Smart Security Surveillance System Using IoT

PROJECT REPORT

Submitted in the fulfilment of the requirements for

the award of the degree of

Bachelor of Technology

in

Electronics and Communication Engineering

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(ACCREDITED BY **NAAC** WITH **"A^{+}"** GRADE)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

(ACCREDITED BY **NBA**)

VIGNAN'S FOUNDATION FOR SCIENCE, TECHNOLOGY AND RESEARCH

(Deemed to be University)

Vadlamudi, Guntur, Andhra Pradesh, India -522213

May 2024

CERTIFICATE

This is to certify that project report entitled **"Smart Security Surveillance System Using IoT"** that is being submitted by Popuri Syam sai [201FA05031], Mohammad Ibrahim [201FA05066] and Shaik. Abubakar Siddiq [211LA05014] in fulfilment for the award of B. Tech degree in Electronics and Communication Engineering, Vignan's Foundation for Science Technology and Research University, is a record of bonafide work carried out by them under the guidance of **Dr. P. J Reginald** of ECE Department.

Signature of faculty guide
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23/5/24.
Signature of Head of the Department
Dr. T. Pitchaiah, M.E, Ph.D, MIEEE ,FIETE
Professor & HoD ECE

DECLARATION

We hereby declare that the project work entitled Smart Security Surveillance System Using IoT is being submitted to Vignan's Foundation for Science, Technology and Research (Deemed to be University) in fulfilment for the award of B. Tech degree in Electronics and Communication Engineering. The work was originally designed and executed by us under the guidance of **Dr. P. J. Reginald** at Department of Electronics and Communication Engineering, Vignan's Foundation for Science Technology and Research (Deemed to be University) and was not a duplication of work done by someone else. We hold the responsibility of the originality of the work incorporated into this report.

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ACKNOWLEDGEMENT

The satisfaction that comes from successfully completing any task would be incomplete without acknowledging the people who made it possible, whose ongoing guidance and encouragement have been essential to the achievement.

We are greatly indebted to **Dr. P. J Reginald**, my revered guide and Associate Professor in the Department of Electronics and Communication Engineering, VFSTR (Deemed to be University), Vadlamudi, Guntur, for his valuable guidance in the preparation of this project report. He has been a source of great inspiration and encouragement to us. He has been kind enough to devote considerable amount of his valuable time in guiding us at every stage. This is our debut, but we are sure that we are able to do many more such studies, under the lasting inspiration and guidance given by respectable guide.

We would also like to thank to **Dr. T. Pitchaiah**, Head of the Department, ECE for his valuable suggestion.

We would like to specially thank, **Dr. N. Usha Rani**, Dean, School of Electrical, Electronics and Communication Engineering for her help and support during the project work.

We thank our project coordinators **Dr. Satyajeet Sahoo, Dr. Arka Bhattacharyya, Mr. Abhishek Kumar** and **Mr. M. Vamsi Krishna** for continuous support and suggestions in scheduling project reviews and verification of the report. Also, thank to supporting staff of ECE Department for their technical support for timely completion of project.

We would like to express our gratitude to **Dr. P. Nagabhusan**, Vice-Chancellor, VFSTR (Deemed to be University) for providing us the greatest opportunity to have a great exposure and to carry out the project.

Finally, we would like to thank our parents and friends for the moral support throughout the project work.

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ABSTRACT

In recent years, we have employed surveillance cameras to monitor and record events, but manual surveillance and real-time monitoring is one of the most essential and challenging fields of computer vision, which has been widely applied in people's lives, such as security monitoring. The placement of surveillance cameras and a warning sign stating that the area is being monitored can serve as a considerable deterrent to criminals and thieves, as recorded film can be used to identify people and track their movements. It can be taken a step further with Wi-Fi, a local area network that operates in a local or spread setting. Wi-Fi network protocol is one of the most popular communication methods in the IoT industry, as it allows for low transmit power and cheap cost. ESP32 is the second iteration of Express if Corporation's IoT solution, which features Wi-Fi. ESP32 alleviates heavy network traffic and computing stress. This system allows the user to receive notifications anytime a known individual enters a surveillance area. When an incursion is detected using sensors connected to the surveillance camera, a message is sent from the database. When an unfamiliar individual enters the surveillance area, a motion detected message is issued, accompanied with a video clip.

Major Design (Final Year Project Work) Experience Information

Student Group	P. Syam sai 201FA05031	Mohammad Ibrahim 201FA05066	Sk Abubakar Siddiq 211LA05014
Project Title	Smart Security Surveillance System using IoT		
Program Concentration Area	Designing in IoT		
Program Concentration Area	Smart Security		
Constraints – Examples			
Economic	Low Budget		
Environmental	Friendly		
Sustainability	Environmentally Friendly, Socially Responsible		
Manufacturability	Yes		
Ethical	Followed the Standard Professional Ethics		
Health and Safety	Guidelines are Followed		
Social	Applicable for Defence		
Political	None		
Other			
Standards			
1.IEEE 802.11b	IEEE standard for Wi-Fi		
2.IEEE 802.15.4	IEEE standard for Low Rate Wireless Personal Area Network(LWPAN)		
Previous Courses Required for the major design experience	1. Introduction to the Internet of Things 2. Wireless Sensor Networks		

