# Surveillance Rover

Submitted in partial fulfilment of the requirements

of the degree of

Bachelor of Engineering

by


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# CERTIFICATE

This is to certify that the project entitled **"Surveillance Rover"** is a bonafide work of

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# Project Report Approval for B. E.

This project report entitled ***Surveillance Rover*** by ***Anurag Goswami, Sandeep Mourya, Shantanu Nimbalkar*** is approved for the degree of ***Bachelor of Engineering*** in ***Computer Engineering*** from ***University of Mumbai***.

Examiners

1.----------

2.----------

Date:

Place:

# Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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# Abstract

In the constant effort to safe guard the country against enemy attacks and terrorists, defense forces have to be equally power full to the enemy countries. For the strengthening of the defense power there was immense need for the non-human war machines such as missiles and rockets, which could track the enemy target and destroy them in order to safe guard the country. Surveillance is a major thing which is going to secure anything as it is a tedious job peoples are getting boarded because of that it will might risky to observing all this things. Thus, a robot will be helpful which will continuously monitor thing. This robot continuously watch and send a live streaming of it to an authorized person. Because of that monitoring work will be some what easy and it will be more accurate because of technology. The implementation of this project is to resolve the problem of replacing human to surveillance robot, because of this it reduces harm of human resource. Robot are usually miniature in size so they are enough capable to enter in tunnels, mines and small holes in building and also have capability to survive in harsh and difficult climatic conditions for life long time without causing any harm. Military robots were designed from last few decades. This project is mainly designed for surveillance of ground in military applications. The project is presented in an advanced Robotic system which can be controlled through RF signals and the robot's geographical position can be continuously monitored. The proposed prototype has a wide application such as, military ground surveillance in naxal threatened area, no man's land between international borders, hijacked buildings. It can also be used to study animals, Stand-alone security systems, Safety monitoring in industries, Continuous monitoring of epidemic patients who are kept isolated.

# Table of Contents


| | | |
|---|---|---|
| | **Abstract** | **v** |
| | **List of Figures** | **viii** |
| | **List of Tables** | **ix** |
| | **List of Abbreviations** | **x** |
| **Chapter 1** | **Introduction** | **1** |
| | 1.1 Motivation | 2 |
| | 1.2 Problem Statement | 2 |
| | 1.3 Objectives | 2 |
| | 1.4 Scope | 2 |
| **Chapter 2** | **Review of Literature** | **3** |
| | 2.1 Development of Autonomous Explorer Robot | 3 |
| | 2.1.1 Advantages | 5 |
| | 2.1.2 Disadvantages | 5 |
| | 2.2 Wireless Controlled Military Combat Robot | 6 |
| | 2.2.1 Advantages | 7 |
| | 2.2.2 System Architecture | 7 |
| | 2.3 Design and Implementation of Web Surveillance Robot for Video Monitoring and Motion Detection | 8 |
| **Chapter 3** | **Requirement Analysis** | **10** |
| | 3.1 Software Requirements | 10 |
| | 3.2 Hardware Requirements | 10 |
| | 3.3 Functional Requirements | 11 |
| | 3.4 Non-Functional Requirements | 11 |
| **Chapter 4** | **Design** | **12** |
| | 4.1 Use Case Diagram for Surveillance System | 12 |
| | 4.2 Sequence Diagram for Surveillance System | 13 |
| | 4.3 Activity Diagram for Surveillance System | 14 |
| **Chapter 5** | **Report on the Present Investigation** | **15** |
| | 5.1 Methodology | 15 |
| | 5.2 Architecture Diagram | 16 |
| | 5.3 Technical Specifications | 18 |
| | 5.4 Implementation | 19 |

| | | |
|---|---|---|
| **Chapter 6** | **Results & Discussions** | **21** |
| **Chapter 7** | **Conclusions** | **23** |
| | **References** | **24** |
| **Appendix** | **Technologies Used/ External Libraries/ etc.** | **25** |
| | **Publication** | **28** |
| | **Acknowledgement** | **29** |

# List of Figures


| Figure No. | Figure Name | Page No. |
|---|---|---|
| 2.1 | Snapshot of Autonomous Explorer Mobile Robot | 4 |
| 2.2 | System Architecture for Wireless Robot | 7 |
| 2.3 | Block Diagram of Robotic Unit | 9 |
| 4.1 | Use Case diagram for Surveillance Rover System | 12 |
| 4.2 | Sequence diagram for Surveillance Rover System | 13 |
| 4.3 | Activity diagram for Surveillance Rover System | 14 |
| 5.1 | Architecture Diagram for Surveillance Rover | 16 |
| 5.2 | Architecture Diagram for Surveillance Rover Controller | 17 |
| 5.3 | Snapshot of Surveillance Rover | 19 |
| 5.4 | Screenshot of Arduino IDE Software | 20 |
| 6.1 | Snapshot of web browser fetching video streaming | 21 |
| 6.2 | Snapshot of Arduino IDE serial monitor showing MQ135 data | 22 |

# List of Tables


| Table No. | Table Name | Page No. |
|---|---|---|
| 5.1 | Arduino Uno technical specifications | 18 |
| 5.2 | Arduino Mega 2560 technical specifications | 18 |

# List of Abbreviations

| Abb. Index | Expansion (Full Form) | Abbreviation |
|---|---|---|
| 1 | 2-Dimensional | 2D |
| 2 | Closed-Circuit Television | CCTV |
| 3 | Direct Current | DC |
| 4 | Global Positioning System | GPS |
| 5 | Graphical User Interface | GUI |
| 6 | Integrated Circuit | IC |
| 7 | Integrated Development Environment | IDE |
| 8 | Input/Output | I/O |
| 9 | Light Emitting Diode | LED |
| 10 | Personal Computer | PC |
| 11 | Passive Infrared Sensor | PIR |
| 12 | Radio Frequency | RF |
| 13 | Universal Serial Bus | USB |
| 14 | Vidya Jyothi Institute Of Technology | VJIT |
| 15 | Wireless Fidelity | Wi-Fi |

# Chapter 1

# Introduction

The main purpose of the robot we are making is to provide visual information of hard to access places, for example a building under a hostage situation. Hence the main feature of our robot is an onboard video camera. Also, the robot must be compact and self-contained in the sense it must have an onboard battery pack and wireless interface to the human controller. Surveillance is the monitoring of behaviour, activities, or information for the purpose of influencing, managing or directing. This can include observation from a distance by means of electronic equipment, such as closed-circuit television (CCTV)[1].

According to Tom Harris, robot is an electro-mechanical machine that is controlled by a computer program or electronic apparatus. It is being used to give convenience to human by doing specific task. Robots are able to execute the task that impossible or beyond capability of human. From this advantage, it can give many advantages in term of safety, ease and efficiency[2].

Surveillance system and robots are two different systems that carry out their own task respectively. The main inspiration for this project is to combine these two systems to produce a mobile robot equipped with a camera as an intelligence surveillance system. By using this Surveillance Robot, the image visualize can be more efficient compared to other typical surveillance system since its multiple viewing angle can be varied. This robot can be used as a medium for a monitoring system wirelessly by remotely-controlled by human via computer[3].

## 1.1 Motivation

Imagine adding a robot to the surveillance environment. In contrast to the static cameras placed at fixed positions, the robot is capable of dynamically patrolling the building. It can move from room to room, using its sensors to scan for anomalies that the static cameras might have missed, and using its actuators to interact with the environment in ways that a static camera cannot. The robot's limitation, however, is that it can only occupy one physical location at a time.

