IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 7, April 2024

# IoT Based Surveillance Robot

**Regula Ramesh[1], J Veena[2], S Sandeep[3], T Prem Kumar[4]**
Assistant Professor, Department of Electronics & Communication Engineering[1]
UG Student, Department of Electronics & Communication Engineering[2,3,4,5]
Christu Jyothi Institute of Technology & Science, Jangaon, Telangana, India

**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 analyzing, 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 through the sensors installed. The sensors collect 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 minimalize the use of wire and help it work smoothly in remote places.*

**Keywords:** IoT

## 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 roboticsto 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 as shown in Fig.1.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

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 7, April 2024

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 [5]. The main applications include:

Record video visuals and broadcast it to the user
Send data from sensors to the IoT channel
Can explore areas that are dangerous for human
Used for the inspection of border areas

## II. LITERATURE REVIEW

Table 1. Literature Review of IoT Based Surveillance and Rescue Robot using various existing solutions.

| Year | Title | Proposed technique | Limitations |
|---|---|---|---|
| 2016 [6] | Design and Implementation of IoT-based Intelligent Surveillance Robot | -SMART-I a mobile robot and moved on fixed line tracing<br>-RealtimeVideo Transmission<br>-Smartphone App | Limited Battery Backup and No Night Vision Camera |
| 2017 [7] | Military Robot for Reconnaissance and Surveillance using Image Processing | -Robot for detecting land mines and can move on any terrain - Face recognition as per the database<br>-Updates a new person after taking 20 pictures<br>- Gas leak , Radiation, Heat Detection | No Battery Backup, Connected to Vulnerable Cloud |
| 2017 [8] | Autonomous Surveillance Robots | -Robots for human assistance<br>- gesture sensing like waving the camera for assistance | 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 | -Smartphone app with easy UI - PIR sensors along with gas sensors, night vision camera instead of IP cam | 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 Monitoring and Control System | -Smartphone app<br>-PIR/IR and Night Vision for patrolling | Only related to data collection about environmental aspects |
| 2020 [11] | IoT Based Smart Multi Application Surveillance Robot | Instead of cayenne use cloud platform self-made UI to customize other feature also | Limited data storage up to 64gb Laser gun to be replaced with much more powerful weapon |

## III. 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

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 7, April 2024

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 patients' vital signs 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].

## IV. PROPOSED SYSTEM

The robot consists of arduinonano micro controller which acts as the 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 ultrasonic sensor for obstacle detection, IR sensor for detecting pits. Surveillance is essential for various sectors such as 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
- Robot that consists of sensors like, metal detector, IR Sensor, ultrasonic sensors , Alarm System and Buzzer
- 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.

## V. ANALYSIS & DESIGN

Methodology for an IoT based surveillance robot :

1. **Hardware setup:** Begin by gathering the necessary components for surveillance robot, including an Arduino nano board, a camera module, wheels, and another peripherals. connect and assemble them according to the provided instructions.
2. **Software installation:** Install the Arduino IDE on computer and connect the Arduino nano board to the computer. write and upload the necessary code to control the motors, camera and other functionalities of the robot.
3. **Camera integration:** connect the camera module to the Arduino nano board and configure it to capture video footage. Adjust the camera settings to achieve the desired field of view and image quality.
4. **IoT Connectivity:** Configure the communication protocols (MQTT, HTTP, WebSocket) for transmitting sensor data and receiving commands from remote devices. Implement security measures (encryption, authentication) to protect data transmission and access to the robots control interface. Set up a cloud-based IoT platform or server for data storage, management, and remote monitoring.
5. **Remote control:** By integrating with cloud services, users can remotely access and control the surveillance robot from anywhere with an internet connection. A web-based dashboard or mobile app provides users with a graphical interface for viewing live video feeds, monitoring sensor data, and controlling the robot's movements and functionalities.
6. **Data transmission:** Implement bidirectional data transmission between the robot and the remote control device. This includes sending control commands (e.g., move forward, turn left, stop) from the user interface to

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 7, April 2024

the robot, as well as transmitting sensor data (e.g., camera feed, environmental data) back to the user interface for monitoring.

7. **Cloud Integration:** The robot collects various types of data from its sensors, including video streams from cameras, environmental data, and positional information. Data is collected continuously as the robot moves and performs its surveillance tasks. the collected data is transmitted to the cloud using internet connectivity. cloud-based services are used to process and analyze the collected data. the results of data processing and analysis can be used to generate insights, trigger alerts or notifications, and automate certain actions based on predefined rules or thresholds.
8. **Power management:** Develop power management systems to optimize battery life. Implement features such as sleep modes, low-power sensors, and efficient motor control algorithms.
9. **Testing and Optimization:** Test the remote control functionality in various scenarios to ensure reliability and responsiveness. This may involve simulated testing as well as real-world trials in different environments. Optimize the remote control system for latency, bandwidth efficiency, and overall user experience, considering factors such as network conditions and device capabilities.
10. **Testing and Optimization:** Test the remote control functionality in various scenarios to ensure reliability and responsiveness. This may involve simulated testing as well as real-world trials in different environments. Optimize the remote control system for latency, bandwidth efficiency, and overall user experience, considering factors such as network conditions and device capabilities.

