Surveillance Robot

GVNSK Sravya, **N Harini, P Lavanya** and **P Roopa Ranjani**

Assistant Professor, Department of Electronics and Communications,

G. Narayanamma Institute of Technology and Science (for Women), Hyderabad, India

sravya.gvnsk@gnits.ac.in, nerellaharini@gnits.ac.in, plavanya@gnits.ac.in, roopa.ece@gnits.ac.in

Abstract: *Security is always become a basic necessity in remote areas. It is not always possible for the police to patrol all the areas and a watch man to secure the premises all the time. In this scenario having the best security system makes life safer and more comfortable. The system uses GPS and GSM for securing any premises. The robotic vehicle will keep on detecting the sound and if any sound is detected, it moves towards the sound. It then takes pictures of the area using four ESP32 camera modules covering 360-degree view and transmits the images of that area to the preassigned Gmail ID and the location information through GPS is sent as an SMS alert to the effected person pre- defined number in terms of latitude and longitude with the help of GSM. A Buzzer is also interfaced to robot which make alert sound whenever it detects any sound from surroundings. Thus, we put forward a fully autonomous robot that operates tirelessly and patrols large areas on its own to secure the facility. It also acts as a surveillance system which reduces the human work.*

**Keywords:** LM393 Sound Sensors, GSM, GPS, ESP32 Camera, Buzzer.

I. INTRODUCTION

Safety in remote areas is a major problem nowadays. The crimes in remote areas go unnoticed usually. It can be robbery, theft, harassment, criminal damage or assault and can happen to anyone. People travelling or passing through remote areas seek for security. It would be very difficult to monitor the area all the time and especially at night time the patrolling by human alone can't ensure the safety of the people. Crimes that take place in remote areas usually wouldn't have any kind of proof and in order catch the perpetrator. Exact location would be very much required to react quick and reach the destination wherethe crime has taken place.

The project aims in designing a robot for surveillance which moves towards the soundand captures the images in 360-degree view and sends mail as well as sends the location link where the incident takes place in the form of SMS as an alert to the predefined numbers which can be the phone numbers of police and any family member. A Buzzer is also interfaced to make alert sound.

The main controlling device of the project is ARDUINO, ESP32cam, four sound sensors and DC motors along with motor driver is interfaced to the Arduino microcontroller. When the sound sensor detects the sound this data process to the Arduino. Then Arduino will rotate the robot towards the sound. After rotating the robot ESP32 cam will start capture the images and it will send to the registered mail through Wi-Fi. Based on sound the robot will moves left, right, back, front directions. Once, the pictures are clicked, the bot also sends the link of location from where the bot has clicked pictures, as in the location where the incident took place will be sent to a set of predefined phone numbers that are loaded into the bot's GSM component. The location of the area will be fetched using GPS module installed on the bot. Thus, using both the GPS and GSM modules of the bot, an alert SMS will be sent to the phone numbers, these phone numbers can be loaded more than one which lets us load the phone number of nearby police station as well as any of the family members or any other.

