KONERU LAKSHMAIAH EDUCATION FOUNDATION

AZIZ NAGAR, HYDERABAD

DEPARTMENT OF ECE

Project Proposal

1.0	**Details of Candidates:**	(i) M. Gayatri (2310040064) (ii) S. Sushmitha (2310040063) (iii) Y. Amuktha (2310040115) (iv) Y. Ashritha (2310040114) (v) T. Charmitha (2310040110)
	Course of Study:	B. TECH/ECE
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2.0	**Course Details:**	23SDEC02R/A/E EMBEDED SYSTEM AUTOMATION
3.0	**Name of Supervisor:**	Dr. Mrs. Kosaraju Madhavi Associate Professor, KLEF/ECE
4.0	**Proposed Title:**	Development of a Motion Activated Security Cam for Monitoring Applications

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5.0 Abstract

The need for motion detection surveillance has become a vital necessity in security systems due to the frequent and widespread cases of theft in the given location. Recently, closed-circuit TV (CCTV) can be seen in many places for particular users to monitor and record the situation in a restricted area. Most CCTVs have to continuously record the incident even when no motion is detected, thus requiring a large memory to store the video. In addition, some CCTVs still use cable installation to transfer video recordings to external storage. The use of cables requires high maintenance costs as they need to be maintained periodically to prevent breakage. There- fore, the project proposes a wireless security cam system that can effectively monitor the attendance of human movement and moving objects in real-time through mobile applications. The system consists of a passive infrared (PIR) sensor and ESP32 CAM embedded with the Internet of Things (IoT) technology. IoT is the main factor behind the changes for this monitoring application system with an embedded sensor. PIR sensors can detect the motion of either humans or animals crossing a particular area within a distance radius of up to 7 m. When motion is detected, a signal is sent to the ESP32 camera to capture an image. Then, with the advancement in technology, the image captured is sent to a Telegram messenger app through Wi-Fi and monitored via smartphone or web browser. This wireless surveillance method provides an effective monitoring system that can send the captured images and alerts immediately regarding any occurrence from anywhere in real-time. Moreover, this project strongly supports the security of all private premises, residences, banks, factories and offices because the users can take immediate necessary action in the case of emergency conditions.

6.0 Literature Review

Security and surveillance systems have evolved from traditional CCTV-based monitoring to IoT-enabled smart surveillance. Conventional CCTV systems face limitations in coverage, real-time access, and complex installation. Wired surveillance solutions require significant infrastructure, while mechanical motion detection methods, such as tripwires, are prone to interference and false alarms.

Recent advancements in wireless surveillance and IoT-based security have introduced efficient solutions. Studies have explored PIR sensors and infrared-based motion detection, offering improved accuracy and reliability. Researchers have also integrated ESP32-CAM, Raspberry Pi, and AI-based image processing to enhance security systems with real-time monitoring, remote access, and instant alerts.

IoT-based motion detection systems leverage wireless sensor networks (WSN), cloud computing, and edge processing for efficient security monitoring. Studies highlight the advantages of using Wi-Fi, Zigbee, and LoRa for seamless data transmission.

Furthermore, integrating AI and computer vision into security systems enables object recognition, facial detection, and behavior analysis, improving surveillance efficiency.

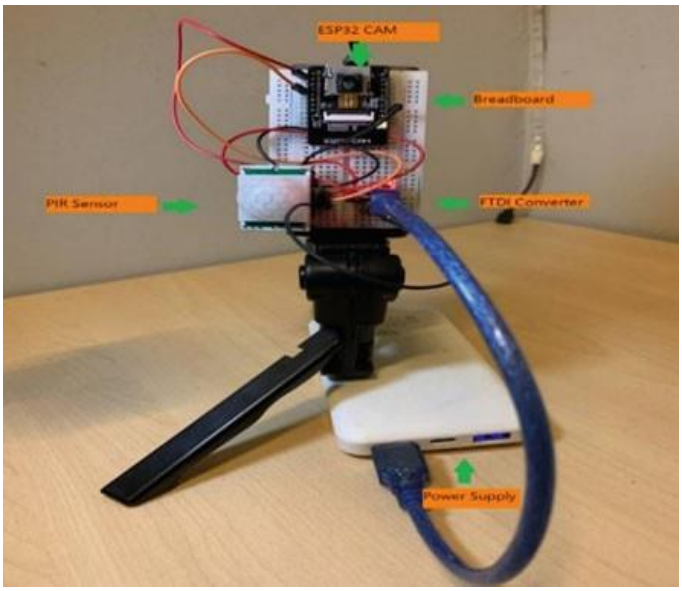
7.0 Introduction

With increasing security threats like burglary and office attacks, surveillance and monitoring systems are essential for safety in places like banks, offices, highways, and residences. CCTV is widely used but has limitations, such as restricted coverage and integration complexity.

