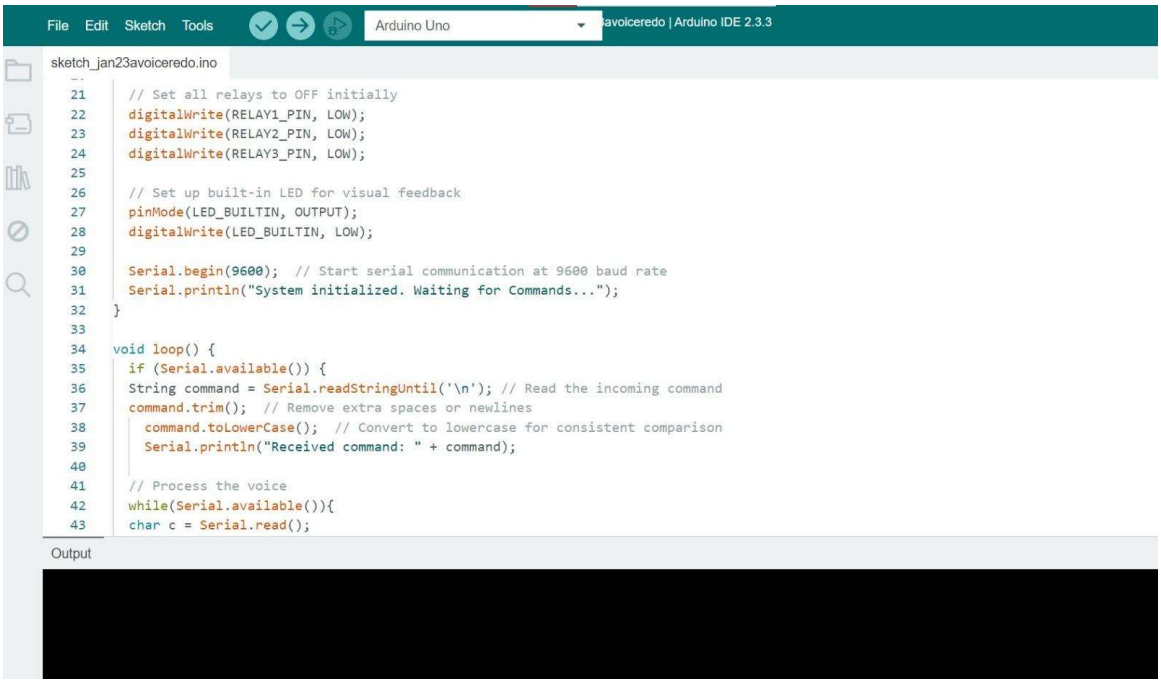
END IF

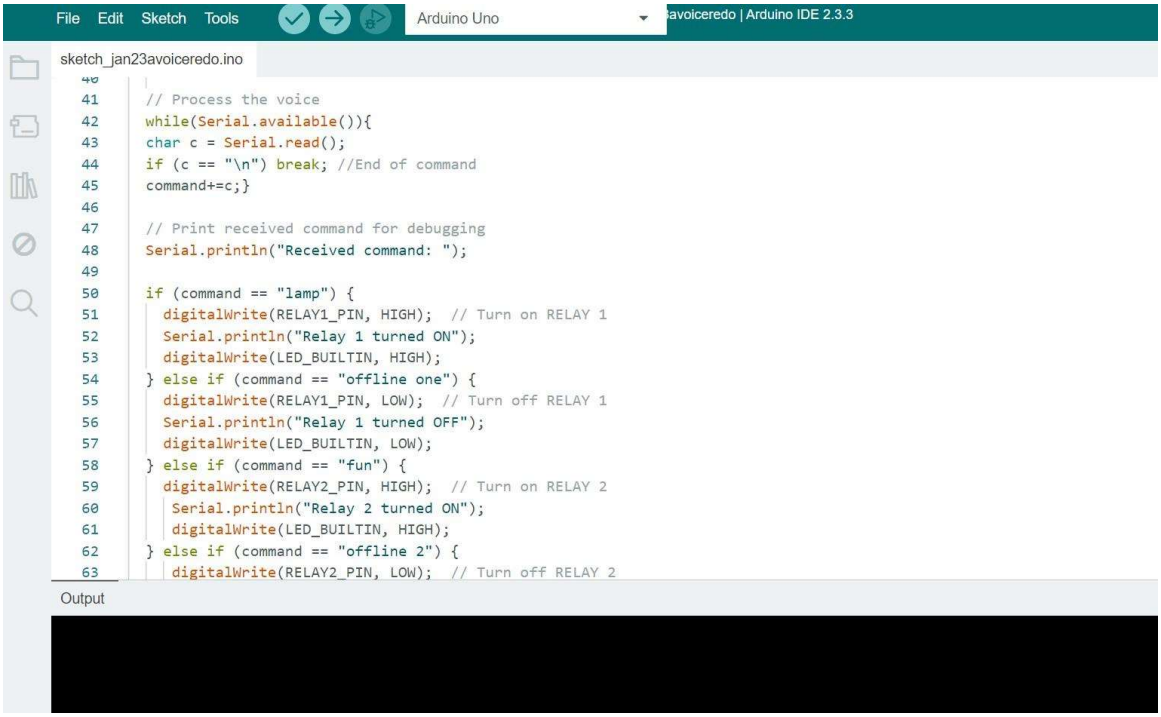
END

3.5 CODE ON ARDUINO IDE

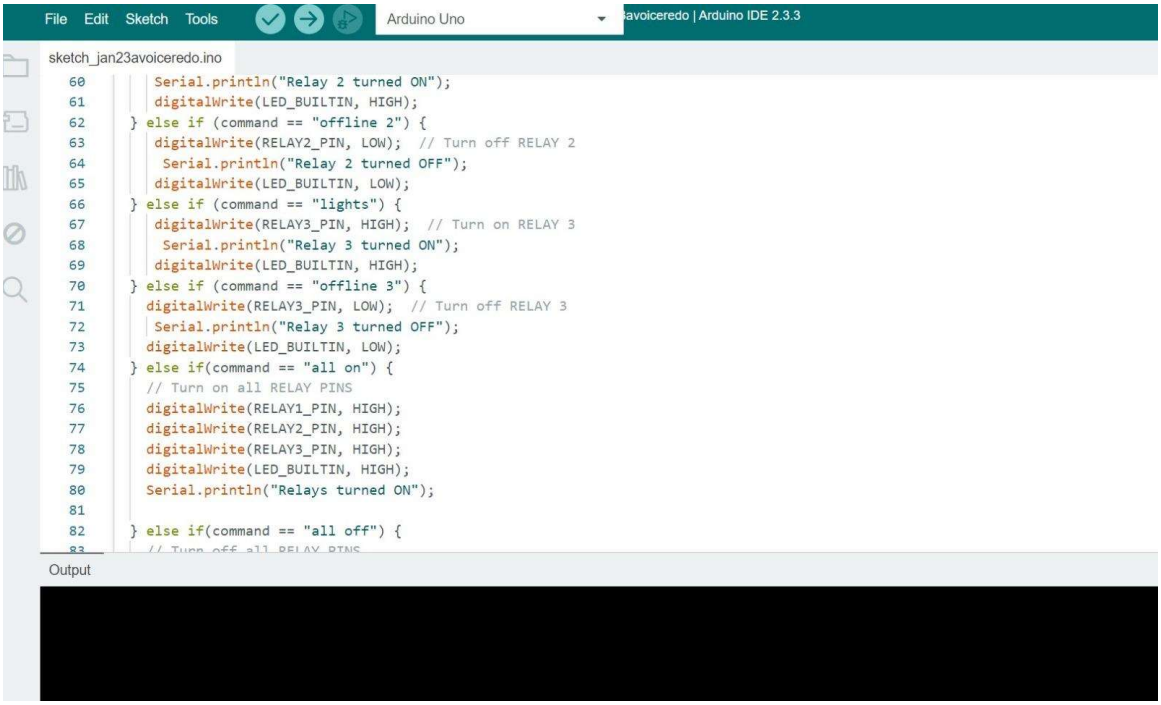


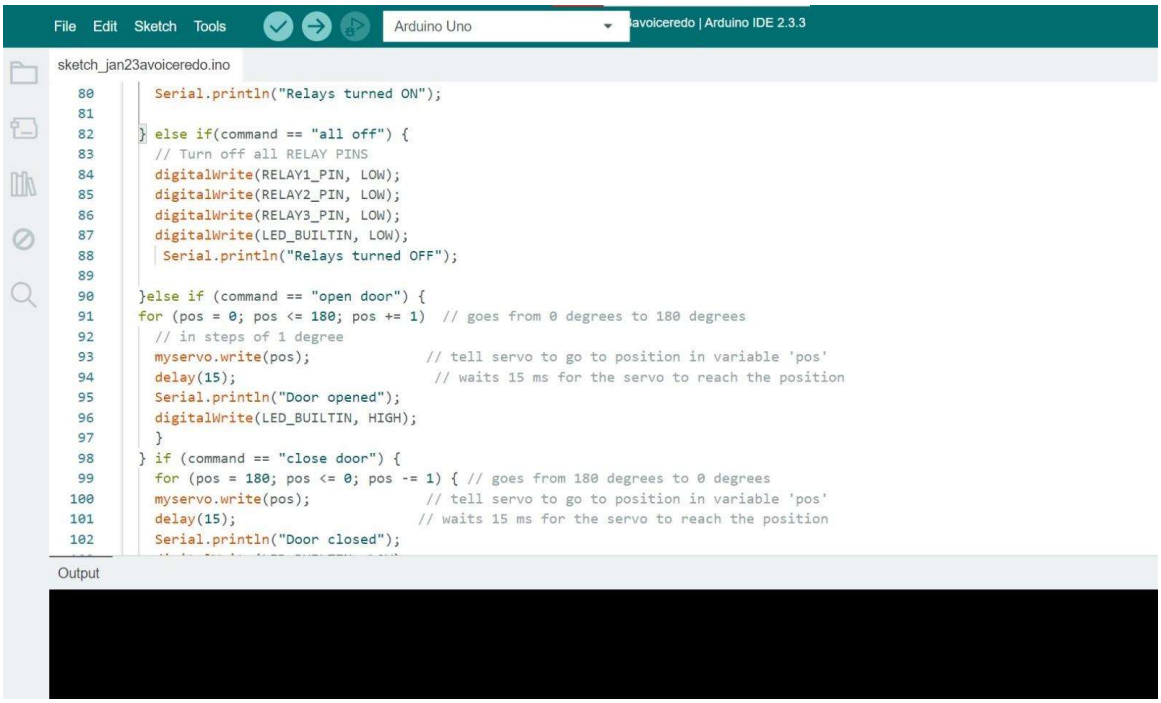
`


File Edit Sketch Tools
Arduino Uno
avoiceredo | Arduino IDE 2.3.3
sketch_jan23avoiceredo.ino
// Set all relays to OFF initially
digitalWrite(RELAY1_PIN, LOW);
digitalWrite(RELAY2_PIN, LOW);
digitalWrite(RELAY3_PIN, LOW);
// Set up built-in LED for visual feedback
pinMode(LED_BUILTIN, OUTPUT);
digitalWrite(LED_BUILTIN, LOW);
Serial.begin(9600); // Start serial communication at 9600 baud rate
Serial.println("System initialized. Waiting for Commands...");
}
void loop() {
if (Serial.available()) {
String command = Serial.readStringUntil('\n'); // Read the incoming command
command.trim(); // Remove extra spaces or newlines
command.toLowerCase(); // Convert to lowercase for consistent comparison
Serial.println("Received command: " + command);
// Process the voice
while(Serial.available()){
char c = Serial.read();
Output

