IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 4, June 2025
Impact Factor: 7.67

Intelligent Surveillance System using ESP32- Cam with Telegram Notifications

Mr. M. S. Anap[1], Pratiksha More[2], Dnyaneshwari Kumkar[3], Vidya Khule[4],
[1,2,3,4] Department of Electronics & Telecommunication Engineering,
Pravara Rural Engineering College, Savitribai Phule Pune University Loni, India.
anapms@pravaraengg.org.in[1] pratiksha8903@gmail.com[2], kumkardnyaneshwari@gmail.com[3],
khulevidya3@gmail.com[4]

Abstract: *The main purpose regarding this research work is, IoT-relied security process which enhances surveillance and access control. The goal of this project is to integrate the ESP32-CAM module with a real-time motion detection mechanism, which captures images and sends alerts via the Telegram app. Additionally, the system incorporates A mechanism for locking doors, enabling Users can manage access remotely. Proposed idea aims to improve security by providing instant notifications and remote management, offering a cost-effective solution for enhancing safety. Key challenges involve integrating motion detection, image capture, and secure remote control of the locking system.*

Keywords: IoT-based Security ESP32-CAM Motion Detection Remote Access Control

I. INTRODUCTION

The main aim of proposed work is developing an IoT-based security system that combines real-time surveillance with remote access control to enhance safety and security. With the increasing need for robust security measures in homes and businesses, this project explores a solution that utilizes the capabilities of the ESP32-CAM module to detect motion, capture images, and instantly send alerts via the Telegram app. The Internet of Things' (IoT) quick development has allowed for the creation of affordable, scalable security systems that offer real-time monitoring and remote management. This project aims for addressing the limitations related to traditional security systems by giving users with instant notifications about potential threats and enabling them to take immediate action from anywhere, at any time.

The system also incorporates a remote door locking mechanism that allows users to control access to their premises via a smartphone or other remote device. This feature adds an extra layer of convenience, as it eliminates the need for physical interaction with locks or doors, making it easier to manage access for authorized individuals while keeping intruders at bay. With automation and remote control, the system not only enhances security but also offers a practical solution to common issues such as forgotten keys or the need for frequent manual access control.

Key challenges in this project include integrating the motion detection and image capture features seamlessly with the ESP32-CAM module, ensuring reliable communication for sending alerts through Telegram, and implementing a secure and user-friendly remote access system for door control. Despite these challenges, the proposed system is expected to improve safety and convenience, providing a modern, cost- effective solution for securing properties. By leveraging the power of IoT, this project demonstrates how connected devices can plays a significant impact in improving quality and efficacy of security solutions in both residential and commercial environments.

II. LITERATURE SURVEY

The paper by Balla and Jadhao (2018) presents a facial recognition security system powered by the Internet of Things, emphasizing advancements in security technology through smart surveillance. This study explores the integration of facial recognition with IoT-enabled devices to enhance access control and security monitoring. The literature review section of this paper likely discusses previous research on facial recognition technologies, including traditional image-processing methods and recent AI-driven approaches. Additionally, it may analyze the role of IoT in security

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 4, June 2025
Impact Factor: 7.67

applications, issues such system scalability, real-time processing, and data privacy. The results of the study show that IoT-based facial recognition is feasible for improved surveillance and automated security management, which advances the expanding field of intelligent security systems. [4].

An Arduino-based Internet of Things (IoT) smart surveillance and monitoring system is shown in the study by Sharma and Gupta (2018). The goal of this effort is to integrate IoT with real- time monitoring capabilities to create an economical and effective security solution. The literature review in this paper likely explores existing surveillance technologies, including conventional CCTV systems and cloud-based security frameworks. It may also examine the advantages of IoT-driven surveillance, such as remote access, automated alerts, and energy-efficient monitoring. Furthermore, the study could address the limitations of traditional systems, such as storage constraints and manual intervention, while highlighting the benefits of Arduino-based implementations for smart surveillance applications [5].

The study by Jain et al. (2017) presents a smart surveillance monitoring system designed to enhance security through intelligent automation. This paper discusses the implementation of advanced surveillance techniques, potentially integrating motion detection, video analytics, and IoT connectivity. The literature review section is likely to cover prior research on smart surveillance methodologies, including sensor-based monitoring, machine learning-driven threat detection, and cloud-based security solutions. Additionally, the study may evaluate the impact of smart surveillance in different domains, such as residential security, industrial monitoring, and public safety. By analyzing the evolution of surveillance technologies, this research provides insights into the development of efficient, responsive, and scalable monitoring systems [6].

