A report on

"Surveillance System Using ESP-32 Cam"

Submitted in partial fulfilment for the award of the degree of

BACHELOR OF TECHNOLOGY (HONOURS)

IN

COMPUTER SCIENCE AND ENGINEERING

(DATA SCIENCE)

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CERTIFICATE

This is to certify that the project work titled **“SURVELLIANCE CAM USING ESP-32 CAM”** is carried out by **T DHEERAJ (18BTRCY011)**, **K NARSIMHA (18BTRCY006), HARSITH GUPTHA(18BTRCY026),** a bonafide students of Bachelor of Technology at the Faculty of Engineering & Technology, Jain (Deemed-to-be University), Bangalore in partial fulfilment for the award of degree, Bachelor of Technology (Honours) in Computer Science & Engineering (Data Science), during the Academic year **2020-2021**.

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DECLARATION

We **T DHEERAJ (18BTRCY011)**, **K NARSIMHA (18BTRCY006), HARSITH GUPTHA(18BTRCY026)**, , are students of sixth semester B. Tech (Honours) in **Computer Science & Engineering (Data Science)**, at Faculty of Engineering & Technology, **Jain (Deemed-To- Be University)**, hereby declare that the project work titled **“Surveillance System using esp32 cam”** has been carried out by us and submitted in partial fulfilment for the award of degree in **Bachelor of Technology (Honours) in Computer Science & Engineering (Data Science)** during the academic year **2020-2021**. Further, the matter presented in the project has not been submitted previously by anybody for the award of any degree or any diploma to any other University, to the best of our knowledge and faith.

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Signature of Students

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ABSTRACT

The need for home surveillance systems nowadays is a serious demand. As the number of crimes are increasing every day, there has to be something that will keep us safe. We are all aware of the high end security systems present in the market but they are not easily available to everyone. We therefore intend to provide a solution by constructing a cost efficient electronic system that has the capability of sensing the motion of the intruders and taking the pictures to send directly to our mobile phones.

The basic idea behind this project is that all the bodies generate some heat energy in the form of infrared which is invisible to human eyes. But, it can be detected by electronic motion sensor. The project involves the use of ESP32-CAM, PIR motion sensor module, Blynk app and a simple program. The sensor detect any motion in its permissible range and triggers the camera. It will also send the signal to Blynk app which processes the signal and send a notification to your smartphone. With this system we can easily set up a surveillance system in our home for unwanted intruders.

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NOMENCLATURE

PIR	Passive Infrared (Motion Sensor)
FTDI	Future Technology Devices International Limited
GPIO	General Purpose Input/Output
BC547	B represents Base, and C represents Collector (terminals in transistor)
NPN	Negative-Positive-Negative Transistor
LED	Light Emitting Diode
USB	Universal Serial Bus
DC	Direct Current
IoT	Internet of Things
DIY	Do It Yourself
CAM	Camera
IDE	Integrated Development Environment
RS	Recommended Serial
TTL	Transistor-Transistor Logic

Chapter 1

INTRODUCTION

Today many homeowners have a home surveillance/monitoring system. Traditionally these systems have been built in an ad hoc fashion with direct wired connections between the control center and all of the sensors. This is changing due to use the use of local area network technology for the interconnections (be they wired or wireless) and the fact that the control system is increasingly connected to the Internet. The connection to the Internet enables home owners (and potentially others) to access information collected by the home security and monitoring system from any place in the Internet.

We have designed an interesting and cheap home surveillance system. This Gadget helps you to protect your house from thieves. In this project we are going to use an ESP32-CAM, P.I.R Sensor module, Blynk app and some other components. This Project can either powered with 5V Battery or with U.S.B of your computer. This is a basic motion-sensing alarm that detects when someone enters the area.

When an intruder is detected, it activates the camera. Our body generates heat energy in the form of infrared which is invisible to human eyes. But it can be detected by electronic sensor. This type of sensor is made up of crystalline material that is Pyroelectric. In this project, we are using P.I.R. Motion Sensor Module as an infrared sensor that generates electric charge when exposed in heat and sends a signal to ESP32-CAM. We can use this system to remotely monitor our home simply through our smartphone. We can not only get the pictures taken by ESP32-CAM when a motion is detected, but also take multiple pictures through the phone remotely.

The automated home security system can be designed with the surveillance camera and multiple sensors, and the use of these sensors will be defining the features of these sensors. Faster data transmission is taking place using the Wi-Fi to security systems which helps the user to control and monitor the system globally

Chapter 1

1.1. Overview

Now a days the technology is increasing rapidly, that leads to an upgradation in home security system. Automation in security sector makes it more authentic. There are many electrical equipment’s are available in home which are in necessity of monitoring from a remote area all at a time. In this paper a home security system is proposed along with the face detection technique. A stand-alone system through Internet of Things as a network of communication is implemented.

The present scenario ensures the safety and security has become an inevitably essential. There is a regressive progress in the security system as the influence of modern technology is reaching its peak. When there is a modern home with minimum human effort, it’s well known as modern home. Since there is an advent of wireless and digital technologies, all together it introduces a automated intelligent security system.

This paper aims to provide a solution for an affordable and efficient home surveillance system, which can be operated easily. This is a DIY Home surveillance system with ESP32 CAM, PIR motion sensor, and Blynk app. When a motion is detected by PIR sensor, the ESP32-CAM Motion Sensor Security Camera will send a notification to smartphone with the photo. Later on we can take multiple pictures using the smartphone.

This proposed system has high latency and low cost. The system is highly reliable and consumes very less power in comparison with existing system. The home security system based on some camera connected to the home and the output for this is in real time with the minimum delay in the operation.

Chapter 1

1.2. Problem Definition

Due to the increase of crime rate and fire/gas accidents in households, it became a necessity to use a home surveillance camera. But the surveillance kits available on the market are expensive, complex, hard to install and maintain by ourselves. So there is a need for home surveillance systems, which are affordable and easy to use by anyone.

The services that can be provided by such a system can also be very convenient for families with children. When the children play in different rooms, using this surveillance system the parent(s) can easily know where each child is, when a child leaves one room and enters another room. For school age children, when the children come home, their parents may still be at work, but the child (or children) can use the surveillance system to set up a conference call to their parent(s).

Today these systems are an intelligent product integrating multiple functions, and future developments will port the user interface to different terminals -- enabling people to better manage their home and do it more easily than they can do at present. The following subsections will describe the structure of the current product whose further development is the focus of this thesis.

1.3. Objectives

The objective of this paper is home security using ESR32-CAM through IoT. Surveilling your own house for security purposes shouldn't cost you a fortune. Even if you find a cheaper version, it may not work properly. So the main objective is to make a simple, easy to use, cheaper, efficient home surveilling system.

- To make an efficient home surveillance camera.
- It should be cost effective, to be used by common households.
- It should be easily accessible through smart phones.

Chapter 1

1.4. Methodology

The methodology of this home surveillance system is very simple. We have to upload the code on to the AI thinker, and them connect it to a motion sensor module. When the sensor senses a motion, the camera will take a picture because of the code uploaded onto it. Then with the help of an app, we can get the pictures took by the camera directly onto our smartphone. We can surveil and take pictures remotely from our smartphones.

- Firstly we programmed the ESP32-CAM board by using FTDI 232 USB to Serial Interface board by connecting these two as in the circuit diagram shown below.
- Then we connected the above board to my laptop to upload the code onto ESP32-CAM.
- After uploading the code, we disconnected ESP32-CAM and then connected it to the PIR motion sensor module as in the circuit diagram shown below.
- When the PIR module senses a motion, the output will become high, and it will give the high pulse to BC547 NPN transistor.
- Then the transistor will turn on and will ground the GPIO 13.
- When GPIO 13 is low the ESP32-CAM will start taking the picture and the LED will also glow whenever the transistor is turned on.

1.5. Hardware and Software Tools Used

- **ESP32-CAM (AI Thinker) :**

  ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. ESP32-CAM is the latest small size camera module released by Essence. The module can work independently as the smallest system, with a size of only 27*40.5*4.5mm, and a deep sleep current as low as 6mA.

  ESP32-CAM can be widely used in various IoT applications, 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 .

