AUTOMATIC THREAT DETECTION AND THEFT TRAPPING THROUGH VIDEO SURVEILLANCE SYSTEM

A PROJECT REPORT

Submitted by

CHANDRASEKAR CS (720818106006)

JAYESH PT (720818106016)

ANSON THOMAS (720818106702)

In partial fulfillment for the award of the degree

Of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

HINDUSTHAN INSTITUTE OF TECHNOLOGY

ANNA UNIVERSITY : CHENNAI 600 025

ANNA UNIVERSITY : CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report entitled **"AUTOMATIC THREAT DETECTION AND THEFT TRAPPING THROUGH VIDEO SURVEILLANCE SYSTEM"** is the bonafide work of "**CHANDRASEKAR C S, JAYESH P T, ANSON THOMAS"** who carried out the project work under my supervision.

SIGNATURE

Dr. B .PAULCHAMY, M.E.,Ph.D.,

HEAD OF THE DEPARTMENT,

Professor & Head,

Department of Electronics and Communication Engineering,

Hindusthan Institute of Technology,

Coimbatore -32.

SIGNATURE

Mrs.R.PRIYADHARSHINI, M.E

SUPERVISOR,

Assistant Professor,

Department of Electronics and Communication Engineering,

Hindusthan Institute of Technology,

Coimbatore- 32.

Submitted for the University Project viva-voice conducted on .....

---------- ----------

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ACKNOWLEDGEMENT

We express our sincere thanks to almighty god , the guiding light of our life for giving us the potential and courage to complete this project successfully.

We would like to express our sincere thanks to the Chairman **Sri.T.S.R.KANNAIYAN** and **Smt. SARASWATHI KHANNAIYAN** of Hindusthan Educational and Charitable Trust for providing the facilities within the College.

We express our gratitude to **Dr. C.NATARAJAN ,M.E.,Ph.D** Principal. We take it as a privilege to express our profuse thanks for his encouragement and facilities provided to complete the project successfully.

We owe our deep gratitude to, **Dr. B.PAULCHAMY, M.E., Ph.D**., Professor and Head of Electronics and communication Department, who took keen interest in our project work and guided us all along, till the completion of our project work by providing all the necessary information for developing a good system.

We Profoundly indebted to our Supervisor **Mrs.R.PRIYADHARSHINI,M.E**., for her invaluable cordial support, valuable information and guidance, which helped us in completing the project through various stages.

We are thankful to and fortunate enough to get constant encouragement, support and guidance from all Teaching staff of Electronics and communication Engineering which helped us in successfully completing our project work. Also, I would like to extend our sincere esteems to all staff in the laboratory for their timely support.

We would like to thank our family and friends for supporting us throughout the years, financially, practically and with moral support to complete our project.

ABSTRACT

Close Circuit Television Camera (CCTV) has played a very important role in many surveillance and security systems. However, such a system requires continuous monitoring by humans and hence there is a possibility of failure because of boredom or fatigue. The requirements of continuous monitoring can be avoided using sensor systems which can alert the human on the occurrence of undesired events. Sensors only detect events and do not provide information about the threat. By analyzing the captured video, information about the threat and cause can be obtained very quickly and accurately in order to take mitigating actions. This paper reviews different approaches for detecting objects and its motion, tracking of object and activity consequences in order to prevent adverse uences. It also proposes methodology to improve the security of Nuclear Power Plants using existing approaches with appropriate modification.

CONTENT

LIST OF FIGURES

LIST OF ABBREVIATIONS

ABBREVIATION	EXPANSION
API	Application Programming Interface
GCP	Google Cloud Platform
SaAS	Software As A Service
AWS	Amazon Web Service
NC	Normally Close
NO	Normally Open
CMOS	Complementary Metal Oxide Semiconductor
LED	Light Emitting Diode
IC	Integrated Circuit
PWM	Pulse Width Modulation
UART	Universal Asynchronous Receiver/Transmitter
PCC	Power Control Center
PCB	Printed Circuit Board

CHAPTER 1

INTRODUCTION

1.1 PROJECT OVERVIEW

One of the most important concerns in the modern day world, be it for homes or businesses is security. An estimated 2,000,000 burglaries are reported each year in the United States out of which 66% are attributed to break-ins. An increased number of people in the workforce limits the amount of time that people spend at home leaving home security vulnerable. In addition to break-ins, the rise of online shopping led to skyrocketed porch pirating in recent times. An estimated 25.9 million Americans reported porch pirating in 2017 which was up from 25.3 million in 2017. This paper focuses on addressing home and business security concerns by providing a motion detection solution using Raspberry Pi and Camera. Automated video surveillance systems have emerged as an important research topic in the computer vision community. The growth in this area is being driven by the increased availability of inexpensive computing power and image sensors, as well as by the inefficiency of manual surveillance and monitoring system Applications such as event detection, human action recognition, and semantic indexing of video are being developed in order to partially or fully automate the task of surveillance.

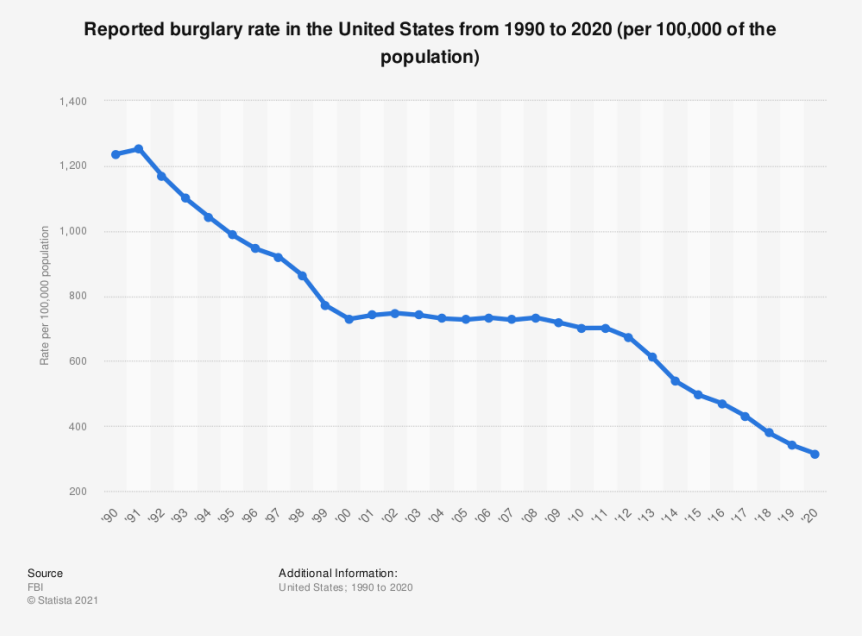

Figure 1.1 : Burglary Rate

The Raspberry Pi is a small-sized computer (almost the size of a credit-card) that has the ability to plug into a computer monitor or any other display and can be connected to a keyboard and mouse for operation. It has an operating system called Raspbian OS and can be a very handy system to run applications in programming languages like Scratch and Python. Although small, the Raspberry Pi is a system that approximates a desktop or a laptop in terms of functionality. The Raspberry Pi can also connect to the internet. Mundane activities performed on a desktop/ laptop such as browsing the internet, spreadsheet creation, word processing and gaming can all be performed on the Raspberry Pi.

A smart surveillance security camera system can have many benefits for industrial site, including (Reduced theft, protect employees, building security, remote monitoring of facility from Smartphone or tablet, deter trespassers from attempting to gain access to facility). The problematic for surveillance system or CCTV camera is costly because of the use many expensive components like computer, camera, cable, also we need a hard disk with higher capacity for save video It reserves too much space for continues recording and require manpower to detect the unauthorized Activity. But compared to Raspberry Pi, the system is much cheaper with high resolution and low power consumption features. Which means it can solve many of the issues of cost that may discourage consumers from investing in remote surveillance technology.

1.2 STRUCTURE OF THE PROJECT

Chapter 2 – Deals with Literature Survey

Chapter 3 – Deals with Existing system

Chapter 4 – Deals with Proposed Methodology

Chapter 5- Deals with Results and Discussion

Chapter 6– Deals with Conclusion

CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

Our focus is to design a system that will detect threats in time under different lighting conditions using camera and sensor networks. This paper reviews different approaches for detecting objects and its motion, tracking of object and activity analysis in order to prevent adverse consequences. The requirements of continuous monitoring can be avoided using sensor systems which can alert the human on the occurrence of undesired events.

The system introduced by Khot Harish S, Gote Swati R, Khatal Sonali B, Pandarge Sangmesh introduces intelligent analysis of single person activity to enhance the security system in home and also enriches the current video surveillance systems through an automatic identification of abnormal behavior of the person. Smart Surveillance is the use of automatic video analytics to enhance effectiveness of surveillance systems. Smart video surveillance systems are capable of enhancing situational awareness across multiple scales of space and time.

Moreover, there is a need to display which frame and which parts of the recording contain the uncommon activity which helps the quicker judgment of that unordinary action being unusual or suspicious. We intend to utilize different Deep Learning models (CNN and RNN) to identify and classify levels of high movement in the frame. From there, we can raise a detection alert for the situation of a threat, indicating the suspicious activities at an instance of time.

2.2 EXTRACTING KNOWLEDGE FROM EXISTING METHODOLOGY

- **Automatic Alert of Security Threat through Video Surveillance System**

Close Circuit Television Camera (CCTV) has played a very important role in many surveillance and security systems. However, such a system requires continuous monitoring by humans and hence there is a possibility of failure because of boredom or fatigue. The requirements of continuous monitoring can be avoided using sensor systems which can alert the human on the occurrence of undesired events. Sensors only detect events and do not provide information about the threat. Hence use of CCTV camera and sensor systems, independently or jointly, may not

be sufficient for timeliness detection of undesired events. When combined with humans and sensors, cameras can provide an immediate method to assess a scene of interest. Human efforts in monitoring can be greatly reduced by using activity analysis of video captured by CCTV. By analyzing the captured video, information about the threat and cause can be obtained very quickly and accurately in order to take mitigating actions. However, in the absence of light, the camera cannot detect such a threat. Hence, some hybrid techniques need to be implemented, which can work in different lighting conditions. So our focus is to design a system that will detect threats in time under different lighting conditions using camera and sensor networks. The system will be aided with smart, measureable, reliable and robust algorithms for motion detection, tracking and activity analyses. This paper reviews different approaches for detecting objects and its motion, tracking of object and activity analysis in order to prevent adverse consequences. It also proposes methodology to improve the security of Nuclear Power Plants using existing approaches with appropriate modification.

- **Smart Video Surveillance Khot Harish S, Gote Swati R, Khatal Sonali B, Pandarge Sangmesh**

Video Surveillance has been used in many applications including elderly care and home nursing etc. Smart video surveillance systems are capable of enhancing situational awareness across multiple scales of space and time. It describes mobile based remote control and surveillance architecture. This project makes use of the Opencv library to capture camera images and detect intrusion using image comparison techniques. Once the comparison is done and an intrusion is found, it sends the streamed video from server to remote administrator over android phone. Admin can then take appropriate action and alert local security. Smart Surveillance is the use of automatic video analytics to enhance effectiveness of surveillance systems. This system introduces intelligent analysis of single person activity to enhance the security system in home and also enriches the current video surveillance systems through an automatic identification of abnormal behavior of the person. The relevant data is recorded and an alert is given to the user by sending MMS, SMS or mail. The user can view the particular video. This system maintains the security situation at home and this reduces the incidence of burglary cases and enhances social stability.

❖ **Real-Time Anomaly Recognition Through CCTV Using Neural Networks**

Nowadays, there has been a rise in the amount of disruptive and offensive activities that have been happening. Due to this, security has been given principal significance. Public places like shopping centers, avenues, banks, etc are increasingly being equipped with CCTVs to guarantee the security of individuals. Subsequently, this inconvenience is making a need to computerize this system with high accuracy. Since constant observation of these surveillance cameras by humans is a near-impossible task. It requires workforces and their constant attention to judge if the captured activities are anomalous or suspicious. Hence, this drawback is creating a need to automate this process with high accuracy. Moreover, there is a need to display which frame and which parts of the recording contain the uncommon activity which helps the quicker judgment of that unordinary action being unusual or suspicious. Therefore, to reduce the wastage of time and labor, we are utilizing deep learning algorithms for Automating Threat Recognition Systems. Its goal is to automatically identify signs of aggression and violence in real-time, which filters out irregularities from normal patterns. We intend to utilize different Deep Learning models (CNN and RNN) to identify and classify levels of high movement in the frame. From there, we can raise a detection alert for the situation of a threat, indicating the suspicious activities at an instance of time.

2.3 SUMMARY

The automated video surveillance system has risen as a significant research topic in the field of public security. A lot of work has been reported, addressing the movement recognition and tracking of an object. Artificial intelligence has also contributed a lot to reduce workload and increase the efficiency of surveillance. There have been numerous attempts to partially or completely automate this task with applications like Event detection, human activity recognition, and behavior analysis. Anomaly recognition is quite a challenging and time-honored concern of Computer Vision . To recognize the violent or aggressive pattern from the recordings in real-time surveillance applications. The system needs to perform multiple attempts.

CHAPTER 3

METHODOLOGIES

3.1 INTRODUCTION

A CCTV (closed-circuit television) system allows the use of video cameras to monitor the interior and exterior of a property, transmitting the signal to a monitor or set of monitors. It keeps the video footage in any storage system like a hard disk. The system consumes more spaces in disk storage to save the video footage. It can monitor anything in its range. But Now many physical attacks towards surveillance systems will cause complete damage to the system.

Figure 3.1 CCTV

3.2 LIMITATIONS

- Existing system cannot prevent any attack towards the surveillance system.
- Consume More disk space to store video footage

3.3 PROPOSED SYSTEM

Considering the drawbacks of the existing system, to overcome these problems, the proposed system aims to ensure security of both surveillance and

surveillance systems by implementing a motion detection system, which can easily be controlled by users around the globe and the users can control it from sitting at one place. In this proposed system, users can easily track people present at that particular surroundings that will analyze their activities if the system finds anything suspicious it will take action accordingly.The user has to set a few parameters in order to let the system know about their choices about the type of security they want. When a person is detected by the system, an image is sent to the user so that they can know all about the activities that are going on in the surroundings.This system also helps in capturing the persons who are creating the undesirable activities and method of trapping such as, closing of doors when a trespasser enters, emergency messages and notifications, release of gas which causes numbness that will help in securing the environment. By using these techniques we can easily trap the trespassed person and catch them without any physical interaction. This system is not only secure but also it helps in finding the trespasser and can take immediate actions towards it, which makes it more unique then the present system.

Technically speaking, this project is mainly implemented using a microcomputer called the raspberry pi along with this, a camera is also attached with the same. Looking onto the user's application, there will be a start button, a stop button as well as an image button. The user can access the live feed of the camera attached which would help the user know about the real time instances.As soon as the start button is clicked by the user,motion detection is activated accordingly. Whenever even a small motion is detected by the camera, real time images are sent to the cloud and sends a push notification as well as an alert music starts playing on the user's mobile phone alerting the user about the movement in that particular area. Clicking upon the image button will let the user know about the incident. If any unwanted activities are tracked, trapping methods would be activated immediately. Hence this secured system helps in tracking down trespassers as well as taking immediate action against them.

