

# **FACE DETECTION BASED DOOR UNLOCK SYSTEM BY IOT**

**A PROJECT REPORT**

*In partial fulfillment for the award of the degree of*

**BACHELOR OF TECHNOLOGY**

**IN**

**ELECTRONICS & COMMUNICATION  
ENGINEERING**

*Under the Guidance of*

**PARTHA BANNERJEE**

*Submitted By*

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**JUNE 2019– JULY 2020**

# PROJECT RESPONSIBILITY FORM

## FACE DETECTION BASED DOOR UNLOCK SYSTEM BY IOT

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	4	<b>Vikash Kumar Mahato</b>	Testing

Each group member must participate in project development and developing the ideas for the required elements. Individual group members will be responsible for completing tasks which help to finalize the project and the performance. All group members must be assigned a task.

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# DECLARATION

We hereby declare that the project work being presented in the project proposal entitled “**FACE DETECTION BASED DOOR UNLOCK SYSTEM**” in partial fulfillment of the requirements for the award of the degree of **BACHELOR OF TECHNOLOGY IN ELECTRONICS & COMMUNICATION ENGINEERING**.

At **ACADEMY OF TECHNOLOGY, ADISAPTAGRAM, HOOGHLY, WEST BENGAL** is an authentic

Work carried out under the guidance of **Mr. PARTHA BANNERJEE**.

The matter embodied in this project work has not been submitted elsewhere for the award of any degree of

Our knowledge and belief.

Date:

Name of the Students

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Signature of the students

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B.

C.

D.

# CERTIFICATE

This is to certify that this proposal of minor project entitled “**FACE DETECTION BASED DOOR UNLOCK SYSTEM**” is a record of bonafide work, carried out by **1. TAMAL MANDAL (16900317003) 2. TAMOJIT SAHA (16900317002) 3. SUBHAYAN BHOWMICK (16900317005) 4. VIKASH KUMAR MAHATO (16900317001)** under my guidance at **ACADEMY OF TECHNOLOGY, ADISAPTAGRAM**. IN my opinion, the report in its present form is in partial fulfilment of the requirements for the award of the degree of **BACHELOR OF TECHNOLOGY IN ELECTRONICS & COMMUNICATION ENGINEERING** and as per **MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY BY AICTE**.

Regulations of the **MAKAUT®**. To the best of my knowledge, the results embodied in this report, are original in nature and worthy of incorporation in the present version of the report.

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*Thanks giving seem to be the most pleasant of all jobs but it is none of the less difficult when one tries this put them in words. Before we get thick of the things we would like to add a few heart felts words for the people who were part of this project “**Face Detection Based Door Unlock System**” in numerous ways people who gave unending support right from the project was conceived.*

*We are thankful to our Director **Mr. Dr. Dilip Bhattacharya (Vice Chancellor, AOT)** who showed us a way whenever we found ourselves in dark.*

*We are thankful to our project guide **Mr. Partha Bannerjee** who has inspired and guided for completion of the project.*

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# Abstract

Home security is growing field. To provide security to home, face recognition system can be implemented. A standard UBS camera captures the image to identify the person. It's a prototype that identifies the visitor. If the door recognize the visitor, it will greet them by name, and the door will be unlocked named opened. If they aren't identified the door will be firmly locked. The system will perform the detection and recognition rapidly in real time. This project utilizes the basic web cam, and the internet connection to create a door that unlocks itself via facial recognition. If the visitor at the door is recognized, the door will be unlocked! This project adds mainly four features: security, safety, control and monitoring to home automation. Firstly the system needs a face authentication for the user to be able to enter the home (locked/unlocked). When an unauthenticated tries to log in, this face will be captured and would be sent to Gmail as an attachment. The system should also support remote home control. Temperature sensor is used for home temperature monitoring, the date can be visualized remotely in real time.

The security system comprises of an A Node MCU ESP-32 microcontroller and a standard ESP-32 CAM Camera Module. The whole system can be powered from any 12VDC/2A power supply unit/battery. We also use a Motor Driver Module L298n to operation the dc motor flexible

The output of face recognition algorithm is conditional statement. At first we capture image then connected to the relay circuit, in which it will lock or unlock the magnetic lock placed at the door.

