IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.414 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 11, November 2025

DOI: 10.17148/IJIREEICE.2025.131135

IoT Based Surveillance Robot

D Jagan[1], M Archana[2], D Varsha[3], B Rahul[4], R Pavan Kumar[5]

Assistant Professor, Department of Electronics & Communication Engineering, Christu Jyothi Institute of Technology & Science, Jangaon, Telangana, India[1]

UG Student, Department of Electronics & Communication Engineering, Christu Jyothi Institute of Technology & Science, Jangaon, Telangana, India[2,3,4,5]

Abstract: The main objective is to develop a surveillance robot to perform surveillance activities in industrial areas, militarized war zones or radioactive field areas with the objective of analysing, governing and protecting the areas from unwanted threats. The use of robots and their role in our day-to-day life has been rapidly increasing since the day they were introduced to the world, further reducing the errors and life risk to humans.

The objective is to design and develop an Internet of Things (IoT) based surveillance robot at a low cost that will roam around freely and give live updates about their surroundings by broadcasting video and information. The sensor collects the data from the surroundings and send it to the Arduino microcontroller which can be seen by the user any time. This technology is controlled by the user remotely through any device such as mobile phone, tablet or laptop with the help of IoT based services. The entire project is built and monitored by wireless platform to minimize the use of wire and help it work smoothly in remote places.

I. INTRODUCTION

In 1954, humans were introduced to the world's first fully functioning industrial robot "The Unimate" and after that, scientists and engineers have come together to create dynamic and diverse changes in the field of automation and robotics to make the daily humane tasks easier and faster. The use of robots in development and automation fields is increasing day by day and there is no doubt about the future being largely controlled by robots and artificial intelligence (AI) [1].

The Surveillance System closely observes and analyzes the surrounding and get instant information about the conditions. It is mainly required in areas of high risk, borders, public places, and prison or in industries which is mainly used for monitoring behavior and activities of a group or any individual. The need of surveillance robots arises when the life risk is too high and the user wants the information to be highly accurate. Robots are nothing but fully automated electronic and internet-controlled devices that are capable of performing various tasks that a normal human might not be able to do. Thus, use of robots for surveillance is one of the greatest advancements in the field of automation [2]. These multifunctional robots are able to perform tasks in dangerous situations like collapsing buildings or radioactive zones. One of its best uses is in the protection and rescue works after unexpected tragedy or unwanted invasions like Ukraine-Russia Cold war or tragedies like Chernobyl/Bhopal Gas Plant [3]. There are many obstacles faced by the rescue forces during inspection of such sudden and unexpected events like narrow spacing, collapsing of damaged structures. It becomes difficult for an ordinary human to deal with such risky tasks to enter areas without knowing the present information. These robots being autonomous in nature are designed to perform efficiently without human interference and have high mobility.

Back in 1999, Kevin Ashton introduced the term 'Internet of Things' to the world in one of his presentations. IoT connected people with everything on the internet from anywhere around the world and since then the definition of IoT has evolved and growth has rapidly increased. Nowadays, we can see the wide use of IoT in various fields to connect the world virtually and physically. The number of devices connected via IoT as of 2021 are close to 30 billion and expected to react 75 billion in the year 2025 enumerated by Statista [4].

This IoT Based Autonomous multi-purpose surveillance and rescue robot is built on mainly two systems. First, the motorized working of the robot with all the connections and second, the communication of the device with the user and smooth data transfer from the sensors to the cloud platform. These systems help in carrying out task properly. The main aim of this project is to combine the two different systems into one machine that would make them work simultaneously and perform the required tasks. To achieve this aim, an IoT based monitoring system is also included with the robot which can be used to monitor by the user through their device.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.414 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 11, November 2025

DOI: 10.17148/IJIREEICE.2025.131135

II. PROPOSED SYSTEM

The robot consists of Arduino UNO micro controller which acts as heart piece of the robot. This robot also consists of DC motors, wheel chassis, battery, Wi-Fi module and various types of sensors such as camera for monitoring. Surveillance is essential for various sectors such security, monitoring, and automation. Traditional surveillance systems have limitations in terms of mobility and flexibility. The proposed system aims to address these limitations by introducing an IoT-based surveillance robot.

Objectives:

- ➢ Aim is to design a robot to replace humans in dangerous areas
- ➢ Long range and night vision camera for clear night monitoring
- ➢ Using WIFI module with Arduino make better connection
- ➢ Develop a surveillance robot capable of remote monitoring and control.
- ➢ Integrate IoT technologies for real-time data transmission and analysis.
- ➢ Enable autonomous navigation and obstacle avoidance.
- ➢ Implement advanced features such as object detection and recognition.

