

SURVEILLANCE ROVER

A Project Report Phase - II

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Engineering Degree in Electronics and Communication Engineering

By

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade “A” by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **P. SOUNDAR (39130436)** and **R. SURENDAR (39130456)**, who carried out the project entitled "**SURVEILLANCE ROVER**" under my supervision from January 2023 to April 2023

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We, **P. SOUNDAR (39130436)** and **R. SURENDAR (39130456)**, hereby declare that the Project Report entitled **SURVEILLANCE ROVER** is done under the guidance of **Dr. S. EMALDA ROSLIN, M.E., Ph.D.**, is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

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SIGNATURE OF THE CANDIDATES

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of **SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my profound gratitude to **Dr. N.M. NANDHITHA, M.E., Ph.D.**, Prof. & Dean, School of Electrical and Electronics and **Dr. T. RAVI, M.E., Ph.D.**, Head of the Department of **Electronics and Communication Engineering**, Sathyabama University for having been a constant source of support and encouragement for the completion of the project.

I consider my self-most fortunate and immensely privileged to have worked under the guidance of **Dr. S. EMALDA ROSLIN, M.E., Ph.D.**, Department of Electronics and Communication Engineering to complete this project successfully.

I express our heartfelt thanks to our family members and all our friends who helped me to complete our project successfully and finally, I thank the exciting Super Natural Power, the Almighty GOD.

ABSTRACT

Surveillance plays an important role in border areas to keep eye on enemies. In such situations, it is difficult to allow duty of surveillance to a soldier, which may cause danger to the life of one. Rather we can use a surveillance rover to keep eye on border areas. So in such cases this kind of rover is very useful they are small in size and provided with many abilities so they can perform the duty of surveillance and spying perfectly. In case if they found by the combatant, they have no identity to whom they belong. Military on border area are facing many problems so this kind of technology help them to aware about the opponent activities, so they can take further decisions The rover's capabilities include real-time video streaming, image capture allowing operators to quickly assess and respond to changing conditions. With its robust design and maneuverability, the surveillance rover provides a flexible and cost-effective solution for a wide range of surveillance applications, improving safety, and reducing the risks associated with manual inspection and monitoring.

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CHAPTER 1

INTRODUCTION

The development of advanced robotics and wireless communication technologies has led to the creation of highly capable surveillance rovers that can operate in harsh environments, providing real-time monitoring and surveillance capabilities that are crucial in a range of applications. In this project, we present a surveillance rover system that is designed specifically for military surveillance applications. The surveillance rover system consists of several key components, including the ESP32CAM camera module, the GSM SIM800L communication module, and the NEO6 GPS module. The ESP32CAM module provides high-quality imaging capabilities, which are critical for surveillance applications. The GSM SIM800L module provides a reliable and efficient means of wireless communication, allowing the rover to transmit data and images in real-time. In addition to these components, the surveillance rover system also includes a metal detector sensor, which is used to detect metal objects. When the metal detector sensor detects metal, it sends an SMS message containing a live location Google Maps link to the operator, enabling the operator to quickly respond to potential threats. One of the key benefits of the surveillance rover system is its versatility. The system can be customized and adapted to meet the specific needs of different applications, making it an ideal solution for a range of industries beyond military surveillance. Furthermore, the development of the surveillance rover system represents a significant step forward in the field of robotics and wireless communication technology. The integration of advanced technologies, such as the ESP32CAM camera module and the GSM SIM800L communication module, demonstrates the potential of combining multiple technologies to create highly capable and versatile solutions.

1.1 ABOUT SURVEILLANCE ROVER

In this project, we have developed a surveillance rover system that utilizes advanced technologies to provide real-time monitoring and surveillance capabilities. The system consists of several key components, including the ESP32CAM camera module, the GSM SIM800L communication module, the NEO6 GPS module, and the TB6612FNG motor driver. The ESP32CAM camera module is used to provide high-quality imaging capabilities, which are crucial for surveillance applications. Additionally, it is used to control the rover's movements using the TB6612FNG motor driver, allowing it to move and explore its surroundings. The GSM SIM800L module is used to transmit an SMS message to a registered mobile number when a metal object is detected using a metal detector sensor. This feature is critical in military surveillance applications, as it allows operators to respond quickly to potential threats. The NEO6 GPS module is used to provide accurate location tracking of the rover. When the metal detector sensor detects metal, it sends an SMS message containing a live location Google Maps link to the registered mobile number. This feature enables operators to track the rover's movements and respond quickly to potential threats. Overall, the surveillance rover system represents a highly capable and versatile solution for military surveillance applications. The combination of advanced imaging capabilities, wireless communication, location tracking, and metal detection makes our system ideal for military surveillance, and we believe that our system has significant potential for future development and expansion. Moreover, the surveillance rover system can be operated remotely, which eliminates the need for human intervention in dangerous or inaccessible environments. This feature significantly reduces the risk of injury to personnel, and also allows for continuous surveillance of the area of interest. In addition to military applications, the surveillance rover system can be utilized in a variety of industries, including mining, construction, and search and rescue operations. The ability to detect metal objects and provide accurate location tracking makes it an ideal solution for these industries.

1.2 MOTIVATION

The development of surveillance technology has been critical in enhancing military capabilities and ensuring national security. However, traditional surveillance methods have limitations, particularly in situations where human access is restricted or dangerous. To overcome these limitations, we have developed a surveillance rover system that utilizes advanced technologies to provide real-time monitoring and surveillance capabilities. The motivation behind this project is to design and develop a surveillance rover system that can be deployed in extreme environments to monitor and gather information remotely. The system's ability to detect metal objects and transmit an SMS message with the detected location to a registered mobile number, coupled with accurate location tracking using GPS, makes it an ideal solution for military surveillance applications. Additionally, the rover's ability to move and explore its surroundings using the TB6612FNG motor driver and transmit live video using the ESP32CAM module, provides a comprehensive surveillance solution that can operate in remote and dangerous environments. The project's motivation is to provide a versatile, efficient, and cost-effective surveillance system that can help military personnel carry out their tasks effectively and safely. Ultimately, this project aims to contribute to the development of advanced surveillance technologies that enhance national security and protect military personnel in challenging environments. The surveillance rover system developed in this project is not limited to military surveillance applications. It has the potential to be used in various fields, such as environmental monitoring and exploration, search and rescue operations, and disaster response management. Additionally, the use of advanced technologies in this project demonstrates the potential for further innovation and advancement in the field of robotics and wireless communication. The knowledge and experience gained from this project can be applied to future research and development of more sophisticated surveillance systems. Finally, the practical application of this project showcases the benefits of interdisciplinary collaboration between experts in engineering, computer science, and military operations.

1.3 OBJECTIVES

The objectives of the research are to develop a user-friendly cost-effective web-enabled control system for rovers that would be useful for general and special uses in the public domain. The specific objectives are:

1. To control the rover over the internet.
2. Making a simple user-friendly interface to control the robot.
3. Having an integrated feedback system in the controlling software.
4. To incorporate a video streaming feature that allows the user to view the rover's surroundings in real-time.
5. To develop a system for remotely monitoring and maintaining the rover's hardware and software components.