Supervisor

Project Co-ordinator

Head of the Department 23/5/24

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List of Acronyms

1. CCTV……Closed Circuit Television
2. GSM……..Global System for Mobile Communication
3. ICSP……..In-Circuit Serial Programming
4. IEEE……..Institute of Electrical and Electronics Engineering
5. IoT…….Internet of Things
6. PCA……...Principal Component Analysis
7. PIR…….Passive Infrared Sensor
8. PWM…….Pulse Width Modulation
9. USB……...Universal Serial Bus
10. Wi-Fi…….Wireless Fidelity

Chapter 1
INTRODUCTION

1.1 Introduction

The Smart Security Surveillance System is a project that aims to enhance security measures using modern technologies. With the increasing rate of crime, it is important to develop a system that can detect, prevent and notify potential threats before they occur. The system is designed to provide real-time surveillance, alert the authorities of potential threats, and capture data for later analysis. The project is developed to cater to the needs of commercial and residential areas. It employs a network of sensors, cameras, and intelligent algorithms to detect and identify potential threats. The system is designed to be scalable, flexible and adaptable to various settings, including homes, schools, hospitals, and businesses.

This documentation report presents a comprehensive overview of the Smart Security Surveillance System project, its design, development, and implementation. The report outlines the project's objectives, the system's architecture, and the technologies employed in its development. It also covers the system's features, functionalities, and performance metrics. The need for security surveillance systems has become increasingly important in recent years, with the rising rates of crime and security threats. Traditional security measures, such as physical security personnel and alarms, are often not enough to prevent or deter criminal activities. Therefore, advanced technological solutions, such as security surveillance systems, have become essential in enhancing security measures.

One such advanced security surveillance system is the Smart Security Surveillance System. This system utilizes cutting-edge technologies, including internet of things (IoT) devices, to provide real-time surveillance, threat detection, and notification of potential threats. The Smart Security Surveillance System is designed to address the limitations of traditional security measures by offering a comprehensive solution that integrates multiple technologies to create a highly effective security network. It can monitor and analyse large amounts of data from various sensors, cameras, and other devices, allowing for more accurate threat detection and prevention. The need for security surveillance systems in India has become increasingly important in recent years due to the rising crime rates in various parts of the country.

According to the National Crime Records Bureau (NCRB), India witnessed 3,78,277 cases of theft, 29,313 cases of robbery, and 21,796 cases of dacoity in 2019 al

one. These numbers are a clear indication of the need for advanced security measures to deter and prevent criminal activities. One of the primary reasons for the high crime rates in India is the lack of effective surveillance systems. Many public places, such as railway stations, bus stops, and malls, do not have adequate surveillance cameras or security personnel, making them vulnerable to criminal activities. Similarly, residential areas often lack proper surveillance systems, which can lead to burglaries, thefts, and other criminal activities.

Moreover, the lack of proper surveillance systems also affects the investigation and prosecution of criminal activities. Without proper evidence, it becomes challenging for law enforcement agencies to identify and apprehend criminals. In conclusion, the need for security surveillance systems in India is critical in ensuring public safety and preventing criminal activities. The lack of proper surveillance systems has contributed significantly to the high crime rates in the country. The Smart Security Surveillance System, with its advanced technologies and customizable features, is an ideal solution to address the limitations of traditional security measures and make India a safer place for its citizens.

1.2 Objectives

- The objective of this project is to design and develop an IoT based security surveillance system using Arduino and ESP32 Camera.
- To create the database using machine learning technique.

1.3 Problem Statement

- The security of homes and public places has become a major concern in recent years due to increasing crime rates in various parts of the world. Traditional security measures, such as security guards and CCTV cameras, have limitations in detecting and preventing criminal activities.

- Moreover, the lack of real-time monitoring and notification systems makes it difficult for individuals and law enforcement agencies to respond quickly to potential threats. To address these limitations, the Smart Security Surveillance System using IoT technology has been proposed.

- The system aims to provide a comprehensive and intelligent security solution that can monitor and detect potential threats in real-time and alert users immediately. However, the development of this system poses several challenges, such as integrating multiple sensors and devices into a single platform, ensuring data security and privacy, and developing an efficient notification system.

- Moreover, the system must be scalable, customizable, and costeffective to cater to different security needs and budgets. Therefore, the problem statement for the Smart Security Surveillance System using IoT technology is to design and develop a comprehensive and intelligent security solution that can overcome the limitations of traditional security measures, ensure real-time monitoring, and provide timely notifications to users.

- The system must be scalable, customizable, and cost-effective, while also ensuring data security and privacy.

1.4 Literature Survey

Surveillance monitoring is an important aspect of security in numerous operations similar as homes, services, and public spaces. The use of cameras and detectors is essential to descry and help unauthorized access to these spaces. The ESP32- Camera module is a low- cost, compact, and easy- to- use camera module that can be integrated with colourful microcontrollers and microprocessors. In this literature check, we will bandy colourful exploration works that have used the ESP32- Camera module for surveillance monitoring.

1.A Low- cost Surveillance System using ESP32- Camera and jeer Pi.This exploration work presents a low- cost surveillance system that uses the ESP32- Camera module and jeer Pi. The ESP32- Camera module is used to capture videotape and images, while the jeer Pi is used to reuse the videotape and shoot cautions to the stoner's mobile phone. The system can descry stir, shoot dispatch cautions, and store vids on an SD card. The exploration shows that the system is effective in covering the surroundings, and the low- cost makes it suitable for home security.