## 1.2 Problem Statement

Presently, an intelligence surveillance system is in high demand where the traditional ways of monitoring system which using CCTV resulting an ineffective image due to its static position. Drones can be detected using radar system.

## 1.3 Objectives

- This project is to scans for various smells.
- It removes the workload from human i.e. efficient resource management.

## 1.4 Scope

The most important use of this project will be for surveillance. It can be used to infiltrate at various locations where it would be hard for a human to infiltrate without getting noticed. Household surveillance can also be done by using this project. Can be used by traffic security to assess fast moving cars. Can be used to hijacked areas/buildings. Can be used under tunnel with introduction of sensors like air quality and pollution sensor.

# Chapter 2

# Review of Literature

## 2.1 Development of Autonomous Explorer Robot [5]

This paper shows the idea of a Surveillance Robot where a portable robot is outfitted with a camera and the robot is utilized for investigating reason not for just observing. The robot contains a huge and simple case to convey the electrical parts and the helpful freight. 2 mm thick fine steel plate was use for Base, that contains the suspensions of wheels, the recessed holder of the accumulator and some sensor fixation point. Separated plates to make possible to use vibration damper equipment's was use for the wheel suspension.

It shows the robot is controlled by ATMEL ATmega128 microcontroller[4]. It's a completely automated form of robot where it includes sonar sensor for obstacle avoiding and infrared sensor for a wall following function. It uses a wireless camera if you want to transmit the photo captured on-web page to a tracking station. It only uses a Wi-Fi community to connect the robotic and computer. This cellular robotic is fully depends on the Wi-Fi access factor that decide its covering. The robotic contains a massive and simple chassis to carry the electric elements and the beneficial cargo.

The base was made from 2 mm thick fine steel plate. That contains the suspensions of wheels, the recessed holder of the accumulator and some sensor fixation point. The wheel suspension has formed from separated plates to make possible to use vibration damper equipments.

Connected to the base plate is the superstructure, which was crafted from 1 mm thick aluminium plate for the clean handling as it contains some complicated structures. In the frontier a part of the bottom plate is the container of logical forums with CPU panel and embedded microcontroller board. The Figure 2.1 shows the snapshot of the autonomous explorer cellular robot.

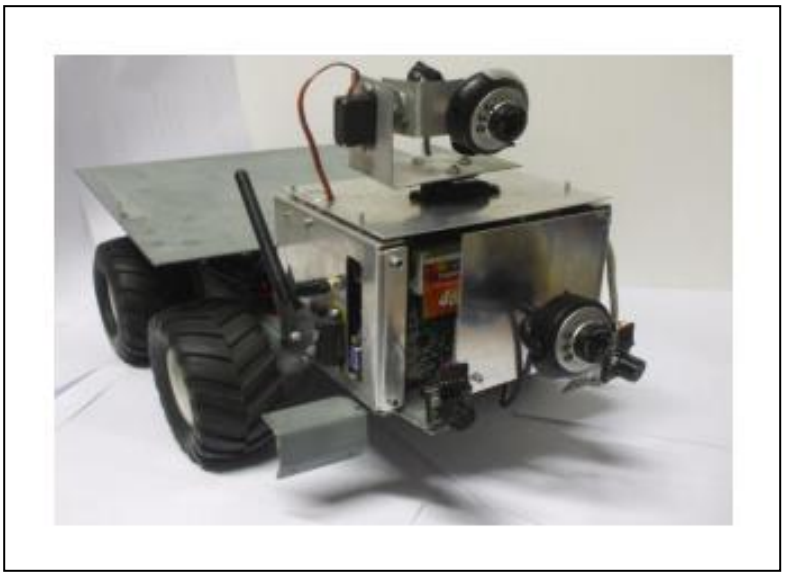

**Figure 2.1: Snapshot of Autonomous Explorer Mobile Robot [5]**

Sensor holders and the cameras joints are made of the same aluminium as the superstructure. The chassis has one more part, the container of the useful cargo. This has approximately the size of a copy paper and has edges to protect carried items to fall down during operation.

The robot can be controlled remotely, or can be assigned to go to a location, known by its inner map. In both cases, the user and the rover communicate through the local Wi-Fi network, using the same java programs. When the robot controlled manually, the user has to choose this function on the application window and then use the direction button on screen, or on the keyboard. In this mode, the signal processing is minimized to the level of collision detection.

When the user just wants the robot to go to the chosen location, regardless of the path of the movement, it can be done by selecting an end location from the robot's map. This map is the visualization of the graph that allows the construction to find the optimal rout by applying the A-star algorithm. This means that the robot has to stand in a known starting point, with a known orientation. The rover is not able to tell the difference, so when it has to stop; first it waits a few seconds for the obstacle to move away. If it does not happen it bypasses it.

### 2.1.1 Advantages:

- This robot is beneficial for exploring any location which is restrained to humans or unreachable to human beings..

- It can also be used for military purpose to survey the area before entering in, for e.g. any hijacked building or any suspicious house.

- The system uses Ultrasonic sensors which sends out ultrasonic sound waves to calculate distance between any subject present in front of the rover.

- The system has artificial intelligence algorithm programmed on the MCU which helps to scan any obstacle in front of the rover using sensors and stop the movement.

### 2.1.2 Disadvantages:

- The robot is used for exploring purpose instead of monitoring.

- It doesn’t have Gas Sensors to locate any harmful gases present within the surroundings risking life of any human if he wishes to enter that location.

- This robot does not use a communicating tool which includes RF transceiver to manually put under control by a computer.

- This robot is only able to operate in a Wi-Fi network environment.

- As this system uses Wi-Fi to control the robot, it has a short range coverage and can’t be reachable from a long distance as compared to using RF controller.

- The rover system has some sophisticated designs and devices on board, which requires more power supply.

## 2.2 Wireless Controlled Military Combat Robot [6].

This paper depicts building up a robot which can be utilized for video reconnaissance and observing which can be controlled through a Graphical User Interface(GUI) interface. The control system is furnished with a video transmission office. The video transmission is for all intents and purposes accomplished through rapid picture transmission.

The robot is specially designed for surveillance purpose. Initially, the robot is equipped with a camera or with an Android smartphone which will capture the scenario in front of it and will transfer the images to the server which provides control of the system and functionality to watch the live feed. The robot is controlled by wireless communication using Zig-bee module. Forward, right move, left move and backward direction from the Microcontroller is used to drive the robot in any desired direction.

The fundamental goal of this framework is to get covered including some extra parameters like blue-tooth module for continuous information prepared by the camera at the video screen and Passive Infrared Sensor(PIR) sensor to follow the intruders [6]. Thus the proposed system using blue-tooth reduces errors at defence and keeps the nation secure from the foe.

A wireless camera is mounted on the robotic body. This wireless camera is used to monitor the exact position of the enemies and send it on real time base. The robotic motion is control by Radio Frequency (RF) technology.

Wireless controlled military combat robot system is utilized to identify objects from a far spot to the specific situation in the combat zone and vital advances can be taken to attack the enemies. This system is also used with the help of visual display of the field so that it can be easy to control the robot and for positioning the weapon for shooting. With this system, lives of army soldiers can be saved, by planning well before attacking. This robot can provide the clear picture of battle field making battalion to move as per situation.

This system is not sensitive to weather conditions. This robot does not need more supply to operate. It consumes 12v DC power supply and having wireless camera to observe the surrounding environment. The robot can be used in place which is hijacked by terrorists. The system can also be implemented to include a target detection and automatic shooting mechanism by combination of image processing and embedded system which can make it fully automated war machine.

