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Smart Surveillance System Using ESP32

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Abstract

The world is expanding quickly, which has led to an increase in attacks and burglaries. As a result, having a trustworthy and efficient surveillance security system is now essential to meeting all security requirements and improving the quality of human life. Computers and CCTV cameras are used in the current security systems. Along with requiring a lot of memory due to continuous recording and the labor-intensive nature of detecting unauthorized activity, these surveillance security systems also do not allow for instantaneous alerting. Therefore, we focused our research on the burglary aspect of surveillance, where the camera will detect motion while the owner is away and instantly notify the user when it does. The use of ESP32 is efficient in comparison to current surveillance systems because of Homes, personal offices, and bank lockers may all use this structure. The framework functions best in small areas and when the owner is not present in the place being utilized. This is so that the system can identify any movement taking place in the area.

Keywords: Wi-Fi, PIR Motion sensor, ESP32, Intrusion, Notification, Smart Surveillance.

Introduction

Recent developments in microcontroller technology have improved surveillance systems' overall performance and capabilities by adding new features such live broadcasting over a distance, enhancing Android apps [5], connecting sensors to trigger a mechanism [6], storing capacity, affordability, and simplicity of installation a further layer of security in sensitive places can be added by implementing different algorithms, such as the background subtraction technique for the detection of unattended objects [7]. the proposed implementation aims to provide the end user with the above specified characteristics by utilizing internet of things (iot) enabled devices to assemble surveillance systems into a single, comprehensive package. the suggested approach uses a removable arducam-mini-2 mega pixels (mp) camera module interfaced with an arducam esp32 uno board to capture low resolution video. the esp32's integrated wi-fi is used to transmit the acquired video, which is then shown on an Adafruit 1.8-inch spitft display module. Smart surveillance systems are state-of-the-art technological solutions that monitor and improve security in a variety of locations by utilizing cutting- edge sensors, artificial intelligence, and data analytics. Intelligent surveillance systems are a powerful tool for protecting public and private areas because, in contrast to traditional surveillance systems, they can notice, evaluate, and respond to events in real-time. We will examine the main features, advantages, and uses of smart surveillance systems in this talk, illuminating how they are transforming security and monitoring in the contemporary day. The need for effective and intelligent surveillance systems has increased

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dramatically in our dynamic environment. The development of technology has led to the replacement of conventional surveillance techniques with more intelligent and adaptable options. One such The Smart Automated Surveillance System, which is based on the ESP32 Cam platform, is innovative. With the help of ESP Cam, an ESP8266-based camera module, this system creates a state-of-the- art surveillance solution with intelligent detecting capabilities, remote access, and real-time monitoring. We'll go over the main attributes and advantages of this system in this introduction, emphasizing how it might completely transform security and monitoring applications. It is also utilized by forests to find and identify untamed creatures [34].

Literature Survey

Smart Automated Surveillance System Using Rasberry pi. This paper is presented by Rohan Namdeo, Sahil Sharma. (July2020) The primary goal of this article is to reveal that in modern day world, when everyone desires to preserve their property secure. It is now crucial to consistently reveal the area with cameras in such situations. This consumes each the power and the storage area required for the footages. Using a Motion Eye the device become aware of human presence for faraway sensing and surveillance. Rasberry Pi operates and controls motion-detecting sensors [1].

Integarted Surveillance system with Mobile Application. This Paper is Presented by A.H Hasan Basari , S. Noorjannah Ibrahim (September 2018) A 5MP camera model and other types of sensors were employed in this project. Through a dedicated website, this system was coupled with a mobile application. Research of Intelligent Home security Surveillance System based on ZigBee. This is presented by Jun Hou, Jiyaun Tan(7 September 2017) In This project the system is wireless. To implement Real-time Surveillance of the home security. The intelligent remote monitoring system was developed for home security based on ZigBee Technology and GSM /GPRS network [2].

