Cyber Geeks

PROJECT REPORT

IntelliScout - The Cyber Rover Version 2
a remote controlled - Spybot equipped with real-time Camera & Radar System for an efficient live surveillance and autonomous high precision operations!

- Prepared For:

Project Exhibition at
IoT Expo - Techno Sapiens 2k25!

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blocknotes-4515.github.io/IntelliScout-Ver.2/

ABOUT OUR PROJECT

Abstract: It is an IoT-based remote-controlled Spybot designed for real-time surveillance and high-precision operations or tasks in hazardous or unreachable environments such as space missions, military operations, pipelines, mines, and manholes. It features an ESP32-CAM, providing a live video feed on a web interface, where users can control the rover's movement, wheel speed, and light intensity. The camera transmits EM signals, allowing any device to connect via WiFi Hotspot (40m range) and access a private IP portal. Additionally, an ultrasonic sensor-based radar system mounted on a servo motor (180° rotation) detects obstacles, displaying a color-coded proximity alert on the interface—green for a clear path and red (intensifying) based on obstacle distance. This system ensures efficient navigation & monitoring in critical scenarios.

Introduction: Robotic systems have revolutionized various industries, including surveillance, defense, space exploration, and hazardous environment monitoring. These systems play a crucial role in areas where human intervention is risky, inefficient, or impossible. However, navigating through dynamic and unpredictable terrains poses significant challenges, requiring real-time obstacle detection, remote control, and adaptive decision-making. To overcome these limitations, modern robotic systems integrate IoT technology, advanced sensors & real-time data processing to enhance their functionality, efficiency, and autonomy. The development of such intelligent robotic solutions enables safer and more effective operations across multiple domains.

MAKERS OF THE PROJECT ARE:

- Pratham Aggarwal

in prathamaggarwal

- Dhruv Dhayal

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MISSION AND VISION

Why we chose this IoT-based Project?

Mission

Our mission is to explore the realms of robotics & IoT technology, harnessing their potential to solve real-world challenges and advance innovation. Via this project, we aim to create a versatile and intelligent platform capable of navigating through the dynamic environments in real-time. Our mission extends beyond mere technical exploration; it encompasses a commitment to learning, creativity, and the pursuit of solutions that have practical implications in various fields and have different applications.

Vision

Our vision is to create a future where robotics and IoT technologies converge to revolutionize how we interact with the world around us. By choosing this complex yet interesting project focused on real-time transmission of data, cam live feeds & radar systems, we envision a world where autonomous systems seamlessly navigate complex env's, enhancing safety & productivity across industries. Our vision extends to empower the communities for embracing tech as a tool for innovation & positive change.

METHODOLOGY

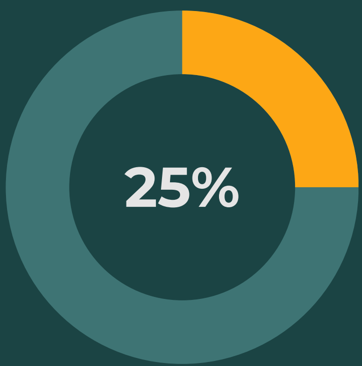
Our way of making this project, based on particular principles and methods!

Hardware Setup

- Assembling robotic car Chassis, mount Motors, Wheels, ESP 32 Camera and Ultrasonic Sensor.
- Connecting components to Arduino Nano, Motor Driver & Batteries, then integrating these with Jumper Wires, Data Cables & USB Adapters etc.

Software Development

- Developing motor control algorithms for movement & setting up live feed of the camera.
- Implementing obstacle detection & avoidance algorithms using ultrasonic sensor.
- Configuring Wi-Fi for external communication & developing a web-based control interface.