### 2.2.1 Advantages:

- It can be used for target detection and automatic shooting mechanism by combination of image processing and embedded system.

- This robot only consumes 12v DC power supply.

- It has wireless camera to observe the surrounding environment.

### 2.2.2 System Architecture:

The robot is controlled by a RF (Radio Frequency) transmitter and receiver module. The receiver block consists of RF receiver, Decoder, driver unit, relay unit, sensor unit, buzzer for indication of toxic gas, motor units for movement of robot and water pump. A micro wireless camera is fitted on the robot where the video and voice are transmitted to the required place i.e. control room. The Figure 2.2 shows the System Architecture for Wireless Robot.

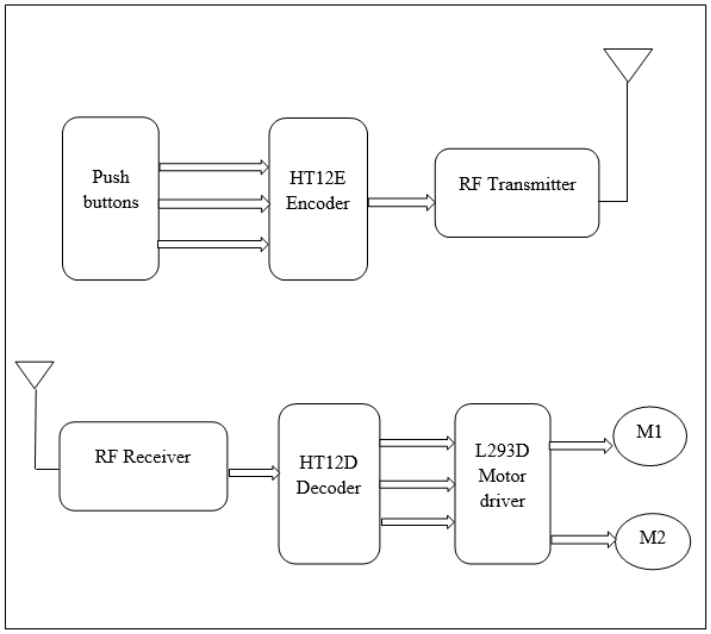


**Figure 2.2: System Architecture for Wireless Robot [6]**

The transmitter and receiver are connected with encoder (HT12E) and decoder (HT12D) ICs respectively. As soon as button pressed in transmitter the signal is send to the encoder (HT12E), which converts the parallel data into serial data and transmits through RF transmitting antenna with oscillating frequency of 434MHz.

## 2.3 Design and Implementation of Web Surveillance Robot for Video Monitoring and Motion Detection [7].

This paper explains how to design and implement wireless robot which provides capability to manipulate the robotic with the help of web and it'll be able to detect the living bodies with the help of PIR sensor. It will assist in rescue operations as properly as may be used to get entry to the video transmitted from the remote place consisting of the sensitive areas that are past their reach. The total system contains mobile robot, controlled with the Internet, which has camera mounted on it and also it has a PIR sensor for detection of living bodies [8]. The camera mounted on the robot is able to flow horizontally round its horizontal axis. Camera movement is managed through web site on the user interface, thus, supplying superior view of the surroundings.

It describes that the control of robotic unit is from remote end with the use of Internet and also ability to get the videos from the robot end for the purpose of surveillance. At the controller end PC, video is continuously streamed on a web browser and provides ability to control the robotic movement and also the camera movement in horizontal direction. DC motors are being used for the movement of robotic wheels.

The PIR sensor on the robotic unit gives them the information about the Moving bodies. Motors and PIR sensor are being interfaced to Raspberry pi 3. Raspberry Pi is used for video processing and sending the processed video to the controller end PC with the help Internet [9]. The use of Internet does not bring the limitation of range into consideration as every equipment has the internet access, so that controlling the robot from anywhere is possible. The images captured by the camera should be processed very fast to provide real time visualization of environment.

In this implementation of robotic system, when someone enters a monitored area, PIR movement detectors which are commonly used in conjunction with specific parts of the war field. When a person enters secured places, immediately it will send an indication to the control room section through wireless communication and is indicated to the control room through alarm. The concerned people can understand that an eventuality has happened in the host section. At the same time web camera connected to the microcontroller keeps on capturing what is going on there at the host vicinity and saves it into the computer.

Raspberry Pi has a strong processing capacity because of using the ARM architecture and Linux-based system PIR (Pyroelectric Passive Infrared) sensor is used for living body detection. Passive infrared sensor designed to pick up heat radiation of wave lengths in a band around 10 microns. The Figure 2.3 shows the block diagram of Robotic unit.

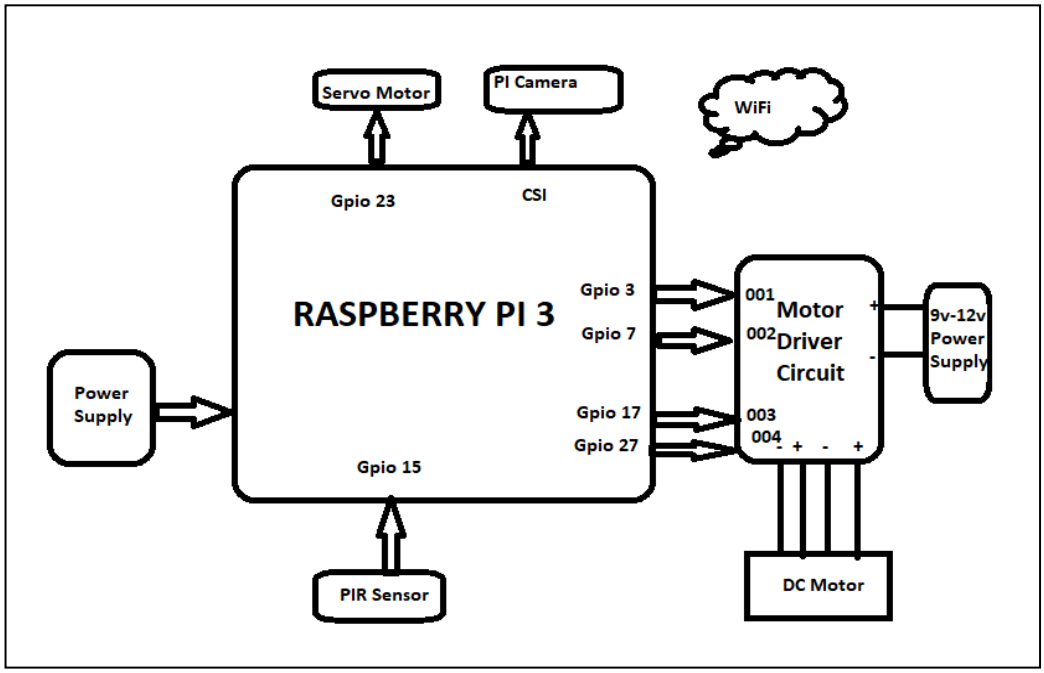


**Figure 2.3: Block Diagram of Robotic Unit [7]**

The block diagram of the proposed system describes the principal parts or functions represented by blocks and connected by lines that show the relationships between the blocks. The power supply is provided externally to the Raspberry Pi 3 to avoid any limitation of power to the system. A servo motor and Pi Camera is connected to The Raspberry module. A PIR Sensor is also connected to it which is used for motion detection. The whole module is connected to Motor Driver Circuit with a DC Motor for moving and rotating the rover. The Motor Driver Circuit is connected to a different external power supply of 9v-12v. This whole system is connected to a Wi-Fi network.