- **PIR Motion Sensor Module :**

  A passive infrared sensor is an electronic sensor that measures infrared light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. PIR sensors are commonly used in security alarms and automatic lighting applications.

- **BC547 NPN Transistor :**

  A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. Transistors are one of the basic building blocks of modern electronics. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit.

- **220hm, 1k, 10k Resistor :**

  A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses.

- **LED :**

  A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

- **FTDI 232 USB to Serial Interface board :**

  Future Technology Devices International Limited, commonly known by its acronym FTDI, is a Scottish privately held semiconductor device company, specializing in Universal Serial Bus (USB) technology. It develops, manufactures, and supports devices and their related cables and software drivers for converting RS-232 or TTL serial transmissions to and from USB signals, in order to provide support for legacy devices with modern computers.

- **5 volt DC supply :**

  A power supply is needed for the hardware tools that are used in this system to operate. Since this system consumes less power supply, 5v DC supply is required.

- **Blynk application :**

  Blynk is an “Internet of Things” (IoT) platform that allows you to build your own apps to control certain devices over the internet. It makes their life easier by being able to control and monitor Blynk-compatible devices through their phone.

- **Arduino IDE :**

  Arduino is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices.

Figure 1.5.1: Hardware Tools

Chapter 2

LITERATURE SURVEY

2.1. Related Work

We have found different papers related to the security systems. Based on the purpose of the security camera, various systems are proposed and used. Ms. Sushma .N. Nichal and Prof. J.K. Singhhas done abstraction of Smart supervisor system using IOT based on embedded Linux O.S. with ARM11 architecture. In this paper they have implemented real-time image monitoring system and acquired data. They have also used PIR sensor. The system first requires authentication from user to activate the system if the system detect human it will send that data to the server or user smart phone.[1]

Shetel and Agarwal (2016) explains in their paper that IoT enables internet connectivity for all kind of devices and physical objects in real time system. The virtualization of this system enables to perform activities without direct physical synchronization between the devices. The IoT enables to manage multiple jobs without any limitation of distances with the help of intelligent devices and high-speed network.[2]

Gill et al. (2009) explains network enabled digital technology is rapidly introduced in the home automation. For the purpose of home automation this technology introduces new and existing opportunities to increase the connectivity of the devices. The remote-control technology is rapidly synchronizing with the expansion of Internet.[3]

Lee et al. (2017) explains in their paper the web of physical objects is Internet of Thing which contains the embedded technology helping in developing machine to machine or man to machine communication. This paper provides a dynamic data sheet about the city environment parameters taken from the stand-alone system.[3]

Sahadevan et al. (2017) explains in their paper how the Internet of Things is amazingly impacting the attention of consumers and the enterprise electronics market rapidly implementing in home automation, smart cities, automated industries, etc. To build these applications many power efficient and low cost sensors are available in the market for the developers.[4]

Chapter 2

2.2. Existing Systems

Traditional security system: They require a lot of wires and cables, and therefore, it takes a lot of time for its installation. A conventional security system requires long hours of installation, wiring and connection for its efficient working. Buying a security system is not what requires a lot of expertise and knowledge, installing it properly at the right angle requires a professional installer and its good hands-on training. A conventional security system is backed up with a lot of manual setups, a large stack of devices and certainly loads of wires and cables.

Security panel is the key operation center for your entire security system: It keeps a check of all the wireless sensors that are intact and in connection with it. A panel is a core and the brain of the entire system. The panel is responsible for all kinds of action taken by the security system. Nowadays most of the panels have a mini pad system which looks after the entire functioning of your automated security alarm system.

2.3. Limitation of Existing Systems

The already existing home surveillance systems are outdated, even if some of them used Internet of Things to make an automated system. The hardware and software tools which were used are not that effective and also consumes a lot of power. The earlier system is very expensive and has poor stability. It is not an efficient system. It is a low intelligence system. It provides weak security. These are the limitations of the existing system.

- Being fully wired, the connection can be interrupted with a single loose cable.
- Easy for burglars to chop off the wires.
- Limited access for homeowners.
- Less technological advancements.
- Hassle of manual planning and management

Chapter 2

2.4. Proposed System

In this paper we are proposing a Home Security System where it senses any intruders, takes picture, and sends directly to the smartphone. We are using ESP32-CAM and Internet of Things for this system. If some unauthorized person is coming near the home the camera will capture their photo and sends it to the phone using Wi-Fi and Blynk app. We are using a motion sensor which detects motion. IoT helps in signaling ESP32-CAM when the motion sensor detects something to take a picture, and then helps in sending the images directly to the smartphone.

In order to solve the limitations of the existing home surveillance systems on the market, this IoT solution uses an Intelligent controller along with a reliable software to access the data. This project has advantages such as higher intelligence, higher stability, and easy installation. The system detects the intruder and immediately and notifies the owner using the Blynk app as a notification alert and also as an email.

Chapter 3

METHODOLOGY

3.1. Dataset

Sensor data is very important in any project to find how system is performing or we just want to monitor a system. We can plot sensor data chart from cloud. So we don't need to be on same Wi-fi network, you can access sensor data from anywhere in the world. All this things will be going in Blynk App. The PIR motion sensor module senses the motion of an object through measuring infrared light radiating from it. Through Blynk app, we can see the dataset and charts regarding the PIR motion sensor module. Regarding the dataset of the images taken by ESP32-CAM, we can save all the images and store them through Blynk app. We can manage the settings of the images like deleting or sharing or archiving through the Blynk app itself.

3.2. Architecture

- The setup of ESP32-CAM with PIR motion sensor is connected to the breadboard as shown in the below figure. We need BC547 NPN transistor, GPIO 13, LED, 3 resistors (220hm, 1k, 10k) to complete the circuit along with ESP32-CAM and PIR motion sensor module.

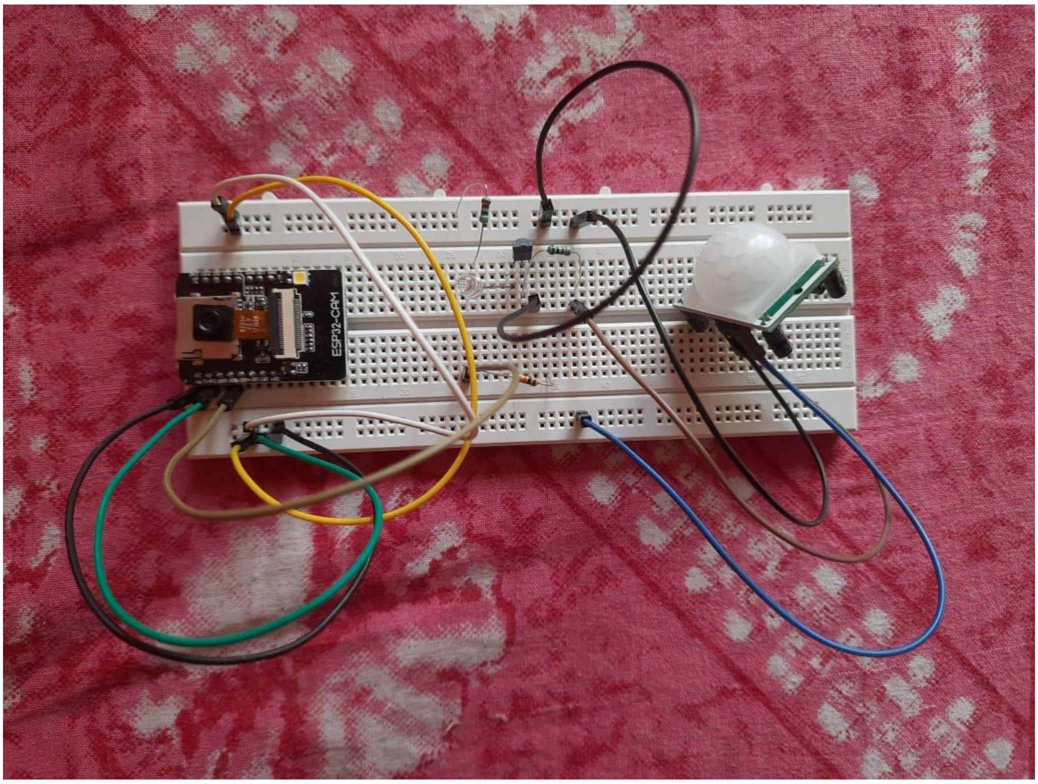

Figure 3.2.1: Circuit Connection

Chapter 3

- The following flow chart Explains the process of the project:

