DEVELOPMENT OF SURVEILLANCE ROBOT TO MONITOR THE PERFORMANCE OF ANIMALS IN FOREST

A MINI PROJECT REPORT

Submitted by

GEETHA M	**420420104011**
SRIMATHI V	**420420104048**
TEENA D	**420420104054**
JAYASHREE K	**420420104307**

in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

ADHIPARASAKTHI ENGINEERING COLLEGE

MELMARUVATHUR-603 319

ANNA UNIVERSITY:: CHENNAI 600 025

MAY 2023

ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report titled **"DEVELOPMENT OF SURVEILLANCE ROBOT TO MONITOR THE PERFORMANCE OF ANIMALS IN FOREST"** is the bonafide work of **GEETHA M (420420104011), TEENA D (420420104054), JAYASHREE K (420420104307), SRIMATHI V (420420104048)** who carried out the work under my supervision.

SIGNATURE	**SIGNATURE**
Dr. C. DHAYA, Ph.D.,	**Mrs. P. GAJALAKSHMI, M.E.,**
Professor/CSE	**Assistant Professor/CSE**
HEAD OF DEPARTMENT	**SUPERVISOR**
Department of CSE	Department of CSE
Adhiparasakthi Engineering College	Adhiparasakthi Engineering College
Melmaruvathur - 603 319.	Melmaruvathur - 603 319.

Submitted for the (CS8611) Mini project and viva-voce examination held on.…………………at Adhiparasakthi Engineering College, Melmaruvathur.

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ACKNOWLEDGEMENT

With the divine blessings of **Goddess Adhiparasakthi**, I express my deep gratitude for the spiritual blessings of His holiness **PADMA SHRI ARULTHIRU AMMA** and the divine guidance of **THIRUMATHI AMMA** that has undoubtedly taken us to path of victory in completing this project.

The infrastructural support with all kinds of lab facilities have been a motivating factor in this completion of project work, all because of our **Correspondent Sakthi Thiru Dr. G. B. SENTHILKUMAR B.E.,** with great pleasure we take this opportunity to thank him.

For the academic side the constant support from our honorable **Principal Dr. J. RAJA, Ph.D.,** as encourages us to work hard and attain this goal of completing the project.

Our sincere thanks to our **Head of the Department Dr. C. DHAYA, Ph.D.,** who has given us both moral and technical support adding experience to the job we have undertaken.

We thank our **Project Coordinator Mr. K. CHAIRMADURAI**, **M.E.,** who has led from the front questioning as at the right time and encouraging us most of the timethereby extracting quality work from us.

We sincerely thank our **Supervisor, Mrs. P. GAJALAKSHMI, M.E.,** who helped us in crossing in the path to our glory. We also thank other staff members, librarian, and non-teaching staff member of computer center, who have given their constant support and motivation in all our endeavor.

ABSTRACT

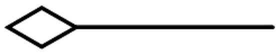
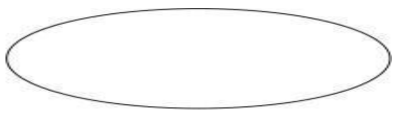
Today even without the help of technology, monitoring wildlife has become challenge job. To address this problem, that developed a solution. Surveillance made a Surveillance Robot to monitor the performance of animals in forest area. The project one can control the robot with the help of mobile or laptop through the IOT technology. A robot to use a ESP32 cam module to get the live footage at daytime as well as night time.

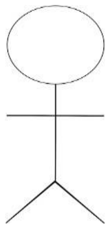
A surveillance robot vehicle that uses the Arduino UNO microcontroller which is controlled using Android smartphones. Surveillance robots generally consist of a video camera and wireless radios which are nowadays available in all smartphones that fulfill all required specifications. Which can be of the asset using APIs (Application Programming Interfaces) i.e., provided for the Android operating system. The robot vehicle perhaps is remotely controlled by a smartphone using Bluetooth connectivity. To capture video from the robot vehicle in real-time, where the camera is in built on the robot and Android Smartphones are utilized for inputs for movements of four motors that can accomplish a zero turning radius.

The camera is attached to the robot vehicle itself this makes it easier to taking video of the scene or object of interest. The surveillance robot uses an ultrasonic sensor to detect any obstacle in front of the vehicle to avoid a collision. The video capturing from the robotic vehicle can be used for recordings and taking pictures.

TABLE OF CONTENTS

LIST OF SYMBOLS

SYMBOL NAME	NOTATION	DESCRIPTION
Class	Class name Visibility attribute Type=initial value Visibility operation (arglist):return type	Class represents a collection of similar entities grouped together
Association		Association represents a static relationship between classes.
Use case		A use case is an interaction between the system and other external examination.
Relational		It is used for Additional Process Communication
Control flow		It represents the control flow between the state
Data process/State		A circle in DFD represent the vertical dimension the object Communication
Object lifeline		An object lifeline represents the vertical dimension then object Communication.

SYMBOL NAME	NOTATION	DESCRIPTION
Message		It represents the Message exchanged
Actor		Actors are the user of the system and other external entity that react with the system

CHAPTER 1
INTRODUCTION

Surveillance Robot focus the development of the surveillance robot to monitor the animal's performance in the hazardous location. Internet of things entered almost every area of our daily lives. one can control the robot with the help of mobile or laptop through Bluetooth and also can get the live streaming of video both in daytime as well as at night with the help of wireless camera from the robot. Observation of behavior, activities, or information for influencing, managing or directing purposes is called surveillance. This includes monitoring from a far distance by using closed-circuit television (CCTV) which can also be done by a robot. Video surveillance is used for the monitoring of some situations, any area or any person of interest. Such scenarios often occur in a military case where surveillance of borders and enemy territory is of the essence to the national security and gathering important intelligence. Human surveillance is appointing a military soldier near sensitive areas like enemy territories to get intelligence on constant changes. However, human beings have physical limitations and stationing in unattainable places is impossible in some cases. Even there are additional risks of a military soldier being lost in the incident of being spotted and captured by the enemy. Currently, available technology enables the possibility of remotely monitoring areas of interest by the usage of robots instead of a human being. Hence, developed a robot is capable of real-time video surveillance that can be controlled by a user through a GUI interface from a safe distance. The robot has an inbuilt camera that will record the scenes in front of it and transmit the real time video to the user where he will be safely watching and controlling the robot to remotely manipulate the system.

1.1 DOMAIN OVERVIEW

A surveillance robot is an autonomous or remotely operated machine designed for monitoring and surveillance purposes. It combines robotic technology with various sensing and imaging systems to gather information and perform surveillance tasks in different environments. Many surveillance robots are designed to operate autonomously, using pre-programmed instructions or advanced algorithms for navigation and surveillance tasks. Finally, surveillance robots support healthcare facilities and elderly care centers by monitoring patient vitals, assisting with medication reminders, and ensuring the safety of elderly individuals. In summary, the domain overview of surveillance robots encompasses a diverse range of industries, highlighting their significant impact on security, monitoring, and data collection in various environments.

1.2 OVERVIEW OF THE PROJECT

The project team conducts a through analysis of the surveillance requirements. This involves identifying the surveillance needs, such as video monitoring, access control, perimeter detection, or environmental sensing. Additionally, factors like coverage area, resolution, storage capacity, and integration with existing systems are considered. Surveillance robots are primarily used for security and surveillance applications. They can be deployed in various settings, such as public areas, industrial facilities, military operations, and even in personal homes or offices. The surveillance robot's primary objective is to provide real-time situational awareness, detect potential threats, and gather valuable data for decision-making purposes. The project involves selecting suitable hardware components, such as cameras, temperature sensors, ultrasonic sensors, and GSM modules, and integrating them into a robust robotic platform.

1.3 OBJECTIVE OF THE PROJECT

The main objective behind this project is to develop a robot to performance of Animal the act of surveillance in wild area. Identify the animal and save the data. To store the information of new creature/species in the system. To remotely manipulate the system. To move system from one place to another. An Ultrasonic sensor is used to avoid the obstacle. Motors are used to move the robot. The currently accessible robotic technologies like locomotive robots and self-guided vehicles like patrol robots, pathfinder robots, industrial carrying robots, etc., make human life comfortable for which they were developed. But the current analytical robots that are available have bulky hardware and controllers mounted onto them, which makes them expensive and hectic to troubleshoot. Hence, to relieve humans from such burden new methods has to be devised and better progression by making the robot lightweight. This project deals with making a robot with a wireless mode of control and monitoring of individuals or areas with manual control techniques and building it in an optimal method that is cost-efficient and user friendly.

CHAPTER 2

LITERATURE SURVEY

A Literature review is a text of a scholarly paper, which includes the current knowledge, including substantive findings, as well as theoretical and methodological contributions to a particular topic. Literature reviews use secondary sources and do not report new or original experimental work. A literature review usually precedes the methodology and results section.

2.1 REVIEW OF LITERATURE:

1. Title: An Arduino Based Robot for Pipe Surveillance and Rescue Operation

Author: Rawshan Habib, Koushik Ahmed

Year: 2019

In this paper, an Arduino based robot is designed and implemented for mainly pipe inspection and rescue operation. It can be used for cleaning and welding, as well. A prototype is built which can move through a pipe with a diameter of 8-20 inches. The architecture of this robot is simple and effective. It has a cylindrical body with adjustable legs.

2. Title: Smart Surveillance Robot using Object Detection

Author: V. Ratna Kumari, P. Siva Sanjay

Year: 2020

This paper proposes These days, we often get updated with the realities about lethal accidents because of harmful conditions, cavern investigation, mining and military surveillance and so forth. This has definitely been a zone of worry over an extensive stretch of time, as the valuable human life has been in question under the cost of investigative purpose applications, such as wildfire detection.