If the active factors of the PIR sensor are exposed to a change in the surrounding temperature field, electrical charges are separated in the sensor elements. The voltage across the sensors controls a J-FET source follower impedance converter and accordingly modulates the output current of the PIR detector. Tiny and lightweight with high output power. Servo can rotate approximately 180 degrees.

# Chapter 3

# Requirement Analysis

## 3.1 Software Requirements:

- Arduino IDE which uses coding for developing programs for required purpose.
- RF24 Library for Arduino.
- Web browser to watch live streaming sent by rover system.

## 3.2 Hardware Requirements:

- Arduino UNO & MEGA
- MQ135 Air-Quality Sensor
- NRF24L01 Transceiver
- L298N Motor Driver
- Ultrasonic Sensor
- DC Motor
- ESP32 CAM Module (or Raspberry Pi Camera Module)

## 3.3 Functional Requirements:

- The rover should be able to move on the land.
- The camera mounted on the rover should be able to capture images clearly.
- Air-Quality sensors should be able to detect harmful gases in environment.
- The joystick should be able to control the rover properly.

## 3.4 Non-Functional Requirements:

- There should be proper radio communication between rover and the controller.
- The rover should not make much noise to avoid being detected.
- Power supplied should not be more than system's capacity.
- The joystick should not be moved very fast.
- The live video streaming should be seamless and clear.

# Chapter 4

# Design

## 4.1 Use Case Diagram for Surveillance Rover System:

The Figure 4.1 shows use case diagram of the Surveillance Rover system which specifies the expected behaviour of the system:

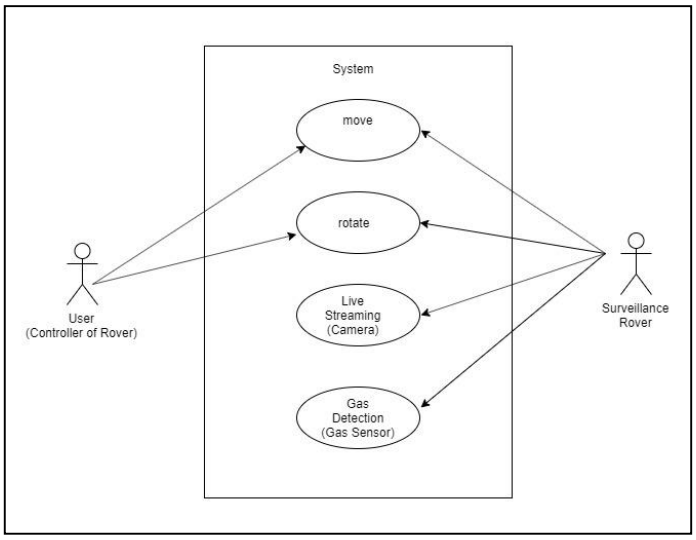


**Figure 4.1: Use Case diagram for Surveillance Rover System**

There are three main components, first one is the Rover Controller which is controlled by the User who utilize this system, second one is the main system which consists of the equipment's to enable functionality and the last one is the Surveillance Rover.

The controller provides input as to moves or rotates the rover, the system takes input and processes over it then the rover is moved or rotated as per the input. The main task of the rover is to continuously feed the live streaming to the controller end and also detecting for gases present in its environment.

## 4.2 Sequence Diagram for Surveillance Rover System:

A sequence diagram describes object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. The Figure 4.2 shows the sequence diagram of the Surveillance Rover System

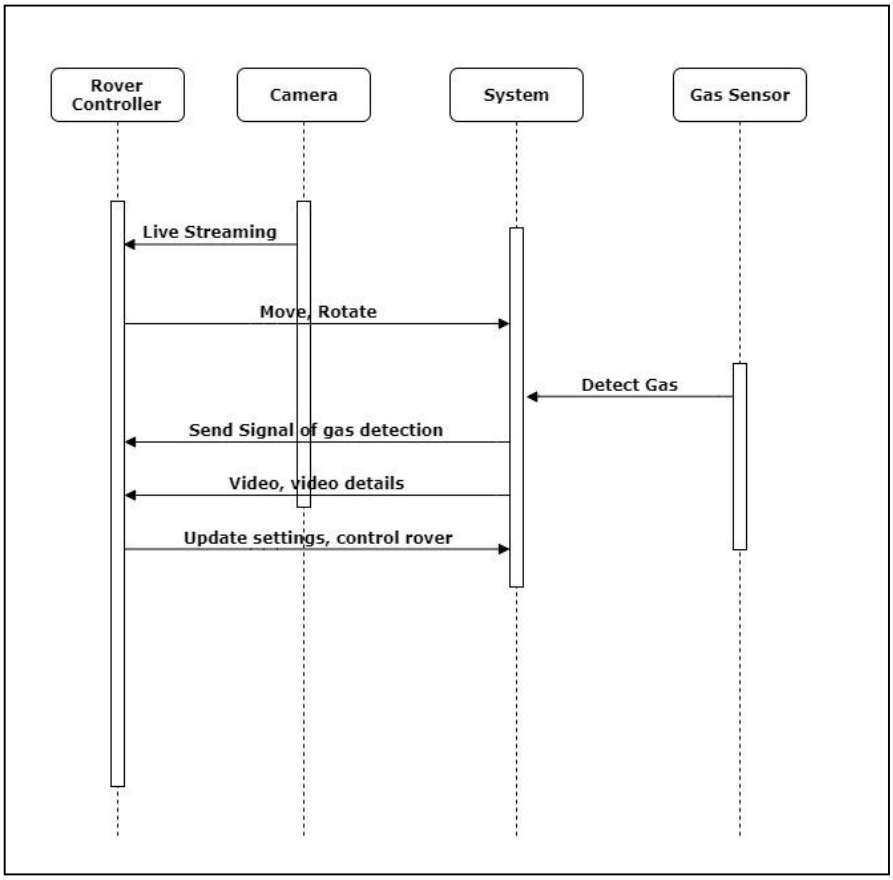


**Figure 4.2: Sequence diagram for Surveillance Rover System**

The Rover controller, Camera, System and the Air-Quality sensor interacts with each other to carry out the whole system's working. Camera continuously feeds the controller end with live video streaming. As per the video feed, controller moves and rotates the system as required. The Gas detector checks for presence of any gases in the environment.

## 4.3 Activity Diagram for Surveillance Rover System:

Activity diagram is defined as, diagram which describes graphical representations of workflows of stepwise activities and actions. It is basically a flowchart to represent the flow from one activity to another activity. It describes the dynamic behaviour of the system. The Figure 4.3 shows the activity diagram of the Surveillance Rover system.