III. LITERATURE REVIEW

2016 [6]: Design and Implementation of IoT-based Intelligent Surveillance Robot
Proposed techniques include SMART-I (a mobile robot on fixed line tracing), Real-time Video transmission, and Smartphone app.
Limitations are Limited Battery Backup and No Night Vision Camera.

2017 [7]: Military Robot for Reconnaissance and Surveillance using Image Processing
Proposed techniques include a robot for detecting landmines and moving on any terrain, face recognition as per the database, updates for a new person after taking 20 pictures, and gas leak, Radiation, Heat Detection.
Limitations are No Battery Backup, Connected to Vulnerable Cloud.

2017 [8]: Autonomous Surveillance Robots
Proposed techniques include robots for human assistance with gesture sensing like waving the camera for assistance.
Limitations are Decision making and the robot can't cover large areas, irregular sensor data.

2018 [9]: IoT-Based Wi-Fi Surveillance Robot with Real-Time Audio and Video Streaming
Proposed techniques include a Smartphone app with easy UI, PIR/IR sensors along with gas sensors, night vision camera instead of IP cam.
Limitations are using third party app may create hindrance with the security concerns like IP cam breach.

2018 [10]: Smart Surveillance Robot for Real-Time Monitoring and Control System
Proposed techniques include Smartphone app PIR/IR and night vision for patrolling.
Limitation is only related to data collection about environmental aspects.

2020 [11]: IoT Based Smart Multi Application Surveillance Robot
Proposed technique is using a self-made UI instead of cayenne cloud platform to customize other features also.
Limitations are limited data storage up to 64gb, Laser gun to be replaced with much more powerful weapon.

IV. INTERNET OF THINGS

IoT, or the Internet of Things, refers to a network of interconnected physical devices, vehicles, appliances, and other objects embedded with sensors, actuators, software, and connectivity capabilities that enable them to collect, exchange, and act on data. The fundamental idea behind IoT is to create a vast ecosystem where everyday objects can communicate with each other, share information, and make intelligent decisions without human intervention.

The Internet of Things (IoT) refers to the interconnection of everyday objects, devices, machines to the internet, allowing them to collect, exchange, and share data. This interconnected network enables devices to communicate and collaborate seamlessly, leading to increased efficiency, automation, and convenience in various industries and sectors. IoT devices can include everything from household appliances like smart thermostats and refrigerators to industrial machinery, vehicles, and wearable devices. These devices are equipped with sensors, actuators, and software that enable them to gather and transmit data, often in real-time. This data can then be analysed and used to make informed decisions, improve processes, and enhance user experiences.

The IoT has numerous applications, such as smart cities, where sensors monitor traffic, energy usage, and waste management to improve urban planning and sustainability. In healthcare, IoT devices can track patient's vital signs

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.414 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 11, November 2025

DOI: 10.17148/IJIREEICE.2025.131135

remotely and alert healthcare providers of any abnormalities.In agriculture, sensors can monitor soil conditions and weather patterns to optimize crop yield and reduce water usage. Despite its many benefits, the IoT also raises concerns about privacy, security, and data breaches, as the sheer number of connected devices increases the potential attack surface for hackers. As the IoT continues to evolve, it has the potential to revolutionize how we interact with technology and the world around [6].

V. ANALYSIS & DESIGN

Methodology for an IoT based surveillance robot:

1. Connectivity: The robot is equipped with communication modules, such as Wi-Fi or cellular connectivity, allowing it to establish a connection to the internet. This connectivity enables seamless communication between the robot and the control system.

2. Sensors: The robot is equipped with a sensor to capture and collect data about its environment. The sensor may include camera. The data collected by the sensor is crucial for surveillance purposes.

3. Data Acquisition: The sensor on the robot continuously gather data from the environment. For example, the camera captures live video feeds. All this data is processed and transmitted to the control system.

4. Data Transmission: The collected data is transmitted from the robot to the control system through the internet connection. This transmission can occur in real-time, ensuring that the control system receives up-to date information about the robot's surroundings.

5. Control System: The control system serves as the central hub for monitoring and controlling the surveillance robot. It can be accessed through a smartphone, computer, or any other device with internet connectivity. The control system provides a user interface where users can view the live video feed from the robot's cameras and control its movements.

6. Remote Control: Users can remotely control the surveillance robot through the control system. They can command the robot to move in different directions. This remote-control capability allows users to navigate the robot to specific areas of interest and gather more detailed surveillance information.

7. Data Analysis and Storage: The control system can analyse and process the collected data from the robot's sensor. The processed data can be stored for future reference or used to trigger alerts or notifications based on predefined criteria.