CHAPTER 2

LITERATURE REVIEW

2.1 LITERATURE SURVEY

T. Akilan, Princi Kumari , Satyam Chaudhary , Utkarsh Pandey (2020). This survey deals with objective of surveillance of human activities or any suspicious activities in war field and border lines with the help of a robot based on IoT technology as human access is not possible everywhere and if possible can lead to risk of losing life. Surveillance takes place through wireless camera interfacing with Arduino and various sensors. WIFI/Bluetooth module is used for communication that is controlled from a distance by smartphone or a PC. Wireless camera sends the real time video signals. Robot also collects data from various sensors send it to micro-controller. The movement of robot is controlled by the user through a smartphone or PC. The robot is fully capable to work as required in defense areas as it can be controlled automatically and manually both. According to security perspective this robot is very useful not only in defense but also in domestic areas too.[1]

Abhijeet Dhule, Neha Sangle, Supriya Nagarkar, Asmita Namjoshi (2020). Surveillance plays an important role in border areas to keep eye on enemies. In such situation sit is difficult to allow duty of surveillance to a soldier, which may cause dangerous to the life on one. Rather we can use an robot to keep eye on border areas. So in such cases this kind of robots are very useful they are small in size and provided with many abilities so they can perform the duty of surveillance and spying perfectly. In case if they found by the combatant, they have no identity to whom they belong. Military on border area are facing many problemsso this kind of technology help them to aware about the opponent activities, so they can take further decisions[2]

Jignesh Patoliya , Haard Mehta , Hitesh Patel(2015). The main objective behind developing this robot is for the surveillance of human activities in

the war field or border regions in order to reduce infiltrations from the enemy side. The robot consists of night vision wireless camera which can transmit videos of the war field in order to prevent any damage and loss to human life. Military people have a huge risk on their lives while entering an unknown territory. The robot will serve as an appropriate machine for the defense sector to reduce the loss of human life and will also prevent illegal activities. It will help all the military people and armed forces to know the condition of the territory before entering it.[3]

Minal S. Ghute, Kanchan P.Kamble, Mridul Korde(2018).The system proposed in this paper consists of a single unit, which will monitor the environment in various hazardous conditions and provide live video feedback. Basics of robotics like sensors and actuators, gives an overview on robotic construction. The proposed system is also able to capture real-time videos which are useful for surveillance for a specific person or area. Controlling of Robot is done using a Raspberry Pi3 processor. This robot is more comfortable for military applications such as surveillance of interested area .It will provide tactical advantage during hostage situations or in hostile grounds. It is capable of walking on any surface and providing monitoring over an area. With the help of high quality video transmission the surveillance become more effective. Video quality is improvised in the proposed system. These will prove important in applications like robots for civil use and military robots.[4]

G. Anand ravi sekar, A. Anto Clinton, T. Mukesh Raj, L. Naveen (2018). The main objective behind this paper is to develop a robot to perform the act of surveillance in domestic areas. Nowadays robot plays a vital role in our day to day life activities thus reducing human labor and human error. Robots can be manually controlled or can be automatic based on the requirement. The purpose of this robot is to roam around and provide audio and video information from the given environment and to send that obtained information to the user. In this project, one can control the robot with the help of mobile or laptop through Internet of Things (IoT) 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. The robot can be controlled both in manual as well as in automated mode with the help of Arduino microcontroller. This robot also uses various sensors that collects data and sends

it to the Arduino microcontroller which controls the robot behavior. Along with the obtained live streamed video output, user can also obtain the presence of metal bombs using metal detectors. Thus the action of surveillance can be performed. Further advancement in our project can provide surveillance even in defense areas.[5]

Ashwini V , AsmaSadia M , SherishaN,Mr.Ronald Lawrence J,Mrs. Jillian Rufus J(2019). The main objective for developing the robot is for the surveillance of human activities in the war field or rescue operations in order to reduce attacks from the enemy side. The robot consists of night vision wireless camera which can transmit videos of the war field in order to prevent any damage and loss to human life. Military men have a huge risk on their lives while entering an unknown territory. The robot will serve as an appropriate machine for the defence sector to reduce the loss of human life and will also prevent illegal activities. It will help all the military people and armed forces to know the condition of the territory before entering it. This can also be used in various rescue operations to save the man power and to monitor hazardous situations. The main advantage of this project is that we can easily control the robot using an android mobile by a blynk app. An ArduinoATMEGA2560 is used for the desired operation. A smart cell phone with IP web cam application is mounted on the robot body for spying purpose even in complete darkness by using infrared lighting. This will send the videos wirelessly at the transmitter side (laptop). This is kind of robot can be helpful for spying purpose in war fields and in order to minimize the attacks like 26/11 in Mumbai in future. It can also be helpful where living beings cannot reach.[6]

Dr. Shaik.Mahaboob Basha , Sk.Abdul Khayyum, B. Amarendra, S.K.Sajid(2017). A robot is a mechanical or virtual artificial agent, usually an electro-mechanical machine that is guided by a computer program or electronic circuitry It is unique spy robot circuit which can be controlled using a RF remote controller. It can act as a live telecast of audio and video information's from the surroundings and can be sent to a remote station through RF. Moment of camera is also. The maximum range is 100 meters. Another feature included it measure the distance of object at front of robot and also automatically stop robot if its detect

distance of object is inside 10cm & data of distance can be also access at remote section unit by send RF signal. RF 2.4GHz ASK transmitter and receiver are used for the remote control which provide serially communication under specific range. The camera has a receiver, which is placed in the remote station. Its output signals are in the form of audio and video. The objective of the paper is to design a unique spy robot circuit which can be controlled by using a remote controller to detect any object or unwanted incident like fire in the night. Thus, our paper can be used as a societal application to identify culprits in the selected area. Further, the advancement of our paper can be established in security systems in defense.[7]

2.2 SUMMARY OF EXISTING WORK

1. The external camera and Arduino uno microcontroller are used for transmission.
2. It is used only for video streaming.
3. It is 2wd motor car model.

2.3 ISSUES IN EXISTING SYSTEMS

The existing models (RF, Bluetooth & GSM) has various disadvantages, few are that it works only for a short-range coverage area, making it a bit difficult for the Spying purpose or surveillance for long range. Also, the wired robots can't be used for spying purpose because of its wired connection, which may restrict the movement of the robot in the vast area of surveillance. In the previous models the video streaming is done as a continuous uninterrupted process hence an lot of unwanted data can be stored. In addition, normal cameras were used for surveillance in war fields, where surveillance during night was a great difficulty. Capturing of images was an unavailable option or, Bluetooth and GSM modules are not budge

CHAPTER 3

PROPOSED METHODOLOGY

3.1 BLOCK DIAGRAM OF PROPOSED WORK

In this project, the proposed methodology involves integrating several key components to develop a surveillance rover system that can be controlled remotely through a user-friendly web interface. The first part of the system involves using an Arduino Nano to interface with the GSM SIM800L module, the NEO6 GPS module, and the metal detector sensor. The metal detector sensor is used to detect metal objects and trigger an SMS message containing the location to the registered mobile number. The second part of the system involves using an ESP32CAM camera module to transmit live video and operate the rover through the TB6612FNG motor driver. The web interface allows the user to control the rover's movements and view the live video feed remotely through a laptop or mobile phone. The proposed methodology involves developing custom software to interface with the various components of the system and provide a user-friendly control interface. This will involve programming the Arduino Nano to communicate with the GSM and GPS modules and handle the metal detector sensor's input. The ESP32CAM module will be programmed to transmit the live video feed and receive commands from the web interface to control the rover's movements. Overall, the proposed methodology aims to integrate advanced technologies to develop a comprehensive surveillance rover system that can be controlled remotely through a user-friendly web interface. The system's ability to detect metal objects, provide accurate location tracking, and transmit live video makes it ideal for military surveillance applications and other scenarios where remote monitoring and surveillance are required.