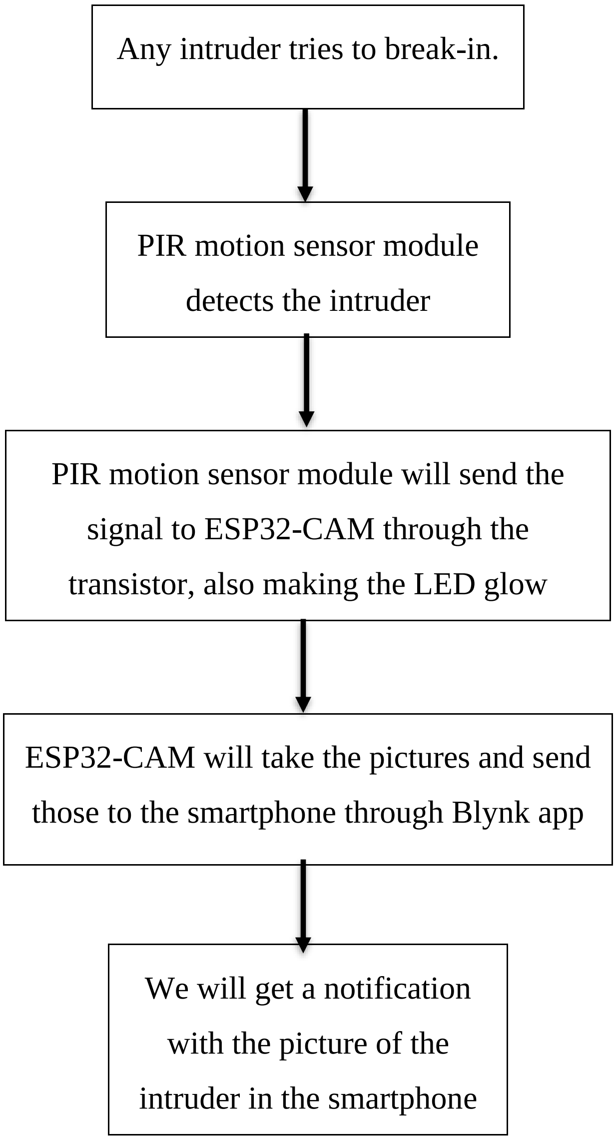

Figure 3.2.2: Flow Chart of the Methodology

We can also take pictures remotely from the smartphone through the Blynk app. We can also surveil the region through the smartphone, if you are connected to the same Wi-fi as that of this home surveilling system. The whole process of the project follows the above flow chart in order to accomplish the goal. It shows how both hardware tools and software tools work to achieve the same.

Chapter 3

3.3. Sequence Diagram

The Block diagram is very simple. So you can easily make this motion sensor security camera using the ESP32 CAM board, PIR motion sensor.

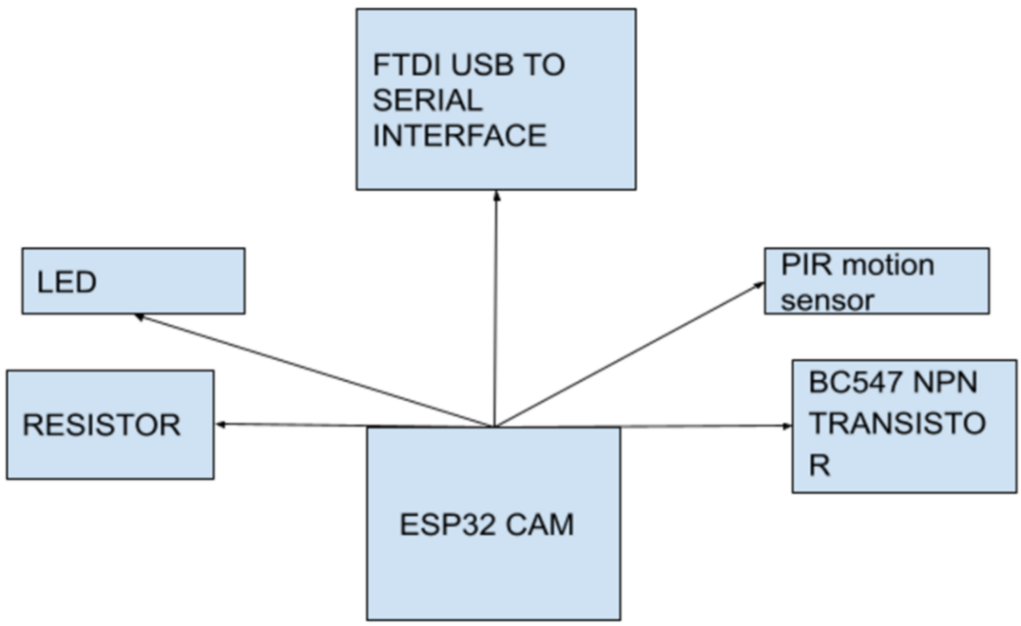

Figure 3.3.1: Sequence Diagram

Chapter 4

TOOL DESCRIPTION

4.1. Hardware Requirements

- **ESP32-CAM (AI Thinker)**

Brand	Super Debug
Model Number	ESP32 Camera WiFi+Bluetooth 4M PSRAM ESP32 5V Low-Power Dual-core 32-bit CPU,with OV2640 OV7670 2MP TF Card Camera Development Board for Wireless Monitoring and QR Wireless Identification
Type	Electronic Components
Minimum Age	3yrs
ROHS Complaint	Yes
Material	Copper
Power Source	DC
Width	3 cm
Height	1 cm
Weight	130gm

It is an ideal solution for 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. ESP-32CAM is packaged in DIP and can be directly plugged into the backplane for quick production. It provides customers with a highly reliable connection method and is convenient for use in various IoT hardware terminals.

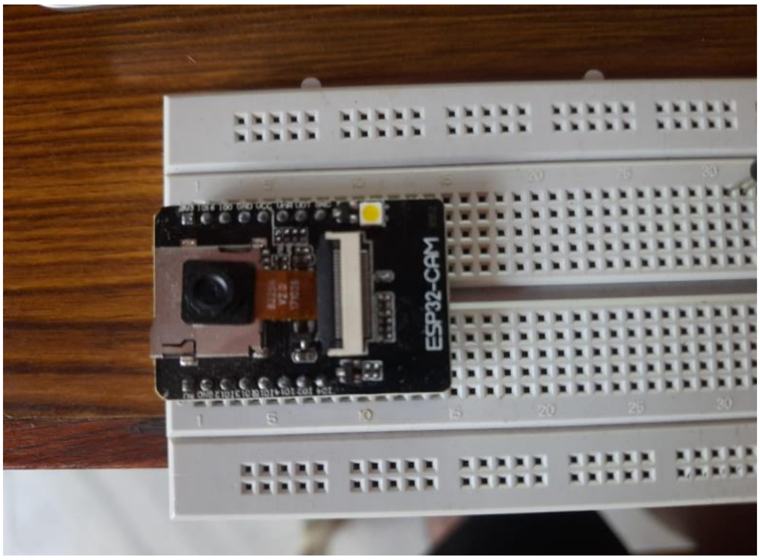

Figure 4.1.1: ESP32-CAM

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- **PIR Motion Sensor Module**

Brand	Raspberry Pi
Model Number	PIR Motion Sensor Detector Module HC-SR501
Type	Temperature Sensor and Controller
ROHS Complaint	Yes
Material	Epoxy
Power Source	DC
Power Consumption	DC 4.5V- 20V
Width	2 cm
Height	4 cm
Other Dimensions	3.2cm x 2.4cm x 1.8cm (Approx)
Weight	20gm

Infrared Sensor with Control Circuit Board, The Sensitivity and Holding Time Can be Adjusted, Current Drain: <60uA, Working Voltage Range: DC 4.5V- 20V, Detection Range: <140Â°, Voltage Output: High/Low level Signal: 3.3V TTL output, Delay Time: 5 to 200s (Can be Adjusted, Default 5s +/- 3%), Detection Distance: 3 to 7m (can be adjusted), Blockade time: 2.5s (Default), Work temperature: -10-+80Â°C, Dimension: 3.2cm x 2.4cm x 1.8cm (Approx)

