



**KLE** Technological University  
Creating Value  
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School  
of  
Electronics and Communication Engineering

Minor Project Report  
on

**HOME AUTOMATION TECHNIQUES BASED ON  
HAND GESTURE RECOGNITION**

By:

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**SCHOOL OF ELECTRONICS AND COMMUNICATION  
ENGINEERING**

**CERTIFICATE**

This is to certify that project entitled "**HOME AUTOMATION TECHNIQUES BASED ON HAND GESTURE RECOGNITION**" is a bonafide work carried out by the student team of "Vinaykumar.B.Patil(01fe19bec207) , Madhukeshwar.Pratahkal (01fe19bec063) , Annapurna.Goudar(01fe19bec021) , Vrashank (01fe19bec033)". The project report has been approved as it satisfies the requirements with respect to the minor project work prescribed by the university curriculum for BE (6th Semester) in School of Electronics and Communication Engineering of KLE Technological University for the academic year 2021-2022.

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-The project team

## **ABSTRACT**

In these days it is common to control electrical appliances and gadgets using switches and infrared remote. Now it is the time for new control system to replace the existing one. A gesture is a type of nonverbal communication in which the hands or other different parts of the body are moved. Gestures are read by a camera. The human body's movements are read and transmits the information to a computer employs gestures as a control input for devices or applications. In this pandemic times, this promotes safety. It will enable the use of contact-less equipment in public spaces, assuring the safety of those who use it. Along with these benefits, the primary purpose of home automation is to give users both comfort and peace of mind with safety precautions. Home appliances like fans, lights, etc will be controlled by the Hand gestures without any physical activities which is most essential in this pandemic situations and future.

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# **Chapter 1**

## **Introduction**

Home automation means to control and use the home appliances automatically. The proposed work consists of fast algorithm for identifying set of hand gestures using images.

It is the new trend in a consumer market. There are many home automation systems with different features and facilities. All the home automation systems are used to control home appliances through a remote control. The remote control can be a stationed unit or a wireless remote. The remote used for controlling appliances usually have keys or touch-based sensors. In this project, a home automation system is designed which can be controlled by gestures.

Home automation means to control and use the home appliances automatically. The proposed work consists of fast algorithm for identifying set of hand gestures using images.

Mechanism of removing as much human interaction as technically possible and desirable in various domestic processes, and replacing them with programmed electronic systems-essentially the automation of the home and housework.

- May include centralized control of lighting, HVAC, appliances, and security locks of doors and gates
- Control of domestic activities such as home entertainment systems, yard watering, pet feeding etc.

### **1.1 Motivation**

In these pandemic times it is not good to use the home automation manually, so as to increase safety we decided to work on automatic home automation using hand gestures. It allows contactless technology to be used in public settings while ensuring the safety of individuals who use it. Along with these advantages, the fundamental goal of home automation is to provide comfort and peace of mind to the users. We first collected the data, then trained the data and then predictions were made.

### **1.2 Objectives**

The objectives are as follows-

- Finger movements and gestures are used to control the devices.
- Home automation refers to the automated control and use of household appliances.
- We build a cheaper and portable model which will be user-friendly for users.

### **1.3 Literature survey**

The papers that were referred to complete the model are as follows:

#### **1.3.1 Voice operated home automation system based on Kinect sensor**

This paper discusses how a Kinect sensor can be used to automate a home. In terms of wireless connections between devices, a Bluetooth-based automation system with online controllability was presented. Kinect Visual C programming is utilised with version 2.0. Four linear microphones are arrayed on the Kinect sensor. Microphone is a device that converts analogue Signal processing is built-in to the device. It does audio pre-processing. It eliminates the collected voice's background noise signal and, using automatic processing, removes echoes of the signal. In order to improve the quality of the audio, echo cancellation algorithms are used. Instead of using a single microphone, a microphone array can be used to effectively reduce noise and eliminate echo. The audio data acquired by the Kinect microphones is sent to the preliminary processor, where beam formation and sound localization algorithms are utilised to detect the direction of the sound source, and the microphone set is used as a directional microphone. Each sound from a suitable source is divided into approximately 24 frames per second. These inputs are then sent to the computer for further processing. Even in noisy environments, the system can identify the voice command, thus it may be used to add several controlling commands in the following stage.

