SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU-572103

(An Autonomous Institute under Visvesvaraya Technological University, Belagavi)

Project Report on

"Automatic Surveillance System"

submitted in partial fulfillment of the requirement for the award of the degree of

BACHELOR OF ENGINEERING

in

ELECTRONICS & COMMUNICATION ENGINEERING

Submitted by

Prajwal B C 1SI18EC067

Sujan D 1SI18EC102

Supreeth G L 1SI18EC107

Dilip N 1SI18EC126

under the guidance of

Dr. Harshalatha Y

Assistant Professor

Department of E&CE

SIT, Tumakuru-03

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

2021-22

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU-572103

(An Autonomous Institute under Visvesvaraya Technological University, Belagavi)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

CERTIFICATE

Certified that the project work entitled "AUTOMATIC SURVEILLANCE SYSTEM" is a bonafide work carried out by Prajwal B C (1SI18EC067), Sujan D (1SI18EC102), Supreeth G L (1SI18EC107) and Dilip N (1SI18EC126) in partial fulfillment for the award of degree of Bachelor of Engineering in Electronics & Communication Engineering from Siddaganga Institute of Technology, an autonomous institute under Visvesvaraya Technological University, Belagavi during the academic year 2021-22. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the department library. The Project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the Bachelor of Engineering degree.

Dr. Harshalatha Y	Head of the Department	Principal
Assistant Professor	Dept. of E&CE	SIT,Tumakuru-03
Dept. of E&CE	SIT,Tumakuru-03	
SIT,Tumakuru-03		

External viva:

Names of the Examiners **Signature with date**

1.

2.

ACKNOWLEDGEMENT

We offer our humble pranams at the lotus feet of **His** Holiness, **Dr. Sree Sree Sivakumara Swamigalu**, Founder President and **His** Holiness, **Sree Sree Siddalinga Swamigalu**, President, Sree Siddaganga Education Society, Sree Siddaganga Math for bestowing upon their blessings.

We deem it as a privilege to thank **Dr. M N Channabasappa**, Director, SIT, Tumakuru, **Dr. Shivakumaraiah**, CEO, SIT, Tumakuru, and **Dr. S V Dinesh**, Principal, SIT, Tumakuru for fostering an excellent academic environment in this institution, which made this endeavor fruitful.

We would like to express our sincere gratitude to **Dr. R Kumaraswamy**, Professor and Head, Department of E&CE, SIT, Tumakuru for his encouragement and valuable suggestions.

We thank our guide **Dr. Harshalatha Y**, Assistant Professor, Department of Electronics & Communincation Engineering, SIT, Tumakuru for the valuable guidance, advice and encouragement.

Prajwal B C	1SI18EC067
Sujan D	1SI18EC102
Supreeth G L	1SI18EC107
Dilip N	1SI18EC126

Course Outcomes

CO 1 : Identify and formulate the problem through literature survey and knowledge of contemporary engineering technology.

CO 2 : Apply engineering knowledge to arrive at optimal design solutions for solving engineering problems in compliance with the prescribed safety norms/standards taking into consideration environmental concerns.

CO 3 : Select suitable engineering tools, platform, sub-system for solving identified engineering problem.

CO 4 : Implement the proposed solution on the selected platform, considering societal, health issues. Validate the design, analyse and interpret the results using modern tools.

CO 5 : Comprehend and prepare document as per the standard, present effectively the work following professional ethics, interact with target group.

CO 6 : Contribute to the team as a member, lead the diverse team.

CO 7 : Demonstrate engineering and management principles, perform the budget analysis through utilization of the resources (finance, power, area, bandwidth, weight, size, etc)

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	3										2	3	
CO-2			3									2		3
CO-3			3											3
CO-4				3	3	2	2					2		3
CO-5								3		3		2		2
CO-6									3					3
CO-7											2		2	
Average	3	3	3	3	3	2	2	3	3	3	2	2	3	3

Attainment level: - 1: Slight (low) 2: Moderate (medium) 3: Substantial (high)

POs: PO1: Engineering Knowledge, PO2: Problem analysis, PO3: Design/Development of solutions, PO4: Conduct investigations of complex problems, PO5: Modern tool usage, PO6: Engineer and society, PO7: Environment and sustainability, PO8: Ethics, PO9: Individual and team work, PO10: Communication, PO11: Project management and finance, PO12: Lifelong learning

Abstract

Surveillance is monitoring of behavior, activities, or information for the purpose of information gathering, influencing, managing, or directing. Automatic surveillance is the use of automatic video analysis technologies in video surveillance applications. In the present world, security plays an important role. The video surveillance system is mainly used for commercial, law enforcement and military applications. The main issue in this case is, it requires more storage for the footage and power consumption is also high. The automatic surveillance system provides the solution to minimize the power consumption by providing efficient surveillance. The storage space can be saved by recording the video and uploading the still images locally only when motion is detected.

The automatic surveillance system consists of Raspberry pi and camera modules. Raspberry pi operates the video cameras for remote sensing and surveillance. The surveillance is triggered by the cameras whenever the motion is detected. The system monitors and recognize the face in the captured images with the help of face recognition algorithm.

The live streaming can be host on a device with the help of motion eye OS. The notification will be sent to the user on detection of an unknown person via Telegram. When the motion or any movement is detected with the help of motion detection algorithm, the bulb will get ON through relay module.

Contents

List of Figures

Chapter 1

Introduction

In present world, there is need to increase in video surveillance to monitor any target environment for the security. These systems allow for continuous security monitoring of surveillance target environment, as well as the storage of data for future reference. However, the main disadvantages of these systems include manual monitoring, more storage requirements, and high power consumption [1]. The surveillance monitoring activities could be related to control of traffic, prediction of accidents, prevention of crimes, motion detection, and home security, among other applications. A better security system that provides automatic analysis of surveillance data with less human operations is becoming popular [2].

The main aim of the automatic surveillance system is to minimize the power consumption as well as storage. The target environment which is under surveillance is monitored using this system. The camera which is interfaced with the raspberry pi will capture the images. The captured images are uploaded to the cloud to minimize the storage. The motion detection algorithm is used to detect any motion in the surveillance area. Then, the face is recognized with the face recognition algorithm. If the unknown face is recognized, it will notify the user through telegram. When the motion is detected, the bulb will turn ON by the help of relay. Automatic surveillance system provides a remote monitoring of the target environment and to enable the user to access the changing information of particular area through his/her device.

1.1 Motivation

Security has always been concern due to increasing crime rate. Being able to monitor the premises is one of the measures that can be taken to prevent such incidents. It's unfeasible to have a set amount of storage to keep all crucial data without worrying about losing it, which is where cloud storage comes into picture. Reducing human involvement or automating processes is important in some areas because it improves efficiency and is

compatible with most smart systems on the market today.

1.2 Objective of the project

The main objectives of this project are to:

- Develop a automatic surveillance system that helps in real-time video monitoring.
- Live stream of video using motion eye OS.
- Automate the lighting system in target environment based on motion detection and to recognize the known persons with the help of face recognition algorithm.

1.3 Organisation of the report

The report is divided into 7 chapters. Chapter 1 describes introduction and the objective of the project. In chapter 2, the detailed literature review on existing methods of an Automatic Surveillance System is carried out. The block diagram of Automatic Surveillance System with the overview of the components is described in chapter 3. The hardware system which includes Raspberry Pi, Camera (Pi. v2) and relay module are described in chapter 4. The algorithms and software requirements are presented in chapter 5. Results and conclusion are depicted in chapters 6 and 7 respectively.

Chapter 2

Literature Survey

This chapter includes summary of the surveys that are carried as a ground work for the project.

