RESEARCH PAPER ON SURVEILLANCE ROBOT USING ESP 32 CAM

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Abstract : The development, design, and implementation of a surveillance robot using the ESP32-CAM module—which combines an integrated camera with the potent ESP32 microcontroller to enable real-time video streaming, wireless communication, and customization—are presented in this paper report. The paper examines the main characteristics and features of this cutting-edge security robot, such as its capacity to record and broadcast live video feeds, keep wifi and Bluetooth connectivity, and adjust to different applications thanks to its programmable and customizable features.Furthermore, the repo rt shows how the robot provides an affordable substitute for conventional surveillance systems and seamlessly integrates with io t platforms for centralized monitoring. The paper's scope is succinctly summarized in the abstract, which also emphasizes the paper's importance in revolutionizing security and monitoring solutions across a range of industries

Keywords : Surveillance, Security, Esp-32 Cam, IOT, Webpage Interface, Global Positioning System

I. INTRODUCTION

Modern technology-equipped surveillance robots are quickly changing the security and monitoring scene. The ESP-CAM-32, a sophisticated platform built on the ESP32 microcontroller and a camera module, stands out among these cutting-edge solutions as a potent tool for remote surveillance. The ESP32 for wireless communication and the high-resolution camera for real-time video capture and streaming are combined in this small and adaptable surveillance robot. The ESP-CAM-32 surveillance robot is at the forefront of modern security systems, improving situational awareness and offering an economical and effective solution for a wide range of applications, from home security to industrial monitoring. Its capabilities include navigating a variety of environments, transmitting live video feeds, and responding to various commands.We will go into greater detail about the features, advantages, and uses of this amazing surveillance robot in this introduction, emphasizing its potential to protect people and property as well as provide insightful information about remote locations and vital infrastructure.

The surveillance robot's brain is the ESP-CAM32 module. Based on the ESP32 microcontroller, it has an integrated camera. The ESP32 can be used for data transmission and remote control since it has Bluetooth and Wi-Fi connectivity. Wheels and Motors: You'll need wheels and motors to make the robot mobile. You can use tracks for more difficult terrains or wheels for a wheeled robot, depending on the design. The robot's body is called the chassis, which serves as a platform for the ESP-CAM32, motors, and other components to be mounted as well as structural support. Power Source To keep the robot running, it needs a suitable power source, such as batteries or rechargeable LiPo cells. Motor Driver: To regulate the robot's motors' speed and direction, a motor driver circuit is required. Sensors: You can add a variety of sensors, such as ultrasonic and infrared ones, depending on your application. An important advancement in security technology is the

incorporation of the ESP32-CAM in surveillance robots. Its ability to integrate AI-driven features, wireless connectivity, and compact design make it a significant player in the continuing evolution of surveillance systems. The ESP32-CAM surveillance robot is evidence of the potential for creative solutions to ensure safety and security in a world that is constantly changing as technology advances.focused on automated identification. With 350 million cases predicted globally by 2030, it has been viewed as a major global health concern. Diabetes-related increases in blood glucose levels are the recognized cause of DR. DR progresses through several stages. "Line hemorrhages, exudates, cotton wool patches, and MAs are indicative of deep vein thrombosis (DR) due to vascular impermeability and deviations from the normal blood distribution pattern. Non-proliferative DR (NPDR) is the term used to describe these early symptoms.
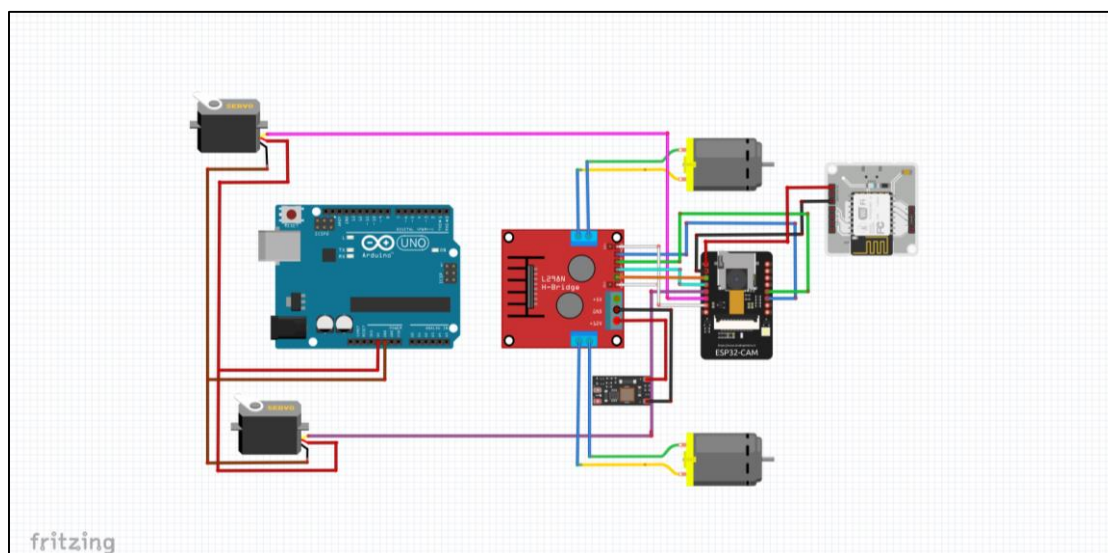
II. .CIRCUIT DIAGRAM