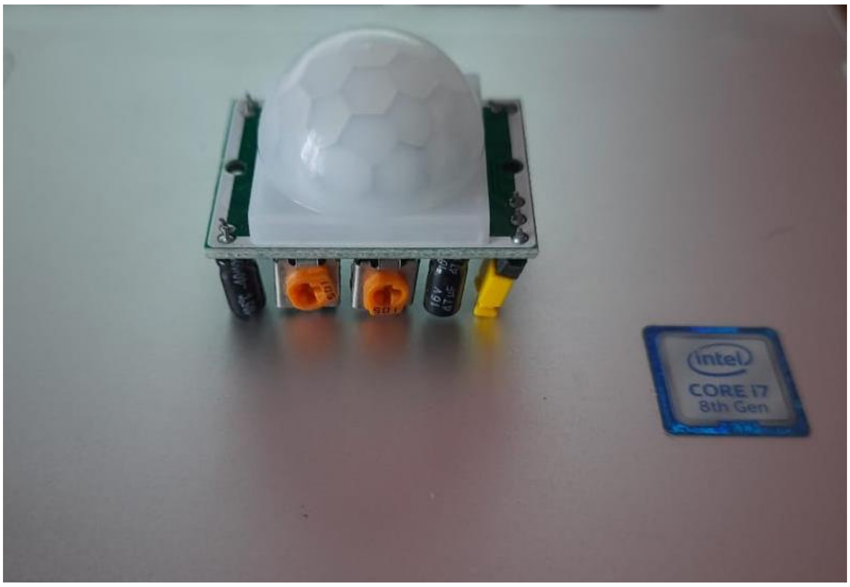

Figure 4.1.2: PIR Motion Sensor Module

Chapter 4

- **FTDI 232 USB to Serial Interface board**

Brand	Easy Electronics
Model Number	FT232RL FTDI USB to TTL Serial Converter Adapter Module - USB to UART
Type	Electronic Components
ROHS Complaint	No
Material	Epoxy
Width	5cm
Height	5cm
Weight	2gm
Power Source	DC

Chip: FT232RL. Draw out all signal port of FT232RL chip. Standard interface, compatible with a variety of official Ardui-no controller RXD / TXD transceiver communication indicator USB power supply, can choose 5V or 3.3V, set by jumper With over current protection, using 500mA self-restore fuse. Pin definition: DTR, RXD, TX, VCC, CTS, GND Pitch: 2.54mm. Size: 36 x 17.5mm (L x W). Interface: Mini USB

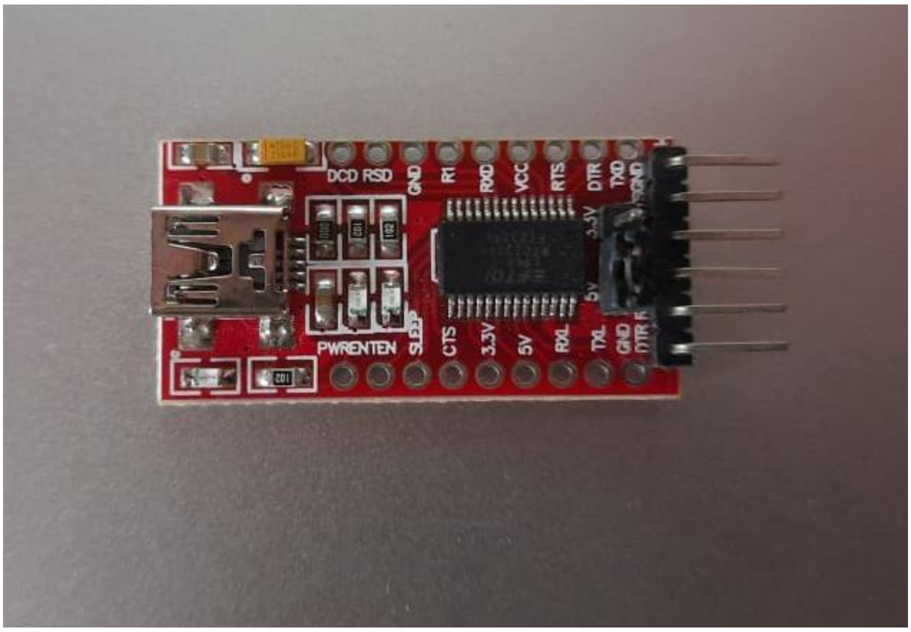

Figure 4.1.3: FTDI 232 USB to Serial Interface board

Chapter 4

4.2. Software Requirements

Blynk App

- Blynk supports hardware platforms such as Arduino, Raspberry Pi, and similar microcontroller boards to build hardware for your projects.
- Blynk supports the following connection types to connect your microcontroller board (hardware) with the Blynk Cloud and Blynk's personal server: Ethernet, Wi-Fi, Bluetooth, Cellular, Serial.
- The Blynk platform includes the following components:

Blynk app builder: Allows to you build apps for your projects using various widgets. It is available for Android and iOS platforms.

Blynk server: Responsible for all the communications between your mobile device that's running the Blynk app and the hardware. You can use the Blynk Cloud or run your private Blynk server locally. It's open source, could easily handle thousands of devices, and can even be launched on a Raspberry Pi.

Blynk libraries: Enables communication with the server and processes all the incoming and outcoming commands from your Blynk app and the hardware. They are available for all the popular hardware platforms.

All the aforementioned components communicate with each other to build a fully functional IoT application that can be controlled from anywhere through a preconfigured connectivity type. You can control your hardware from the Blynk app running on your mobile device through the Blynk Cloud or Blynk's personal server. It works the same in the opposite direction by sending rows of processed data from hardware to your Blynk app.

Arduino IDE :

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as **Windows, Mac OS X, and Linux**. It supports the programming languages C and C++. Here, IDE stands for **Integrated Development Environment**.

The program or code written in the Arduino IDE is often called as sketching. We need to connect

Chapter 4

the Genuino and Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension '.ino.

HOW ARDUINO IDE WORKS?

When a user writes code and compiles, the IDE will generate a Hex file for the code. (Hex file are Hexa Decimal files which are understood by Arduino) and then sent to the board using a USB cable. Every Arduino board is integrated with a microcontroller, the microcontroller will receive the hex file and runs as per the code written.

FUNCTIONS OF ARDUINO IDE:

Arduino IDE consists of different sections

1.WindowBar
2.MenuBar
3.ShortcutButtons
4.Text Editor
5.Output Panel

Chapter 5

IMPLEMENTATION

We have to upload the code onto ESP32-CAM for it to take pictures and send it to the smartphone through Blynk app. Before uploading the code to ESP32CAM, please check the following setting:

Update the Preferences-> Aditional boards Manager URLS:

https://dl.espressif.com/dl/package_esp32_index.json,

http://arduino.esp8266.com/stable/package_esp8266com_index.json

• Board Settings:

Board: "ESP32 Wrover Module"

Upload Speed: "921600"

Flash Frequency: "80MHz"

Flash Mode: "QIO"

Partition Scheme: "Hue APP (3MB No OTA/IMB SPIFFS)"

Core Debug Level: "None"

.COM Port: Depends On Your System

• GPIO O must be connected to GND pin while uploading the sketch

• After connecting GPIO 0 to GND pin, press the ESP32 CAM on-board RESET button to put the board in flashing mode.