Results showed the effectiveness of our proposed system, in which we obtain around 90% face Recognition accuracy. We also proposed a hierarchical image processing approach to reduce the training

Or testing time while improving the recognition accuracy.

## **Chapter-1A: Introduction**

We want to provide high level security to home by using IoT technology. IoT is new technology which has made an enormous impact on the modern world. The IoT can be defined as the system of interconnected mechanical, electrical and computing devices and other objects like animals, humans which are given a unique identifier and this system has an ability to transfer data over a wide network of such interrelated systems without requiring human-to-human or human-to-computer interaction. In short, the IoT has an ability to make things self-instructed. Hence it can make significant impact on modern security technologies.

Home security has become a solemn issue in the society. Anyone can be harassed in its own house. Older security systems can't tackle some situations like hacking, break down in the system. Unwanted persons like thieves, murderers and some known criminals will try to intrude in the home any time they want. Also we know that the gadgets now a days are not that secured and hence can be easily hacked. Even intruders have found their way to take over these gadgets. So to avoid such situations, we have to develop the system in such way that no one should get an intrusion to the system. The use of IoT will enhance some security level as well as it will help in accessing and controlling the system remotely. Therefore we are trying to develop a face recognizable [7] automated door unlocking system using an IoT.

IoT will enable sensing, actuating and communication in the system. System can be made automated easily. So we can go on developing a smart home by extending this security system. To develop this we will use a Node MCU micro-controller board for system development, a pi camera module for face recognition and a programmable stepper motor to open door lock. We will install appropriate Arduino based operating system on Node MCU micro-controller board. For the door unlocking system, we will place a stepper motor at door latch. This motor will be programmed in such a way that when the system authenticates the person in front of the camera, the motor will rotate to open latch.

## **Chapter -2: Review of Previous Work**

- *Basically we get allotted on this project during the 5<sup>th</sup> semester, we started the immediately after the allocation. We have started our project by making a thorough project overview report which is later on submitted on 7<sup>th</sup> semester during seminar of the project. After making the project report, we focused in hardware components. We searched about the components best to fit to our system and noted down immediately. Then we checked our components our desired equipment by our project guide.*
- *After verifying our equipment's we get them by offline and online store. The following components we have purchase till date -*
  - *Node MCU (ESP-32) processor*
  - *Camera Module (ESP-32 CAM)*
  - *Motor driver module (L298N)*
  - *Servo Motor*
  - *FTDI Cable*
  - *12 volt power adaptor*
  - *Jumper wires and normal connecting wires*
  - *Some resistors and LEDs for indication purpose*
- *Next we make the physical connection between the different components that we bring from the market. The way by which make have done contacts between the hardware components that is mentioned in following -*