3. **Title: Automated Surveillance Robots for Harsh Climatic Conditions like Siachen**

Author: Shivani Ingale, Shailaja Jadhav

Year: 2019

This paper proposes into consideration some geographical regions like Siachen with extremely harsh and diverse environmental conditions such as temperature ranging from -10 to -60 degrees, which result in a challenging human survival and surveillance. With the successful communication establishment between Ground Communication Center (GCC) and the robot with a 360-degree rotating camera

4. **Title: Surveillance Robot in Hazardous Place**

Author: T. Ahilan, Satyam Chaudhary, Princi Kumar

Year: 2020

The paper focuses on the idea of providing surveillance using a robot with the techniques of IOT. Surveillance is a major issue in public restricted areas. The robot is hired here to monitor throughout the day. This robotic vehicle has ability to substitute the human in hazardous area to provide surveillance.

The robot is operated manually by connecting it to Wi-Fi and consists of sensors for identifying any obstacles and identifying humans and give live streaming to respective admin.

5. **Title: Autonomous Surveillance for an Indoor Security Robot**

Author: Min-Fan Ricky Lee, Zhih-Shun Shih

Year: 2022

This paper proposes an autonomous robotic system based on CNN (convolutional neural network) to perform visual perception and control tasks. The visual perception aims to identify all objects moving in the scene and to verify whether the target is an authorized person. The visual perception system includes a motion detection module, a tracking module, face detection, and a recognition module. The control system includes motion control and navigation (path planning and obstacle avoidance).

2.2 PROBLEM STATEMENT

- The first problem statement is to develop full live streaming video is used to capturing the behavior of animals and in forest and this system gives the continuous updates of the sensed data to the admin.
- The second problem statement is to determine object detection is used to where objects are located in a given image and which objects present in forest.
- The third problem statement is to develop a temperature sensor it is used to sensing temperature and humidity value continuously updates to the admin.
- The fourth problem statement is to develop GSM module that can used to temperature is high to intimate admin through message using GSM module.

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

The existing system for Surveillance robots is equipped with various types of cameras, including visible light cameras, thermal cameras, and infrared cameras. These cameras capture video footage and images, providing visual information about the robot's surroundings.

One of the most used machine learning algorithms for Surveillance robot is the Convolutional Neural Network (CNN). The CNN model is CNN algorithms excel at detecting and localizing objects within images or video frames. In surveillance robots, CNNs can be used to identify and track specific objects of interest, such as people, vehicles, or suspicious items. This helps in real-time monitoring and enables the robot to focus on relevant targets.

3.1.1 DISADVANTAGES

- **Maintenance and Repair:** Surveillance robots, like any other robotic systems, require regular maintenance and repair. Mechanical components can wear out, sensors may malfunction, or software glitches can occur.
- **Limited Adaptability:** Surveillance robots are often designed for specific tasks or environments. Adapting them to new scenarios or changing requirements can be challenging and may require significant modifications or upgrades.
- **High Initial Cost:** Surveillance robots can be expensive to develop, acquire, and deploy. They require sophisticated hardware components, advanced sensors and integration with communication systems.

3.2 PROPOSED SYSTEM

GSM modem: GSM module is a device that uses GSM mobile telephone technology to provide a wireless data link to a network. GSM modems are used in mobile telephones and other equipment that communicates with mobile telephone networks.

Temperature sensor: It is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes.

Ultrasonic Sensor: An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected.

3.2.1 ADVANTAGES

- **Efficiency and Precision:** Robots are designed to perform tasks with high precision and repeatability, reducing human error. They can work continuously without fatigue, improving efficiency and productivity in tasks that require repetitive actions, such as manufacturing, assembly lines.
- **Enhanced Safety:** Surveillance robots can be deployed in hazardous environments, such as disaster sites, chemical plants, or conflict zones, where human presence can be risky or impractical. Robots can withstand extreme conditions, including high temperatures, radiation, or toxic substances, and perform tasks that would put humans in danger.
- **Remote Accessibility:** Forest areas can be challenging to access due to rough terrains, dense vegetation, or geographical remoteness. Surveillance robots can navigate these environments more easily, reaching areas that are difficult for humans to explore.

CHAPTER 4

REQUIREMENT ANALYSIS

Requirement analysis determines the requirements of a new system. This project analyzes product and resource requirements, which is required for this successful system.

The product requirement includes input and output requirements it gives the want in terms of input to produce the required output. The resource requirements give in brief about the software and hardware that are needed to achieve the required functionality.

4.1 FUNCTIONAL REQUIREMENTS

A Functional requirement defines the function of a system or its components. A function is described as the set of inputs, the behavior, and the outputs. Functional requirements may be calculations, technical details, data manipulation and other specific functionalities that show how a use case is to be fulfilled. They are supported by non-functionalities requirements, which impose constraints on the design or implementation.

4.2 NON-FUNCTIONAL REQUIREMENTS

Non-Functional Requirements are requirements that specify criteria that can be used to judge the operations of a system.

Rather than specific behaviors, Non-functional requirements are often called qualities of the system. The non-functional requirements in this system are:

1. The system should be accurate and efficient.
2. The system should be able to meet all user requirements.

4.3 HARDWARE REQUIREMENTS

The most common set of requirements defined by any operating system or software application is the physical computer resources, also known as hardware.

A hardware requirements list is often accompanied by a hardware compatibility list, especially in the case of operating systems.

The minimal hardware requirements are as follows,

1. Arduino UNO
2. ESP 32 Camera Module
3. Motor Driver
4. Temperature Sensor
5. Bluetooth Module
6. Ultrasonic Sensor
7. GSM Module
8. DC Motor

1. ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode. At mega 16U2 replace the 8U2. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform for a comparison with previous versions, see the index of Arduino boards.

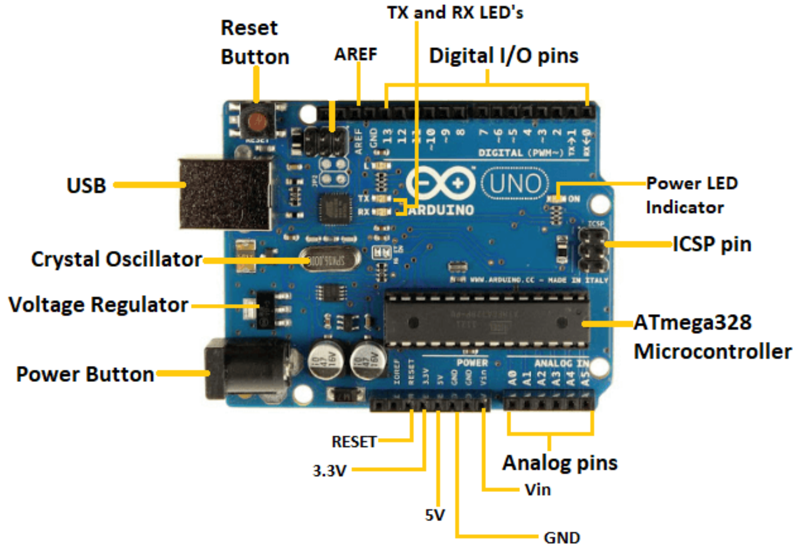


Fig.4.1 Arduino UNO

5. ESP32 CAMERA MODULE

The ESP32-CAM module is a compact development board that combines an ESP32 microcontroller and a camera module. It is specifically designed for projects requiring image capture and processing capabilities, making it popular for applications such as surveillance cameras, IoT devices, robotics, and home automation. The ESP32-CAM module has built-in Wi-Fi and Bluetooth connectivity, allowing it to connect to networks, communicate with other devices, and transfer data wirelessly. This feature enables remote monitoring, control, and communication capabilities in applications. The ESP32-CAM module can be programmed with ESP-IDF or with Arduino IDE. ESP32-CAM module also has several GPIO pins to connect the external hardware. The ESP32-CAM doesn't have a USB connector, so to program the module you need an FTDI board.

3. MOTOR DRIVER:

A motor driver is an electronic circuit or module that provides the necessary control signals and power amplification to drive and control the operation of electric motors. It is commonly used in robotics, automation systems, electric vehicles, and other applications where precise motor control is required. Motor drivers are designed to handle the high current requirements of electric motors. They typically include power transistors or MOSFETs that can handle the motor's current demands, providing the necessary amplification to drive the motor. Motor drivers provide various control interfaces to communicate with external devices and systems.

4. TEMPERATURE SENSOR:

Temperature sensors are widely used in various industries and applications to measure and monitor temperature levels. These sensors play a crucial role in ensuring the efficient operation and safety of systems and processes. In industrial settings, temperature sensors are employed to monitor equipment, detect anomalies, and prevent overheating or damage. They are utilized in HVAC systems to regulate indoor climate and maintain a comfortable environment.

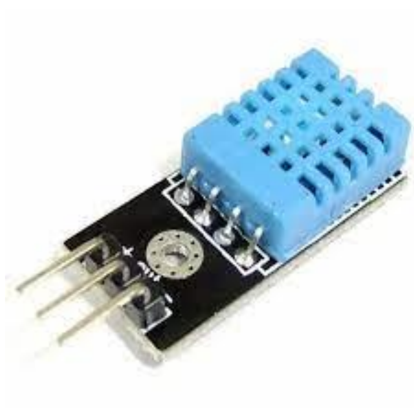


Fig 4.2 Temperature Sensor

5. BLUETOOTH MODULE:

A Bluetooth module is a device that enables wireless communication between electronic devices over short distances. It utilizes Bluetooth technology, a wireless protocol that allows for the transfer of data and communication between devices without the need for physical connections. Bluetooth modules are widely used in a variety of applications due to their versatility and ease of integration. They typically consist of a Bluetooth chip, an antenna, and associated circuitry. These modules can be easily connected to microcontrollers, embedded systems, or other electronic devices, providing them with Bluetooth connectivity capabilities. The main purpose of a Bluetooth module is to facilitate wireless communication between devices. It allows for the seamless transfer of data, audio, and control signals over short distances, typically within a range of a few meters to tens of meters. This makes Bluetooth modules ideal for applications such as wireless audio streaming, wireless data transfer between devices, and remote control of devices.