Figure 1
Circuit Diagram

III. LITERATURE SURVEY

In recent years, numerous DL-based automatic DR detection systems have been created. This section has discussed a few of the research papers that are currently underway.

Aarya Aalase a , Pranali Bandgar a , Karuna Kamble a , Shreya Bhosale a , A. A. Udgave b*[1] Microcontroller used is Arduino Uno, ESP-32 Cam, GSM cam, IR Sensor.The system designed is cost effective and which can also work in hazerdous environment.

Menaka M^1 , Stella K^2 , Ramya D^3 , Sakthi Sri R^4 , Thirisha M^5 [2]A system that uses a robot chassis and the ESP32-CAM board to create a mobile surveillance device is known as a surveillance robot using ESP32-CAM. A low-cost development board with integrated Wi-Fi and a small camera module is called the ESP32-CAM. The robot chassis enables the apparatus to move and record video in various settings. The ESP32-CAM board has a web interface that can be used to control the system. The user can view live video streams, take screenshots of the video feed, and operate the robot with the web interface. In addition, the system can be configured to alert the user when it detects motion using computer vision algorithms like object tracking and detection.
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Dr.P.D. selvam, K. Nikhil, K. Ranjitha reddy, A. Mounika, P. Reddy sekhar, M. Reddy siva sai [3]the theme of this paper is intelligent visual surveillance systems. In recent times,they used surveillance cameras for monitoring and recording moments, but manual surveillance and real-time monitoring is one of the most important and challenging branches of computer vision, which has been widely applied in peoples' life, such as monitoring security. The system is able to overcome the challenges of the current system and accomplish all of the previously mentioned goals. The suggested system significantly enhances

surveillance. We were able to use active sensors in the field, minimize human intervention, and monitor in real-time thanks to the system's design.

Dev Jyoti Ghosh, Shaarang Sahane, Shreyash Bhandari, Vedant Shirale, and Mudit Kapoor[4]The Raspberry Pi, camera streaming, and SSH connectivity all point to a robust and safe system that could be used for remote monitoring or surveillance. The Raspberry Pi is a good option for applications ranging from home automation to security systems because of its versatility and capacity to stream video. Furthermore, the focus on SSH connectivity highlights the value of secure communication, which is an essential component of any system that manages sensitive information or remote control.

Krishna Marapalli, Pooja Dundgekar, Ashutosh Bansode, Nilesh Rathod[5] The principal objective of the paper is to improve the technological prowess of the armed forces through the development of a wirelessly monitorable intelligent vehicle. GPS functionality is suggested by the Neo6M module, which enables location-based data transmission to the ThingSpeak Cloud and real-time tracking. IoT applications frequently use this cloud platform, which makes it possible to store and analyze data from a variety of sensors.Obstacle detection and motor control functionalities are indicated by the inclusion of an ultrasonic sensor and a DC motor controller, respectively. These characteristics are essential for an intelligent vehicle, particularly for military use where navigating across a variety of terrains may be difficult.