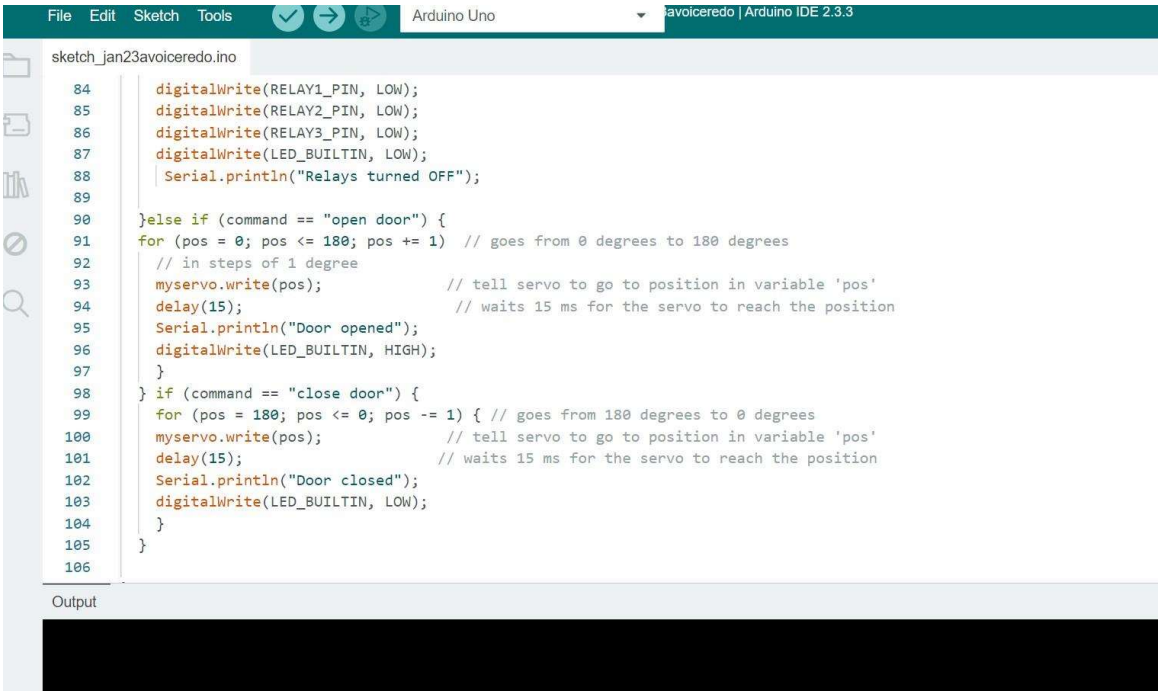

File Edit Sketch Tools
Arduino Uno
avoiceredo | Arduino IDE 2.3.3
sketch_jan23avoiceredo.ino
// Process the voice
while(Serial.available()){
char c = Serial.read();
if (c == "\n") break; //End of command
command+=c;}
// Print received command for debugging
Serial.println("Received command: ");
if (command == "lamp") {
digitalWrite(RELAY1_PIN, HIGH); // Turn on RELAY 1
Serial.println("Relay 1 turned ON");
digitalWrite(LED_BUILTIN, HIGH);
} else if (command == "offline one") {
digitalWrite(RELAY1_PIN, LOW); // Turn off RELAY 1
Serial.println("Relay 1 turned OFF");
digitalWrite(LED_BUILTIN, LOW);
} else if (command == "fun") {
digitalWrite(RELAY2_PIN, HIGH); // Turn on RELAY 2
Serial.println("Relay 2 turned ON");
digitalWrite(LED_BUILTIN, HIGH);
} else if (command == "offline 2") {
digitalWrite(RELAY2_PIN, LOW); // Turn off RELAY 2
Output