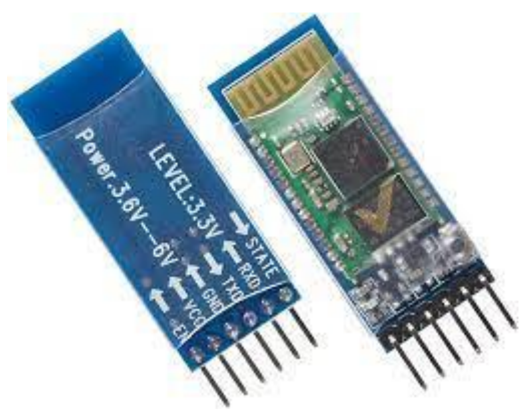


Fig 4.3 Bluetooth Module

6. **ULTRASONIC SENSOR:**

An ultrasonic sensor is a device that uses sound waves of high frequency to detect the presence or measure the distance of objects. It operates based on the principle of echolocation, similar to how bats navigate and locate objects in their environment. Ultrasonic sensors consist of a transmitter and a receiver. The transmitter emits ultrasonic waves, typically in the range of 20 kHz to 200 kHz, which are inaudible to human ears. These waves propagate through the air and bounce off objects in their path. The receiver then detects the reflected waves and measures the time it takes for them to return the value of object detection.

Fig 4.4 Ultrasonic Sensor

7. **GSM MODULE:**

A GSM (Global System for Mobile Communications) module is a compact electronic device that enables communication via mobile networks. It integrates a GSM modem and associated circuitry into a single module, providing a convenient and efficient way to add GSM capabilities to various electronic devices. GSM modules utilize standard cellular networks to establish voice and data communication. They support various frequencies and bands, making them compatible with different network providers worldwide. By incorporating a SIM card, GSM modules can access mobile networks and perform functions such as voice calls, SMS (Short Message Service) messaging, and data transfer. GSM modules are employed in applications such as security systems, where they can send SMS alerts or make phone calls in case of intrusions or emergencies. They are also utilized in telemetry and remote monitoring systems, enabling devices to transmit data over the cellular network, providing real-time information from remote locations.

Fig 4.5 GSM Module

8. DC MOTOR:

DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

4.4 SOFTWARE REQUIREMENTS:

Software requirements deal with defining resource requirements and prerequisites that need to be installed on a computer to provide the functioning of an application. The minimal software requirements are as follows,

1. Arduino IDE

2. Mobile App

1. ARDUINO IDE:

The Arduino IDE (Integrated Development Environment) is a software platform that provides a user-friendly interface for programming and developing applications for Arduino microcontrollers. It is specifically designed to simplify the process of writing, compiling, and uploading code to Arduino boards.

The Arduino IDE offers a beginner-friendly environment that allows users, regardless of their programming experience, to easily create and prototype projects with Arduino boards. It provides a simple code editor where users can write their program logic using the Arduino programming language, which is based on C/C++. The IDE supports syntax highlighting, code auto-completion, and error highlighting, which helps users write clean and error-free code.

Fig 4.6 Arduino IDE

2. MOBILE APP:

A Bluetooth controller app is a mobile application designed to control and interact with Bluetooth-enabled devices. It allows users to wirelessly connect to and control devices that support Bluetooth connectivity, such as audio speakers, smart home devices, robotics systems, or IoT (Internet of Things) devices.

The Bluetooth controller app acts as a bridge between the user's smartphone or tablet and the Bluetooth-enabled device. It establishes a communication link using the Bluetooth protocol, enabling the user to send commands, adjust settings, or access various features and functionalities of the connected device.

The functionalities of a Bluetooth controller app can vary depending on the capabilities of the connected device. Some apps may provide advanced features such as equalizer settings, sound effects, or custom configurations, allowing users to personalize their audio experience. In the case of IoT devices, the app might offer options to monitor and control sensors, lights, or other connected devices remote.

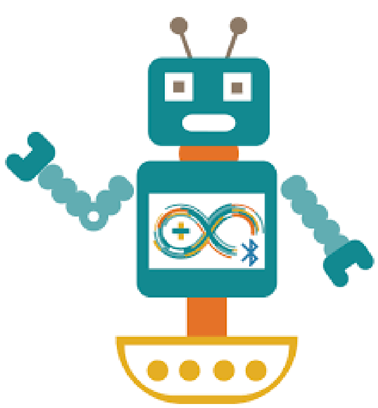


Fig 4.7 Arduino Bluetooth Control app

CHAPTER 5

DESIGN ENGINEERING

5.1 SYSTEM ARCHITECTURE DIAGRAM

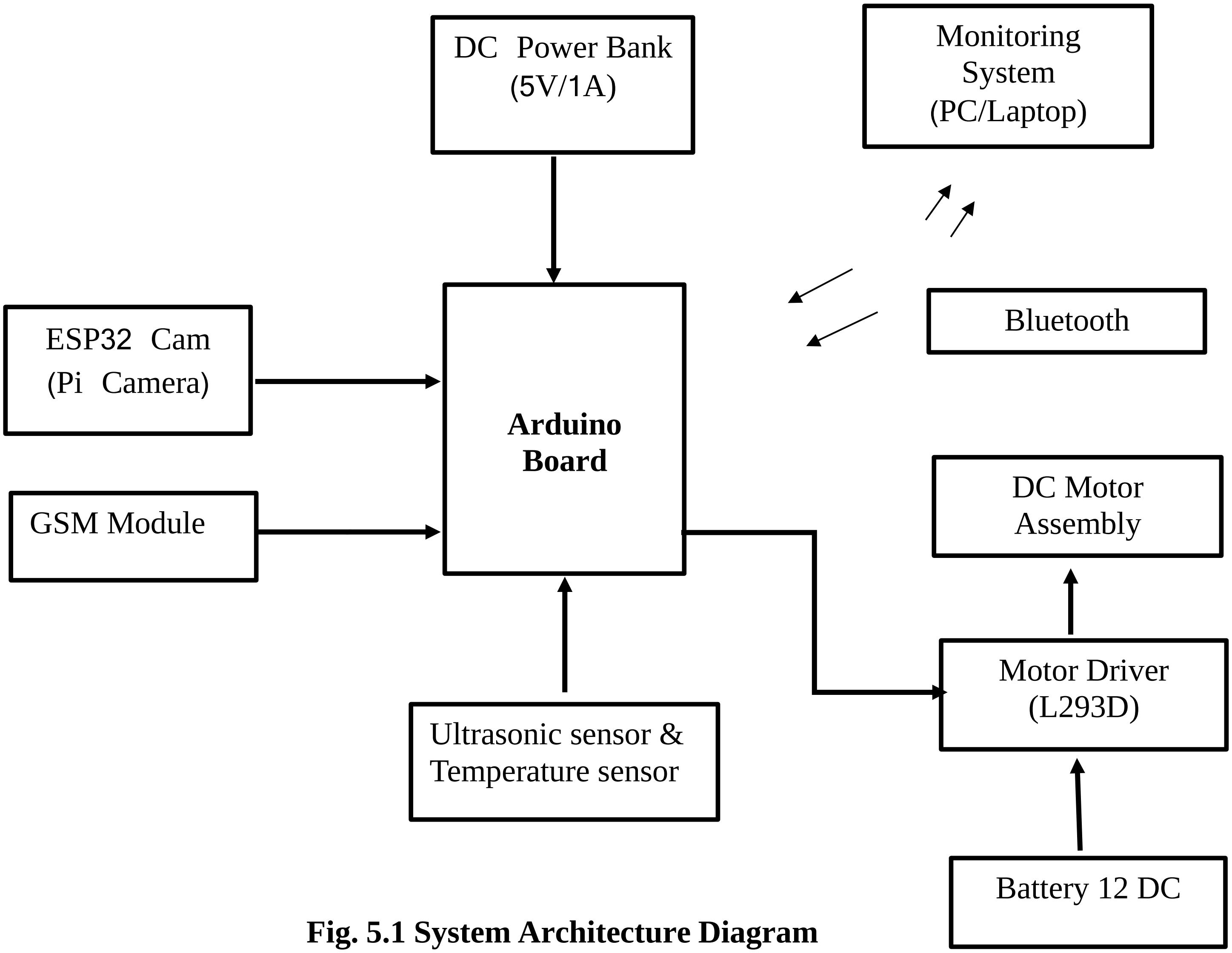


Fig. 5.1 System Architecture Diagram

An architecture diagram is a visual representation of a system's components and their relationships, depicted using shapes and lines. It provides a high-level overview of the system's architecture, including external systems or resources, security controls, and performance metrics. The diagram's specific format and details vary based on the system's complexity and requirements.

