
IRONHOUND
An endeavor by Team TRIGGERZ

Who are We?

We are team Triggerz, culmination of 5 different minds working in a harmony behind a single motive “To create something for greater good”. The team comprises of the students from IIIT Trichy from various branches who are:-

- Anand Prakash (Ist Year ECE)
- Ayush Soni (Ist Year ECE)
- Utkarsh Shukla (Ist Year CSE)
- Nikhil Upadhyay (IInd Year ECE)
- Utkarsh Verma (IInd Year ECE)

Hope you like for what we are here to present :)

The Inception

Tis' the age of automation, and technology nowadays thrives to improve our life in ways one can only comprehend of. If simple tasks can be facilitated by technology then why not the grave ones.

Threat detection in defense, mining , research fields are still done at expense of human lives. To safeguard those lives and provide and better set of information, this is where we come up with our plan. An autonomous threat detection rover which can detect the defined threat and provide the info to the operator remotely.Moreover it is versatile enough to do mapping, delivery etc based on the need of the hour.

Enough talk, let's see what is in the store for you.

Materials:

Along with main things like mood,coffee and time some other things used in the module are:-

- Omnidirectional camera servo
- Battery
- Wi-fi module
- Central processing module
- Open camera vision module
- Ultrasonic sensor
- Motor drivers
- Web socket infrastructure
- Control server
- GPS Sensors
- Cardboard
- Wood
- Battery monitor
- Metal detector

WORKING OF MODULE

MOVEMENT AND MANEUVERABILITY :

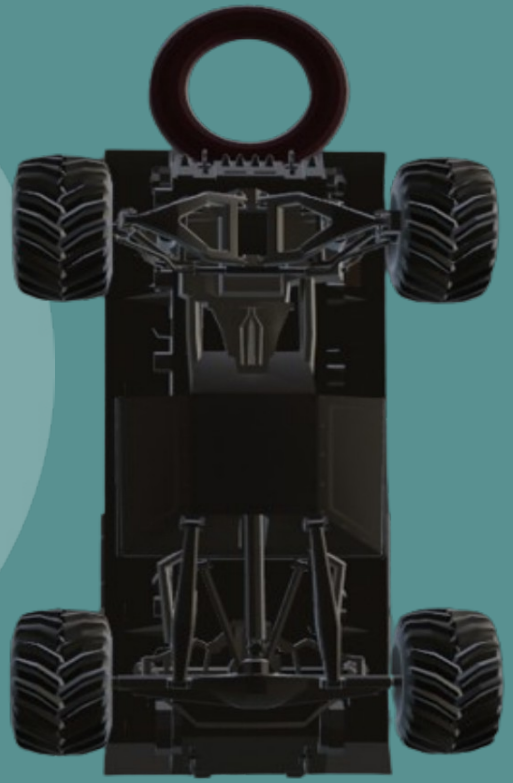
The incorporation of a 4-wheel tire system with front-wheel steering in rover applications mirrors the conventional drive system employed in everyday cars.

MOBILITY -

- The power is delivered to each wheel by a BO motor which source energy from a set of batteries.

MANEUVERABILITY -

- The front axle is connected to a shaft which enables horizontal movement.
- The axle is joined with right and left swingarms which move in accordance to the shaft.



ELECTRONICS :

ESP32-CAM -

•A setup of ESP32-CAM camera module based on the ESP32 microcontroller, equipped with an OV2640 camera and onboard TF card slot.

•A powerful 4MB PSRAM, allowing for image buffering during video streaming without compromising the ESP32's stability.

•With WiFi and Bluetooth support, the ESP32-CAM facilitates wireless communication and integration into IoT applications.

WiFi and CAM INTEGRATION-

•The ESP32-CAM's WiFi capabilities, supported by the ESP-32S module, enable versatile applications such as real-time video streaming, image uploads, and remote control.

•The OV2640 camera with flash delivers high-quality images in JPEG format and supports other formats like BMP and GRAYSCALE.