#### **1.3.2 Smart home automation using Bluetooth technology**

This research paper presents a low-cost, user-friendly concept for a home automation system. It performs better than before compared to traditional Bluetooth-based home automation. It provides a generic approach to home automation systems. This is not just appropriate for the elderly and handicapped. However, it is also advantageous to reduce human labour and conserve energy with the assistance of sensors. This is for the benefit of readers' knowledge. The first study of a home automation system using ultrasonic sensors. The water level is detected using a sensor and a floating plate. In Furthermore, the proposed system has the ability to communicate data. Sensor measurement report on the user's smartphone application. Furthermore, the suggested system's smartphone application has the potential to connect up to 18 home appliances. Within a 20-mile radius, the proposed system is evaluated and tested. It measured everything to the nearest tenth of a millimetre and was 100 percent accurate. The proposed system can only control the appliances that are within its range. In the medium term, it is suggested that for future study work Increase the range and add more sensors to the interface, and it should be OK. A low-cost and easy-to-use system Moreover, the house. The automation system can be linked to biological devices (EMG) signals. Amputees will benefit from it since they will be able to walk again. Their muscle action is used to operate the equipment.

#### **1.3.3 Hand gesture recognition using OpenCV and Python**

This paper tells about Hand Gesture Recognition using OpenCV and Python. This method employs coloured gloves that are worn in the hand and are useful for capturing the fingers and palm during hand snapping. Using geometric elements, this glove frames the form of the hand. To portray the palms and fingers, I used a wool glove with three distinct colours. When compared to Sensor or Data Glove , this methodology is considered basic and inexpensive, yet the basic contact between people and computer remains unsatisfactory.Due to the difficulty of

removing the targeted object, such as the hand, from a framework that was producing a mess in real time, the challenge of differentiating movement was critical in computer perception for a long hour. In reality, a person can easily identify what is in a picture while gazing at it, however a computer, due to its functionality of dealing with a picture as a three-dimensional matrix, will have a considerably more difficult time doing so when looking at the same picture. We'd like to increase the precision even more in the future, as well as add more gestures to perform more functions.

#### **1.3.4 Review and performance analysis on Wireless smart home and Home automation using IoT**

This paper tells about Home Automation using IoT. This project is primarily concerned with the safety and security aspects of home automation, and it does so by utilising home automation technologies. From anywhere, a smart house may be controlled and automated around the servers in general. It conserves energy while maintaining command. It is designed in such a way that it conserves energy allows people with disabilities to maintain control over their smart homes. Because we're using a Wi-Fi module, we'll be able to 7-8 different devices can control the system at the same time. While utilising Bluetooth , this was not possible, and the range was also reduced. That way it cuts down on the utilisation of humans who are overworked or unneeded. Efforts are made to raise the living standards of the people in our community which is a society

#### **1.3.5 Smart home automation using Machine learning algorithms**

The information in this paper is about Home Automation Using Machine Learning. This research shows how machine learning techniques may be used to develop intelligent control systems from any current automation system. It helps in energy conservation by providing accurate power management. There is also control and dependability. It provides security and comfort at the touch of a button. Furthermore, by using machine learning, remote monitoring can be set up fast, allowing for the cost-effective and intelligent conversion of existing home automation systems. Machine Learning-powered Home Automation systems are designed to eliminate all manual settings [8]. Because of its ever-expanding uses, artificial intelligence will revolutionise not only our workplaces, but also the way we live in our homes.

### **1.4 Problem statement**

Design the Home automation techniques based on hand gesture recognition using image processing, VNC server,relay and raspberry pi.

## 1.5 Project Planning and bill of materials

Sl.no	Component	Price(Rs.)	Quantity
1	Raspberry Pi 4	5,400	1
2	Web Camera	450	1
3	Relay	120	2
4	Bulb Holder	25	1
5	Socket	30	1
6	Transistor(npn)	20	2
7	LED	10	2
8	Resistor (1k)	5	4
9	Wire	50	
10	Adapter	150	1
11	Foam Sheet	40	1
Grand Total		6,300	

## 1.6 Organization of the report

Chapter 2 - gives details about the system that we have designed and the various functional blocks and flow diagrams that we have used in the project. It starts on from small general block diagram.

Chapter 3 - deals with the implementation aspect of the project hence all related achievements in the form of the software and hardware are here mentioned.

Chapter 4 - the crucial part of the project and hence talks about the results and observations derived from the project and experiments.