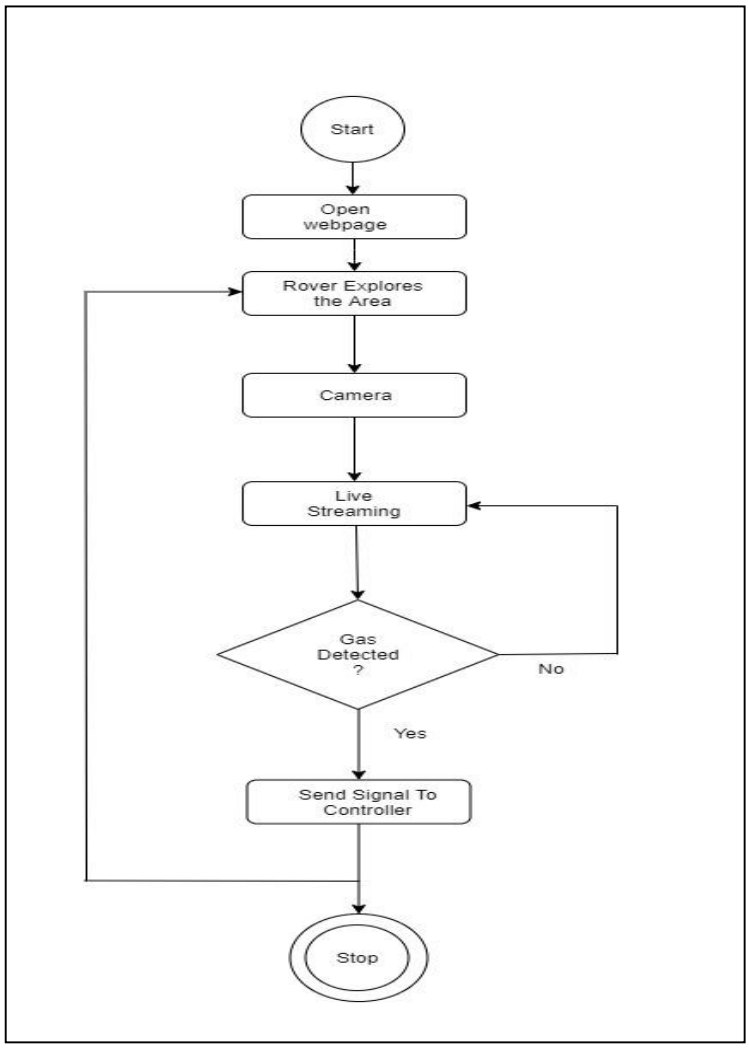


**Figure 4.3: Activity Diagram for Surveillance Rover System**

The stepwise activity of the system where at the controller end first web page is opened to initialize the system and to get all the data from rover. The rover explores the area and captures the environment video through the camera and feeds it live. The gas detector checks for the presence of gas in environment if it detects any gases it sends the signal to the controller otherwise it continues its exploration and video streaming.

# Chapter 5

# Report on Present Investigation

## 5.1 Methodology:

The primary purpose of this project is for surveillance of ground in military applications. There are many devices are used in this project. The important devices that we have used on the robot are wireless camera, two pairs of RF transmitter-receiver, temperature sensor, Ultrasonic Sensor and Gas Sensor. If the intensity level of the light is less for clear view while performing video streaming, then additional lights can be switched on wirelessly so a clear view is captured. The robotic movement can be controlled wirelessly by the user with the Joystick provided on the user module via RF. Along with the live streaming, the robot also senses the temperature of the robot's surrounding. All the four wheels are energized. Hence, the robot is able to rotate about 360 degrees on stand as well as move in any directions. The project presented by us is an advanced Robotic system which can be controlled through RF signals and the robot's geographical position can be continuously monitored.

The proposed prototype based and programmed on Arduino microcontroller has many applications such as, military ground surveillance in nasal threatened area, no man's land between international borders as well as hijacked buildings. It can also be used to study animals, Stand-alone security systems, Safety monitoring in industries, Continuous monitoring of epidemic patients who are kept isolated.

## 5.2 Architecture Diagram:

The main surveillance rover will act as a receiver node in terms of the RF communication, which moves forward or backward and rotate right or left as per the user's action over the controller. Rover explores the area and captures images and streams live video of the surroundings. By this user get better idea of rover's surroundings. It also senses harmful gases present in the surrounding environment which either toxic to the environment or not. The Figure 5.1 shows the architecture diagram for Surveillance Rover.

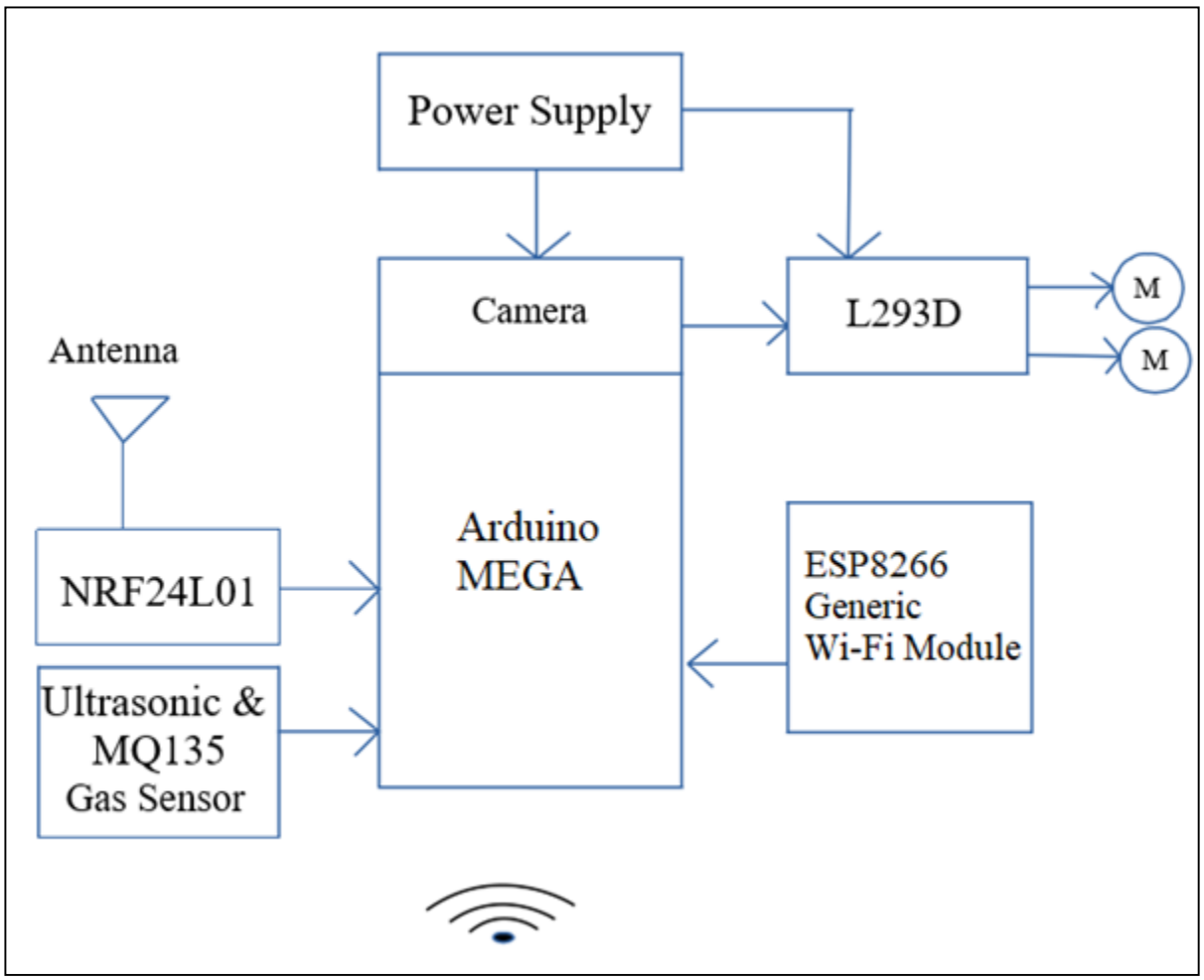


**Figure 5.1: Architecture Diagram for Surveillance Rover**

This architecture defines the communications of different components with each other and the Arduino MEGA Board. The power supply is given to Arduino and L298N Motor Driver. A Camera module is mounted on Arduino board. The L299N has two DC Motors connected to it which will be used to drive the rover. A wi-fi module ESP-CAM32 is connected to Arduino

which is used to provide live video streaming to the controller side. NRF24L01 is a Radio Frequency Transceiver module which is also connected to Arduino.

