



# Multi-Surveillance Robot for Real – Time Human Detection and Alert System

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**ABSTRACT:** Surveillance systems play a crucial role in ensuring safety and security in various environments such as industries, public areas, and residential zones. Traditional surveillance systems are mostly static and require continuous human monitoring, which can lead to inefficiencies and delayed responses.

This paper proposes a Multi-Surveillance Robot capable of real-time human detection and alert generation. The system uses a camera module integrated with a microcontroller and machine learning algorithms to identify human presence. Once detected, the robot sends alerts to the user through wireless communication.

The robot is capable of autonomous movement using motor drivers and sensors for navigation. The integration of IoT enables real-time monitoring and control. This system reduces human effort, enhances security, and provides a scalable solution for smart surveillance applications.

It uses Yolo based human tracking and Sensor like (gas, Temperature) to detect the surface level on the places like border and emergencies areas such as fire buildings and damaged constructions

Thus it sends alert message to the controller and it can be operated by remote via use of Wifi connection via NodeMCU modules

We can control the robot by use of both automated and manual control. Path analysis can be done by upload the path of the ground level like International borders to increase the surveillance and safety measure on the line of control

**KEYWORDS:** Surveillance Robot, Human Detection, IoT, Machine Learning, Autonomous Navigation, Security System, Yolo Tracking, Sensor Tracking, Internet Of things, Realtime Monitoring, Security Purpose.

## I. INTRODUCTION

Monitoring the regions where threats can occur is needed because it will be useful for future decision making and problem finding. Traditional surveillance like (CCTV Cameras and human Monitoring Police military) are not much efficient on the real time. Thus intrusion in areas such as International Land based Border are getting High and current Traditional robots are being out of power and poor surveillance and human tracking is not possible

To overcome these issues we propose a robot system that overcomes all these problems and maintains Real and live monitoring and analysis of the environment

The main objective of this project is to develop an automated robot system that can monitor the areas which need to be controlled thus it allows us to predict the person entering in the areas of surveillance

### 1. Surveillance of Area :

The project develops a robotic system capable of automatic detection of humans and the other parameters on the surrounding environment.

## 2. Automated Path system :

The Robot can be move on the path by setting the point via the microcontroller.so that we can automate in the border lines

## 3. Manual System for Remote Operation :

Robot can be control by use of VCR( Virtual Controller ) that can be connect via WIFI upto 1km via IOT system

## 4. Yolo Face detection :

The yolo is human detection model that used to detect the human on the field and the intrusion on the land fields

## 5. Sensor for environment trackage :

The Sensor used to collect the data of the environment parameters like temperature, gas level of O<sub>2</sub>,CO<sub>2</sub>,etc and also the humidity level of the environment

## 6. Power Back with solar :

The motor will consume high range of power ,so we use solar pannel to charge the battery . so that the robot will have enough power to run as well to get high efficiency on the output

## 6.Alert Message System :

This robot will detect the human intrusion .if there is any intrusion occur that will be get caught as an alert from the robot the user via a Alert message

and the timing of the capture are also been get on the alert message so that we can find them easily

## 7. Cost Reduction :

The present models are been get with high cost due to the modules used and the battery backup of the robot.but we over come this problem with help solar and low cost modules

## 8. Design and Update :

This is a simple robot design and no complex PCB design so we can easily use it.thus it can be integrated with drown system for future usage on the Z category security service



## II. BACKGROUND

The demand for the surveillance robot is been get in increase by the Boom of AI and use of the bots to detect the criminals are been easy and fast

Ex : Visakapatnam Police use a robot to detect the criminals on the database with the camera robot thus it can check 2000 + images at a time

Surveillance systems play a vital role in ensuring safety and security in various environments such as industries, public places, and residential areas. Traditional surveillance systems mainly rely on fixed CCTV cameras, which provide limited coverage and require continuous human monitoring. These systems are not capable of accessing remote or hazardous areas, making them less efficient in critical situations.



With the advancement of robotics and Internet of Things (IoT) technology, mobile surveillance systems have gained significant attention. Robotic surveillance systems can move freely in different environments, collect real-time data, and transmit information remotely. This makes them highly suitable for applications such as disaster management, military operations, and industrial monitoring.