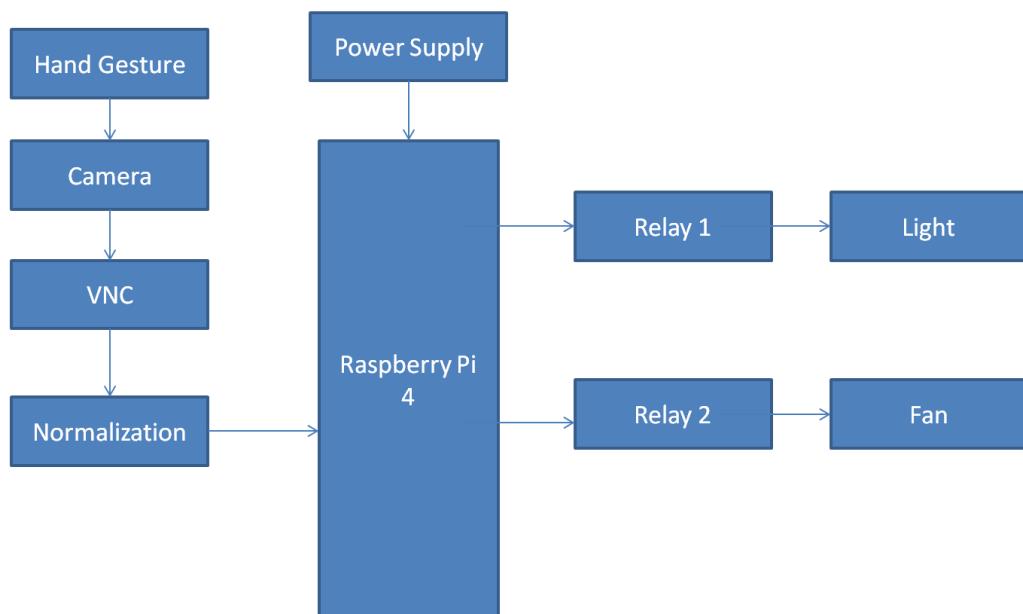
Chapter 5 - Further the conclusion and application of the project has been briefed in the last chapter

# Chapter 2

## System design

In this Chapter, we list out the interfaces.

### 2.1 Functional block diagram



**Figure 2.1.1 : System Block Diagram**

This system design shows the model design. The human body's movements are read and transmits the information to a computer employs gestures as a control input for devices or applications. In this pandemic times, this promotes safety. It will enable the use of contact-less equipment in public spaces, assuring the safety of those who use it. Along with these benefits, the primary purpose of home automation is to give users both comfort and peace of mind with safety precautions. Home appliances like fans, lights, etc will be controlled by the Hand gestures without any physical activities which is most essential in this pandemic situations and future.

## **2.2 Design alternatives**

Home automation system can be done by using the following technologies:

Flex sensor

Kinect sensor

Bluetooth technology

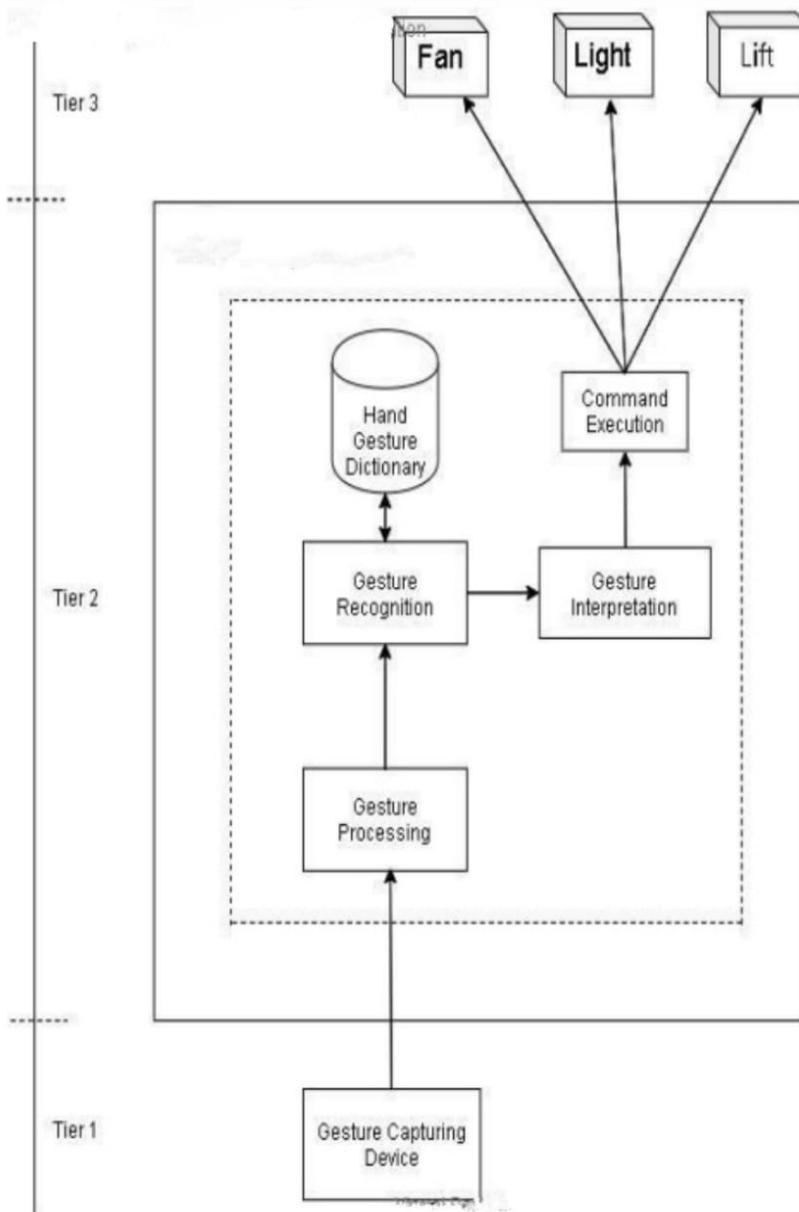
Raspberry pi infrared IR night vision

Raspberry pi, Relay, Camera, SD card and Power adapter

So we have finalized to work on Raspberry pi, Relay, Camera, SD card and Power adapter as hardware for our project.

## 2.3 Final design

We select one of the optimal solutions based on its working and ease of the implementation, that is Home automation using hand gestures



# Chapter 3

## Implementation details

### 3.1 Specifications and final system architecture

#### 3.1.1 Components

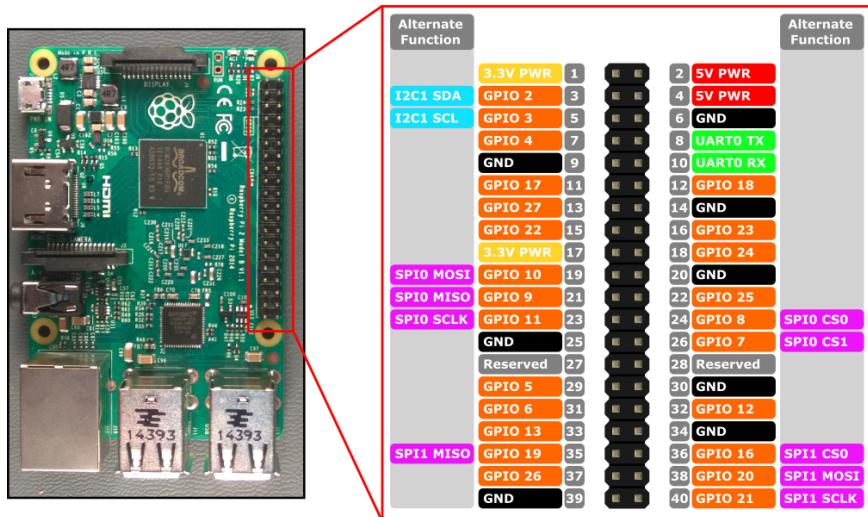


Figure 3.1.1: Raspberry pi  
Specifications:

Processor Broadcom BCM2387 chipset. 1.2GHz Quad-Core ARM Cortex-A53 802.11 b/g/n  
Wireless LAN and Bluetooth 4.1 (Bluetooth Classic and LE)

