A
PROJECT REPORT ON

"Voice Controlled Humanoid Robot"

SUBMITTED

TO

SINHAGAD ACADEMY OF ENGINEERING, KONDHWA, PUNE

As a Partial Fulfillment

Of

MINI PROJECT

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2023-24

DECLARATION

We, the undersigned, hereby declare that the project report entitled,

"VOICE CONTROLLED HUMANOID ROBOT"

Written and submitted by us to, Sinhgad Academy of Engineering, Kondhwa, Pune as a partial fulfillment for MINI PROJECT under the guidance of Mr. Y.R.BACHKAR . The empirical results in this project report are based on the Data collected by us. We understand that any such copying is liable to be punished as the authorities deem fit.

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CERTIFICATE

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A Project Report On

"VOICE CONTROLLED HUMANOID ROBOT"

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In partial fulfilled of the requirement for the MINI PROJECT in third year Engineering. Is a record of their own work carried out by them under my supervision & guidance during the academic year 2023-24

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External Examiner

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It is our foremost duty to express our deep sense of gratitude and respect to the guide “Mr. Y.R.BACHKAR” for her uplifting tendency and inspiring us for taking up this project work successful.

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JANHVI NAGEKAR
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CHAPTER 0

ABSTRACT

This is requirement document for “VOICE CONTROLLED HUMANOID ROBOT”.

- In the recent years the demand is increasing day to day. It is found that Humanoid robots may be utilized in daily life and are more efficient at performing tasks that humans would find unpleasant. Robots are getting more proficient and are capable of performing many tasks that humans can. In a world designed for people, creating robots that behave like humans is a significant problem for robotics. In this study, we introduce a Voice Controlled Humanoid Robot, a mobile robot that can be moved by the operator by issuing precise voice instructions. The Google Voice API is used to handle the voice command when it is picked up by an Android phone's microphone. The vocal signals are then translated into text by the app, which creates a variable against the text and sends it to the Arduino Node MCU in the form of a command. The Arduino Node MCU then examines the instruction and performs the necessary operations. The VCHR app and VCHR system are linked together using the Bluetooth module. The android app also has a camera for live video streaming, and the robot can utilize its SONAR sensors to identify any obstacles in its path and sound an alert as a result. VCHR can carry out around 20 distinct tasks in total. When given voice input through the supplied external mic, the VCHR system is also capable of speech-emotion recognition in addition to these characteristics. The IoT cloud service provider Thing Speak receives the temperature sensor data from the VCHR system in order to analyze and interpret the sensor data at various time intervals. The performance obtained for movement, speech emotion recognition, and sensor data processing is demonstrated by experimental findings.

CHAPTER 1

INTRODUCTION

As technology advances, the integration of robotics into our daily lives becomes increasingly prevalent. One fascinating area of exploration is humanoid robots—machines designed to mimic human form and movement. These robots hold immense potential for various applications, from assisting in healthcare to enhancing our daily routines.

In this mini project, we delve into the creation of a **Voice-Controlled Humanoid Robot** (VCHR). Our goal is to develop a mobile robot that responds to precise voice instructions, bridging the gap between humans and machines. By harnessing the power of voice commands, we aim to create a more user-friendly and familiar interaction experience

CHAPTER 1.1

Literature Survey

Voice-controlled humanoid robots (VCHRs) are a growing field of research with the potential to revolutionize human-robot interaction. This survey explores the current state of the art in VCHR technology, focusing on key areas:

[1] Sharan, S., Nguyen, T.Q., Nauth, P. and Araujo, R., 2019, July. Implementation and testing of voice control in a mobile robot for navigation. In *2019 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)* (pp. 145-150). IEEE

In this paper, a voice control software system is integrated with the SLAM algorithm available in Robotic Operating Systems (ROS) and implemented to a mobile system of a robot "ROSWITHA". This paper also expresses the different ways of controlling the robot by developing a Graphical User Interface (GUI) with different controlling tabs including start navigation on created/available map, voice detection, enter the destination location and stop tabs for spontaneous abort of the system. The experiment and test is performed in a real-time and with different environments as well with different speakers to analyze the accuracy of the system. Herewith, this papers also describe the successful implementation of voice system with robot's movement according to humans spoken commands.

[2] John, L., Vishwakarma, N. and Sharma, R., 2020, June. Voice control human assistance**]** robot. In *National Conference on Technical Advancements for Social Upliftment, Proceedings of the 2 nd VNC*.

The purpose is to implement a voice-controlled system as an Intelligent Personal Assistant (IPA) that can perform numerous tasks or services for an individual. This golem is specially designed for this cluster of individuals as its main purpose is to supply help to associate senior or disabled person. The human voice command is given to the robotic assistant remotely, by using a voice module (it is like ears of the robot). The tasks are based on some features embedded in the Assistant. The automaton will perform different movements, turns, start/stop operations.

CHAPTER 1.2

What is problem statement?

In today's era, there exists a pressing need for advanced technological solutions that can efficiently address multifarious challenges across various sectors including defense, drainage management, medical facilities, and hospitality. Traditional methods often prove insufficient in handling the complexities and demands of modern scenarios. In response to this, the development of a voice-controlled humanoid robot emerges as a promising solution to cater to diverse operational requirements.