Problem Definition

ESP32-CAM is used to create a surveillance system that detects the presence of wild animals. We could build a system that protects crops from wild animals destroying them using the ESP32- CAM module, all without the need for intricate programming or additional components. An ESP32 camera with PIR sensors will be utilized in this configuration. If a moment or action is placed, a message or picture is sent to Telegram. If the sensors detect any animals entering, the humans will be notified by the Wi-Fi module and buzzer alerts at the position of the monitoring system. Instead of using a Raspberry Pi board, we used an ESP32 board in our project, which reduced project costs.

Methodology

Identify Requirements

Understand the specific security needs of the farm, including areas to monitor, types of threats, and desired features like remote access and alerting.

Select Hardware

Choose appropriate sensors such as PIR motion sensors, cameras, and environmental sensors based on the farm's requirements and conditions. Ensure compatibility with ESP32.

Hardware Setup

Connect the selected sensors to the ESP32 microcontroller board. Design the physical layout considering factors like sensor coverage and power source availability.

ESP32 Programming

Write firmware to initialize sensors, capture data, and control actuators like cameras or alarms. Implement Wi-Fi connectivity to enable communication with a central server or cloud platform. Develop algorithms for real-time data processing, including motion detection, object recognition, and environmental monitoring.

Data Transmission

Configure ESP32 to send sensor data securely to a remote server or cloud platform using protocols like MQTT or HTTP over Wi-Fi. Implement error handling and retry mechanisms to ensure reliable data transmission, especially in rural areas with intermittent connectivity.

Centralized Processing

Set up a server or cloud-based application to receive and process incoming data from the ESP32 devices. Implement algorithms for analyzing sensor data, detecting anomalies, and triggering alerts based on predefined rules.

Alerting System

Design an alerting mechanism to notify farm owners or security personnel in real-time when security breaches or abnormal events are detected.

Deployment and Maintenance

Install the surveillance system at strategic locations across the farm, considering factors like coverage, visibility, and protection from environmental elements. Establish a maintenance plan for regular system checks, software updates, and troubleshooting to ensure continuous operation and security effectiveness.

Block Diagram

Block diagram of proposed system of designing surveillance system using ESP32 is shown in Figure 1.