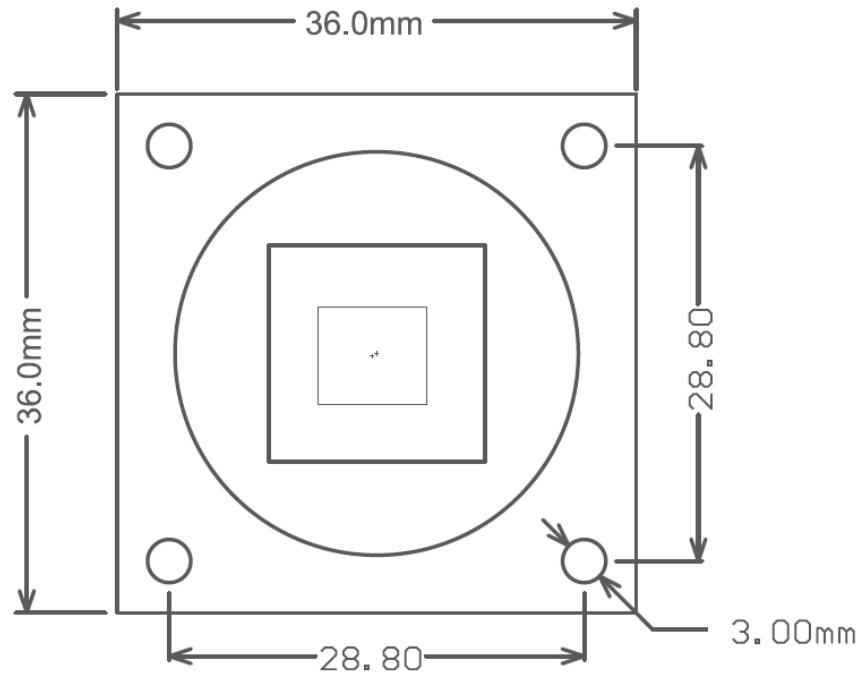
GPU Dual Core VideoCore IV® Multimedia Co-Processor. Provides Open GL ES 2.0, hardware-accelerated OpenVG, and 1080p30 H.264 high-profile decode. Capable of 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering and DMA infrastructure

Memory 1GB LPDDR2

Operating System Boots from Micro SD card, running a version of the Linux operating system or Windows 10 IoT

Dimensions 85 x 56 x 17mm

Power Micro USB socket 5V1, 2.5A



**Figure 3.1.2: Pi Camera**

Specifications:

High-Definition video camera for Raspberry Pi Model A/B/B+ and Raspberry Pi 2

Omnivision OV5647 sensor in a fixed-focus module with replaceable Lens

Lens holder: M12x0.5 , CS mount or C mount

5MPixel sensor

Integral IR filter

Still picture resolution: 2592 x 1944

Max video resolution: 1080p

Max frame rate: 30fps

Support FREX/ STROBE feature

Size: 36 x 36 mm

15 cm flat ribbon cable to 15-pin MIPI Camera Serial Interface (CSI) connector



**Figure 3.1.3: Relay**

Specifications:

Trigger Voltage (Voltage across coil) : 12V DC.

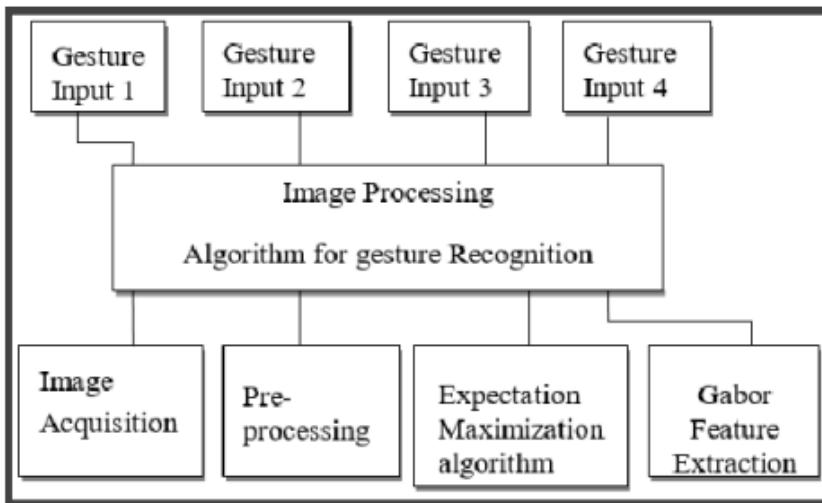
Trigger Current (Nominal current) : 100mA.

Maximum AC load current: 7A @ 250/125V AC.