2.Wireless Video Surveillance System Grounded on ESP32- Camera Module This exploration work presents a wireless videotape surveillance system grounded on the ESP32- Camera module. The system uses Wi- Fi to transmit videotape data to a remote garçon, where it can be viewed in real- time. The system also has stirred discovery capabilities and can shoot cautions to the stoner's mobile phone. The exploration shows that the system is effective in covering the surroundings, and the wireless point makes it suitable for remote monitoring.

3.ESP32- Camera grounded Security System for Home robotization .This exploration work presents an ESP32- Camer grounded security system for home robotization. The system is designed to descry stir and shoot cautions to the stoner's mobile phone. The system can also be integrated with other home robotization systems, similar as lighting and air exertion. The exploration shows that the system is effective in covering the surroundings, and the integration with home robotization makes it suitable for smart homes.

4.Wireless Security and Surveillance System using ESP32- Camera and Arduino This exploration work presents a wireless security and surveillance system that uses the ESP32- CAM module and Arduino. The system uses Wi- Fi to transmit videotape data to a remote garçon, where it can be viewed in real-

time. The system also has stirred discovery capabilities and can shoot cautions to the stoner's mobile phone. The exploration shows that the system is effective in covering the surroundings, and the low-cost makes it suitable for home security.

5.IoT- grounded Surveillance System using ESP32- CAM and jeer Pi.This exploration work presents an IoT- grounded surveillance system that uses the ESP32- CAM module and jeer Pi. The system is designed to descry stir and shoot cautions to the stoner's mobile phone. The system can also be integrated with other IoT systems, similar as smart cinches and smart lighting. The exploration shows that the system is effective in covering the surroundings, and the integration with IoT makes it suitable for smart homes.

Chapter 2
Proposed System and Implementation

2.1 Proposed system

We'll use the ESP32-CAM in this project to build a surveillance system that detects the presence of people . The ESP32-CAM is a very small camera that uses the ESP32-S chip module. In this system, we'll are using an ESP32 camera with PIR sensors and an Arduino Uno. If the sensors detect an person entering, a notification will be sent to the individuals via the GSM module.

The design's proposed functionalities; we divide the system into two sections: data acquisition and system control. The Arduino, PIR sensor is used to model data acquisition. The control system is a single-chip microcomputer that controls the GSM Module, SIM800L, and ESP Camera, and then the ESP Camera displays the received information in real time.

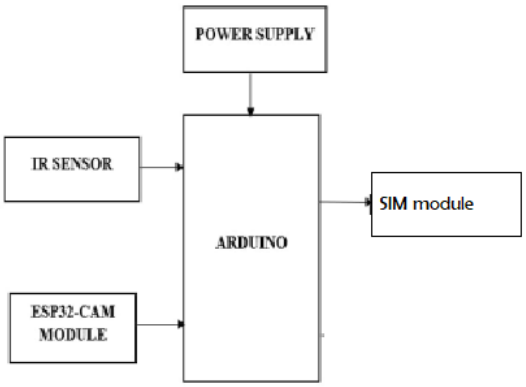

Fig 2.1.1 : Block diagram of the system

2.2Implementation

Arduino and PIR sensor connection:

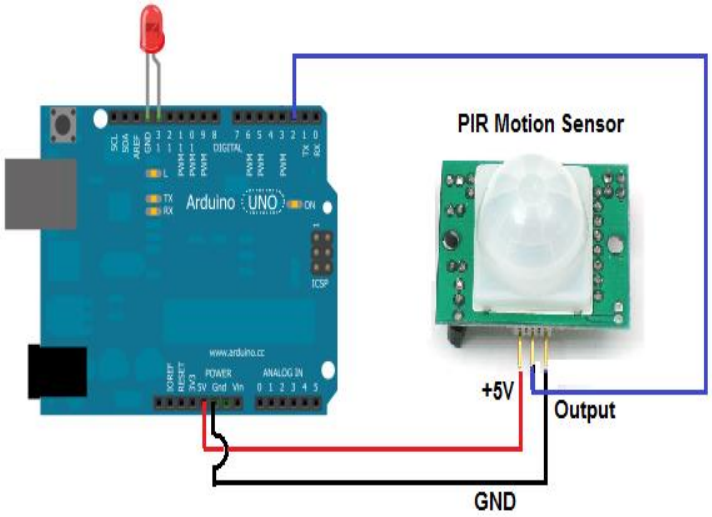

Fig 2.2.1 : Arduino and PIR sensor connection

Arduino and sim800l connection

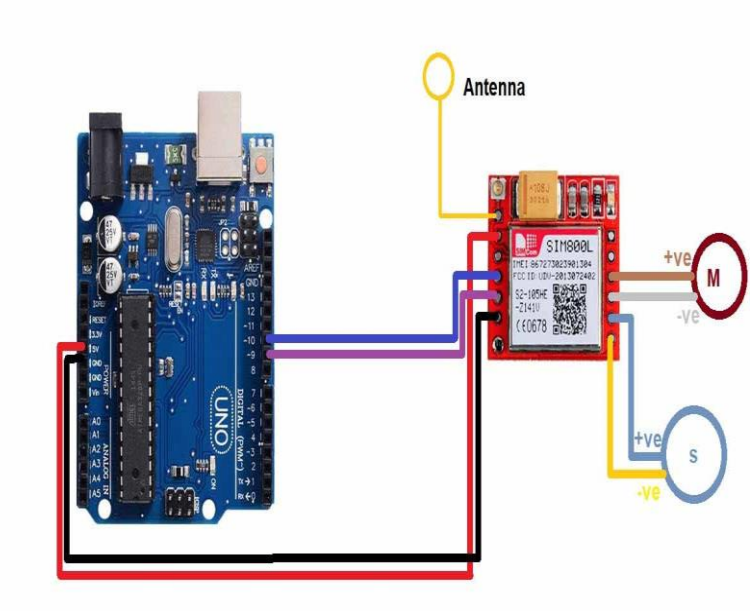

Fig 2.2.2 : Arduino and sim800L connection

- According to the connection diagram, connect the hardware requirements for the proposed system.