III. BLOCK DIAGRAM

The operation of the Smart Security Camera is simple and user- friendly, but the underlying technology is intricate and sophisticated. The system comprises essential components such as a buzzer, a relay, and an electronic lock, all of which are integrated to enhance security. The core functionality is managed by a microcontroller, which executes a pre-uploaded program to control these components efficiently. Additionally, the system is paired with the Telegram application, enabling remote monitoring and control of security features by users. The suggested system's block diagram, which shows its structure and functionality visually, is shown in Figure 1.

IV. COMPONENTS

A. ESP32-CAM

A compact microcontroller with an integrated camera, ideal for IoT applications. It supports video streaming, image processing, and face recognition over WIFI, making it useful for surveillance and smart automation projects The Arduino IDE can be used to program it, or Micro Python and integrates with various sensors and modules.

B. RELAY MODULE

An electrically powered switch that enables high-power devices to be controlled by low-power microcontrollers such as the ESP32-CAM. It switches an external power source to turn on or off solenoid locks, buzzers, or lights. frequently found in industrial control systems, security systems, and home automation systems.

C. WI-FI ROUTER

A network device that provides internet connectivity, allowing remote access to IoT systems. It enables the ESP32-CAM to stream video, send alerts, and receive commands for controlling relays or locks. Essential for smart home automation, remote monitoring, and cloud-based applications.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 4, June 2025
Impact Factor: 7.67

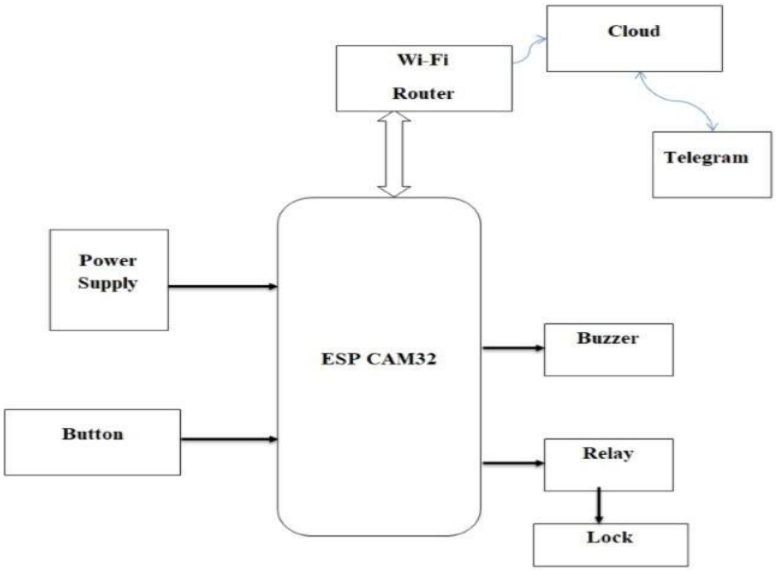

Fig 1. Block Diagram

D. SOLENOID LOCK

An electromechanical locking device that operates when a magnetic field is created when an electric current flows through it. It is commonly used in smart door systems and security applications, allowing remote or automated access control using microcontrollers like the ESP32-CAM.

E. PUSH BUTTON

A simple mechanical switch used to trigger electronic circuits. In an ESP32-CAM-based system, it can be used for unlocking the solenoid lock, activating the camera, or controlling other connected devices. Often used in smart access control and IoT projects

F. BUZZER

An audio signaling device that emits sound alerts when triggered. In security systems, it can provide feedback for successful or failed authentication, alert users to unauthorized access, or indicate status changes in the locking mechanism.

G. ARDUINO IDE

Code can be written, compiled, and uploaded to microcontrollers such as the ESP32-CAM using an open-source development environment. It is perfect for embedded and Internet of Things projects since it enables hardware debugging, multiple libraries, and C/C++ development.

H. TELEGRAM APPLICATION

A cloud-based messaging app with bot support, used for remote control and real-time notifications in Internet of Things projects. It allows users to interact with ESP32-CAM-based systems for unlocking doors, viewing camera feeds, or receiving security alerts.

V. CIRCUIT DIAGRAM

This circuit diagram Fig 2 represents a smart security system powered by an ESP32 microcontroller, designed to control an electronic lock. It consists of two key sections: the power supply unit and the control circuit. The power supply

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 4, June 2025
Impact Factor: 7.67

section includes a step-down transformer that lowers the AC voltage. This voltage is then converted to DC using a bridge rectifier and further stabilized by a capacitor. To provide a consistent 5V output required by the components, an LM7805 voltage regulator is used. This ensures reliable power for the ESP32 microcontroller and other connected devices.

The control circuit section features an ESP32, which serves as the main processing unit. A push button is connected to one of its input pins to detect user commands. The microcontroller controls a BC547 transistor, which acts as a switch to activate a relay module. When triggered, the relay completes the circuit, allowing the lock to engage or disengage. Additionally, the system may be operated remotely through Telegram, allowing users to utilize a smartphone application to lock or open doors. This feature is perfect for smart home and business security systems since it improves security by offering remote access, automation, and real-time control.