Maximum DC load current: 10A @ 30/28V DC.

Maximum switching: 300 operating/minute (mechanically)

### 3.2 Algorithm

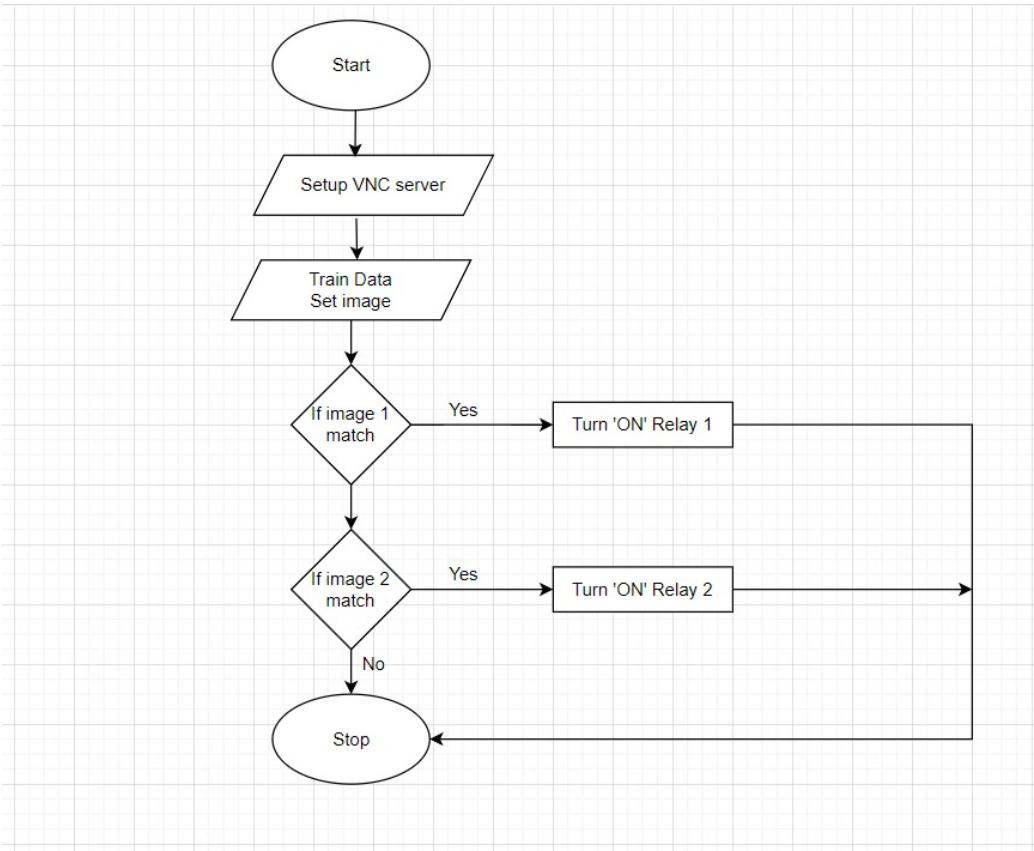


**Figure 3.2.1: Image processing algorithm**

Algorithm for the image processing algorithm are as follows-

- Step1 - Start.
- Step2 - Setup VNC Server.
- Step3 - Train Data set using Google Readable.
- Step4 - Give hand gestures using Pi Camera.
- Step5 - Compare given hand gesture with the Train data set.
- Step6 - If the given hand gesture matches with relay 1 then socket 1 is on.
- Step7 - If the given hand gesture matches with relay 2 then socket 2 is on.
- Step8 - Stop

### 3.3 Flowchart



**Figure 3.3.1: Flowchart of the model**

The above figure shows the flowchart of the proposed design. Firstly the VNC Server is been setup. Then the data is trained. If the image 1 matched then the relay 1 gets on keeping the relay 2 off. If image 2 is matched then the relay 2 gets on keeping the relay 1 off.

At first we have tried on normal model i.e, when the gesture 1 is matched then the source 1 gets on and when that gesture is matched again then the source 2 gets on.

Then we have used the Toggle method i.e, when the gesture 1 is matched then the source 1 gets on then when that gesture matches again then the source when gets off.