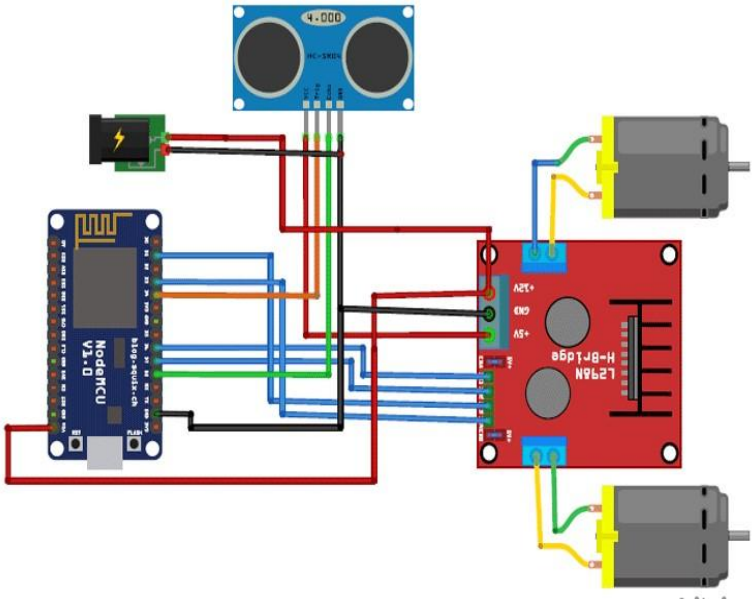



Figure 1.2. Circuit Diagram of IoT Based Surveillance Robot

## VI. SOFTWARE USED

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board.

**The key features are:**

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 LED on/off, connect to the cloud and many other actions.

You can control your board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE (referred to as uploading software).

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 7, April 2024

Unlike 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.
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

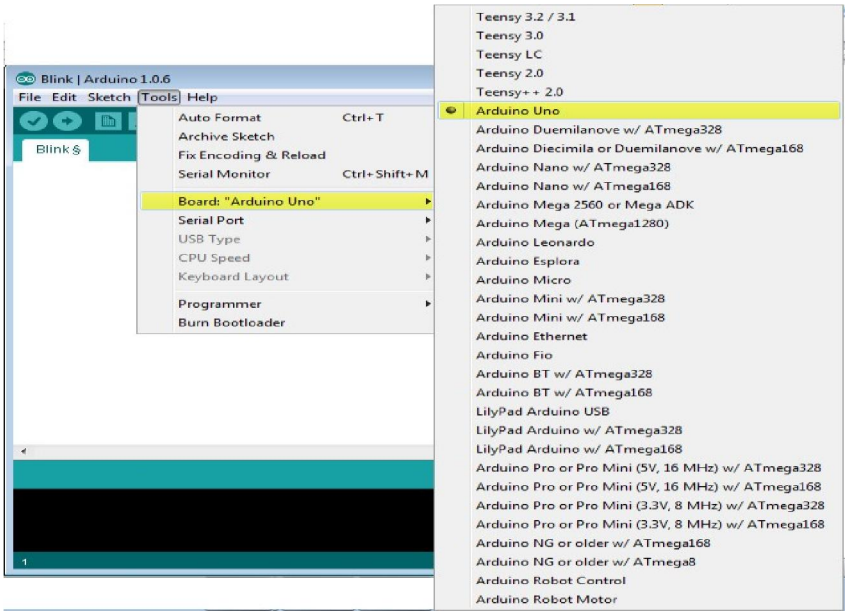


Figure 2 selection of Arduino Uno Board

**Thingspeak**

ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize and analyze live data streams in the cloud. You can send data to ThingSpeak from your devices, create instant visualization of live data, and send alerts. It provides instant visualizations of data posted by your devices to ThingSpeak [14].

