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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

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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.

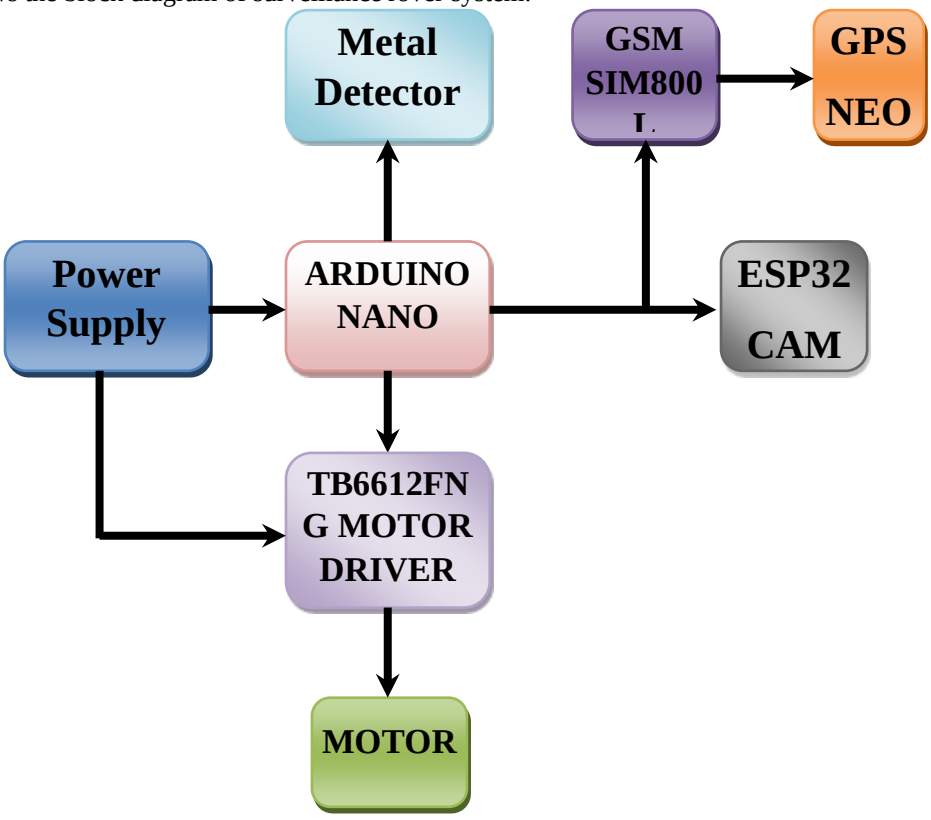

Figure 1: Block Diagram of Surveillance Rover

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3. IMPLEMENTATION OF SURVEILLANCE ROVER

Ardiuno 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.

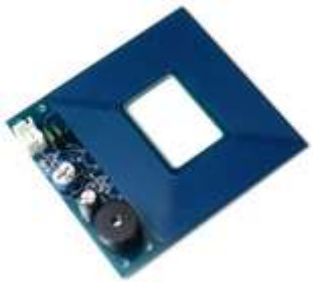

Figure 3: Metal detector module

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.

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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.

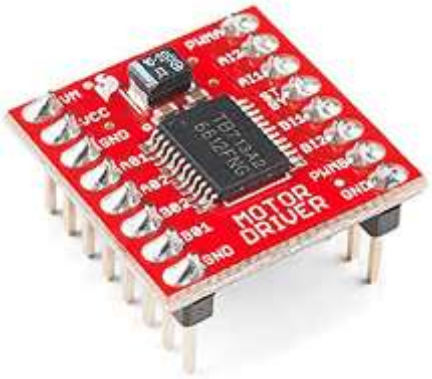

Figure 5: TB6612FNG Motor Driver Module

GSM SIM800LModule

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

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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.

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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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