# Chapter 4

## Results and discussions

### 4.1 Result Analysis

A solution of the problem statement is achieved. This proposed product of Home automation using hand gestures successfully detects the hand gestures through the camera and then based on the analysis of which gesture is detected with the help of algorithm we have used in it, it updates the gesture and sends it to the raspberry pi which in turns updates data to relays. Hence, based on the snapshots of the results above there, we can say that our problem statement is achieved.

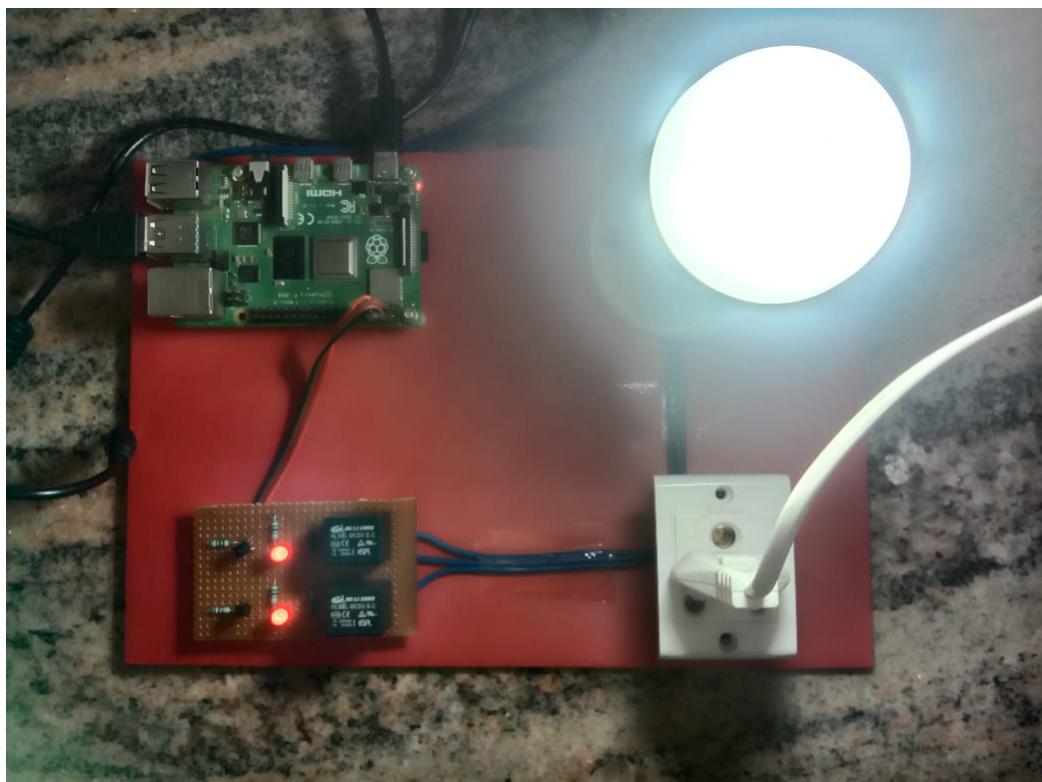
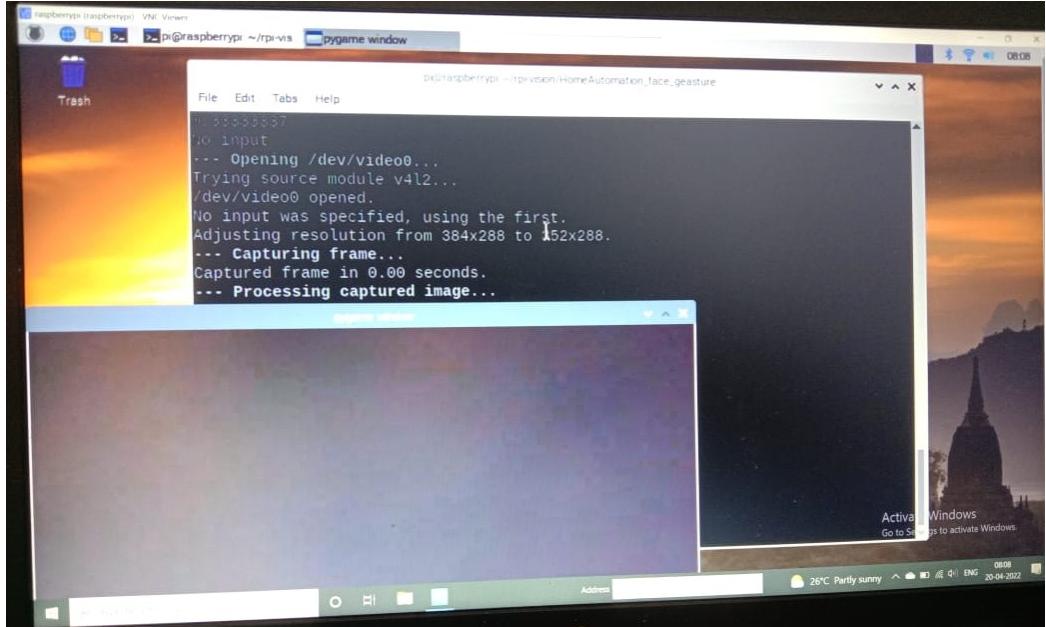