II. BLOCK DIAGRAM
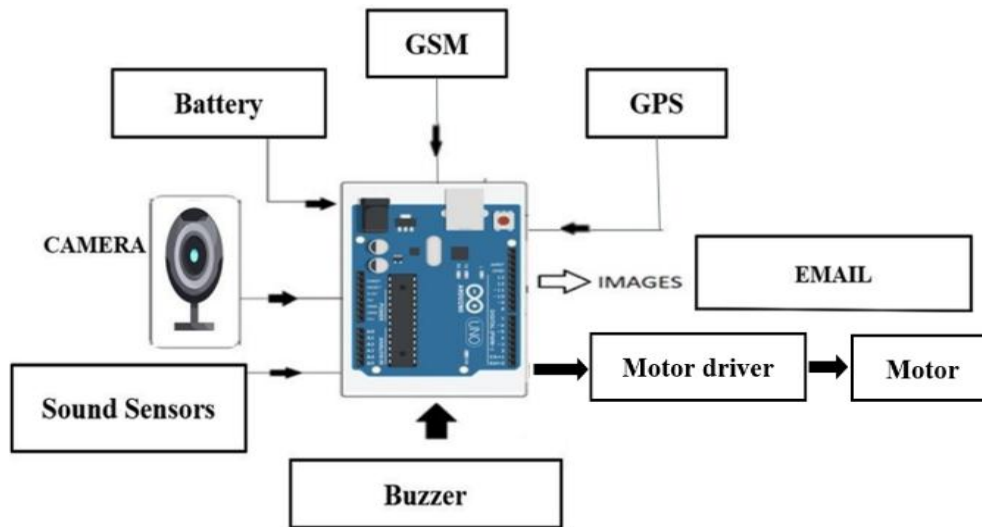
Figure 2.1: Block Diagram

The following are the main features that are included in system

- It sends the captured images to the predefined Email ID.
- It sends the location of the place through SMS.
- It alerts the surroundings on hearing any sound through Buzzer.

III. HARDWARE REQUIREMENTS

- Arduino UNO: It is a microcontroller board based on ATmega328P. It is used for interfacing hardware and software.
- LM393 Sound Sensor: It detects the intensity of sound waves and converts it into electrical signals.
- ESP32 Camera: It captures the images of the surroundings in all four directions and sends it to the predefined Email ID.
- NEO-6M GPS: It provides two-dimensional location i.e., latitude and longitude of a place. GPS receiver with a built-in ceramic antenna, which provides a strong satellite searchcapability.
- SIM900 GSM: It sends the location determined by the GPS to the predefined mobile number through SMS.
- Buzzer: It alerts the surroundings whenever sound is detected. LM293D Motor driver: It is a quadruple high current half-H driver which act as an interface between Arduino and motors. It provides the direction in which the motors have to turn in.
- DC Motor: A dc motor uses electrical energy and converts it it into mechanical energy which powers the wheels of the robot
- Battery: A 12V Sealed lead acid battery is required to supply powers to the entire system

IV. SOFTWARE REQUIREMENTS

4.1 Arduino IDE

Arduino IDE (Integrated Development Environment) is the software for Arduino. Arduino IDE is an open-source Software which makes it easy to write code and upload it to the board. It is a cross-platform software which is available for every Operating System like Windows, Linux, macOS.

It is used for writing code, compiling the code to check if any errors are there and uploading the codeto the Arduino. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors.
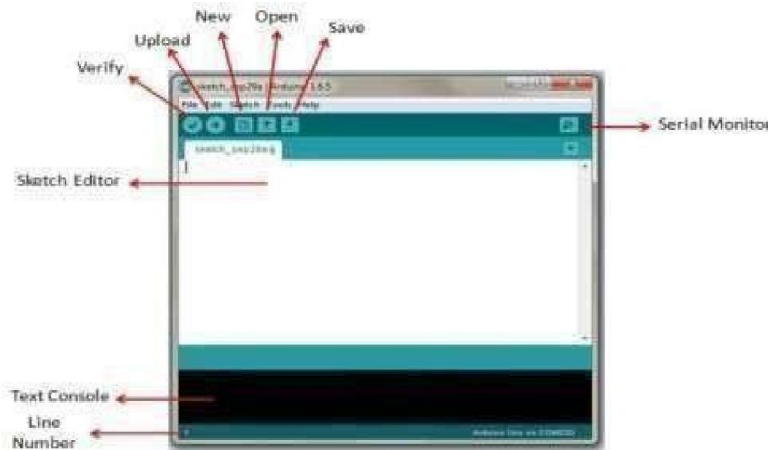
Figure 4.1 Arduino IDE platform

The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right-hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