It has become challenging to keep an eye on the security of homes and businesses in today's fast-paced environment. Thus, there is an increased need for camera surveillance systems. It is not worthwhile to continuously monitor the area with cameras in some locations, such as bank vaults and homes where there is little human activity. This uses up the power as well as the storage required for the footage. To all these problems, smart surveillance monitoring system is the answer. Using a PIR sensor, this system will identify person's presence. For remote sensing and monitoring, the raspberry pi operates and controls motion-detecting sensors and cameras, broadcasts live footage, and records it for future reference. The surveillance will start when the cameras detect any movement. This methodology gathers data and sends it to smartphones and laptops over the Internet. The WAN is used for live streaming [1].

A brief account of different architectures on video surveillance system along with its general description with working has been discussed. Further, it describes about the analytics involved in object tracking, face recognition, motion detection, action detection and recognition, person re-identification, face detection. A brief note on camera calibration with their advantages and disadvantages are briefed. The existing surveillance systems are compared with each other in terms of characteristics, advantages and difficulties [2].

Surveillance plays an important role in security system. But, traditional method uses devices that consume more power and less efficient. As a result, a portable, cost effective system is developed for recognition of faces. Real time video stream is processed and motion is detected using background subtraction. For tracking an unidentified person, a dual-axis servo pan-tilt system is used. By employing the concept of servo positioning, the mechanism will follow the person. The servo will travel inside a specified frame region, monitoring any unidentified people's movements. Principal Component Analysis (PCA)

represents faces into components of eigenfaces. It performs co-variance analysis between factors acting correlation between samples and elements [3].

Intelligent Video Analytic Model (IVAM) is used for analysing and detecting the abnormal activities. The object is to quickly recognize the peculiarities in video by considering minimal resources and a fast working time. The two different datasets used in this approach are UCSD-AD dataset and convert the video into frames. The model consists of background subtraction, people and object detection, statistical and spatio temporal feature extraction and event actively classifier. When successfully categorising the normal and abnormal frames from the benchmark dataset and the custom dataset, IVAM has a lower error rate and has reached 99.77 percent and 98.19 percent accuracy, respectively [4].

The main objective is to operate the surveillance system without human interaction. A camera is mounted on the top of a car and it is controlled via android app. Histogram of oriented gradients (HOG) is used as a feature descriptor algorithm and Haar cascade algorithm for obtaining the better results by locating faces, pedestrians, objects and facial expression in a image. The advantage of HOG based classifier is that, it functions well with a range of shades, hues, noisy image and low quality images. Haar uses machine learning algorithm to keep a huge number of photos of object indefinitely [5].

Authors have built a facial recognition using OpenCv with its libraries. The paper had a brief discussion with the problems that are faced during implementation of facial recognition system. The difficulties may be aging, position, lighting conditions. The other problems like hardware problems that is image capturing device are also considered. The facial expression characteristics i.e. nodal points are the system's pillars. These nodal points are different and unique for individuals. The whole system approaches in mainly four stages: the detection, capturing, database creation and the recognition phase. The system is integrated in Python 3 with the help of the OpenCv library [6].

The narrow differences between face detection and face recognition has been discussed here. The two main algorithmic approaches are geometric and photo-metric stereo approach. The face detection involves main steps: pre-processing, classification and localization. Feature based and image based approach are used by authors to recognize facial part in an image. Here, authors have used digital image processing technique to recognise

the face and match it with existing data-set. All level of processing is used in this domain to achieve accuracy of more than 90%. This technique is employed for both manual and automatic face recognition system [7].

Histogram of Oriented gradients(HOG) is used for detecting abnormal human activity. The object is differentiated into human or non human by the descriptors. Gradients are calculated using centered derivative mask, after that magnitude and directions are calculated. Each gradient is sorted into a distinct bin direction with respect to localized blocks. The detection task is carried out by extracting features using a window at multiple scales and directions .The approach can identify people in both still photos and video file. The algorithm produces effective detection result compared to the background subtraction method [8].

The attendance system is used monitor whether a student arrives for class or not. Biometric-based, radiofrequency card-based, face recognition-based, and classic paper-based attendance systems are all examples of distinct types of attendance systems. Attendance systems which are based on face recognition are the most secure and time-saving of them all. In [9], Authors discussed face recognition based attendance system. The Local Binary Pattern Histogram (LBPH) approach outperforms previous euclidean distance-based algorithms like Eigenfaces and Fisherfaces. Authors chose the Haar cascade for face detection and the LBPH algorithm for face recognition. It withstands monotonic grayscale modifications with ease. The system is evaluated under different scenarios such as facial recognition error rates probability with and without a threshold for identifying strangers.

2.1 Summary

This section shows key results of the literature survey on automatic surveillance system along with the hardware and software requirements.

Understanding the operation of Raspberry Pi [1]. Introduction to OpenCV for image processing [6]. Understanding of HOG algorithm for motion detection [8]. Face is recognised using Local Binary Pattern Histogram algorithm [9].

Chapter 3

System Overview

The Automatic Surveillance System's system overview is described in this chapter. It consists of block diagram of automatic surveillance system and block description.

3.1 Automatic Surveillance System

The Block diagram of the Automatic Surveillance System is as shown in Figure 3.1. The camera module is interfaced with the raspberry pi. The target area is monitored and the motion is detected using motion detection algorithm. The face is recognized using face recognition algorithm. If the face is mismatched with the database, the user will get notified. When any movement is detected, the bulb will turn ON.

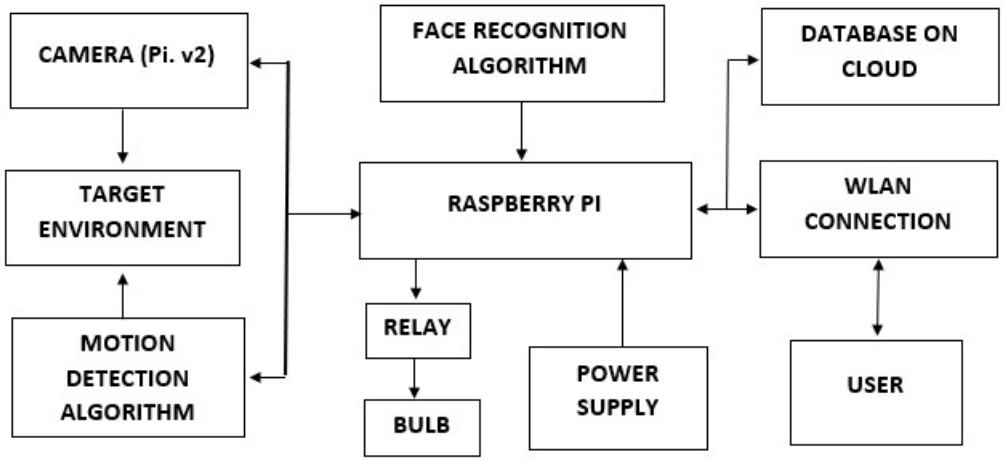

Figure 3.1: The Block diagram of Automatic Surveillance System.

The hardware modules of automatic surveillance system is shown in the Figure 3.1 are discussed below,

1. **Power Supply:** The raspberry pi 3B+ requires 2.5A of current at 5.0 V DC. So, the power is supplied with the help of 2.5A/5V DC mobile adapter. The adapter converts the AC power that comes from the AC supply to DC and its output is regulated to 5V.

2. **Raspberry pi:** Raspberry pi 3B+ is used as a processing unit for the surveillance system. The camera is connected to the raspberry pi which will capture the images whenever the motion is detected and uploading the images to the cloud. It also initiates the algorithm for face recognition and reports the same.

3. **Camera (Pi.v2):** It is interfaced with the raspberry pi. A high-definition camera is used to take good quality images. It supports 1080p, 720p and 640x480p video. It is attached to the CSI camera port of the raspberry pi by short ribbon cable.

4. **Database on cloud:** The photos will be stored in the cloud storage i.e google drive. That will provide the user to access the resources without the burden of local data storage and maintenance.

5. **Target environment:** It is the environment which is subjected to be under surveillance. The target environment is monitored remotely.

6. **Motion detection algorithm:** The foremost step in the system begins with the motion detection. The motion detection is done by the frame difference method. When the system detects the motion in the targeted area, it triggers the face recognition algorithm.