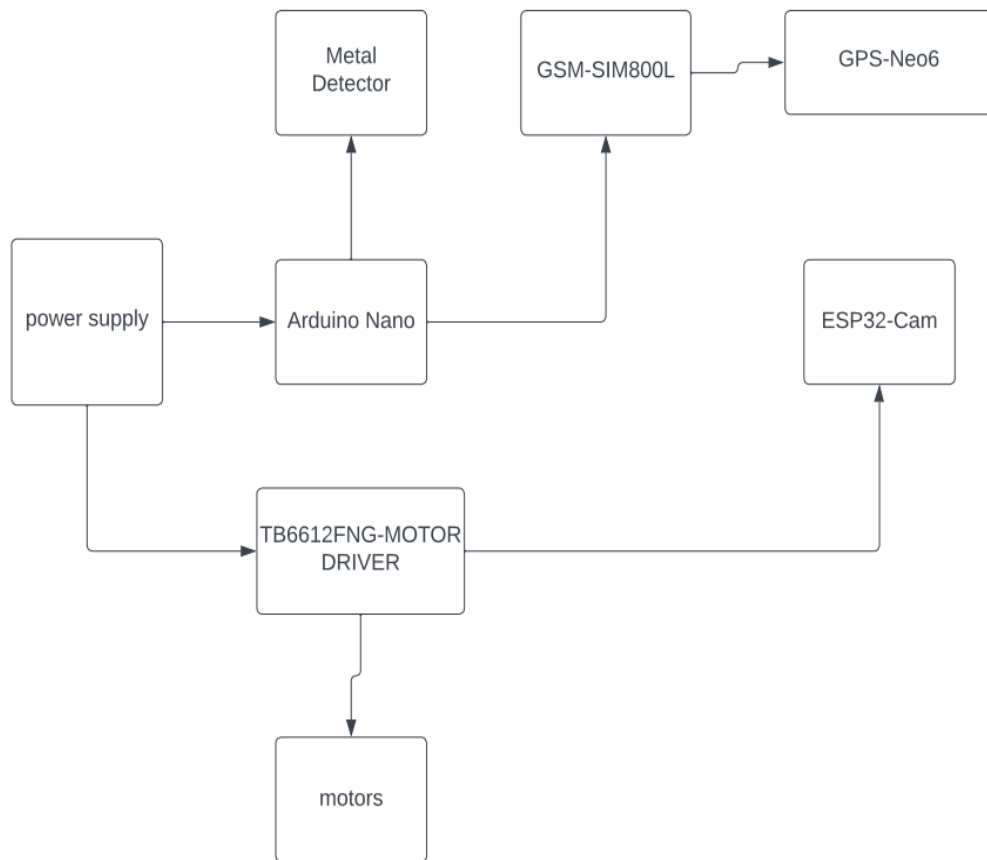


Fig. 3.1 Block diagram of proposed work

3.2 IMPLEMENTATION OF SURVEILLANCE ROVER

ARDUINO MICROCONTROLLER

The Arduino Nano is a small, versatile board based on the ATmega328P microcontroller. It is designed for easy integration into a wide range of projects and can be programmed using the Arduino Integrated Development Environment (IDE). The Nano is similar to the Arduino Uno in terms of functionality, but is much smaller in size and has fewer input/output pins. It measures just 18mm x 45mm and has 14 digital input/output pins, 8 analog inputs, and 6 pulse-width modulation (PWM) outputs. The Nano can be powered using a USB cable or an external power supply and can communicate with other devices using serial communication, I2C, or SPI protocols. The Arduino Nano is popular among hobbyists, students, and professionals for its compact size, ease of use, and affordability. It can be used for a wide range of applications, including robotics, home automation, and data logging, among others.



Fig.3.2 Arduino Nano

METAL DETECTOR

Metal detectors can detect nearly all metallic objects. That means anything that contains elements like gold, silver, iron, nickel, copper, aluminium, tin and lead or mixtures and combinations like bronze and brass. Metal detectors cannot detect non-metal items such as wood, plastic, stones and bone. Some metal detectors are able to discriminate which means that they can differentiate between various types of metal. Like everything there is more than one way to detect metal and thus more than one way to make a metal detector. There are three main types of metal detectors that are available. Metal detectors use electromagnetic induction to detect metal. Uses include de-mining (the detection of land mines), the detection of weapons such as knives and guns, especially at airports, geophysical prospecting, archaeology and treasure hunting. Metal detectors are also used to detect foreign bodies in food, and in the construction industry to detect steel reinforcing bars in concrete and pipes and wires buried in walls and floors.

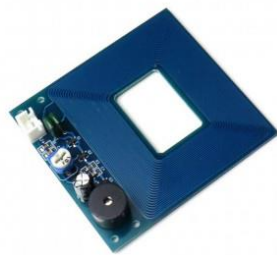


Fig.3.3 Metal Detector

ESP32-CAM

The ESP32-CAM is a small-sized, low-cost development board that combines an ESP32 microcontroller with a camera sensor. It is designed for building Internet of Things (IoT) projects that require wireless connectivity and image capturing capabilities. The ESP32-CAM features an OV2640 camera module with a resolution of 2 megapixels, which is capable of capturing JPEG and BMP images, and recording video in various formats such as MJPEG and YUV422. It has a built-in Wi-Fi and Bluetooth module, which allows it to connect to the internet and communicate with other devices wirelessly. IN addition, the ESP32-CAM has several input/output pins that can be used for interfacing with other devices and sensors. It can be programmed using the Arduino IDE, which makes it easy to get started with for developers who are familiar with the Arduino platform. The ESP32-CAM is a versatile board that can be used for a wide range of applications such as home security systems, remote monitoring, and video streaming. Its compact size and low cost make it an ideal choice for hobbyists, students, and professionals who want to build their own IoT projects.



Fig.3.4 Esp32-Cam

TB6612FNG MOTOR DRIVER

The TB6612FNG is a dual motor driver IC that is commonly used in robotics and other projects that require motor control. It is designed to drive two DC motors or one stepper motor, and can provide up to 1.2A of continuous current per channel (3A peak). The TB6612FNG is a versatile motor driver that can be controlled using a variety of input signals, including PWM, analog voltage, and I2C. It also includes a built-in thermal shutdown circuit to protect the IC from overheating. One of the advantages of the TB6612FNG is its small size and low power consumption, which make it ideal for use in battery-powered projects. It also has a low voltage operation range (2.5V to 13.5V), which makes it compatible with a wide range of microcontrollers and other devices. The TB6612FNG can be used for a variety of applications, such as robotics, RC vehicles, and other motor control projects. Its ease of use, compact size, and low power consumption make it a popular choice among hobbyists, students, and professionals alike.