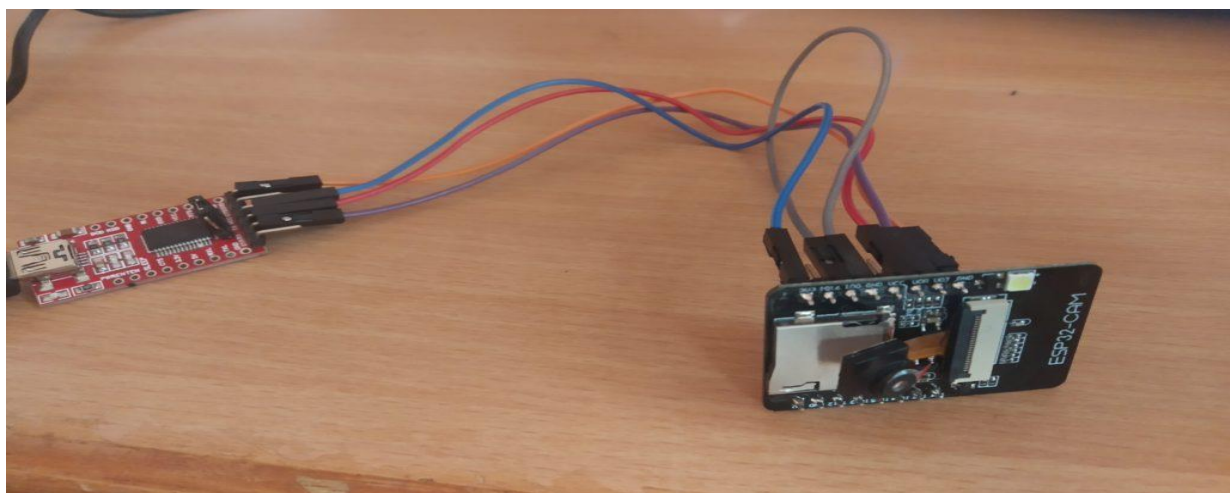


Fig. 2.1. Physical Connection of the components

*After connecting physically, we have programmed the NODE MCU, CAMERA MODULE and a interfacing program which makes the circuit work automatically, i.e. a bridge program should need. It is mostly mentioned in the above discussion only physical connection done till date, but programming part is incomplete.*

***The next step we need to follow algorithm to make the program part. The algorithm is as follows –***

- 1. One individual person get stands in front of the door.*
- 2. Camera captures the face and send it to the ESP 32*
- 3. Node MCU (ESP-32) checks and verify the captured face by comparing to image store in database.*
- 4. If it is verified and match, Node MCU sends a signal to motor driver module.*
- 5. Motor driver module (L298N) receives that signal and starts rotating the servo motor.*
- 6. Door is unlock.*
- 7. If the captured picture not matches then a message send to the owner of the house.*
- 8. After certain time door will lock automatically.*

***For program the components we need to follow the following steps –***

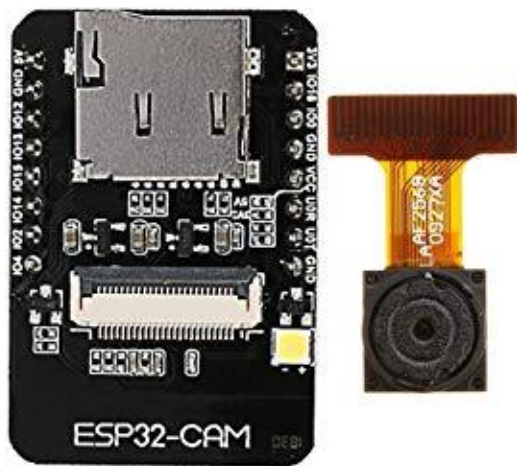
***I. Program to make an interface between Node Mcu and Camera module.***

***II. Program to make an interface between Node Mcu and Motor driver Module.***

## **Chapter – 3: Theory/Theoretical Background**

### **3.1. Theoretical Description of components:-**

#### **CAMERA MODULE: -**



**Fig 3.1:- ESP32 CAM Module**

#### **ESP32 CAM:**

The ESP32- CAM has a very competitive small-size camera module that can operate independently as a minimum system with a footprint of only 27\*40.5\*4.5 mm and a deep sleep current of up to 6mA. ESP-32 CAM can be widely used in various IoT applications. It is suitable for home smart devices, industrial wireless control, wireless monitoring, QR wireless identification, Wireless positioning system signals and other IoT applications. It is an ideal solution for IoT applications.

ESP-32CAM adopts DIP package and can be directly inserted into the backplane to realize rapid production of products, providing customers with high-reliability connection mode, which is convenient for application in various IoT hardware terminals.

#### **Features:**

- Low power 32-bit CPU, can also serve the application processor
- Up to 160MHz clock speed, Summary computing power up to 600 DMIPS
- Built-in 520 KB SRAM, external 4MPSRAM
- Supports UART/SPI/I2C/PWM/ADC/DAC
- Support OV2640 and OV7670 cameras, Built-in Flash lamp.
- Support image Wi-Fi upload
- Support TF card
- Supports multiple sleep modes.
- Embedded Lwip and FreeRTOS

## **Applications:**

- Industrial wireless control
- Wireless monitoring
- Wireless positioning system