7. **Face recognition algorithm:** It is the algorithm used to recognize the faces. The known person face images are stored in the dataset with a unique id. If the known person face is recognized, it will notify the user through telegram with the person's name. If the unknown face is recognized, it will notify the user as unknown person detected in the surveillance area.

8. **WLAN connection:** It is the local wireless LAN connected to the raspberry pi and it establishes the connection between the user PC and the raspberry pi. In this project, the mobile hotspot is used to establish connection.

9. **User:** Here, user refers to the individual,company or the administrator who is/are deployed to empower the security of the defined target area. The movement in the targeted area is notified to the user.

10. **Relay:** It acts as a switch to close or open the electric circuit. It consists of components that facilitate switching and connectivity and act as indicators of whether

the module is powered and whether the relay is active. The VCC pin is connected to pin 4 (5V), ground pin is connected to pin 6 (Ground) and input pin is connected to pin 16 (GPIO 23) of raspberry pi respectively. It is used to switch ON/OFF the bulb.

Chapter 4

System Hardware

This chapter describes each component used in the Automatic Surveillance System. It consists of Raspberry Pi, Camera(Pi.v2), Relay module.

4.1 Raspberry Pi

Raspberry Pi is a small, affordable computer about size of a credit card that connects to a computer monitor or TV and operates with a regular keyboard and mouse. It can accomplish all tasks that a desktop computer can, includes watching high-definition video, accessing the internet, creating spreadsheets, word editing, and playing games. Python language is used for the coding. Raspberry pi is as shown in the Figure 4.1.

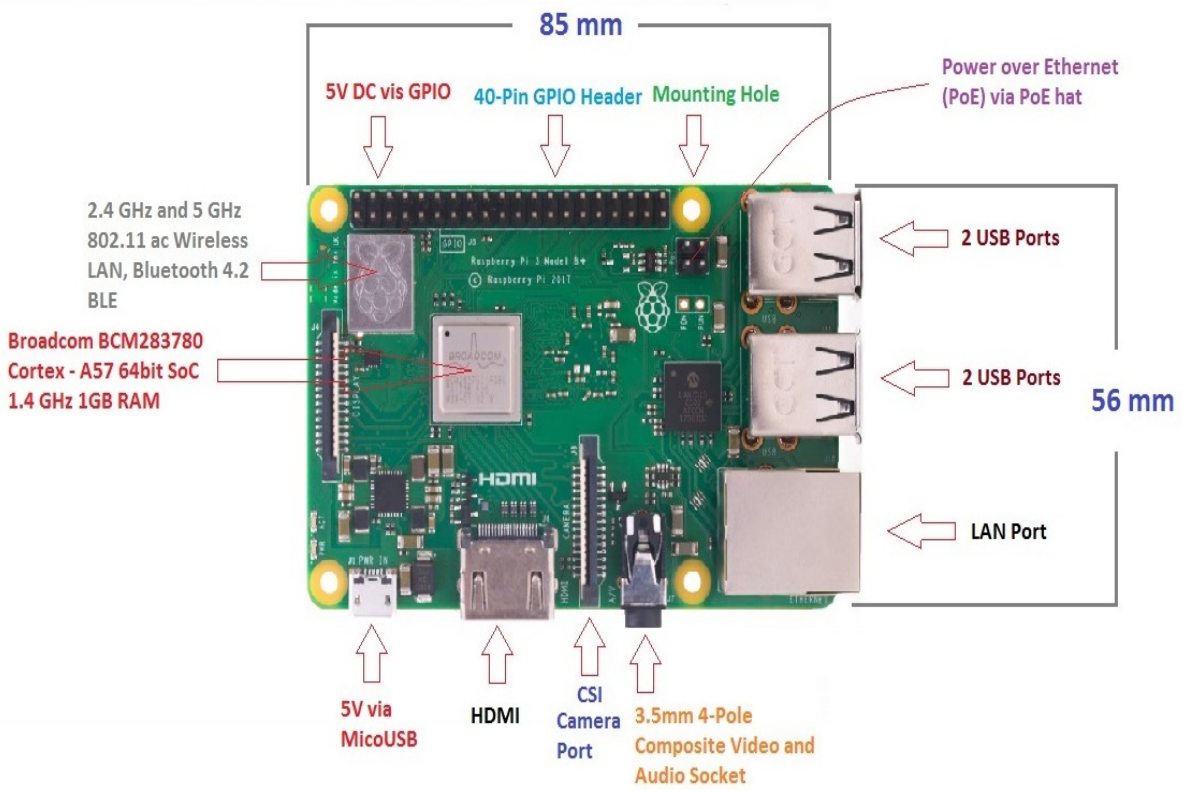

Figure 4.1: Raspberry Pi.

Specifications:

- 1.4GHz clocked quad core 64-bit processor.

- 1GB LPDDR2 SRAM.
- 2.4GHz and 5GHz wireless LAN.
- Bluetooth 4.2.
- High speed ethernet.
- 5V/2.5A DC input power.
- GPIO: 40-pin.
- Operating system support: Linux and Unix.

4.2 Camera (Pi.v2)

The camera module is used to take good quality videos and snapshots. It is making with high quality 8 megapixel Sony IMX219 image sensor. The captured video and images are send to the Raspberry Pi for further process. The Raspberry pi camera v2 is as shown in the Figure 4.2.

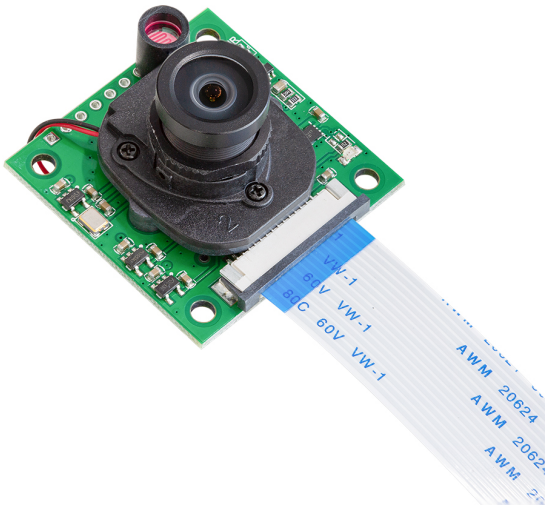

Figure 4.2: Raspberry Pi camera v2.

Specifications:

- 8 megapixel camera.
- Capture video at 1080p, 720p and 640x480p resolutions.
- It is supported with Raspbian Operating System.
- Supports Raspberry Pi 1,2 and 3.

4.3 Relay

Relay is an electrical switch that controls a high voltage circuit employing a low voltage supply. A relay fully isolates the low voltage circuit from the high voltage circuit. Each relay has a common pin, a normally open (NO) pin, and a normally closed (NC) pin. It will accept the input voltage ranges from 4V to 12V. The Relay is as shown in the Figure 4.3.

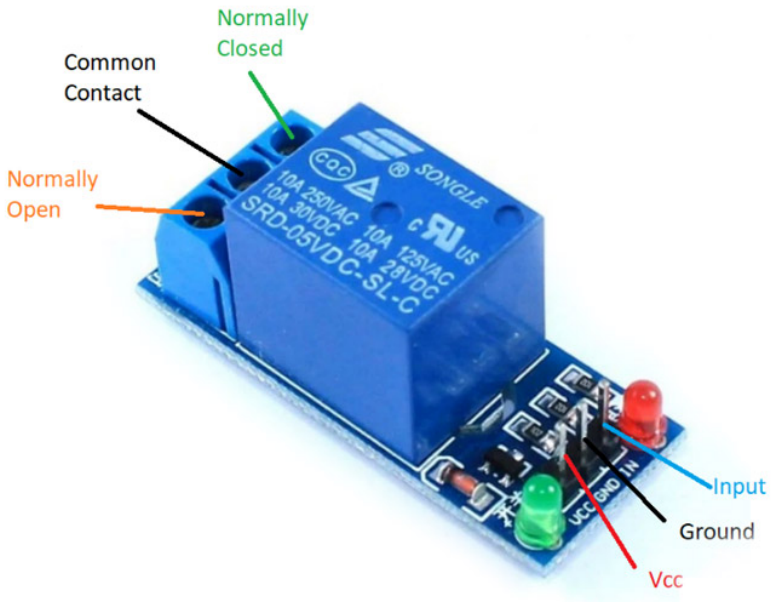

Figure 4.3: Relay.