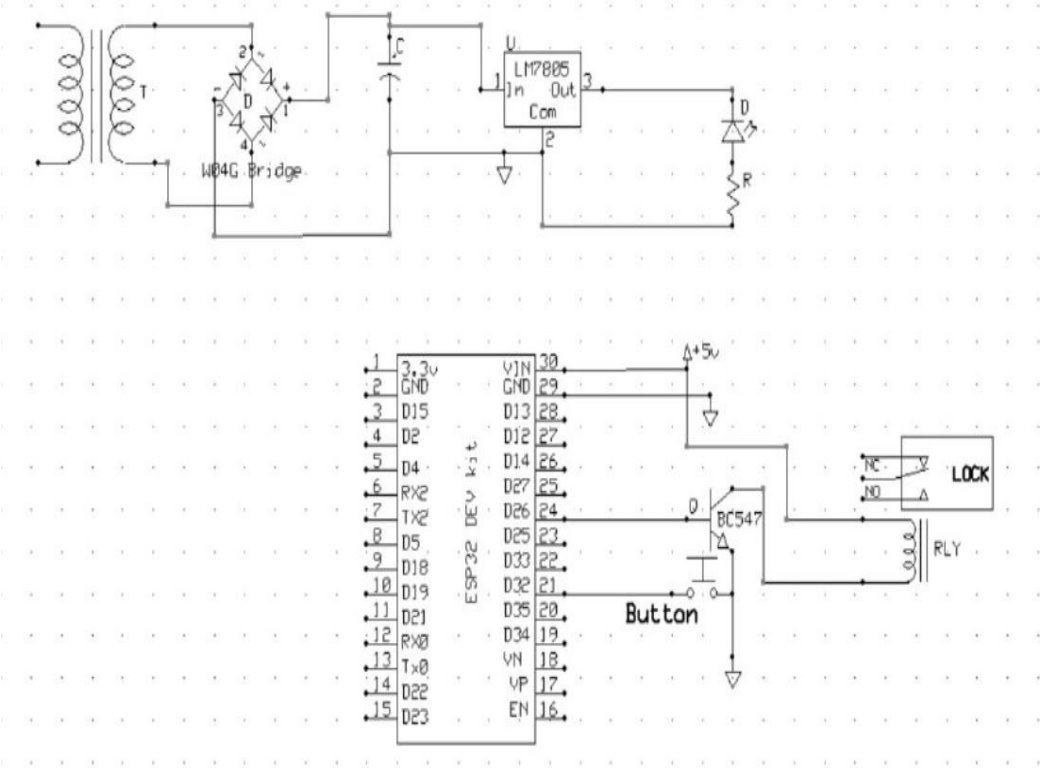

Fig 2. Circuit diagram of proposed work

VI. WORKING OF PROPOSED WORK

The IoT-based security system integrates an ESP32-CAM module, a relay-controlled solenoid lock, and a Telegram bot to provide enhanced surveillance and remote access control. A DC-DC power supply is used to ensure stable voltage for all components. The ESP32-CAM continuously monitors the area, capturing images when triggered. Users can manually request a snapshot using the "Photo" option in the Telegram bot, and the captured image is sent directly to their device. Additionally, the "Flash" option in the bot allows users to turn the ESP32-CAM's LED flash ON/OFF for better visibility in low-light conditions. For door access, the system supports both manual and remote control. Users can unlock the solenoid lock by pressing a push button, which also triggers the ESP32-CAM to capture and send an image for security verification. Alternatively, the Telegram bot provides two commands: "D Open" to turn on the relay and open the door, and "D Close" to deactivate the relay and lock it again. To enhance usability, an LED indicator is included to display the door's status—LED ON indicates an open door, while LED OFF signifies a locked state. With

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 4, June 2025
Impact Factor: 7.67

its real-time monitoring, remote access, and rapid notification features, this system is an affordable and effective security solution that is perfect for homes, workplaces, and places with restricted access.

VII. RESULTS

The developed smart security system effectively utilizes an ESP32 microcontroller to manage an electronic lock. The power supply unit efficiently converts AC voltage into a stable 5V DC using a transformer, bridge rectifier, capacitor, and voltage regulator. The control section, consisting of a BC547 transistor and a relay, responds accurately to button inputs and remote commands via Telegram. Testing confirmed that the system functions reliably, enabling secure and seamless access control. The remote access feature enhances security by allowing real- time operation. All things considered, the system exhibits effectiveness and dependability, which qualifies it as a good option for office and smart home security.