Abhijeet Dhule, Neha Sangle, Supriya Nagarkar, Asmita Namjoshi[6].The presence of a PIR sensor indicates that the system has motion detection capabilities, which are frequently used to identify the presence of people or other living things. A mechanism for controlled movement or orientation is implied by the Servo Motor, and a wireless communication capability enabling remote control or data exchange is indicated by the HC205 Bluetooth Module.The paper is referred to as a smart robot, and the military is mentioned as one of its intended applications. The employment of these robots is emphasized as a cuttingedge technology meant to reduce risks to human life and preserve human resources.

Anandravisekar, . Anto Clinton, Mukesh Raj, Naveen, [7]. The main objective of the suggested framework is to create a surveillance robot that uses Internet of Things (IoT) technology to get around the restriction of limited-range surveillance. This implies that the robot may be able to send information, including potentially video feeds, over the internet to allow for remote control and monitoring. Resolving the restricted range is a noteworthy progression, particularly in surveillance situations where instantaneous information is crucial.The robot's use of Internet of Things technology suggests that it might be a part of a larger network, and that remote access and analysis of its data is possible. This could improve the effectiveness of surveillance activities and increase the system's environmental adaptability

Dr M Senthamil Selvi2 M.Faesa Fathima3 S.Dhivyuaa, 4 S.Mouriya [8]presents The Raspberry Pi 3 microcontroller is a powerful and adaptable platform that can handle a wide range of tasks, as suggested by its selection. The presence of a Wi-Fi router suggests that wireless communication is possible, allowing for data transfer or remote control. It's possible that IR and proximity sensors are utilized to identify obstacles and make sure the robot can successfully navigate its surroundings. When a DC motor driver is used, motor control capabilities are implied, enabling the robot to move precisely and react to its surroundings. These elements working together point to the possibility of an all-encompassing robotic surveillance system with autonomous operation and realtime monitoring capabilities.

Shraddha Londhe*1, Pooja Shinde*2, Sanket Mendke*3, Sahil Dhage*4, Prof. Dr. Niteen Futane*5[9] the presence of multiple sensors, including the voltage detector, HC-SR04 ultrasonic, and metal detector sensors, indicates that the robot has sophisticated environmental perception capabilities, allowing it to identify metals, obstacles, and track the condition of its batteries. Accurate control over the robot's movements is demonstrated by motor drivers such as TA6586 and L9110, in conjunction with a servo gear motor, enabling agility and responsiveness.The incorporation of wireless communication components, namely the ESP32-CAM, ESP8266- 12E, and RF transmitter and receiver, suggests that the robot has the ability to wirelessly transmit data, which may include recorded surveillance footage. There might be more features available on the A9G board, perhaps in relation to GPS or GSM capabilities

[1]Pramod Singh, 2Vimlesh Singh, 3Harsh Vardhan, 4Nandanee Maurya 5Ajay Sharma [10]The primary controller, the ESP32- CAM module, enables wireless communication with other devices. The robot can move forward, backward, left, right, and stop thanks to the motor driver module's control over its movements. In order to guarantee that the robot has a reliable power source and the ability to recharge, the TP5100 module serves as the power supply and charge management system.The robot can be controlled wirelessly thanks to the NodeMCU ESP32-CAM microcontroller. Through the Wi-Fi module, this microcontroller receives data sent from PCs or smartphones. Users can control the robot's movements in all four directions—forward, backward, left, and right—as well as the option to stop it, as it is programmed to respond to specific commands.