3.4 ADVANTAGES

- Prevention of theft can be easily done using this method without any physical damage.
- Detection of theft can be done efficiently using this technique.
- This system can be controlled anywhere and the prevention method can be executed easily.

3.5 BLOCK DIAGRAM

The Block diagram consists of a Raspberry Pi, Pi Cam, Relays and Sprayer. The Raspberry Pi is the brain of the system. Then a Pi Camera to capture video. Other peripheral components like Electric sprayer, Relays are connected to the Raspberry Pi GPIO. The entire system connected to the cloud via the internet.

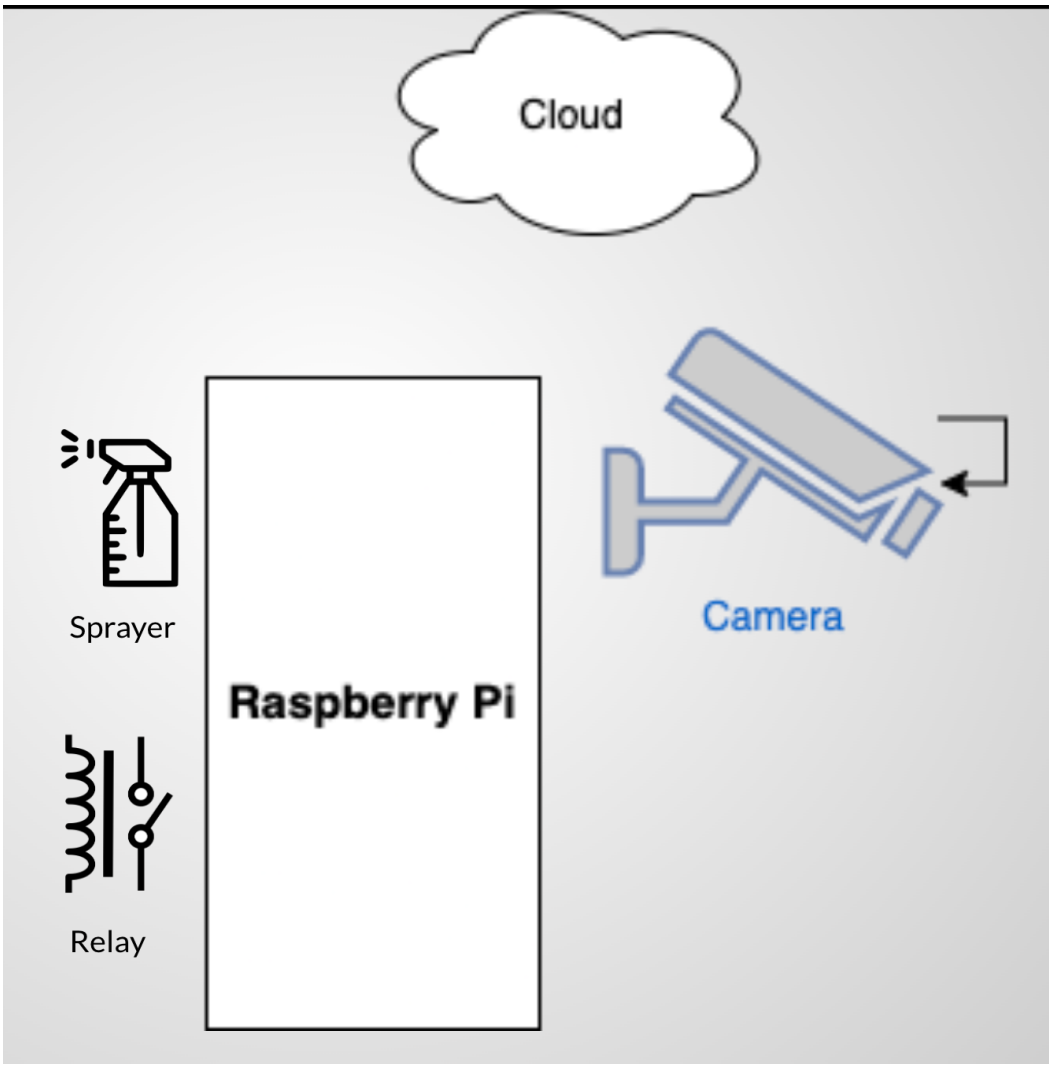

Figure 3.2 : Block Diagram

3.6 CIRCUIT DIAGRAM

The Peripheral parts, Relay module pins Input 1(INT1) and Input 2(INT2) are connected to GPIO06 and GPIO13 of the Raspberry Pi GPIO. The VCC and GND also took from the Raspberry Pi itself. The LED indicator is connected to GPIO26 and Buzzer is connected to GPIO19. The Pi Cam is connected to an FFC pin.

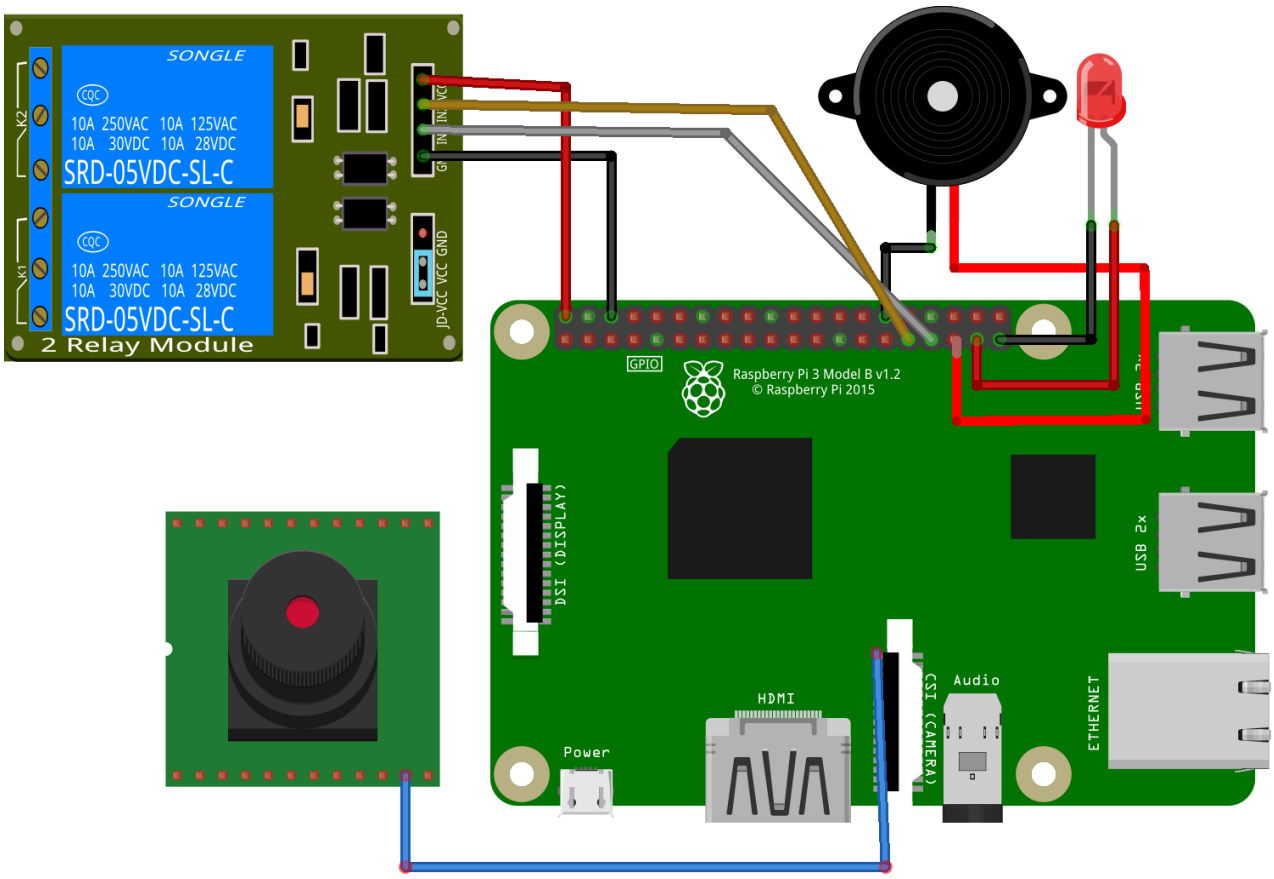

Figure 3.3 : Circuit Diagram

3.7 FLOW CHART

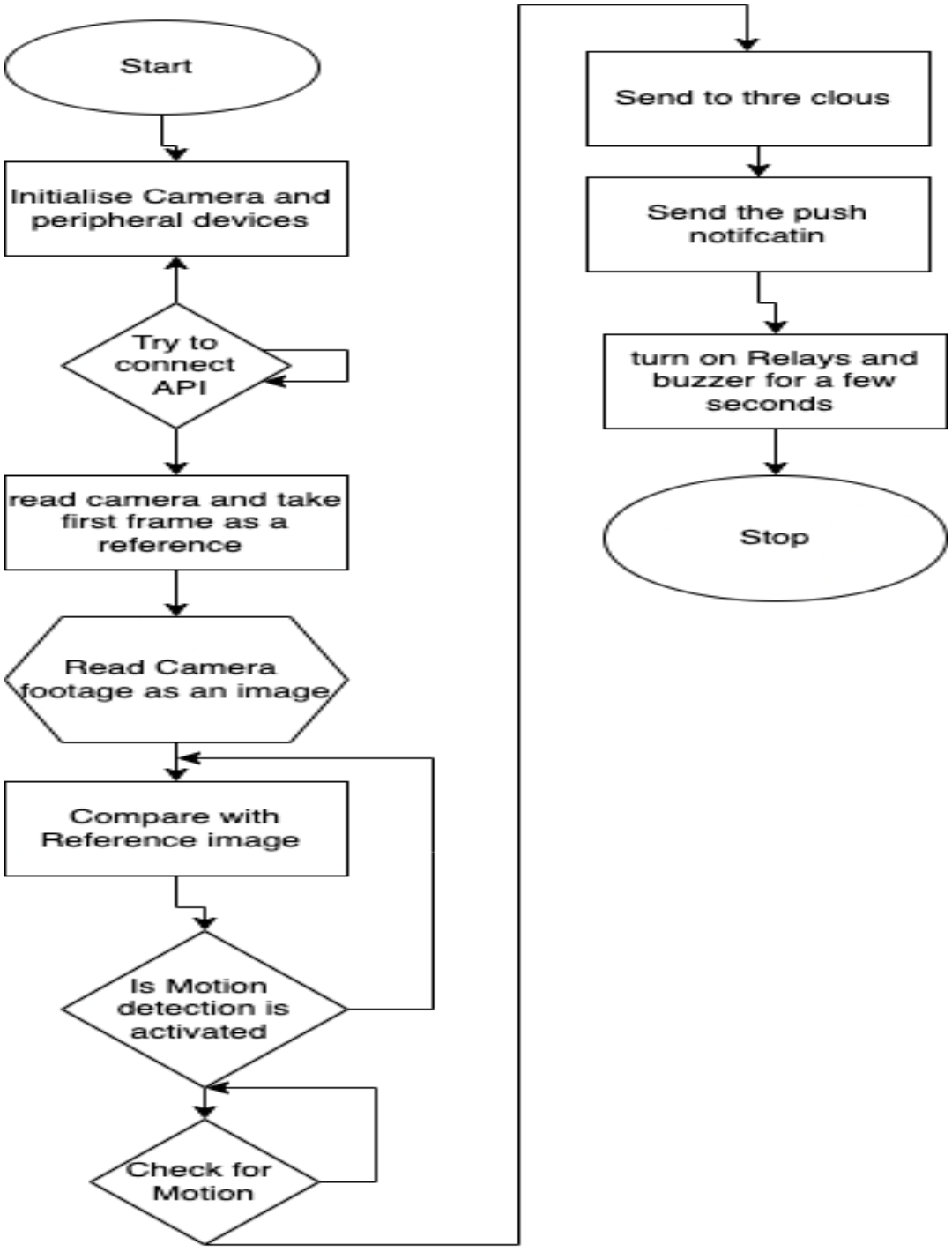

Figure 3.4 : Flow chart

3.8 ALGORITHM

1. START
2. Initialize Peripheral devices and Camera
3. Check internet connection
    a. If not, repeat the step 3
4. Connect to API
5. Start video camera
6. Take first image as a reference and save into a variable
7. Read next frame
8. Compare with Next image
9. Check for motion
    a. If Motion, Proceed to next step
    b. Else, Repeat step 7 onwards
10. Send image to cloud
11. Turn on Relay, Buzzer and LED
12. Wait for 2 Second
13. Turn of Relay, buzzer and LED
14. Send Push notification to the user
15. Repeat the step from 7 onwards
16. STOP

CHAPTER 4

HARDWARE DESCRIPTION

4.1 RASPBERRY PI

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games. The Raspberry Pi has the ability to interact with the outside world, and has been used in a wide array of digital maker projects.