## **Product Specification:**

Module Model	ESP32-CAM
Package	DIP-16
Size	27*40.5*4.5(+/-0.2)mm
SPI Flash	Default 32Mbit
RAM	520KB SRAM +4M PSRAM
Bluetooth	Bluetooth 4.2 BR/EDR and BLE standards
Wi-Fi	802.11 b/g/n
Support interface	UART,SPI,I2C,PWM
IO port	9
UART Baud rate	Default 115200 bps
Image Output Format	JPEG(OV2640 support only),BMP,GRAYSCALE
Spectrum Range	2412 ~2484MHz
Antenna	Onboard PCB antenna, gain 2dBi
Transmit Power	802.11b: 14 +/- 2 dBm (@11Mbps) 802.11g: 14 +/- 2 dBm (@54Mbps) 802.11n: 14 +/- 2 dBm (@MCS7)
Receiving Sensitivity	CCK, 1Mbps :- -90dBm CCK, 11Mbps :- -85 dBm 6 Mbps(1/2 BPSK):- -88 dBm 54 Mbps(3/4 64-QAM):- 70dBm MCS7(65 Mbps,72.2 Mbps):- -67dBm
Power Dissipation	WPA/WPA2/WPA2- Enterprise/WPS
Security	5V
Operating Temperature	-20 C ~ 85 C
Storage Environment	-40 C ~ 90 C, <90%RH

## **Motor Driver Module:-**

### **L298N Dual H-Bridge Motor Driver**

This dual bidirectional motor driver, is based on the very popular L298 Dual H-Bridge Motor Driver Integrated Circuit. The circuit will allow you to easily and independently control two motors of up to 2A each in both directions. It is ideal for robotic applications and well suited for connection to a microcontroller requiring just a couple of control lines per motor. It can also be interfaced with simple manual switches, TTL logic gates, relays, etc. This board equipped with power LED indicators, on-board +5V regulator and protection diodes.

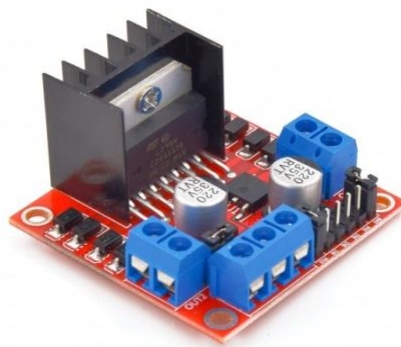


Fig 3.2:- L298n Dual H-Bridge Motor Driver Module

### **Specification:-**

- Input Voltage: 3.2V~40Vdc.
- Driver: L298N Dual H Bridge DC Motor Driver
- Power Supply: DC 5 V - 35 V
- Peak current: 2 Amp
- Operating current range: 0 ~ 36mA
- Control signal input voltage range :
- Low:  $-0.3V \leq V_{in} \leq 1.5V$ .
- High:  $2.3V \leq V_{in} \leq V_{ss}$ .
- Enable signal input voltage range :

Low:  $-0.3 \leq V_{in} \leq 1.5V$  (control signal is invalid).

High:  $2.3V \leq V_{in} \leq V_{ss}$  (control signal active).

- Maximum power consumption: 20W (when the temperature  $T = 75\text{ }^{\circ}\text{C}$ ).
- Storage temperature:  $-25\text{ }^{\circ}\text{C} \sim +130\text{ }^{\circ}\text{C}$ .
- On-board +5V regulated Output supply (supply to controller board i.e. Arduino).
- Size: 3.4cm x 4.3cm x 2.7cm

### **Pin Functions:-**

Pin Name	Pin Functions
OUT 1	Stepper motor A+ or DC motor 1(+)
OUT 2	Stepper motor A- or DC motor 1(-)
12 V Jumper	Enables power to on board 5V Regulator
12V	Voltage supply
GND	Ground(0V)
5V	Voltage supply
ENA	DC motor 1 enable
IN 1	Input from Node MCU
IN 2	Input from Node MCU
IN 3	Input from Node MCU
IN 4	Input from Node MCU
ENB	DC motor 2 enable
OUT 3	Stepper motor B+ or DC motor 2(+)
OUT 4	Stepper motor B- or DC motor 2(-)

### **Applications:**

- Automatic door control systems
- CNC machines
- Weight lifters



## **Servo Motor:**

A **servo motor** is an electrical device which can push or rotate an object with great precision. If we want to rotate an object at some specific angles or distance, then we use servo motor. It is just made up of simple motor which runs through **servo mechanism**. If a motor is used is DC powered then it is called DC servo motor, and if it is AC powered motor then it is called AC servo motor. We can get a very high torque servo motor in a small and light weight packages. Due to these features they are being used in many applications like toy car, RC helicopters and planes, Robotics, Machine etc. The position of a servo motor is decided by electrical pulse and its circuitry is placed beside the motor.