Specifications:

- High current: 10A at 250V AC or 15A at 125V AC.
- Input voltage: 4V to 12V.

4.4 Power Supply

Raspberry pi requires 5V power source. The raspberry pi will be operating at 5V/2.5A. The mobile adapter converts 220V AC supply to 5V regulated DC. So, 5V/2.5A mobile adapter is be used to deliver the power for the raspberry pi.

Chapter 5

System Software

5.1 Algorithm

This section describes about the algorithms used. It consist of HOG algorithm for motion detection, Motion detection algorithm based on background subtraction and Face recognition using Local Binary Pattern Histogram Algorithm.

5.1.1 Histogram of Oriented Gradients (HOG) Algorithm for motion detection

First calculate gradient of the image and centered derived mask. On image object [-1 0 1] and $[-1\ 0\ 1]^T$ are used in the x and y directions. Next, the size and direction (orientation) of the gradient are computed. Each of the gradients is then classified into one of predefined discrete groups with a direction of (0, 180] degrees relative to a local volume. The detection task is achieved by scanning the input data (image) by a window at different scales and directions, and classifies each window as human or non-human.
The basic theory behind the algorithm is shown in equations 5.1 to 5.3.

$$f^1 = \lim_{h \to 0} \frac{f(x+h) - f(x-h)}{h} \tag{5.1}$$

$$G = \sqrt{I_x^2 + I_y^2} \tag{5.2}$$

$$\theta = arctan\left(\frac{I_x}{I_y}\right) \tag{5.3}$$

Where, G and θ are the gradient magnitude and the orientation respectively.
I denotes the grayscale of image pixel.

Default people detector classifier from the HOG library is used in this project as pre trained model for person detection.

Figure 5.1: Person detected using HOG algorithm.

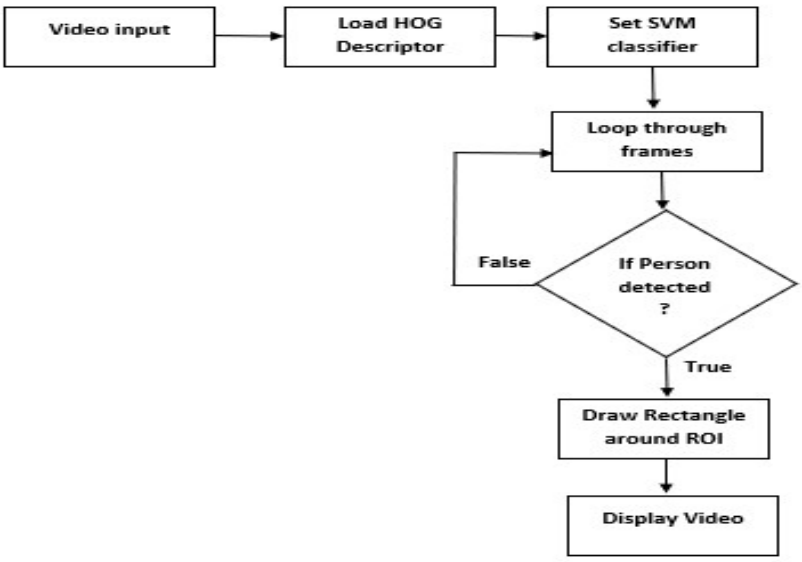

Figure 5.2: Flow chart of HOG algorithm.

5.1.2 Motion detection algorithm based on background subtraction

1. The first step is capture the background. For each pixel (x,y), the corresponding value of the background frame B(x,y) is calculated using the following formula:

$$B(x,y) = B_{t-1}(x,y) + \frac{1}{t}.(I_t(x,y) - B_{t-1}(x,y)) \tag{5.4}$$

where,

$B_{t-1}(x,y)$ is background frame.

$I_t(x,y)$ is the current frame.

t is the number of the captured frames.

2. Calculate the difference image by an absolute difference between the foreground and background image.

Figure 5.3: Calculating absolute difference

$$d(x,y) = \begin{cases} 0\ , |I_t(x,y) - B(x,y) \leq \Delta t| \\ 255\ , |I_t(x,y) - B(x,y) \geq \Delta t| \end{cases} \tag{5.5}$$

where, Δt = threshold

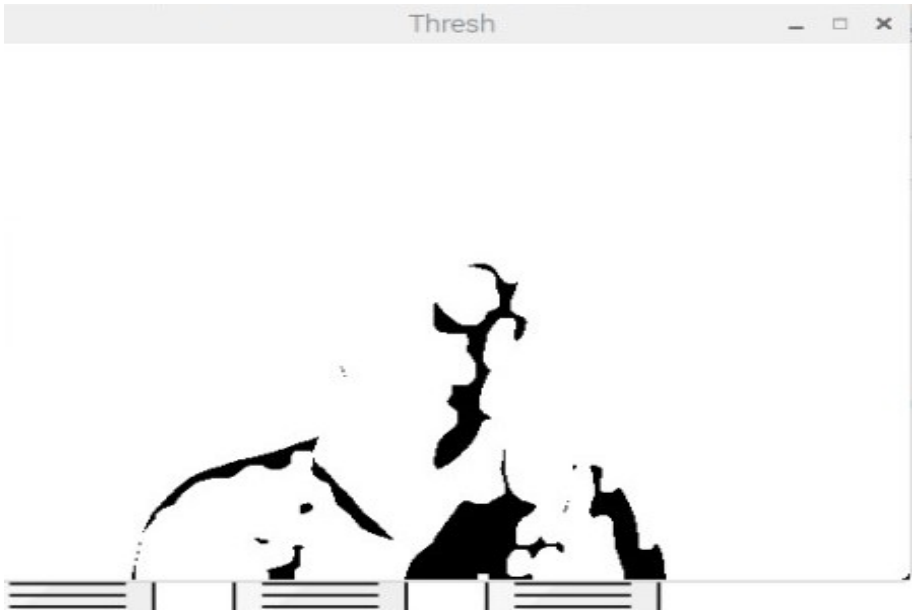

Figure 5.4: Threshold

3. The background is updated slightly towards the current frame. For each pixel(x,y) in Image Z,

$$Z(x,y) = 0.75 * B_{t-1}(x,y) + (1 - 0.75) * I_t(x,y) \tag{5.6}$$

where, $B_{t-1}(x,y)$ is the background frame.

$I_t(x,y)$ is the current frame.