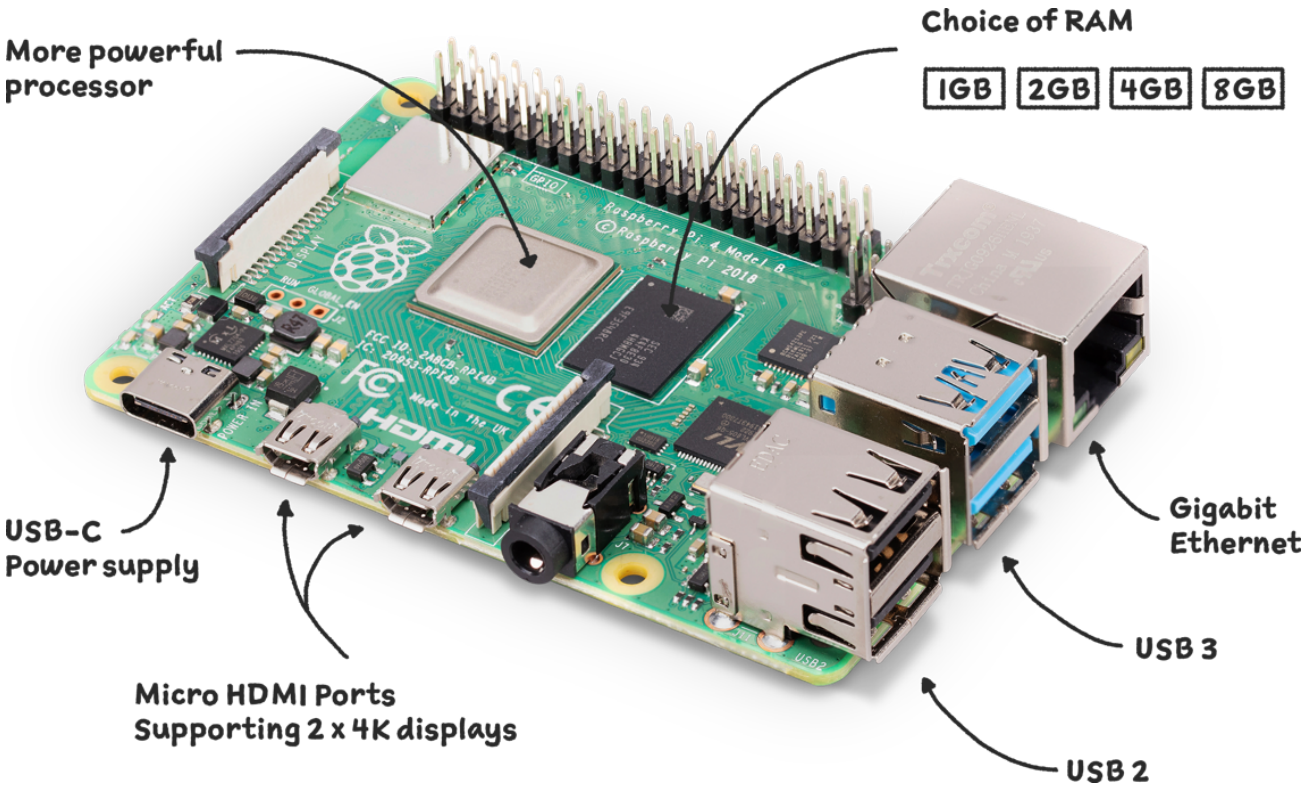

Figure 4.1 Raspberry Pi

Raspberry Pi 4 Model B is the latest product in the popular Raspberry Pi range of computers. It offers ground-breaking increases in processor speed,

multimedia performance, memory, and connectivity compared to the prior-generation Raspberry Pi 3 Model B+, while retaining backwards compatibility and similar power consumption. For the end user, Raspberry Pi 4 Model B provides desktop performance comparable to entry-level x86 PC systems. This product's key features include a high-performance 64-bit quad-core processor, dual-display support at resolutions up to 4K via a pair of micro-HDMI ports, hardware video decode at up to 4Kp60, up to 4GB of RAM, dual-band 2.4/5.0 GHz wireless LAN, Bluetooth 5.0, Gigabit Ethernet, USB 3.0, and PoE capability (via a separate PoE HAT add-on). The dual-band wireless LAN and Bluetooth have modular compliance certification, allowing the board to be designed into end products with significantly reduced compliance testing, improving both cost and time to market.

4.2 SPECIFICATIONS

- Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
- 1GB, 2GB or 4GB LPDDR4-2400 SDRAM (depending on model)
- 2.4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth 5.0, BLE
- Gigabit Ethernet
- 2 USB 3.0 ports; 2 USB 2.0 ports.
- Raspberry Pi standard 40 pin GPIO header (fully backwards compatible with previous boards)
- 2 × micro-HDMI ports (up to 4kp60 supported)
- 2-lane MIPI DSI display port
- 2-lane MIPI CSI camera port
- 4-pole stereo audio and composite video port
- H.265 (4kp60 decode), H264 (1080p60 decode, 1080p30 encode)
- OpenGL ES 3.0 graphics
- Micro-SD card slot for loading operating system and data storage
- 5V DC via USB-C connector (minimum 3A*)
- 5V DC via GPIO header (minimum 3A*)
- Power over Ethernet (PoE) enabled (requires separate PoE HAT)
- Operating temperature: 0 – 50 degrees C ambient

4.3 GPIO PINS

The GPIO is the most basic, yet accessible aspect of the Raspberry Pi. GPIO pins are digital which means they can have two states, off or on. They can have a direction to receive or send current (input, output respectively) and we can control the state and direction of the pins using programming languages such as Python, JavaScript, node-RED etc.

The operating voltage of the GPIO pins is 3.3v with a maximum current draw of 16mA. This means that we can safely power one or two LEDs (Light Emitting Diodes) from a single GPIO pin, via a resistor. But for anything requiring more current, a DC motor for example, we will need to use external components to ensure that we do not damage the GPIO.

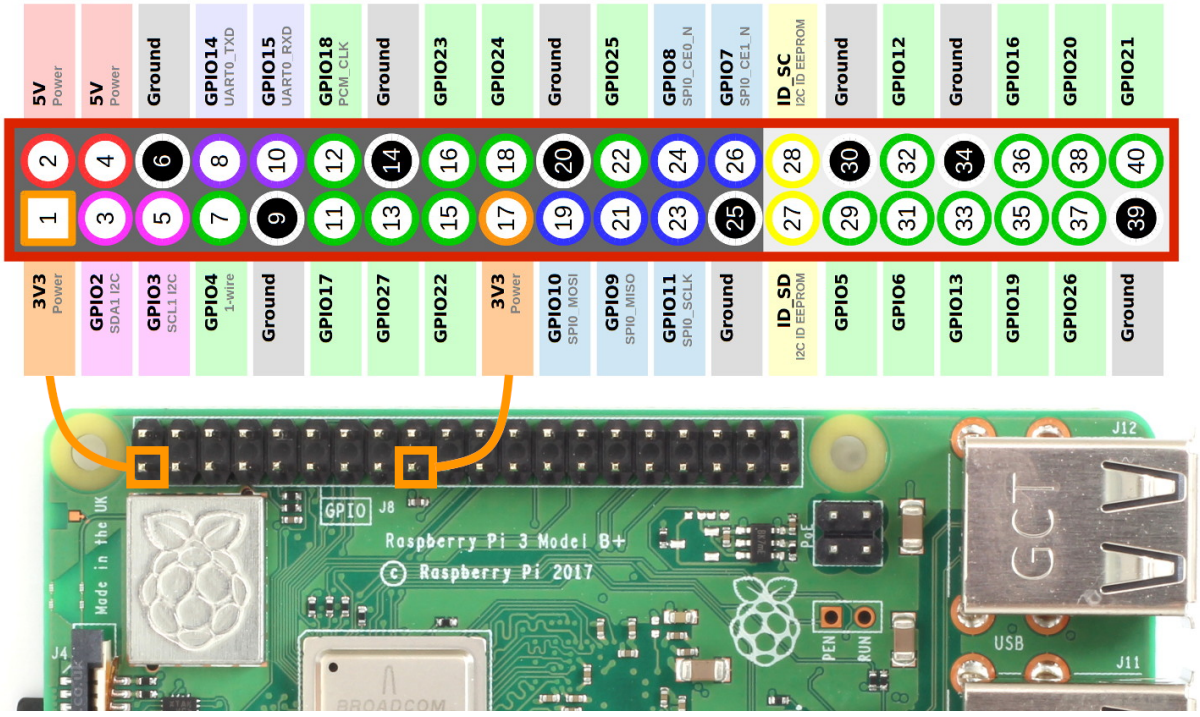

Figure 4.2 : Rpi GPIO Pinout

Controlling a GPIO pin with Python is accomplished by first importing a library of pre-written code. The most common library is RPi.GPIO (https://pypi.org/project/RPi.GPIO/) and it has been used to create thousands of projects since the early days of the Raspberry Pi. In more recent times a new library called GPIO Zero (https://pypi.org/project/gpiozero/)has been introduced, offering

an easier entry for those new to Python and basic electronics. Both of these libraries come pre-installed with the Raspbian operating system.

GPIO pins have multiple names; the first most obvious reference is their "physical" location on the GPIO. Starting at the top left of the GPIO, and by that we mean the pin nearest to where the micro SD card is inserted, we have physical pin 1 which provides 3v3 power. To the right of that pin is physical pin 2 which provides 5v power. The pin numbers then increase as we move down each column, with pin 1 going to pin 3, 5,7 etc until we reach pin 39. You will quickly see that each pin from 1 to 39 in this column follows an odd number sequence. And for the column starting with pin 2 it will go 4,6,8 etc until it reaches 40. Following an even number sequence. Physical pin numbering is the most basic way to locate a pin, but many of the tutorials written for the Raspberry Pi follow a different numbering sequence.

Broadcom (BCM) pin numbering (aka GPIO pin numbering) seems to be chaotic to the average user. With GPIO17, 22 and 27 following on from each other with little thought to logical numbering. The BCM pin mapping refers to the GPIO pins that have been directly connected to the System on a Chip (SoC) of the Raspberry Pi. In essence we have direct links to the brain of our Pi to connect sensors and components for use in our projects.

You will see the majority of Raspberry Pi tutorials using this reference and that is because it is the officially supported pin numbering scheme from the Raspberry Pi Foundation. So it is best practice to start using and learning the BCM pin numbering scheme as it will become second nature to you over time. Also note that BCM and GPIO pin numbering refer to the same scheme. So for example GPIO17 is the same as BCM17.

Certain GPIO pins also have alternate functions that allow them to interface with different kinds of devices that use the I2C, SPI or UART protocols. For example GPIO3 and GPIO 4 are also SDA and SCL I2C pins used to connect devices using the I2C protocol. To use these pins with these protocols we need to enable the interfaces using the Raspberry Pi Configuration application found in the Raspbian OS, Preferences menu.

4.4 PI CAMERA

This Raspberry Pi Camera Module is a custom designed add-on for Raspberry Pi. It attaches to Raspberry Pi by way of one of the two small sockets on the board upper surface. This interface uses the dedicated CSI interface, which was designed especially for interfacing to cameras. The CSI bus is capable of extremely high data rates, and it exclusively carries pixel data. The board itself is tiny, at around 25mm x 23mm x 8mm. It also weighs just over 3g, making it perfect for mobile or other applications where size and weight are important. It connects to Raspberry Pi by way of a short flexible ribbon cable. The camera connects to the BCM2835 processor on the Pi via the CSI bus, a higher bandwidth link which carries pixel data from the camera back to the processor. This bus travels along the ribbon cable that attaches the camera board to the Pi. The sensor itself has a native resolution of 5 megapixels and has a fixed focus lens onboard. In terms of still images, the camera is capable of 2592 x 1944 pixel static images, and also supports 1080p30, 720p60 and 640x480p60/90 video.

4.5 PI CAMERA SPECIFICATION

- Fully Compatible with Both the Model A, Model B and Model B+ Raspberry Pi
- 5MP Omnivision 5647 Camera Module Still
- Picture Resolution: 2592 x 1944
- Video: Supports 1080p @ 30fps, 720p @ 60fps and 640x480p 60/90 Recording
- 15-pin MIPI Camera
- Serial Interface - Plugs Directly into the Raspberry Pi
- Board Size: 20 x 25 x 9mm
- Weight 3g

Figure 4.3 Raspberry Pi Camera

4.6 RELAY MODULE

A relay is an electromagnetic switch operated by a relatively small current that can control much larger current. Initially the first circuit is switched off and no current flows through it until something (either a sensor or switch closing) turns it on. The second circuit is also switched off. When a small current flows through the first circuit, it activates the electromagnet, which generates a magnetic field all around it. The energized electromagnet attracts contact in the second circuit toward it, closing the switch and allowing a much bigger current to flow through the second circuit. When the current stops flowing, the contact goes back up to its original position, switching the second circuit off again.

This module is designed for switching two high powered devices from your Arduino. It has two relays rated up to 10A per channel at 250VAC or 30VDC. There are two LEDs on the relay module indicating the position of the relay. Whenever a relay is activated, the respective LED will light up. One of the best things about

these modules is that they come with two Optocoupler ICs which provide good isolation between relay and Arduino.

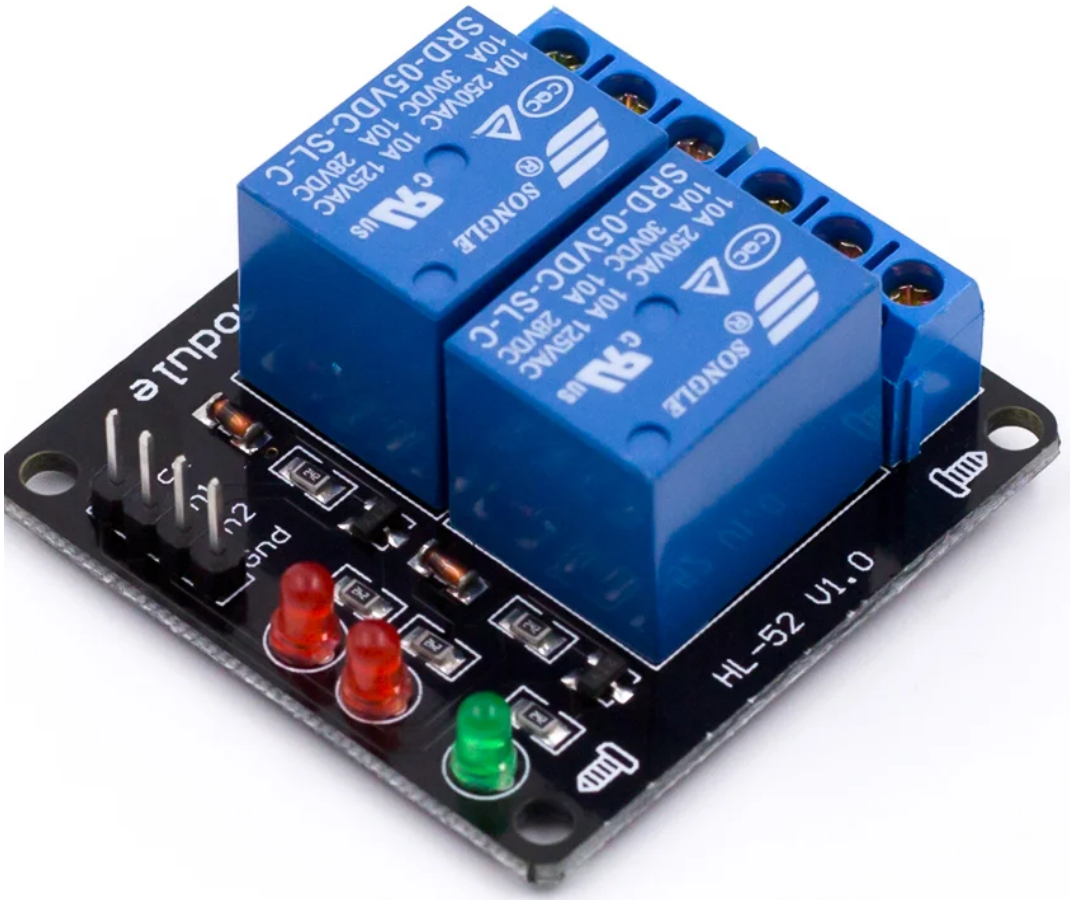

Figure 4.4 Relay Module

4.7 FEATURES

- Good for safe control of higher amperage circuits.
- In power systems, the lower current can control the higher one.
- 2-channel high voltage system output, meeting the needs of dual channel control.
- Brand new and high quality.
- Standard interface that can be controlled directly by microcontroller (Arduino , 8051, AVR, PIC, DSP, ARM)]
- Wide range of controllable voltages.
- Being able to control high load current, which can reach 250V, 10A or 125V, 15A With a normally-open (NO) contact and a normally-closed (NC) contact.
- Around the board with 4 mounting holes, easy installation and fixing It has a common end, a beginning, a closed-end

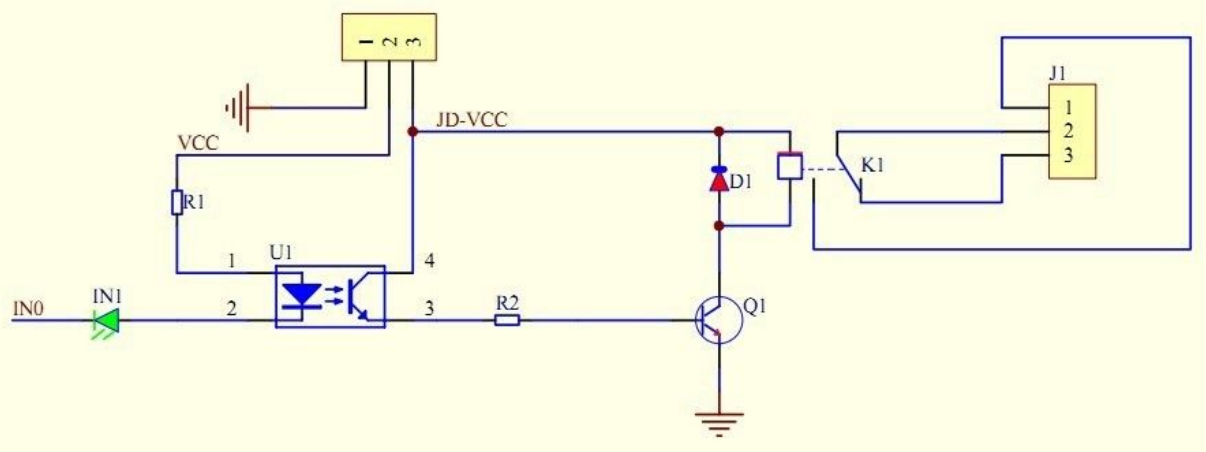

Figure 4.5 Relay Schematic

4.8 BUZZER

Buzzer is an active buzzer, which basically means that it will buzz at a predefined frequency (2300 ±300 Hz) on its own even when you just apply steady DC power. Advantage to an active buzzer is that you can still produce a sound from the buzzer connected to a microcontroller, such as an Arduino, by just driving a standard high output on the connected pin. The benefits of this are that you don't need to use processing power, hardware timers, or additional code to produce sound.

