Project Report

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Subject Name: Internet of Things **Subject Code:E6667**

Aim: To develop a voice-controlled IoT robot that can monitor the environment, perform human-like gestures and respond to commands intelligently.

Objectives:

• To control robot using voice commands and cloud communication.

• To collect real-time data from sensors like PIR and Ultrasonic.

• To perform robot gestures through servo motors.

• To monitor and control robot using IoT Hub.

Components Required:

Sno	Name of Component	Qty.
1.	Raspberry Pi	1
2.	Ultrasonic Sensor (HC-SR04)	1
3.	Power Supply & Jumper Wires	1
4.	Microphone & Speaker	1
5.	Servo Motors (Neck + Left Hand + Right Hand)	1
6.	DHT11 Temperature & Humidity Sensor	1

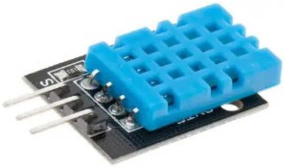
Details of Components:

1.Raspberry Pi: A mini-computer that controls all sensors and motors. It processes voice commands and sends control signals to the robot.

2.Ultrasonic Sensor (HC-SR04): Used to measure the distance of objects using ultrasonic sound waves. Helps in obstacle detection.

3.PIR Motion Sensor: Detects human or animal movement by sensing changes in infrared radiation.

4.DHT11 Sensor: Measures temperature and humidity of the environment and sends data digitally.



4.MQ-3 Gas Sensor: Detects the presence of alcohol or harmful gases and alerts in dangerous conditions.

5. Servo Motors: Used for movements like nodding, waving, and head rotation to show gestures.

6.L298N Motor Driver: Controls motor direction and speed and helps in robot movement.

7.Microphone & Speaker: Microphone receives voice commands, speaker produces alerts or responses.

8.Power Supply: Provides stable voltage to Raspberry Pi and sensors for safe working.

Hardware Pin Connections:

• Servos: BCM 18, 23, 24 (Neck + Left Hand + Right Hand)

• Ultrasonic Sensor: TRIG GPIO 27, ECHO GPIO 22

• PIR Motion Sensor: GPIO 17

• DHT11 Temperature & Humidity Sensor: GPIO 4

• MQ-3 Gas Sensor connected via MCP3008 ADC using SPI pins:

CLK-11, MISO-9, MOSI-10, CS-8

• Motor Driver (L298N) ENA/ENB + IN pins connected to Raspberry Pi GPIO pins

• Audio Input: USB Microphone for voice commands

• Audio Output: 3.5mm/USB speaker for robot response

• All modules share a common ground with Raspberry Pi

Block Diagram of Designed Model:

```
[User Voice]
       |
   [Microphone]
       |
[Raspberry Pi Controller]
 |       |        |         |        |
 |       |        |         |        |
 |   Ultrasonic   |      Gas Sensor (MQ-3 via MCP3008 ADC)
 |    Sensor      |
 |                |
 PIR Sensor     DHT11 Sensor
 |                |
 +--- Environment Monitoring ---+
 |
 Servos (Neck & Arms)
 |
 Motor Driver (L298N)
 |
 Wheels / Movement
 |
[Speaker - Audio Output]
 |
[IoT Hub / Cloud for Remote Control]
```

Working of Designed Model:

The proposed system is designed to create an intelligent robotic platform that can interact with humans through voice commands, perform physical gestures, and collect real-time environmental data using IoT integration. The system combines the power of speech recognition, embedded control, sensor feedback, and cloud-based monitoring to achieve smooth and responsive automation.

1. Voice Command Input

The operation begins when the user gives a voice command through a connected microphone or any compatible audio input device. The voice is converted into a digital signal and processed by the Raspberry Pi, which serves as the central controller of the robot. Using built-in libraries such as *SpeechRecognition* or *Google Voice API*, the Raspberry Pi translates the spoken words into text commands. These recognized commands are then interpreted to determine the desired action, such as moving forward, turning, stopping, waving, or collecting sensor data.

2. Command Processing and Motor Control:

After recognizing the command, the Raspberry Pi executes the corresponding control instructions through GPIO (General Purpose Input/Output) pins. These pins are connected to motor driver modules that control the robot's movement and gestures. Depending on the received command, the Raspberry Pi can send PWM (Pulse Width Modulation) signals to adjust the motor speed and direction. For example, a command like *"Move forward"* activates both motors in the forward direction, whereas *"Turn left"* rotates one motor forward and the other backward. This real-time command processing enables the robot to respond quickly and accurately to human instructions.

3. Sensor Integration and Data Collection:

To enhance functionality, the robot is equipped with various sensors such as ultrasonic sensors, temperature sensors, gas sensors, and light intensity sensors. These sensors continuously collect environmental data, including obstacle distance, ambient temperature, air quality, and light levels. The collected data is transmitted to the Raspberry Pi, which processes it locally and can make autonomous decisions, such as stopping the robot when an obstacle is detected or sending alerts when abnormal conditions are found. This allows the robot to operate safely and intelligently in dynamic environments.

4. Robotic Gestures and Interaction:

Beyond movement, the robot is capable of performing simple gestures such as nodding, waving, or rotating its head to express acknowledgment or responses. Servo motors or stepper motors are used to enable these actions. For instance, when the user says *"Hello,"* the robot may respond by waving its arm or nodding its head as a friendly gesture. Such features not only make the robot more interactive and human-like but also enhance user engagement and communication effectiveness.

5. IoT Connectivity and Remote Monitoring:

A major feature of the system is its Internet of Things (IoT) integration. The Raspberry Pi is connected to an IoT Hub or a cloud platform such as ThingSpeak, Blynk, or Azure IoT Hub. Through this connection, sensor readings and operational status are continuously uploaded to the cloud. Remote users can monitor these readings in real-time using dashboards or mobile applications. Additionally, the system can generate alerts and notifications if certain thresholds are crossed—for example, if the temperature exceeds a predefined limit or an obstacle is detected within a danger range. This ensures that the robot can be supervised and controlled even from distant locations, making it suitable for applications such as surveillance, industrial monitoring, or home automation.

Pictures of Prototype:

Learning outcomes (What I have learnt):

1. Learned integration of sensors with Raspberry Pi.

2. Understood IoT monitoring and control system.

3. . Implemented human-like gestures using servo motors.

4. Built a smart interactive robot model.