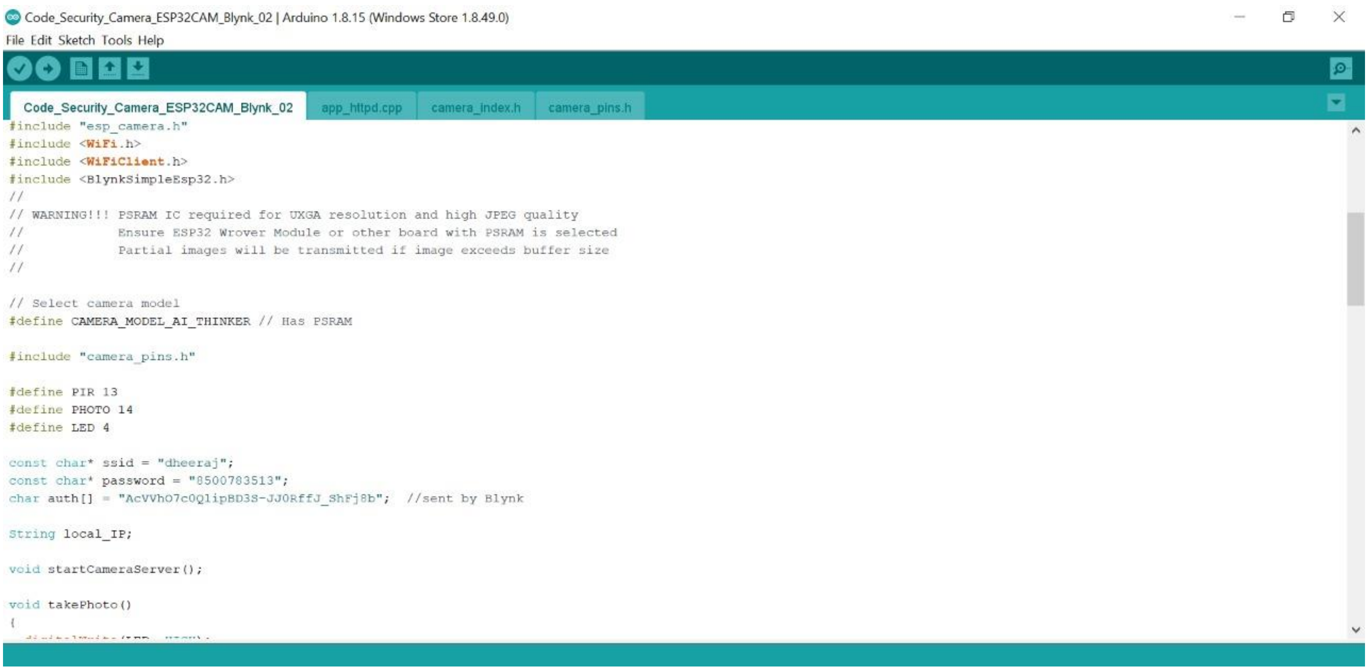

Figure 5.1.1: Main Code

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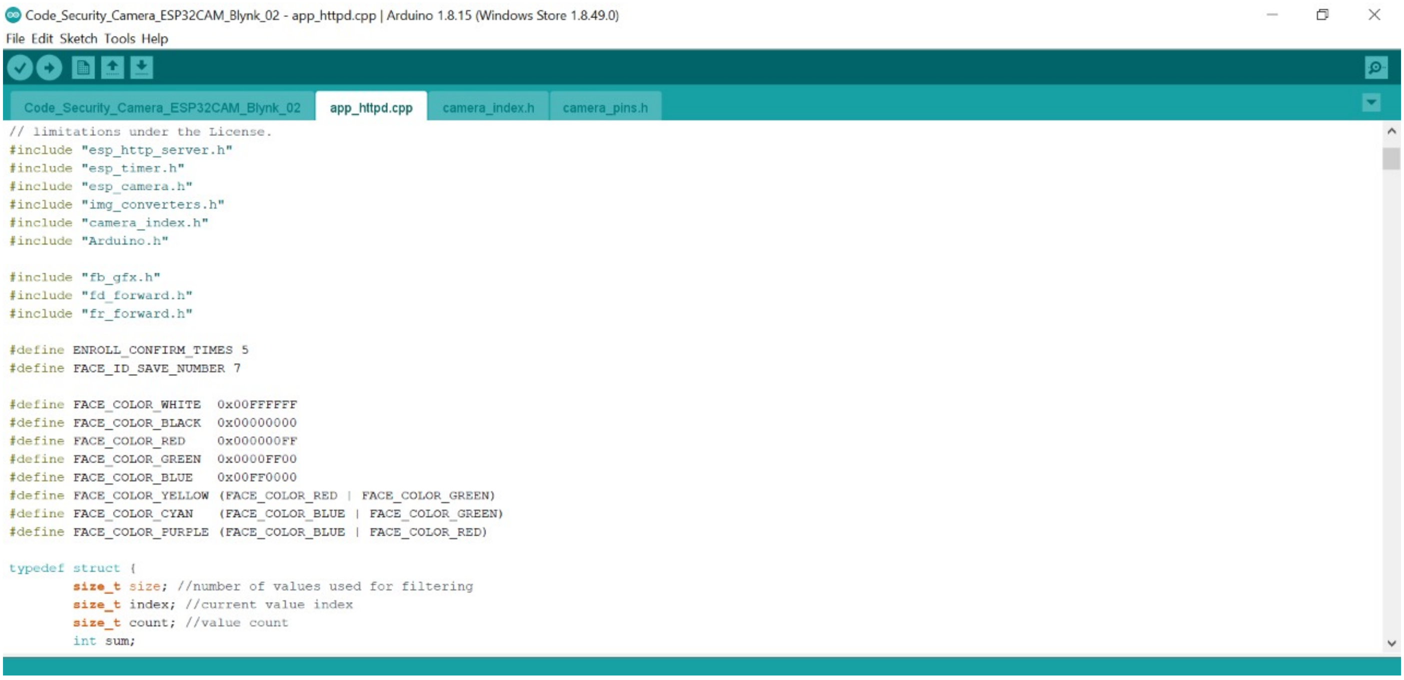