8. User Interaction: Users can interact with the control system to receive real-time updates, set surveillance schedules, configure alert.

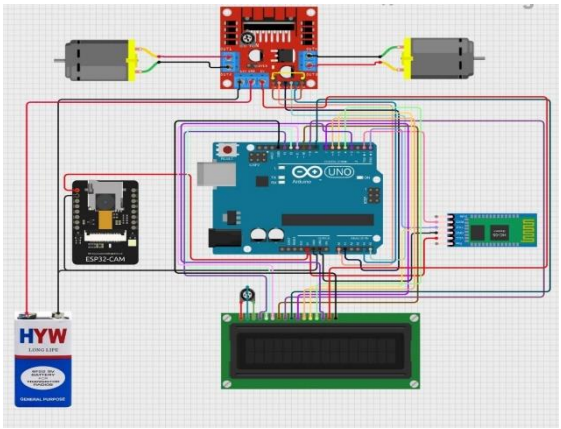


Figure: Circuit Diagram of IoT Based Surveillance Robot

VI. SOFTWARE USED

Arduino is a prototype platform based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed and a ready-made software called Arduino IDE, which issued to write and upload the computer code to the physical board.

Key Features:

• Arduino boards are able to read analog or digital input signals from different Sensors and turn it into an output such as activating a motor, turning LEDon/off, connect to the cloud and many other actions.

• It can control the board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE.

•Most previous programmable circuit boards, Arduino does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. You can simply use a USB cable.

• Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

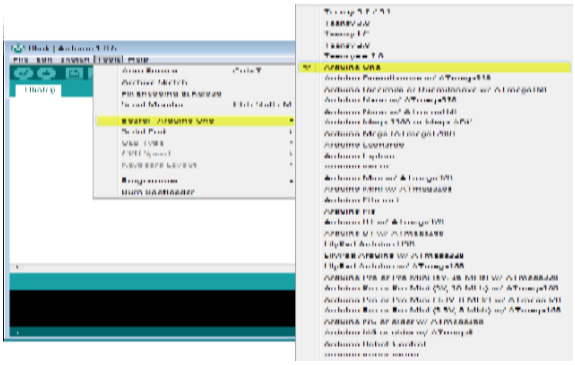
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.414 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 11, November 2025

DOI: 10.17148/IJIREEICE.2025.131135

•Finally, Arduino provides a standard form factor that breaks the functions of the microcontroller into a more accessible package.

After learning about the main parts of the Arduino UNO board, we are ready to learn how to set up the Arduino IDE. Once we learn this, we will be ready to upload our program on the Arduino board.



VII. RESULTS

In an IoT-based surveillance robot, such an LCD display could be used to show navigation status, directions, to operators monitoring the robot remotely. The display can enhance user interaction by providing real-time feedback on robot movements or status in a simple way.

The word “FRONT” implies the robot is indicating a direction of movement in forward path.

The word “RIGHT” implies the robot is indicating a direction of movement in Right path.

The word “LEFT” implies the robot is indicating a direction of movement in Left path.

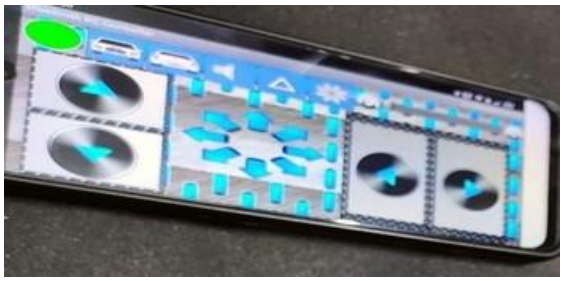
The word “STOP” indicates that the movement of the robot will be stopped/it can’t move.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.414 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 11, November 2025

DOI: 10.17148/IJIREEICE.2025.131135



It is a Bluetooth RC Controller app has a directional arrows and other controls, likely for controlling a remote device via Bluetooth.

It is the live streaming of the surroundings through the camera of the robot.

VIII. CONCLUSION

An IoT-based surveillance robot is proposed which can solved the problems regarding inspection of difficult areas and unexpected situations. The robot is fully capable of replacing humans and providing extremely accurate data to the user. It overcomes the problem of short ranged communication with the help of IoT platform and broadcasts the live videos to the user. The robot is small in size and is capable of maneuvering hard terrains, also it rotates in all directions. There are many applications to this robot such as surveillance while being steady or in motion, analyzing the surrounding areas, displaying land mines, spying and other militarized operations.