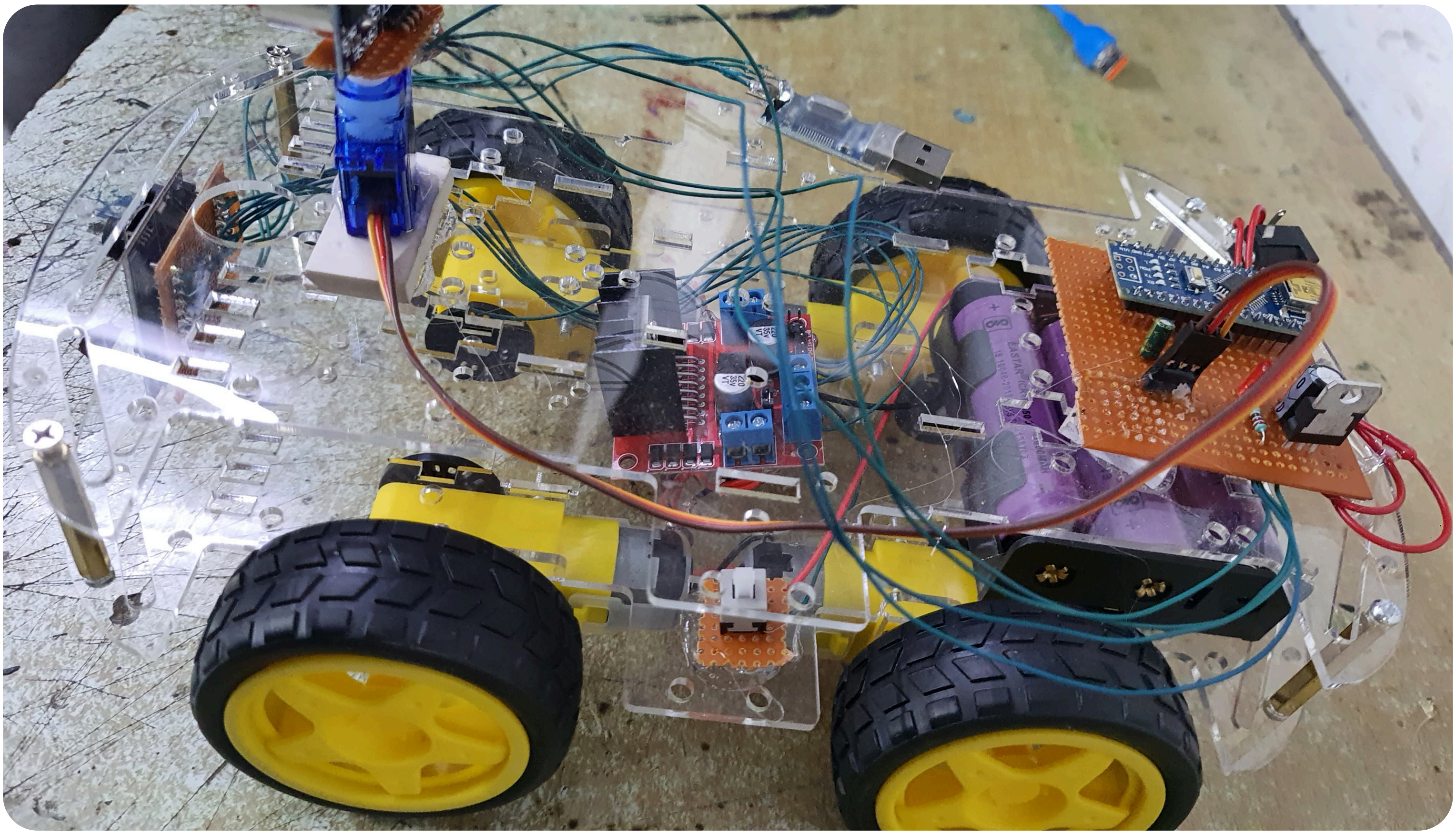
Integration & Testing

- Integrating hardware and software for a functional prototype, ensuring smooth communication between the two.
- Conducting comprehensive testing for reliability & seeking feedbacks.

IN-DEPTH ANALYSIS

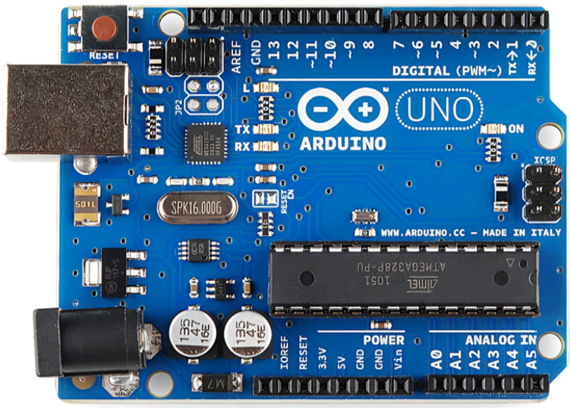
Basic Principle:

The robotic system operates using an ultrasonic sensor-based radar for obstacle detection and a motor driver to control movement based on sensor feedback. The ESP32-CAM provides a real-time video feed, while IoT connectivity enables remote control and monitoring. The system ensures efficient navigation through dynamic environments by integrating sensor data with motor control algorithms.



The **ultrasonic sensor** consists of a signal generator and a receiver. The generator emits ultrasonic waves in the forward direction. When these waves encounter an obstacle, a significant portion is reflected back. The receiver detects the reflected waves, and based on the time delay, the system calculates the distance of the obstacle. This data is then used to update the radar display and adjust the rover's movement accordingly.

COMPONENTS USED



Arduino: Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs (Like-light on a sensor, a signal of a button, or a signal from sensor etc) and turn it into an output (Like- activating a motor, turning on an LED, publishing something online etc). We can tell our board what to do by sending a set of instructions to the microcontroller on the board. To do so we use the Arduino programming language and the Arduino Software (IDE).

In this project, to avoid the obstacle in the path, a condition is put in the system which says: if the distance between the robot and the object gets below a certain level, stop the robot and take a backward motion and then turn the robot into other direction and continue the loop. This logic is applied to the system by writing the code in the arduino.