4. Focus the moving object.

Figure 5.5: Motion detection

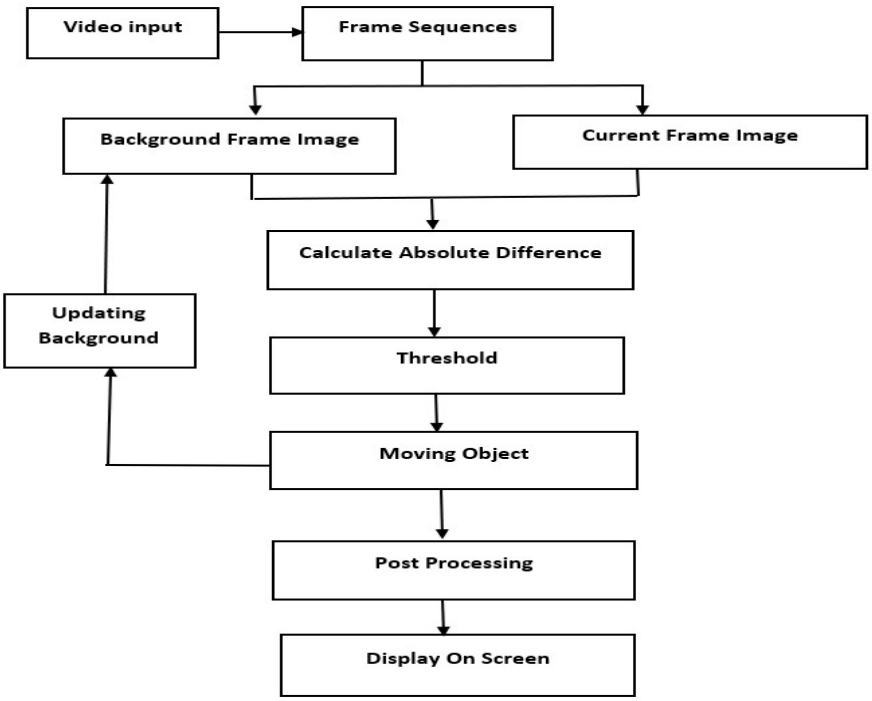

Figure 5.6: Flow chart of background subtraction algorithm

5.1.3 Face recognition using Local Binary Pattern Histogram Algorithm

It make use of a data set with face pictures of the persons who will be recognised. Each image has a special ID so that the algorithm can use this information to identify the image and export the output.

1. An intermediate image that takes into consideration the neighbour and the radius has been created to reflect the original image.
2. For each neighbor value which is greater than threshold is set to 1 and which is less than threshold is set to 0.
3. The binary number is converted into decimal number to create central value of the matrix as shown in the Figure 5.7.

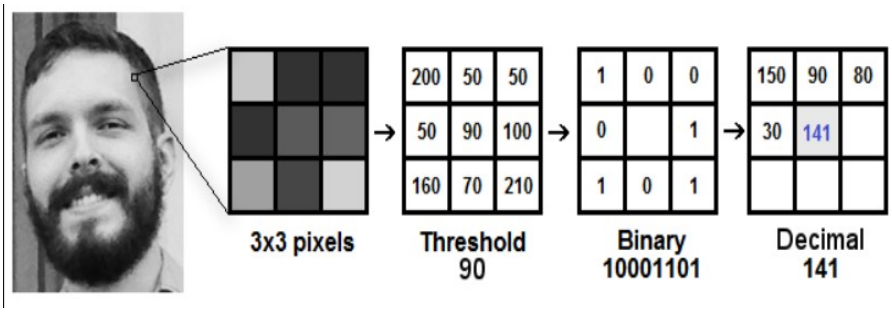

Figure 5.7: Performing LBP operation on an image.

4. Extract the histogram of each image. The characteristics of the original image are represented by a new histogram that is produced by combining each histogram. as shown in the Figure 5.8.

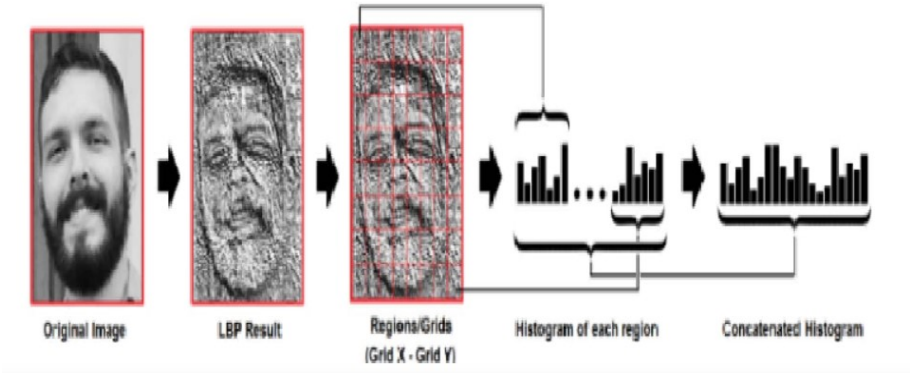

Figure 5.8: Process of LBPH algorithm on an image.

5. Create a histogram for an image in the training data set, then the two histograms are compared. If the closest histogram matches to an image, this displays the ID or name of the image.
6. The confidence and threshold are used to estimate the accuracy of the recognition.

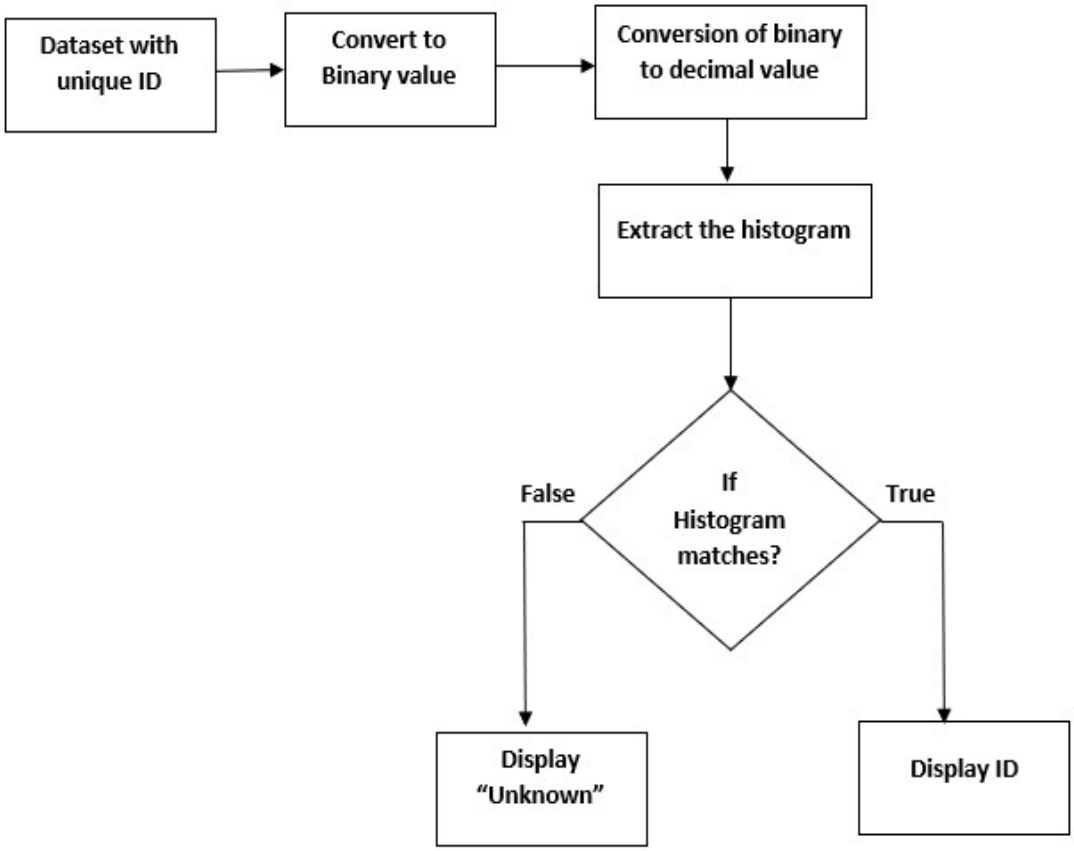

Figure 5.9: Flow chart of LBPH algorithm.

5.2 Flowchart

Figure 5.10 shows the working flow of the automatic surveillance system. First, the raspberry pi module need to be powered up. Once the device is powered up, then the device is initialized in secure boot to run the program. Then the live streaming takes place with the help of motion eye os. The real time video can be monitored on user PC and also on smart phones by entering the IP address of the raspberry pi. When the motion is detected, the bulb will turn ON. Then the camera module will capture the images. Then the face is recognized with the help of face recognition algorithm and notification is send to user via telegram. Finally, the captured snapshots are stored in a google drive.