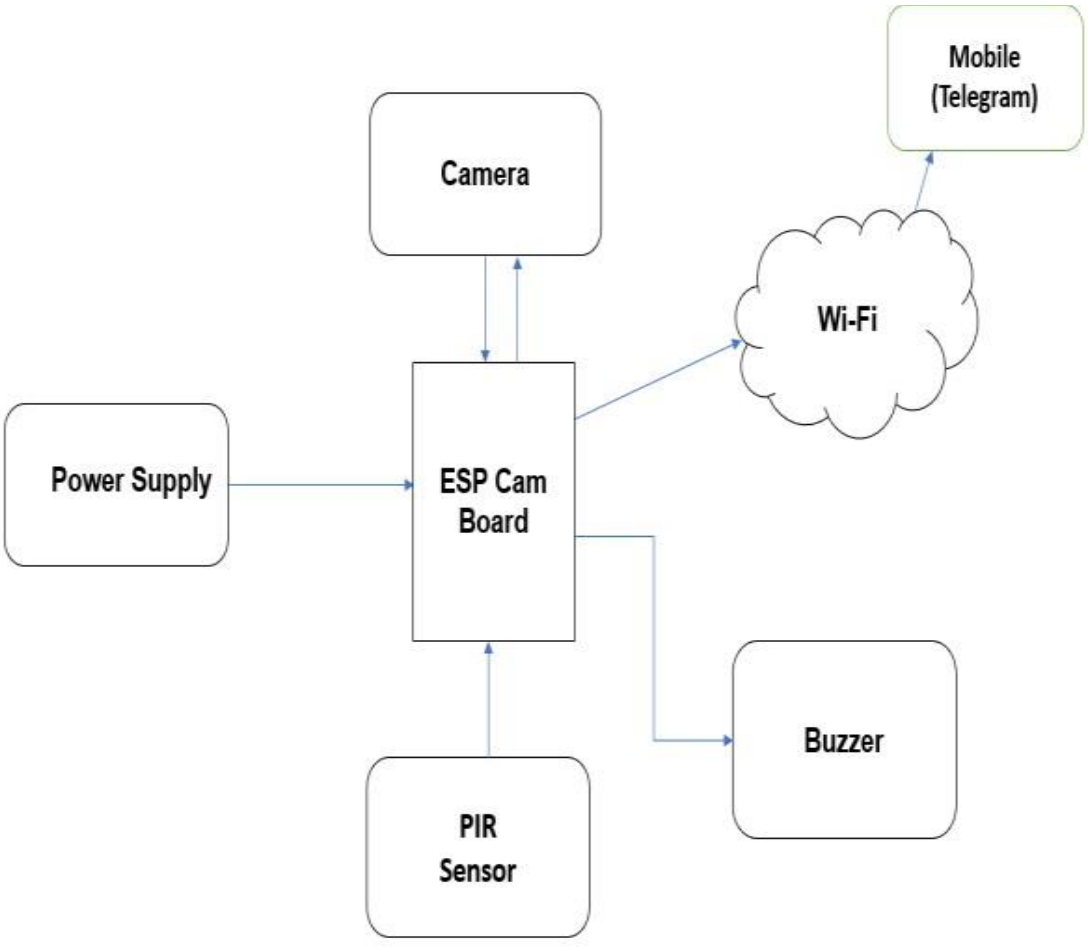

Figure 1. Block Diagram of Proposed System

Flow Diagram

Transfer of information is shown in Figure 2 . in the form of blocks.

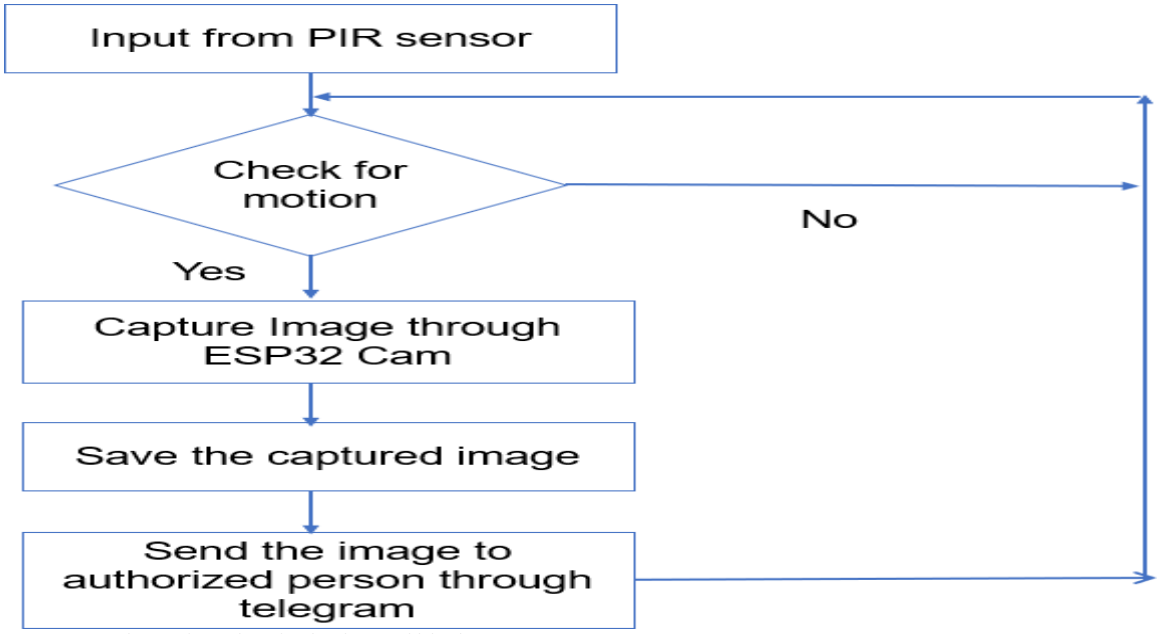

Figure 2. Information Flow in the form of blocks

System Architecture and Implementation

To carry out certain duties and responsibilities, the hardware components are incorporated into the system architecture and connected to one another. The PIR motion sensor detects motion and provides a signal to the ESP32, which in turn gives a signal to the camera. The camera then takes a photo and transmits it to the ESP32 over Wi-Fi image publish on Telegram.