4.9 BUZZER SPECIFICATION

- Rated Voltage - 5 V
- Operating Voltage 4~8 V
- Max Rated Current - ≤32 mA
- Min. Sound Output at 10cm - 85 dB
- Resonant Frequency - 2300 ±300 Hz
- Operating Temperature - -20°C to 45°C
- Dimensions (Excluding Pins) Height 9.16 mm, Diameter 11.78 mm
- Weight - 1.6 g

Figure 4.6 : Buzzer

4.10 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.

Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared (IR) light. Infrared LEDs are used in remote-control circuits, such as those used with a wide variety of consumer electronics. The first visible-light LEDs were of low intensity and limited to red. Early LEDs were often used as indicator lamps, replacing small incandescent bulbs, and in seven-segment displays. Recent developments have produced LEDs available in visible, ultraviolet (UV), and infrared wavelengths, with high, low, or intermediate light output, for instance white LEDs suitable for room and outdoor area lighting.

LEDs have also given rise to new types of displays and sensors, while their high switching rates are useful in advanced communications technology with applications as diverse as aviation lighting, fairy lights, automotive headlamps, advertising, general lighting, traffic signals, camera flashes, lighted wallpaper, horticultural grow lights, and medical devices. LEDs have many advantages over incandescent light sources, including lower power consumption, longer lifetime,

improved physical robustness, smaller size, and faster switching. In exchange for these generally favorable attributes, disadvantages of LEDs include electrical limitations to low voltage and generally to DC (not AC) power, inability to provide steady illumination from a pulsing DC or an AC electrical supply source, and lesser maximum operating temperature and storage temperature. In contrast to LEDs, incandescent lamps can be made to intrinsically run at virtually any supply voltage, can utilize either AC or DC current interchangeably, and will provide steady illumination when powered by AC or pulsing DC even at a frequency as low as 50 Hz. LEDs usually need electronic support components to function, while an incandescent bulb can and usually does operate directly from an unregulated DC or AC power source.

Figure 4.7 : LED

CHAPTER 5

SOFTWARE SETUP

5.1 PYTHON

Python is an easy to learn, powerful programming language. It has efficient high-level data structures and a simple but effective approach to object-oriented programming. Python's elegant syntax and dynamic typing, together with its interpreted nature, make it an ideal language for scripting and rapid application development in many areas on most platforms. The Python interpreter and the extensive standard library are freely available in source or binary form for all major platforms from the Python web site, https://www.python.org/, and may be freely distributed. The same site also contains distributions of and pointers to many free third party Python modules, programs and tools, and additional documentation. The Python interpreter is easily extended with new functions and data types implemented in C or C++ (or other languages callable from C). Python is also suitable as an extension language for customizable applications.

5.2 FEATURES OF PYTHON

There are many features in Python, some of which are discussed below –

- Easy to code: Python is a high-level programming language. Python is very easy to learn the language as compared to other languages like C, C#, Javascript, Java, etc. It is very easy to code in python language and anybody can learn python basics in a few hours or days. It is also a developer-friendly language.
- Free and Open Source: Python language is freely available at the official website and you can download it from the given download link below click on the Download Python keyword. Download Python Since it is open-source, this means that source code is also available to the public. So you can download it, use it as well as share it.
- Object-Oriented Language: One of the key features of python is Object-Oriented programming. Python supports object-oriented language and concepts of classes, object encapsulation, etc.

- GUI Programming Support: Graphical User interfaces can be made using a module such as PyQt5, PyQt4, wxPython, or Tk in python. PyQt5 is the most popular option for creating graphical apps with Python.
- High-Level Language: Python is a high-level language. When we write programs in python, we do not need to remember the system architecture, nor do we need to manage the memory.
- Extensible feature: Python is an Extensible language. We can write some Python code into C or C++ language and also we can compile that code in C/C++ language.
- Python is Portable language: Python language is also a portable language. For example, if we have python code for windows and if we want to run this code on other platforms such as Linux, Unix, and Mac then we do not need to change it, we can run this code on any platform.
- Python is an Integrated language: Python is also an Integrated language because we can easily integrate python with other languages like c, c++, etc.
- Interpreted Language: Python is an Interpreted Language because Python code is executed line by line at a time. Unlike other languages C, C++, Java, etc. there is no need to compile python code; this makes it easier to debug our code. The source code of python is converted into an immediate form called bytecode.
- Large Standard Library Python has a large standard library which provides a rich set of modules and functions so you do not have to write your own code for every single thing. There are many libraries present in python such as regular expressions, unit-testing, web browsers, etc.
- Dynamically Typed Language: Python is a dynamically-typed language. That means the type (for example- int, double, long, etc.) for a variable is decided at run time not in advance because of this feature we don't need to specify the type of variable.

5.3 COMPUTER VISION

Computer vision is a field of artificial intelligence (AI) that enables computers and systems to derive meaningful information from digital images, videos and other visual inputs — and take actions or make recommendations based on that information. If AI enables computers to think, computer vision enables them to see, observe and understand. Computer vision works much the same as human vision, except humans have a head start. Human sight has the advantage of lifetimes of context to train how to tell objects apart, how far

away they are, whether they are moving and whether there is something wrong in an image.

Computer vision trains machines to perform these functions, but it has to do it in much less time with cameras, data and algorithms rather than retinas, optic nerves and a visual cortex. Because a system trained to inspect products or watch a production asset can analyze thousands of products or processes a minute, noticing imperceptible defects or issues, it can quickly surpass human capabilities.

Computer vision needs lots of data. It runs analyses of data over and over until it discerns distinctions and ultimately recognizes images. For example, to train a computer to recognize automobile tires, it needs to be fed vast quantities of tire images and tire-related items to learn the differences and recognize a tire, especially one with no defects. Two essential technologies are used to accomplish this: a type of machine learning called deep learning and a convolutional neural network (CNN).

Machine learning uses algorithmic models that enable a computer to teach itself about the context of visual data. If enough data is fed through the model, the computer will “look” at the data and teach itself to tell one image from another. Algorithms enable the machine to learn by itself, rather than someone programming it to recognize an image. A CNN helps a machine learning or deep learning model “look” by breaking images down into pixels that are given tags or labels. It uses the labels to perform convolutions (a mathematical operation on two functions to produce a third function) and makes predictions about what it is “seeing.”

The neural network runs convolutions and checks the accuracy of its predictions in a series of iterations until the predictions start to come true. It is then recognizing or seeing images in a way similar to humans. Much like a human making out an image at a distance, a CNN first discerns hard edges and simple shapes, then fills in information as it runs iterations of its predictions. A CNN is used to understand single images. A recurrent neural network (RNN) is used in a similar way for video applications to help computers understand how pictures in a series of frames are related to one another.

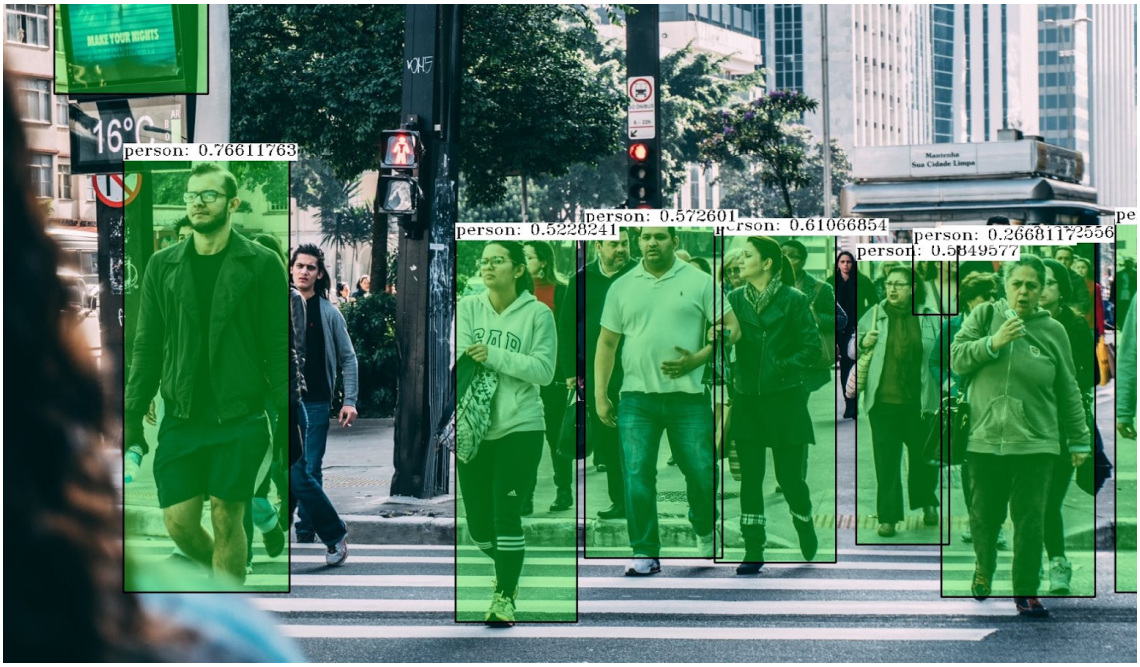

Figure 5.1 Computer Vision

5.4 OPENCV

OpenCV is a huge open-source library for computer vision, machine learning, and image processing. OpenCV supports a wide variety of programming languages like Python, C++, Java, etc. It can process images and videos to identify objects, faces, or even the handwriting of a human. When it is integrated with various libraries, such as Numpy which is a highly optimized library for numerical operations, then the number of weapons increases in your Arsenal i.e whatever operations one can do in Numpy can be combined with OpenCV.

5.5 APPLICATION OF OPENCV

There are lots of applications which are solved using OpenCV, some of them are listed below

- Face recognition
- Automated inspection and surveillance
- Number of people – count (foot traffic in a mall, etc)
- Vehicle counting on highways along with their speeds
- Interactive art installations
- Anomaly (defect) detection in the manufacturing process (the odd defective products)

- Street view image stitching
- Video/image search and retrieval
- Robot and driver-less car navigation and control
- Object recognition
- Medical image analysis
- Movies – 3D structure from motion
- TV Channels advertisement recognition

5.6 OPENCV FUNCTIONALITY

- Image/video I/O, processing, display (core, imgproc, highgui)
- Object/feature detection (objdetect, features2d, nonfree)
- Geometry-based monocular or stereo computer vision (calib3d, stitching, videostab)
- Computational photography (photo, video, superres)
- Machine learning & clustering (ml, flann)
- CUDA acceleration (gpu)

5.7 IMAGE PROCESSING

Image processing is the process of transforming an image into a digital form and performing certain operations to get some useful information from it. The image processing system usually treats all images as 2D signals when applying certain predetermined signal processing methods.

There are five main types of image processing:

- Visualization - Find objects that are not visible in the image
- Recognition - Distinguish or detect objects in the image
- Sharpening and restoration - Create an enhanced image from the original image
- Pattern recognition - Measure the various patterns around the objects in the image
- Retrieval - Browse and search images from a large database of digital images that are similar to the original image

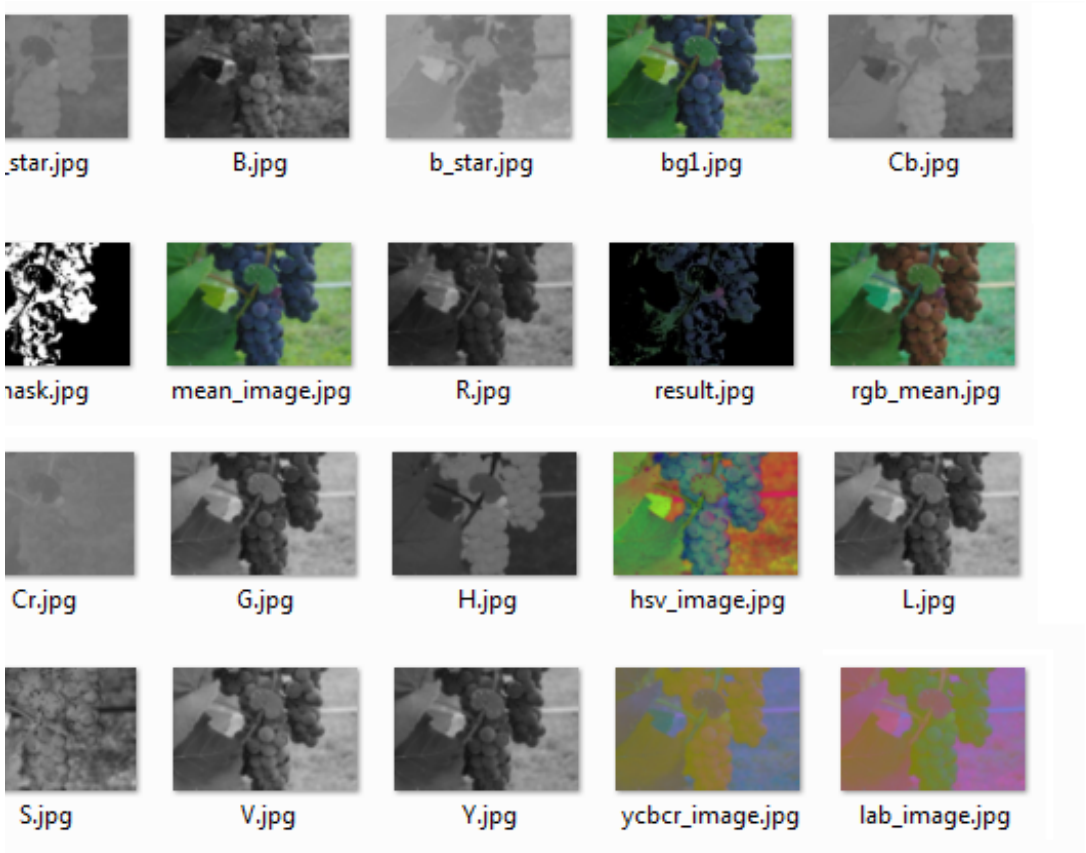

Figure 5.2 Image processing

5.8 DIGITAL IMAGE

An image may be defined as a two-dimensional function f(x, y), where x and y are spatial(plane) coordinates, and the amplitude of any pair of coordinates (x, y) is called the intensity or gray level of the image at that point. In another word An image is nothing more than a two-dimensional matrix (3-D in case of coloured images) which is defined by the mathematical function f(x, y) at any point is giving the pixel value at that point of an image, the pixel value describes how bright that pixel is, and what color it should be.