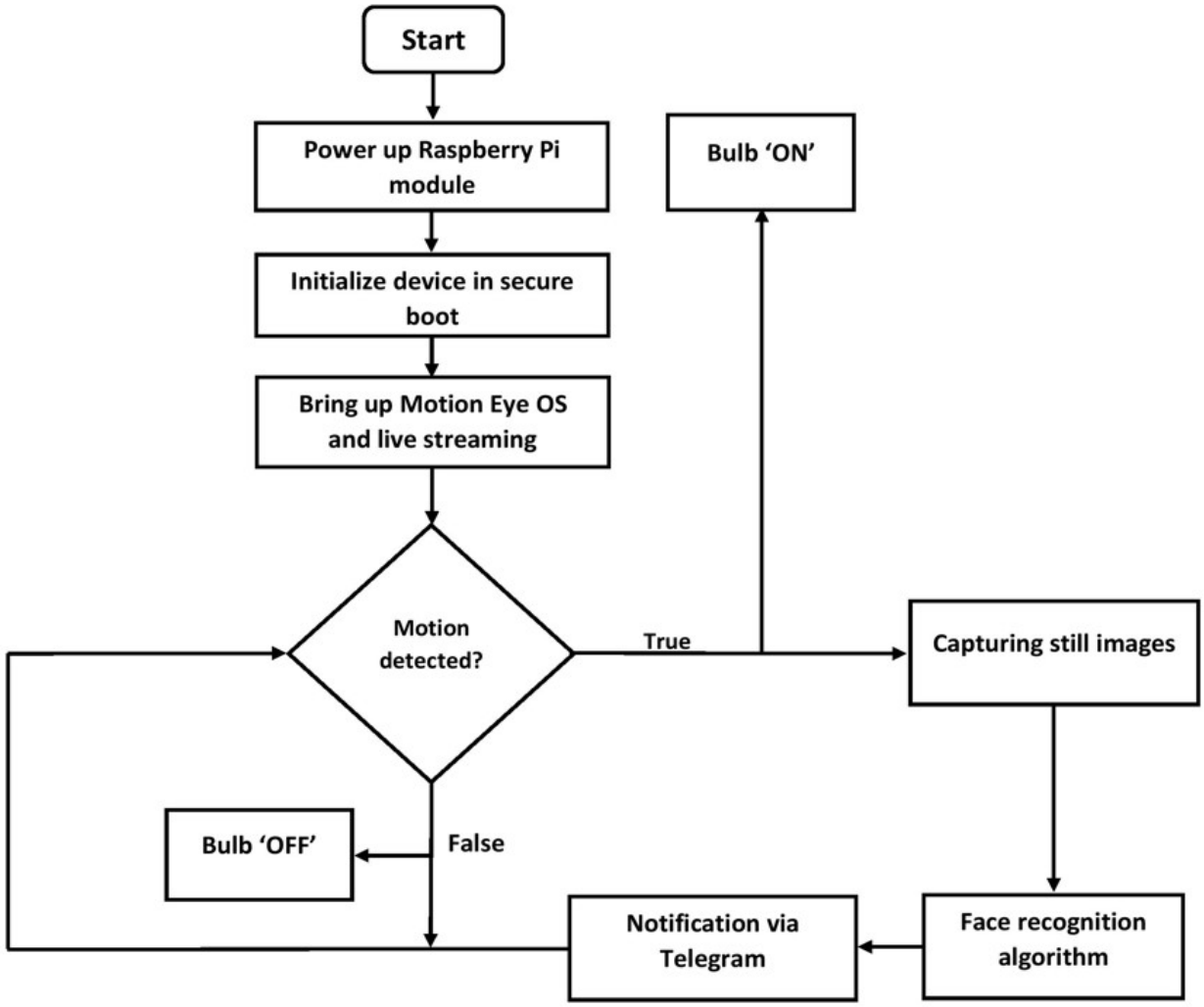

Figure 5.10: Flow chart of Automatic Surveillance System.

5.3 Software Requirements

This section gives the information about software requirements. Its consists of Pi OS, VNC Server, OpenCV, Motion eye OS, Google Drive and Telegram.

5.3.1 Raspberry Pi OS

Raspberry Pi OS is an operating system for the raspberry pi which is based on Dabian. It is officially powered by the Raspberry Pi platform as the core operating system for the raspberry pi series of compact single-board computers. The Raspberry Pi operating system is highly optimized for the compact single-board computers with ARM processors of raspberry pi series.

5.3.2 VNC Server

VNC is the abbreviation of Virtual Network Computing. It is a platform for screen sharing, created to control another computer remotely. This means that users can remotely access and control the computer's screen, keyboard, and mouse from a secondary device as if they were sitting right in front of it. VNC works under the client / server model. A server component is installed on the raspberry pi and a client or a VNC viewer is installed on the device such as user PC. This may include another desktop, PC or mobile phone. When the connection established between the server and client, server makes a copy of raspberry pi desktop's screen to the viewer.

5.3.3 OpenCV

OpenCV (Open Source Computer Vision Library) is a library of programming functions mainly focused on real-time computer vision. The purpose of an openCV is to provide a common infrastructure for computer vision applications. The library contains more than 2,500 optimized algorithms, including a complete collection of classical and advanced computer vision and computer algorithms. These algorithms can be used for face detection and recognition, object identification, human action classification in video, camera motion tracking, moving object tracking, tissue extraction 3D rendering of the object, creating 3D point clouds from the stereo camera, etc. Windows, Linux, Android, Mac OS X, Python, Java, and MATLAB are all compatible with this software.

5.3.4 Motion Eye OS

Motion Eye OS, a freely available software application, this allows user to make a raspberry pi with a camera into a home video surveillance system, where captured snapshots and videos can be saved on user device or if the user wish to automatically upload to a online storage services like Google Drive or Dropbox. Most of USB cameras, raspberry pi camera modules, and IP cameras are supported by this application.

Features:

- Web-based, mobile/tablet-friendly user interface.
- Email notifications.
- JPEG files for still images, AVI files for videos.
- Timelapse movies.

- Connects to local network using ethernet or Wi-Fi.

5.3.5 Google Drive

Google drive is the files storage application. Google drive allows anyone to back up, sync, upload, transfer and share photos, documents, videos and other files to cloud storage and access them from any device, anywhere. The user can easily share documents using google drive and send large or small files to family and friends.

5.3.6 Telegram

Telegram is a free service online messaging application. The service also provides end-to-end encrypted video calling, VoIP, file sharing and several other features. This application is used to notify the user with photos of unknown and known persons in the surveillance area.

5.3.7 Database

The database will contain face images of faculties of the ECE department. For every faculty member, the folder is created by giving their name. Faculty's face images will be stored in the respective folder and it will be accessed during the time of face recognition.

Chapter 6

Experimental setup and Results

Automatic surveillance system based on raspberry pi has been implemented. The system is used to trigger the lighting system in the surveillance area and monitor the target area. By adopting a motion detection algorithm and pi camera, which detects motion events and covers the target environment's live video. When motion is detected, the system enables face recognition algorithm and it notifies the user via Telegram as known person if particular person's face images are stored in the database, else it notifies as unknown person detected. The cloud network on the system is used to store captured images. The Figure 6.1 shows the experimental setup of automatic surveillance system.

Figure 6.1: Experimental setup.

6.1 Live streaming

The live video stream of the target area on web browser can be obtained by specifying the IP address of the Raspberry Pi, which can be accessed on both smart phones and personal computers. Figure 6.2 shows live streaming using motion eye OS.