IV. COMPONENTS

1]

Figure 2

ESP 32 Cam Module

Featuring the ESP32-S chip, Espressif Systems created the small development module known as the ESP32-CAM. This module is designed for Internet of Things (IoT) applications that need camera functionality in embedded systems. Its integrated WiFi and Bluetooth functionality, which are based on the potent ESP32-S chip, make it appropriate for wireless communication in Internet of Things applications. A 2-megapixel OV2640 camera module with a resolution of 1600x1200 pixels is included with the ESP32CAM. It provides flexibility in paper development with GPIO pins and interfaces for external peripherals, a microSD card slot for storage, and support for a wide voltage range. Because of its affordability and adaptability, the ESP32-CAM, which can be programmed using the Arduino IDE, has become more and more popular in the open-source community, drawing in makers and DIY enthusiasts. Because it allows for real-time video streaming. It works well for applications that need to be monitored in real time. The robust feature set and compact form factor of the ESP32- CAM make it an invaluable tool for developing creative IoT and camera papers.

2]

Figure 3

GPS Module

A GPS (Global Positioning System) module is a small electronic device that is used to pinpoint a location by receiving signals from GPS satellites. A GPS module is made up of an integrated circuit and a GPS receiver. It is commonly used in a range of applications, such as tracking, location-based services, navigation systems, and mapping devices. The GPS receiver uses trilateration to pinpoint the precise location of the module on Earth by first capturing signals sent by several satellites, then calculating the distance to each satellite based on signal travel time. The module's interface provides access to the obtained latitude, longitude, altitude, and time data, making it a useful tool for papers requiring precise positioning data.
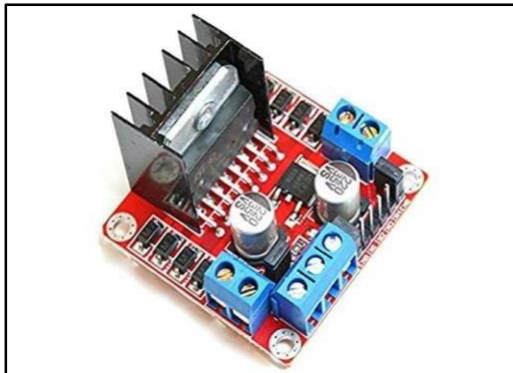
3]

Figure 4

L298N Motor Driver

A well-liked integrated circuit (IC) for controlling DC motors in robotics and electronics papers is the L298N motor driver. The L298N is a bidirectional motor control device that can drive two motors at once, which makes it ideal for use in robot cars, motorized platforms, and other mechatronic systems. Due to the integrated high voltage and high-current dual full-bridge drivers, the IC can independently regulate the speed and direction of two DC motors. Because it runs on a logic input signal, microcontrollers such as Arduino can interface with it. The robust design and capacity to manage moderate to high power loads of the L298N are well known. Protection diodes are incorporated into it to protect the circuit from the back electromotive force that the motors produce when they decelerate.
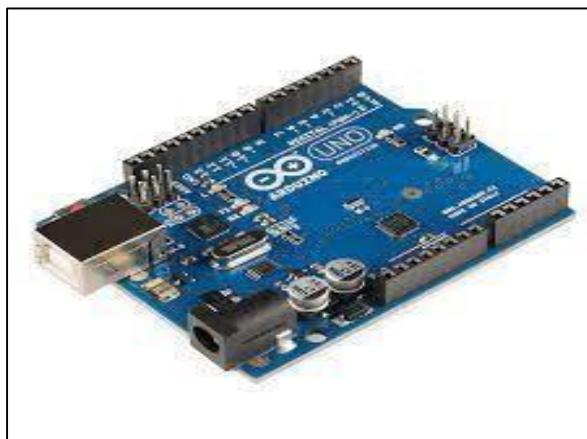
4]

Figure 5

Arduino Uno

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller (MCU) and developed by Arduino.cc and initially released in 2010. The microcontroller board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.It can be powered by a USB cable or a barrel connector that accepts voltages between 7 and 20 volts, such as a rectangular 9-volt battery. It has the same microcontroller as the Arduino Nano board, and the same headers as the Leonardo board.