The other part of the system is a controller of the rover which controls the movement of the rover. It is a joystick module which establishes communication with the main surveillance rover using radio frequency. The joystick controls both X and Y axis directional controlling of the rover. With this user can control movement of rover. The Figure 5.2 shows the Architecture diagram for Surveillance Rover controller.

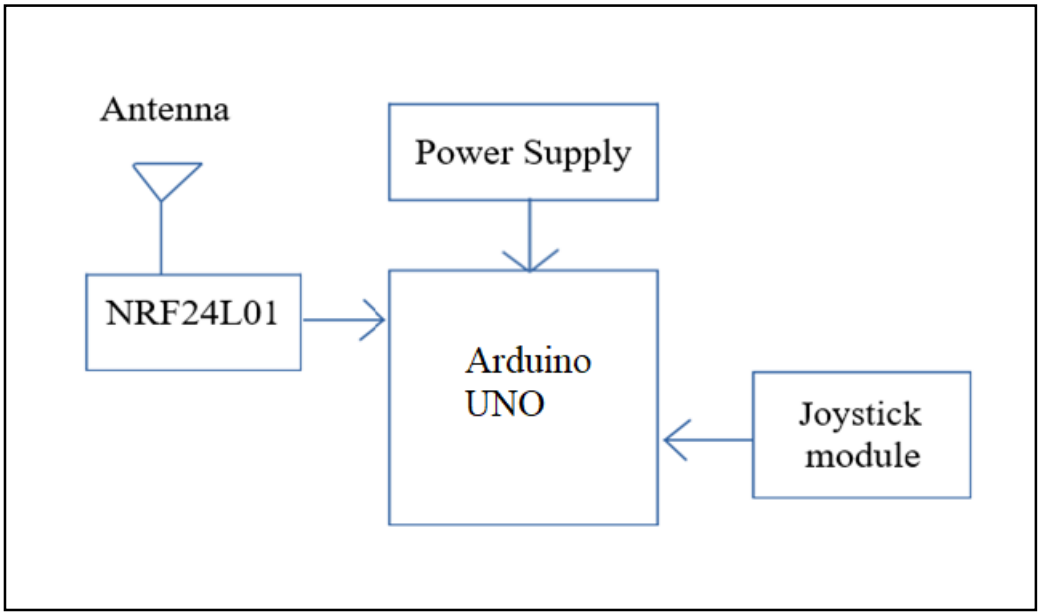


**Figure 5.2: Architecture Diagram for Surveillance Rover Controller**

This architecture diagram describes the interfacing of the controller part of the rover system. The primary task of controller is to only control the main rover system wirelessly. It has a Joystick module which is mounted on the Arduino board. The joystick provides controlling at X and Y axis. The NRF24L01 Radio Frequency Transceiver is used to connect this module to the main rover module which establishes a radio frequency connection between the two devices.The interfacing between all this components is done using Arduino IDE and external Libraries. An Antenna is used in NRF24L01 Transceiver module to increase the range of transmission so that the rover can be controlled from a long distance. To fetch the live video streaming a web browser is required on which we can monitor rover's position and watch video surveillance and also capture images if any suspicious object is seen. Also at the controller side one can see the air quality measure and presence of harmful gases sent via the MQ135 gas sensor using the serial monitor of Arduino IDE software.

## 5.3 Technical specifications:

Below given tables shows the technical specifications of Arduino Uno and Arduino Mega 2560.

| | |
|---|---|
| Microcontroller | ATmega328P |
| Operating Voltage | 5V |
| Recommended Input Voltage | 7-12V |
| Input Voltage Limits | 6-20V |
| Analog Input Pins | 6(A0-A5) |
| Digital I/O Pins | 14 |
| Flash Memory | 32KB |
| SRAM | 2KB |

**Table 5.1 Arduino Uno technical specifications**

| | |
|---|---|
| Microcontroller | ATmega2560 |
| Operating Voltage | 5V |
| Recommended Input Voltage | 7-12V |
| Input Voltage Limits | 6-20V |
| Analog Input Pins | 16 |
| Digital I/O Pins | 54 |
| Flash Memory | 256KB |
| SRAM | 8KB |

**Table 5.2 Arduino Mega 2560 technical specifications**

## 5.4 Implementation:

Surveillance rover implemented till now will explores the area and provides live streaming of its surrounding using a camera module which is mounted on top of the rover. The Figure 5.3 shows a snapshot of Surveillance Rover.

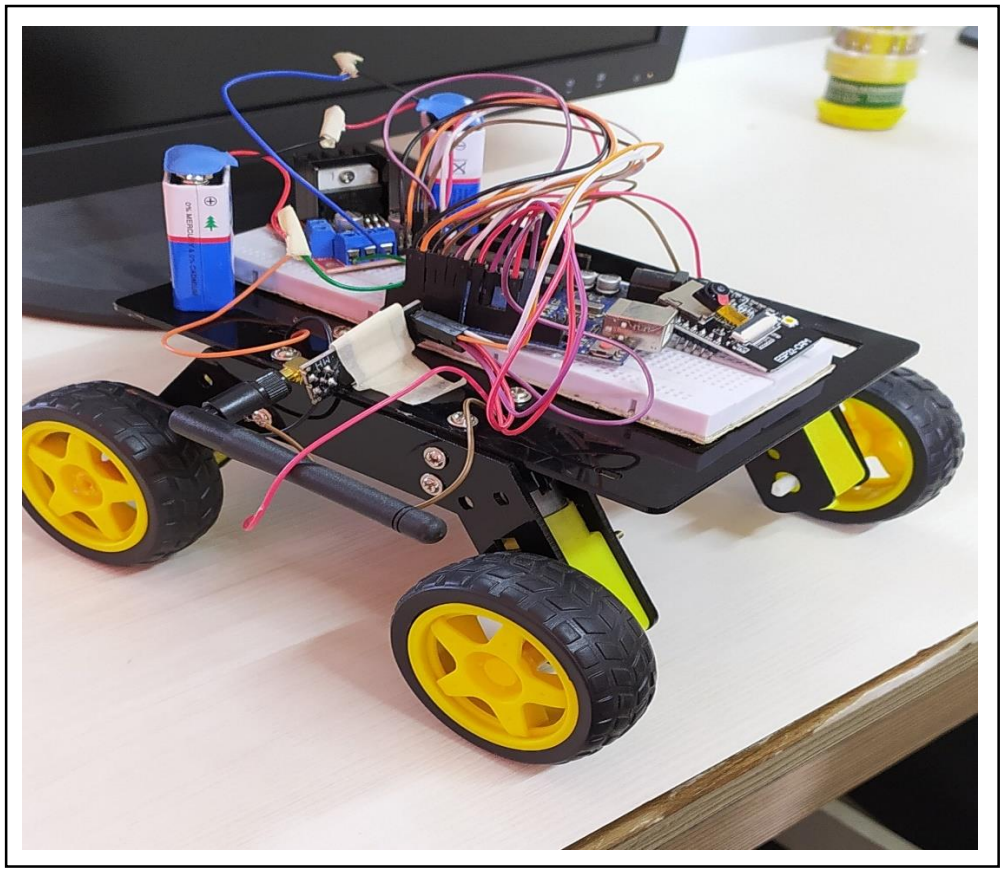

**Figure 5.3: Snapshot of surveillance rover**

The snapshot shows the implementation of the Surveillance Rover System. The rover is based on a 4-wheeler Chassis and has the main rover module with Camera mounted on it. The camera continuously streams the video of the surroundings of the rover. The rover moves with a decent speed to maintain stability of the system.