### **Wire Configuration:**

Wire Number	Wire Color	Description
1	Brown	Ground wire connected to the ground of system
2	Red	Powers the motor typically +5V is used
3	Orange	PWM signal is given in through this wire to drive the motor

### **TowerPro SG-90 Features**

- Operating Voltage is +5V typically
- Torque: 2.5kg/cm
- Operating speed is 0.1s/60°
- Gear Type: Plastic
- Rotation: 0°-180°
- Weight of motor: 9gm
- Package includes gear horns and screws

### **Selecting your Servo Motor:-**

There are lots of servo motors available in the market and each one has its own specialty and applications. The following two paragraphs will help us identify the right type of servo motor for our project/system. Most of the hobby Servo motors operate from 4.8V to 6.5V, the higher the voltage higher

the torque we can achieve, but most commonly they are operated at +5V. Almost all hobby servo motors can rotate only from 0° to 180° due to their gear arrangement so make sure project can live with the half circle if no, you can prefer for a 0° to 360° motor or modify the motor to make a full circle. The gears in the motors are easily subjected to wear and tear, so if your application requires stronger and long running motors you can go with metal gears or just stick with normal plastic gear. Next comes the most important parameter, which is the **torque** at which the motor operates. Again there are many choices here but the commonly available one is the 2.5kg/cm torque which comes with the Tower pro SG90 Motor. This 2.5kg/cm torque means that the motor can pull a weight of 2.5kg when it is suspended at a distance of 1cm. So if you suspend the load at 0.5cm then the motor can pull a load of 5kg similarly if you suspend the load at 2cm then can pull only 1.25. Based on the load which you use in the project you can select the motor with proper torque.

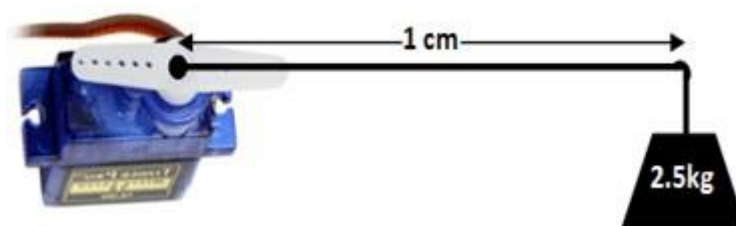
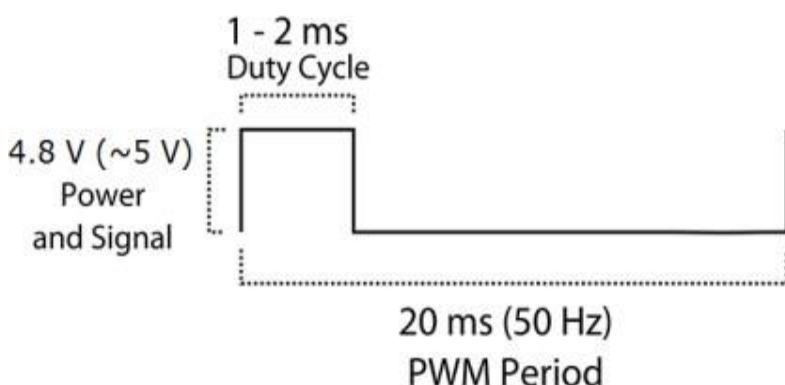


Fig 3.3:- Servo Motor Mechanism

### Use of Servo Motor:

After selecting the right Servo motor for the project, comes the question how to use it. As we know there are three wires coming out of this motor. The description of the same is given on top of this page. To make this motor rotate, we have to power the motor with +5V using the Red and Brown wire and send PWM signals to the Orange colour wire. Hence, we need something that could generate PWM signals to make this motor work, this something could be anything like a 555 Timer or other Microcontroller platforms like Arduino, PIC, ARM or even a microprocessor like Raspberry Pie. Now, how to control the direction of the motor? To understand that let us a look at the picture given in the datasheet.