5.2 DATA FLOW DIAGRAM

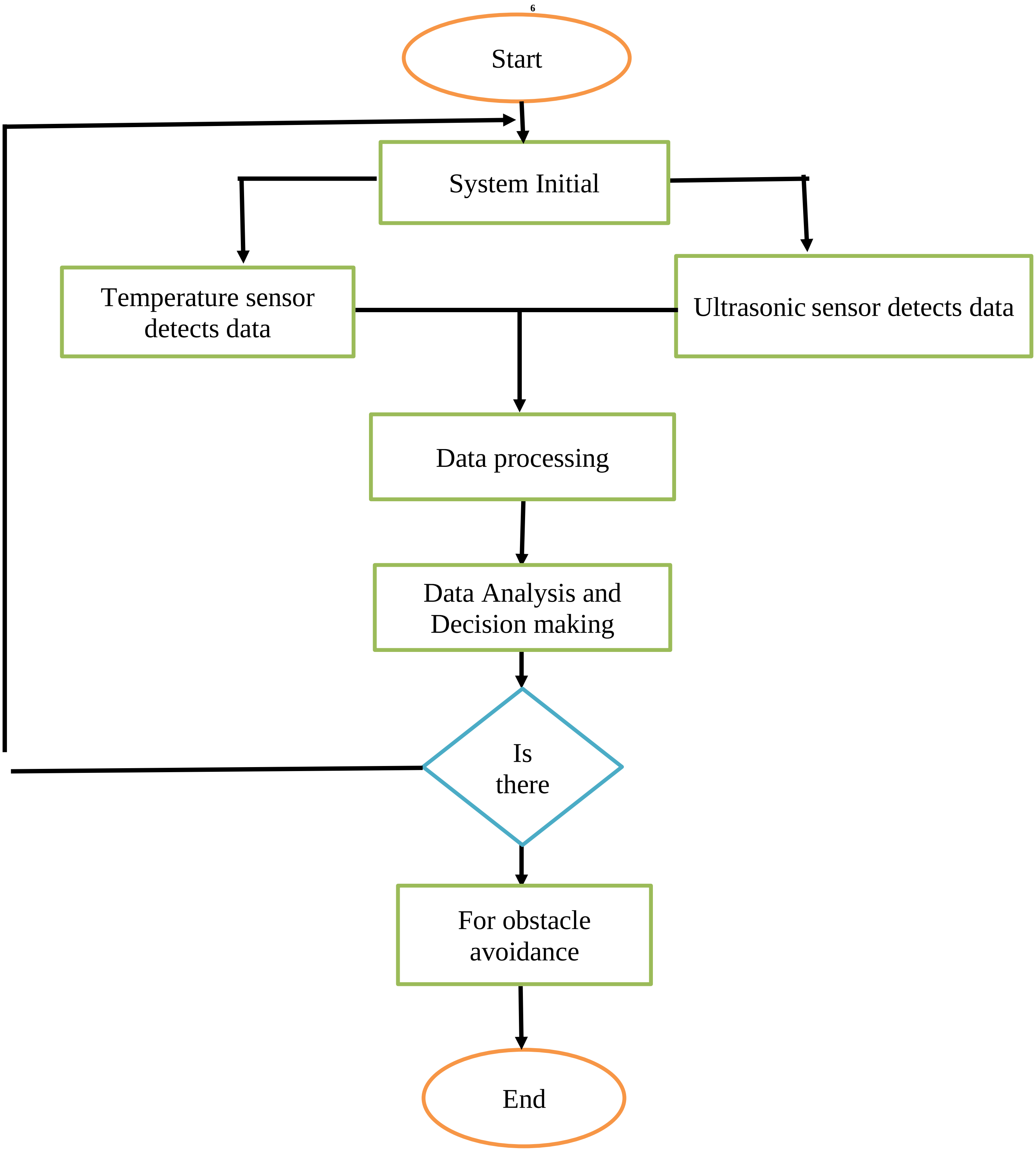


Fig. 5.2 Data Flow Diagram

A data flow diagram (DFD) is a graphical representation of the "flow" of data through an information system, modeling its process aspects. A DFD is often used as a preliminary step to create an overview of the system without going into detail, which can later be elaborated. DFDs can also be used for the visualization of data processing (structured design).

5.3 USE CASE DIAGRAM

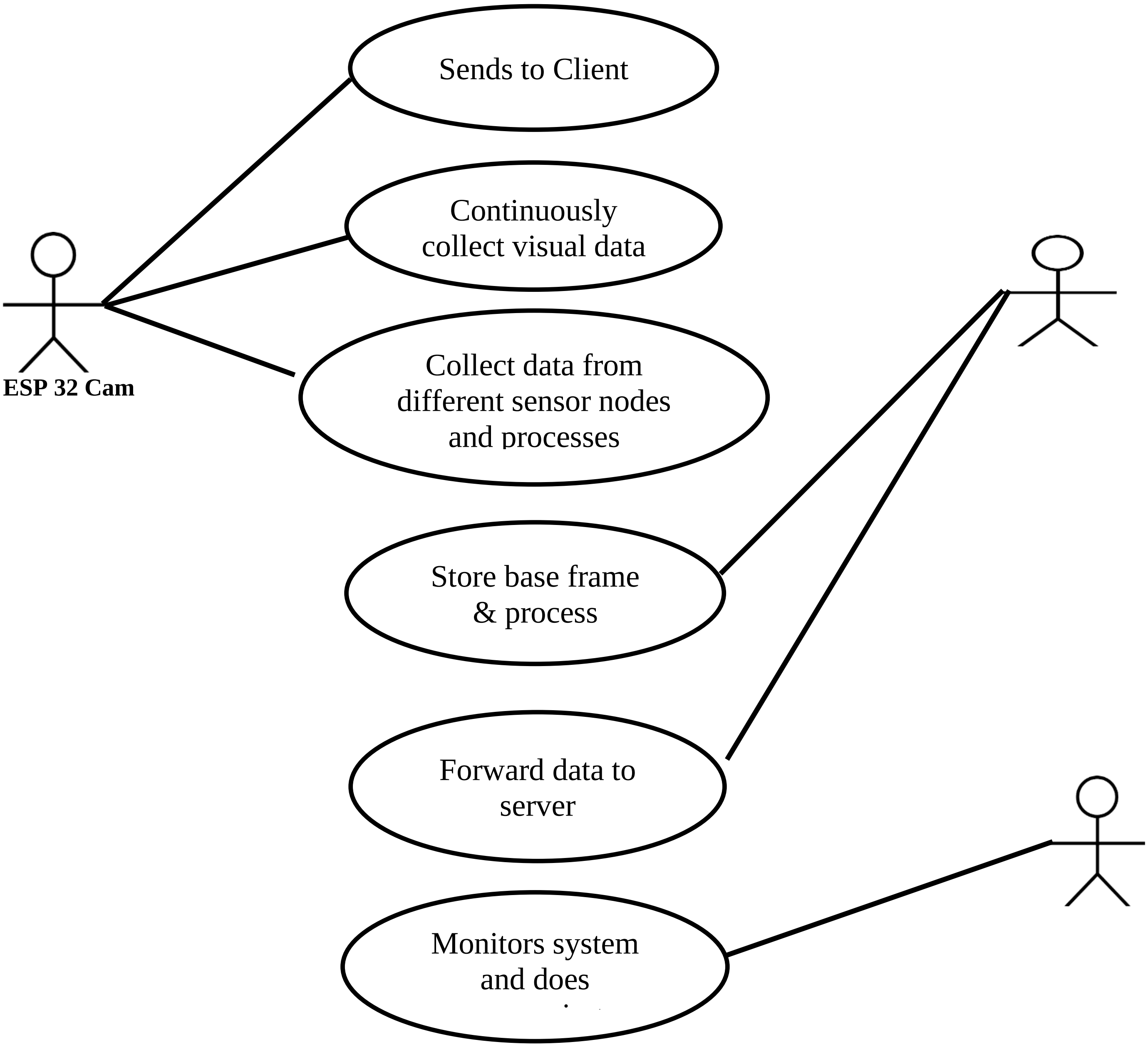


Fig. 5.3 Use Case Diagram

CHAPTER 6

MODULES DESCRIPTION

6.1 IMPORTING NECESSARY LIBRARIES

A library is a collection of functions that can be added to your Embedded C and called as necessary, just like any other function. There is no reason to rewrite code that will perform a standard task. With libraries, you can import pre-existing functions and efficiently expand the functionality of your code.

6.2 DATA PREPROCESSING

Data processing involves data preprocessing, where raw data from the sensors is cleaned, filtered, and formatted for further analysis. This may include removing noise or outliers, normalizing data, and ensuring data consistency and integrity. Next, the processed data can be analyzed using various techniques and algorithms. For example, in the case of temperature data, statistical analysis can be performed to identify patterns, trends, or anomalies in temperature variations over time. Machine learning algorithms can be applied to classify and predict certain temperature behaviors based on historical data. Finding meaningful patterns in data.

1. Post modeling strategies
2. Debugging strategies
3. Visualization of results

6.3 MODEL DEVELOPMENT

The deployment of a surveillance robot involves the physical setup and configuration of the robot, as well as the integration of its sensors and software components. Here is a general overview of the model deployment process for a surveillance robot:

1. Hardware Assembly
2. Software Installation
3. Sensor Calibration and Configuration
4. Algorithm Implementation
5. Testing and Validation
6. Maintenance and Updates

6.4 MODEL EVALUATION

The evaluation of a surveillance robot is crucial to determine its performance and effectiveness in carrying out surveillance tasks. The evaluation process involves assessing various aspects of the robot's functionality. Firstly, the performance of the integrated sensors, including GSM, temperature, Bluetooth, and ultrasonic sensors, is evaluated for accuracy, reliability, and responsiveness. This ensures that the robot can collect and interpret data accurately from its environment. Secondly, the robot's navigation and mobility capabilities are assessed to determine its ability to maneuver through different terrains, avoid obstacles, and reach designated locations. The accuracy and efficiency of its movement are crucial for effective surveillance. Overall, the evaluation process aims to assess the surveillance robot's performance, identify strengths and weaknesses, and optimize its capabilities for efficient surveillance operations.