- The Arduino and ESP32 cam module code is Written with the Arduino IDE software.

- The code specifies the hotspot requirements for the ESP32 cam.

- The Arduino code contains information about the registered mobile number and required code for SMS alert.

- Turn on the power supply.
- If an person is detected using PIR sensors, live video is transmitted using ESP32 camera.

- Using a GSM module, an SMS alert is sent to the registered mobile number and video is sent to telegram.

2.3 DATA PREPARATION

2.3.1 Arduino Uno

Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again.

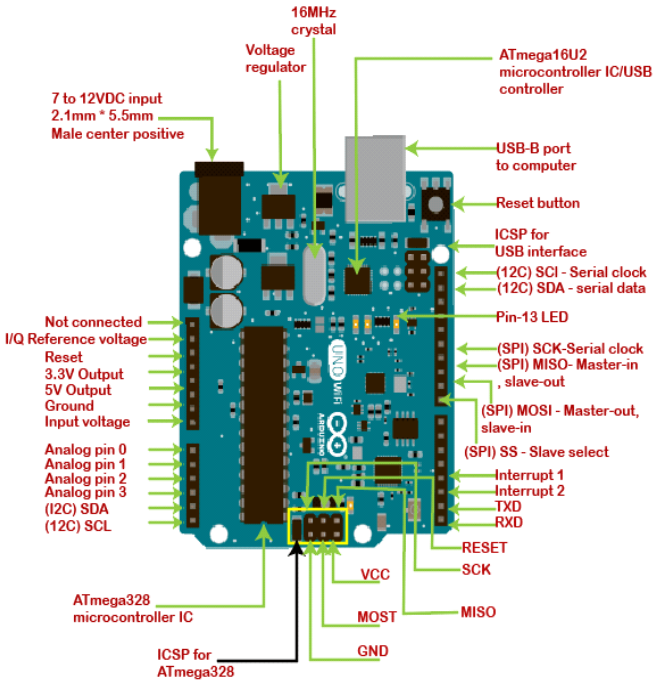

Fig 2.3.1.1 : Arduino UNO

Board	**Name**	Arduino UNO R3
	SKU	A000066
Microcontroller	ATmega328P	
USB connector	USB-B	
Pins	**Built-in LED Pin**	13
	Digital I/O Pins	14
	Analog input pins	6
	PWM pins	6
Communication	**UART**	Yes
	I2C	Yes
	SPI	Yes
Power	**I/O Voltage**	5V
	Input voltage (nominal)	7-12V
	DC Current per I/O Pin	20 mA
	Power Supply Connector	Barrel Plug

Fig 2.3.1.2 : Arduino UNO pin description

2.3.2 SIM800L GSM MODULE

The SIM800L is a GSM module from Sim com that gives any microcontroller GSM functionality, meaning it can connect to the mobile network to receive calls and send and receive text messages, and also connect to the internet using GPRS, TCP, or IP. Another advantage is that the board makes use of existing mobile frequencies, which means it can be used anywhere in the world.

Fig 2.3.2.1 : SIM800L GSM Module

SPECIFICATIONS OF SIM800L GSM MODULE:

- SIM800L Quad Band GSM / GPRS Module.
- Power Supply: 3.7 to 4.2V Rated At 2A.
- Low Power Consumption: < 3 mA during sleep mode.
- Max Current: 2A (During transmission bursts).
- Supports transmission of Voice, SMS, and Data (max speed 85.6 Kbps).
- Supports Serial Communication (5v tolerant).
- Supports Micro SIM Card.

SIM800L GSM/GPRS Module Pin Configuration		
Number	Pin	Descriptions
1	NET	Network antenna
2	VCC	3.7V – 4.4V supply
3	RST	Reset
4	RXD	Data Receiver
5	TXD	Data Transmitter
6	GND	Ground
7	SPK-	Speaker negative pin
8	SPK+	Speaker positive pin
9	MIC-	Microphone negative
10	MIC+	Microphone positive
11	DTR	Control sleep mode
12	RING	Ringing indicator

Fig 2.3.2.2 : GSM Module pin description

2.3.3 PIR MOTION SENSOR.

- PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out.
- For that reason, they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors. PIRs are basically made of a pyroelectric sensor (which you can see above as the round metal can with a rectangular crystal in the center), which can detect levels of infrared radiation.
- Everything emits some low level radiation, and the hotter something is, the more radiation is emitted. The sensor in a motion detector is actually split in two halves. The reason for that is that we are looking to detect motion (change) not average IR levels.
- The two halves are wired up so that they cancel each other out. If one half sees more or less IR radiation than the other, the output will swing high or low.
- Along with the pyroelectric sensor is a bunch of supporting circuitry, resistors and capacitors. It seems that most small hobbyist sensors use the BISS0001 ("Micro Power PIR Motion Detector IC"), undoubtedly a very inexpensive chip.

