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Review on Solar Iot Based Surveillance Robot

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ABSTRACT

The growing demand for intelligent security systems has led to the development of smart surveillance solutions using Internet of Things (IoT) technology. This research paper presents the design and implementation of an IoT-based surveillance robot capable of real-time video monitoring and remote navigation through the internet. The system integrates a microcontroller with wireless communication, a camera module, and multiple sensors for obstacle detection and motion sensing. Live video streaming and robot control are achieved through a web or mobile interface, enabling surveillance from remote locations. The proposed system provides a low-cost, flexible, and efficient alternative to traditional static surveillance systems, making it suitable for applications such as home security, industrial monitoring, military surveillance, and disaster management.

Keywords—IoT, Surveillance Robot, Wireless Monitoring, Security System, Remote Control

1. INTRODUCTION

Surveillance systems play a crucial role in ensuring safety and security in residential, industrial, and military environments. Traditional surveillance systems are mostly static and limited to fixed camera positions, reducing their effectiveness in large or dynamic areas. With the advancement of IoT technology, mobile surveillance robots have emerged as an effective solution to overcome these limitations. An IoT-based surveillance robot combines robotics, wireless communication, and cloud computing to provide real-time monitoring and remote accessibility. Such systems allow users to monitor live video feeds and control robot movement from anywhere using the internet. This paper focuses on the design, architecture, and implementation of an IoT-based surveillance robot that enhances security and situational awareness.

2. LITERATURE REVIEW

G. Anandravisekar, 2A. Anto Clinton, T. Mukesh Raj, 4L. Naveen, Department of Electronics and Communication Engineering Saranathan College of Engineering Trichy, Tamilnadu, India this paper is to develop arobot to perform the act of surveillance in domestic areas. Nowadays robot plays a vital role in our day-to-day life activities thus reducing human labor and human error. Robots can be manually controlled or can be automatic based on the requirement. The purpose of this robot is to roam around and provide audio and video information from the given environment and to send that obtained information to the user. Divakar U1, Ningaraju A.M2, Sudarshana Chakravarthy3, Suraj Sharma S4, Harish S.V5, Pawan Bharadwaj, this paper present The main goal of IoT based Multipurpose Surveillance Robot is to design and develop a surveillance robot that is capable of being used for rescue and spying in military operations. It is known that humans cannot venture into hazardous/disaster-affected places as it can be lifethreatening and hence robots are required where human intervention is nearly impossible. Wireless surveillance robots can help to prevent the endangerment of humans or animals. Sonu Kumar, Kundan Singh, Kumar Mayank, Sakshi Bhure, Ruchika Asatkar Prof. P.U Tembhare etl, Priyadarshini College of Engineering Nagpur, Maharashtra India. In this paper, we present a modern approach for surveillance at remote and border areas using multifunctional robot based on current IOT used in defense and military In today's world border military force is facing huge destruction. Hence, most of the military organizations take the help of military robots to carry out risky operations which cannot be handled by humans. In this project, we can control the robot with the help of mobile or laptop through the Internet of Things (IoT) and we also get live streaming of video with the help of camera from the robot [3]

3. PROPOSED SYSTEM ARCHITECTURE AND HARDWARE DESIGN

The proposed IoT-based surveillance robot is designed to provide real-time monitoring, remote navigation, and intelligent obstacle detection through internet connectivity. The system architecture consists of three main layers: Sensing Layer, Control Layer, and Application Layer, as shown in Figure 1. The Sensing Layer includes the camera module and sensors such as ultrasonic and motion sensors, which continuously collect environmental data. The Control Layer consists of a microcontroller unit with built-in Wi-Fi capability that processes sensor

data and executes control commands. The Application Layer enables the user to remotely monitor and control the robot through a web or mobile interface via a cloud server. The robot connects to the internet using a wireless network, allowing users to access live video streaming and movement control from any remote location. Commands issued by the user are transmitted through the cloud server to the robot, where the microcontroller interprets and executes them in real time.