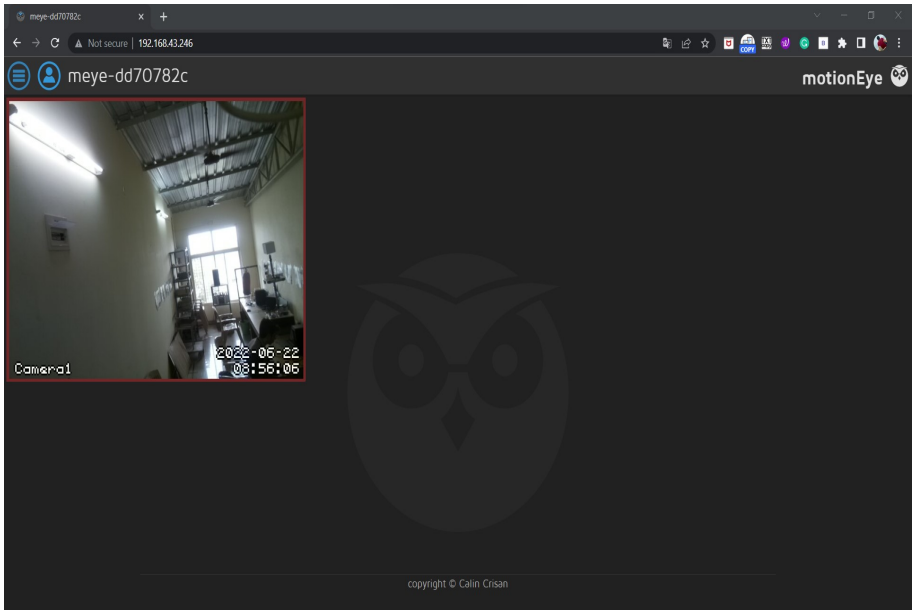

Figure 6.2: Live streaming using motion eye OS.

6.2 Motion detection and Face recognition

The targeted environment is under the surveillance of the designed system. When the motion is detected by the system, then it triggers the face recognition algorithm. The face recognition module then analyzes the faces, If face is known, then it will notify with the label allocated as shown in Figure 6.3. If the face is not matched with any of the dataset available, then it will label the face as "Unknown" as shown in Figure 6.4. It also notifies the user through Telegram as shown in Figure 6.5.

Figure 6.3: Face recognition of known person.

Figure 6.4: Face recognition of unknown person.

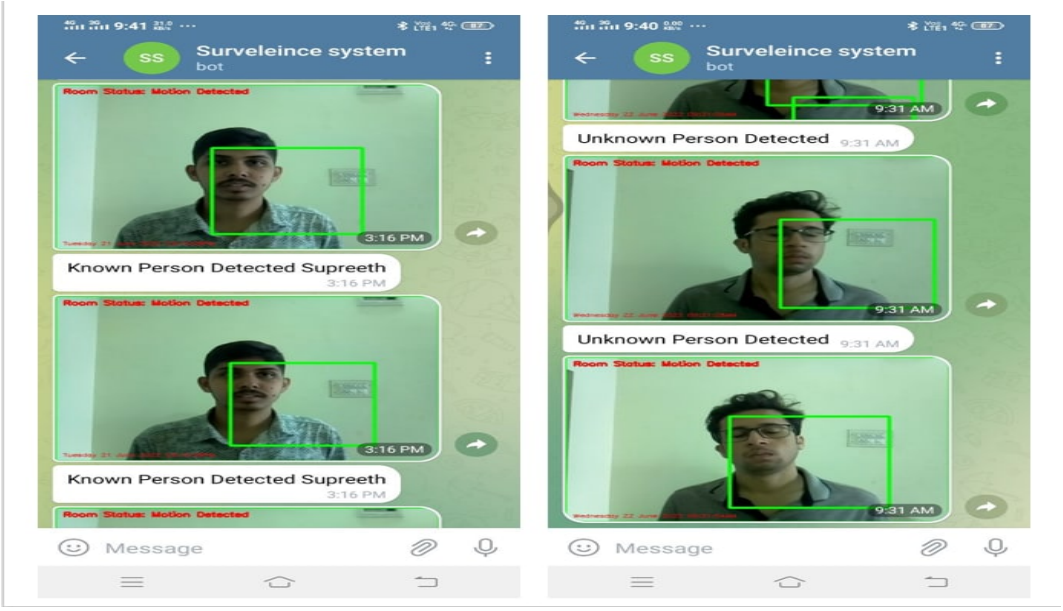

Figure 6.5: Notification in Telegram.

6.3 Storage

The snapshots which are captured during live streaming, will be stored in Google Drive. Google Drive provides users with 15GB of free storage space through Google One. The maximum size of the uploading file is 750GB. Here, users can search for images by describing them. Figure 6.6 shows still images stored in google drive taken during live streaming.

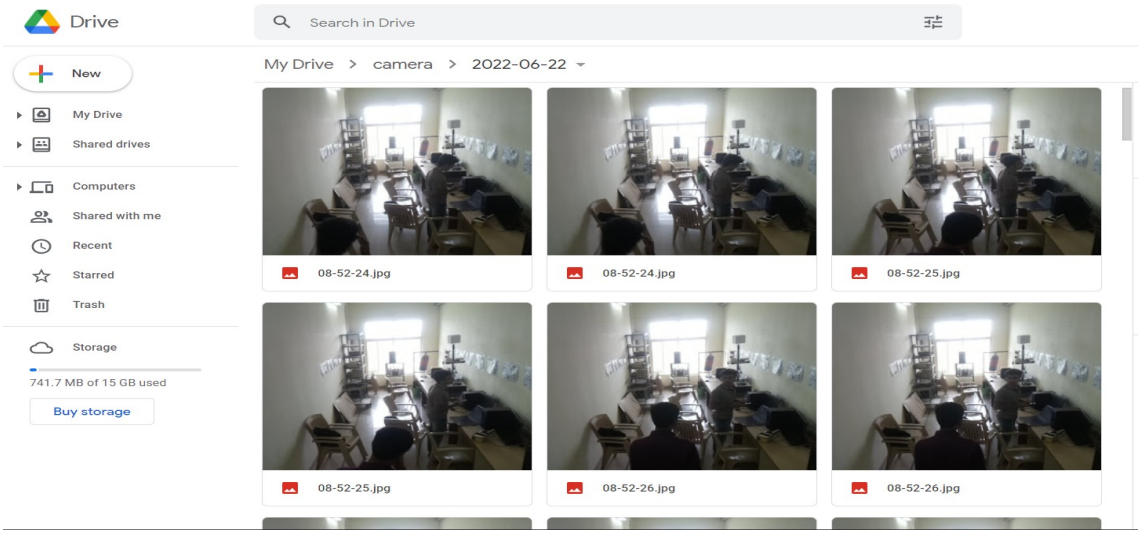

Figure 6.6: Still images stored in Google drive

6.4 Analysis

The developed system provides a satisfactory results when the illumination of the environment and the distance of the target is sufficient enough to the camera. The illumination plays an important role to recognise the face from the same distance. The face which is detected but showing as unknown in Figure 6.7 (a) due to interference of illumination but cannot be detected in Figure 6.7 (b) due to the side view.

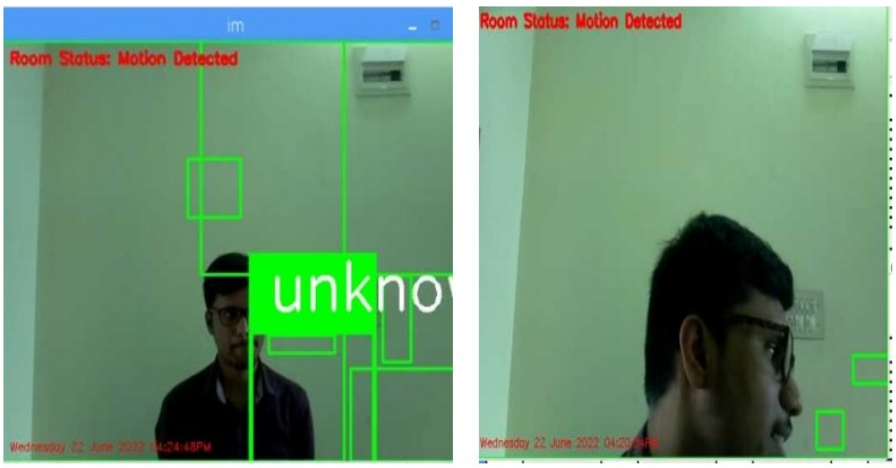

Figure 6.7: (a): Face recognition of known person as unknown due to poor illumination and more distance between face and camera. (b): No face detected due to side view.