•The module's ability to support up to 4GB TF cards for data storage further enhances its utility.

WEBSOCKETS CHANNEL INTEGRATION-

Websockets provide a robust communication protocol for real-time, bidirectional communication between the ESP32-CAM and external devices (Control server), making it an ideal choice for surveillance and control applications.

The integration involves three key channels:

1.Camera Streaming Channel-

- The ESP32-CAM streams video in real-time over a websocket connection.
- Clients can receive and display the live camera feed on web applications or other compatible platforms.

2.Rover Control Channel-

- Websockets facilitate remote control of the surveillance rover by enabling bidirectional communication.
- Commands from a control interface, such as a web application, are sent to the ESP32-CAM, allowing users to navigate the rover.

3.Sensor Data Channel-

- Websockets enable the transmission of sensor data from the ESP32-CAM to a monitoring interface.
- Information such as metal detector readings or environmental data collected by sensors on the rover can be relayed in real-time.

CONTROL SERVER:

It acts as a central hub where data from various sources is stored, crunched, and presented for user monitoring and control.

- The server, serving as the control server, is hosted on laptop.
- All three channels, including camera streaming, rover control and sensor data, are connected to the control server.
- In this setup, the control server plays a crucial role in collecting and processing data transmitted by the rover,encompassing information from the camera, sensors, trajectory, and GPS.
- The collected data is then transformed into a user-friendly format and displayed on the rver page, providing an intuitive user interface.

Moreover, the control server serves as a command center, allowing users to maneuver and

WebSocket SERVER ARCHITECTURE:

The architecture of the WebSocket system with ESP32-CAM and laptop as the server comprises the following key components:

1.ESP32-CAM Module (WebSocket Client):
•Operates as a WebSocket client, connecting to the WebSocket server on laptop.

•Manages bidirectional communication, handles both incoming and outgoing messages with the server.

2.WebSocket Library:
•Utilizes a WebSocket library compatible with the ESP32 framework, facilitating communication protocols.

•Ensures efficient and secure data exchange between the ESP32-CAM (client) and the server.

3.Communication Protocols:
•Adopts the WebSocket protocol (RFC 6455) for bidirectional communication between the ESP32-CAM (client) and the server.

•Implements specific messaging protocols for each channel, ensuring organized and secure data transfer.

4.Server:
•Functions as the WebSocket server, managing multiple WebSocket clients, including the ESP32-CAM.

•Handles communication channels and processes data received from the ESP32-CAM, such as camera streaming, rover control, and sensor data.

5.Client Interfaces (ESP32-CAM):
•The ESP32-CAM serves as a WebSocket client, connecting to the WebSocket server running on my laptop.

•Allows clients, like external devices or web applications, to subscribe to various channels based on functionality (e.g., camera streaming, rover control, sensor data).

In this configuration,laptop operates as the WebSocket server, managing communication with the ESP32-CAM acting as the WebSocket client. The bidirectional flow of data ensures seamless integration and control between the server and the ESP32-CAM, providing a flexible and responsive framework for real-world applications such as surveillance rovers and metal detectors

Neo-6M GPS MODULE INTEGRATION:

The Neo-6M GPS module is a compact and affordable Global Positioning System (GPS) receiver designed for accurate location tracking. It operates on the principles of trilateration, utilizing signals from multiple satellites to determine its precise location on Earth. Here's an overview of its working principle:

1.Satellite Signal Reception:

•The Neo-6M module relies on signals transmitted by a network of GPS satellites orbiting the Earth.

•A minimum of four satellite signals is needed for accurate position triangulation.

2.Trilateration Calculation:

•The module calculates its distance from each satellite based on the time it takes for the signals to reach the receiver.

•By combining these distances, the Neo-6M determines its 3D position (latitude, longitude, and altitude) using a process known as trilateration.

3.Data Processing:

•The module processes the received satellite signals and extracts essential information such as location, time, and satellite data.