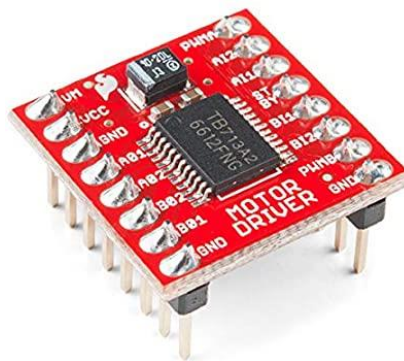


Fig.3.5 TB6612fng Motor Driver

GSM SIM800L

The SIM800L is a small, low-cost, and easy-to-use GSM/GPRS module that allows devices to communicate over the cellular network. It is commonly used in IoT projects and other applications that require wireless communication, such as remote monitoring and control. The SIM800L module supports quad-band GSM/GPRS networks, which allows it to be used in almost any country. It can be controlled using AT commands, making it easy to integrate with microcontrollers and other devices. It also has a built-in SIM card slot, which allows it to connect to the cellular network without the need for an external SIM card holder. In addition to GSM/GPRS communication, the SIM800L also supports SMS and voice calls. It has a small form factor and low power consumption, making it ideal for use in battery-powered projects. The SIM800L is a popular choice among hobbyists, students, and professionals who want to add cellular connectivity to their projects. Its ease of use, low cost, and small size make it a versatile module that can be used in a wide range of applications.

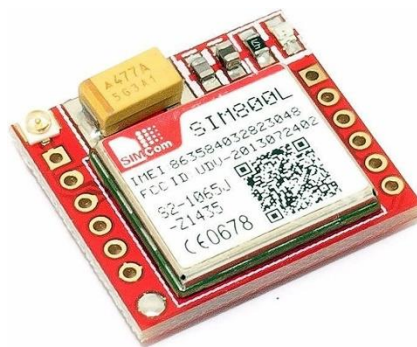


Fig.3.6 GSM Sim800L

NEO6 GPS MODULE

The NEO-6 GPS module is a small, low-cost GPS receiver that can be used to add location-tracking capabilities to a wide range of projects. It is designed to work with the Global Positioning System (GPS), which is a network of satellites that provide location and time information to GPS receivers around the world. The NEO-6 module features the u-blox NEO-6M GPS chip, which is capable of receiving signals from up to 22 GPS satellites simultaneously. It can provide accurate location and time information with a positional accuracy of up to 2.5 meters. The module communicates with a microcontroller or other device using serial communication, and can be controlled using standard AT commands. It also includes a built-in rechargeable backup battery, which allows it to retain its location data and settings even when power is removed. The NEO-6 GPS module is widely used in applications such as vehicle tracking, asset tracking, and geocaching. Its small size, low cost, and ease of use make it a popular choice among hobbyists, students, and professionals who want to add GPS capabilities to their projects.

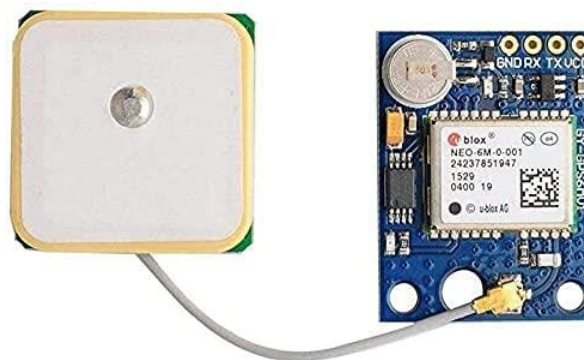


Fig.3.7 Neo6 GPS Module

BATTERY

A lithium-ion battery or Li-ion battery (abbreviated as LIB) is a type of rechargeable battery in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging. Li-ion batteries use an intercalated lithium compound as one electrode material, compared to the metallic lithium used in a non-rechargeable lithium battery. The electrolyte, which allows for ionic movement, and the two electrodes are the constituent components of a lithium-ion battery cell. Lithium-ion batteries are common in home electronics. They are one of the most popular types of rechargeable batteries for portable electronics, with a high energy density, tiny memory effect and low self-discharge. LIBs are also growing in popularity for military, battery electric vehicle and aerospace applications. For notebooks or laptops, lithium-ion cells are supplied as part of a battery pack with temperature sensors, voltage converter/regulator circuit, voltage tap, battery charge state monitor and the main connector. These components monitor the state of charge and current in and out of each cell, capacities of each individual cell (drastic change can lead to reverse polarities which is dangerous), and temperature of each cell and minimize the risk of short circuits



Fig.3.8 LI-ION BATTERY

SOFTWARE REQUIRED

Programs written using Arduino Software (IDE) are called sketches. The Sketch IDE (Integrated Development Environment) is a special program running on your computer that allows you to write sketches for the Arduino board in a simple language modelled after the Processing language. The magic happens when you press the button that uploads the sketch to the board: the code that you have written is translated into the C language, and is passed to the AVR-GCC compiler, an important piece of open source software that makes the final translation into the language understood by the microcontroller. This last step is quite important, because it's where Arduino makes your life simple by hiding away as much as possible of the complexities of programming microcontrollers. The programming cycle on Arduino is basically as follows: Plug your board into a USB port on your computers Write a sketch that will bring the board to life Upload this sketch to the board through the USB connection and wait a couple of seconds for the board to restart. The board executes the sketch that you wrote. The idea of sketching in code is a way of thinking about writing code as a simple intuitive process, just like drawing in a sketchbook. In this way, an Arduino program is called a sketch and is saved in a folder called a sketchbook. Sketching means we can get our hands dirty and quickly try out a new idea. It is a skill available to all of us. Arduino sketches can be customized and modified to suit a wide variety of applications, making it a flexible tool for both hobbyists and professionals. Additionally, the Arduino community is a vibrant and active community, with a wealth of resources and tutorials available online for those looking to learn and explore. With the availability of a wide range of sensors and modules, Arduino sketches can be used to create innovative and interactive projects that can respond to changes in the environment. Furthermore, Arduino sketches can be programmed to communicate with other devices and systems, making it possible to create complex and integrated projects. With its ease of use and versatility, Arduino has become a popular choice for creating interactive installations, wearable technology, and Internet of Things (IoT) projects.

3.3 STANDARDS

The ESP32-CAM development board uses several industry-standard protocols and interfaces to enable communication between the various components on the board. Some of the standards used in the ESP32-CAM include:

- **Wi-Fi (802.11b/g/n):** The ESP32-CAM includes a built-in Wi-Fi module that supports the 802.11b/g/n standards. This allows the board to connect to wireless networks and communicate with other devices over the internet.
- **Bluetooth (4.2/5.0):** The ESP32-CAM also includes a built-in Bluetooth module that supports the Bluetooth 4.2 and 5.0 standards. This allows the board to communicate wirelessly with other Bluetooth-enabled devices.
- **UART:** The ESP32-CAM uses a UART (Universal Asynchronous Receiver-Transmitter) interface to communicate with external devices such as microcontrollers, sensors, and displays. The UART is a standard interface that is commonly used in embedded systems.
- **I2C:** The ESP32-CAM includes an I2C (Inter-Integrated Circuit) interface that allows it to communicate with other devices using the I2C protocol. I2C is a standard protocol used for communication between microcontrollers and other devices, such as sensors and displays.
- **SPI:** The ESP32-CAM also includes an SPI (Serial Peripheral Interface) interface that allows it to communicate with other devices using the SPI protocol. SPI is a standard interface that is commonly used for communication between microcontrollers and other devices, such as memory chips and displays.

3.4 CONSTRAINTS

- To design a rover.
- To capture the videos at the night using night vision camera.
- Monitoring using IOT Technology.
- To monitor the night activities at the war field.
- To control the rover long range.