- This chip takes the output of the sensor and does some minor processing on it to emit a digital output pulse from the analog sensor The HC-SR04 ultrasonic sensor uses sonar to determine the distance to an object.
- This sensor reads from 2cm to 400cm (0.8inch to 157inch) with an accuracy of 0.3cm (0.1inches), which is good for most hobbyist projects. In addition, this particular module comes with ultrasonic transmitter and receiver modules.

Fig 2.3.3.1 : PIR Sensor

How Does It Work?

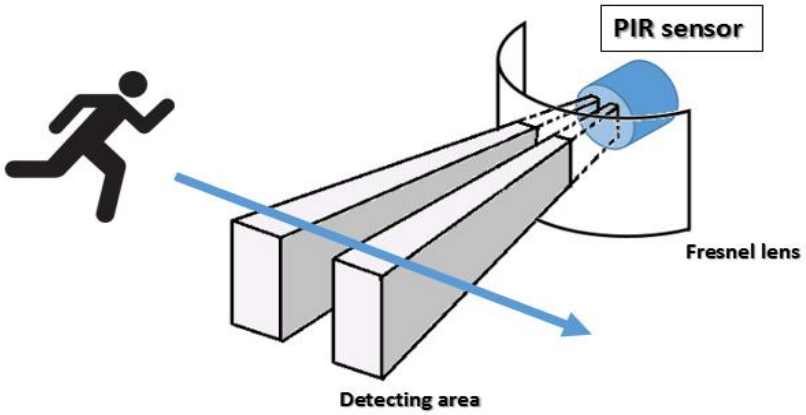

Fig 2.3.3.2 : Working of PIR sensor

The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected.

Main Specifications

Encapsulation Type	TO-5
IR Receiving Electrode	2x 1mm, 2 elements
Window Size	4x3mm
Spectral Response	5-14μm
Transmittance	≥75%
Signal Output [Vp-p]	≥3500mV
Sensitivity	≥3300V/W
Detectivity (D*)	$\geq 1.4 \times 10^{8}$ cmHz$^{1/2}$/W
Noise[Vp-p]	<70mV
Output Balance	<10%
Offset Voltage	0.3-1 .2V
Supply Voltage	3-15V
Operating Temp.	-30-70℃
Storage Temp.	-40-80℃
Field of View Equivalent Circuit	138° 125° X-X Y-Y

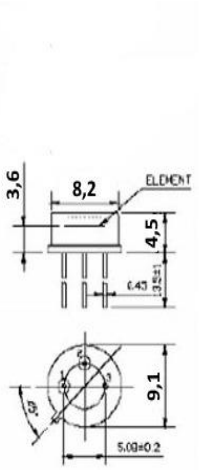

Fig 2.3.3.3 : Main Specification of PIR sensor

2.3.4 ESP32 CAM

ESP32-CAM is a low-cost ESP32-based development board with onboard camera, small in size. It is an ideal solution for IoT application, prototypes constructions and DIY projects. The board integrates Wi-Fi, traditional Bluetooth and low power BLE, with 2 high performance 32-bit LX6 CPUs. It adopts 7-stage pipeline architecture, on-chip sensor, Hall sensor, temperature sensor and so on, and its main frequency adjustment ranges from 80MHz to 240MHz. Fully compliant with Wi-Fi 802.11b/g/n/e/i and Bluetooth 4.2 standards, it can be used as a master mode to build an independent network controller, or as a slave to other host MCUs to add networking capabilities to existing devices ESP32-CAM can be widely used in

various IoT applications. It is suitable for home smart devices, industrial wireless control, wireless monitoring, QR wireless identification, wireless positioning system signals and other IoT applications. It is an ideal solution for IoT applications.

Fig 2.3.4.1 : ESP32 Camera module

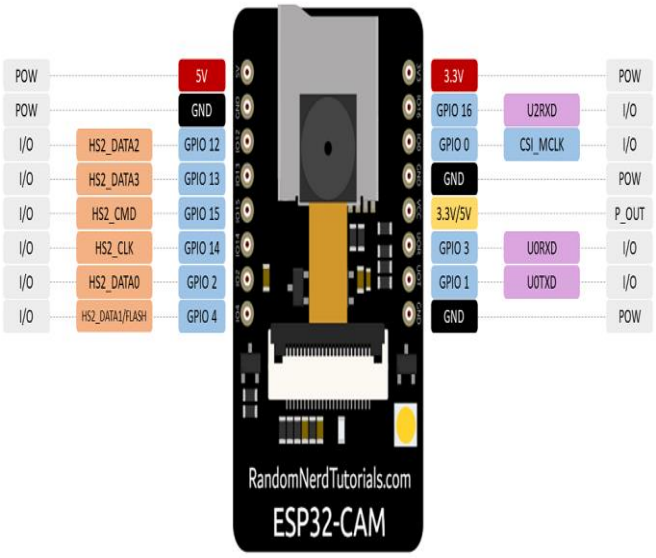

Fig 2.3.4.2 : ESP32 module pin description

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 and OV7670 cameras, Built-in Flash lamp.
- Support image Wi-Fi upload
- Support TF card • 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)

SPECIFICATION

- SPI Flash: default 32Mbit
- RAM: built-in 520 KB+ external 4MPSRAM
- Dimension: 27*40.5*4.5（±0.2）mm/1.06*1.59*0.18”
- Bluetooth: Bluetooth 4.2 BR/EDR and BLE standards
- Wi-Fi: 802.11b/g/n/e/i
- Support Interface: UART, SPI, I2C, PWM
- Support TF card: maximum support 4G
- IO port: 9
- Serial Port Baud-rate: Default 115200 bps
- Image Output Format: JPEG (OV2640 support only), BMP, GRAYSCALE
- Spectrum Range: 2412 ~2484MHz
- Antenna: onboard PCB antenna, gain 2dBi
- Transmit Power: 802.11b: 17±2 dBm (@11Mbps); 802.11g: 14±2 dBm (@54Mbps); 802.11n: 13±2 dBm (@MCS7)

2.4 SOFTWARE DETAILS - ARDUINO IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttonsfor common functions and a series of menus. It connects to the Arduino hardwareto upload programs and communicate with them.