5]

Figure 6

Boost Converter

One kind of DC-DC converter used to raise the input voltage to a higher output voltage level is called a boost converter. It is made up of parts such a diode, capacitor, switch (often a transistor), and inductor and is used for charging batteries, powering electronics, and renewable energy systems, among other things. When the switch shuts, the inductor stores energy that permits current to flow. When the switch is opened, the inductor resists changes in current, creating a voltage boost that raises the input voltage. By guaranteeing a constant channel for current flow, a diode keeps voltage collapse at bay. As a result, the output voltage is higher than the input voltage, which makes effective power conversion possible in a number of situations.
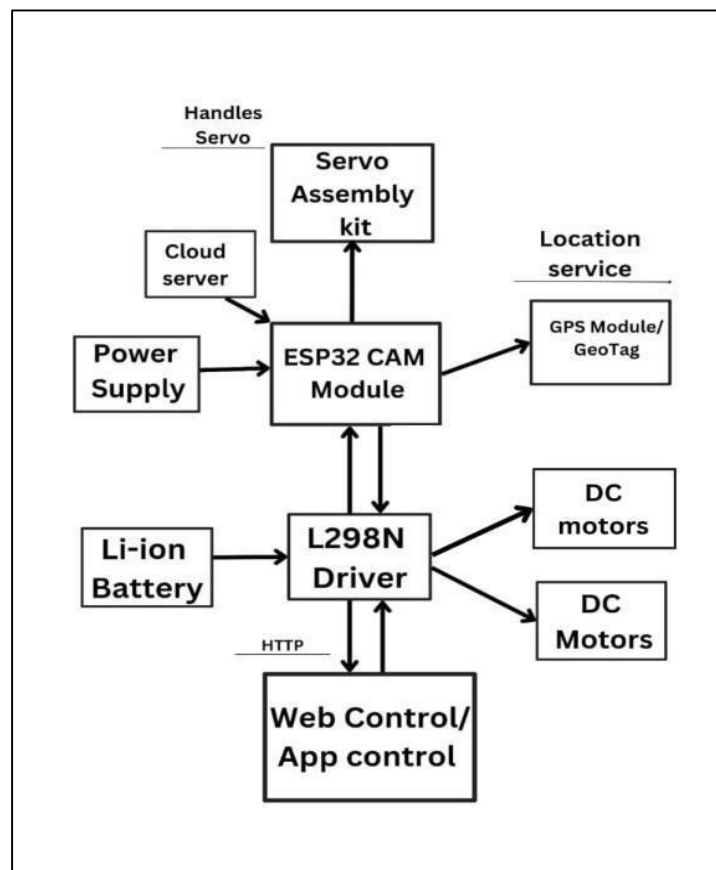
V. BLOCK DIAGRAM

Figure 6

Block Diagram

VI. METHODOLOGY

There are several essential steps in the process of developing and managing a surveillance robot that uses the ESP-CAM32.

First and foremost, hardware assembly is important. Assemble the ESP-CAM32 module first, making sure the camera lens is pointed straight ahead on the robot's chassis. Utilizing the wheels, motor driver, and motors together, construct a mobile platform. Make sure all wiring and connections are correct, and use the right batteries to power the system. The ESP32 microcontroller must then be programmed. To manage the robot's movement, camera function, and data transfer, write or upload firmware. Use the Arduino IDE or the ESP-IDF (IoT Development Framework) based on your level of programming language experience

VII. RESULT

The ESP32-CAM module has gained popularity in surveillance papers due to its wireless capabilities, integrated camera, and small size. However, the particular implementation and goals of the paper determine how effective it is to use an ESP32-CAM for a surveillance robot paper. A number of variables, including camera quality, capabilities, power supply, programming, control schemes, and security considerations, could affect the result.

Regarding image quality, the ESP32-CAM's 2MP camera typically produces films and images of respectable quality. The requirements of the surveillance application, the resolution settings selected, and the ambient lighting conditions all affect the actual performance. The Wi-Fi feature of the ESP32 module is useful because it makes it possible to stream images or videos over a network.

It is imperative to guarantee a dependable power source for the ESP32-CAM and additional components within the surveillance robot. It's especially crucial to take power consumption into account if the robot will be used for prolonged periods of time. The Arduino IDE can be used to program the ESP32-CAM, and numerous libraries are available for image processing and camera control. A dedicated application, a web interface, or other approaches can be considered when thinking about the robot's control and communication interface.