6.4 MODEL DEPLOYMENT

The deployment of a surveillance model involves the strategic implementation of surveillance systems and technologies to ensure effective monitoring and security. Firstly, a comprehensive assessment of the surveillance requirements is conducted, considering factors such as the area to be monitored, potential threats or risks, and specific objectives. Based on this assessment, appropriate surveillance technologies are selected, including cameras, sensors, and communication systems.

The deployment of a surveillance model involves a systematic and iterative process to establish a robust surveillance system capable of meeting the specific monitoring and security needs of the intended environment.

6.5 CNN ALGORITHM

A Convolutional Neural Network (CNN) is a powerful algorithm commonly used in computer vision tasks, including surveillance applications. When applied to a surveillance robot, a CNN can help analyze visual data, detect objects or events, and make intelligent decisions based on the processed information.

By utilizing a CNN algorithm, a surveillance robot can effectively analyze visual data, enabling tasks such as object detection, event recognition, or behavior monitoring. This enhances the robot's surveillance capabilities, enabling it to make more informed decisions and contribute to enhanced security and monitoring in various environments.

CHAPTER 7
CODING & TESTING

7.1 PROGRAM

```
#include <SoftwareSerial.h>
SoftwareSerial gsm(8,9);
#include "DHT.h"

#define DHTPIN 2

#define DHTTYPE DHT11 // DHT 11

DHT dht(DHTPIN, DHTTYPE);
#define i1 6
#define i2 5
#define i3 4
#define i4 3
int trigger=A0;
int echo=A1;
String a;
void setup() {
  Serial.begin(9600);
  gsm.begin(9600);
  dht.begin();
  pinMode(trigger,OUTPUT);
  pinMode(echo,INPUT);
  pinMode(i1,OUTPUT);
  pinMode(i2,OUTPUT);
  pinMode(i3,OUTPUT);
```

```
  pinMode(i4,OUTPUT);
}
void loop() {
  delay(1000); // Wait a few seconds between measurements
   float h = dht.readHumidity();
   // Reading temperature or humidity takes about 250 milliseconds!
   float t = dht.readTemperature();
   // Read temperature as Celsius (the default)
   float f = dht.readTemperature(true);
   // Read temperature as Fahrenheit (isFahrenheit = true)
   // Check if any reads failed and exit early (to try again).
   if (isnan(h) || isnan(t) || isnan(f) ) {
      Serial.println("Failed to read from DHT sensor!");
      return;
   }
   Serial.print ("Humidity: ");
   Serial.print (h);
   Serial.print (" %\n");
   Serial.print ("Temperature: ");
   Serial.print (t);
   Serial.print (" *C ");
   Serial.print (" %\n");
   if(t>36){
    gsm.println("AT+CMGF=1");    //Sets the GSM Module in Text Mode
    delay(1000);  // Delay of 1000 milli seconds or 1 second
    gsm.println("AT+CMGS=\"+9176391931438   \"\r");
```

```
  delay(1000);
  gsm.println("Temperature is obnormal");// The SMS text you want to send
  delay(1000);
  gsm.println((char)26);// ASCII code of CTRL+Z
  delay(1000);
 }
long distance;
long duration;
digitalWrite(trigger,HIGH);
delay(10);
digitalWrite(trigger,LOW);
duration=pulseIn(echo,HIGH);
distance=duration*0.0343/2;
Serial.println(distance);
while(Serial.available()>0){
  a=Serial.readString();
  Serial.println(a);
}
  if(a=="1" && distance>30){
    digitalWrite(i4,HIGH);
    digitalWrite(i2,HIGH);
    digitalWrite(i3,LOW);
    digitalWrite(i1,LOW);
  }
  else if(a=="2" && distance>30){
    digitalWrite(i2,LOW);
```

```
    digitalWrite(i4,LOW);
    digitalWrite(i3,HIGH);
    digitalWrite(i1,HIGH);
  }
  else if(a=="3" && distance>30){
    digitalWrite(i2,HIGH);
    digitalWrite(i4,LOW);
    digitalWrite(i3,LOW);
    digitalWrite(i1,LOW);
  }
  else if(a=="4" && distance>30){
    digitalWrite(i4,HIGH);
    digitalWrite(i2,LOW);
    digitalWrite(i3,LOW);
    digitalWrite(i1,LOW);
  }
  else if(a=="0" && distance>30){
  digitalWrite(i3,LOW);
  digitalWrite(i1,LOW);
  digitalWrite(i4,LOW);
  digitalWrite(i2,LOW);
  }
else if(a=="7" && distance<30){
    digitalWrite(i3,HIGH);
    digitalWrite(i1,HIGH);
    digitalWrite(i4,LOW);
```

```
      digitalWrite(i2,LOW);
    }
  else if(distance<10){
      digitalWrite(i3,LOW);
      digitalWrite(i1,LOW);
      digitalWrite(i4,LOW);
      digitalWrite(i2,LOW);
    }
 }
```

7.2 CODE FOR ESP32 MODULE

```
#include "esp_camera.h"
#include <WiFi.h>
// WARNING!!! PSRAM IC required for UXGA resolution and high JPEG quality
//            Ensure ESP32 Wrover Module or other board with PSRAM is selected
//            Partial images will be transmitted if image exceeds buffer size
// Select camera model
// #define CAMERA_MODEL_WROVER_KIT // Has PSRAM
//#define CAMERA_MODEL_ESP_EYE // Has PSRAM
//#define CAMERA_MODEL_M5STACK_PSRAM // Has PSRAM
//#define CAMERA_MODEL_M5STACK_V2_PSRAM // M5Camera version B
Has PSRAM
//#define CAMERA_MODEL_M5STACK_WIDE // Has PSRAM
//#define CAMERA_MODEL_M5STACK_ESP32CAM // No PSRAM
#define CAMERA_MODEL_AI_THINKER // Has PSRAM
//#define CAMERA_MODEL_TTGO_T_JOURNAL // No PSRAM
```

```
#include "camera_pins.h"
const char* ssid = "iotadmin";
const char* password = "12345678";
void startCameraServer();
void setup() {
  Serial.begin(115200);
  Serial.setDebugOutput(true);
  Serial.println();
  camera_config_t config;
  config.ledc_channel = LEDC_CHANNEL_0;
  config…..ledc_timer = LEDC_TIMER_0;
  config.pin_d0 = Y2_GPIO_NUM;
  config.pin_d1 = Y3_GPIO_NUM;
  config.pin_d2 = Y4_GPIO_NUM;
  config.pin_d3 = Y5_GPIO_NUM;
  config.pin_d4 = Y6_GPIO_NUM;
  config.pin_d5 = Y7_GPIO_NUM;
  config.pin_d6 = Y8_GPIO_NUM;
  config.pin_d7 = Y9_GPIO_NUM;
  config.pin_xclk = XCLK_GPIO_NUM;
  config.pin_pclk = PCLK_GPIO_NUM;
  config.pin_vsync = VSYNC_GPIO_NUM;
  config.pin_href = HREF_GPIO_NUM;
  config.pin_sscb_sda = SIOD_GPIO_NUM;
  config.pin_sscb_scl = SIOC_GPIO_NUM;
  config.pin_pwdn = PWDN_GPIO_NUM;
```

```
  config.pin_reset = RESET_GPIO_NUM;
  config.xclk_freq_hz = 20000000;
  config.pixel_format = PIXFORMAT_JPEG;
  // if PSRAM IC present, init with UXGA resolution and higher JPEG quality
  // for larger pre-allocated frame buffer.
  if(psramFound()){
    config.frame_size = FRAMESIZE_UXGA;
    config.jpeg_quality = 10;
    config.fb_count = 2;
  } else {
    config.frame_size = FRAMESIZE_SVGA;
    config.jpeg_quality = 12;
    config.fb_count = 1;
  }
#if defined(CAMERA_MODEL_ESP_EYE)
  pinMode(13, INPUT_PULLUP);
  pinMode(14, INPUT_PULLUP);
#endif
  // camera init
  esp_err_t err = esp_camera_init(&config);
  if (err != ESP_OK) {
    Serial.printf("Camera init failed with error 0x%x", err);
    return;
  }
  sensor_t * s = esp_camera_sensor_get();
  // initial sensors are flipped vertically and colors are a bit saturated
```

```
  if (s->id.PID == OV3660_PID) {
    s->set_vflip(s, 1); // flip it back
    s->set_brightness (s, 1); // up the brightness just a bit
    s->set_saturation(s, -2); // lower the saturation
  }
  // drop down frame size for higher initial frame rate
  s->set_framesize(s, FRAMESIZE_QVGA);
#if
defined(CAMERA_MODEL_M5STACK_WIDE)                                    ||
defined(CAMERA_MODEL_M5STACK_ESP32CAM)
  s->set_vflip(s, 1);
  s->set_hmirror(s, 1);
#endif
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");
  startCameraServer ();
  Serial.print("Camera Ready! Use 'http://");
  Serial.print(WiFi.localIP());
  Serial.println("' to connect");
}
void loop() {
```

```
// put your main code here, to run repeatedly:
delay(10000);
}
```