Figure 5.1.2: Code A

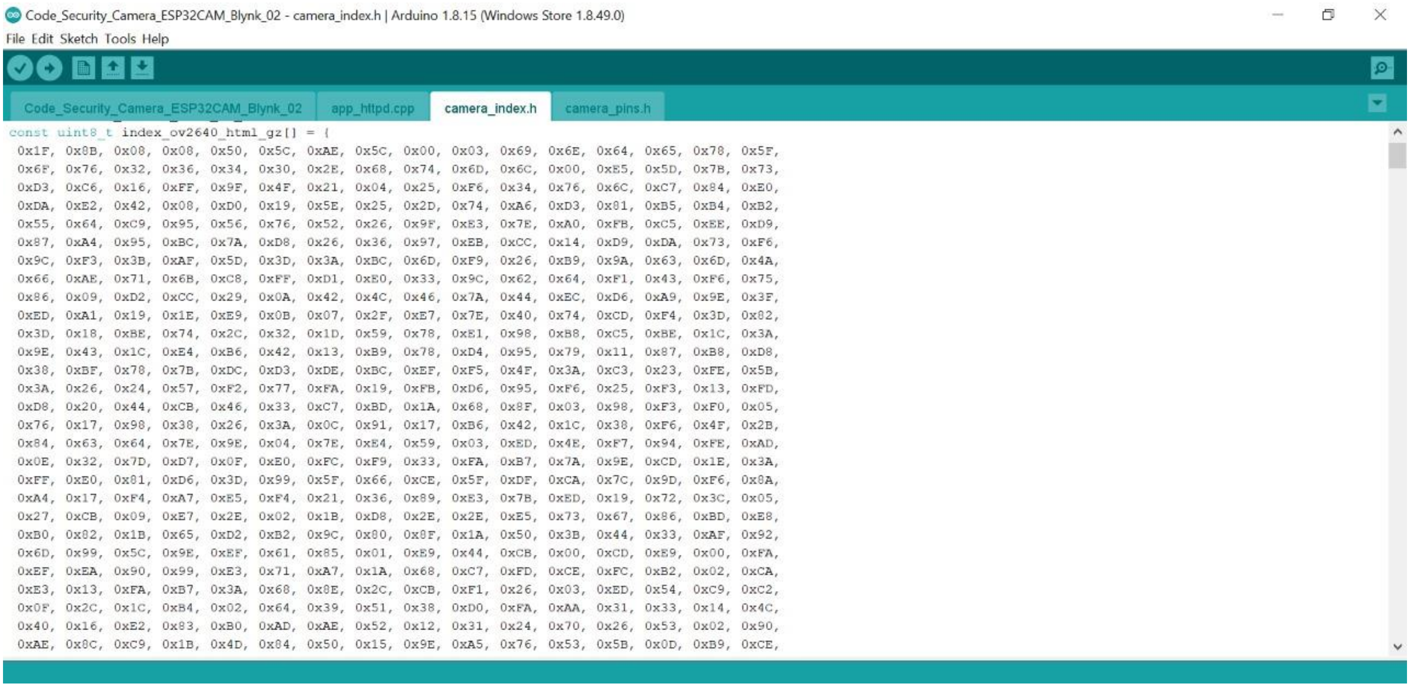

Figure 5.1.3: Code B

Chapter 5

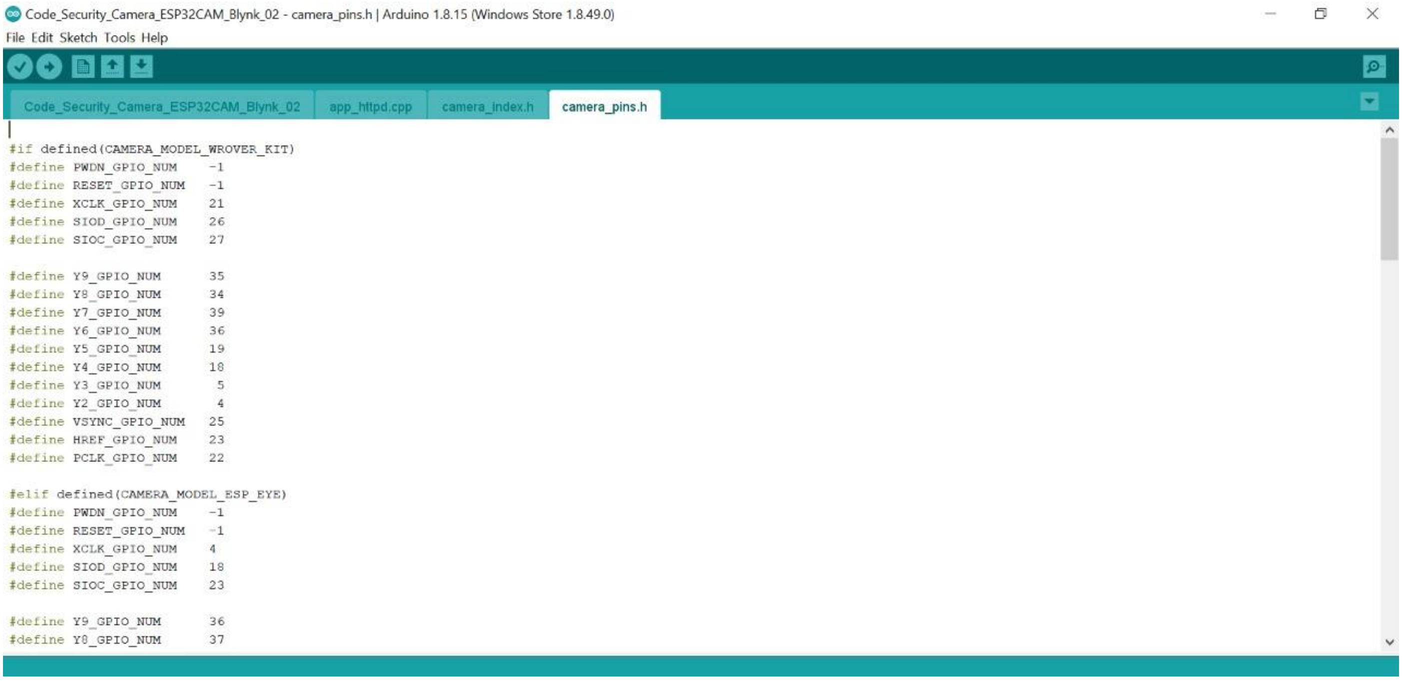

Figure 5.1.4: Code C

The above figures shows the code which is uploaded onto ESP32-CAM by Arduino IDE from the computer. The Main code o the project is shown in the figure 5.1.1. Figueres 5.1.2, 5.1.3 and 5.1.4 shows the extended codes of the main code.

Now that we uploaded the code onto ESP32-CAM, we have to setup the Blynk app for it to receive the pictures and also to take pictures through it remotely.

Steps for the Blynk App setup:

- Open the project in the Blynk App Click on the "+" icon on the top.
- Select the Image Gallery Widget from the Widget Box
  (Setting: Pin- V1) (Function: show the image)
- Select the Styled Button from the Widget Box
  (Setting: Pin- GP14, Mode- PUSH) (Function: capture photo)
- Select the Notification from the Widget Box
  (Function: get the notification)