CHAPTER 4

RESULTS AND DISCUSSION

This is a prototype of a surveillance rover, designed for remote monitoring and surveillance purposes. The rover is equipped with an ESP32 Cam module, which is mounted on the top of the rover for a better video view. The TB6612FNG motor driver is mounted on the body of the rover, and it is connected to the ESP-32 Cam module, allowing for smooth and accurate movement of the rover. In addition, the rover is equipped with a GPS and GSM module, which are connected to the Arduino Nano also placed on the body of the rover, enabling real-time tracking and remote control of the rover. Overall, this surveillance rover is an innovative and effective solution for various surveillance and monitoring applications.

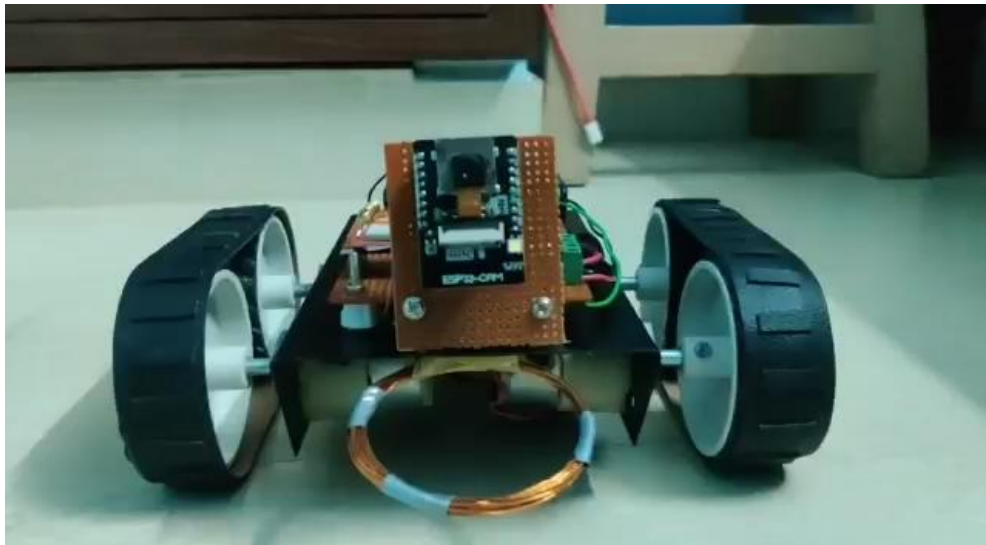


Fig.4.1 Front View Of The Surveillance Rover

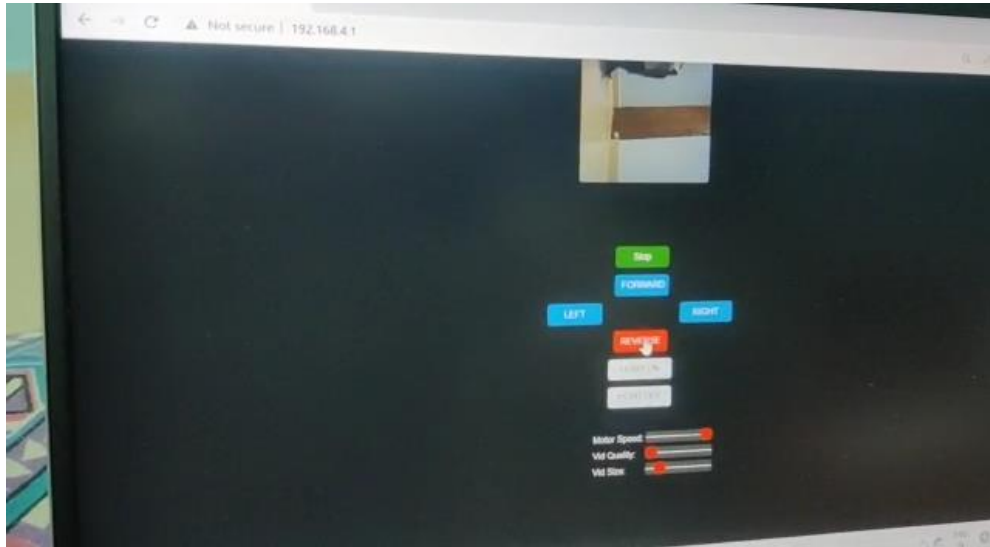


Fig.4.2 Video Output Of The Surveillance Rover

The surveillance rover is capable of providing live video output that can be viewed remotely. The video output can be accessed through a web page, allowing for easy monitoring from a remote location. The rover's camera captures high-quality video, providing a clear view of the surroundings. The video can be viewed in real-time, and the rover's movements can be controlled remotely through the web page, making it an effective tool for surveillance and monitoring applications. With its web-based video output, the surveillance rover provides a convenient and reliable way to monitor remote locations.



Fig.4.3 SMS Alert While Metal Is Detected

The surveillance rover is equipped with a metal detector that can detect the presence of metals in its vicinity. When metal is detected, the rover sends an SMS alert to a designated phone number. The SMS alert includes the message "metal detected" and the location of the metal detected area. The location is provided via Google Maps, making it easy to pinpoint the exact location of the metal. This feature makes the surveillance rover an effective tool for security applications where detecting metal is important, such as in airports, prisons, or other secure areas.

CHAPTER 5

CONCLUSION AND FUTURE WORKS

The surveillance rover system we have developed is a highly capable and versatile solution for military surveillance applications. It combines advanced imaging capabilities, wireless communication, location tracking, metal detection, and manual control through a web interface, making it an ideal solution for remote and dangerous environments. The integration of different technologies such as the ESP32CAM camera module, GSM SIM800L communication module, NEO6 GPS module, metal detector, and TB6612FNG motor driver has resulted in a comprehensive system that can operate efficiently and effectively. The proposed methodology for this project involves developing a user-friendly and cost-effective web-enabled control system for rovers. The system's specific objectives include controlling the rover over the internet, providing a simple user-friendly interface for controlling the robot, and having an integrated feedback system in the controlling software. The proposed methodology is expected to offer significant benefits over existing methods, such as improved control, ease of use, and a more cost-effective solution. Overall, we believe that our surveillance rover system represents a significant step forward in the development of advanced surveillance technologies, and we are confident that it has significant potential for future development and expansion. The system's ability to operate in extreme environments and provide real-time monitoring and surveillance capabilities will help military personnel carry out their tasks effectively and safely, ultimately enhancing national security.

Following are the future works

- Integrating more advanced sensors: While the current project includes a metal detector sensor and GPS module, future work could involve integrating additional sensors such as thermal imaging, gas detection, or motion sensors to enhance the system's surveillance capabilities.
- Automating rover movements: In the current project, the rover movements are controlled manually through a web page. Future work could involve developing algorithms to automate rover movements and allow it to navigate through its surroundings autonomously.
- Implementing machine learning: Machine learning algorithms could be implemented to detect and classify potential threats or anomalies in the video feed, alerting operators in real-time.
- Improving the web interface: The web interface could be improved to include additional features such as live video streaming, interactive maps, and alerts for potential threats.
- Enhancing wireless communication: The current project utilizes GSM and Wi-Fi for wireless communication. Future work could involve exploring other wireless communication options such as satellite communication or implementing more secure encryption protocols to ensure secure data transmission.
- Overall, there is significant potential for future work to further develop and enhance the surveillance rover system, making it an even more effective tool for military surveillance applications.