CHAPTER 8

RESULTS

8.1 SNAPSHOTS

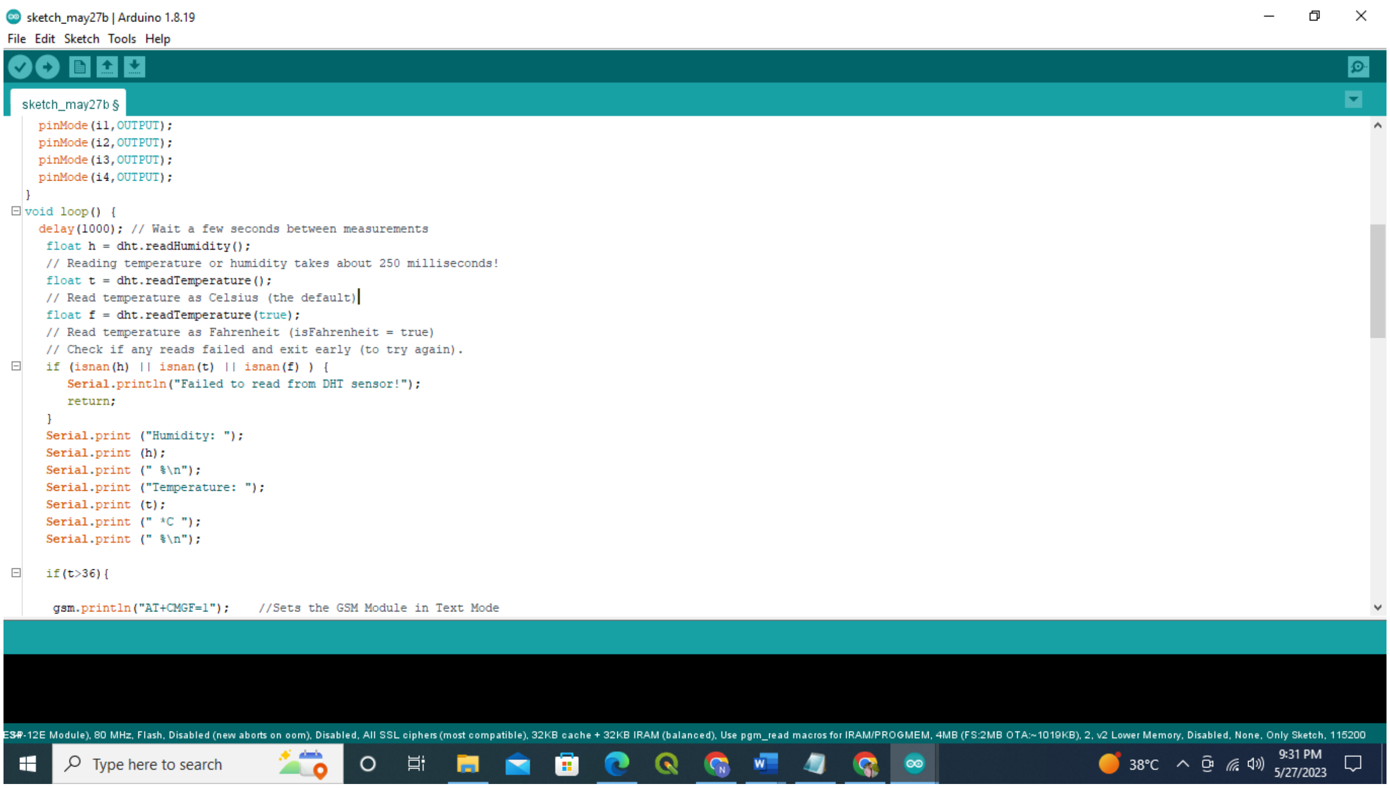


Fig 8.1 Arduino IDE

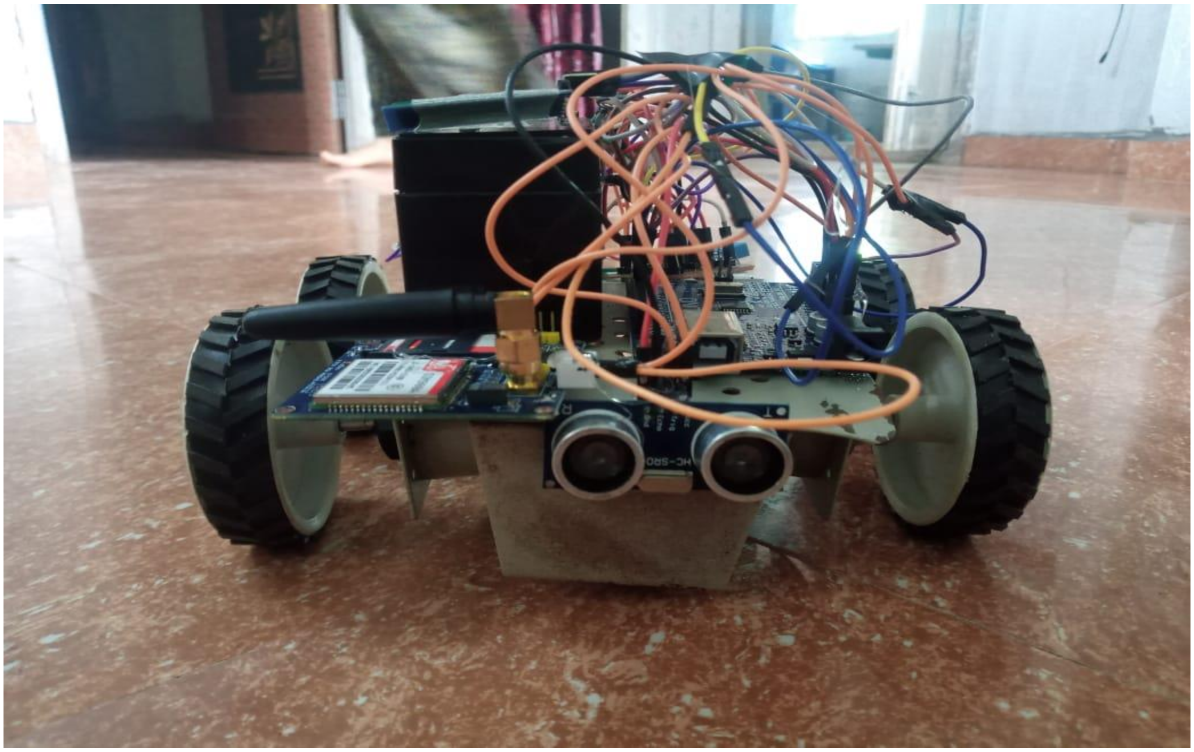


Fig 8.2 Sample Output_1

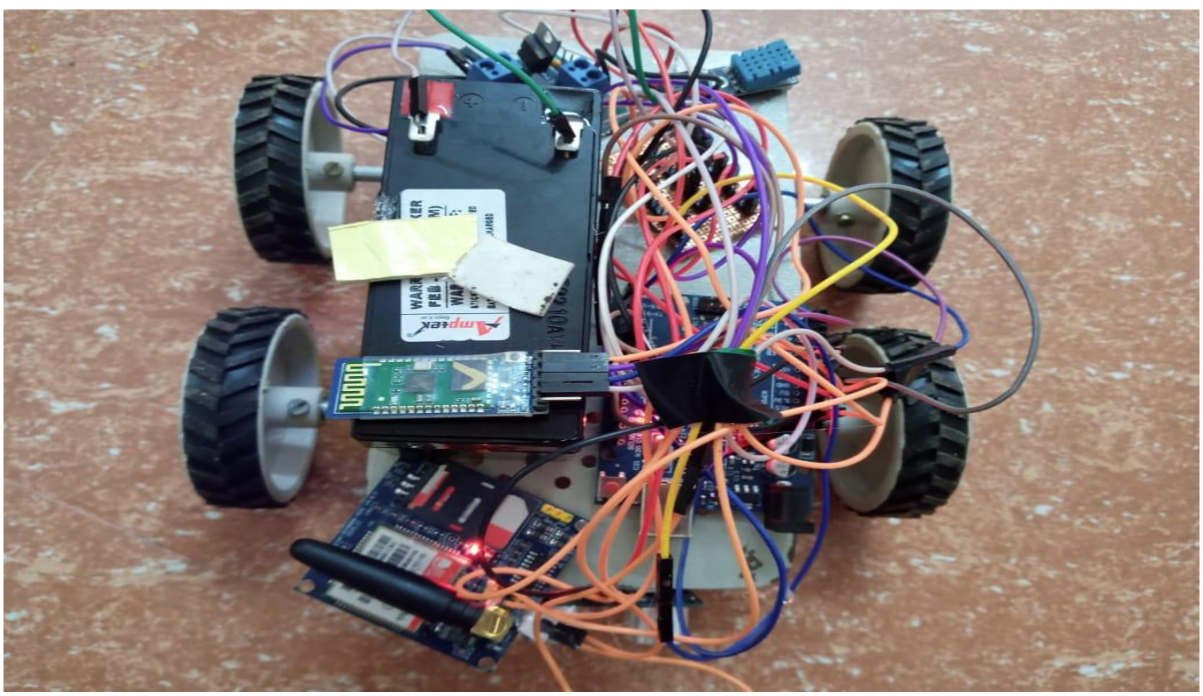