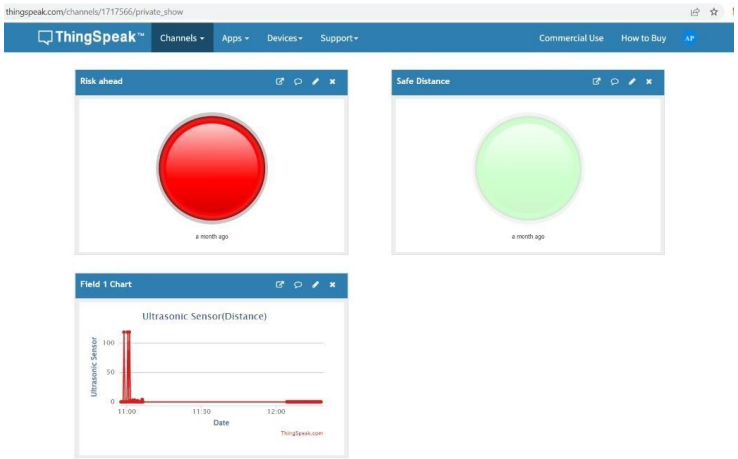


Figure ThingSpeak interface

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 7, April 2024

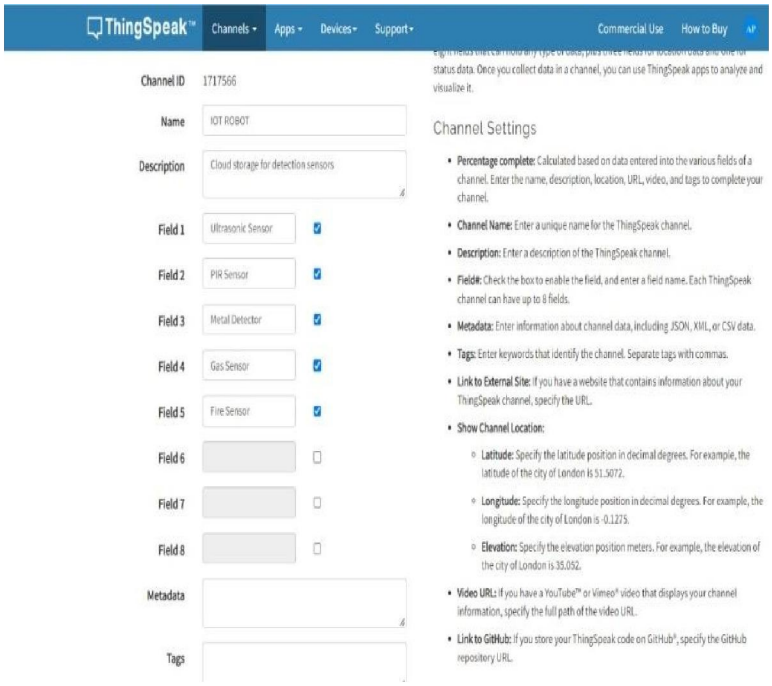


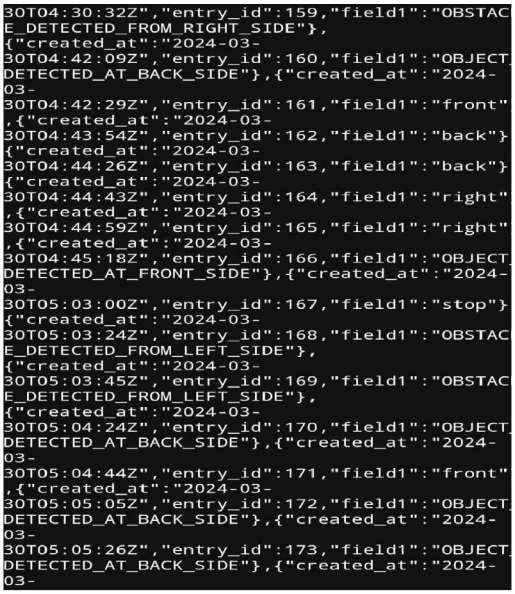

Figure Thingspeak Channels for IoT Based surveillance robot

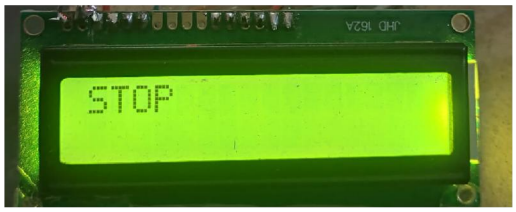
The Thingspeak channels are used to gather all the information collected by the various sensors, i.e., Ultrasonic Sensor, Metal Detector and IR Sensor. These details help the user to understand the surrounding environment of the robot and to monitor the situation. Separate channels are made for each sensor and have their own interface to monitor or gather live data from these sensors as shown in figure.

## VII. RESULTS




IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 7, April 2024







## VIII. CONCLUSION

An IoT-based surveillance and 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 ThingspeakIoT platform and broadcasts the live videos to the user. The robot is small in size and is capable of maneuvering hard terrains, also it rotate 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.

## REFERENCES

[1]. Gasparetto 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.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 7, April 2024

[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 muiltiagent systems. IEEE Robotics & Automation Magazine.2017; 24(3):52-64.
[9]. Singh, D., Nandgaonkar, 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 RealTime 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, Hariguru YP. Multi-Application Surveillance Robot using IoT. International Research Journal of Engineering and Technology. 2021; 8(4): 4554 – 4558.
[13].Anandravisekar G, Clinton A, Mukesh T, Naveen L. IOT Based Surveillance Robot. International Journal of Engineering Research & Technology. 2018; 7(4): 315 – 320.
[14]. IoT Analytics – Thing Speak Internet of Things, www.thingspeak.com [Accessed: 2022-05-05]