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IoT based Smart Surveillance with Landmine Detection and Alerts

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Abstract

The research uses a Node MCU microcontroller and Internet of Things (IoT) technology to create a robot for handheld applications. The robot has a night vision camera that connects to the internet, allowing it to take photos and videos from a distance, even at night. It also has a metal detector to find landmines and an infrared (IR) sensor to detect obstacles and prevent accidents. These sensors immediately notify and alert users through LCD screens, messages, and buzzers. The research aims to develop a robot with increased accessibility and user friendliness by offering simple manual and operator controls for robotic inspection. The high-definition camera provides clear photos and videos for detailed analysis of any suspects, helping to make informed decisions quickly and improve situational awareness. On detecting a landmine, the robot alerts the user through the email and displays the information on the LCD screen, enhancing the safety at checkpoints. The IR sensor helps the robot avoid obstacles by alerting the user and sounding a buzzer when something is detected at a close distance. This feature allows the robot to navigate complex environments safely. Overall the robot is designed to provide a smart surveillance by offering an immediate threat response to handle the security concerns in various situations.

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1. Introduction

More specifically, the research has developed a smart IoT-based surveillance robot capable of transforming security technologies into reliable and advanced intelligent security systems, using a NodeMCU microcontroller[1]. The research has three main parts: a land mine detector and infrared (IR) sensor, a video camera for obstacle detection and a remote control device to manage the operation from a distance. The main objective is to provide detailed and timely information to the user [2,3]. The ultimate goal is to develop surveillance robots that can be remotely controlled from any location and capture high-quality images and video for in-depth, real-time analysis. When something is detected, the system alerts, user and displays the appropriate information on the LCD screen [4-7]. This multi-tiered warning system reacts swiftly to potential threats, providing users with immediate awareness. Obstacles are detected using infrared sensors [9-10]. Whenever an obstacle is detected, alerts are triggered on the LCD screen and the alarm is raised when the object is very close. The proposed IoT-based smart robot, is designed using the NodeMCU and sensors, is integrated with the functions like mine detection, obstacle avoidance, remote control, and high-definition surveillance, thereby enhancing the safety under various situations [11-14].

2. Hardware and Software Requirements

2.1 Hardware Tools

The Table 1 below describes the specification and the uses of the hardware components used in the proposed.

Table 1. Hardware Components

S.No.	Component	Uses	Specification
1	NodeMCU	Serves a central controller that integrates the sensors and the devices.	Wi-Fi module, compact size, supports Lua/Arduino programming

		Enables Wi-Fi communication for devices Process the data from sensors and makes decision based on the data Also supports remote controlling capability.	
2	IR Sensor	Detects infrared radiation and proximity (used in detecting the obstacles)	Detects heat, used in robotics and security systems
3	Metal Detector	Used for detecting land Mines	senses the metallic signature of the landmine buried underground.
4	16X2 LCD	Displays information	16 columns x 2 rows, liquid crystal display
5	DC Gear Motor	Provides mechanical motion	Adjustable torque and speed, used in robotics
6	L298N Motor Driver	Controls motor direction and speed	Adjustable torque and speed, used in robotics
7	Buzzer	Generates sound for alerts and notifications	Small size, various tones, used in devices for alerts
8	V380 Pro Camera	Provides real-time video surveillance	720p resolution, dual antennas, IR night vision
9	Laser Module	Emits laser light for various applications	Adjustable spot size, used in DIY projects

2.2 Software Tools

The Table.2 below shows the details of the software's used in the proposed design

Table 2. Software Components

S. No.	Component	Uses	Specification
1.	Arduino IDE	Arduino IDE is used to program the Node MCU microcontroller for integrating sensors (night vision camera, IR sensor, metal detector), controlling output devices (LCD screens, buzzers), and enabling IoT capabilities in an IoT-based smart surveillance system with landmine detection and alerts.	Code is written using C++ Variant.
2.	Blynk Cloud	Displays real time data, Enables remote monitoring and control	Compatible with various hardware, real-time monitoring
3.	V380 Pro	Video monitoring and security alerts	Remote tracking, voice talkback, device sharing