Image processing is basically signal processing in which input is an image and output is image or characteristics according to requirements associated with that image. Image processing basically includes the following three steps: Importing the image Analyzing and manipulating the image Output in which result can be altered image or report that is based on image analysis.

5.9 FLASK

Flask is a web application framework written in Python. Armin Ronacher, who leads an international group of Python enthusiasts named Pocco, develops it. Flask is based on the Werkzeug WSGI toolkit and Jinja2 template engine. Both are Pocco projects. Web Server Gateway Interface (WSGI) has been adopted as a standard for Python web application development. WSGI is a specification for a universal interface between the web server and the web applications. It is a WSGI toolkit, which implements requests, response objects, and other utility functions. This enables building a web framework on top of it. The Flask framework uses Werkzeug as one of its bases. Jinja2 is a popular templating engine for Python. A web templating system combines a template with a certain data source to render dynamic web pages. Flask is often referred to as a micro framework. It aims to keep the core of an application simple yet extensible. Flask does not have a built-in abstraction layer for database handling, nor does it have form validation support. Instead, Flask supports the extensions to add such functionality to the application. Some of the popular Flask extensions are discussed later in the tutorial.

5.10 API

An application programming interface, or API, enables companies to open up their applications' data and functionality to external third-party developers, business partners, and internal departments within their companies. This allows services and products to communicate with each other and leverage each other's data and functionality through a documented interface. Developers don't need to know how an API is implemented; they simply use the interface to communicate with other products and services. API use has surged over the past decade, to the degree that many of the most popular web applications today would not be possible without APIs.

An API is a set of defined rules that explain how computers or applications communicate with one another. APIs sit between an application and the web server, acting as an intermediary layer that processes data transfer between systems.

Here's how an API works:

1. A client application initiates an API call to retrieve information—also known as a *request*. This request is processed from an application to the web server

via the API's Uniform Resource Identifier (URI) and includes a request verb, headers, and sometimes, a request body.
2. After receiving a valid request, the API makes a call to the external program or web server.
3. The server sends a *response* to the API with the requested information.
4. The API transfers the data to the initial requesting application.

While the data transfer will differ depending on the web service being used, this process of requests and response all happens through an API. Whereas a user interface is designed for use by humans, APIs are designed for use by a computer or application.

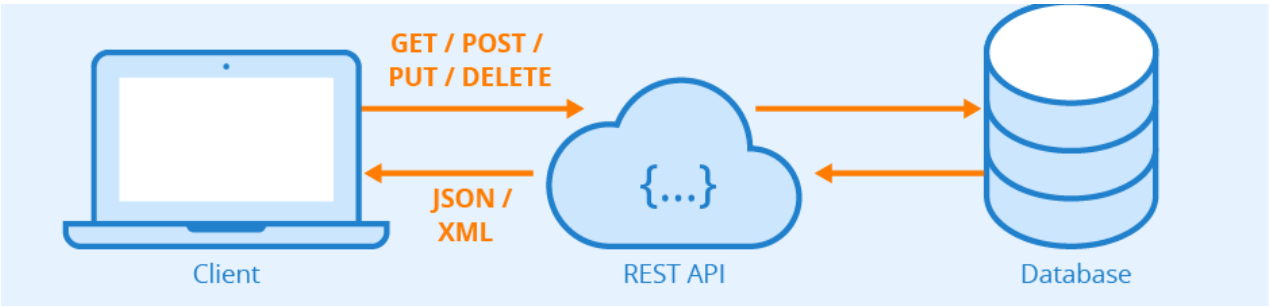

Figure 5.3 API

APIs offer security by design because their position as middleman facilitates the abstraction of functionality between two systems—the API endpoint decouples the consuming application from the infrastructure providing the service. API calls usually include authorization credentials to reduce the risk of attacks on the server, and an API gateway can limit access to minimize security threats. Also, during the exchange, HTTP headers, cookies, or query string parameters provide additional security layers to the data.

For example, consider an API offered by a payment processing service. Customers can enter their card details on the frontend of an application for an ecommerce store. The payment processor doesn't require access to the user's bank account; the API creates a unique token for this transaction and includes it in the API call to the server. This ensures a higher level of security against potential hacking threats.

5.11 ANDROID JAVA

Android is an open source and Linux-based operating system for mobile devices such as smartphones and tablet computers. Android was developed by the Open Handset Alliance, led by Google, and other companies. This tutorial will teach you basic Android programming and will also take you through some advanced concepts related to Android application development.

Android applications are developed using the Java language. As of now, that's really your only option for native applications. Java is a very popular programming language developed by Sun Microsystems (now owned by Oracle). Developed long after C and C++, Java incorporates many of the powerful features of those powerful languages while addressing some of their drawbacks. Still, programming languages are only as powerful as their libraries. These libraries exist to help developers build applications.

Some of Java's important core features are:

- It's easy to learn and understand.
- It's designed to be platform-independent and secure, using virtual machines
- Its object-oriented

Android relies heavily on these Java fundamentals. The Android SDK includes many standard Java libraries (data structure libraries, math libraries, graphics libraries, networking libraries and everything else you could want) as well as special. Android libraries that will help you develop awesome Android applications.

5.12 ANDROID SDK

Android SDK is a collection of libraries and Software Development tools that are essential for Developing Android Applications. Whenever Google releases a new version or update of Android Software, a corresponding SDK also releases with it. In the updated or new version of SDK, some more features are included which are not present in the previous version. Android SDK consists of some tools which are very essential for the development of Android Application. These tools provide a smooth flow of the development process from developing and debugging. Android SDK is compatible with all operating systems such as Windows, Linux, macOS, etc.

5.13 COMPONENTS OF ANDROID SDK

Android SDK Components play a major role in the Development of Android applications. Below are the important components:

1. Android SDK Tools

Android SDK tool is an important component of Android SDK. It consists of a complete set of development and debugging tools. Below are the SDK developer tools:

- Android SDK Build tool.
- Android Emulator.
- Android SDK Platform-tools.
- Android SDK Tools.

2. Android SDK Build-Tools

Android SDK build tools are used for building actual binaries of Android Apps. The main functions of Android SDK Build tools are built, debug, run and test Android applications. The latest version of the Android SDK Build tool is 30.0.3. While downloading or updating Android in our System, one must ensure that its latest version is downloaded in SDK Components.

3. Android Emulator

An Android Emulator is a device that simulates an Android device on your system. Suppose we want to run our android application that we code. One option is that we will run this on our Android Mobile by Enabling USB Debugging on our mobile. Another option is using Android Emulator. In Android Emulator the virtual android device is shown on our system on which we run the Android application that we code. Thus, it simply means that without needing any physical device Android SDK component "Android Emulator" provides a virtual device on the System where we run our Application. The emulator's come with the configuration for Various android phones, tablets, Wear OS, and Android TV devices.

In Android Virtual Emulator all functions that are feasible on real Android mobile is works on virtual Device like:

- Phone calls, text messages.
- Stimulate different network speeds.
- Specify the location of a device access on google play store and lot's more.

But there is one disadvantage of this emulator. It is very slow when System's PC has less RAM. It works fine when a maximum GB of RAM is present on our device.

4. Android SDK Platform-tools

Android SDK Platform-tools is helpful while working on a Project and they will show the error messages at the same time. It is specifically used for testing. It includes:
Android Debug Bridge (ADB), is a command-line tool that helps to communicate with the device. It allows us to perform actions such as Installing apps, Debugging apps etc.
Fastboot allows you to flash a device with a new system image. Systrace tools help to collect and inspect timing information. It is very crucial for App Debugging.

5. Android SDK Tools

Android SDK tool is a component of SDK tool. It consists of a set of tools and other Utilities which are crucial for the development of Android Application. It contains the complete set of Debugging and Development tools for android.

6. SDK Platforms

For each Android Software, one SDK platform is available as shown below:

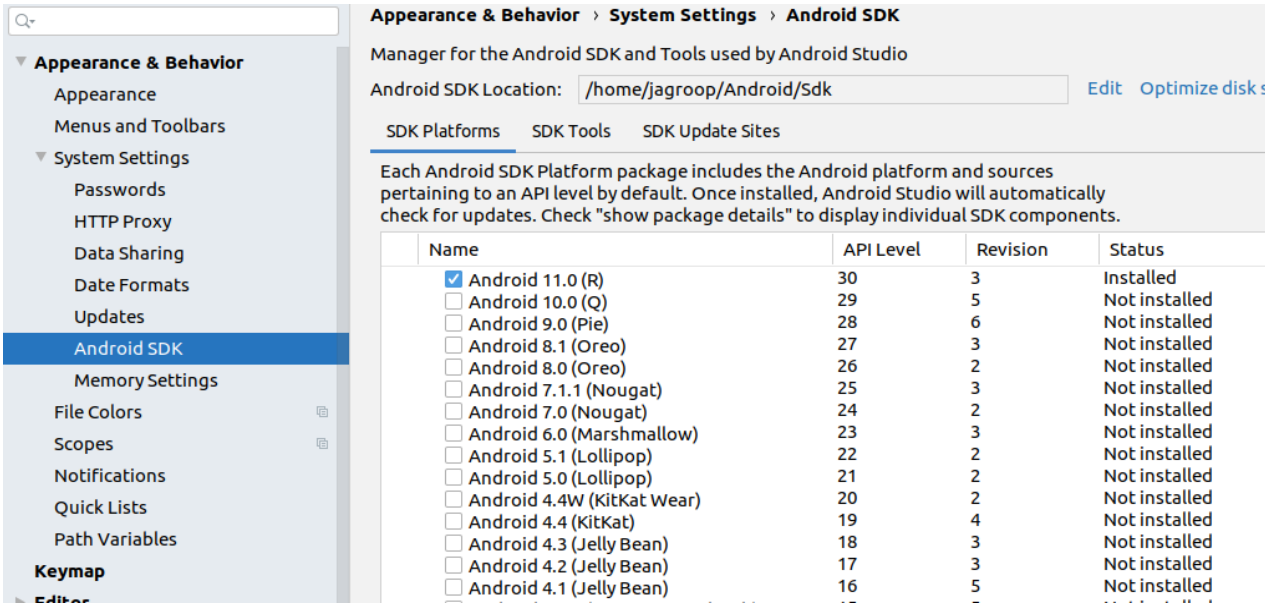

Figure 5.4 SDK platform

Like in this Android 11.0(R) is installed. These are numbered according to the android version. The new version of the SDK platform has more features and is more compatible but the old version is less compatible with fewer features. Like in Android 11.0(R) are more compatible and have more features but the below versions like Android 10.0(Q), Android4.4(KitKat) have less features and are less compatible.

7. SDK Update Sites

In SDK Update Sites, some sites are embedded in it which will check for Android SDK Updates Tools. In this, one must ensure we don't unclick the button below because these are checked by default which will check for updates if we unclic it then it doesn't check updates for those.

5.14 ANDROID XML

XML stands for Extensible Markup Language. XML is a markup language much like HTML used to describe data. It is derived from Standard Generalized Markup Language(SMGL). Basically, the XML tags are not predefined in XML. We need to implement and define the tags in XML. XML tags define the data and are

used to store and organize data. It's easily scalable and simple to develop. In Android, the XML is used to implement UI-related data, and it's a lightweight markup language that doesn't make layout heavy. XML only contains tags, while implementing they need to be just invoked.

Figure 5.5 Android XML

5.15 VOLLEY

Volley is an HTTP library that makes networking very easy and fast, for Android apps. It was developed by Google and introduced during Google I/O 2013. It was developed because there is an absence in Android SDK, of a networking class capable of working without interfering with the user experience. Although Volley is a part of the Android Open Source Project(AOSP), Google announced in January 2017 that Volley will move to a standalone library. It manages the processing and caching of network requests and it saves developers valuable time from writing the same network call/cache code again and again. Volley is not suitable for large download or streaming operations since Volley holds all responses in memory during parsing.

5.16 FEATURES OF VOLLEY

- Request queuing and prioritization
- Effective request cache and memory management
- Extensibility and customization of the library to our needs
- Canceling the requests

5.17 ADVANTAGES OF USING VOLLEY

- All the tasks that need to be done with Networking in Android, can be done with the help of Volley.
- Automatic scheduling of network requests.
- Catching
- Multiple concurrent network connections.
- Canceling request API.
- Request prioritization.
- Volley provides debugging and tracing tools.
- While dealing with high-resolution compressed images, Volley is the only solution here that works well.

5.18 WEBVIEWS

WebView objects allow to display web content as part of activity layout, but lack some of the features of fully-developed browsers. A WebView is useful when we need increased control over the UI and advanced configuration options that will allow you to embed web pages in a specially-designed environment for your app.

5.19 RECYCLERVIEW

RecyclerView makes it easy to efficiently display large sets of data. You supply the data and define how each item looks, and the RecyclerView library dynamically creates the elements when they're needed. As the name implies, RecyclerView recycles those individual elements. When an item scrolls off the screen, RecyclerView doesn't destroy its view. Instead, RecyclerView reuses the view for new items that have scrolled on screen. This reuse vastly improves performance, improving your app's responsiveness and reducing power consumption.

5.20 HEROKU

Heroku is a cloud service platform whose popularity has grown in recent years. Heroku is so easy to use that it’s a top choice for many development projects.

With a special focus on supporting customer-focused apps, it enables simple application development and deployment. Since the Heroku platform manages hardware and servers, businesses that use Heroku are able to focus on perfecting their apps. And not the infrastructure that supports them. More time goes towards ensuring that users receive the highest quality experiences as possible.

Heroku officially supports these languages. However, it does not limit itself to these languages.

- Java
- Ruby
- PHP
- Node.js
- Python
- Scala
- Clojure

You can also run any language that runs on Linux or Heroku via a third-party build pack.