Images are also saved on MicroSD cards. Used in the ESP32 CAM is the ESP8266 IC.

A picture is taken by the ESP32-CAM and stored on a microSD card.

System Description

ESP32 Cam Module

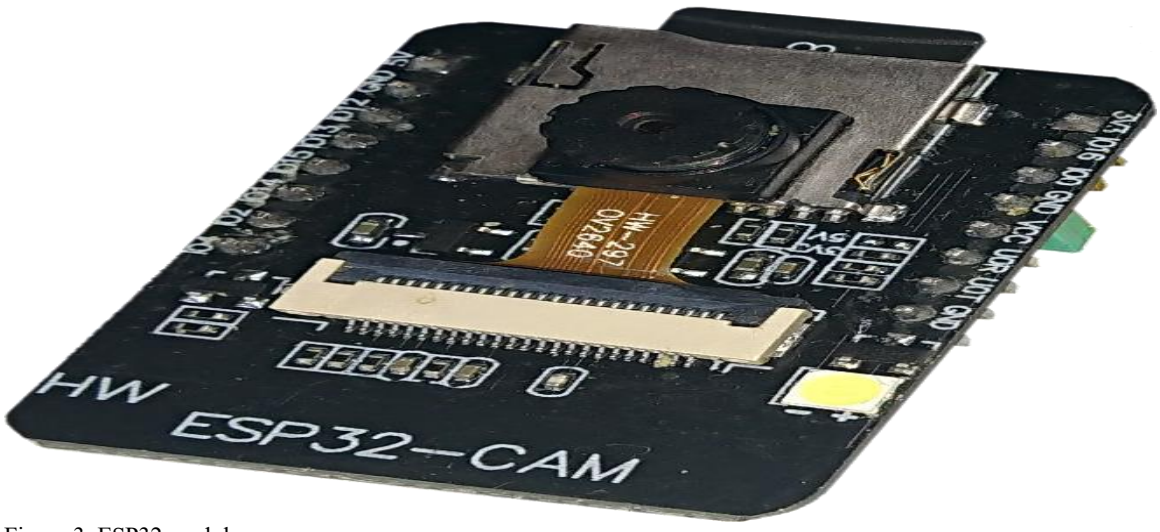

Figure 3. ESP32 module

Description

The ESP32-CAM module as shown in Figure 3. is a small, low-cost development board featuring the ESP32-S chip, a microcontroller with built-in Wi-Fi and Bluetooth capabilities. It includes a camera module and supports various functions like image capture, video streaming, and motion detection. It's commonly used in smart surveillance systems for its compact OP size, affordability, and versatility [8]

Features

- Up to 160MHz clock speed， Summary computing power up to 600 DMIPS
- Built-in 520 KB SRAM, external 4MPSRAM
- Supports UART/SPI/I2C/PWM/ADC/DAC
- Support OV2640 cameras, Built-in Flash lamp.
- Support image WiFi upload
- Supports multiple sleep modes.
- Embedded Lwip and FreeRTOS
- Supports STA/AP/STA+AP operation mode .
- Support Smart Config/AirKiss technology .
- Support for serial port local and remote firmware upgrades (FOTA).

PIR Sensor

Figure 4. PIR Sensor

Description

The PIR sensor as shown in Figure 4. detects motion by sensing changes in infrared radiation emitted by warm objects within its field of view. It triggers a signal when motion is detected, making it ideal for motion-activated applications like smart surveillance systems [9].

Features

- Motion detection based on changes in infrared radiation.
- Passive operation, meaning it doesn't emit any radiation itself.
- Low power consumption, suitable for battery-power ed applications.
- Adjustable sensitivity and detection range.
- Fast response time, typically triggering within milliseconds of detecting motion.
- Wide field of view, covering a large area for detection.
- Simple and compact design for easy integration into various devices and systems.

WI-FI

Description

Wi-Fi is a wireless networking technology that enables devices to connect to the internet and communicate with each other without the need for physical wired connections, using radio waves based on IEEE 802.11 standards [10].