3. Proposed System

The framework consists of two primary sections: the robot and the user interface. Users can communicate with the robot using a computer or smartphone. Here, we use two NodeMCU microcontroller. One microcontroller is used to integrate the robot controlling and laser module and the second one integrates a metal detector, IR sensor, and a 16x2 LCD display. DC motors with a peak speed of 100 RPM are connected to the frame's wheels, powered by an external 12V source and controlled through an L298N driver. The laser module is used for pointing out objects in the field. Laser module is used to point out the things in the field. The metal detector uses electromagnetic induction to detect landmines, while the IR sensor detects obstacles ahead of the robot. Potentiometers adjust sensor detection ranges with minimal interference. The 16x2 LCD displays messages when landmines or obstacles are detected. With the help of Arduino IDE, we can write and upload the code into the microcontroller so that robot works accordingly. Additionally, a V380 camera captures videos and photos, managed through the V380 application, enabling remote monitoring of the robot

over long distances. Internet connectivity is important, as it links the microcontrollers to Blynk Cloud and the smart camera to the V380 application. The camera requires a 5V power supply to operate. The schematic diagram of the prototype is depicted in Figure 1, illustrating the entire system layout, component connections, and their interrelationships.

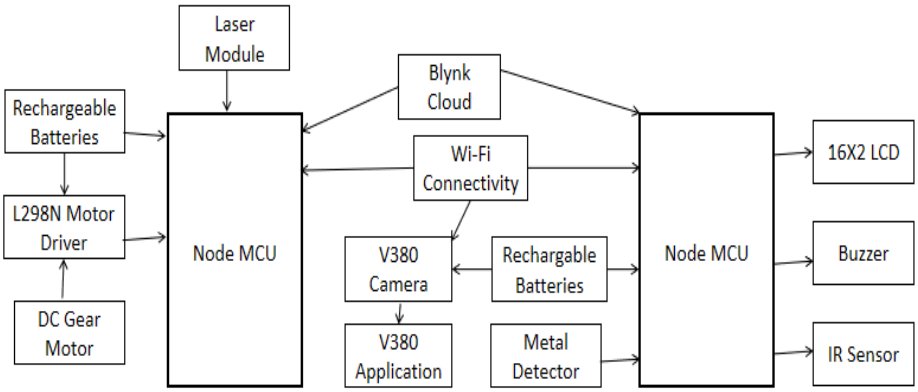

Figure 1. Architecture for the Proposed System

4. Results Discussion

The prototype of the research is designed to detect landmines, and with the help of a camera, the proposed robot is capable of capturing photos and videos. Figure 2 illustrates the prototype of the proposed model.

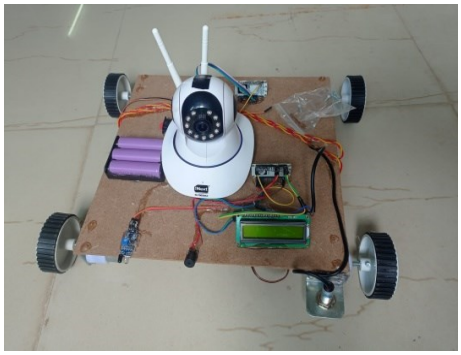

Figure 2. Prototype of the Proposed Robot

To control the robot, we are using the Blynk interface. Along with these, laser module is used to point out the things that are suspicious. Figure 3 shows the dashboard on Blynk interface for controlling robot i.e., left, right, forward and backward, and laser module switches.

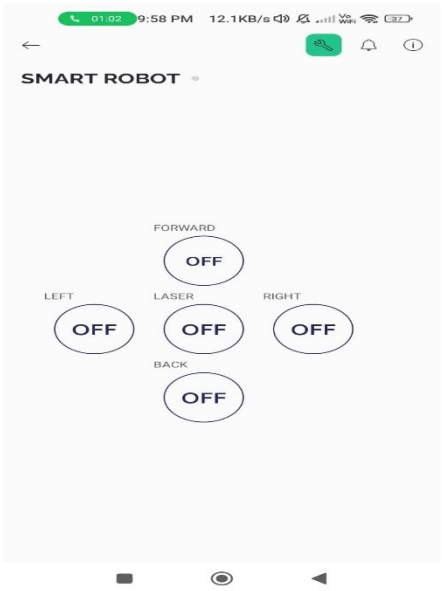

Figure 3. User-Interface on Blynk App.