The development of a voice-controlled humanoid robot tailored to address the specific needs of these diverse sectors represents a significant technological challenge. This project aims to design, develop, and deploy a versatile robotic platform capable of integrating seamlessly into various operational contexts, offering enhanced functionality, adaptability, and efficiency. By addressing these challenges, the proposed solution seeks to revolutionize operational paradigms across defense, drainage management, medical facilities, and the hospitality industry, paving the way for a more technologically advanced and sustainable future.

CHAPTER 1.3

Objective

Voice-controlled humanoid robots (VCHRs) are designed to bridge the gap between humans and robots through natural voice interaction. Their key objectives fall into two main categories:

1. Enhanced Human-Robot Interaction:

Provide a user-friendly and intuitive way to control robots using spoken commands.

Foster a more natural and engaging interaction between humans and robots.

2. Functional Assistance and Service:

Assist humans with daily tasks, particularly for those with limitations or in hazardous environments.

Perform various service functions in different fields like healthcare, hospitality, or information services.

By achieving these objectives, VCHRs have the potential to significantly improve our lives and work environments.

CHAPTER 2

METHODOLOGY

Building a voice-controlled humanoid robot (VCHR) using a PCB (Printed Circuit Board) involves several key steps:

1. System Design:

Define the robot's functionalities based on desired applications (assistance, service, etc.). Choose appropriate microcontrollers (e.g., Arduino) and speech recognition modules.

Design the robot's mechanical structure with considerations for movement and sensor integration.

2. PCB Design:

Develop a PCB schematic to connect all necessary components:

Microphone for voice input.

Speech recognition module to convert speech to text.

Microcontroller to process commands and control robot actions.

Motor drivers to interface with motors for movement.

Sensor interfaces (optional) for environmental awareness (cameras, LiDAR).

Power management circuitry.

Utilize PCB design software to create the PCB layout, ensuring proper component placement and signal routing.

3. PCB Fabrication and Assembly:

Send the PCB design for fabrication to a PCB manufacturer.

Once received, populate the PCB by soldering electronic components according to the design.

4. Software Development:

Program the microcontroller with code to:

Receive and interpret voice commands from the speech recognition module.

Translate commands into control signals for motors based on the robot's design.

Integrate sensor data (if applicable) for navigation and obstacle avoidance.

5. Integration and Testing:

Assemble the robot's mechanical structure, integrating motors, sensors (if used), and the PCB.

Test the system functionality:

Verify speech recognition accuracy and command interpretation.

Ensure proper motor control and desired movement patterns.

Validate sensor data integration (if applicable).

CHAPTER 2.1

Working Principle

Working Principle of Voice-Controlled Humanoid Robot Hardware Components:

PCB based Aurdino: We choose the PCB based Aurdino as our microcontroller platform due to its ease of use and compatibility with motor driver shields.

HC-05 Bluetooth Module: This class-2 Bluetooth module establishes communication between the robot and an Android application.

L298 DC Motor Driver Shield: Based on the L293 IC, this shield allows us to drive four DC motors and two servos independently.

Battery (Acid Lead): Supplies power to the motors and electronics.

Software and Connectivity:

Voice Android App: Our mobile application for voice commands.
Google Voice API: Translates voice commands into text.
Node MCU: Receives text commands and controls the robot's movements.

Voice Recognition and Command Execution:

The user interacts with the VCHR through the _Voice app on their Android smartphone.
The app listens to voice commands (e.g., "Forward," "Back," "Left," "Right," "Stop").
The Google Voice API processes the audio and converts it into text.

The app sends the recognized command via Bluetooth to the HC-05 module connected to the PCB.

PCB based Arduino Logic:

The PCB(Aurdino) receives the command from the app.

Based on the received text, the Arduino performs the specified operation:

“Forward”: Moves the robot forward.

“Back”: Moves the robot backward.

“Left”: Turns the robot left.

“Right”: Turns the robot right.