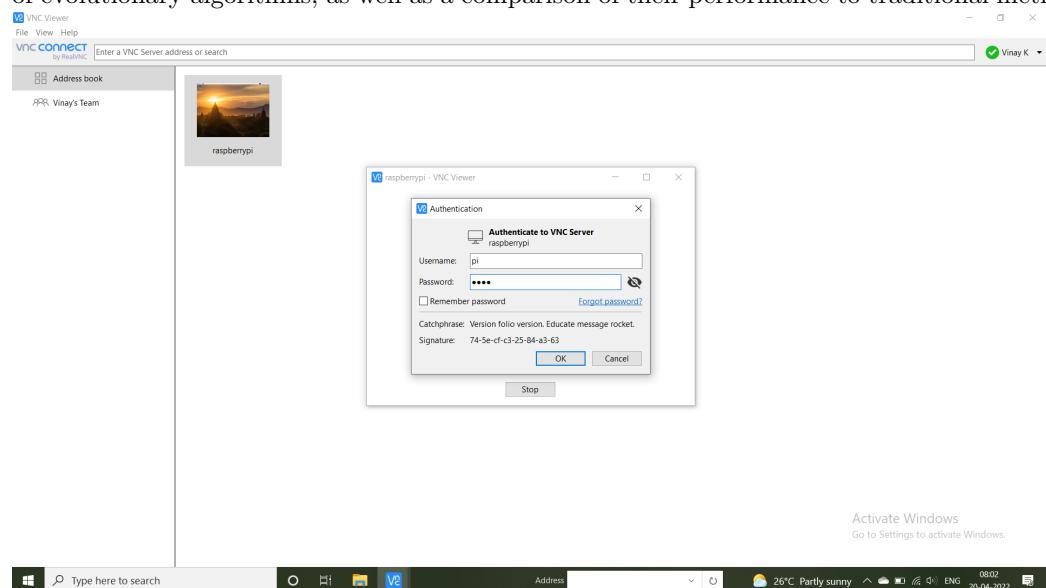
Figure 4.1.1: Final design of the model



**Figure 4.1.2: Running the code through VNC Server**

## 4.2 Discussion on optimization

Optimization plays a vital role in the system design. We are still looking to optimize the memory related topics. The length of the code, execution time, memory needs, and resource allocation are all important factors in code optimization. One of the most often utilized optimization techniques for engineering and non engineering applications is the evolutionary algorithm. This study presents a review of numerous code optimization methodologies based on different types of evolutionary algorithms, as well as a comparison of their performance to traditional methods.



**Figure 4.2.1: Login page of VNC Server**

# **Chapter 5**

## **Conclusions and future scope**

### **5.1 Conclusion**

Home appliances like fans, lights, etc will be controlled by the Hand gestures without any physical activities which is most essential in this pandemic situation. It offers security and comfort at the push of a button. Additionally, remote monitoring is simple to set up and enables for the cost-effective and intelligent conversion of current home automation systems. It lowers the use of excessive or needless human effort and raises the level of living of individuals in our society, making life easier and more comfortable for us.

### **5.2 Future scope**

It is now necessary to replace the old control system with a new one. The major goal of this new system is to use finger movements and gestures to manage the gadgets. The term "home automation" refers to the ability to automatically operate and use household appliances. The proposed work includes a quick algorithm for recognising a set of hand movements from photographs. Hand gestures are used to operate the home gadgets such as lights, fans, and many more. Keeping in mind the everyday difficulties in the era with the advancement of technologies in everyone's life, this proposed work was created. In future this can be utilized by the people.