Figure 5.6 : Heroku

5.21 GOOGLE FIREBASE

Firebase is a development platform for mobile and web apps. With Firebase, you can quickly build high-quality apps, grow an engaged user base, and earn more money. The platform includes several tightly integrated features that you can mix and match, including analytics, a mobile-first backend, and app growth and monetization tools to help maximize app success.

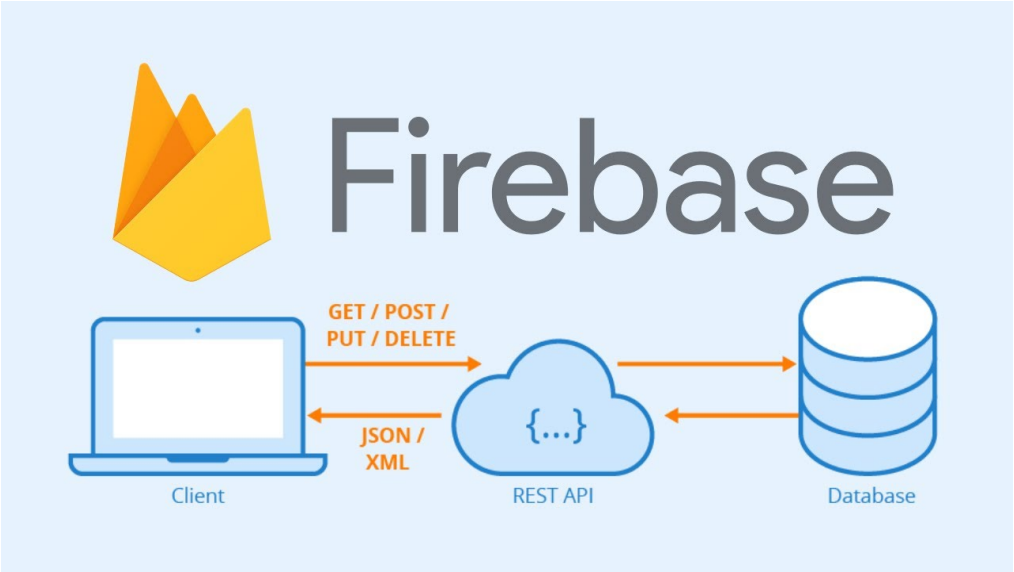

Figure 5.7 : Firebase

5.22 KEY FEATURES

1. Authentication:- It supports authentication using passwords, phone numbers, Google, Facebook, Twitter, and more. The Firebase Authentication (SDK) can be used to manually integrate one or more sign-in methods into an app.
2. Realtime database:- Data is synced across all clients in real time and remains available even when an app goes offline.
3. Firebase Hosting provides fast hosting for a web app content is cached into content delivery networks worldwide.
4. Test lab:- The application is tested on virtual and physical devices located in Google's data centers.
5. Notifications:- Notifications can be sent with firebase with no additional coding.

5.23 REALTIME DATABASE

The Firebase Realtime Database is a cloud-hosted database in which data is stored as JSON. The data is synchronized in real-time to every connected client. All of our clients share one Realtime Database instance and automatically receive

updates with the newest data, when we build cross-platform applications with our iOS, and JavaScript SDKs.

The Firebase Realtime Database is a NoSQL database from which we can store and sync the data between our users in real-time. It is a big JSON object which the developers can manage in real-time. By using a single API, the Firebase database provides the application with the current value of the data and updates to that data. Real-time syncing makes it easy for our users to access their data from any device, be it web or mobile.

The Realtime database helps our users collaborate with one another. It ships with mobile and web SDKs, which allow us to build our app without the need for servers. When our users go offline, the Real-time Database SDKs use local cache on the device for serving and storing changes. The local data is automatically synchronized, when the device comes online.

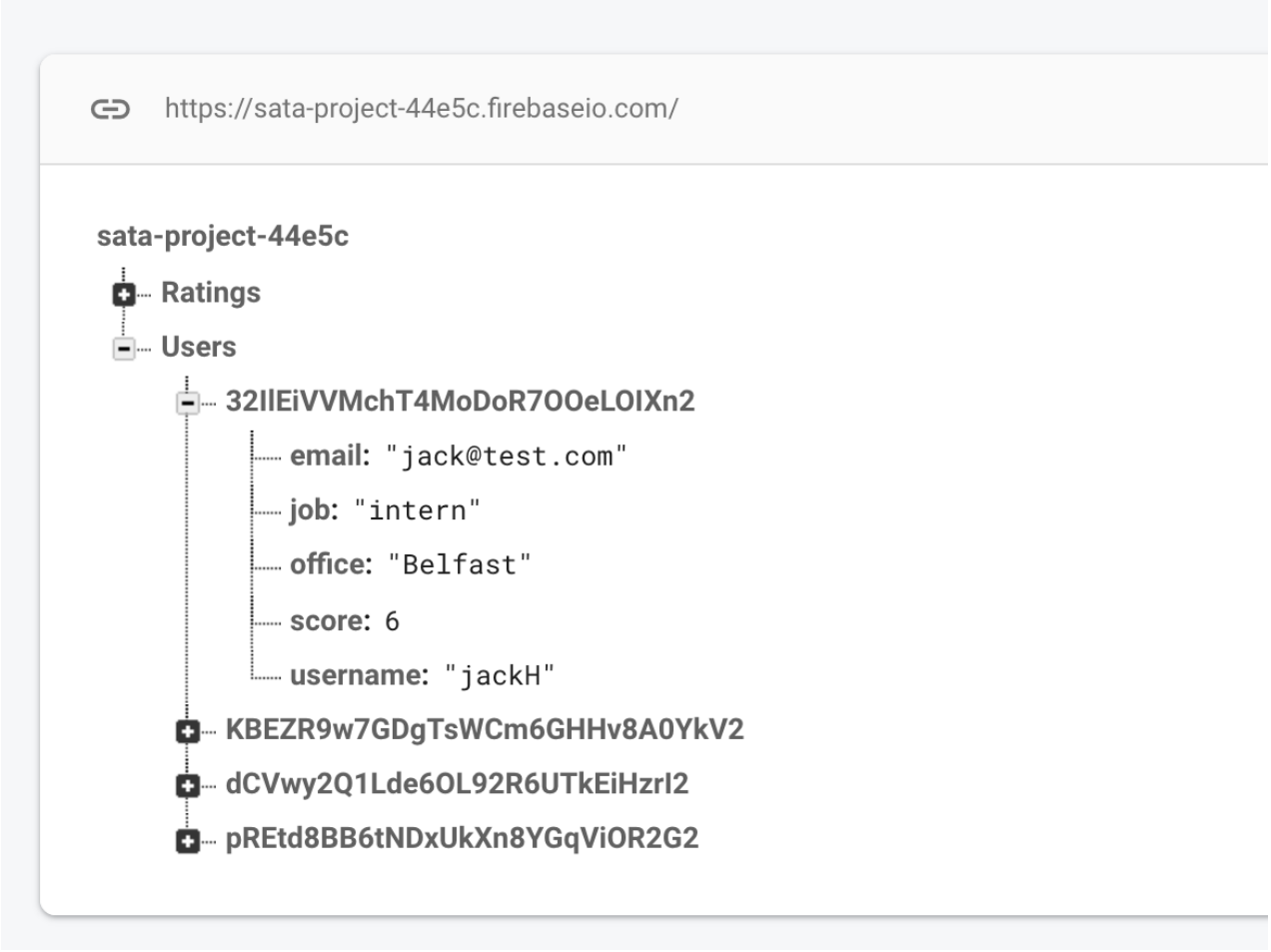

Figure 5.8 : Real Time Database

5.24 CLOUD STORAGE

Cloud Storage for Firebase is a powerful, simple, and cost-effective object storage service built for Google scale. The Firebase SDKs for Cloud Storage add Google security to file uploads and downloads for your Firebase apps, regardless of network quality. You can use our SDKs to store images, audio, video, or other user-generated content. On the server, you can use Google Cloud Storage APIs to access the same files.

Firebase Cloud Storage is capable of performing the following things:

- Robust Operations :- Reliability is one of the biggest advantages of the Cloud Firestore. Firebase SDKs perform uploads and downloads regardless of network quality. Downloads and uploads both are robust. Robust means from where it stopped, will restart from there, and save the user time and bandwidth.
- Strong security:- For providing simple and intuitive authentication to the developer, Firebase SDKs for Cloud Storage integrate with Firebase Authentication. For allowing access based on filename, size, content type, and other metadata, we can use declarative security models.
- High Scalability:- Cloud Storage is built for the Exabyte scale when our app goes viral. Easily grow from prototype to production using the same structure that powers Spotify and Google Photos.

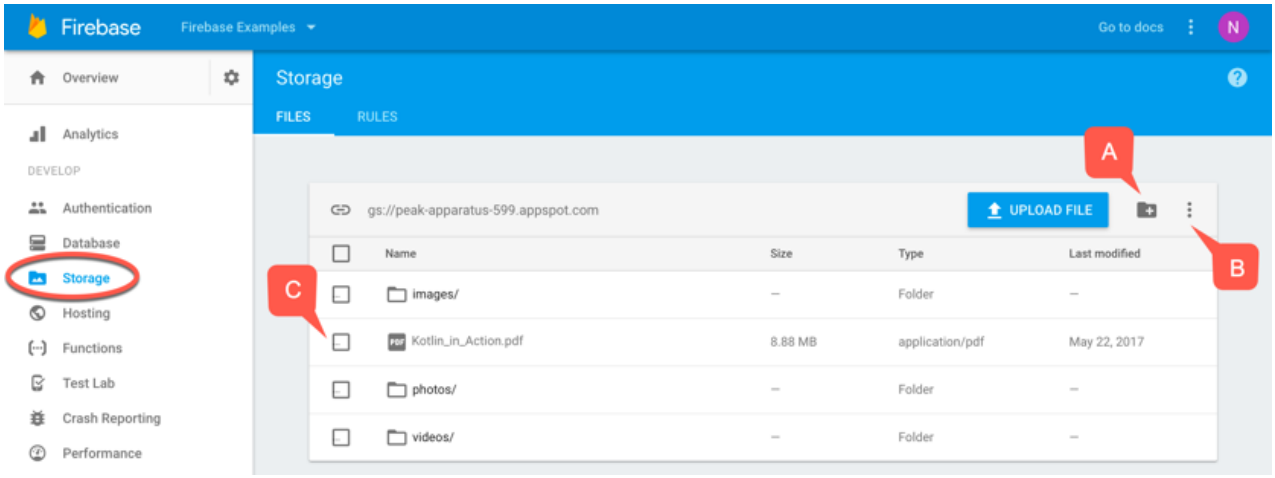

Figure 5.9 : Cloud Storage

5.25 CLOUD MESSAGING

Firebase Cloud Messaging (FCM) is a cross-platform messaging solution that lets you reliably send messages at no cost. Using FCM, you can notify a client app that new email or other data is available to sync. You can send notification messages to drive user re-engagement and retention. For use cases such as instant messaging, a message can transfer a payload of up to 4000 bytes to a client app. Using deprecated Google Cloud Messaging APIs. FCM inherits the core infrastructure of GCM, however, it simplifies the development of the client side. GCM and FCM offer encryption, push notification and messaging, native Android and iOS SDK support. Both require a third-party entity between the client application and the trusted environment which may create delays in the communication path between the mobile terminal and application server. FCM supports server protocols HTTP and XMPP which are identical to GCM protocols.

Developers are not required to write individual registrations or subscripting retrying login in the client application.FCM and GCM handle messages through the same instructions, however, instead of GCM connection servers, messages are passed through FCM servers. The FCM Software Development Kit (SDK) excludes writing individual registration or subscription retry logic for a shortened client development process. The FCM SDK provides a new notification solution allowing developers to use the serverless Firebase Notifications on a web console, based on Firebase Analytics insights. FCM enables unlimited upstream and downstream messages to be sent.

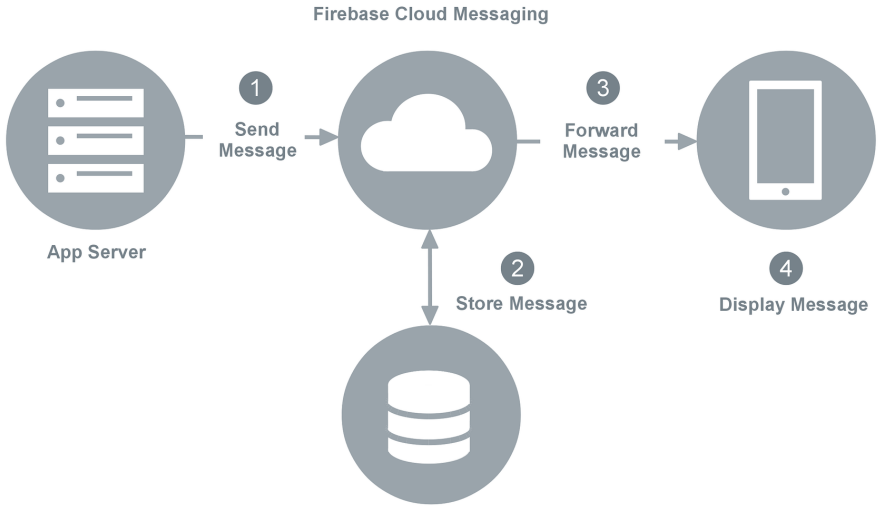

Figure 5.10 : Cloud Messaging

CHAPTER 6

WORKING PRINCIPLES

6.1 INTRODUCTION

When the system is first turned on, it checks to see if the user has selected surveillance mode. When a user activates the surveillance mode via a mobile app, the system activates as well. To detect any movements, the live feed from the webcam will be continuously evaluated using openCV and a backdrop comparison algorithm.When motion is detected, the system takes a picture and sends it to the cloud API. The system will then start a self-protection procedure by turning on the linked relays. The user will receive the warning message via the app. The image will be shown to the user during the time of motion. The image sensor is located within the camera and is where the camera lens focuses light. When light strikes the image sensor, each individual pixel registers how much light it receives.

The sensitivity level or percentage level settings on the motion detection system define how much change is "enough." Higher sensitivity will detect more changes, but lesser sensitivity will need a significant amount of change, such as turning on the lights in a dark room, to trigger the alerts. The camera software compares successive photos from your video and evaluates if enough pixels have changed between those frames, indicating that something has moved and sending an alarm. To create foreground pictures, the background image is approximated and then removed from each video frame. The median will be increased or decreased by a factor that is proportional to the running standard deviation and the size of the time series data. Based on the new data sample, this algorithm will update the median value of the time series data. The moving objects in the first few image frames will

be identified by this technique, and the related pixels will be labeled as foreground pixels. The system estimates more and more background pixels as the foreground items move. The programme then recognises the pixels that do not belong to the foreground as the incomplete background.

6.2 WORKFLOW

1. Initially, once the system is connected to the power, it will check whether the user has set the system into surveillance mode or not.
2. If the user turns on the surveillance mode via a mobile app, the system will turn on to surveillance mode.
3. The live feed from the webcam will be continuously checked using openCV and background comparison algorithm to find any motion.
4. If any motion occurs the system immediately captures the image and sends it to the cloud API.
5. Then the system itself will initiate a self protecting method by turning on the connected relays.
6. The system will send the warning message to the user via app. User will get the image at the time of motion.