Motion detection systems enhance security by sensing movement through mechanical (tripwire) or electronic sensors (infrared, acoustical, or optical detection). Modern surveillance has evolved from wired to wireless systems, improving ease of installation and integration with IoT.

IoT-based surveillance solutions use devices like Raspberry Pi and IR sensors to transmit video/images and alert users via smartphones. Combining IoT with wireless sensor networks (WSN) enables real-time security monitoring and data transfer.

This project proposes an **IoT-based motion detection system** using a **PIR sensor and ESP32-CAM**. The ESP32-CAM captures image and transmits them over a network for real-time monitoring, ensuring enhanced security with embedded IoT capabilities.



8.0 Methodology

Project Development

Figure 1 shows the block diagram of the security cam monitoring system. The power supply at 5 V with 1200 mA is required to power the ESP-32 CAM and the PIR motion sensor. The microcontroller is integrated with the ESP-32 CAM. Arduino UNO SMD Rev3 is used to program the microcontroller. The PIR sensor connects to the microcontroller and thus can transmit and receive the signal when the sensor detects movement. FTDI USB connectors function to connect the ESP-32 CAM with the power supply. Telegram apps are implemented to monitor every captured image. Figure 2 describes the flowchart functionality of the system. Firstly, the connected sensors are to ensure with active mode, so that the sensors can detect the object movement and send signal data to the ESP-32 CAM microcontroller. If the object movement is not detected, the sensor connection troubleshot setup is conducted.

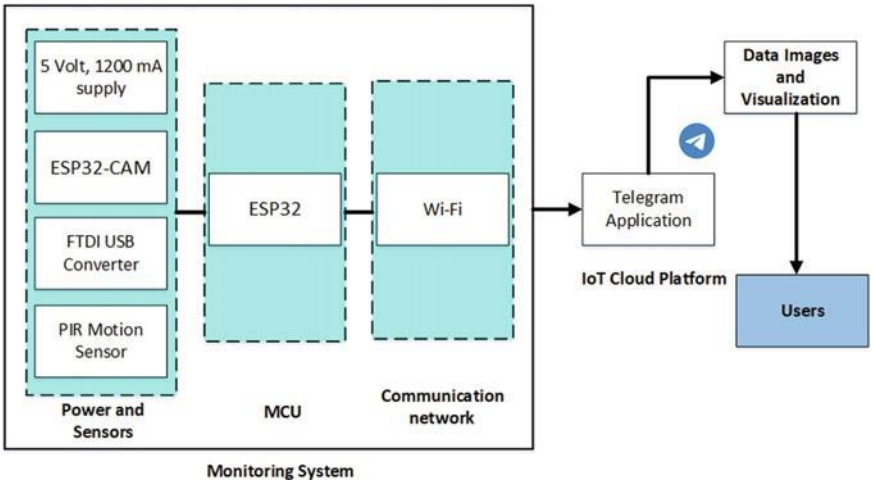
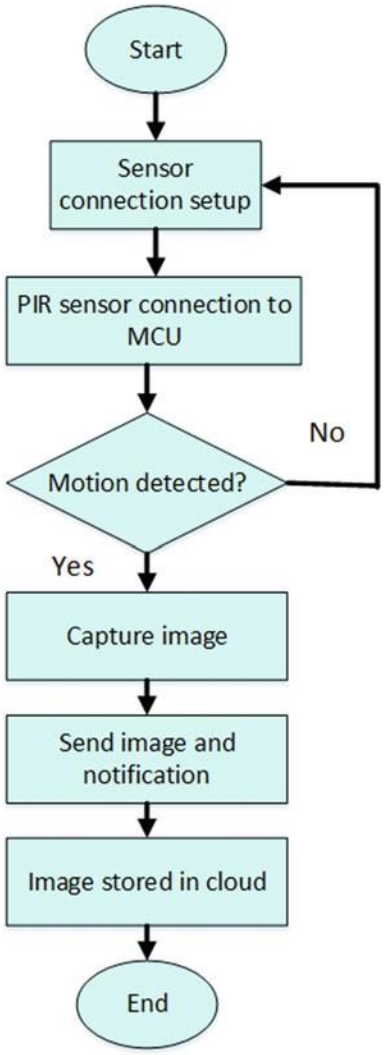


Fig. 1 Block diagram of the security cam monitoring system

When the microcontroller receives a signal, the image will be captured and sent to the user via the Telegram application. Users will get a notification from a Telegram that shows the image is received. The image will be saved in the cloud and be displayed in a Telegram application.