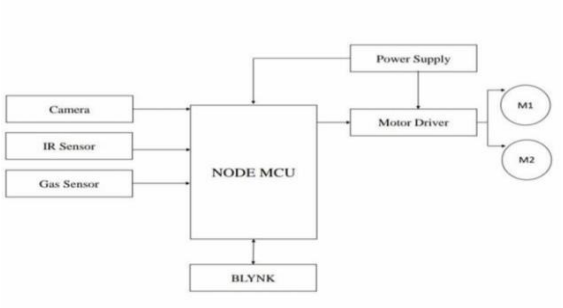

Fig. 3.1 Functional block diagram of the Iot Based Surveillance Robot

The hardware design of the IoT-based surveillance robot integrates multiple electronic components to achieve mobility, sensing, and communication. The overall hardware structure is modular, enabling easy maintenance and future upgrades.

1. Microcontroller Unit:
An ESP32 / Arduino Uno with Wi-Fi module (ESP8266) is used as the central control unit. It manages sensor data acquisition, motor control, and wireless communication with the cloud server. The built-in Wi-Fi feature ensures seamless internet connectivity for remote operation.

2 Camera Module:
A Wi-Fi camera module (ESP32-CAM) is used to capture real-time video.

The camera streams live footage over the internet, enabling continuous surveillance. The video feed can be accessed through a browser or mobile application.

3. Motor Driver and Motors:

A motor driver module (L298N or L293D**)** is used to control the speed and direction of DC motors. The motors provide mobility to the robot, allowing it to move forward, backward, left, and right based on user commands.

4. Sensors:

- Ultrasonic Sensor**:** Measures distance to detect obstacles and avoid collisions.
- Motion Sensor (PIR): Detects human movement and enhances security monitoring.
- IR Sensor (optional): Supports line detection or short-range obstacle sensing. These sensors improve the intelligence and safety of the surveillance robot.

5. Power Supply:
The system is powered by a rechargeable battery pack. Voltage regulators are used to provide stable power to the microcontroller, camera, and sensors. Efficient power management ensures longer operational time.

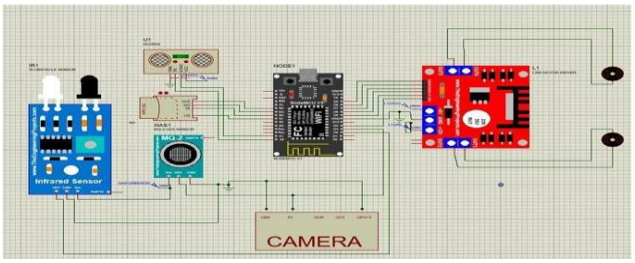

Fig 3.2 Circuit schematic of the proposed Iot Based Surveillance Robot

The following hardware components are used in the design
1. ESP32 Camera:- The ESP32-CAM is a small size, low power consumption camera module based on ESP32. It comes with an OV2640 camera and provides onboard TF card slot.The ESP32-CAM can be widely used in

intelligentIoT applications such as wireless video monitoring, WiFi image upload, QR identification.

2. IR Sensor :- IR Sensor Module is an electronic device, that emits the light in order to sense some object of the surroundings. Infrared (IR) sensors are also capable of measuring/computing the heat being emitted by an object and detecting the motion. Infrared sensors from Infra Tec are used in gas warning devices, gas analysers, medical gas measurement technology, flame detectors and in contactless precision temperature measurement
.
3. NODE MCU:- NodeMCU is an open-source microcontroller development board based on the ESP8266 Wi-Fi chip. It combines the functionality of a microcontroller and a Wi-Fi module, making it ideal for IoT-based projects. It can connect to the internet, collect data from sensors, control motors, and communicate with cloud platforms like Blynk or ThingSpeak.

4. Motor Driver:- The motor driver is an essential electronic component that acts as an interface between the microcontroller (NodeMCU) and the DC motors of the robot. Since the NodeMCU cannot supply sufficient current to drive motors directly, the motor driver module is used to amplify control signals and provide the necessary power for motor movement.

5. Gas sensor:- The motor driver is an essential electronic component that acts as an interface between the microcontroller (NodeMCU) and the DC motors of the robot. Since the NodeMCU cannot supply sufficient current to drive motors directly, the motor driver module is used to amplify control signals and provide the necessary power for motor movement.