Chapter 5

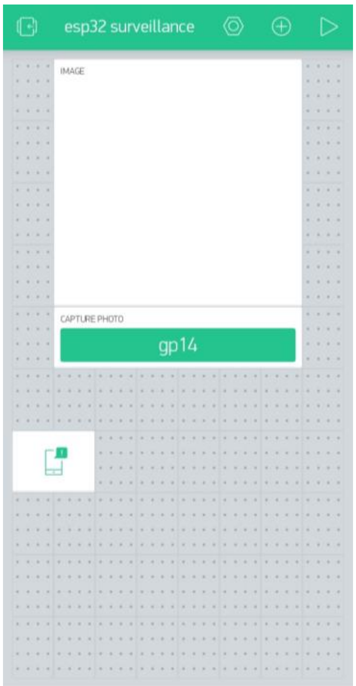

Figure 5.1.5: ESP32 Surveillance Pin

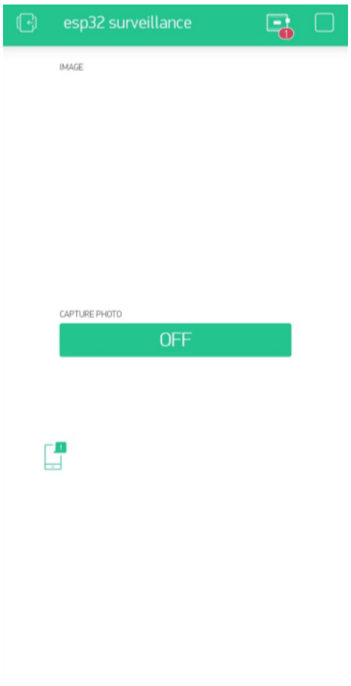

Figure 5.1.6: ESP32 Surveillance Off

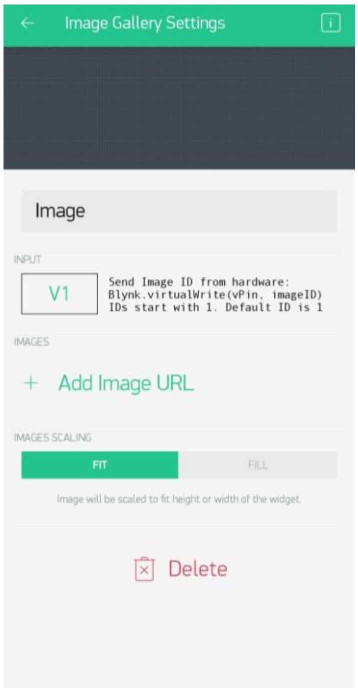

Figure 5.1.7: Image Gallery Settings

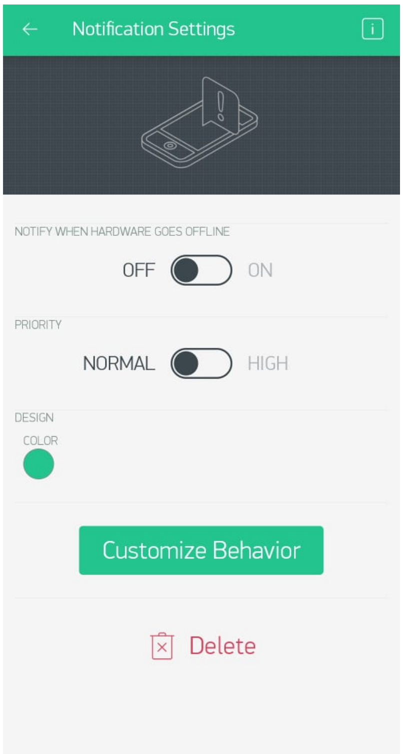

Figure 5.1.8: Notification Settings

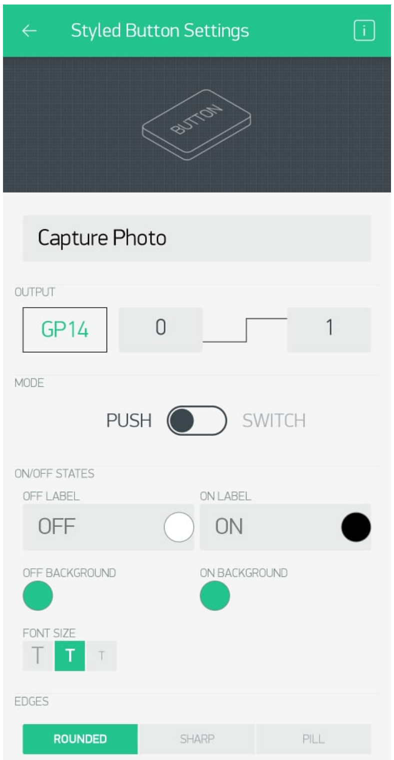

Figure 5.1.9: Styled Button Settings

Chapter 5

Figure 5.1.5 shows that the signal is received from gp14 pin, since in the circuit, we connected ESP32-CAM at that place. We have the facility to on and off the surveillance whenever we wish. When the surveillance is off, you can see figure 5.1.6 in the Blynk app. When PIR motion sensor detects no motion, we can see figure 5.1.7 in the Blynk app. If it senses any motion, instead of blank space we will can see the image of the intruder. We can also customize the notification settings as shown in the figure 5.1.8. Since we are able to take pictures through Blynk app remotely, we can customize the settings regarding the same as shown in the figure 5.1.9.

After the Blynk app setup we have tested the circuit. We Supplied 5V DC to this security camera circuit and connect your smartphone with the same Wi-Fi network. Now if the PIR sensor detects any motion, you should get a notification on the mobile phone. After that click on the ‘Take Picture’ button to get the picture. The camera can also take pictures in the dark as the inbuilt LED on the ESP32-CAM will provide sufficient light.

Chapter 6

RESULTS AND ANALYSIS

6.1. Result Discussion

The end result which is expected is for this system to take photos, whenever it senses a motion nearby it, and then send those pictures directly to our smartphone. We should also be able to take the pictures through ESP32-CAM from our smartphone. If this system is able to achieve the above, we can say that it serves its purpose. The following are the steps I took to check whether this system works properly or not.

We installed the Blynk app in my smartphone, which is connected to the board and sends notification when ESP32-CAM takes a photo. After the Blynk app setup I have tested the circuit. We installed the circuit board at my front door. Then we supplied 5V DC to this security camera circuit and connect your smartphone with the same Wi-Fi network. Now if the PIR sensor detects any motion, you should get a notification on the mobile phone. After that click on the ‘Take Picture’ button to get the picture. Later on we was able to take multiple pictures remotely with the help of the Blynk app. The camera can also take pictures in the dark as the inbuilt LED on the ESP32-CAM will provide sufficient light.

After the whole setup, the system sent pictures directly to my phone when it sensed any motion. We was also able to take the pictures through my phone, which means the results are astounding. The system worked as expected in theory, and provided better results.

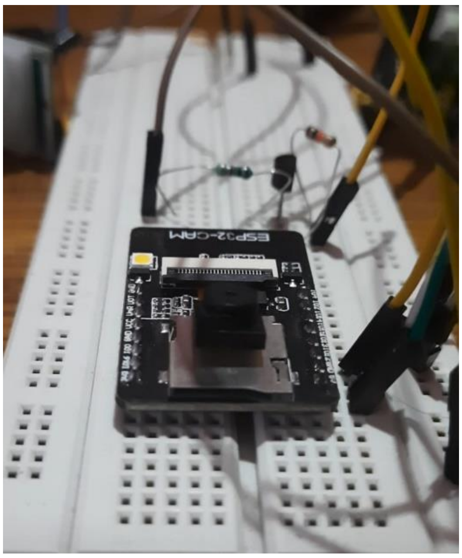

Figure 6.1.1: Camera before detecting intruder

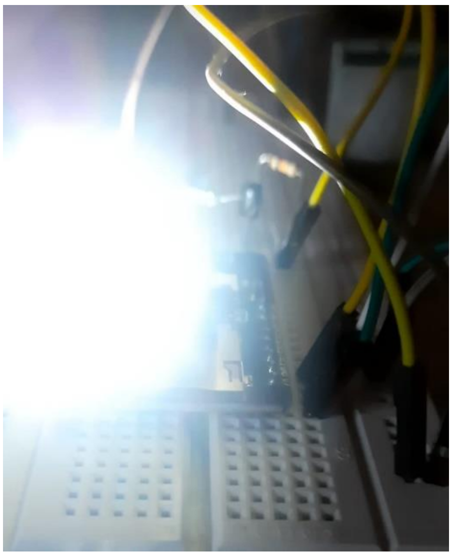

Figure 6.1.2: Camera Flash after detecting intruder

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When the PIR motion sensor module doesn't detect any intruder, ESP32-CAM looks as in figure 6.1.1. After detecting the intruder, it send a signal to the camera to take the picture. When this happens the camera will flash as in figure 6.1.2.