`


File Edit Sketch Tools
Arduino Uno
avoiceredo | Arduino IDE 2.3.3
sketch_jan23avoiceredo.ino
Serial.println("Relay 2 turned ON");
digitalWrite(LED_BUILTIN, HIGH);
} else if (command == "offline 2") {
digitalWrite(RELAY2_PIN, LOW); // Turn off RELAY 2
Serial.println("Relay 2 turned OFF");
digitalWrite(LED_BUILTIN, LOW);
} else if (command == "lights") {
digitalWrite(RELAY3_PIN, HIGH); // Turn on RELAY 3
Serial.println("Relay 3 turned ON");
digitalWrite(LED_BUILTIN, HIGH);
} else if (command == "offline 3") {
digitalWrite(RELAY3_PIN, LOW); // Turn off RELAY 3
Serial.println("Relay 3 turned OFF");
digitalWrite(LED_BUILTIN, LOW);
} else if(command == "all on") {
// Turn on all RELAY PINS
digitalWrite(RELAY1_PIN, HIGH);
digitalWrite(RELAY2_PIN, HIGH);
digitalWrite(RELAY3_PIN, HIGH);
digitalWrite(LED_BUILTIN, HIGH);
Serial.println("Relays turned ON");
} else if(command == "all off") {
Output


File Edit Sketch Tools
Arduino Uno
avoiceredo | Arduino IDE 2.3.3
sketch_jan23avoiceredo.ino
Serial.println("Relays turned ON");
} else if(command == "all off") {
// Turn off all RELAY PINS
digitalWrite(RELAY1_PIN, LOW);
digitalWrite(RELAY2_PIN, LOW);
digitalWrite(RELAY3_PIN, LOW);
digitalWrite(LED_BUILTIN, LOW);
Serial.println("Relays turned OFF");
}else if (command == "open door") {
for (pos = 0; pos <= 180; pos += 1) // goes from 0 degrees to 180 degrees
// in steps of 1 degree
myservo.write(pos); // tell servo to go to position in variable 'pos'
delay(15); // waits 15 ms for the servo to reach the position
Serial.println("Door opened");
digitalWrite(LED_BUILTIN, HIGH);
}
} if (command == "close door") {
for (pos = 180; pos <= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
myservo.write(pos); // tell servo to go to position in variable 'pos'
delay(15); // waits 15 ms for the servo to reach the position
Serial.println("Door closed");
Output

`



3.6 System Connection and Wiring in Proteus

1. Connecting the Relays

Pins 6, 5, and 4 of the Arduino Uno are connected to three relay circuits, each consisting of:

A 1KΩ resistor

A 2N2222 transistor

A 1N4007 diode

A relay coil

The Normally Open (NO) terminal of the relay is connected to one side of the appliance (lamp, motor, or LED).

The Common (COM) terminal is connected to a 20V power source shared among the appliances.

`

2. Feedback LED (Green LED) Connection
The green LED is connected to pin 13 of the Arduino.
A 220Ω resistor is placed in series with the LED to limit current.
The LED lights up when an appliance is turned on and turns off when the appliance is turned off.

3. Servo Motor (Automatic Door) Connection
The signal pin of the servo motor is connected to pin 9 of the Arduino Uno.
The other two terminals are connected to power (VCC) and ground (GND).
The servo moves 0° to 180° to open the door and 180° to 0° to close the door.

4. Bluetooth Module Connection
The RX (Receiver) pin of HC-05 is connected to pin 1 (TX) of Arduino Uno.
The TX (Transmitter) pin of HC-05 is connected to pin 0 (RX) of Arduino Uno.
This allows communication between the Arduino and a smartphone app sending voice commands.
How the System Works

Voice Command Recognition:

A smartphone sends a voice command via Bluetooth to the Arduino.
The Arduino reads the command, processes it, and takes action accordingly.