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APPENDIX

A. SOURCE CODE (SAMPLE CODE)

```
#include "esp_wifi.h"

#include "esp_camera.h"

#include <WiFi.h>

#include "soc/soc.h"

#include "soc/rtc_cntl_reg.h"


// Setup Access Point Credentials

const char* ssid1 = "SURVEILLANCE ROVER";

const char* password1 = "1234567890";


extern volatile unsigned int  motor_speed;

extern void robot_stop();

extern void robot_setup();

extern uint8_t robo;

extern volatile unsigned long previous_time;

extern volatile unsigned long move_interval;


#define CAMERA_MODEL_AI_THINKER

#define PWDN_GPIO_NUM    32

#define RESET_GPIO_NUM  -1

#define XCLK_GPIO_NUM    0
```

```
#define SIOD_GPIO_NUM 26
```

```
#define SIOC_GPIO_NUM 27
```

```
#define Y9_GPIO_NUM 35
```

```
#define Y8_GPIO_NUM 34
```

```
#define Y7_GPIO_NUM 39
```

```
#define Y6_GPIO_NUM 36
```

```
#define Y5_GPIO_NUM 21
```

```
#define Y4_GPIO_NUM 19
```

```
#define Y3_GPIO_NUM 18
```

```
#define Y2_GPIO_NUM 5
```

```
#define VSYNC_GPIO_NUM 25
```

```
#define HREF_GPIO_NUM 23
```

```
#define PCLK_GPIO_NUM 22
```

```
void startCameraServer();
```

```
void setup()
```

```
{
```

```
    WRITE_PERI_REG(RTC_CNTL_BROWN_OUT_REG, 0); // prevent brownouts  
    by silencing them
```

```
    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;

//init with high specs to pre-allocate larger buffers

if(psramFound()){

    config.frame_size = FRAMESIZE_QVGA;

    config.jpeg_quality = 10;

    config.fb_count = 2;

} else {

    config.frame_size = FRAMESIZE_QVGA;

    config.jpeg_quality = 12;

    config.fb_count = 1;

}


// 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;

}


//drop down frame size for higher initial frame rate

sensor_t * s = esp_camera_sensor_get();

s->set_framesize(s, FRAMESIZE_QVGA);

s->set_vflip(s, 1);

s->set_hmirror(s, 1);

```

```

WiFi.softAP(ssid1, password1);

IPAddress myIP = WiFi.softAPIP();

Serial.print("AP IP address: ");

Serial.println(myIP);


startCameraServer();


ledcSetup(7, 5000, 8);

ledcAttachPin(4, 7); //pin4 is LED

robot_setup();


for (int i=0;i<5;i++)
{
    ledcWrite(7,10); // flash led

    delay(50);

    ledcWrite(7,0);

    delay(50);
}


previous_time = millis();

}


void loop() {

```

```

if(robo)
{
    unsigned long currentMillis = millis();

    if (currentMillis - previous_time >= move_interval) {

        previous_time = currentMillis;

        robot_stop();

        char rsp[32];

        sprintf(rsp,"SPPED: %d",motor_speed);

        Serial.println("Stop");

        robo=0;

    }

}

delay(1);

yield();

}

#include <SoftwareSerial.h> //Include SoftwareSerial Library

#include <TinyGPS.h> //Include TinyGPS Library


#define GPS_RX_PIN 3

#define GPS_TX_PIN 4


#define SIM_RX_PIN 8

#define SIM_TX_PIN 9

#define BAUDRATE 9600

```

```
SoftwareSerial SIM(SIM_RX_PIN, SIM_TX_PIN);
```

```
SoftwareSerial GPS(GPS_RX_PIN, GPS_TX_PIN);
```

```
TinyGPS gps;
```

```
const byte npulse = 12; // number of pulses to charge the capacitor before each measurement
```

```
const byte pin_pulse = A0; // sends pulses to charge the capacitor (can be a digital pin)
```

```
const byte pin_cap = A1; // measures the capacitor charge
```

```
void setup() {
```

```
    Serial.begin(9600);
```

```
    GPS.begin(9600);
```

```
    SIM.begin(BAUDRATE);
```

```
    pinMode(A0, INPUT);
```

```
    pinMode(pin_pulse, OUTPUT);
```

```
    digitalWrite(pin_pulse, LOW);
```

```
    pinMode(pin_cap, INPUT);
```

```
}
```

```

void loop() {

    //Read metal detector sensor value

    int metalVal = analogRead(A0);


    if(metalVal > 100) { //If metal is detected

        Serial.println("Metal Detected");


        //Get GPS location

        float lat, lng;

        unsigned long age;


        do {

            while (GPS.available()) {

                if (gps.encode(GPS.read())) {

                    gps.f_get_position(&lat, &lng, &age);

                }

            }

        } while (age > 1000);


        //Get Google Maps link

        String mapsLink = "http://maps.google.com/maps?q=" + String(lat, 6) + "," +
        String(lng, 6);


        //Send SMS message
    }
}

```

```

SIM.println("AT+CMGF=1"); //Set SMS mode to text

delay(1000);

SIM.print("AT+CMGS=\"+912345679\\r\""); //Replace with your recipient's phone
number

delay(1000);

SIM.print("Metal detected at: ");

SIM.print(lat, 6);

SIM.print(", ");

SIM.print(lng, 6);

SIM.print("\\n");

SIM.print(mapsLink);

SIM.write(0x1A); //End SMS message

delay(1000);

}

```

```

int minval = 2000;

int maxval = 0;

//perform measurement

long unsigned int sum = 0;

for (int imeas = 0; imeas < 256 + 2; imeas++) {

    //reset the capacitor

    pinMode(pin_cap, OUTPUT);

    digitalWrite(pin_cap, LOW);

```

```

delayMicroseconds(20);

pinMode(pin_cap, INPUT);

//apply pulses

for (int ipulse = 0; ipulse < npulse; ipulse++) {

    digitalWrite(pin_pulse, HIGH); //takes 3.5 microseconds

    delayMicroseconds(3);

    digitalWrite(pin_pulse, LOW); //takes 3.5 microseconds

    delayMicroseconds(3);

}

//read the charge on the capacitor

int val = analogRead(pin_cap); //takes 13x8=104 microseconds

minval = min(val, minval);

}

}

```

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DESIGN AND DEVELOPMENT OF SURVEILLANCE ROVER FOR BORDER SECURITY

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ABSTRACT

Surveillance plays an important role in border areas to keep eye on enemies. In such situations, it is difficult to allow duty of surveillance to a soldier, which may cause danger to the life of one. Rather we can use a surveillance rover to keep eye on border areas. So in such cases this kind of rover is very useful they are small in size and provided with many abilities so they can perform the duty of surveillance and spying perfectly. In case if they found by the combatant, they have no identity to whom they belong. Military on border area are facing many problems so this kind of technology help them to aware about the opponent activities, so they can take further decisions The rover's capabilities include real-time video streaming, image capture allowing operators to quickly assess and respond to changing conditions. With its robust design and maneuverability, the surveillance rover provides a flexible and cost-effective solution for a wide range of surveillance applications, improving safety, and reducing the risks associated with manual inspection and monitoring.

KEYWORDS: Surveillance Rover, Image processing, Monitoring, GSM module.