α. It is available for all operating systems i.e. MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital rolein debugging, editing and compiling the code.

β. A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more.

χ. Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code

δ. The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.

ε. The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.

ϕ. This environment supports both C and C++ languages.

USING ARDUINO IDE TOOL

The editor contains the four main areas:

1. A Toolbar with buttons for common functions and a series of menus. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

2. The message area, gives feedback while saving and exporting and also displays errors.

3. The text editor for writing your code.

1. The text console displays text output by the Arduino Software (IDE), including complete error messages and other information

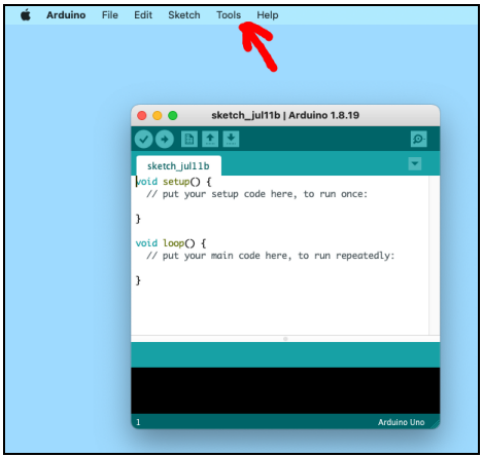

Fig 2.4.1 : Tools bar in Arduino IDE

2. Connect your Arduino or Genuino board to your computer.

3. Now, you need to select the right core & board. This is done by navigating to Tools > Board > Arduino AVR Boards > Board. Make sure you select the board that you are using. If you cannot find your board, you can add it from Tools > Board > Boards Manager.

4. Now, let's make sure that your board is found by the computer, by selecting the port. This is simply done by navigating to Tools > Port, where you select your board from the list.

5. To upload it to your board, simply click on the arrow in top left corner.

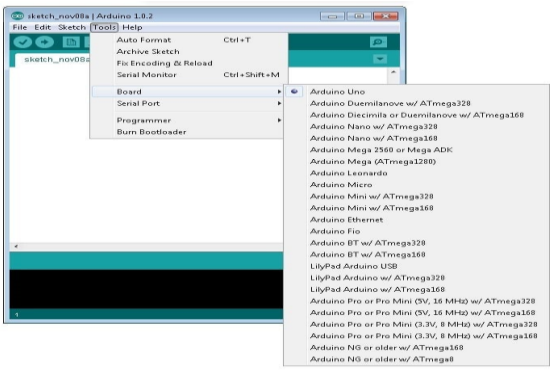

Fig 2.4.2 : To select port in Arduino IDE

2.5 Machine Learning Technique

Principal Component Analysis

Principal component analysis, or PCA, is a dimensionality reduction method that is often used to reduce the dimensionality of large data sets, by transforming a large set of variables into a smaller one that still contains most of the information in the large set.

Reducing the number of variables of a data set naturally comes at the expense of accuracy, but the trick in dimensionality reduction is to trade a little accuracy for simplicity. Because smaller data sets are easier to explore and visualize, and thus make analyzing data points much easier and faster for machine learning algorithms without extraneous variables to process.

So, to sum up, the idea of PCA is simple**:** reduce the number of variables of a data set, while preserving as much information as possible.

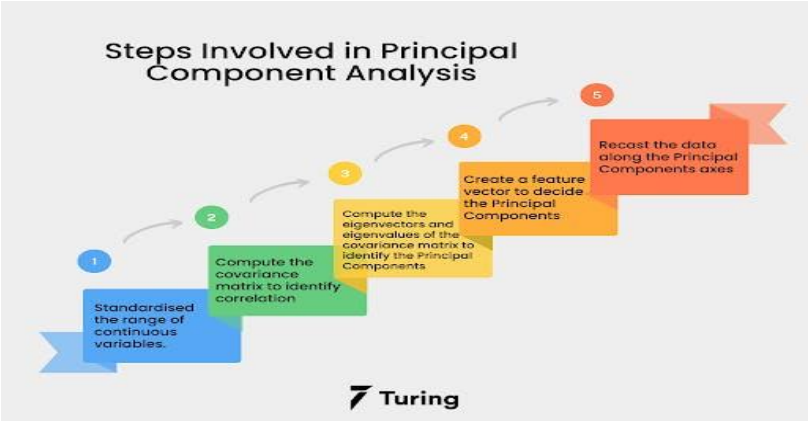

Fig 2.5.1 : Steps involved in PCA

Chapter 3

Proposed work

3.1 Work design

The following diagram describes the complete connection of the system.