Fig. 2 Flow chart of system



8.1 Hardware Component

The developed monitoring system consists of the NodeMCU ESP32 microcontroller as the main controller unit (MCU), ESP-32 CAM, PIR motion sensor and FTDI programmer. In addition, there is a connected Wi-Fi network to the MCU.
The HC-SR501 PIR motion detector is the most significant part as a motion- sensing tool used to detect such levels of infrared radiation, which can detect the presence of humans and animals. The PIR motion sensor is functioning in this project to detect motion presence.
The ESP32-CAM is a low-cost development board with a small onboard camera. It is well-found with 4 MB external RAM, a microcontroller already available inside and ready to be programmed with built-in Wi-Fi and Bluetooth. The ESP32-CAM functions to capture the image and send it to the user when the PIR sensor identifies the motion at home or in the building area.
The FT 232RL FTDI programmer is a converter to serial USB cable to connect a PC through a USB port. The 232RL FTDI is used to connect the power from the power supply.

8.2 Software Development

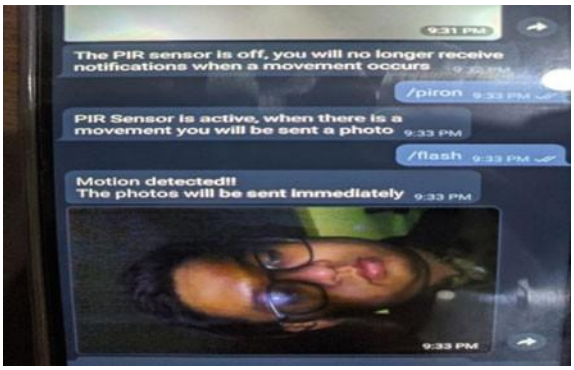
The functionality of the system includes integrating the peripheral devices with soft- ware. The monitoring system includes several sensors, communication connectivity and MCU programmable by Arduino UNO SMD Rev3 as the significant part of the security cam monitoring system. All of the virtual connections and hardware components are to be corresponding with the IoT application. Besides, the Arduino IDE application was used as an editor to develop the coding. Once the coding was successfully verified and compiled, the data codes were transferred to the NodeMCU via the serial interface of the MCU. The controller unit will allow the sensor to send the signal to the Telegram application via the Wi-Fi connection.

9.0 Results and Discussion

The ESP32-CAM is one of the necessary components in the prototype development. The cam works to take each picture only when it is needed. Then, the PIR sensor is a device to support detection by the camera. A PIR sensor works to sense motion and detect anything such as humans or animals based on the heat sense emitted from bodies. The FTDI converter functions as one of the process tools to connect the power supply from the power bank.
A new photo is captured using the flash when the surroundings are dark and there is no lighting. The on and off buttons are also available for any probability. When any movement is sensed from the surroundings; the image is automatically sent through the Telegram application.
Figures 4 and 5 show the image display of the real-time signal collected by the sensor when the motion is detected. The image is sent via Telegram as defined in the coding. The Telegram application will deliver a notification every moment a motion is detected. This project focuses on a security monitoring system by using a Telegram application to notify the user.

Fig. 4 Image display from PIR-on menu function

Fig. 5 Image and notification display from flash menu function



10.0 Conclusion

In this paper, the development of a wireless motion activated surveillance system based on IoT technology is presented. The system applied sensor technology, signal processing techniques of capture recording images when the PIR sensor detects motion. Several development achievements have been made, including; (1) systems that use an ESP32-CAM as a microcontroller connected to Wi-Fi can effectively display all images from video recording in real-time, (2) the monitoring system is integrated with the Telegram messenger application for notification alerts, then a respective person can receive notifications effectively and take the necessary actions, and (3) the wireless surveillance system was beneficial for mobile users to access and receive real-time information on the situation in a restricted area such as premises, offices and residences.

Advances in wireless security camera systems are needed to produce better ones. In the future, further research on the sensitivity detection rate enhancement of the PIR sensor for motion detection should be conducted. Other than that, long-range (LoRa) communication technology connectivity as low power and long-range technology capabilities preference should be developed in future.