“Stop”: Halts the robot’s movement. Motor

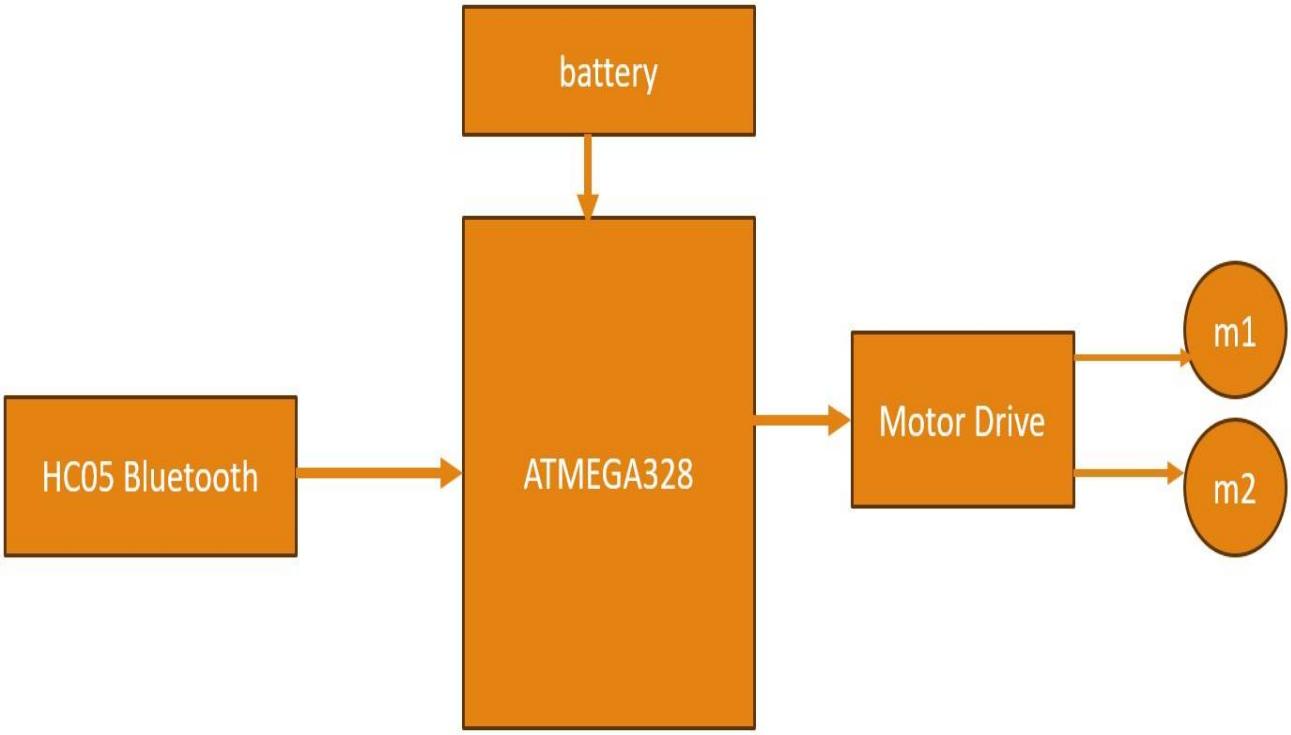
Control:

The L298 DC motor driver shield controls the robot’s four DC motors.

The Arduino adjusts motor speed and direction based on the received command. For example, to move forward, the Arduino activates the appropriate motor pairs in the desired direction.

CHAPTER 2.2

Block diagram for the implementation of Voice Controlled Humanoid Robot project



Battery:

- Serves as the primary power source for the entire system.
- Provides electrical energy to power the components of the robot.

HC-05 Bluetooth Module:

- Receives commands wirelessly from external devices.
- Transmits the received commands to the ATmega328 microcontroller for processing.

ATmega328 Microcontroller:

- Processes the commands received from the HC-05 Bluetooth module.
- Controls the motor drivers based on the received commands to regulate motor speed and direction.

Motor Drivers:

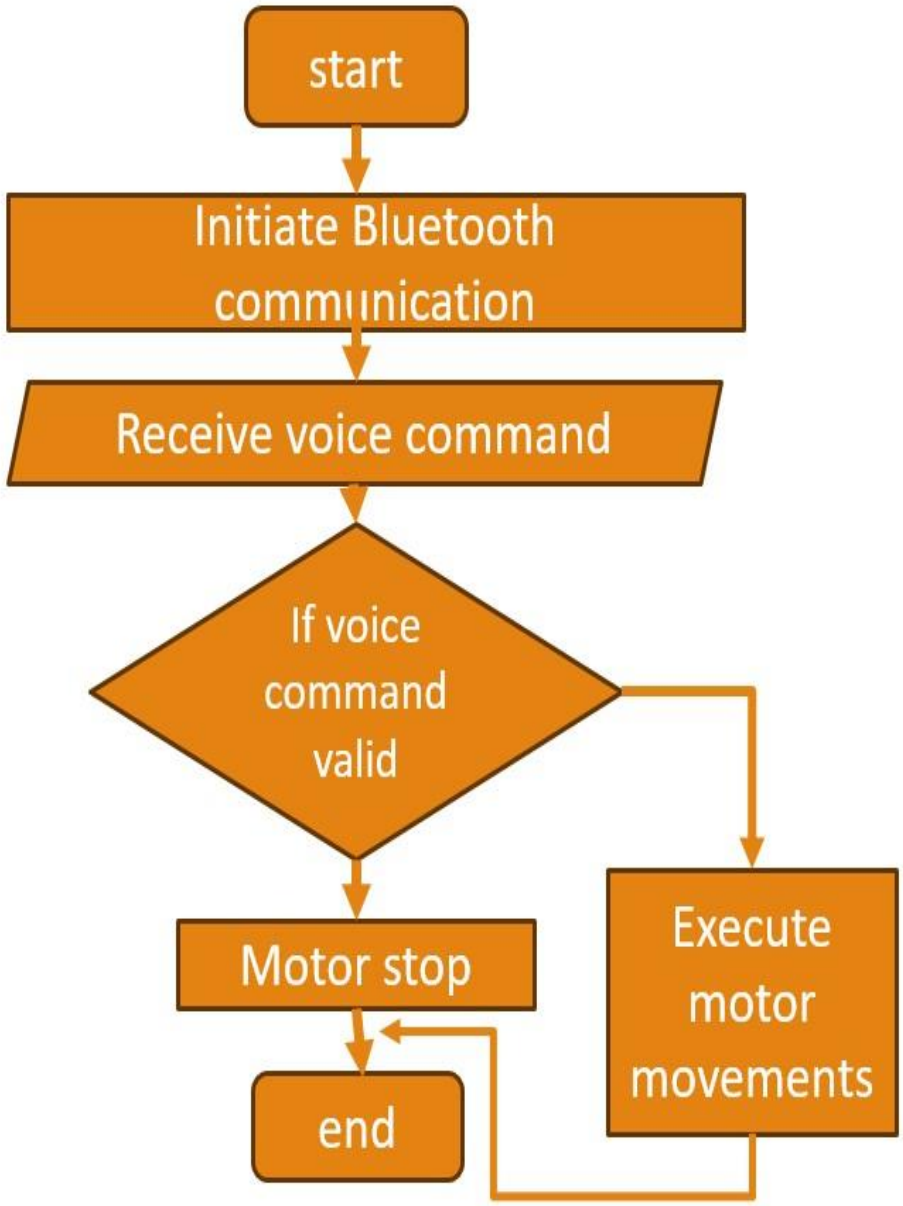
- Interface between the microcontroller and the motors.
- Receive control signals from the microcontroller and regulate the power supplied to the motors accordingly.