In addition, integrating renewable energy sources like solar power into robotic systems enhances sustainability and reduces dependency on external power sources. Solar-powered robots can operate for longer durations without frequent charging, making them ideal for continuous monitoring tasks.

The proposed Multi-Surveillance Robot combines mobility, real-time video monitoring, environmental sensing, and solar energy utilization to provide an efficient and intelligent surveillance solution.

### III. RELATED WORK

Several research works have been carried out in the field of surveillance robots and IoT-based monitoring systems.

#### 1. IoT-Based Surveillance Robot

Researchers developed a robot using IoT technology that can transmit real-time data to users through the internet. The system improved remote monitoring capabilities but lacked multi-sensor integration.

#### 2. Human Detection Using Camera Systems

Various studies implemented camera-based human detection systems using image processing and machine learning algorithms. These systems achieved good accuracy but were mostly limited to static environments.

#### 3. Wireless Controlled Surveillance Robot

Some systems used Bluetooth or RF communication to control robots for surveillance. However, these systems had limited range and were not suitable for long-distance monitoring.

#### 4. Solar-Powered Robotic Systems

Recent works introduced solar-powered robots to improve energy efficiency. These systems demonstrated longer operational time but did not focus on surveillance applications.

#### 5. Multi-Sensor Monitoring Robots

Some researchers integrated sensors like gas and temperature sensors into robots for environmental monitoring. However, these systems often lacked real-time video surveillance and alert mechanisms.

Compared to existing systems, the proposed system integrates IoT, real-time video monitoring, multi-sensor data collection, and solar energy, making it more efficient and versatile.

### IV. PROPOSED SYSTEM

The proposed system is an IoT-based Smart Multi-Surveillance Robot designed for real-time monitoring and security applications. The system integrates a camera module, sensors, microcontroller, and wireless communication to provide efficient surveillance.

The robot is built using a NodeMCU microcontroller, which acts as the main control unit. It connects to the internet via Wi-Fi and enables remote monitoring and control. The movement of the robot is controlled using DC motors driven by an L298N motor driver, allowing the robot to move in multiple directions such as forward, backward, left, and right.

A camera module (ESP32-CAM) is used for real-time video surveillance. It continuously captures the surroundings and allows users to monitor the area remotely. The system detects human presence using the camera and sends an alert message to the control unit or user through IoT communication.

The robot is also equipped with sensors such as temperature and gas sensors to monitor environmental conditions. The collected data is transmitted to an IoT platform for real-time monitoring.

To improve energy efficiency, the system uses a solar-powered battery charging system. Solar panels charge the battery, ensuring continuous operation of the robot without frequent manual charging.



An I2C LCD display is used to show important system parameters locally. The combination of mobility, sensing, and communication makes the system highly effective for surveillance in remote and hazardous environments.

Data Collection :

Data collection is an important part of evaluating the performance of the surveillance robot. The system collects different types of data from sensors and the camera module.

#### 1. Video Data

The camera module continuously captures real-time video data from the surroundings. This data is used to detect human presence and monitor activities.

#### 2. Sensor Data

The system collects environmental data using sensors such as:

- Temperature sensor for measuring environmental temperature
- Gas sensor for detecting harmful gases

#### 3. System Data

The system also records operational data such as:

- Battery voltage level
- Robot movement status
- Network connectivity status
- Remote Control System status

#### 4. Solar Power Data

Data related to battery charging through solar panels is monitored to evaluate energy efficiency.

#### 5. Sensor Data

Collect of sensor that need for the areas where the risk are been high area collect and implemented

## V. TESTING AND VERIFICATION

Testing and verification are carried out to ensure the proper functioning of the surveillance robot under different conditions.

#### 1. Hardware Testing

All hardware components such as NodeMCU, sensors, camera module, motor driver, and motors are tested individually to ensure correct operation.

#### 2. Movement Testing

The robot is tested for movement in all directions (forward, backward, left, right) to verify navigation capability.

#### 3. Camera and Detection Testing

The camera module is tested for real-time video streaming. Human detection is verified by placing objects and observing the system response.