Fig 8.3 Sample Output_2

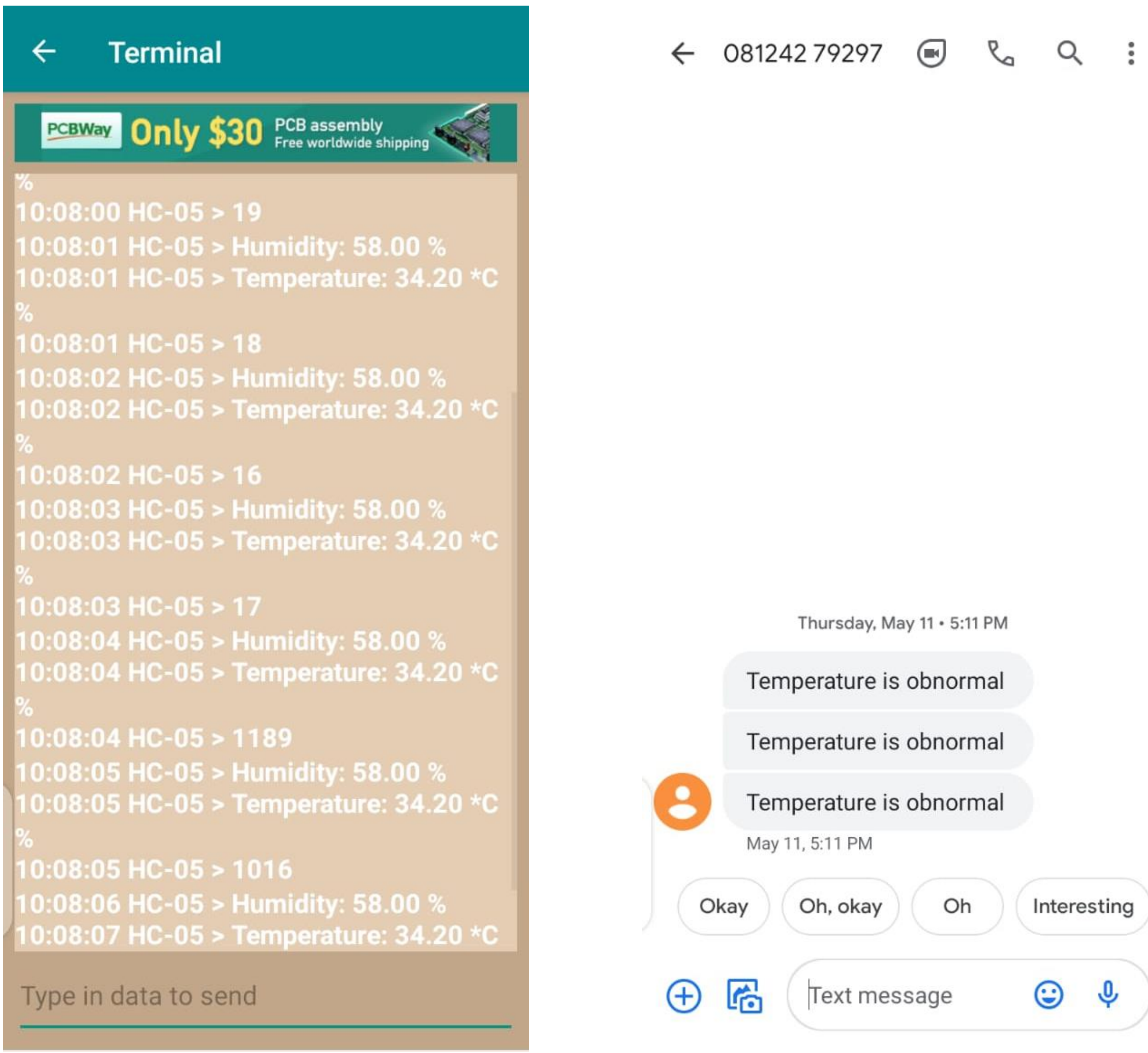


Fig 8.4 Bluetooth control App & Message

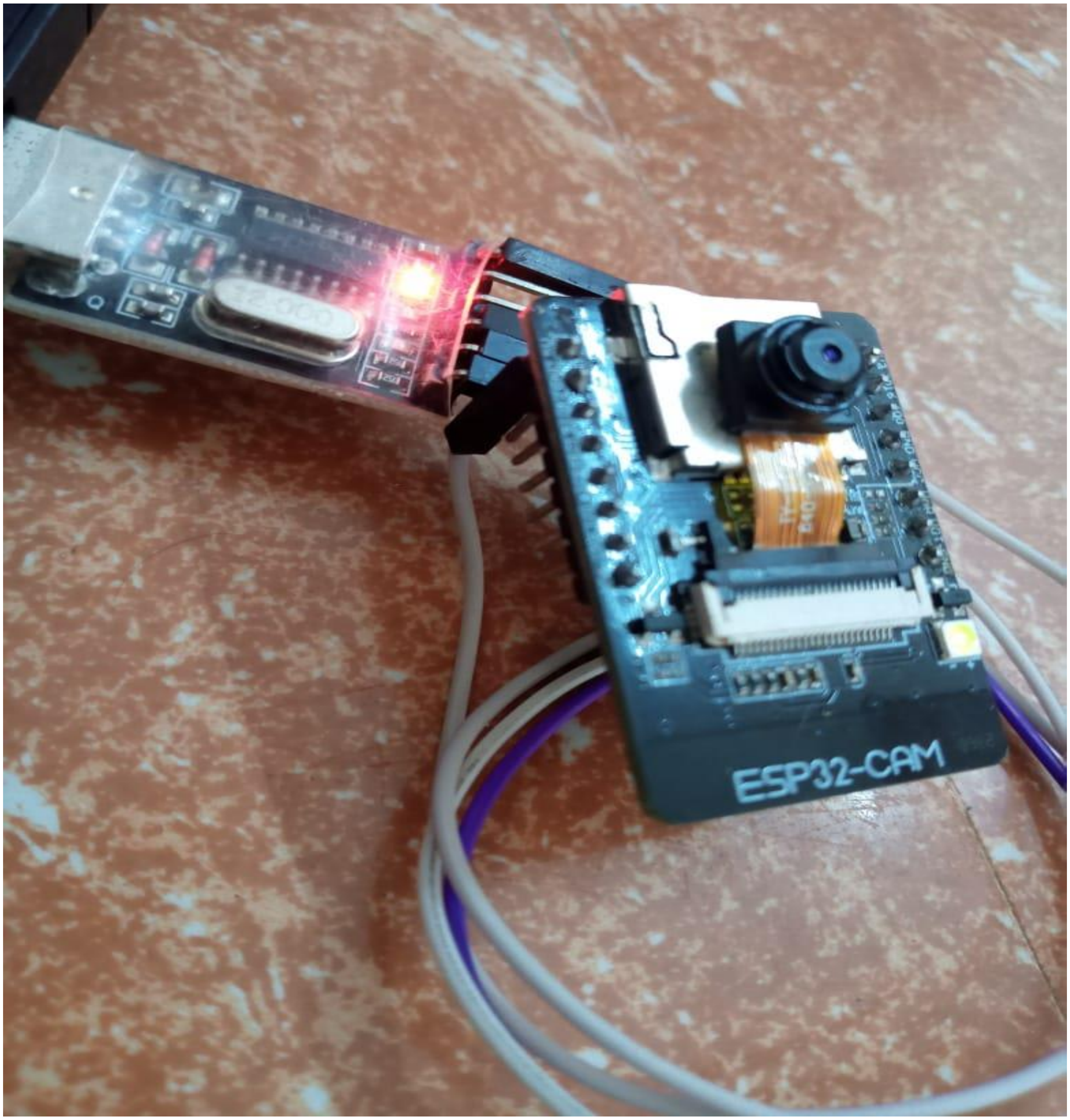
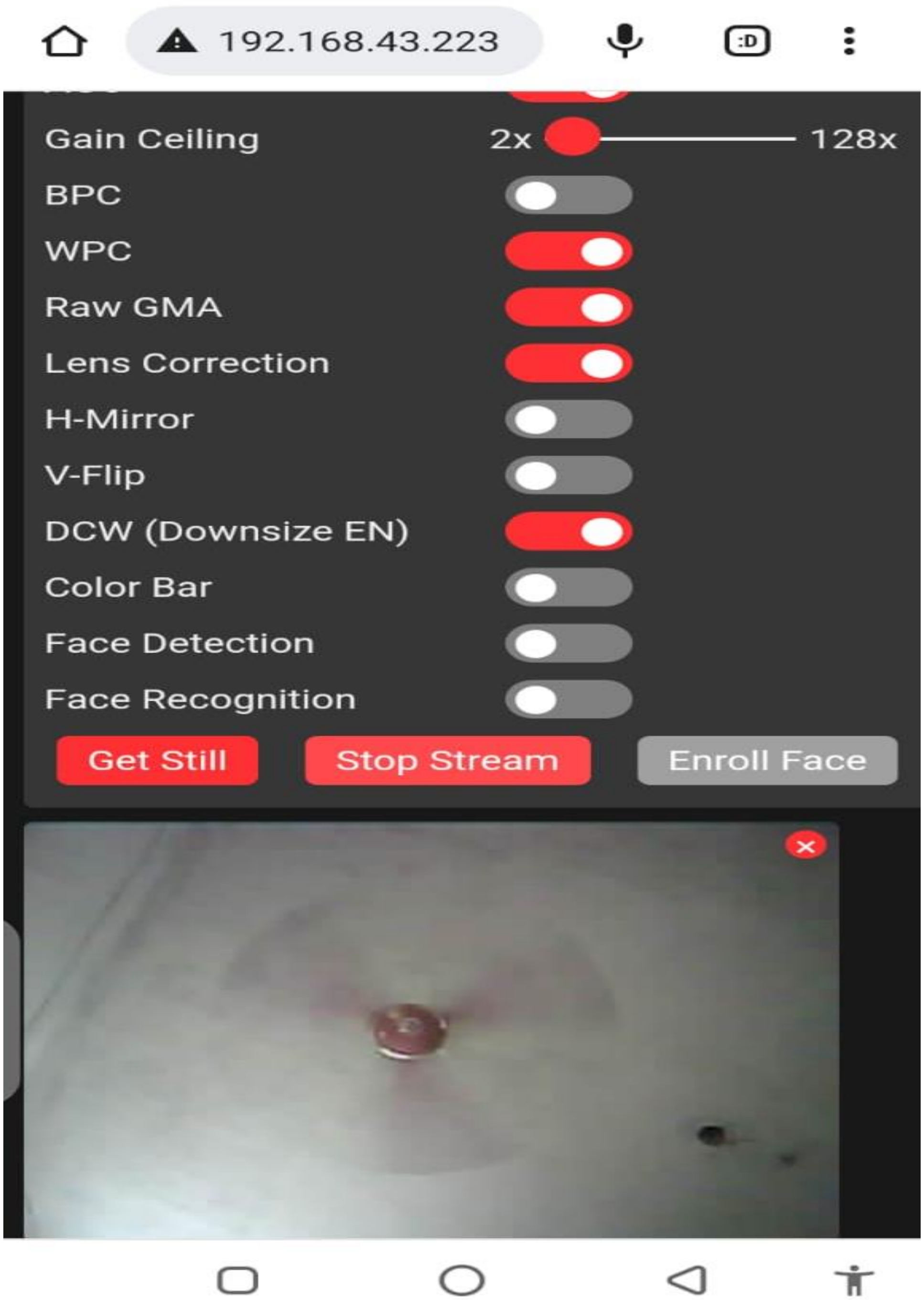