From the picture we can understand that the PWM signal produced should have a frequency of 50Hz that is the PWM period should be 20ms. Out of which the On-Time can vary from 1ms to 2ms. So when the on-time is 1ms the motor will be in 0° and when 1.5ms the motor will be 90°, similarly when it is 2ms it will be 180°. So, by varying the on-time from 1ms to 2ms the motor can be controlled from 0° to 180°

Fig. 3.4:- Impact of PWM signal in Servo

## **Servo Mechanism:-**

It consists of three parts:

1. Controlled device
2. Output sensor
3. Feedback system

It is a closed loop system where it uses positive feedback system to control motion and final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal.

Here reference input signal is compared to reference output signal and the third signal is produced by feedback system. And this third signal acts as input signal to control device. This signal is present as long as feedback signal is generated or there is difference between reference input signal and reference output signal. So the main task of servomechanism is to maintain output of a system at desired value at presence of noises.

## **Working principle of Servo Motors:-**

A servo consists of a Motor (DC or AC), a potentiometer, gear assembly and a controlling circuit. First of all, we use gear assembly to reduce RPM and to increase torque of motor. Say at initial position of servo motor shaft, the position of the potentiometer knob is such that there is no electrical signal generated at the output port of the

Potentiometer. Now an electrical signal is given to another input terminal of the error detector amplifier. Now difference between these two signals, one comes from potentiometer and another comes from other source, will be processed in feedback mechanism and output will be provided in term of error signal. This error signal acts as the input for motor and motor starts rotating. Now motor shaft is connected with potentiometer and as motor rotates so the potentiometer and it will generate a signal. So as the potentiometer's angular position changes, its output feedback signal changes. After sometime the position of potentiometer reaches at a position that the output of potentiometer is same as external signal provided. At this condition, there will be no output signal from the amplifier to the motor input as there is no difference between external applied signal and the signal generated at potentiometer, and in this situation motor stops rotating.



Fig 3.5:- Servo Motor's Components

## Controlling Servo Motor:

Servo motor is controlled by PWM (Pulse with Modulation) which is provided by the control wires. There is a minimum pulse, a maximum pulse and a repetition rate. Servo motor can turn 90 degrees from either direction from its neutral position. The servo motor expects to see a pulse every 20 milliseconds and the length of the pulse will determine how far the motor turns. For example, a 1.5ms pulse will make the motor turn to the 90° position, such as if pulse is shorter than 1.5ms shaft moves to 0° and if it is longer than 1.5ms than it will turn the servo to 180°. Servo motor works on **PWM (Pulse width modulation)** principle means its angle of rotation is controlled by the duration of applied pulse to its Control PIN. Basically servo motor is made up of **DC motor which is controlled by a variable resistor (potentiometer) and some gears**. High speed force of DC motor is converted into torque by Gears. We know that  $WORK = FORCE \times DISTANCE$ , in DC motor Force is less and distance (speed) is high and in Servo, force is High and distance is less. Potentiometer is connected to the output shaft of the Servo, to calculate the angle and stop the DC motor on required angle. Servo motor can be rotated from 0 to 180 degree, but it can go up to 210 degrees, depending on the manufacturing. This degree of rotation can be controlled by applying the **Electrical Pulse** of proper width, to its Control pin. Servo checks the pulse in every 20 milliseconds. Pulse of 1 ms (1 millisecond) width can rotate servo to 0 degree, 1.5ms can rotate to 90 degrees (neutral position) and 2 ms pulse can rotate it to 180 degrees.

