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Intruder Detection System (IDS)

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Abstract: *The project titled "Advance Security System with Intruder Detection and sending alert message through SMS" focuses on developing a smart security solution that detects intruders, and sends alert message to the user via SMS. This system utilizes an IR sensor, ESP32 cam module, Arduino uno ATmega328 and a GSM module to achieve real-time monitoring and remote alerts. When the IR sensor detects unauthorized movement, the ESP32 processes the signal. The alert message is then forwarded to the user's designated mobile number, ensuring prompt notification.*
This advanced security system is designed for applications in residential, commercial, and industrial environments, where real-time detection and documentation are critical. By leveraging SMS for remote alerts, users can receive and review security updates regardless of their location, provided they have internet access. The system is easy to install, cost- effective, and highly reliable, providing enhanced security with features such as automated SMS alerts, and remote monitoring..

Keywords: SMS Alert ,Arduino Atmega328 ,ESP32-CAM,IR Sensor ,GSM Module.

I. INTRODUCTION

The theme of this project is Intelligent Visual Surveillance Systems, which represents a modern evolution from traditional surveillance methods. While conventional systems rely on passive camera recording, today's security needs demand real-time monitoring and automated detection. Manual surveillance is often inefficient and resource-intensive. Intelligent systems, on the other hand, combine computer vision and automation to actively detect intrusions, notify users instantly, and deter criminal activity. The visible presence of surveillance cameras, along with warning signs, acts as a powerful deterrent, and recorded footage can aid in identifying individuals and tracking their movements.
This system enhances traditional surveillance by integrating IoT technologies like Wi-Fi and the ESP32 microcontroller, enabling smart communication and remote monitoring. Wi-Fi is one of the leading protocols in IoT due to its low power consumption, cost-effectiveness, and fast data transmission. The ESP32, with built-in Wi-Fi, is capable of handling image processing and notification tasks efficiently.

II. LITERATURE SURVEY

Recent advancements in intrusion detection systems have focused on integrating machine learning, IoT, and advanced sensor technologies for enhanced security. Saheed et al. (2022) presented a machine learning-based intrusion detection model utilizing IoT data over the Things Network, emphasizing intelligent edge-based monitoring (Alexandria Engineering Journal). Similarly, Li et al. (2022) proposed a self-training multi-sequence learning framework using Transformers for weakly supervised video anomaly detection, demonstrating strong performance with minimal labeled data (AAAI Conference). Mahmoud et al. (2021) introduced a real-time distributed fiber optic sensor system that supports intrusion detection through event classification and nuisance mitigation, offering reliable monitoring in various environments (Photonic Sensors). These studies highlight the shift towards intelligent, real-time, and scalable surveillance systems by combining deep learning models, low-power IoT communication protocols, and robust sensing technologies to enhance detection accuracy and responsiveness in modern security infrastructures.

III. EXISTING SYSTEM

Traditional security systems primarily use CCTV cameras for passive surveillance, which only record footage without providing real-time alerts. These systems depend on manual monitoring, making them ineffective in detecting and

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responding to intrusions instantly. The absence of automated notifications, such as SMS alerts, limits timely user awareness and immediate action during security breaches.

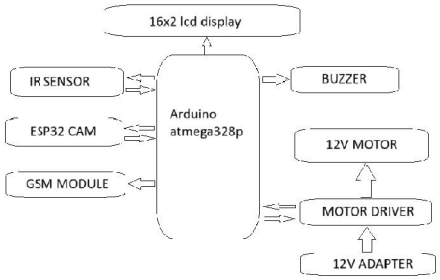
IV. PROPOSED SYSTEM

The proposed Advanced Security System with Intruder Detection and SMS Alert enhances traditional surveillance solutions by integrating real-time motion detection, wireless communication, and smart image capture to ensure immediate threat recognition and user notification. Unlike conventional CCTV systems that rely on passive recording and manual supervision, this system leverages IR sensors for motion detection, an ESP32-CAM module for visual evidence capture, and a GSM module for instant SMS alerts to the user's mobile phone. The use of Arduino Uno (ATmega328) as the central controller ensures low-cost yet efficient coordination between all hardware components.

A key innovation in this system is its ability to automatically detect intrusions, capture an image of the intruder, and notify the user remotely in real-time—regardless of internet availability. By employing the ESP32's built-in Wi-Fi and processing capabilities, the system reduces reliance on external devices and ensures low-latency operation. With compact design, low power consumption, and simple setup, the system supports long-term use in homes, offices, and warehouses. This intelligent surveillance solution offers a proactive approach to security by combining sensor-based detection, instant alerting, and visual documentation.

V. SYSTEM ARCHITECTURE

The Advanced Security System is structured as an integrated, multi-component solution that combines various hardware and communication modules to deliver real-time intrusion detection and alerting. The core components include IR sensors for motion detection, an ESP32-CAM module for capturing images upon detecting movement, an Arduino Uno (ATmega328) as the central processing unit, and a GSM module for sending SMS alerts to the user. When motion is detected by the IR sensor, the Arduino processes the signal and activates the ESP32-CAM to capture an image of the intruder.