Source code can be uploaded into ArduinoUNO by the following procedure

1. Download and install Arduino IDE 2.0.
2. Open Arduino IDE 2.0.
3. With the editor open, at the very left, there is a checkmark and an arrow pointing right.
4. Click on the verify tool (checkmark). After a few seconds, we can see the result of the action in the console.
5. Now the code is compiled, and that it is working. Now, before the code is uploaded to our board, the board which is to be used need to be selected. It can be achieved by navigating to Tools > Port > {Board}. The board(s) that are connected to your computer should appear here, and we need to select it by clicking it. In this case, our board is displayed as COM44(Arduino UNO).
6. After the board selected, click on the upload button and it will start uploading the sketch to the board.
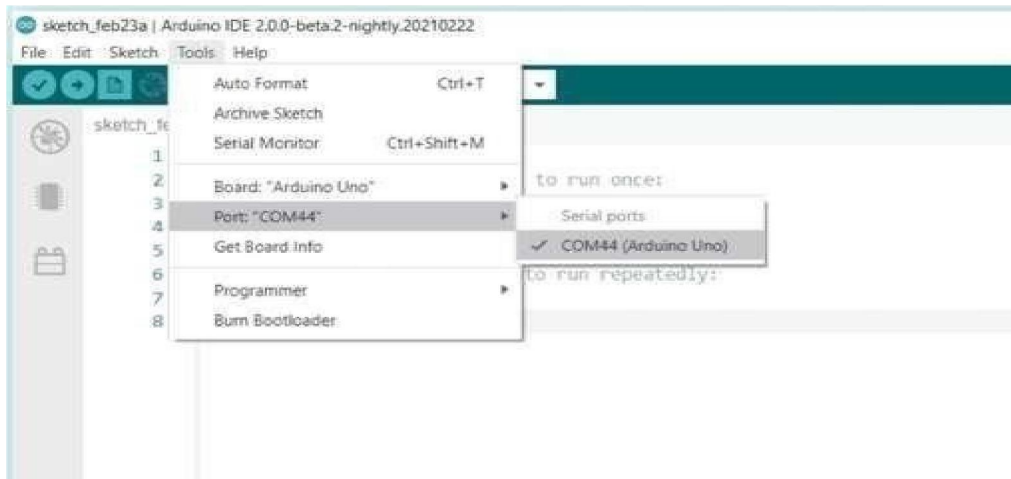
Figure 4.2: Uploading the Code in Arduino IDE

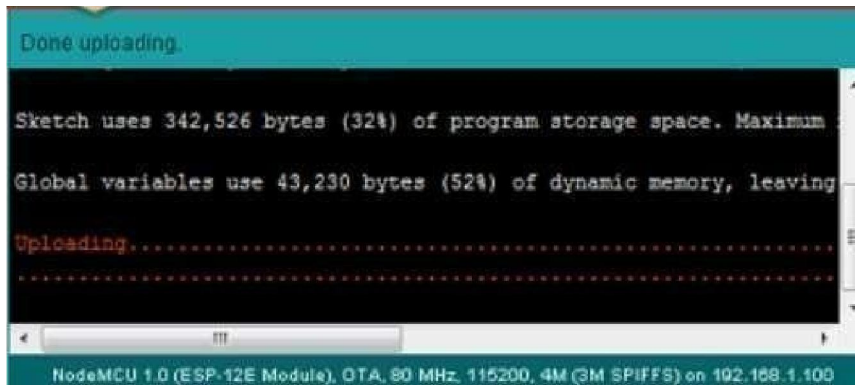7. When it is finished, it will notify in the console log.

Figure 4.3 Output in the Console

V. RESULTS

The following results were observed.

Output 1 - Moment of Robot in the Direction of Sound

Sound is detected in the direction of flower pot. Hence the robot is turning to the direction of sound.

Figure 5.1 Robot When no Sound is Detected

Figure 5.2 Robot Moving Towards Right Direction

Figure 5.3 Moment of the Robot in Right Direction

Output 2 - Capturing and Sending the Pictures to the E-mail

After the robot moves in the direction of sound, it captures the photos and sends it to the predefined E-mail.
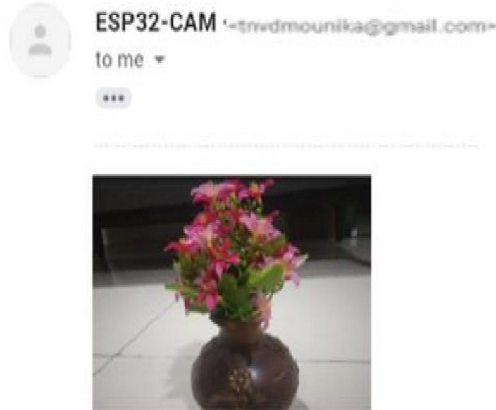