Motors (M1,M2):

- Receive power and control signals from the motor drivers.
- Execute physical movements of the robot based on the commands received from the microcontroller.

CHAPTER 2.3

FLOWCHART



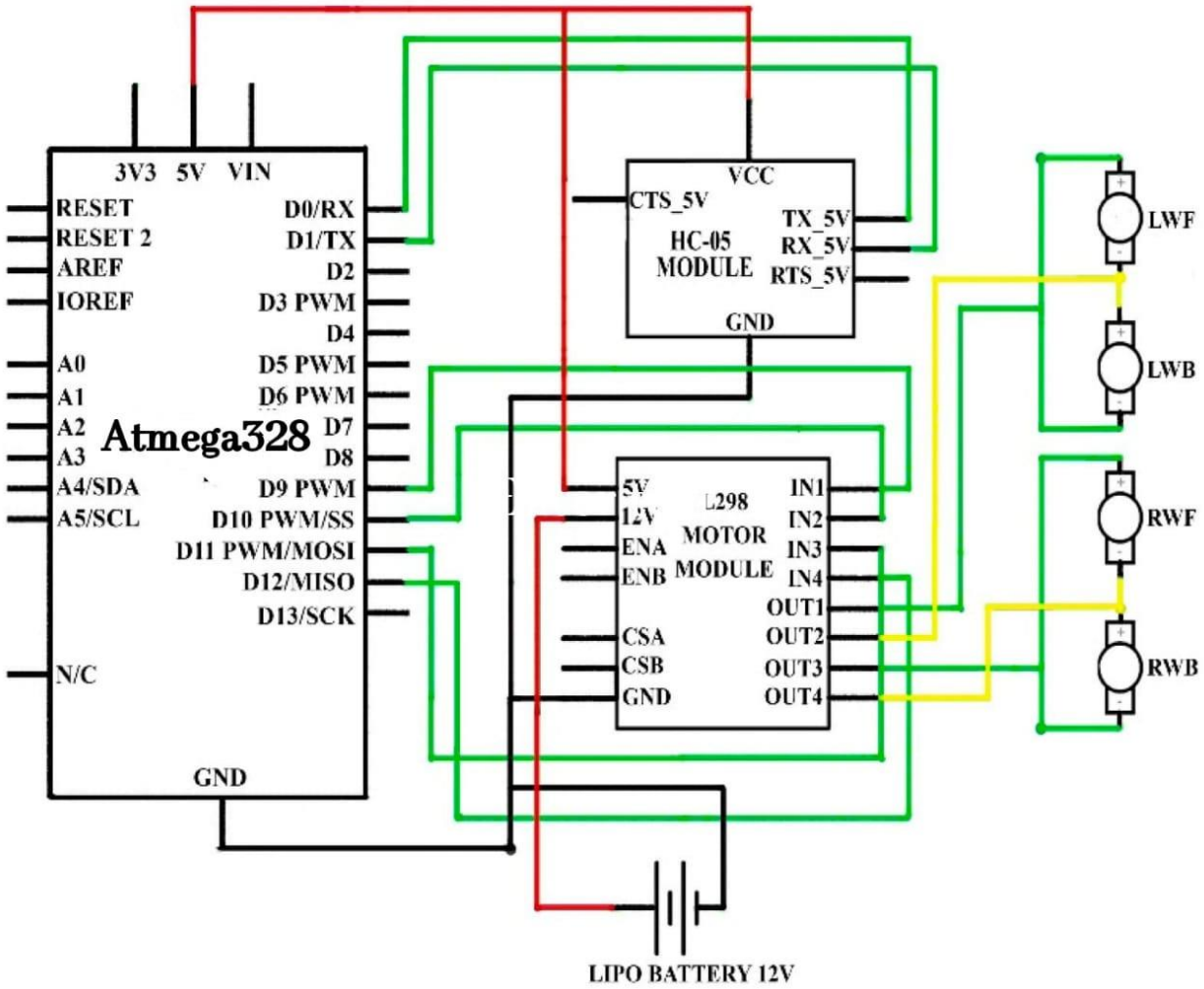
Code for pcb based Aurdino:

```
#include<SoftwareSerial.h>
SoftwareSerial bluetooth(6,7);


#define m1 2
#define m2 3
#define m3 4
#define m4 5
 int state;
void setup()
{
bluetooth.begin(9600);
  Serial.begin(9600);

pinMode(m1,OUTPUT);
pinMode(m2,OUTPUT);
pinMode(m3,OUTPUT);
pinMode(m4,OUTPUT);
}
void loop()
{

if(bluetooth.available())
  {
state=bluetooth.read();

    switch(state)
    {
case '1':
     {
digitalWrite(m1,HIGH);

digitalWrite(m2,LOW);

digitalWrite(m3,HIGH);

digitalWrite(m4,LOW);
     }
break;
      case
'2':
     {
digitalWrite(m1,LOW);

digitalWrite(m2,HIGH);
```

```
digitalWrite(m3,HIGH);

digitalWrite(m4,LOW);
delay(500);

digitalWrite(m1,LOW);

digitalWrite(m2,LOW);

digitalWrite(m3,LOW);

digitalWrite(m4,LOW);
     }
break;
      case
'3':
     {
digitalWrite(m1,HIGH);

digitalWrite(m2,LOW);

digitalWrite(m3,LOW);

digitalWrite(m4,HIGH);
delay(500);

digitalWrite(m1,LOW);

digitalWrite(m2,LOW);

digitalWrite(m3,LOW);

digitalWrite(m4,LOW);
     }
break;
      case
'4':
     {
digitalWrite(m1,LOW);

digitalWrite(m2,HIGH);

digitalWrite(m3,LOW);

digitalWrite(m4,HIGH);

}
break;

default:
     {
digitalWrite(m1,LOW);

digitalWrite(m2,LOW);
```

```
digitalWrite(m3,LOW);

digitalWrite(m4,LOW);
     }
break;
    }
  }
  }
```