Security is of the utmost importance, particularly if the surveillance robot is networked. Preventing unwanted access necessitates the implementation of suitable security measures, such as secure communication protocols and authentication techniques. In summary, the ESP32-CAM's adaptability opens up a wide range of surveillance application possibilities, but careful consideration of

The surveillance robot, equipped with the ESP32-CAM module, creates a flexible monitoring system by smoothly integrating hardware and software components. The ESP32-CAM module, which functions as both an integrated camera and a microcontroller, is the central component of its hardware. Robot mobility is guaranteed by a wheeled and motorized chassis, and its surveillance capabilities are further enhanced by PIR, infrared, and ultrasonic sensors.

The ESP32-CAM's 2MP camera records images and videos, giving monitoring users a dependable visual feed. In addition to the camera, a microSD card allows for local data storage, which enables the robot to store captured video for later use. The power supply is carefully chosen, guaranteeing a balanced distribution to satisfy the needs of the ESP32-CAM, motors, and sensors for continuous operation. The robot's design incorporates ethical considerations pertaining to regulatory compliance and monitoring.

Software-wise, the Arduino IDE acts as the programming platform, allowing for functions like motor control, camera initialization, remote control through an online interface, and wireless connectivity through the ESP32's Wi-Fi capabilities. Motion detection algorithms increase productivity by reacting to detected movement with pictures or videos. Security measures like encryption and authentication are used to protect operational integrity and stop unwanted access.

Problems with power supply stability, wireless connection dependability, camera initialization, and motor control can occur during setup. To find and fix these issues, the software includes logging and debugging tools. The hardware for the surveillance robot is successfully implemented, resulting in the realization of a mobile, remote-controlled system that can record, store, and navigate its surroundings as well as react to motion stimuli. The robot's efficacy in surveillance applications is further influenced by potential software updates and ongoing performance monitoring.
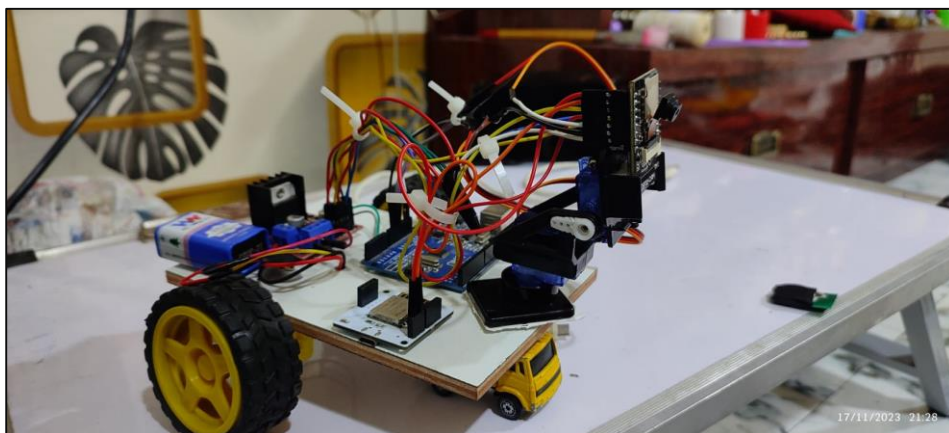
Surveillance Robot Model
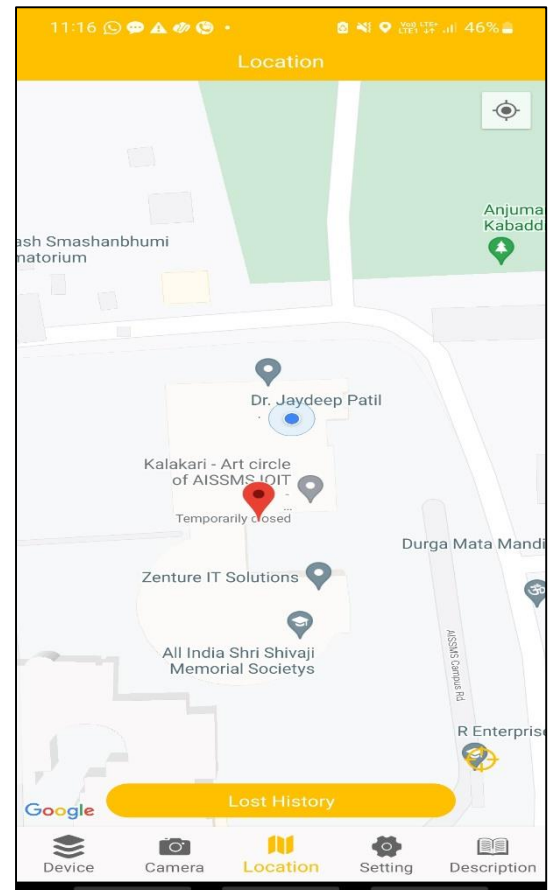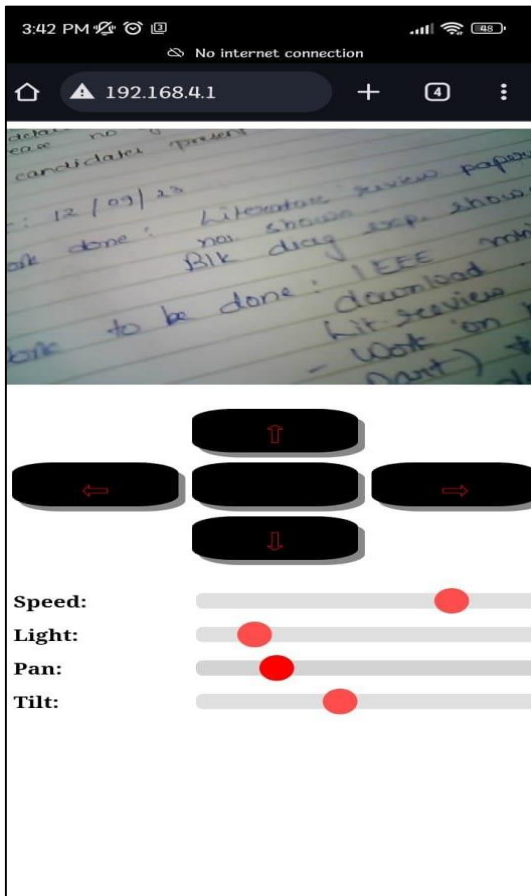
Webpage