1. INTRODUCTION

The development of advanced robotics and wireless communication technologies has led to the creation of highly capable surveillance rovers that can operate in harsh environments, providing real-time monitoring and surveillance capabilities that are crucial in a range of applications. In this paper, we present a surveillance rover system that is designed specifically for military surveillance applications [1,2]. The surveillance rover system consists of several key components, including the ESP32CAM camera module, the GSM SIM800L communication module, and the NEO6 GPS module. The ESP32CAM module provides high-quality imaging capabilities, which are critical for surveillance applications. The GSM SIM800L module provides a reliable and efficient means of wireless communication, allowing the rover to transmit data and images in real-time[3,4]. In addition to these components, the surveillance rover system also includes a metal detector sensor, which is used to detect metal objects. When the metal detector sensor detects metal, it sends an SMS message containing a live location Google Maps link to the operator, enabling the operator to quickly respond to potential threats. One of the key benefits of the surveillance rover system is its versatility. The system can be customized and adapted to meet the specific needs of different applications, making it an ideal solution for a range of industries beyond military surveillance [5]. Furthermore, the development of the surveillance rover system represents a significant step forward in the field of robotics and wireless communication technology. The integration of advanced technologies, such as the ESP32CAM camera module and the GSM SIM800L communication module, demonstrates the potential of combining multiple technologies to create highly capable and versatile solutions. In this paper, a surveillance rover system that utilizes advanced technologies to provide real-time monitoring and surveillance capabilities has been developed[6,7]. The system consists of several key components, including the ESP32CAM camera module, the GSM SIM800L communication module, the NEO6 GPS module, and the TB6612FNG motor driver. The ESP32CAM camera module is used to provide high-quality imaging capabilities, which are crucial for surveillance applications. Additionally, it is used to control the rover's movements using the TB6612FNG motor driver, allowing it to move and explore its surroundings. The GSM SIM800L module is used to transmit an SMS message to a registered mobile number when a metal object is detected using a metal detector sensor. This feature is critical in military surveillance applications, as it allows operators to respond quickly to potential threats. The NEO6 GPS module is used to provide accurate location tracking of the rover. When the metal detector sensor detects metal, it sends an SMS message containing a live location



Google Maps link to the registered mobile number. This feature enables operators to track the rover's movements and respond quickly to potential threats. Overall, the surveillance rover system represents a highly capable and versatile solution for military surveillance applications. The combination of advanced imaging capabilities, wireless communication, location tracking, and metal detection makes our system ideal for military surveillance, and we believe that our system has significant potential for future development and expansion. Moreover, the surveillance rover system can be operated remotely, which eliminates the need for human intervention in dangerous or inaccessible environments. This feature significantly reduces the risk of injury to personnel, and also allows for continuous surveillance of the area of interest. In addition to military applications, the surveillance rover system can be utilized in a variety of industries, including mining, construction, and search and rescue operations. The ability to detect metal objects and provide accurate location tracking makes it an ideal solution for these industries.

2. PROPOSED METHODOLOGY

The proposed methodology involves integrating several key components to develop a surveillance rover system that can be controlled remotely through a user-friendly web interface. The first part of the system involves using an Arduino Nano to interface with the GSM SIM800L module, the NEO6 GPS module, and the metal detector sensor. The metal detector sensor is used to detect metal objects and trigger an SMS message containing the location to the registered mobile number. The second part of the system involves using an ESP32CAM camera module to transmit live video and operate the rover through the TB6612FNG motor driver. The web interface allows the user to control the rover's movements and view the live video feed remotely through a laptop or mobile phone. The proposed methodology involves developing custom software to interface with the various components of the system and provide a user-friendly control interface. This will involve programming the Arduino Nano to communicate with the GSM and GPS modules and handle the metal detector sensor's input. The ESP32CAM module will be programmed to transmit the live video feed and receive commands from the web interface to control the rover's movements. Overall, the proposed methodology aims to integrate advanced technologies to develop a comprehensive surveillance rover system that can be controlled remotely through a user-friendly web interface. The system's ability to detect metal objects, provide accurate location tracking, and transmit live video makes it ideal for military surveillance applications and other scenarios where remote monitoring and surveillance are required. The figure 1 shows the block diagram of surveillance rover system.

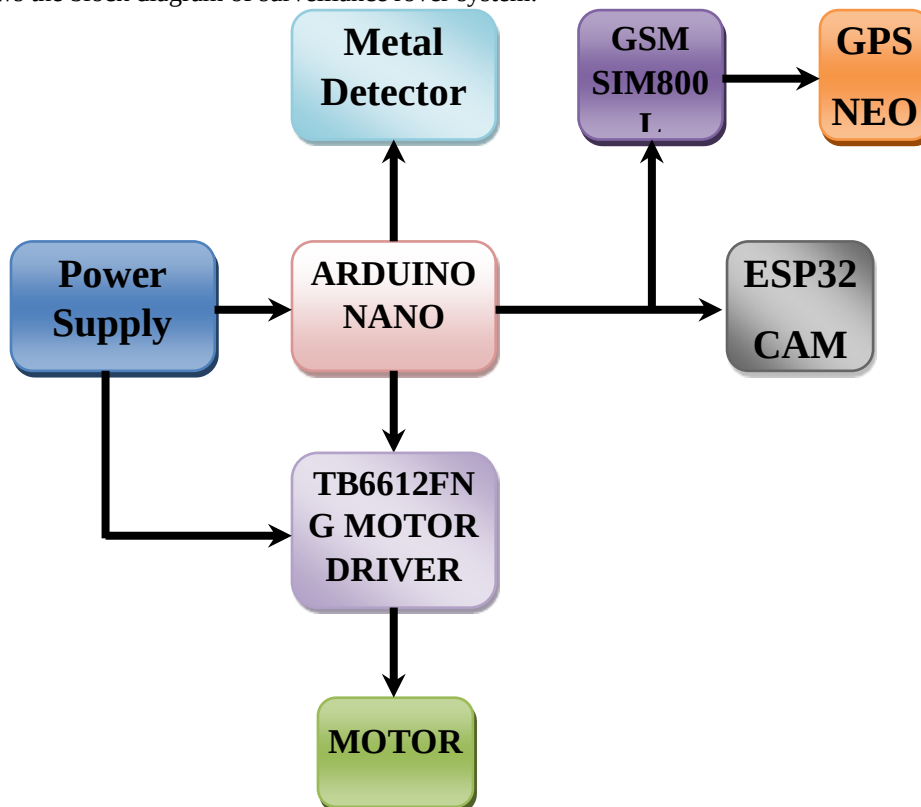


Figure 1: Block Diagram of Surveillance Rover



3. IMPLEMENTATION OF SURVEILLANCE ROVER

Arduino Microcontroller Module

The Arduino Nano is a small, versatile board based on the ATmega328P microcontroller. It is designed for easy integration into a wide range of projects and can be programmed using the Arduino Integrated Development Environment (IDE). The Nano is similar to the Arduino Uno in terms of functionality, but is much smaller in size and has fewer input/output pins. It measures just 18mm x 45mm and has 14 digital input/output pins, 8 analog inputs, and 6 pulse-width modulation (PWM) outputs. The Nano can be powered using a USB cable or an external power supply and can communicate with other devices using serial communication, I2C, or SPI protocols. The Arduino Nano is popular among hobbyists, students, and professionals for its compact size, ease of use, and affordability. It can be used for a wide range of applications, including robotics, home automation, and data logging, among others. Figure 2 shows the development module.