4.Output:

•The Neo-6M outputs the acquired GPS data in standard NMEA (National Marine Electronics Association) sentences, a common protocol for GPS data communication.

5.Data Transmission to Control Server:

•The ESP32-CAM dispatches formatted GPS data through the dedicated sensor data channel on the WebSocket connection.

6.Control Server Processing:

•The control server, hosted on my laptop, assumes the role of an omniscient overseer, meticulously processing incoming GPS data streams.

•This processing stage intelligently intertwines location specifics with mapping services or other applications, presenting the culmination in a user-

METAL DETECTOR :

The metal detector works on the principle of electromagnetic induction, utilizing coils and oscillating circuits to identify the presence of metal.

Here's a breakdown of how a metal detector works:

•Coil System (Search Coil) : Often referred to as the search coil, the coil generates an electromagnetic field when an electric current flows through it.

•Oscillator Circuit: An oscillator circuit produces an alternating current (AC) in the coil. This AC creates a varying magnetic field around the coil.

•Emission of Electromagnetic Field: As the AC passes through the coil, it emits an electromagnetic field into the surrounding space.

•Interaction with Metal Objects: Eddy currents are induced in metal when the electromagnetic field encounters metal . These eddy currents create their own magnetic fields, which in turn interact with the original electromagnetic field produced by the search coil.

•Signal Response: The interaction between the induced magnetic field from the metal and the original field from the coil causes a variance in the oscillation of the detector circuit. This variance results in a change in the electrical signal.

•Detection Mechanism: The detection mechanism in detector ,involves a control unit that analyzes the changes in the signal. When the significant alteration indicative of the presence of metal is detected, the detector signals us.

•Alerting the User: To alert the us about the presence of metal, an alert signal is sent to control server. The control server later on processes on data and emits an “ALERT” sound.

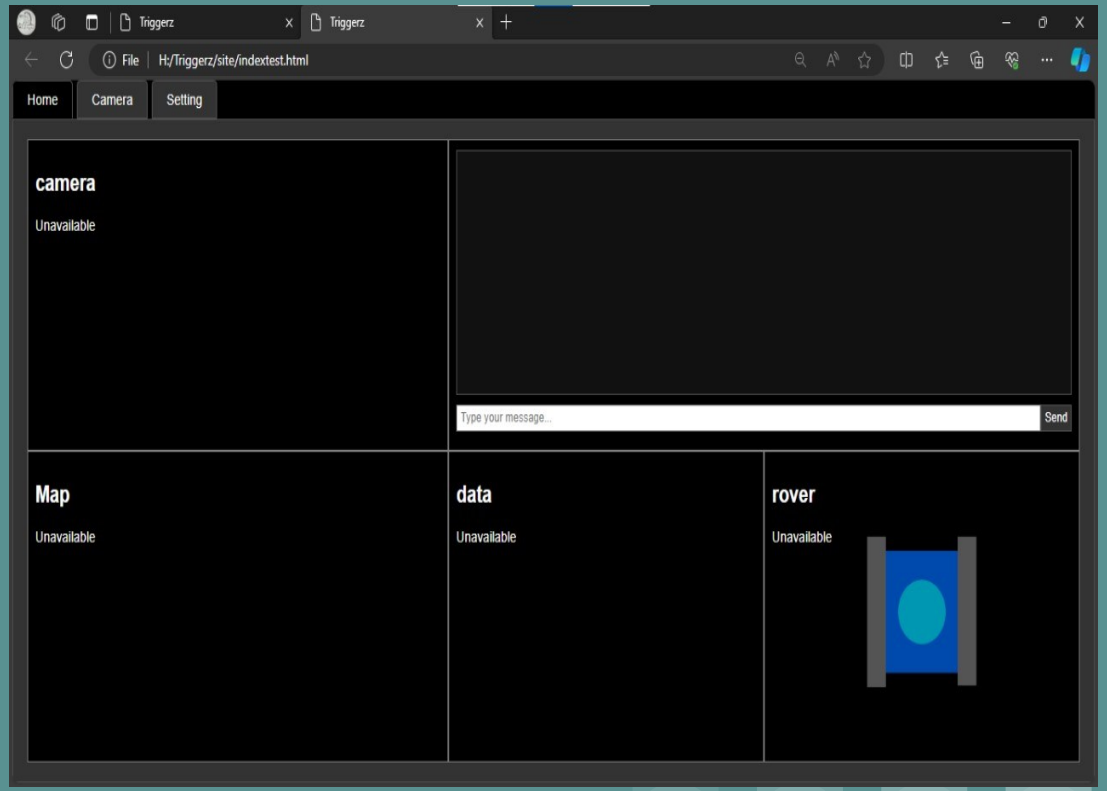
•Sensitivity Calibration : To keep up with various needs the rover can be calibrated to varying sensitivity, enabling us to