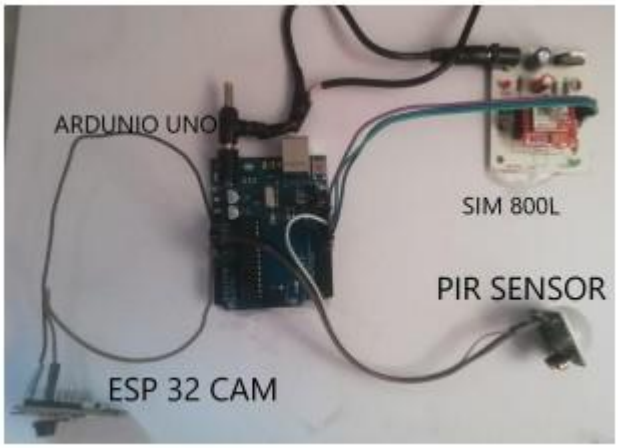

Fig 3.1.1 Complete connection of the system

Initially the circuit gets ON and motion sensor senses the motion. When the motion is detected ESP32 Camera module gets activated. GSM SIM800L contains a sim which should have a network. Wi-Fi [802.11b] is connected to the SIM800L and the operating system. When the Wi-Fi is connected, an alert will be sent to the host. The data rate may be less or in normal level, in case of low data rate transmission "Low rate Wireless Personal Area Network[802.15.4]" is used to overcome the low data transmission.

3.2 Expected Output

The Output is in the form of SMS that was received to the Registered mobile number. The Registered mobile number will receive an SMS when an unknown person enters the room. And That SMS contains video link , so that the person can see who had entered the room.