6. Ultrasonic Sensor:- The ultrasonic sensor is a device used to measure the distance between the robot and any obstacle in its path using sound waves. It operates by emitting an ultrasonic pulse and calculating the time it takes for the echo to return. This sensor is commonly used for obstacle detection and avoidance in robotics applications. These inputs are sent to the microcontroller for processing

4. METHODOLOGY AND EXPERIMENTAL SETUP

1.1 Methodology

The methodology of the proposed IoT-based surveillance robot focuses on integrating sensing, communication, control, and monitoring modules to achieve real-time remote surveillance and navigation. The system operates using a structured workflow that ensures reliable data acquisition, processing, transmission, and actuation.

1. System Initialization

Initially, the robot is powered on and establishes a connection with a predefined Wi-Fi network. Once connected, the microcontroller initializes all peripherals including the camera module, motor driver, and sensors. Successful network connection enables communication with the cloud server and user interface.

2. Data Acquisition: The sensing unit continuously collects environmental data:

- The camera module captures live video frames.
- The ultrasonic sensor measures distance to detect obstacles.
- The PIR sensor monitors motion to identify human presence These inputs are sent to the microcontroller for processing.

3. Data Processing and Decision Making

The microcontroller processes sensor data in real time. If an obstacle is detected within a predefined threshold distance, the controller triggers an avoidance mechanism by stopping or redirecting the robot. Motion detection events can generate alerts for enhanced security.

4. Communication and Control

Processed data and live video are transmitted to the cloud server via Wi-Fi. The user sends control commands (forward, backward, left, right, stop) through a web or mobile application. These commands are received by the microcontroller and translated into motor control signals.

5. Actuation

The motor driver module receives control signals from the microcontroller and drives the DC motors accordingly. This enables smooth and responsive robot movement in the monitored environment. Feedback Mechanism

Live video streaming and sensor feedback provide real-time situational awareness to the user. This closed-loop system ensures accurate control and monitoring.

from a mobile controller and generate appropriate control signals for the actuators. The L298N motor driver is used to interface the ESP32 with DC motors, enabling controlled motor operation. A servo motor is employed to regulate the seed outlet mechanism, ensuring precise control of seed flow. A relay module is used to control the blower fan, which assists in uniform seed dispersion. The overall methodology emphasizes low power consumption, reliable control, and efficient seed spraying to support sustainable agricultural practices.

Sr. No.	Components	Rating	Quantity
1	Camera(ESP32)	-	1
2	IR Sensor	3.3V	1
3	NODE MCU(ESP8266)	3.3V	1
4	Motor Driver	5V TO 12V	1
5	Gas Sensor	3.3V	1
6	Ultrasonic Sensor	5V	1
7	DC Gear Motor	12V	4

Fig 3.3 Hardware Component Description

5. DESIGN ANALYSIS AND EXPECTED OUTCOMES

The design of the proposed IoT-based surveillance robot emphasizes mobility, real-time monitoring, and efficient wireless communication to overcome the limitations of traditional static surveillance systems. The integration of a Wi-Fi-enabled microcontroller ensures reliable data processing and seamless remote connectivity, while the camera module provides continuous live video streaming for effective visual surveillance. The Sensor integration, including ultrasonic and motion sensors, enhances system intelligence by enabling obstacle avoidance and intrusion detection. The modular hardware architecture allows scalability and simplifies maintenance, while the battery- powered design supports portability and extended operation. Based on this design analysis, the expected outcomes include stable real-time video transmission, accurate remote navigation, improved situational awareness, and cost-effective surveillance performance across various environments such as residential, industrial, and hazardous areas

6. CONCLUSION

The framework for making a robot for surveillance purpose is proposed. It overcomes the problem of limited range surveillance by using the concept of IOT. We can control the robot with the help of laptop/mobile manually. Automatic monitoring can also be done. Our proposed robot is small in size thus maneuvering into area where human access is impossible. Wireless technology is one of the most integral technologies in the electronics field. This technology is used to serve our project as a supreme part of surveillance act. This provides highly efficient and a cost-effective robot that replaces human work and reduces human labor and performing monitoring works in a well effective manner.

7. REFERENCES

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