6.3 MOTION DETECTION

Motion detection is an important feature of the proposed system to secure the surveillance area. To understand motion detection, first you need to understand how a camera works. Inside the camera is an image sensor, which the camera lens directs light to - when light hits the image sensor each individual pixel records how much

light it's getting. That pattern of light and dark areas on the pixels becomes the complete video image. When setting up motion detection, select a region or area to monitor, say a doorway. The way it works is to compare sequential images from your video and if enough of the pixels have changed between those frames, the camera software determines something moved and sends an alert. How "enough" change is determined depends on the sensitivity level or percentage level settings on the motion detection system. The sensitivity level looks at the changing light/dark levels in the pixels. Higher sensitivity will pick up on more changes while lower sensitivity will require a large level of change, such as the lights going on in a dark room, to set off the alerts. Percentage, on the other hand, looks to the percentage of pixels that have registered a change. If you are monitoring a door, setting the percentage at 50% will alert you when something is large.

Figure 6.1 : Motion Tracking

6.4 MOTION DETECTION ALGORITHM

Initially, We needed to create a VideoCapture object to read the frames from the input. That is, a Pi Cam video. If you want to work with another input file already saved on your PC, you can use the same. The first frame typically means it contains only the background. It is the reference frame of our program. If there is any difference in the current frame with respect to the first frame, it means motion is

detected. We store our first frame in the frame1 variable. So, The first line is to read the frame. We then convert the colored frame to B&W since we do not need colors to detect motion. Then we smooth out the image using GaussianBlur. Now we store the current frame in the frame2 variable and apply the same filters as our first frame. We need a loop since the read() method only captures one frame at a time. So, to capture a continuous video, we have to loop instructions.

Now we compare our current frame with the first frame, to check if any motion is detected. The absdiff() method gives the absolute value of pixel intensity differences of two frames. The first parameter is the background frame and the second is the current frame. Now we have to threshold the data frame variable using the cv2.threshold() method. The first parameter is the frame to be thresholded. The second and third are the threshold limits and the last parameter is the method used. The THRESH_BINARY method paints the background in black and motion in white.

The dilate() method removes all the gaps in between. Using contours, we can find the white images in the black background. We detect contours using the findContours() method. It returns two variables, contour and hierarchy, and the parameters passed to it are the threshold variable, retrieval method and approximation method. We now loop through the contour numpy array and draw a rectangle around the moving object.

We get the rectangle bounds using boundingRect() and draw the rectangle onto frame2 using the rectangle() method. And the last lines of code waits for the user to enter a certain character, for instance ‘q’, to break out of the loop and quit all the windows.

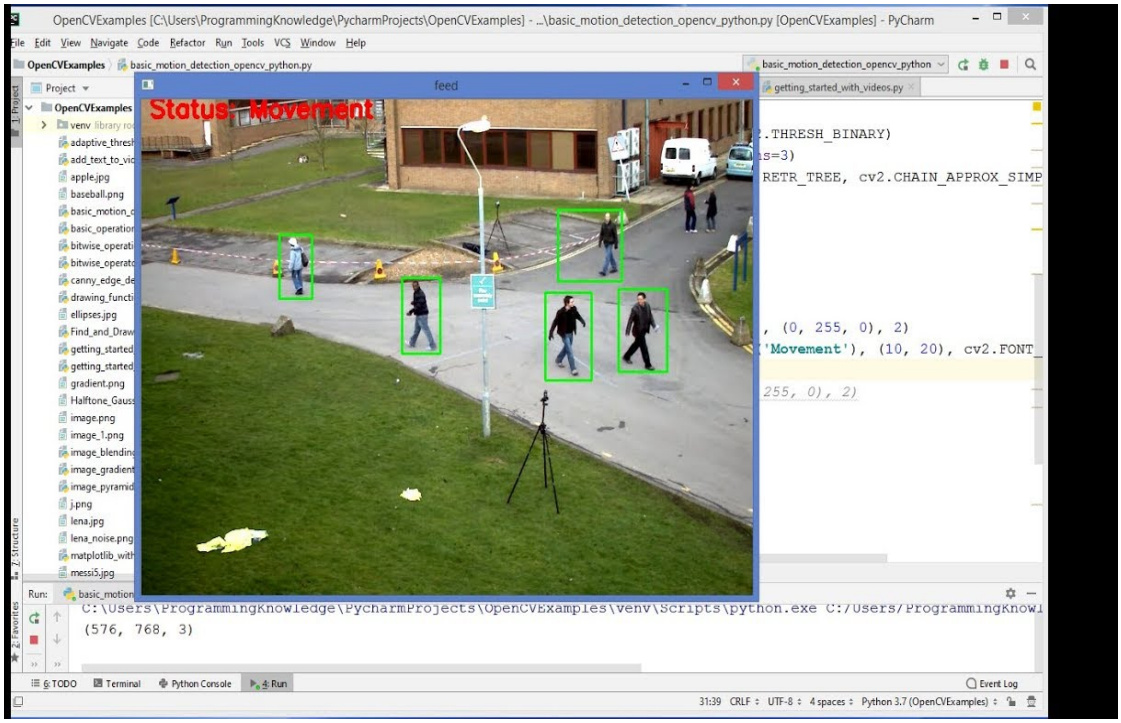

Figure 6.2 Motion Detection

6.5 BACKGROUND SUBTRACTION

Detection of motion in many current tracking systems relies on the technique of background subtraction. Background subtraction is a widely used approach for detecting moving objects in videos recorded from static cameras. The background image must be such that it should not contain any moving objects and must be kept regularly updated to adapt the varying lighting conditions and geometry settings. By subtracting background images from the incoming video frames, the presence of an object and its motion can be tracked. Graphical representation of background subtraction technique is shown in the Figure

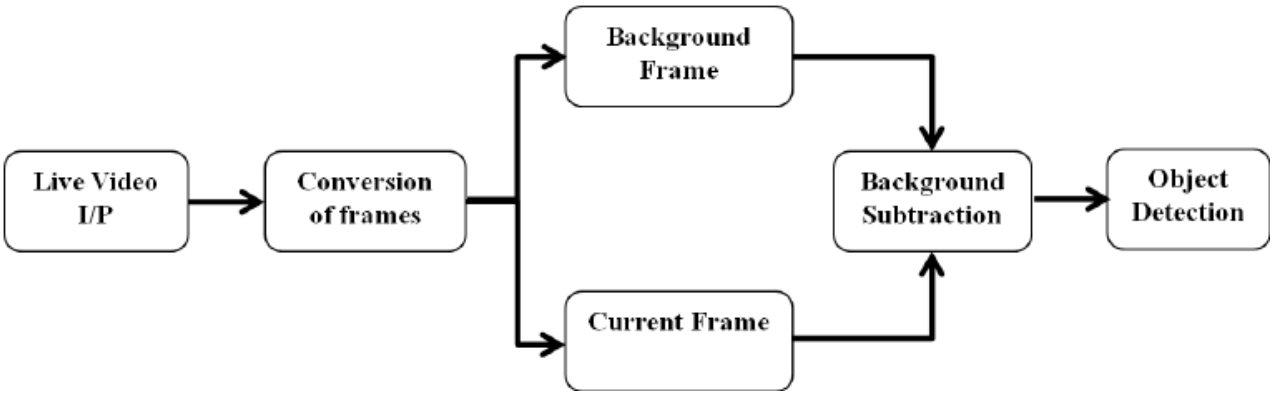

Figure 6.3 : Background subtraction

The methods also exist for background estimation, which will establish the model of background for the subtraction. There is no need to update background images. Various techniques for background estimations are listed below.

Estimating median over time :- This algorithm will update the median value of the time series data based upon the new data sample. The will increment or decrement the median by an amount that is related to the running standard deviation and the size of the time series data. The approach will also apply a correction to the median value if it detects a local ramp in the time series data. Overall, the estimated median is constrained within Chebyshev's bounds, which are square root (3/5) of the standard deviation on either side of the mean of the data.

Computing median over time :- This method will compute the median of the values at each pixel location over a time window of 30 frames. Eliminating moving objects - This algorithm will identify the moving objects in the first few image frames and label the corresponding pixels as foreground pixels. Next, the algorithm identifies the incomplete background as the pixels that do not belong to the foreground pixels. As the foreground objects move, the algorithm estimates more and more of the background pixels.

The methods also exist for background estimation, which will establish the model of background for the subtraction. There is no need to update background images. Various techniques for background estimations are listed below. Estimating median over time - This algorithm will update the median value of the time series data based upon the new data sample.

The will increment or decrement the median by an amount that is related to the running standard deviation and the size of the time series data. The approach will also apply a correction to the median value if it detects a local ramp in the time series data. Overall, the estimated median is constrained within Chebyshev's bounds, which are square root (3/5) of the standard deviation on either side of the mean of the data. Computing median over time - This method will compute the median of the values at each pixel location over a time window of 30 frames. Eliminating moving objects - This algorithm will identify the moving objects in the first few image frames and label the corresponding pixels as foreground pixels.

Next, the algorithm identifies the incomplete background as the pixels that do not belong to the foreground pixels. As the foreground objects move, the algorithm estimates more and more of the background pixels. Once the background image is estimated, it is subtracted from each video frame to produce foreground images. By thresholding and performing morphological closing on each foreground image, the model produces binary feature images

The model locates the cars in each binary feature image and draws a green rectangle around the cars that pass beneath the white line. The counter in the upper left corner of Figure 2d tracks the number of cars in the region of interest

6.6 GAUSSIAN BLUR

Gaussian blur (also known as Gaussian smoothing) is the result of blurring an image by a Gaussian Function. It is widely used to reduce noise and detail[20]. The visual effect of this blurring technique is a smooth blur resembling that of viewing the image through a translucent screen, distinctly different from the bake effect produced by an out-of-focus lens or the shadow of an object under usual illumination. Gaussian smoothing is also used as a pre-processing stage in computer vision algorithms in order to enhance image structures at different scales. The equation of a Gaussian function in one dimension is:

$$G_\sigma = \frac{1}{2\pi\sigma^2} e^{-\frac{(x^2+y^2)}{2\sigma^2}}$$

----------(Equation 6.1)

Grayscale is a range of shades of gray without apparent color. The darkest possible shade is black, which is the total absence of transmitted or reflected light. The lightest possible shade is white, the total transmission or reflection of light at all visible wavelengths . Intermediate shades of gray are represented by equal brightness levels of the three primary colors (red, green and blue) for transmitted light, or equal amounts of the three primary pigments (cyan, magenta and yellow) for reflected light. In the case of transmitted light (for example, the image on a computer display), the brightness levels of the red (R), green (G) and blue (B) components are each represented as a number from decimal 0 to 255, or binary 00000000 to 11111111. For every pixel in a red-green-blue (RGB) grayscale image, R = G = B. The lightness of the gray is directly proportional to the number representing the brightness levels of the primary colors.

6.7 TRAPPING THE TRESPASSER

In the existing surveillance method, instead of surveillance there is no prevention method. Also, There is a chance of an attack on the surveillance system. That will completely lose the camera and connected system. The proposed system has a self protection feature to prevent any attack on the surveillance system. The motion detection system will trigger two separate relays. Here users can connect any prevention methods like door locking system, Chemical spraying, Industrial siren triggering, warning light etc depending on the user requirement. For Example. If the prevention mechanism is activated in any sensitive area. By taking the seriousness of the activity, System can easily trap the trespasser by activating any poisonous gas. Which makes them unconscious. Then, Make sure the doors are closed. Hence, It's easy to trap the trespasser. Also, it prevents further movement and ensures security for the CCTV and related systems.

6.8 ALERTS

While running the system, It will send the live feed to android APP like a normal IP cam. Users can easily monitor the entire surrounding by just a click. The same system will check in a regular interval whether the user activated the motion detection. If it is in the activated state, The system will act as motion detection. Then the system will look for any motions on the video feed. If it is found, Will capture a picture of that moment and send the Image to the Flask API, which is hosted in Heroku. Then the heroku system will send the same to Firebase storage with a reference link to the image. The same will send a push notification to the user. To let them know about detection in real time. The application will make an alert sound. Users can easily access the captured image through the app itself. The same system will activate a few alert systems near to the camera itself. Buzzer and LED indicator will be activated once the system catches any anomaly.

CHAPTER 7

RESULTS AND DISCUSSIONS

7.1 INTRODUCTION

After successful completion of the project, following were the results that were obtained. When motion is detected, the system captures a picture and transmits it to the cloud API. The system will then start a self-protection procedure by turning on the linked relays. The user will receive the warning notice via the app. The picture will be shown to the user during the time of motion.

7.2 CAMERA FEED

Figure 7.1 : Camera Test 1

Figure 7.2 : Camera Test 2

When the motion occurs the system immediately captures the image and sends it to the cloud API.Then the system itself will initiate a self protecting method by turning on the connected relays. The system will send the warning message to the user via app. User will get the image at the time of motion.