Figure 2: Arduino Nano Development module

Metal Detector Module

Metal detectors is shown in figure 3, can detect nearly all metallic objects. That means anything that contains elements like gold, silver, iron, nickel, copper, aluminum, tin and lead or mixtures and combinations like bronze and brass. Metal detectors cannot detect non-metal items such as wood, plastic, stones and bone. Some metal detectors are able to discriminate which means that they can differentiate between various types of metal. Like everything there is more than one way to detect metal and thus more than one way to make a metal detector.



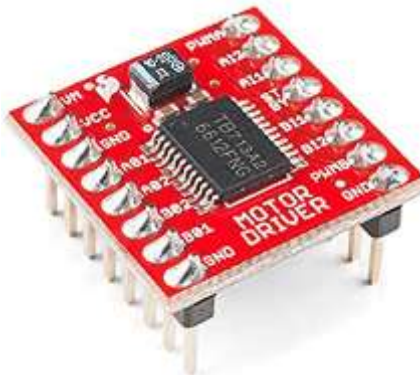
Figure 3: Metal detector module

ESP32-CAM Module

The ESP32-CAM is shown in figure 4, a small-sized, low-cost development board that combines an ESP32 microcontroller with a camera sensor. It is designed for building Internet of Things (IoT) projects that require wireless connectivity and image capturing capabilities. The ESP32-CAM features an OV2640 camera module with a resolution of 2 megapixels, which is capable of capturing JPEG and BMP images.

**Figure 4: ESP32-CAM module*****TB6612FNG Motor Driver Module***

The TB6612FNG is a dual motor driver IC that is commonly used in robotics and other projects that require motor control. It is designed to drive two DC motors or one stepper motor, and can provide up to 1.2A of continuous current per channel (3A peak). The TB6612FNG is a versatile motor driver that can be controlled using a variety of input signals, including PWM, analog voltage, and I2C. It also includes a built-in thermal shutdown circuit to protect the IC from overheating.

**Figure 5: TB6612FNG Motor Driver Module*****GSM SIM800L Module***

The SIM800L is shown in figure 6 is a small, low-cost, and easy-to-use GSM/GPRS module that allows devices to communicate over the cellular network. It is commonly used in IoT projects and other applications that require wireless communication, such as remote monitoring and control. The SIM800L module supports quad-band GSM/GPRS networks, which allows it to be used in almost any country. It can be controlled using AT commands, making it easy to integrate with microcontrollers and other devices.

**Figure 6: GSM SIM800L Module**



NEO6 GPS MODULE

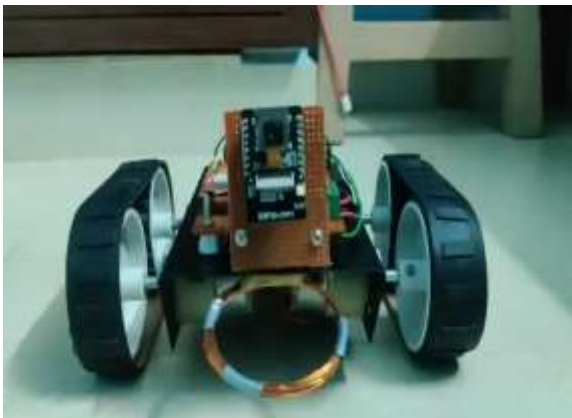
The NEO-6 GPS module is a small, low-cost GPS receiver that can be used to add location-tracking capabilities to a wide range of projects. It is designed to work with the Global Positioning System (GPS), which is a network of satellites that provide location and time information to GPS receivers around the world. The NEO-6 module features the u-blox NEO-6M GPS chip, which is capable of receiving signals from up to 22 GPS satellites simultaneously. It can provide accurate location and time information with a positional accuracy of up to 2.5 meters. The module communicates with a microcontroller or other device using serial communication, and can be controlled using standard AT commands.

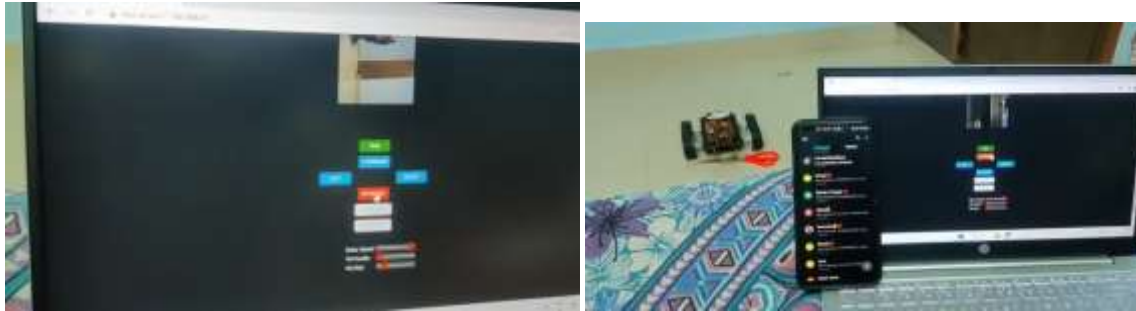


Figure 7: NEO6 GPS Module

4. RESULTS AND DISCUSSION

Programs written using Arduino Software (IDE) are called **sketches**. The Sketch IDE (Integrated Development Environment) is a special program running on your computer that allows you to write sketches for the Arduino board in a simple language modeled after the Processing language. The magic happens when you press the button that uploads the sketch to the board: the code that you have written is translated into the C language, and is passed to the AVR-GCC compiler, an important piece of open source software that makes the final translation into the language understood by the microcontroller. This last step is quite important, because it's where Arduino makes your life simple by hiding away as much as possible of the complexities of programming microcontrollers. The programming cycle on Arduino is basically as follows: Plug your board into a USB port on your computers. Write a sketch that will bring the board to life. Upload this sketch to the board through the USB connection and wait a couple of seconds for the board to restart. The board executes the sketch that you wrote. The idea of sketching in code is a way of thinking about writing code as a simple intuitive process, just like drawing in a sketchbook. In this way, an Arduino program is called a sketch and is saved in a folder called a sketchbook. Sketching means we can get our hands dirty and quickly try out a new idea. It is a skill available to all of us. Figure 8 shows the developed prototype module.



**Figure 8: Developed prototype module**

5. CONCLUSION

The surveillance rover system we have developed is a highly capable and versatile solution for military surveillance applications. It combines advanced imaging capabilities, wireless communication, location tracking, metal detection, and manual control through a web interface, making it an ideal solution for remote and dangerous environments. The integration of different technologies such as the ESP32CAM camera module, GSM SIM800L communication module, NEO6 GPS module, metal detector, and TB6612FNG motor driver has resulted in a comprehensive system that can operate efficiently and effectively. The proposed methodology for this project involves developing a user-friendly and cost-effective web-enabled control system for rovers. The system's specific objectives include controlling the rover over the internet, providing a simple user-friendly interface for controlling the robot, and having an integrated feedback system in the controlling software. The proposed methodology is expected to offer significant benefits over existing methods, such as improved control, ease of use, and a more cost-effective solution. Overall, we believe that our surveillance rover system represents a significant step forward in the development of advanced surveillance technologies, and we are confident that it has significant potential for future development and expansion. The system's ability to operate in extreme environments and provide real-time monitoring and surveillance capabilities will help military personnel carry out their tasks effectively and safely, ultimately enhancing national security.

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