#### 4. Alert System Testing

The system is tested to ensure that alert messages are sent to the control unit when a human is detected.

#### 5. Sensor Testing

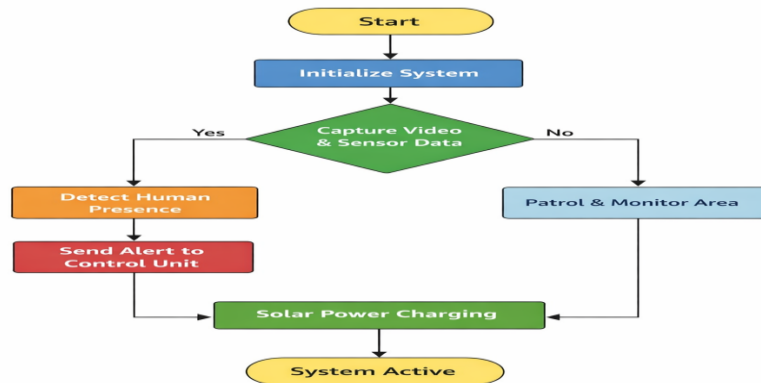
Temperature and gas sensors are tested to verify accurate data collection.

#### 6. Power System Testing

The solar charging system is tested to ensure that the battery is charged efficiently and provides continuous power to the robot.

#### 7. System Validation

The overall system is tested in real-time environments to verify performance, reliability, and response time and prevent the intrusion of peoples



## VI. RESULTS

The experimental results demonstrate that the proposed Multi-Surveillance Robot performs effectively in real-time monitoring and detection tasks.

The camera module successfully captures live video and detects human presence. The system generates alert messages with minimal delay, improving response time. The robot is able to move smoothly in different directions and cover a wider area compared to fixed surveillance systems.

Sensor data such as temperature and gas levels are accurately measured and transmitted to the IoT platform. The solar power system efficiently charges the battery, allowing longer operational time without external power.

Overall, the system improves surveillance efficiency, reduces human effort, and enhances safety in hazardous environments. The integration of IoT, robotics, and solar energy makes the system reliable, cost-effective, and suitable for multiple applications.

## V. CONCLUSION

The IoT Based Smart Multi-Application Surveillance Robot provides an efficient and intelligent solution for real-time monitoring and security applications. Traditional surveillance systems are limited by fixed positions and require continuous human supervision, whereas the proposed system overcomes these limitations through mobility, automation, and remote accessibility. The developed robot integrates a camera module for live video streaming, environmental sensors for monitoring conditions such as temperature and gas levels, and a NodeMCU microcontroller for data processing and communication. The system successfully detects human presence and sends alert messages to the control unit, improving response time and security. The inclusion of IoT technology enables real-time data transmission and remote control using mobile devices or computers. Additionally, the use of solar power for battery charging enhances the sustainability and efficiency of the system by reducing dependence on external power sources. Experimental results show that the system performs reliably in different environments, providing accurate monitoring and effective alert generation. The robot is capable of covering a wider area compared to fixed surveillance systems, making it suitable for applications such as industrial monitoring, disaster management, military surveillance, and home security. Overall, the proposed system is cost-effective, energy-efficient, and scalable. It demonstrates how the integration of IoT, robotics, and renewable energy can significantly improve modern surveillance systems and reduce human risk in hazardous environments.

## VI. FUTURE SCOPE

1 Add of Matlab for path Analysis:

Matlab can be used for the path analysis and to check the field by plotting the x & y axis from vertical axis



2 Open cv for Image Prediction:

Use of opencv for the analysis of image type (human count and the age of the human)

3 Drone Intgration:

The drone are been used for the survillenc of the border where we can integrate the robot with drones to improve safety and less no of soldiers for border security

4 Explosive Carriage :

This robot can be used to carry the RDX on First line of defence and be a suicide force in the BSF (Border security force)

5 GPS Interaction :

The gps module can be used to find the accurate Location of the intrusion Areas and automate path tracking can be possible on those areas

6 Disaster Management :

Future add of the mechanical hands and CNC System for rescue the people on the damage areas on the disaster places

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