This whole module is controlled remotely via the joystick which is on the another Arduino at a distance. This whole communication is dependent upon the Radio Frequency provided by the NRF24L01 Transceiver. The video streaming connection is established by Wi-Fi connectivity.

To program the different components to function and establish communication with other components Arduino IDE is used. It is an Integrated Development Environment based on C, Java and developed by Arduino software. The Figure 5.4 shows a screenshot from Arduino IDE software.

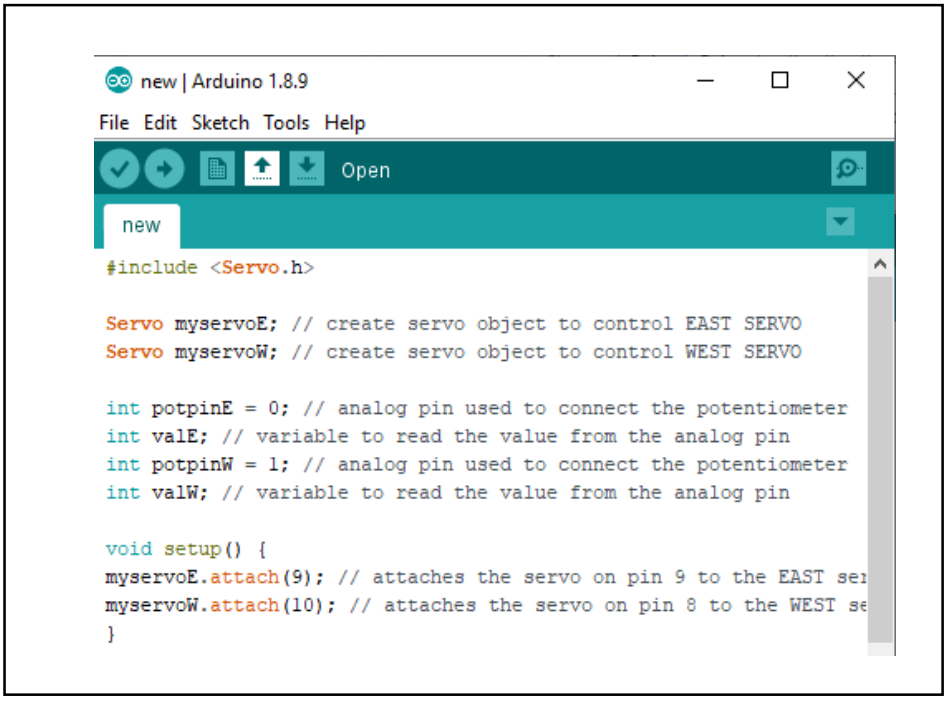


**Figure 5.4: Screenshot of Arduino IDE Software**

To interface different components and module with each other coding is required to successfully establish a connection between them. There are several header files already available to ease the programming for the smaller inner workings of the components but some modules require lines of code to work. The Arduino IDE is entirely used for programming of the Arduino board and different components. Once the programming is done, uploading the program to the board is required which is done by connecting the Arduino to PC via a USB cable.

# Chapter 6

# Results & Discussion

Surveillance Rover is ready to explore the areas and able to stream video surveillance on user side on a web browser. The system is also equipped with MQ135 gas sensor which will detect hazardous gases and notifies the controller side about it on a serial monitor of Arduino IDE. Fig. 6.1 shows a snapshot of web browser fetching video footage fetched from the rover.

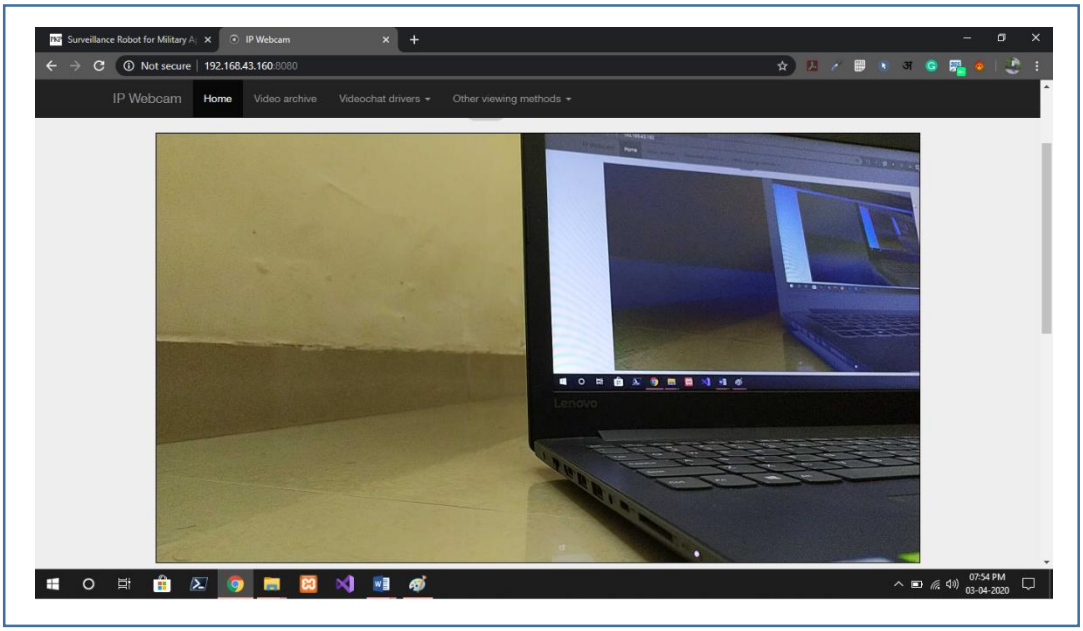


**Fig 6.1 Snapshot of web browser fetching video streaming**

The web browser fetches video streming from the camera mounted on the rover. The browser page also provide features such as capturing image of video streaming.

The data shown by MQ135 gas sensor is in PPM(parts per million). This measurement shows the concentration of air pollutants present in the environment. One ppm is equivalent to the absolute fractional amount multiplied by one million. Fig 6.2 shows the snapshot of Arduino IDE serial monitor showing air quality data fetched from MQ135 gas sensor.