This data is then used to trigger the GSM module to send an SMS alert along with real-time intrusion information to a pre-configured mobile number. The ESP32-CAM also supports Wi-Fi, enabling optional image transmission over a local network if desired. Each component operates in a coordinated manner to ensure fast detection, evidence capture, and immediate notification. The system's lightweight design and minimal power usage make it suitable for residential, commercial, and industrial applications. Together, these components form a cost-effective, scalable, and intelligent security architecture that proactively protects against unauthorized access.

VI. METHODOLOGY

The Advanced Security System follows a step-by-step methodology to ensure efficient intruder detection and alert notification. The process begins with IR sensors that continuously monitor the area for any unauthorized movement. When motion is detected, the signal is sent to the Arduino Uno, which acts as the central controller. It then activates the ESP32-CAM module to capture an image of the intruder in real-time. Simultaneously, the GSM module is triggered to send an SMS alert to the user's registered mobile number. This message provides immediate notification, even without internet access. All operations are performed automatically without requiring manual input. The system's logic is

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embedded in the Arduino, ensuring fast and reliable execution. Overall, this approach enables the system to act quickly, accurately, and independently in securing the environment.

VIII. HARDWARE

Microcontroller

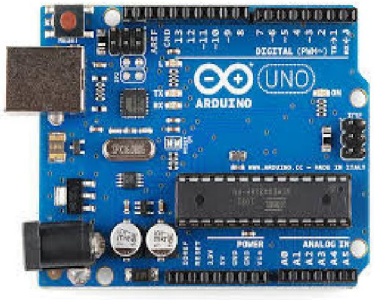

Fig.1

Acts as the central processing unit of the system, coordinating input from the sensors and controlling the communication modules. It processes sensor data in real time and triggers necessary actions like image capture and alert messaging.

ESP32-CAM Module

Fig.2

A compact camera module with built-in Wi-Fi and image processing capabilities. It captures photos of intruders upon detection and can optionally send them over a network. Its low power consumption and wireless connectivity make it ideal for smart security systems.

IR Sensor

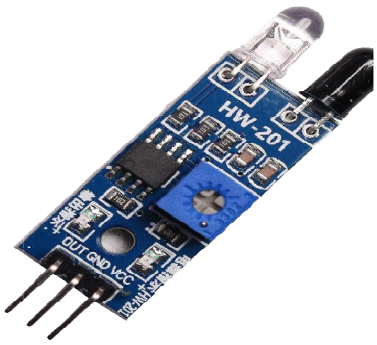

Fig.3

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Used to detect motion or the presence of an intruder. When an object passes through the sensor's infrared beam, it generates a signal that is sent to the Arduino for further action.

GSM Module (SIM800L)

Fig.4

Responsible for sending SMS alerts to the registered mobile number. It ensures the user is notified in real-time, even in locations without internet access.

Buzzer

Fig.5

An audio output device that serves as an on-site alert mechanism. It beeps when an intrusion is detected, providing immediate sound-based warning.

LCD Display (16x2)

Fig.6

Displays system messages such as “System Armed,” “Intruder Detected,” or “Enter Password.” This module provides real-time feedback and helps users interact with the system easily.

L298N Motor Driver Module

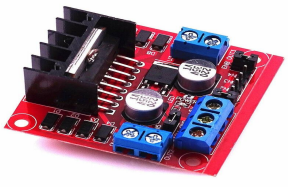

Fig.7

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Controls the direction and operation of the 12V DC motor. This dual H-Bridge driver takes control signals from the Arduino and regulates the power flow to the motor to either open or close the door when the correct password is entered.

12V DC Motor

Fig.8

Physically operates the door locking/unlocking mechanism. Once authorized access is granted, the motor opens the door automatically and locks it back after a preset duration for security.

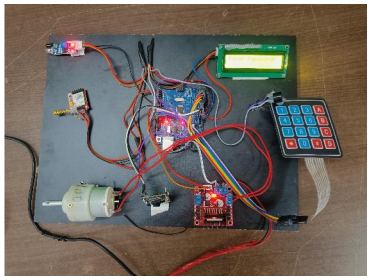
Keypad (4x4 Matrix)

Fig.9

A keypad allows secure user input, such as entering a password to disarm the alarm or unlock the door. It enhances the system by enabling only authorized access through a programmable passcode mechanism.

VII. EXPERIMENTAL RESULTS

The experimental testing of the Advanced Security System yielded highly effective outcomes. The IR sensor demonstrated accurate intrusion detection under varying lighting conditions. The GSM module delivered instant SMS alerts to the user's registered number within seconds of detection. The ESP32-CAM successfully captured and stored images of intruders when motion was detected. The keypad-based access control system worked reliably, preventing unauthorized entry through secure password input. Additionally, the L298N motor driver and 12V DC motor ensured smooth operation of the automated door mechanism upon valid authentication, confirming the system's effectiveness and reliability in real-time security scenarios.



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IX. CONCLUSION

The Advanced Security System effectively surpasses the limitations of traditional setups by integrating real-time monitoring, image capture, and SMS alerting. Active sensors ensure accurate intrusion detection, instantly triggering the ESP32-CAM to capture evidence. This enables timely alerts to users, regardless of location. The system operates autonomously, minimizing the need for human monitoring. Unlike manual systems, it ensures 24/7 surveillance with immediate response. These innovations make it suitable for residential, commercial, and industrial security. Overall, it delivers a reliable, automated, and scalable solution for modern security challenges.

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