`

3.7 Appliance Control:

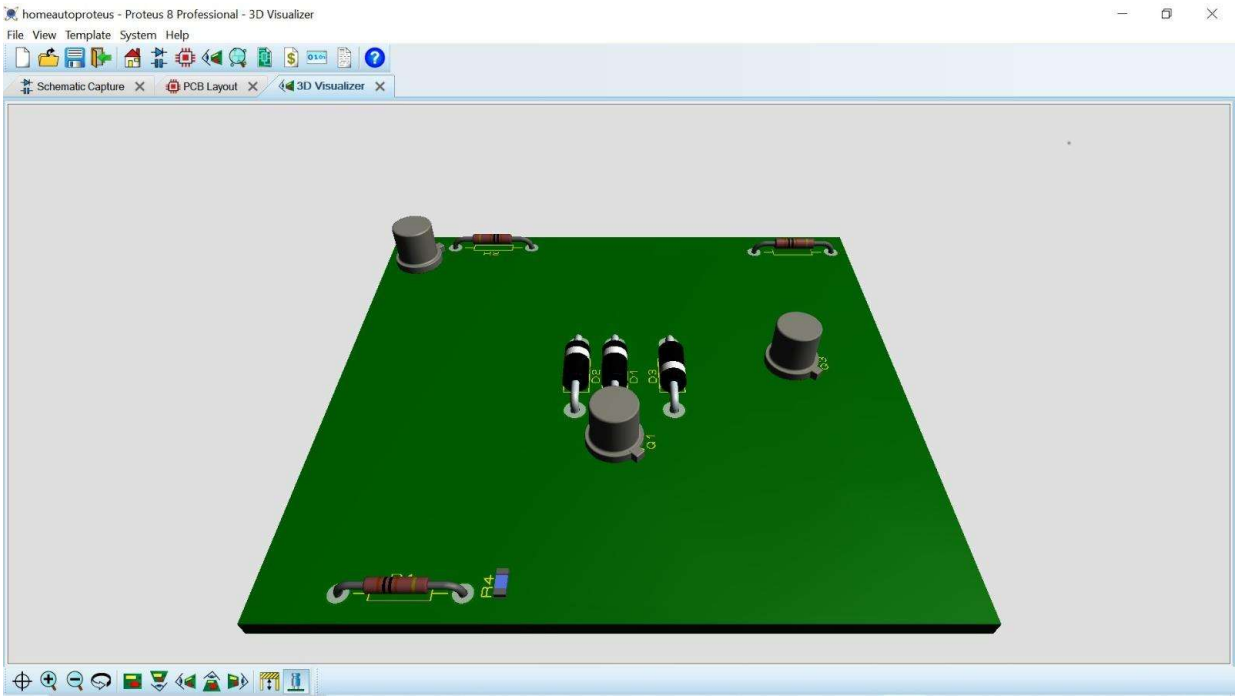
"lamp" → Turns on the light.
“offline one" → Turns off the light.
"fun" → Starts the motor.
"offline 2" → Stops the motor.
"lights" → Turns on the yellow LED.
"offline 3" → Turns off the yellow LED.