So what we have right now at Phase 1?

Coding:

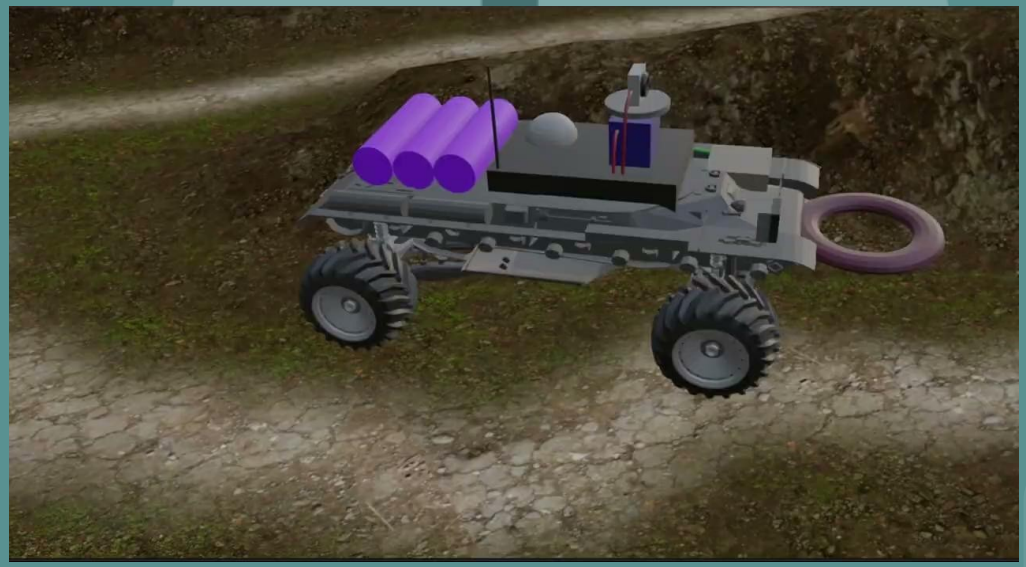
On the coding front we have completed the basic integration of components for transmitting signal, processing data, and detection.