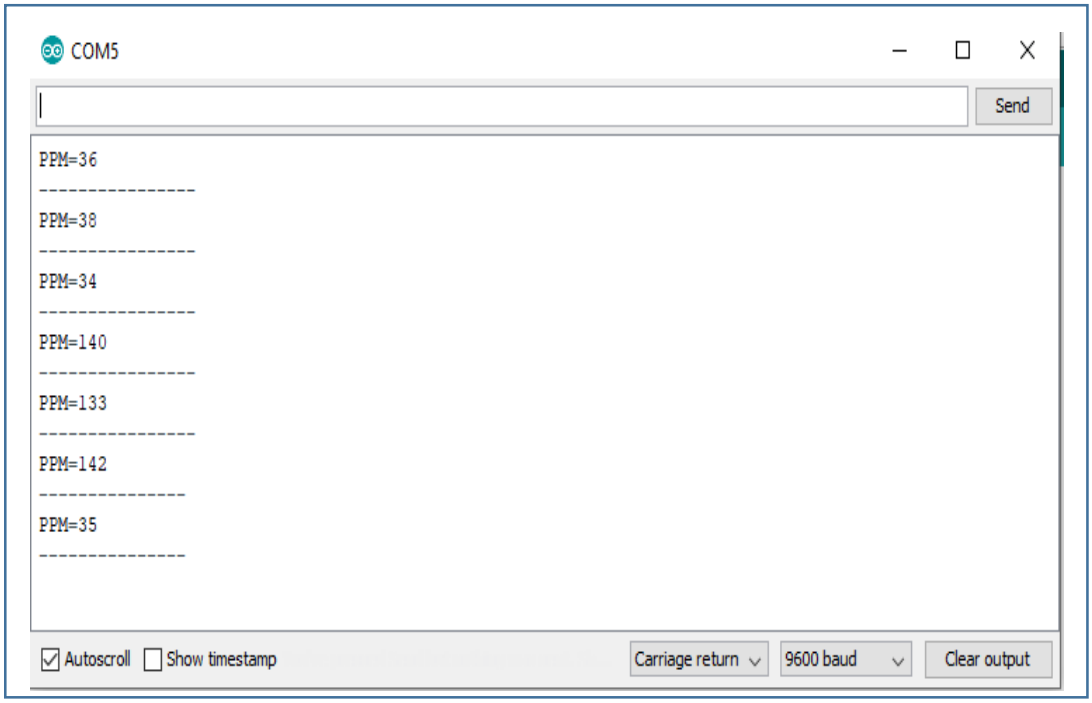


**Fig. 6.2 Snapshot of Arduino IDE serial monitor showing MQ135 data**

The Air quality can be affected by gases, particulates, microbial contaminants (mold, bacteria), or any mass or energy stressor that can induce adverse health condition. The MQ135 sensor can detect a wide range of gases, including NH3, NOx, alcohol, benzene, smoke and CO2. It has high sensitivity to Ammonia, Sulfide and Benze steam, also sensitive to smoke and other harmful gases. Its detection rate is 10 - 300 ppm of NH3, 10 - 1000 ppm of Benzene, and 10 – 300 ppm of Alcohol. One ppm is equivalent to the absolute fractional amount multiplied by one million. A better way to think of ppm is to visualize putting four drops of ink in a 55-gallon barrel of water and mixing it thoroughly. This procedure would produce an ink concentration of 1 ppm. The less number of ppm means more safe the environment will be. As the number increases it depicts the present of harmful gas present in the environment which can affect a human being or can cause severe internal injuries.

# Chapter 7

# Conclusion

Thus, the project Surveillance Rover is implemented which is principally intended for observation of ground in military applications. The project is presented in a Advanced Robotic system which can be controlled through RF signals and the robot's land position can be constantly monitored as well as it is able to hit upon the toxic gas present within the environment.

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# Appendix

# Technologies Used

## **Arduino**:

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

## **DC Motors**:

A DC motor is an electric motor that runs on direct current power. In any electric motor, operation is dependent upon simple electromagnetism. A current carrying conductor generates a magnetic field, when this is then placed in an external magnetic field, it will encounter a force proportional to the current in the conductor and to the strength of the external magnetic field.

## **NRF 24L01**:

The nRF24L01 is a wireless transceiver module, meaning each module can both send as well as receive data. They operate in the frequency of 2.4GHz, which falls under the ISM band and hence it is legal to use in almost all countries for engineering applications. The power consumption of this module is just around 12mA during transmission, which is even lower than a single LED. The operating voltage of the module is from 1.9 to 3.6V, but the good thing is that the other pins tolerate 5V logic, so we can easily connect it to an Arduino without using any logic level converters.

## **MQ135 Air quality sensor**:

The MQ135 is a air quality sensor for detecting a wide range of gases, including NH3, NOx, alcohol, benzene, smoke and CO2. Ideal for use in office or factory. It has high sensitivity to Ammonia, Sulfide and Benze steam, also sensitive to smoke and other harmful gases. It is with low cost and particularly suitable for Air quality monitoring application.

## **Joystick module:**

It is an analog JoyStick, which is similar to two potentiometers connected together, one for the vertical movement (Y-axis) and other for the horizontal movement (X-axis). The joystick also comes with a Select switch. It can be very handy for retro gaming, robot control or RC cars. The X and Y axes are two 10k potentiometers which control 2D movement by generating analog signals. When the module is in working mode, it will output two analog values, representing two directions. This module uses the 5V power supply, and value, when reading through analog input, would be about 2.5V, a value will increase with joystick movement and will go up till maximum 5V; the value will decrease when the joystick is moved in other direction till 0V.

## **Arduino IDE**:

To program the different components to function and establish communication with other components Arduino IDE is used. It is an Integrated Development Environment based on C, Java and developed by Arduino software.

To interface different components and module with each other coding is required to successfully establish a connection between them. There are several header files already available to ease the programming for the smaller inner workings of the components but some

modules require lines of code to work. The Arduino IDE is entirely used for programming of the Arduino board and different components. Once the programming is done, uploading the program to the board is required which is done by connecting the Arduino to PC via a USB cable.

### L298N motor driver:

The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time making it ideal for building two-wheel robot platforms. H Bridge is a simple electronic circuit which enables us to apply voltage to load in either direction. The module can drive DC motors that have voltages between 5 and 35V, with a peak current up to 2A. The L298N motor driver module is powered through 3-pin 3.5mm-pitch screw terminals. The module has two screw terminal blocks for the motor A and B, and another screw terminal block for the Ground pin, the VCC for motor and a 5V pin which can either be an input or output.

## External Libraries Used:

### RadioHead Library for Arduino IDE:

RadioHead consists of 2 main sets of classes: Drivers and Managers.

Drivers provide low level access to a range of different packet radios and other packetized message transports. Managers provide high level message sending and receiving facilities for a range of different requirements. Every RadioHead program will have an instance of a Driver to provide access to the data radio or transport, and a Manager that uses that driver to send and receive messages for the application. The programmer is required to instantiate a Driver and a Manager, and to initialise the Manager. Thereafter the facilities of the Manager can be used to send and receive messages.

It is also possible to use a Driver on its own, without a Manager, although this only allows unaddressed, unreliable transport via the Driver's facilities. In some specialised use cases, it is possible to instantiate more than one Driver and more than one Manager. A range of different common embedded microprocessor platforms are supported, allowing your project to run on your choice of processor. Example programs are included to show the main modes of use.

# Publication

The project paper on “Surveillance Rover” is published in the “St.John Journal of Engineering Sciences”.

# Acknowledgement

We are pleased to present **"Surveillance Rover"** project and take this opportunity to express our profound gratitude to all those people who helped us in completion of this project. We thank our college for providing us with excellent facilities that helped us to complete and present this project. We express our warm thanks to the Principal, **Dr. G. V. Mulgund** and our Head of the Department **Dr. Rahul Khokale** for their support and guidance. We would also like to thank the staff members and lab assistants for permitting us to use computers in the lab as and when required. We express our deepest gratitude towards our project guide **Mr. Sunny Sall** for his valuable and timely advice during the various phases in our project. We would also like to thank our project coordinator **Mrs. Angelin Florence** for providing us with all proper facilities and support as the project co-coordinator. We would like to thank her for support, patience and faith in our capabilities and for giving us flexibility in terms of working and reporting schedules. We would like to thank all our friends for their smiles and friendship making the college life enjoyable and memorable and family members who always stood beside us and provided the utmost important moral support. Finally we would like to thank everyone who has helped us directly or indirectly in our project.

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**Final Year, Eight Semester**

**Session: 2020**