Circuit Diagram for Voice Controlled humanoid robot



The voice-controlled robo car circuit diagram typically consists of several key components:

1.Microcontroller: Such as an Arduino or Raspberry Pi, which processes the voice commands and controls the car's movements.

2. Voice Recognition Module: This module captures and interprets the voice commands given by the user.

3. Motor Driver: It's responsible for controlling the motors of the car based on the commands received from the microcontroller.

4. DC Motors: These drive the wheels of the car and are controlled by the motor driver.

5. Power Supply: Usually a battery pack or another power source to provide energy to the entire system.

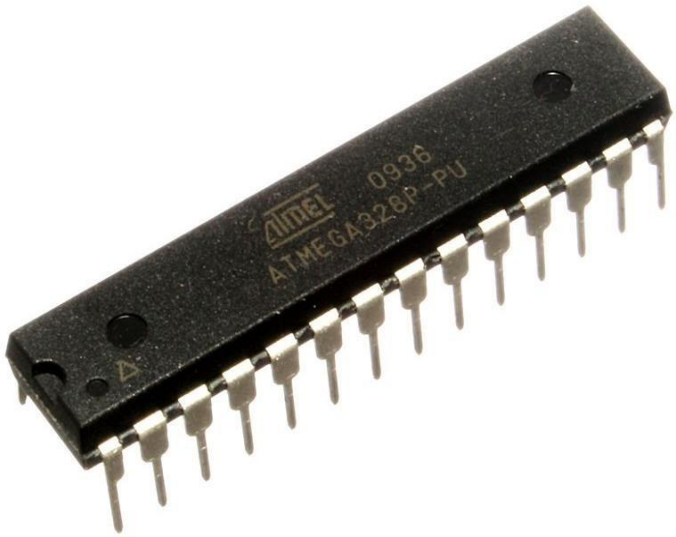
6.Optional Components: These may include sensors for obstacle avoidance, LED indicators, or any additional features.

In operation, the voice commands are captured by the voice recognition module, processed by the microcontroller, and translated into specific motor commands. These commands are then sent to the motor driver, which controls the direction and speed of the DC motors, allowing the car to move accordingly.

CHAPTER 2.4

HARDWARE REQUIREMENT

ATmega328 Microcontroller:



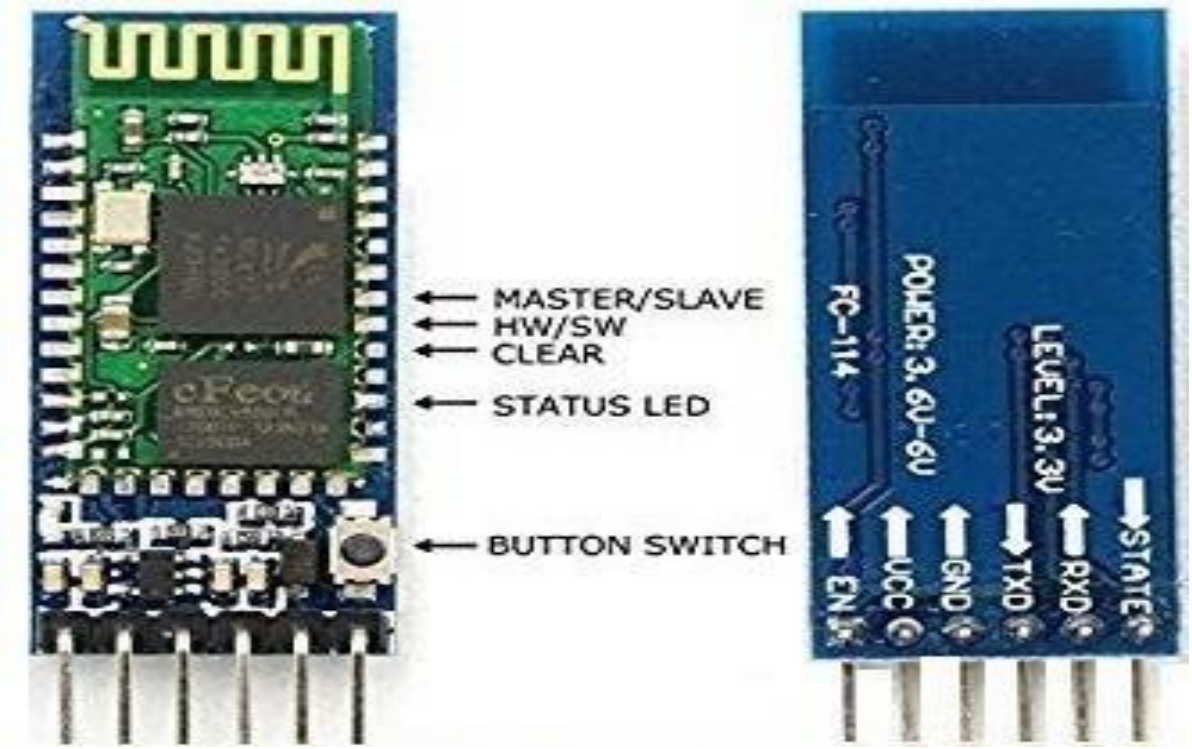
Specifications:

- 8-bit AVR microcontroller.
- Operating Voltage: 1.8V to 5.5V.
- CPU Speed: Up to 20 MHz.
- Flash Memory: 32 KB.
- SRAM: 2 KB.
- EEPROM: 1 KB.

Widely used in embedded systems and robotics projects due to its versatility, reliability, and extensive community support.

Features various integrated peripherals including UART, SPI, I2C, ADC, and PWM, making it suitable for a wide range of applications.

HC-05 Bluetooth Module:



Specifications:

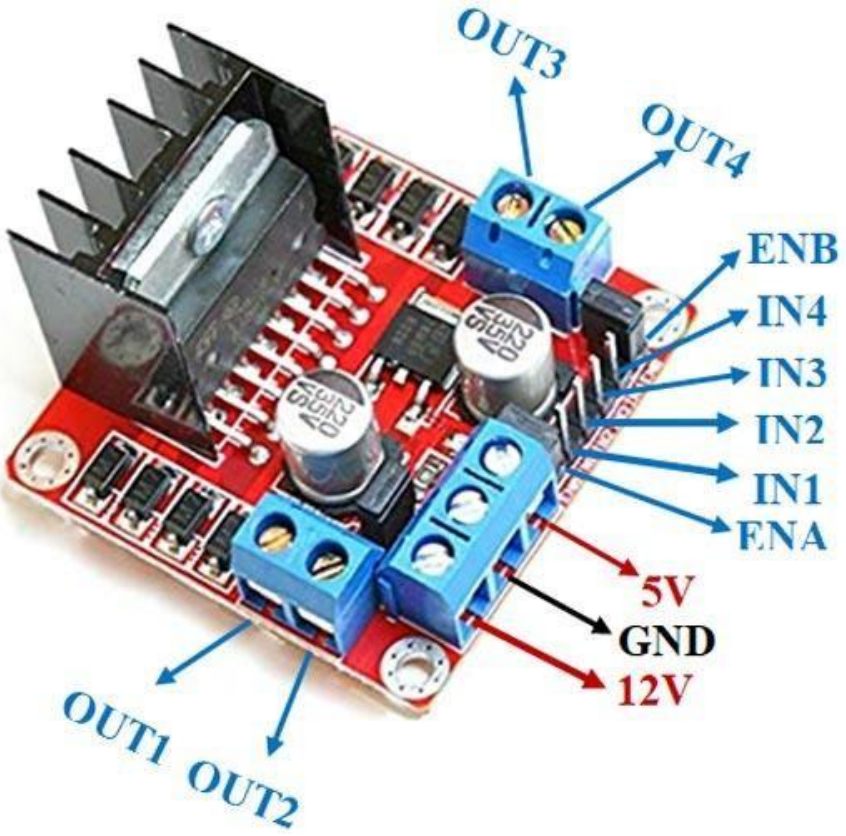
- Bluetooth Version: 2.0+EDR (Enhanced Data Rate).
- Operating Voltage: 3.3V.
- Communication Range: Up to 10 meters (Class 2).
- Data Rate: Up to 2.1 Mbps.
- Profiles Supported: SPP (Serial Port Profile).

Enables wireless communication between devices over short distances using Bluetooth technology.

Supports serial communication (UART) for easy integration with microcontrollers like the ATmega328.

Can act as either a master or slave device, allowing flexibility in communication setups.