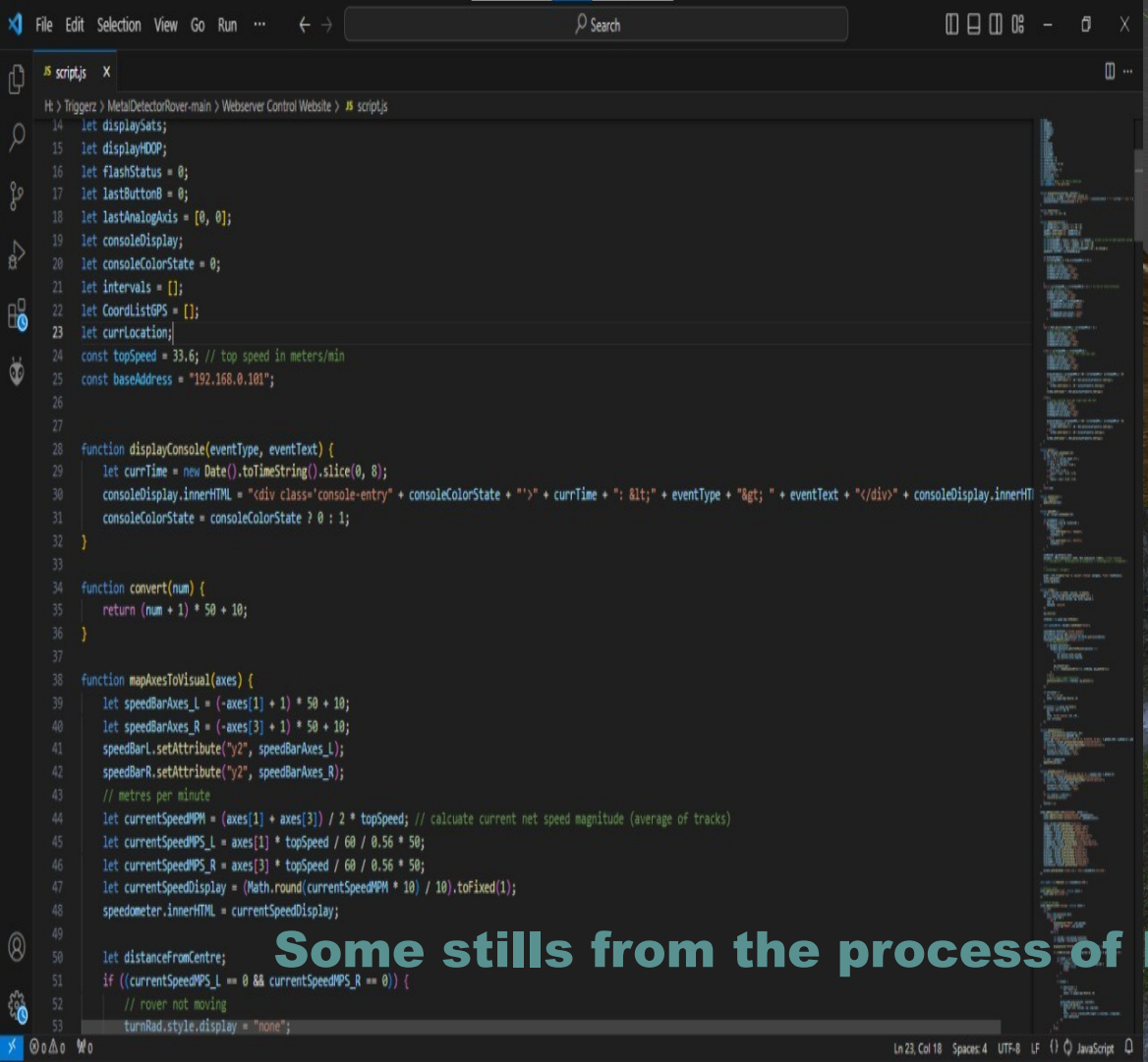
- The servo motors and sensors have been calibrated in accordance to requirements.
- The integration of camera module is in progress
- Further code blocks are being edited to improve the output quality.
- Along with this we are developing a site for broadcasting the output which will house the control systems as



Mechanical:

On the mechanical front we are currently working on with the components and designing. We have started the build of the rover. We are going on with a ladder frame chassis as it will be easy to mount components, distribute weight and save weight also. In addition to this we are building a frame first on which we will attach the panels and components.Moreover we have created a test render of the prototype as how it will look in reality, have a look:





Some stills from the process of Phase 01

Thus at the end of Phase 1 we have been through with ideation, designing,and obtaining components. Now what is left is to refine our code, sync it well with the components and tweak the hardware to respond with the software.We look forward to present the functioning prototype in Phase 2 as this is a project with an aim for greater good.