Application For GPS Tracking
iSearching APP

VIII. CONCLUSION

A user-friendly web interface provides live camera feeds, media retrieval, and remote robot operation. The user experience is improved by the responsive and user-friendly interface. Under realworld conditions with changing lighting, uneven ground, and possible obstacles, the surveillance robot operates reliably every time.Seen as an iterative paper, the surveillance robot is constantly being improved. Consistent testing, observation, and user input inform updates that improve functionality and performance. With this strategy, the surveillance robot will continue to evolve and become more capable of handling new tasks and technological advancements.Prioritizing adherence to ethical and legal regulations, privacy concerns are addressed, and relevant laws are followed.

IX. FUTURE SCOPE

Continuous advancements in processing power and image quality, along with a focused effort to improve hardwaresoftware interaction, characterize the evolution of surveillance robots. Better functionality and seamless integration are made possible by ongoing advancements in software libraries and frameworks, which guarantee a harmonious relationship between the robot's operational capabilities and its physical components.In order to advance real-time data transfer between the surveillance robot and the command

center, communication protocols are essential. Modern communication technologies are implemented to guarantee efficient wireless connectivity for remote control and monitoring. Furthermore, advanced image processing, object recognition, and behavior analysis are introduced by the fusion of machine learning (ML) and artificial intelligence (AI), endowing the robot with capabilities like automated tracking of particular objects or people.

Complex algorithms are being developed for autonomous navigation to allow accurate navigation and obstacle avoidance. Accurate environment mapping is made possible by the combination of sophisticated algorithms and sensors such as LiDAR. Energy efficiency is still a key component of long-term operations, which is why power consumption optimization and research into energy harvesting and renewable sources are still being done.

One major trend that is emerging is the combination of cloud computing and storage, which makes it possible to store surveillance data and connect to cloud services for remote control and monitoring. Strong safeguards against manipulation and unauthorized access are in place to ensure security and privacy features. To allay worries about data collection and storage, privacy features are included.

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