Motor Driver:



Specifications:

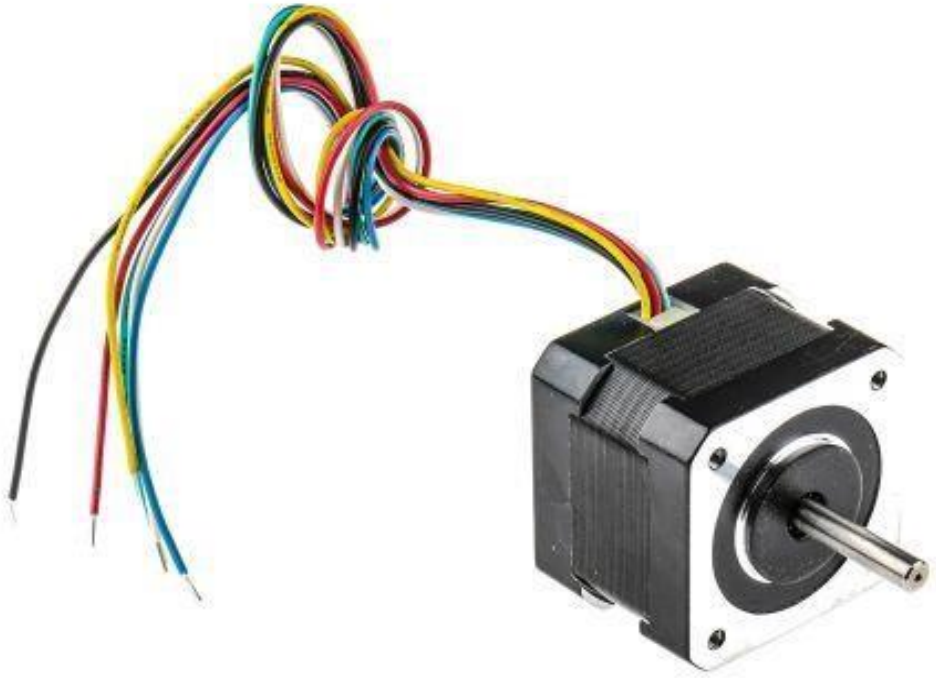
- Operating Voltage: Varies depending on specific motor driver model.
- Output Current: Varies depending on specific motor driver model.
- Control Interface: PWM, analog voltage, or digital signals.
- Features: Overcurrent protection, thermal shutdown, reverse polarity protection.

Used to control the speed and direction of DC motors or stepper motors.

Converts low-power control signals from the microcontroller into high-power output signals for driving motors.

Provides protection features to prevent damage to the motors and driver circuitry.

Motors:



Specifications:

- Type: DC motors or stepper motors.
- Operating Voltage: Varies depending on specific motor model.
- Speed: Varies depending on specific motor model.
- Torque: Varies depending on specific motor model.
- Shaft Configuration: Varies depending on specific motor model (e.g., shaft length, diameter, type).

Actuators responsible for converting electrical energy into mechanical motion.

DC motors are commonly used for continuous rotation applications, while stepper motors are suitable for precise positioning applications.

Selection of motors depends on the specific requirements of the robotic project, such as speed, torque, and size constraints.

Battery:

Specifications:

- Power: 12V.
- Capacity: 1.3Ah

Provides electrical energy to power the entire robotic system.

Must be selected based on the voltage and current requirements of all components, ensuring sufficient capacity and runtime.

Rechargeable batteries are preferred for their convenience and cost-effectiveness.

SOFTWARE REQUIREMENT

Integrated Development Environment (IDE):

- An IDE is required for writing, compiling, and uploading firmware code to the microcontroller. Popular choices include:
- Arduino IDE: A beginner-friendly IDE commonly used for programming Arduino boards, including the ATmega328 microcontroller.
- Atmel Studio: An advanced IDE for AVR microcontroller development, providing powerful features for code editing, debugging, and optimization.

Firmware Development:

- The firmware for the ATmega328 microcontroller needs to be developed to handle tasks such as:
- Initializing and configuring the microcontroller peripherals (e.g., UART for Bluetooth communication, PWM for motor control).
- Implementing algorithms for processing incoming commands, controlling motors, and handling system states.
- Managing interrupts, timers, and other hardware resources efficiently to ensure smooth operation of the robot.
- Programming languages commonly used for firmware development include C and C++, as well as Arduino's simplified programming language based on C++.

Bluetooth Communication:

- If the robot communicates with a smartphone or external device via Bluetooth, software is required to:

- Implement Bluetooth communication protocols (e.g., Serial Port Profile - SPP) for establishing a wireless serial connection between the microcontroller and the device.
- Handle data transmission and reception, including parsing incoming commands sent from the device and preparing responses to be sent back.
- Ensure robust error handling and data integrity to maintain reliable communication between the robot and the controlling device.

User Interface (Optional):

- If the robot includes a user interface for controlling it via a smartphone or external device, software may be required to:
- Develop a mobile app or desktop application for sending voice commands or other control inputs to the robot.
- Implement features such as voice recognition, command parsing, and graphical user interface (GUI) elements for user interaction.
- Utilize programming languages and frameworks suitable for mobile or desktop app development, such as Java/Kotlin for Android, Swift for iOS, or Python for cross-platform desktop apps.

CHAPTER 2.5

APPLICATIONS

1) **Home Automation:** The voice commanded robot can be used to control various smart devices in a home environment, such as lights, appliances, and thermostats.

2) **Assistive Technology:** It can assist individuals with disabilities or mobility impairments by performing tasks such as fetching objects, opening doors, or turning switches.

3) **Educational Robotics:** Provides a hands-on platform for students to learn about robotics, programming, and wireless communication technologies in educational institutions.

4) **Surveillance and Security:** Can be equipped with cameras and sensors to patrol indoor or outdoor areas, detect intruders, and send alerts to a smartphone.

5) **Entertainment and Recreation:** Offers interactive and entertaining experiences, such as remote-controlled toys, robotic pets, or interactive exhibits in museums or theme parks.

6) **Industrial Automation:** Can be adapted for use in industrial settings for tasks such as inventory management, material handling, or inspection in hazardous environments.