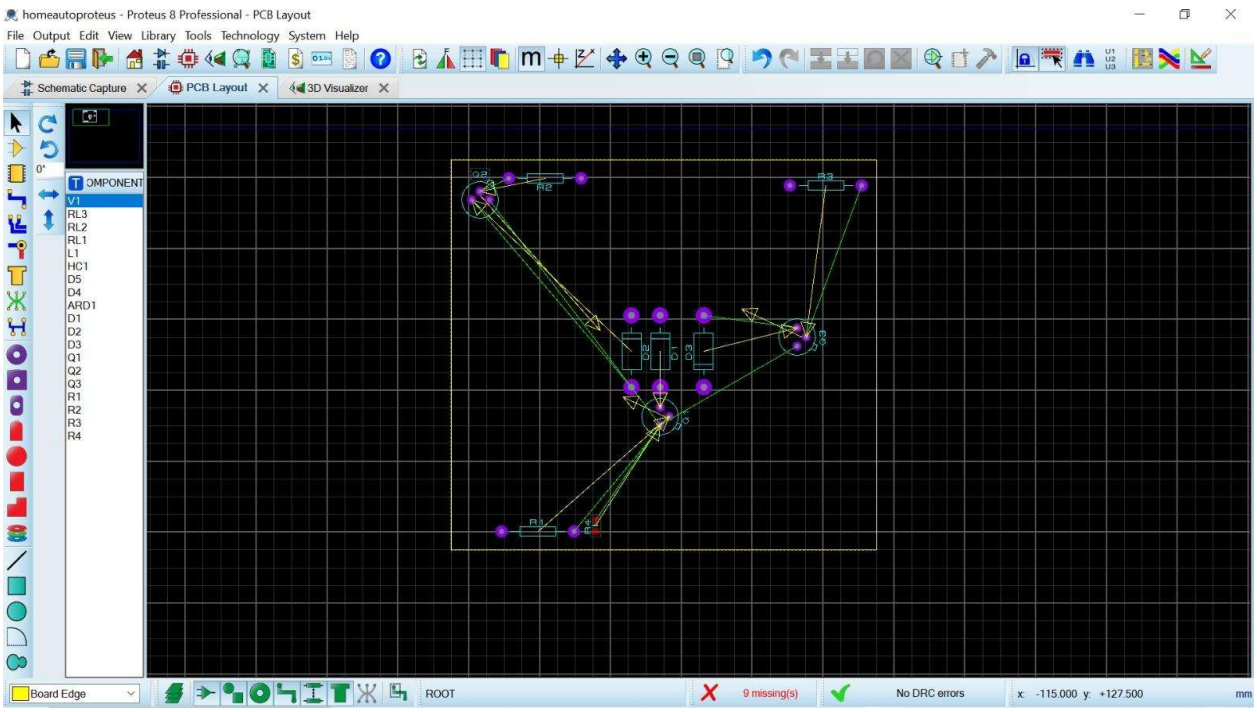
Door Control Using Servo Motor:
"Open door" → The servo motor rotates to 180° to open the door.
"Close door" → The servo motor rotates back to 0° to close the door.

Feedback LED Functionality:
The green LED lights up when an appliance is ON.
The green LED turns off when an appliance is OFF.

`

3.8. 3D VIEW AND PCB LAYOUT OF THE VOICE-CONTROLLED HOME AUTOMATION SYSTEM.