Figure 4 shows the dashboard on v380camera interface on v380 application that has capable of rotating the camera, alarm to alert and also it has spoken option which is used to communicate the person who are in the field.

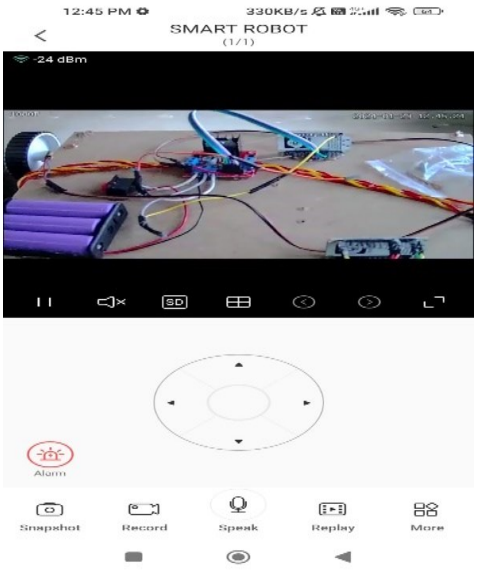

Figure 4. User-Interface on V380 App.

Figure 5 shows the mail messages after detecting the landmines. We are able to receive the mail messages from the Blynk whenever the landmine is detected.

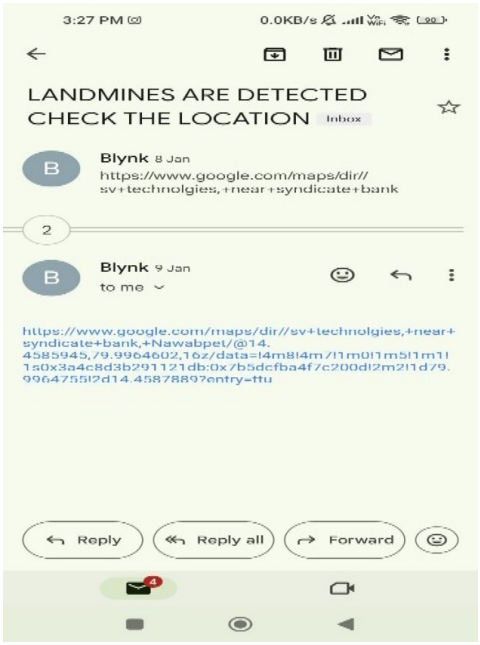

Figure 5. Mail Messages After Detecting Landmine.

Figure 6 shows the mail messages after detecting the obstacles. We are able to receive the mail messages from Blynk server after detecting obstacles.

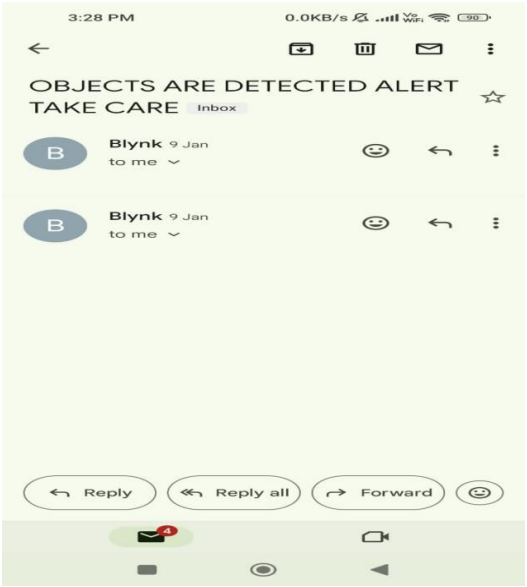

Figure 6. Mail Messages After Detecting Object.

Figure 7. LCD Interface After Detecting Landmine and Objects.

Figure 7 shows the LCD interface after detecting the landmines and obstacles.

5. Conclusion

The proposed work introduces a smart IoT-based surveillance robot capable of detecting obstacles and landmines. Utilizing NodeMCU, landmine detectors, IR sensors, and high-definition cameras, this method enhances security protocols in various environments by alerting users to potential threats in real-time and offering advanced navigational safety features. This innovative solution not only improves situational awareness but also demonstrates the potential of IoT in efficiently mitigating security risks.

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