Fig 8.5 ESP32 Cam Module

ESP 32 CAM MODULE:



s

Fig 8.6 Capture Video

CHAPTER 9
IMPLEMENTATION

STEP 1: Define Objectives

Determine the specific goals and objectives of the surveillance robot. Identify the target area, the type of surveillance required, and the specific tasks the robot should perform.

STEP 2: Select Hardware

Choose the appropriate hardware components for your surveillance robot. This may include a robotic platform or chassis, motors, wheels or tracks for movement, sensors (such as cameras, ultrasonic sensors, temperature sensors), and communication modules (such as GSM or Bluetooth).

STEP 3: Design and Assemble

The Robot design and assemble the physical structure of the robot. This involves mounting the chosen hardware components onto the robotic platform, ensuring proper wiring and connections, and securing everything in place. Consider factors like stability, weight distribution, and power supply.

STEP 4: Install Sensors

Integrate the necessary sensors onto the robot. This can include cameras for visual surveillance, ultrasonic sensors for obstacle detection, temperature sensors for environmental monitoring, or any other sensors relevant to your surveillance objectives. Ensure proper placement and calibration of the sensors.

STEP 5: Develop User Interface

Design and develop a user interface that allows remote monitoring and control of the surveillance robot. This can be a web-based interface, a mobile application, or a dedicated control panel. The interface should provide access to live video feed, sensor data, and control options.

STEP 6: Implement Communication

Integrate communication modules, such as GSM or Bluetooth, to enable remote control and data transmission. This allows operators to monitor the robot and receive alerts or notifications remotely. Ensure secure and reliable communication channels.

STEP 7: Test and Refine

Conduct comprehensive testing of the surveillance robot in various scenarios. Evaluate its functionality, performance, and reliability. Make adjustments and refinements as necessary, addressing any issues or shortcomings that are identified during testing.

STEP 8: Deployment and Operation

Deploy the surveillance robot in the target environment. Ensure proper setup, calibration, and configuration. Train operators on how to effectively control and operate the robot.

STEP 9: Deployment and Operation

Regular Maintenance and Upgrades: Regularly maintain the surveillance robot, including checking for wear and tear, replacing batteries, and ensuring software updates. Consider incorporating feedback from operators and users to make continuous improvements and upgrades to enhance the robot's capabilities.

CHAPTER 10

CONCLUSION AND FUTURE ENHANCEMENT

10.1 CONCLUSION

In conclusion, our project aimed to develop the integration of GSM, temperature, Bluetooth, and ultrasonic sensors in a surveillance robot creates a powerful and versatile system with a wide range of applications. The inclusion of a GSM module enables remote control, real-time data transmission, and notifications, enhancing the robot's connectivity and enabling monitoring from a distance. The temperature sensor provides environmental monitoring capabilities, allowing the robot to assess temperature variations and ensure optimal conditions. The Bluetooth module enables wireless communication, facilitating seamless data transfer, remote control, and integration with other devices or systems. The ultrasonic sensor enhances the robot's awareness of its surroundings, enabling distance measurement, obstacle detection, and safe navigation through complex environments. Together, these sensors enable the robot to monitor environmental conditions, detect obstacles, navigate autonomously, and transmit data in real-time, making it a valuable tool for surveillance, research, and conservation efforts in forest areas. In summary, the surveillance robot, with its integrated GSM, temperature, Bluetooth, and ultrasonic sensors, presents a powerful tool for enhancing surveillance capabilities. It enables efficient data collection, real-time communication, obstacle detection, and environmental monitoring. The application of advanced algorithms and the continuous refinement of the robot's capabilities contribute to improved surveillance practices, ensuring enhanced security and monitoring in various settings.

10.2 FUTURE ENHANCEMENT

In terms of future enhancements, In the future, the surveillance robot integrated with GSM, temperature, Bluetooth, and ultrasonic sensors can be further enhanced to provide even more advanced capabilities. One potential enhancement could be the integration of artificial intelligence and machine learning algorithms, enabling the robot to analyze the data collected by its sensors in real-time. This would allow the robot to make intelligent decisions, such as identifying anomalies in temperature patterns, recognizing specific objects or animals in its environment, and adapting its behavior accordingly. Additionally, the robot's connectivity can be expanded to include advanced wireless communication protocols such as 5G or Wi-Fi 6, enabling faster and more reliable data transmission. By continuously improving and expanding the robot's capabilities, it can become an even more effective tool for surveillance, research, and conservation efforts, aiding in the protection of forest areas and wildlife in increasingly intelligent and interconnected ways.

High-resolution cameras provide sharper and more detailed images, allowing for better identification and recognition of objects, individuals, and events. Future enhancements may focus on even higher resolutions and improved image processing techniques to extract more precise information from captured visuals.

REFERENCES

1. V. Ratna Kumari and P. Siva Sanjay **"Smart Surveillance Robot using Object Detection"** International Conference on Communication and Signal Processing, July 28 - 30, 2020, India.
2. Sushma Sirasanagandla, Mounisha Pachipulusu and Ramesh Jayarama **"Development of Surveillance Robot to Monitor the Work Performance in Hazardous Area"** International Conference on Communication and Signal Processing, July 28 - 30, 2020, India.
3. Min-Fan Ricky Lee and Zhih-Shun Shih **"Autonomous Surveillance for an Indoor Security Robot"** International Conference on Communication and Signal Processing, Sept 10 2019, India.
4. Md. Rawshan Habib, Koushik Ahmed, Anika Sadia Reza **"An Arduino Based Robot for Pipe Surveillance and Rescue Operation"** International Conference on Computer and Information Technology (ICCIT), 18-20 December 2019, India.
5. Shivani Ingale, Vishakh Shewalkar, Shailaja Jadhav **"Automated Surveillance Robots for Harsh Climatic Conditions like Siachen"** International Conference on Inventive Research in Computing Applications (ICIRCA-2020), September 03,2020
6. Sri Dinesh Kumar P 1, Pragadishwaran T.R2, Mohamed Askar A 3, Mohamed SulthanIbrahim M4**, "Implementation Of Spy Robot For A Surveillance System Using Internet protocol"** International Journal for Research Trends, 2023
7. V. Parthipan1, V. Mahendra Prasaath2, R. Kiran Kumar3, K. Manoju Prabhu4, B. Manishwara Prabhu5**," Surveillance Robot for Deep Forest Areas"** International Journal of Research in Engineering, March-2019

8. Esra Yılmaz, Sibel T. Özyer* **“Remote and Autonomous Controlled Robotic Car based on Arduino with Real Time Obstacle Detection and Avoidance”** Universal Journal of Engineering Science sept 2019, India.
9. Azeta J*a, Bolu C. Aa, Hinvi Da, Abioye A. Aa, Boyo Ha, Anakhu Pa, Onward Pa. An **“Android Based Mobile Robot for Monitoring and Surveillance”** 2nd International Conference on Sustainable Materials Processing and Manufacturing (SMPM 2019)
10. S. S. Pujari, M. S. Patil, and S. S. Ingleshwar, **“Remotely controlled autonomous robot using Android application”**, 2017 IEEE International Conference on I-SMAC (IoT in Social, Mobile, Analytics, and Cloud) (ISMAC).
11. E. Amareswar, G. S. S. K. Goud, K. R. Maheshwari, E. Akhil, S. Aashraya, and T. Naveen, **“Multipurpose military service robot,”** 2017 IEEE International Conference of Electronics, Communication, and Aerospace Technology (ICECA).
12. S. J. Lee, J. Lim, G. Tewolde, and J. Kwon, **“Autonomous tour guide robot by using ultrasonic range sensors and QR code recognition in an indoor environment,”** IEEE International Conference on Electro/Information Technology.
13. D. Chakraborty, K. Sharma, R. K. Roy, H. Singh, and T. Bezboruah**, “Android application-based monitoring and controlling of movement of a remotely controlled robotic car mounted with various sensors via Bluetooth,”** IEEE International Conference on Advances in Electrical, Electronic and Systems Engineering (ICAEES).