VIII. CONCLUSION

This research successfully demonstrates an IoT-Dependent Surveillance system and access control using the ESP32-CAM module. By integrating real-time motion detection, image capture, and Telegram-based alerts, the system provides instant notifications, improving security and response time. The inclusion of a remotely controlled door locking mechanism allows users to manage access efficiently from anywhere. This cost-effective solution offers a practical approach to modern security challenges. Despite challenges in motion detection accuracy, image transmission, and secure remote control, the system proves to be a reliable and scalable option for smart security applications. Additionally, the system can be expanded with AI-based face recognition to improve authentication accuracy. Future improvements may include cloud storage for captured images, multi-user access management, and enhanced encryption for better security. Overall, this IoT-based solution provides convenience, efficiency, and enhanced safety, by creating it perfect for households and restricted areas.

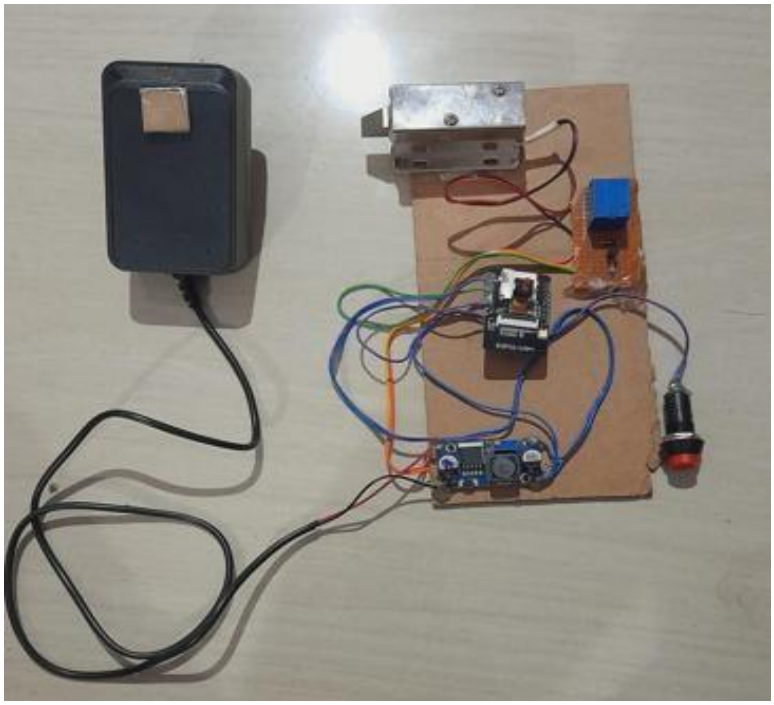

Fig 3. Actual image of proposed work

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 4, June 2025
Impact Factor: 7.67

REFERENCES

[1]. Rohan Namdeo , Sahil Sharma ,Varun Anand, Chanchal Lohi " Smart Automated Surveillance System using Raspberry Pi " International Journal of Recent Techonology Engineering, Volume: 09 Issue:02| Julyl- 2020.

[2]. A.H Hasan Basari , S.Noorjannah Ibrahim " Integarted Surveillance system with Mobile Application " Department of Electrical & Computer Engineering University, malaysia, kuala Lumpur(September 2018) .

[3]. Jun Hou, Jiyaun Tan "Research of Intelligent Home security Surveillance System based on ZigBee" Collage of Information Science & Engineering Northeasten University(7 September 2017).

[4]. Prashant Balraj Balla , K. T. Jadhao "IoT Based Facial Recognition Security System" International Conference on Smart City and Emerging Technology (ICSCET) Volume:01 Issue:04| May- 2018

[5]. M. Sharma and S. C. Gupta, "An Internet of Things Based Smart Surveillance and Monitoring System using Arduino," 2018 Int. Conf. Adv. Comput. Commun. Eng., no. June, pp. 428–433, 2018

[6]. A. Jain, S. Basantwani, O. Kazi, and Y. Bang, "Smart surveillance monitoring system," 2017 Int. Conf. Data Manag. Anal. Innov. ICDMAI 2017, pp. 269–273, 2017

[7]. S. Hargude and S. R. Idate, "I-Surveillance: Intelligent Surveillance System Using Background Subtraction Technique," Proc. - 2nd Int. Conf. Comput. Commun. Control Autom. ICCUBEA 2016, vol. 1, 2017.

[8]. Rai P, Rehman M. ESP32 based smart surveillance system. In2019 2nd International Conference on Computing, Mathematics and Engineering Technologies (iCoMET) 2019 Jan 30 (pp. 1-3). IEEE.

[9]. Babiuch M, Postulka J. Smart home monitoring system using esp32 microcontrollers. Internet of Things. 2020 Nov 11:82-101.

[10]. Lulla G, Kumar A, Pole G, Deshmukh G. IoT based smart security and surveillance system. In2021 international conference on emerging smart computing and informatics (ESCI) 2021 Mar 5 (pp. 385-390). IEEE.