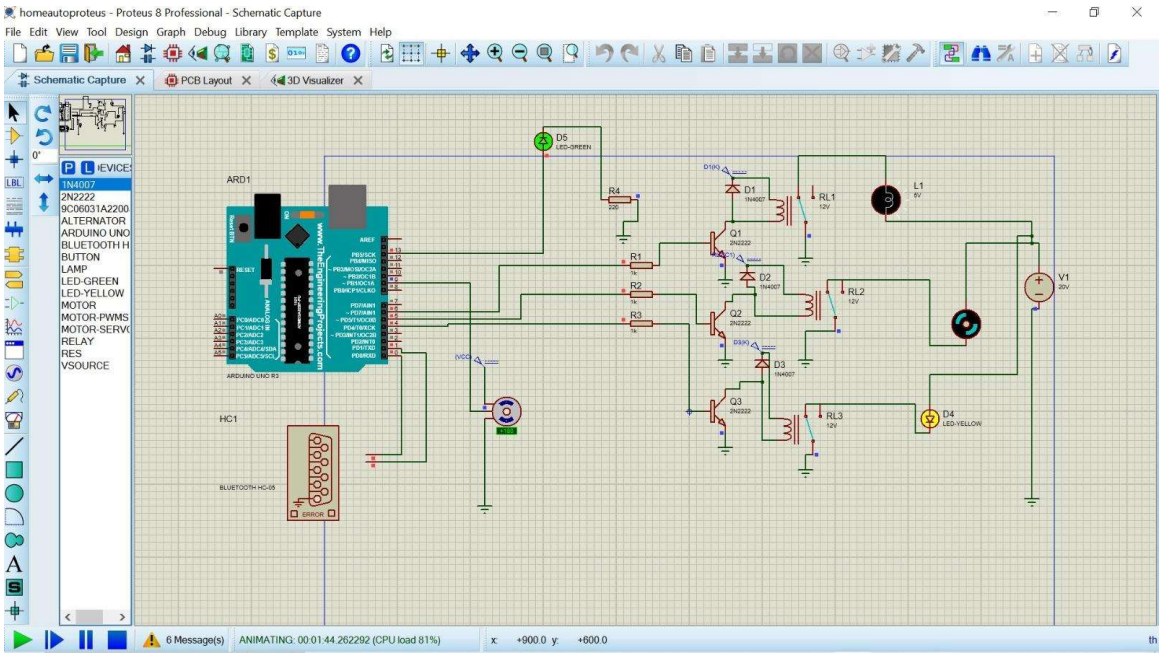


CHAPTER FOUR

`

4. RESULT OF THE SYSTEM

The voice-controlled automation system achieved its core objectives by demonstrating seamless interaction between voice commands and hardware components. The system reliably activated lamps and appliances using keywords like “lamp” and “fun,” while group command commands (“all on/off”) enhanced multi-device control. The servo motor responded effectively to both the “close door” and the open-door instructions simulating a functional automated door. Utilities with LED markings and serial monitoring confirmed command execution. While the prototype performed well under controlled conditions, occasional delays highlighted opportunities for future refinement. Overall, the project validated the practicality of voice-AI integration for everyday automation tasks offering a base for scalable smart home solutions.



CHAPTER FIVE

`

5.0 CONCLUSION

This project demonstrated successfully the viability of integrating voice commands with home automation systems. By enabling control of appliances via keywords such as "lamp" and "lights," and automating door operations through servo motors, the prototype represented practical applications for AI-driven voice recognition in everyday situations. While minor processing delays were noted the system's reliability in executing commands and providing real-time feedback underscored its potential for real-world adoption. Future work could enhance responsiveness through advanced NLP models and expand compatibility with IoT devices. This project lays a foundation for affordable and user-friendly smart home solutions powered by voice AI technology.

5.1. Recommendations for the enhancement of the project.

1. **Enhanced Voice Recognition**: Implement advanced NLP models to improve command accuracy and support natural language inputs.
2. **Scalability**: Integrate IoT compatibility and wireless protocols (e.g., Wi-Fi/Bluetooth) to expand device control capabilities.
3. **User Interface**: Develop a mobile app or web dashboard for real-time monitoring and command customization.
4. **Robust Testing**: Conduct noise-interference tests to optimize performance in real-world environments.

`

5.2. REFERENCES

1. Arduino LLC. (2023). *Arduino Programming Language Reference*. https://www.arduino.cc/reference/en/
2. Banzi, M., & Shiloh, M. (2022). *Getting Started with Arduino: The Open-Source Electronics Prototyping Platform*. Maker Media.
3. Kurniawan, A. (2021). *Voice Recognition Systems with Machine Learning*. IEEE Transactions on Human-Machine Systems, 51(4), 321–330.
4. Servo Library Documentation. (2023). *Servo.h Library for Arduino*. https://www.arduino.cc/reference/en/libraries/servo/
5. Mittal, R. (2020). *Home Automation Using IoT and Voice Commands*. International Journal of Smart Home, 14(3), 45–58.
6. Smith, J. (2019). *Serial Communication Protocols for Embedded Systems*. CRC Press.
7. Hughes, L. (2021). *Practical Electronics: Relays and Switching Circuits*. Newnes.
8. Zhao, Y., & Liu, Q. (2022). *Real-Time Feedback Systems in Embedded Applications*. Journal of Embedded Systems, 8(2), 112–125.
9. OpenAI. (2023). *Natural Language Processing for Command Recognition*. https://openai.com/research
10. Kumar, S. (2021). *Debugging Embedded Systems: Tools and Techniques*. Springer.
11. IoT Alliance. (2023). *IoT Standards for Smart Home Devices*. https://iotalliance.org/standards
12. Patel, A. (2020). *Low-Cost Automation Solutions for Developing Countries*. IEEE Global Humanitarian Technology Conference, 89–94.