Figure 5.4 Sample E-mail Alert Sent

Output 3 - SMS Alert with Location

When the sound is detected, an SMS will come to the authorized number containing the latitude and longitude of the location of the victim, using which the person can inform police or anyone. Using this information, the police will be able to save the victim from the location. The link is provided in the message through which the location can be easily tracked.
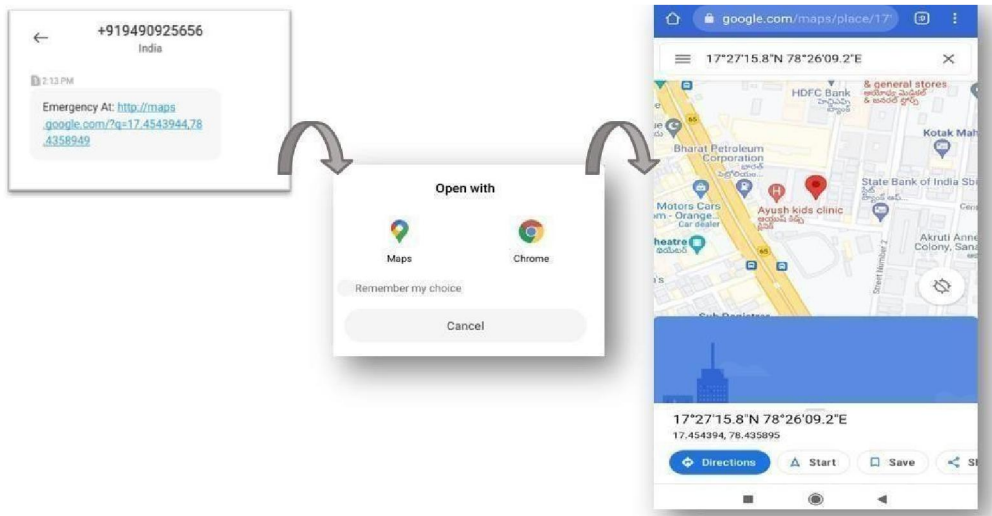

Figure 5.5 SMS Alert with Location

Output 4- Captured Images covering 360-degree view

The robot captures the images in all the four directions covering 360-degree view as shown below.

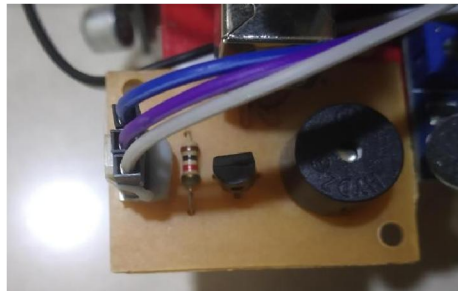**Figure 5.6** Left Camera view

Figure 5.7 Right Camera view

Figure 5.8 Front Camera view

Figure 5.9 Rare Camera view

Output 5- Buzzer Alert

The robot is interfaced with a buzzer which gives an alert to the surrounding people whenever it detects sound. Buzzer gives an audible sound signal on detecting sound.

Figure 5.10 Buzzer

VI. CONCLUSION

 Nowadays, safety is the biggest issue in the remote areas. The proposed safety night patrolling robot makes the best use of its features such as sound endorses cameras and IoT in order to patrol in the area with least human intervention. The robot reaches to the particular direction of sound and sends the pictures to the mail id of the police or any other department which are used in emergency situations. GPS and GSM modules are also included, we can get an SMS with the exact location through a link and we can reach the location easily. The robot is provided with 360-degree coverage view. It also includes a buzzer to ensure the more safety. It acts as a surveillance robot and enhances the safety of the area. Additionally, this surveillance system also acts as a deterrent and prevents crime from happening in the place. This is because when an individual knows he/she is continuously monitored; they are less likely to indulge in a criminal act. If a crime that is committed in a remote place is caught on camera, then chances of bringing the offender to justice are higher. Law enforcement authorities can efficiently use these sophisticated systems to identify and track down criminals easily.

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