Features

- Wireless connectivity
- High speed
- Wide coverage
- Multiple device support
- Security options
- Convenience
- Compatibility

Buzzer

2D model of Buzzer is shown in Figure 5.

Figure 5. Buzzer Model

Required Features:

- Operation Voltage: 3-24V DC.
- Current: <15mA.
- SPL: 85dBA/10cm.
- Frequency: 3,300Hz.
- Color: Black.
- Operating Temperature: - 20° to +60°C.

Power Supply

Requirements

- Input power 5-10 volt
- output power 5volt 2amp vdc
- Frequency. 2,4 GHz

Software Details

IDE, which is stands for Integrated Development environment, is an official Arduino.cc software that is primarily used for authoring, building, and uploading code to the Arduino device. Almost all Arduino modules are compatible with this open source software, which is simple to install and begin compiling code on the fly [11].

Steps

1. Download and Install Arduino IDE
2. Open Arduino IDE
3. Go to Preferences
4. Add Board Manager URL
5. Click OK
6. Open Boards Manager
7. Search for ESP32
8. Install ESP32 Platform
9. Select ESP32 Board
10. Set Port

Result

Hardware Setup

Upper view of set up is shown in Figure 6.

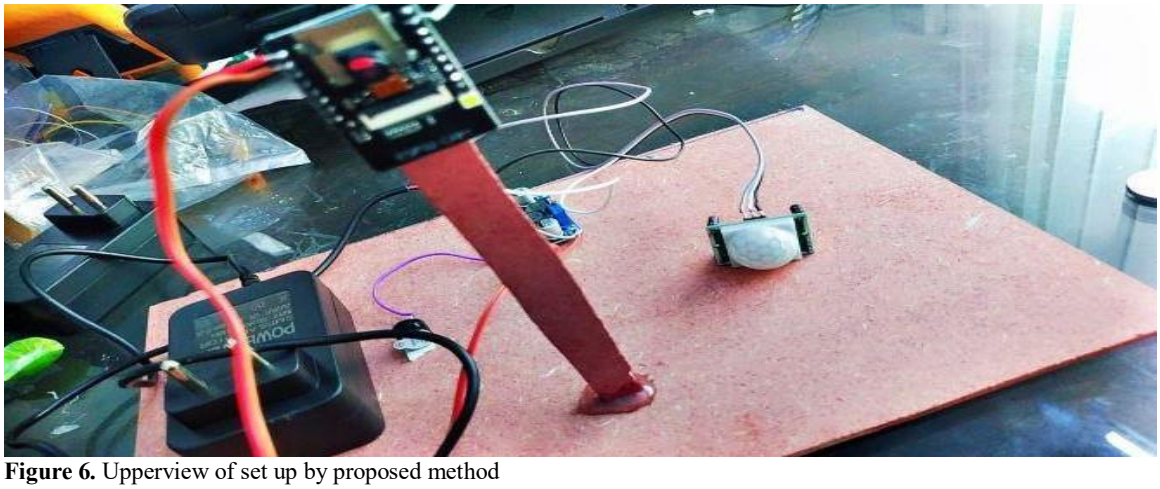

Figure 6. Upperview of set up by proposed method

Output

Yield after applying proposed system is shown in window shown in Figure 7.

Figure 7. Output window

CONCLUSION

The smart surveillance system employing ESP32-CAM project's conclusion may demonstrate the practical application of an affordable and adaptable method for keeping an eye on and safeguarding property. It might go over how the system can record and provide live video, identify motion or particular events, and allow remote access for monitoring via a mobile app or web interface. In addition, the project's lessons learned, difficulties encountered, and prospective opportunities for growth or progress could all be discussed in the conclusion. In general, it technologies to improve security and surveillance capabilities.

Future Scope

- To make this extended for larger areas as now it is limited to smaller areas and to make the application much more effective. Integrating a 360 degree webcam to view all the angles.
- More home appliances will be controlled by incorporating various sorts of sensors in the next years.
- Sensor fusion, low-power digital components, and smartphone cellular capabilities can all be used to extend the life of such devices.

- Physically handicapped persons will benefit greatly from this equipment in the future.

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