- **Arduino Nano**
- **Lithium Batteries**
- **Jumper wires**
- **L298 Motor Driver**
- **4 Wheel Drive Robotic Chassis**
- **HC-SR04 Ultrasonic Sensor**
- **4 DC BO Motors**
- **ESP 32 Camera**
- **Servo Motor**
- **Nut-Bolts, Spacer**

CONNECTIONS

L293 motor driver: We now have the conditions set up for the robot car but it needs to be executed/implemented on the hardware. The hardware used is the DC motor. To drive these DC BO Motors, we need motor driver. In this project we are using L293 motor driver. Motor driver is used to send the commands to motors according to signal received from Arduino.

BO Motors: Two motors are used in this process: left motor and right motor. To move the robot car forward, both the motors are turned on. For backward step, both motors need to run in opposite direction. To turn the robot car to avoid obstacle, one of the motor is reversed for a while, keeping the other motor forward.

Results & Discussion:
The IntelliScout - The Cyber Rover Version 2 successfully demonstrated real-time surveillance, remote control, and obstacle detection in dynamic environments. The ESP32-CAM provided a live video feed, while the ultrasonic sensor-based radar system detected obstacles with a color-coded proximity alert. IoT connectivity enabled remote control of movement, wheel speed, and light intensity via a web-based interface, ensuring efficient navigation and high-precision operations for surveillance, defense, and exploration applications.

Types

Motor Driver connection:

- Vin → 9v Battery (+) ve
- GND → 9v Battery (-) ve
- M1 → Left Motor connection
- M2 → Right Motor connection
- IN1 & IN2 → Arduino 4 and 5 (If motor runs in wrong direction, connection is swapped)
- IN3 & IN4 → Arduino 6 and 7 (If motor runs in wrong direction, connection is swapped)

Ultrasonic connection:

- Gnd: Arduino GND
- Echo: Arduino A2
- Trig: Arduino A1
- Vcc: Arduino 5V

ESP32-CAM Connection:

- GND → ESP32-CAM GND
- VCC → ESP32-CAM 5V
- U0R (RX) → Arduino TX
- U0T (TX) → Arduino RX
- GPIO 0 → GND (Only while uploading code)
- GND → GND of FTDI Module
- VCC → 3.3V of FTDI Module

SOURCE CODE

The following code is intentionally omitted for privacy & security reasons!

```
#include <Servo.h>
#include <NewPing.h>

//our L298N control pins
const int LeftMotorForward = 7;
const int LeftMotorBackward = 6;
const int RightMotorForward = 4;
const int RightMotorBackward = 5;

#define trig_pin A1 //analog input 1
#define echo_pin A2 //analog input 2

#define maximum_distance 200
boolean goesForward = false;
int distance = 100;

NewPing sonar (trig_pin, echo_pin,
maximum_distance);
Servo servo_motor;

void setup(){

 pinMode(RightMotorForward, OUTPUT);
 pinMode(LeftMotorForward, OUTPUT);
 pinMode(LeftMotorBackward, OUTPUT);
 pinMode(RightMotorBackward, OUTPUT);
}

void loop(){

 int distanceRight = 0;
 int distanceLeft = 0;

 if (distance <= 25) {
  moveStop ();
  delay(100);
  moveBackward ();
  delay (400);
  moveStop ();
  delay (300);
```

```
  if (distance >= distanceLeft) {
   turnRight();
   moveStop();
  }
  else{
   turnLeft();
   moveStop();
  }
 else{
  moveForward();
 }
  distance = readPing();
}

int lookRight() {
 servo_motor.write (50);
 delay (500);
 int distance = readPing();
 delay (100);
 servo_motor.write (115);
 return distance; }

int lookLeft(){
 servo_motor.write (170);
 delay(500);
 int distance = readPing();
 delay (100);
 servo_motor.write (115);
 return distance;
 delay (100);
}

void turnLeft(){

 delay (900) ;
 digitalWrite(LeftMotorForward, HIGH);
 digitalWrite(RightMotorForward, HIGH);
 digitalWrite(LeftMotorBackward, LOW);
 digitalWrite(RightMotorBackward, LOW);
}
```

ENDING NOTES

Programming the Arduino:

1. Download and Install the Arduino Desktop IDE.
2. Download and paste NewPing library (Ultrasonic sensor function library) file to the Arduino libraries folder.
3. Paste files to the path (Example) - C:\Arduino\libraries.
4. Write Arduino code for the robot functioning.
5. Upload the code to the arduino board via a cable.

Power the Robot: We will use pack of 9V batteries to power our robot and Arduino.

Demonstration: When we put the robot and turn ON the switch, it goes forward. The robot detects the obstacle in its path and takes a backward step and then takes a turn and then moves forward with the same loop.

In conclusion, our Arduino IoT-based Obstacle Detection & Avoidance Robotic Car project represents a step towards intelligent, autonomous systems, poised to navigate dynamic environments with precision and efficiency.

References for the Project

- Arduino Official Website: https://www.arduino.cc/
- Internet of Things (IoT) Overview: https://www.internetsociety.org/resources/iot-overview/
- Ultrasonic Sensor Tutorial: https://www.arduino.cc/Tutorial/LibraryExample/UltrasonicSensor

This project report outlines the design, development, and implementation of our IntelliScout - The Cyber Rover Version 2, an IoT-based Spybot, highlighting its components, methodology, results, and potential future enhancements.

Thankyou!