Chapter 7

Conclusion

The automatic surveillance system is successfully implemented. The targeted area under the surveillance can be monitored and secured remotely. The face recognition is offering more strength to security aspects. The bulb which lights up only when the motion is detected indicates the presence. This system also drives two key aspects: one is memory management and second is energy management. The snapshots that are taken during the surveillance in the targeted area is uploaded to google drive only if the motion is detected which helps in memory management.

The illuminations and the distance plays major role in the face recognition. The face recognition based on Local Binary Pattern Histogram works finely at appropriate distance and in a good lighting conditions.

7.1 Scope for future work

This section provides an overview of the different approaches that can be developed with this system in future.

- Aligning IoT with this system, which will provide more opportunities for interfacing to the security systems.
- Improving the speed and accuracy of the face recognition algorithms.

Bibliography

[1] A. Jain, S. Basantwani, O. Kazi and Y. Bang, *"Smart Surveillance Monitoring System",* IEEE International Conference on Data Management, Analytics and Innovation, Pune, India, pp. 269-273, Feb 2017.

[2] Omar Elharrouss, Noor Almaadeed, Somaya Al-Maadeed, *"A Review of Video Surveillance Systems",* Journal of Visual Communication and Image Representation, Elsevier, vol. 77, no. 1, pp. 1047-3203, May 2021.

[3] S. U. Ahmed, H. Khalid, M. Affan, T. A. Khan and M. Ahmad, *"Smart Surveillance and Tracking System",* IEEE 23rd International Multitopic Conference, Bahawalpur, Pakistan, pp. 1-5, Nov 2020.

[4] Balasundaram, A., Chellappan, C. *"An Intelligent Video Analytics Model for Abnormal Event Detection in Online Surveillance Video",* Journal of Real-Time Image Processing, Springer, vol. 17, no. 4, pp. 915–930, Dec 2020.

[5] H. A. Patel and R. D. Rajput, *"Smart Surveillance System Using Histogram of Oriented Gradients (HOG) Algorithm and Haar Cascade Algorithm",* IEEE Fourth International Conference on Computing Communication Control and Automation, Pune, India, pp. 1-4, Aug 2018.

[6] Thakur A., Prakash A., Mishra A.K., Goldar A., Sonkar A. *"Facial Recognition with OpenCv",* In: Computational Vision and Bio-Inspired Computing, Advances in Intelligent Systems and Computing, Springer, vol. 1108, pp. 213 - 218, Jan 2019.

[7] G. Singh and A. K. Goel, *"Face Detection and Recognition System using Digital Image Processing",* IEEE 2nd International Conference on Innovative Mechanisms for Industry Applications, Bangalore, India, pp. 348-352, Mar 2020.

[8] Yussiff AL., Yong SP., Baharudin B.B, *"Detecting People Using Histogram of Oriented Gradients: A Step towards Abnormal Human Activity Detection",* In: Jeong H., S. Obaidat M., Yen N., Park J. (eds) Advances in Computer Science and its Applications, Springer, Vol. 279, pp. 1145 - 1150, 2014.

[9] B. Tej Chinimilli, A. T., A. Kotturi, V. Reddy Kaipu and J. Varma Mandapati, *"Face Recognition based Attendance System using Haar Cascade and Local Binary Pattern Histogram Algorithm",* IEEE 4th International Conference on Trends in Electronics and Informatics, Tirunelveli, India, pp. 701-704, Jun 2020.

[10] Anurag K S (1SI17EC008), Arun Totad (1SI17EC011), Basava Chetan R K (1SI17EC014) and Chethan Kumar K R (1SI17EC019), *"Automatic Surveillance System",* Major project under the guidance of Dr. R Kumaraswamy and Mr. Prathap C, Department of ECE, SIT, Tumakuru, 2020-21.

[11] Raspberry Pi 3 Model B. Available at: https://www.raspberrypi.com/products/raspberry-pi-3-model-b/.

[12] Raspberry Pi camera v2. Available at: https://www.distrelec.biz/en/raspberry-pi-camera-v2-raspberry-pi-pi-camera-module-v2/p/30134462.

[13] Relay. Available at: https://www.electronicscomp.com/1-channel-5v-relay-module.

Appendices

Appendix A

Raspberry Pi 3B+

Specifications:

- Quad-Core 1.2GHz Broadcom BCM2837 64bit CPU 1GB RAM
- BCM43438 wireless LAN and Bluetooth Low Energy (BLE) on board
- 100 Base Ethernet
- 40-pin extended GPIO
- 4 USB 2 ports
- 4 Pole 3.3mm stereo output and composite video port
- Full-size HDMI CSI (Camera Serial Interface) camera port for connecting a camera
- DSI (Display Serial Interface) display port for connecting a touchscreen display
- Micro SD port
- Micro USB power port (up to 2.5A)
- Size – 85 x 56 x 17 mm

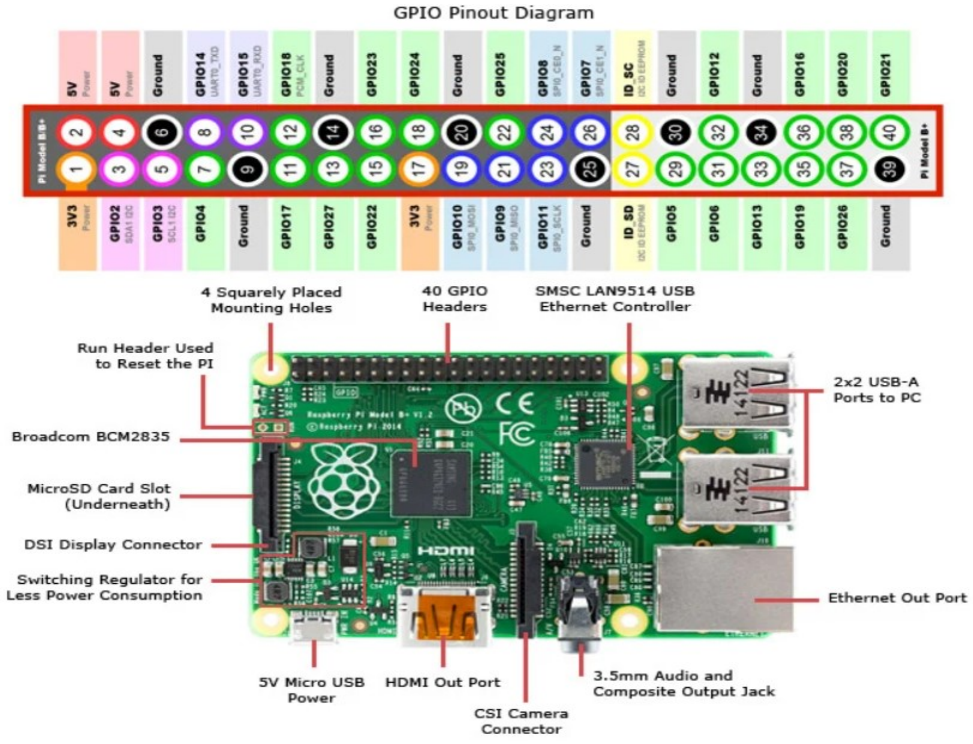

Figure A.1: Pin-out diagram

Appendix B

Relay Module

Specifications:

1. No. of Channels: 1
2. Operating Temperature Range: -40 to 85 °C
3. Switching Voltage(AC): 250V@10A
4. Switching Voltage(DC): 30V@10A
5. Trigger Current: 20 mA
6. Trigger Voltage: 5 V(DC)

Figure B.1: Relay module