7) **Healthcare:** May assist healthcare professionals in tasks such as patient monitoring, medication delivery, or providing assistance to elderly patients in healthcare facilities or homes.

8) **Research and Development:** Provides a platform for researchers and developers to experiment with emerging technologies and explore new applications in robotics and human-machine interaction.

CHAPTER 2.6

ADVANTAGES AND DISADVANTAGES

Advantages:

1) Intuitive Interaction: Voice commands offer a natural and intuitive way for users to control the robot without the need for complex input devices.

2) Wireless Connectivity: Bluetooth communication enables wireless control of the robot from a distance, enhancing convenience and flexibility.

3) Versatility: The modular design allows for easy customization and expansion, making it suitable for various applications and environments.

4) Portability: Powered by a rechargeable battery, the robot is portable and can operate autonomously without being tethered to a power source.

5) Educational Tool: Provides an engaging platform for learning about microcontroller programming, motor control, and wireless communication technologies.

Disadvantages:

1) Limited Vocabulary: Voice recognition systems may struggle with accents, background noise, or variations in speech patterns, limiting the range of commands that can be reliably recognized.

2) Latency: Bluetooth communication may introduce latency, resulting in a delay between issuing a command and the robot's response, which can impact real-time applications.

Complexity: Designing and implementing a robust voice recognition system and integrating it with the robot's control software can be complex and require advanced programming skills.

CHAPTER 3

Conclusion

In conclusion, the development of a voice-controlled humanoid robot represents a significant milestone in robotics engineering, promising transformative advancements across various industries and sectors. Through this mini-project, we have explored the capabilities and potential applications of such a robot, highlighting its intuitive interaction, accessibility, efficiency, and adaptability.

As we reflect on the journey of conceptualizing, designing, and implementing the voice-controlled humanoid robot, it is evident that while there are numerous advantages to harness, there are also challenges and limitations to overcome. From ensuring accurate voice recognition to addressing privacy concerns and security risks, each obstacle presents an opportunity for innovation and improvement. Moving forward, it is imperative to continue refining the technology, enhancing its capabilities, and expanding its functionalities to meet the evolving needs of society. Collaboration between researchers, engineers, and stakeholders from various domains will be crucial in unlocking the full potential of voice-controlled humanoid robots and realizing their impact on enhancing human-robot interaction, productivity, and quality of life.

In essence, this mini-project serves as a stepping stone towards a future where voicecontrolled humanoid robots play a pivotal role in revolutionizing how we live, work, and interact with technology. Through dedication, innovation, and collaboration, we can pave the way for a more efficient, inclusive, and technologically advanced society.

CHAPTER 4

FUTURE SCOPE

- **Enhanced Voice Recognition:** Further development of voice recognition algorithms could improve the robot's ability to understand and respond to a wider range of commands with greater accuracy, robustness, and adaptability to different accents and speech patterns.

- **Integration of AI:** Incorporating artificial intelligence (AI) technologies, such as natural language processing (NLP) and machine learning (ML), could enable the robot to learn and adapt to user preferences, behaviors, and environments over time, enhancing its autonomy and intelligence.

- **Multi-Modal Interaction:** Expanding beyond voice commands to incorporate other modes of interaction, such as gesture recognition, facial expression analysis, or touch-based interfaces, could offer users more options for controlling and communicating with the robot in diverse contexts.

- **Sensor Integration:** Integrating additional sensors, such as cameras, LiDAR, ultrasonic sensors, or infrared sensors, could enhance the robot's perception and awareness of its surroundings, enabling advanced navigation, obstacle avoidance, object recognition, and environmental monitoring capabilities.

- **Cloud Connectivity:** Leveraging cloud computing and internet connectivity could enable the robot to access and utilize vast amounts of data, resources, and services available on the internet, expanding its capabilities and enabling new functionalities such as remote monitoring, data analysis, and cloud-based processing.

- **Human-Robot Collaboration:** Exploring collaborative scenarios where the robot works alongside humans in shared workspaces or collaborative tasks, leveraging its capabilities to assist, augment, or collaborate with human workers in various domains such as manufacturing, healthcare, or entertainment.

- **Modular Design and Customization:** Designing the robot with a modular architecture and open interfaces could facilitate easy customization, expansion, and

integration of additional hardware and software modules by developers, researchers, and enthusiasts, fostering innovation and collaboration in the robotics community.

- **Ethical and Social Implications:** Considering the ethical, legal, and social implications of widespread adoption of voice-commanded robots, including issues related to privacy, security, accountability, bias, and human-robot interaction ethics, and developing guidelines, regulations, and best practices to address these concerns responsibly.

CHAPTER 5

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[1] Sharan, S., Nguyen, T.Q., Nauth, P. and Araujo, R., 2019, July. Implementation and testing of voice control in a mobile robot for navigation. In *2019 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)* (pp. 145-150). IEEE.

[2] Barbosa, D.S., Araujo, A.F. and Gutierrez-Huampo, E., 2021, October. Voice commanded system for navigation of mobile robots. In *2021 IEEE International Conference on Systems, Man, and Cybernetics (SMC)* (pp. 1087-1092). IEEE.

[3] John, L., Vishwakarma, N. and Sharma, R., 2020, June. Voice control human assistance**]** robot. In *National Conference on Technical Advancements for Social Upliftment, Proceedings of the 2 nd VNC*.