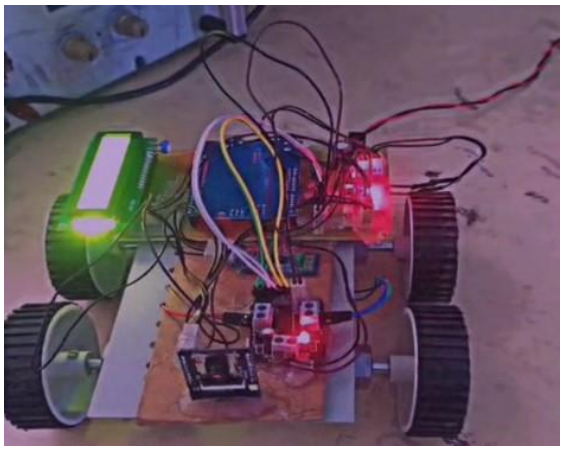


Figure: IoT based surveillance robot

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
Impact Factor 8.414 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 11, November 2025
DOI: 10.17148/IJIREEICE.2025.131135

IX. FUTURE SCOPE

New technologies can be implemented to make the robot more efficient. A proper HD camera can be used and a separate network can be made for fast and accurate transfer of data. Instead of using the IoT platform an API can be built for fetching data. The design of the robot can be upgrades as per the needs and an arm can be attached to the robot, which will have new functionalities and a few more sensors. Instead of using battery, a proper solar powered battery might be planted the working of robot. Further, thermal imaging or face/identity detection systems can be installed on the robot that will help in identifying people and thermal imaging can be used to get information regarding any hostage or people in restrict.

REFERENCES

[1]. SGasparetto A, Scalera L. From the Unimate to the Delta Robot: The Early Decades of Industrial Robotics. In: Zhang, B., Ceccarelli, M. (eds) Explorations in the History and Heritage of Machines and Mechanisms. History of Mechanism and Machine Science: Springer, Cham; 2019. 37.
[2]. Basan A, Basan E, Makarevich O. Analysis of ways to secure group control for autonomous mobile robots. In: Proceedings of the 10th International Conference on Security of Information and Networks (SIN '17) 13 October 2017: IEEE; 2017., pp. 134139
[3]. Mahmud H, Ahamed JU. An Autonomous Surveillance Robot with IoT based Rescue System Enhancement. International Journal on Emerging Technologies.2020; 11(5): 489 – 494.
[4]. Thiele LP. Rise of the Centaurs: The Internet of Things Intelligence Augmentation. In: Keskin, T., Kiggins, R.D. (eds) Towards an International Political Economy of Artificial Intelligence. International Political Economy Series. Palgrave Macmillan: Cham; 2021.39 – 61.
[5]. Akilan T, Kumari P, Chaudhary S, Utkarsh P. A Survey on Surveillance Robot in Hazardous Place Using IoT Technology, International Journal of Research in Engineering, Science and Management. 2020; 3(6): 310 – 315.
[6]. Hin MS, Kim B C, Hwang SM, Ko MC. Design and Implementation of IoT-based Intelligent Surveillance Robot. Studies in Informatics and Control. 2016; 25(4); 421- 432.
[7]. Ghouse Z, Hiwrale N, Ranjan N. Military robot for reconnaissance and surveillance using image processing. International Research Journal of Engineering and Technology. 2017; 4(5): 2395-0072
[8]. Witwicki S, Castillo JC, Messias J, Capitan J, Melo FS, Lima PU, Veloso M. Autonomous surveillance robots: A decision-making framework for networked multi agent systems. IEEE Robotics & Automation Magazine.2017; 24(3):52-64.
[9]. Singh, D., Nand Gaonkar, A. IOT-Based Wi-Fi Surveillance Robot with Real-Time Audio and Video Streaming. In: Iyer, B., Nalbalwar, S., Pathak, N. (eds) Computing, Communication and Signal Processing. Advances in Intelligent Systems and Computing: Springer; 2019.
[10]. Nayyar, A., Puri, V., Nguyen, N.G., Le, D.N. Smart Surveillance Robot for Real Time Monitoring and Control System in Environment and Industrial Applications. In: Bhateja, V., Nguyen, B., Nguyen, N., Satapathy, S., Le, DN. (eds) Information Systems Design and Intelligent Applications. Advances in Intelligent Systems and Computing: Springer; 2018. vol 672.
[11]. Telkar AK, Gadgay B. IoT Based Smart Multi Application Surveillance Robot. Second International Conference on Inventive Research in Computing Applications (ICIRCA): IEEE; 2020. pp. 931-935.
[12]. Pravallika GL, Rakesh P, Srikanth N, Multi-Application Surveillance Robot using IoT. International Research Journal of Engineering and Technology. 2021; 8(4): 4554 – 4558.