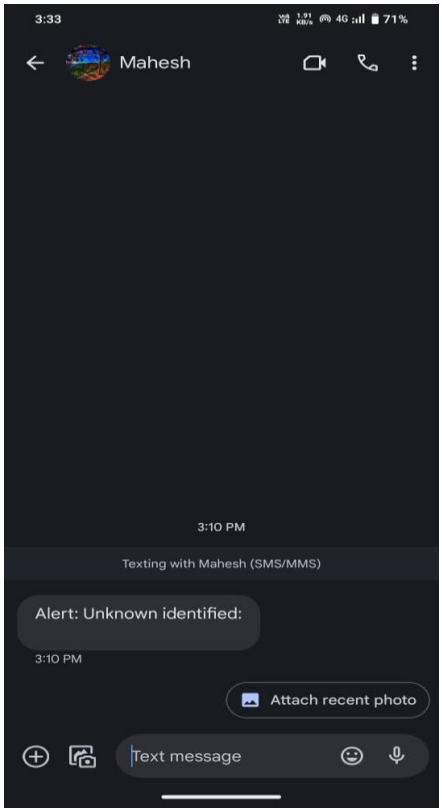

Fig 3.2.2: Expected Output

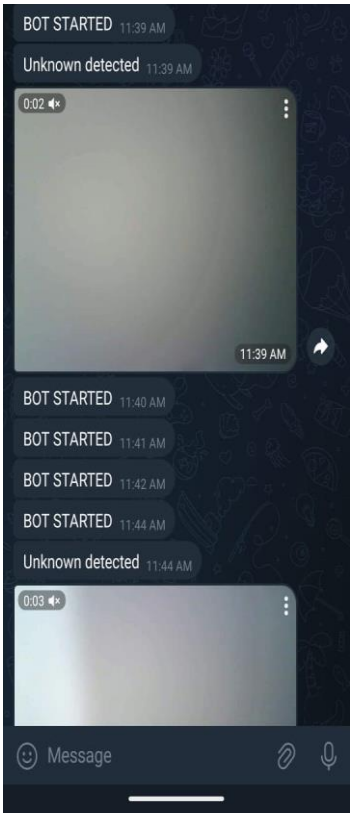

Fig 3.2.3 : Expected Output

3.3 To train the data set

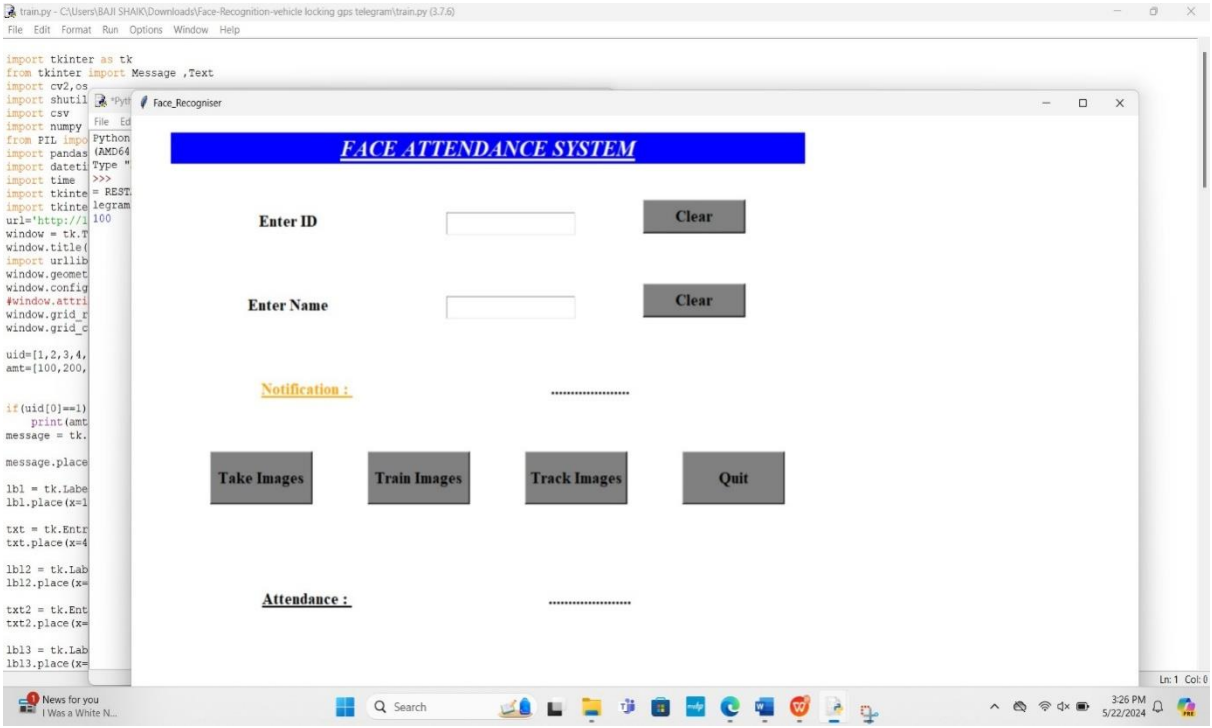

Fig 3.3.1 : To train the data set

3.4 Output

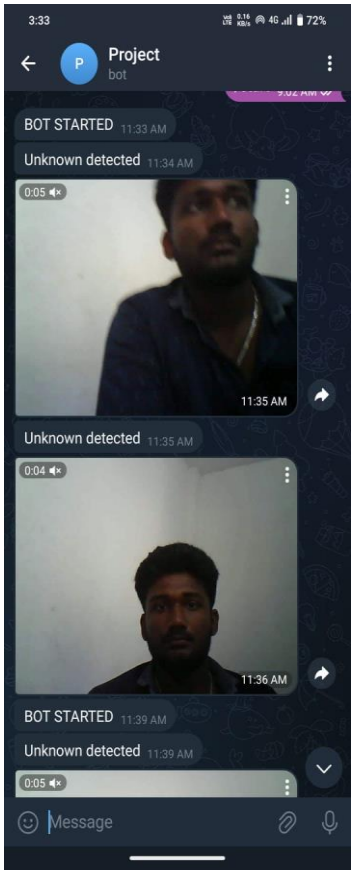

Fig 3.4.1 : Obtained Output

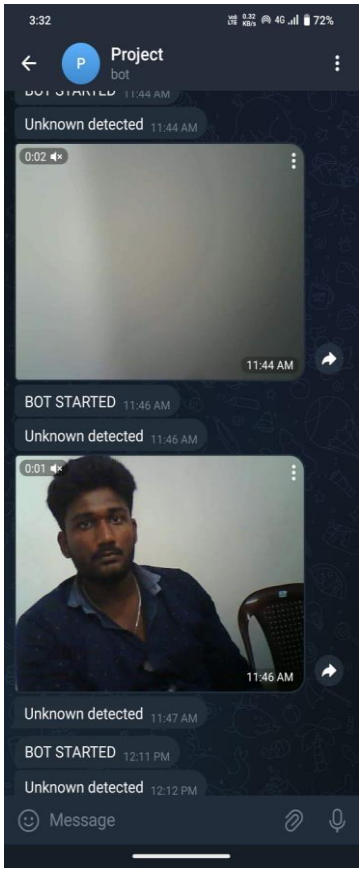

Fig 3.4.2 : Obtained Output

Chapter 4

4.1 Conclusion

In conclusion, the ESP32- CAM module is an effective and low- cost result for surveillance monitoring. The module can be integrated with colourful microcontrollers and microprocessors, making it suitable for different operations similar as home security and smart homes. The exploration works bandied in this check have shown the effectiveness of the ESP32- CAM module for surveillance monitoring and the eventuality for integration with other systems.

4.2 Future Scope

The smart security surveillance system using IoT has immense potential for future growth and development. Some potential future scopes for this technology are:

1. Enhanced Security: With advancements in IoT technology, smart security systems can become even more sophisticated and effective in detecting and preventing security threats. For example, the use of AI-based algorithms and machine learning can help identify suspicious behavior patterns and alert security personnel in real-time.

2. Integration with Other IoT Devices: Smart security systems can be integrated with other IoT devices such as smart locks, thermostats, and lighting systems, to create a complete smart home security system. This integration can enable users to control their home security systems through a single platform.

3. Cloud-based Surveillance: Cloud-based surveillance can allow for more efficient storage and analysis of surveillance data. With cloud-based surveillance, users can access realtime footage from anywhere in the world, making it easier to monitor their homes or businesses remotely.

4. Predictive Analytics: Predictive analytics can help improve the accuracy of security systems by analyzing data and predicting potential security breaches before they occur. This technology can also help identify security trends and patterns, making it easier to identify potential vulnerabilities and take preventative measures.

5. Use of Drones: Drones can be used for surveillance in hard-to-reach areas or for monitoring large outdoor spaces. With the use of IoT sensors and AI algorithms, drones can be programmed to patrol and monitor specific areas and report any suspicious activity.

Overall, the future of smart security surveillance systems using IoT is bright, and there are numerous possibilities for further development and growth. As the technology continues to evolve, we can expect to see even more advanced and sophisticated security solutions that provide greater peace of mind for users.

4.3References

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