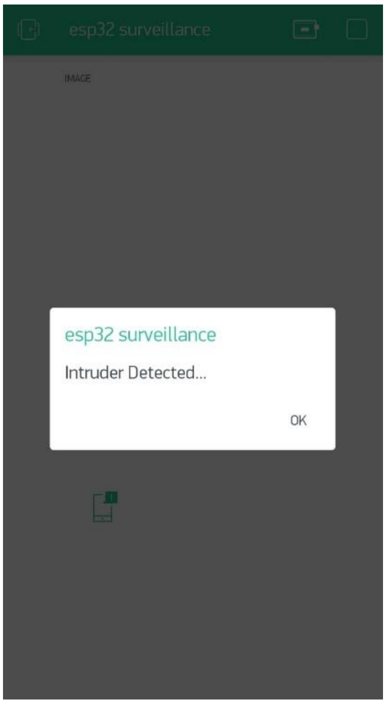

Figure 6.1.3: Notification 1 on intruding

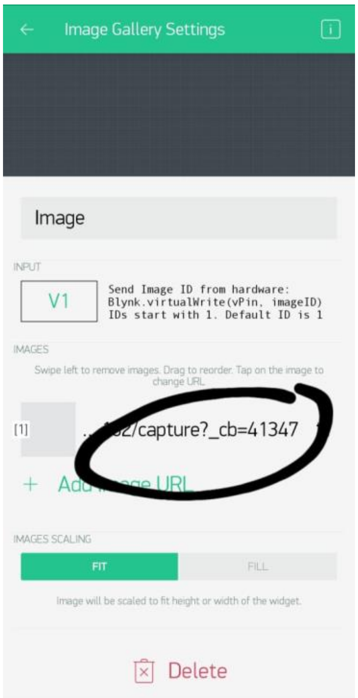

Figure 6.1.4: Image 1

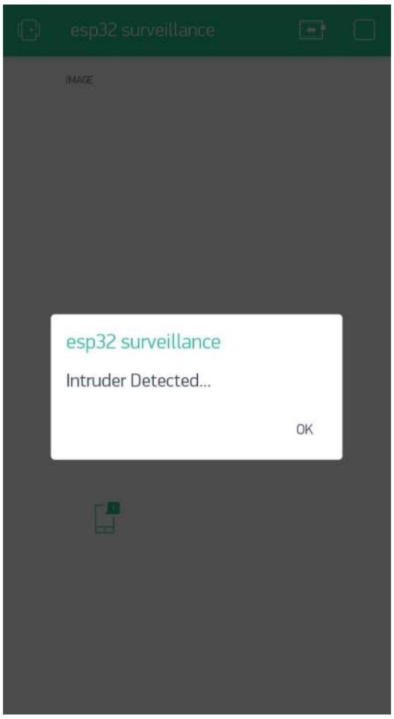

Figure 6.1.5: Notification 2 on intruding

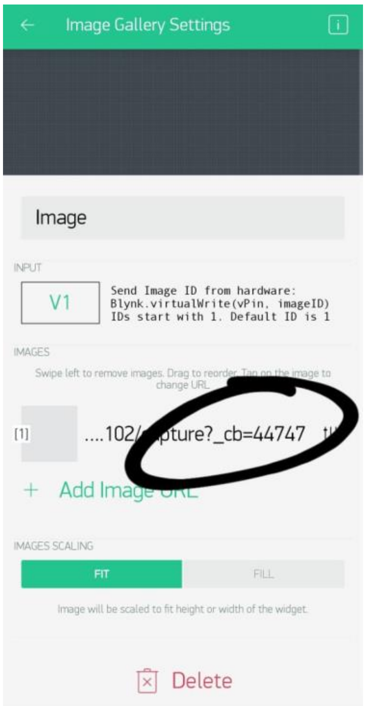

Figure 6.1.6: Image 2

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When the camera clicks the picture of the intruder, it will send the notification to your phone through Blynk app. In the figures 6.1.3 and 6.1.5, we can see the notification sent to the phone. If we open the image widget, we will be able to see the images taken by the camera. In figures 6.1.4 and 6.1.6, we can see the different image URLs taken by the camera at different times. Thus we can conclude that we got the results which are intended to achieve in the project.

6.2. Comparison with Previous Studies

As compared to the previous studies, this system is more efficient, more affordable, and easier to install, operate and maintain. Various hardware and software tools are available on the market to make a home surveillance system. This system consumes very less power than others. By using the best and cheaper versions, this home surveillance system has many advantages as compared to the others. But for this surveillance system, we need constant internet to get the notifications to the smartphone. Some systems in the market may not use internet to notify, but those are very expensive to be afforded by common people. In conclusion, we can say that this home surveillance system has more advantageous as compared to the other systems.

	Previous system	**Proposed system**
Speed	Slow (it’s manual)	Fast (it’s automatic)
Complexity	Very complex	Easy to operate/ maintain
Power consumption	High	Low
WiFi facility	Not needed	Must
User expertise	Advanced	Basic
Price	Very expensive	Affordable
Efficiency	More efficient	Less efficient
User Friendly	No	Yes
Takes much time/ efforts	Yes	No

Table 1: Comparison Of Proposed And Existing Systems

Chapter 6

6.3. Analysis

After comparing and analyzing, we can observe that the proposed home surveillance system is more efficient, affordable, easy to use, and less power consuming than the existing or traditional home surveillance systems available on the market. So we may even expect this system to take over the traditional market in the near future. On the other hand, a constant need of Wi-Fi is there for this system to work. Since Wi-fi facilities are becoming more cheaper and available (even in remote areas) day by day, we can remove this as a factor of disadvantage in the coming future. Or maybe a perfect combination of the traditional and modern system can be made, which will have best of the both worlds. But for the present scenario, the proposed system has more advantages than the traditional system from the analysis.

Chapter 7

CONCLUSIONS AND FUTURE SCOPE

Based on the survey of all these papers different authors have presented different security systems. We have found that most of the security systems are developed using ESP32, because it is cost effective and it is easily programmable and also connected to internet. ESP32 can work with various sensors like PIR to detect movement of person, smoke sensor to detect fire and temperature sensor to detect temperature. With the help of ESP32 and PIR person can implement security system which will be accessed remotely and user will be notify about the illegal activity. We can conclude that every person needs cost effective security system. There are different tools and parameters are used to provide the security. These security systems are useful for securing many places from remote location using mobile devices.

There is a great scope that the future of home surveilling systems may become more affordable and efficient than the present ones. In the future cheaper than ESP32 cams may come, which will make the surveillance system more affordable. The sensitivity of the motion sensors may increase, which increases the efficiency of the surveillance system. More simpler surveillance systems may be possible in the future, which can be operated by kids. Better apps than Blynk may exist, which will be very easy to use with just a simple click. Maybe a complete different approach is found to surveil in future. Whatever it is, the future holds more advantageous and improvised systems as the technology is continuously growing rapidly.

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APPENDIX

Project Main Code:

```
#include "esp_camera.h"
#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
//
// WARNING!!! PSRAM IC required for UXGA resolution and high JPEG quality y
//            Ensure ESP32 Wrover Module or other board with PSRAM is selected
//            Partial images will be transmitted if image exceeds buffer size
//

// Select camera model
#define CAMERA_MODEL_AI_THINKER // Has PSRAM

#include "camera_pins.h"

#define PIR 13
#define PHOTO 14
#define LED 4

const char* ssid = "dheeraj";
const char* password = "8500783513";
char auth[] = "AcVVhO7c0QlipBD3S-JJ0RffJ_ShFj8b";  //sent by Blynk

String local_IP;

void startCameraServer();

void takePhoto()
{
  digitalWrite(LED, HIGH);
  delay(200);
  uint32_t randomNum = random(50000);
  Serial.println("http://"+local_IP+"/capture?_cb="+ (String)randomNum);
  Blynk.setProperty(V1, "urls", "http://"+local_IP+"/capture?_cb="+(String)randomNum);
  digitalWrite(LED, LOW);
  delay(1000);
}

void setup() {
  Serial.begin(115200);
  pinMode(LED,OUTPUT);
  Serial.setDebugOutput(true);
  Serial.println();

  camera_config_t config;
  config.ledc_channel = LEDC_CHANNEL_0;
  config.ledc_timer = LEDC_TIMER_0;
```

APPENDIX

```
config.pin_d0 = Y2_GPIO_NUM;
config.pin_d1 = Y3_GPIO_NUM;
config.pin_d2 = Y4_GPIO_NUM;
config.pin_d3 = Y5_GPIO_NUM;
config.pin_d4 = Y6_GPIO_NUM;
config.pin_d5 = Y7_GPIO_NUM;
config.pin_d6 = Y8_GPIO_NUM;
config.pin_d7 = Y9_GPIO_NUM;
config.pin_xclk = XCLK_GPIO_NUM;
config.pin_pclk = PCLK_GPIO_NUM;
config.pin_vsync = VSYNC_GPIO_NUM;
config.pin_href = HREF_GPIO_NUM;
config.pin_sscb_sda = SIOD_GPIO_NUM;
config.pin_sscb_scl = SIOC_GPIO_NUM;
config.pin_pwdn = PWDN_GPIO_NUM;
config.pin_reset = RESET_GPIO_NUM;
config.xclk_freq_hz = 20000000;
config.pixel_format = PIXFORMAT_JPEG;

// if PSRAM IC present, init with UXGA resolution and higher JPEG quality
//                      for larger pre-allocated frame buffer.
if(psramFound()){
  config.frame_size = FRAMESIZE_UXGA;
  config.jpeg_quality = 10;
  config.fb_count = 2;
} else {
  config.frame_size = FRAMESIZE_SVGA;
  config.jpeg_quality = 12;
  config.fb_count = 1;
}

// camera init
esp_err_t err = esp_camera_init(&config);
if (err != ESP_OK) {
  Serial.printf("Camera init failed with error 0x%x", err);
  return;
}

sensor_t * s = esp_camera_sensor_get();
// initial sensors are flipped vertically and colors are a bit saturated
if (s->id.PID == OV3660_PID) {
  s->set_vflip(s, 1); // flip it back
  s->set_brightness(s, 1); // up the brightness just a bit
  s->set_saturation(s, -2); // lower the saturation
}
// drop down frame size for higher initial frame rate
s->set_framesize(s, FRAMESIZE_QVGA);

WiFi.begin(ssid, password);
```

APPENDIX

```
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");

  startCameraServer();

  Serial.print("Camera Ready! Use 'http://");
  Serial.print(WiFi.localIP());
  local_IP = WiFi.localIP().toString();
  Serial.println("' to connect");
  Blynk.begin(auth, ssid, password);
}

void loop() {
  // put your main code here, to run repeatedly:
  Blynk.run();
  if(digitalRead(PIR) == LOW){
  Serial.println("Send Notification");
  Blynk.notify("Intruder Detected...");
  Serial.println("Capture Photo");
  takePhoto();
  delay(3000);
  }
  if(digitalRead(PHOTO) == HIGH){
  Serial.println("Capture Photo");
  takePhoto();
  }
}
```