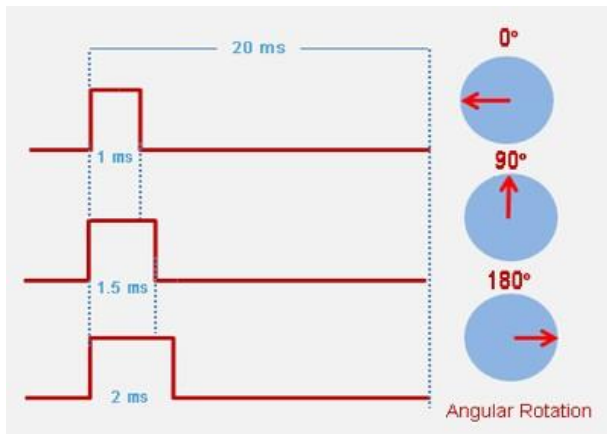


Fig. 3.6:- Controlling of Servo Motor

## USB to TTL converter:-

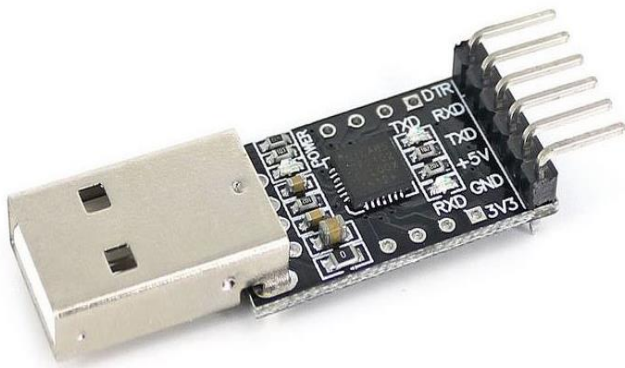


Fig. 3.7: TTL Converter

CP2102 its high integration, built-in USB2.0 full-speed function controller, USB transceiver, crystal oscillator, EEPROM, and asynchronous serial data bus (UART), supports full-featured modem signals, without any external USB device. CP2102 with other USB-UART adapter circuit works similar to the PC through the driver's USB port into a virtual COM port in order to achieve the purpose of expansion.

### **Features:-**

- Uses the CP2102 USB to UART controller
- Windows, Mac, and Linux Compatible
- 5V and 3.3V Operation

### **12 Volt Power Adapter:-**



12 Volt power supply is use mainly in Motor Driver Module L298n.To Drive driver module we need the operating voltage between 5v-35v.To drive the servo motor properly here we use 12V DC power supply. Power supply is mainly consist of 12V and 2 Amp of Current.

Fig 3.8:- 12 Volt Power Supply

### 3.2. Theoretical Background of this Project:-

Our project is mainly working on two technologies, they are the **Xaamp** which is a **free and open-source cross-platform web server solution** works through **Static HTML** by which we can get the notifications on webpage that we made and the face detection is done by the camera module which will be work on **Arduino IDE Camera Webserver**.

#### 3.2.1. Static HTML :-

- ✓ HTML stands for "Hypertext Markup Language." HTML is the language used to create webpages. "Hypertext" refers to the hyperlinks that an HTML page may contain. "Markup language" refers to the way tags are used to define the page layout and elements within the page.

```
<!doctype html>
<html>
<head>
<title>TechTerms.com</title>
</head>
<body>
<p>This is an example of a paragraph in HTML.</p>
</body>
</html>
```

The first line defines what type of contents the document contains. "<!doctype html>" means the page is written in HTML5. Properly formatted HTML pages should include <html>, <head>, and <body> tags, which are all included in the example above. The page title, metadata, and links to referenced files are placed between the <head> tags. The actual contents of the page go between the <body> tags.

- ✓ A static website contains Web pages with fixed content. Each page is coded in HTML and displays the same information to every visitor. Static sites are the most basic type of website and are the easiest to create. Unlike dynamic websites, they do not require any Web programming or database design. A static site can be built by simply creating a few HTML pages and publishing them to a Web server. Since static Web pages contain fixed code, the content of each page does not change unless it is manually updated by the webmaster. This works well for small websites, but it can make large sites with hundreds or thousands of pages difficult to maintain. Therefore, larger websites typically use dynamic pages, which can be updated by simply modifying a database record. Static sites that contain a lot of pages are often designed using templates. This makes it possible to update several pages at once, and also helps provide a consistent layout throughout the site.

### 3.2.2. Xaamp Software:-

- ✓ **XAMPP** is a free and open source cross-platform web server solution stack package developed by Apache Friends, consisting mainly of the Apache HTTP Server, MariaDB database, and interpreters for scripts written in the PHP and Perl programming languages. XAMPP stands for Cross-Platform (X), Apache (A), MariaDB (M), PHP (P) and Perl (P). It is a simple, lightweight Apache distribution that makes it extremely easy for developers to create a local web server for testing and deployment purposes. Everything needed to set up a web server – server application (Apache), database (MariaDB), and scripting language (PHP) – is included in an extractable file. XAMPP is also cross-platform, which means it works equally well on Linux, Mac and Windows. Since most actual web server deployments use the same components as XAMPP, it makes transitioning from a local test server to a live server extremely easy as well.