7.3 MOBILE APP

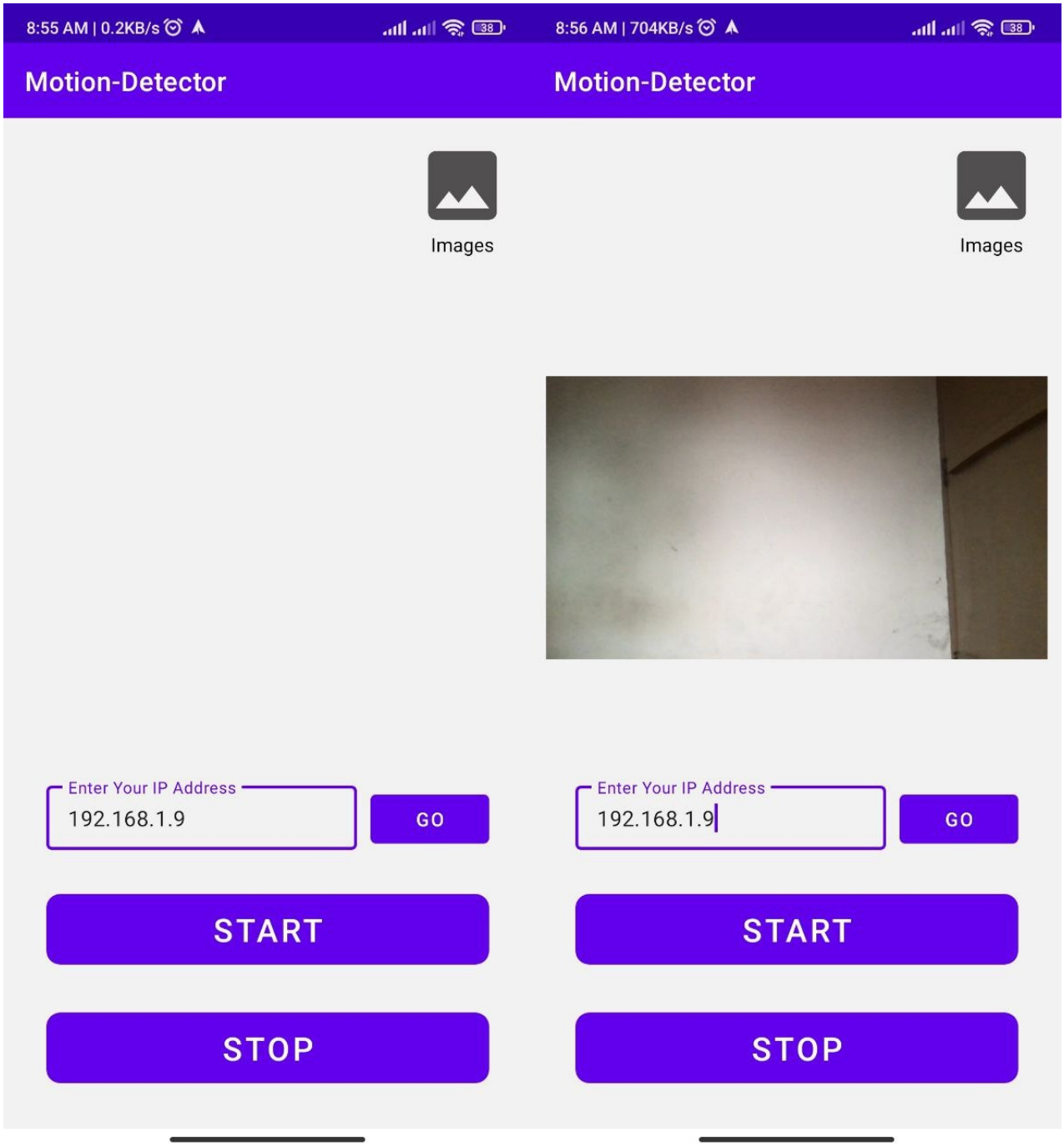

Figure 7.4 : App UI

7.4 ALERT

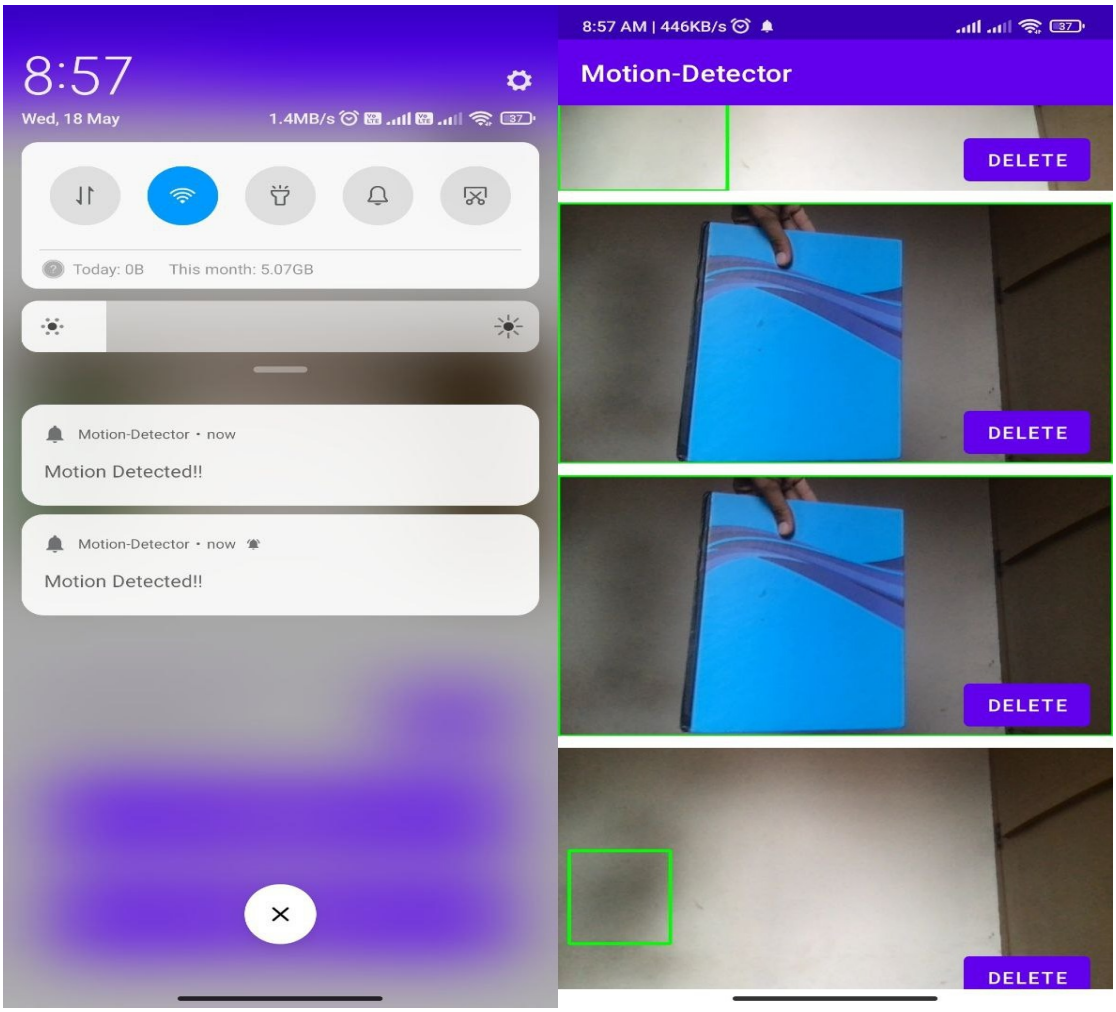

Figure 7.5 : App Notification and Alert 2

7.5 ADVANTAGES

Advantages

- Easy to connect
- Uses Less Disk Space
- Easy to get notification on mobile phone
- Only required less resources and infrastructure
- Less power is required
- Less maintenance cost

CHAPTER 8

CONCLUSION AND FUTURE SCOPE

8.1 CONCLUSION

The proposed system can easily be implemented and will provide a complete safety solution for surveillance systems. This project has designed a smart surveillance system which captures real-time images and transmits them to the owner's mobile phone. Detection of the theft can be done using the system. The system will prevent theft without any physical damage. After successfully completing the project, it may be used to detect motion for a smart home security system, which would be extremely useful in detecting auto theft for security purposes. It can also be useful at midnight in a bank, museum, or on the street. The same can be controlled from anywhere and prevention can execute easily. Real-time video analysis provides smart surveillance systems with the ability to react in real time. This project also provides a device that can give authority to the user or owner to take actions against the alert message through options. Our system senses the intrusion and sends notifications to authorized persons so that action can be taken in response to the intrusion. One of the best features about our project is that it is easy to implement, low cost and easy to implement.

8.2 FUTURE ENHANCEMENT

Computer vision and image processing can be used to make a wide variety of applications. Adding extra features into the proposed system will be very useful for several future applications. Implementing this system for anomaly detection in a moving environment will make the system more efficient. Adding Face recognition with the system will make it more efficient. Can be very useful to fault triggering of the system from authorized people. As sensors enable previously lifeless common

things to become not just interactive, but also predictive, human connection with our surroundings will become more natural and intuitive.In this system, we can add faces of known people, i.e. people who can be trusted around that area other than the user. This could make the system more reliable as well as scalable. These sorts of systems will be employed in a wide range of consumer and industrial applications, from predictive maintenance and asset tracking to self-driving automobiles, fully linked smart cities, and beyond.

REFERENCES

- Nahum Kiryati, Tammy Riklin Raviv, Yan Ivanchenko, Shay Rochel , “Real-time Abnormal Motion Detection in Surveillance Video”,19th International Conference on Pattern Recognition,Dec 2008.
- M. Valera and S.A. Velastin, “Intelligent distributed surveillance systems: a review”. Vision, Image and Signal Processing, IEE Proceedings - (Volume:152 , Issue: 2),8 April 2005.
- Bhavana C. Bendale, Prof. Anil R. Karwankar, “Moving Object Tracking in Video Using MATLAB”,International Journal of Electronics, Communication & Soft Computing Science and Engineering,ISSN: 2277-9477, Volume 2, Issue 1,2013
- C. Stauffer and W. E. L. Grimson, (1999) ‘Adaptive Background Mixture Models for Real-time Tracking’, in Proc. IEEE Conf. Computer Vision and Pattern Recognit., Vol.2, pp.246–252.
- J. D., “Real Time Embedded Network Video Capture And SMS Alerting system,” June.2014
- S. Sneha, “IP Camera Video Surveillance using Raspberry Pi.,” Feb. 2015
- U. Kumar, R. Manda, S. Sai, and A. Pammi, “Implementation Of Low Cost Wireless Image Acquisition And Transfer To Web Client Using Raspberry Pi For Remote Monitoring. International Journal of Computer Networking, Wireless and Mobile Communications (IJCNWMC).,” vol. No. 4, no. 3, pp. 17–20, 2014.
- https://developer.android.com/reference/android/webkit/WebView
- https://pyimagesearch.com/2018/09/26/install-opencv-4-on-your-raspberry-pi/
- https://www.jeremymorgan.com/tutorials/raspberry-pi/how-to-install-opencv-raspberry-pi/
- https://medium.com/google-cloud/building-a-flask-python-crud-api-with-cloud-firestore-firebase-and-deploying-on-cloud-run-29a10c502877
- Richardson, M., & Wallace, S. (2012). Getting started with raspberry PI. " O'Reilly Media, Inc.".

- Patel, P. B., Choksi, V. M., Jadhav, S., & Potdar, M. B. (2016). Smart motion detection system using raspberry pi. International Journal of Applied Information Systems (IJAIS), 10(5), 37-40.
- Abaya, W. F., Basa, J., Sy, M., Abad, A. C., & Dadios, E. P. (2014, November). Low cost smart security camera with night vision capability using Raspberry Pi and OpenCV. In 2014 International conference on humanoid, nanotechnology, information technology, communication and control, environment and management (HNICEM) (pp. 1-6). IEEE.
- Prasad, S., Mahalakshmi, P., Sunder, A. J. C., & Swathi, R. (2014). Smart surveillance monitoring system using Raspberry Pi and PIR sensor. Int. J. Comput. Sci. Inf. Technol, 5(6), 7107-7109.
- Kumar, K. K., Natraj, H., & Jacob, T. P. (2017, April). Motion activated security camera using Raspberry Pi. In 2017 International Conference on Communication and Signal Processing (ICCSP) (pp. 1598-1601). IEEE.
- Kaur, B., Pateriya, P. K., & Rai, M. K. (2018, April). An illustration of making a home automation system using raspberry Pi and PIR sensor. In 2018 International Conference on Intelligent Circuits and Systems (ICICS) (pp. 439-444). IEEE.
- Iversen, T. K., Kristoffersen, K. J., Larsen, K. G., Laursen, M., Madsen, R. G., Mortensen, S. K., ... & Thomasen, C. B. (2000, June). Modelchecking real-time control programs: verifying lego mindstorms tm systems using uppaal. In Proceedings 12th Euromicro Conference on Real-Time Systems. Euromicro RTS 2000 (pp. 147-155). IEEE.
- Y. Amit and P. Felzenszwalb, "Object Detection", Computer Vision, pp. 537-542, 2014.
- "Convolutional neural network", En.wikipedia.org, 2019. [Online]. Available: https://en.wikipedia.org/wiki/Convolutional_neural_network. [Accessed: 10-Feb- 2019]
- A. Krizhevsky, I. Sutskever and G. Hinton, "ImageNet classification with deep convolutional neural networks", Communications of the ACM, vol. 60, no. 6, pp. 84-90, 017.
- "What is a Raspberry Pi?", Raspberry Pi, 2019. [Online]. Available: https://www.raspberrypi.org/help/what-%20is-a-raspberry-pi/. [Accessed: 06-Mar- 2019]

- J. Huang, V. Rathod, C. Sun, M. Zhu, A. Korattikara, A. Fathi, I. Fischer, Z. Wojna, Y. Song, S. Guadarrama, and K. Murphy, “Speed/Accuracy Trade-Offs for Modern Convolutional Object Detectors,” 2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2017.
- D. Velasco-Montero, J. Fernández-Berni, R. Carmona-Galán and Á. Rodríguez-Vázquez, "Performance analysis of real-time DNN inference on Raspberry Pi", Real-Time Image and Video Processing 2018, 2018.
- W. Liu, D. Anguelov, D. Erhan, C. Szegedy, S. Reed, C. Fu and A. Berg, "SSD: Singlehot MultiBox Detector", Computer Vision – ECCV 2016, pp. 21-37, 2016.
- Redmon, J., & Farhadi, A. (2017). YOLO9000: Better, Faster, Stronger. 2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR). doi:10.1109/cvpr.2017.690
- T.-Y. Lin, M. Maire, S. Belongie, J. Hays, P. Perona, D. Ramanan, P. Dollár, and C. L. Zitnick, “Microsoft COCO: Common Objects in Context,” Computer Vision – ECCV 2014 Lecture Notes in Computer Science, pp. 740–755, 2014.
- Y. Jia, E. Shelhamer, J. Donahue, S. Karayev, J. Long, R. Girshick, S. Guadarrama and T. Darrell, "Caffe", Proceedings of the ACM International Conference on Multimedia - MM '14, 2014.
- J. Redmon, "Darknet: Open Source Neural Networks in C", Pjreddie.com, 2013-2016. [Online]. Available: https://pjreddie.com/darknet/. [Accessed: 22- Apr- 2019]
- Abadi, M. et al., “Tensorflow: A system for large-scale machine learning,” in [12th USENIX Symposium on Operating Systems Design and Implementation (OSDI 16)], 265–283 (2016).
- S. Mallick, "CPU Performance Comparison of OpenCV and other Deep Learning frameworks | Learn OpenCV", Learnopencv.com, 2019. [Online]. Available: https://www.learnopencv.com/cpu-performance-comparison-of-opencv-and-other-deep-learning-frameworks/#object-detection. [Accessed: 08- Sep- 2019].
- GitHub. (2019). Tensorflow detection model zoo. [online] Available at: https://github.com/tensorflow/models/blob/master/research/object_detection/g3doc/detection_model_zoo.md#coco-trained-models [Accessed 20 May 2019].

PUBLICATIONS

JOURNAL PUBLICATIONS:

Published the paper entitled “AUTOMATIC THREAT DETECTION AND THEFT TRAPPING THROUGH VIDEO SURVEILLANCE SYSTEM” in the Dickensian Journal UGC-CARE Approved Group ‘II’ Journal,Volume 22,issue 5,2022 Page No: 1100-1103,DOI:10.12001.DK.J2022.V22.15.293 May 2022

CONFERENCE PUBLICATION:

Presented the paper entitled “AUTOMATIC THREAT DETECTION AND THEFT TRAPPING THROUGH VIDEO SURVEILLANCE SYSTEM”,in the national conference on“RECENT ADVANCED IN ELECTRICAL,ELECTRONICS AND COMMUNICATION NETWORKS” on 27th may 2022 held at HINDUSTHAN INSTITUTE OF TECHNOLOGY ,Coimbatore