### 3.2.3. Arduino IDE Camera webserver:-

Camera webserver program does not include in Arduino IDE library initially. So, you need to have Arduino IDE installed as well as the ESP32 add-on. Follow the next steps to install the ESP32 add-on, if you haven't already:

1. In your Arduino IDE, go to **File> Preferences**

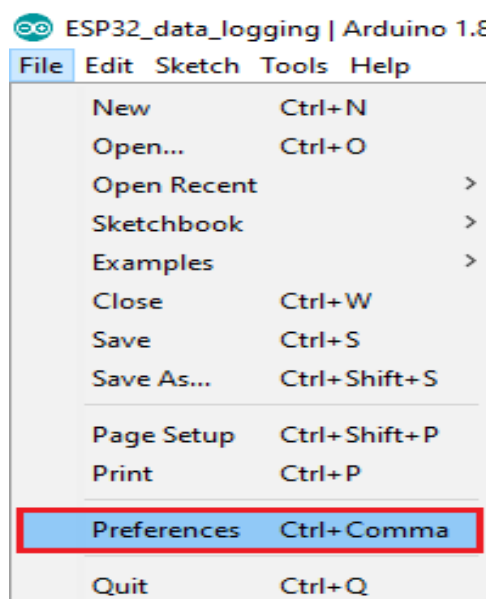
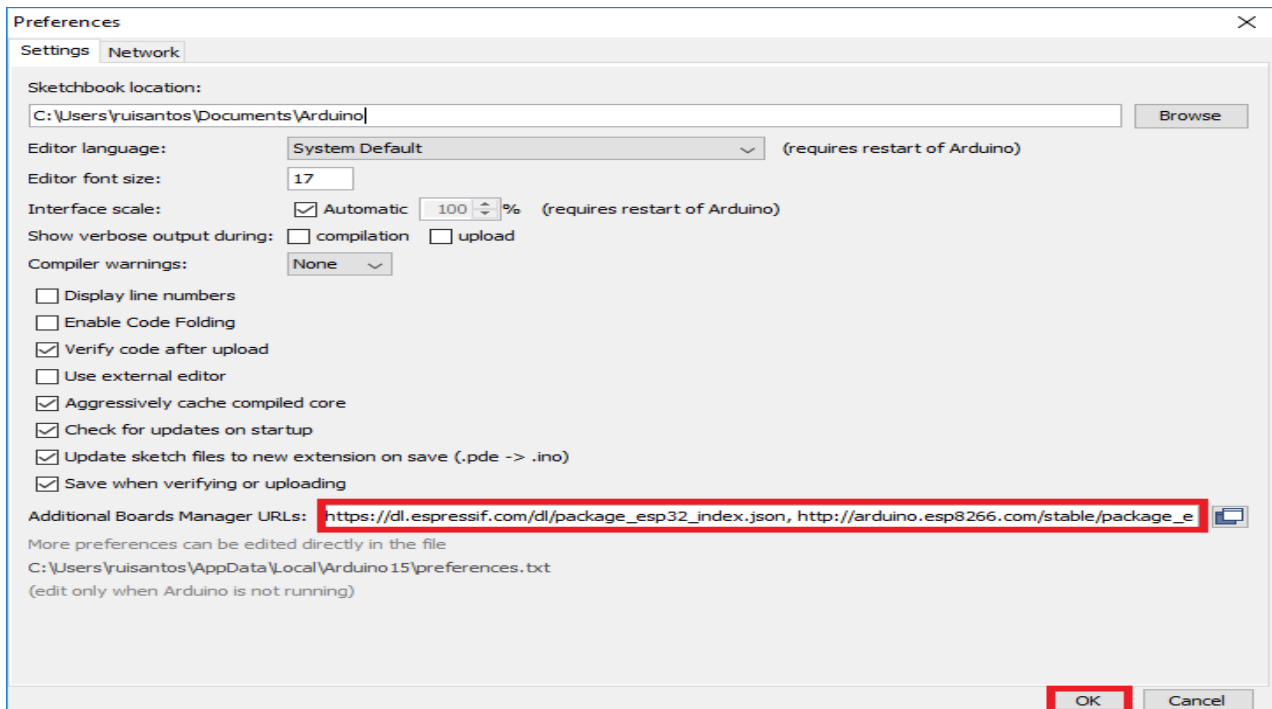
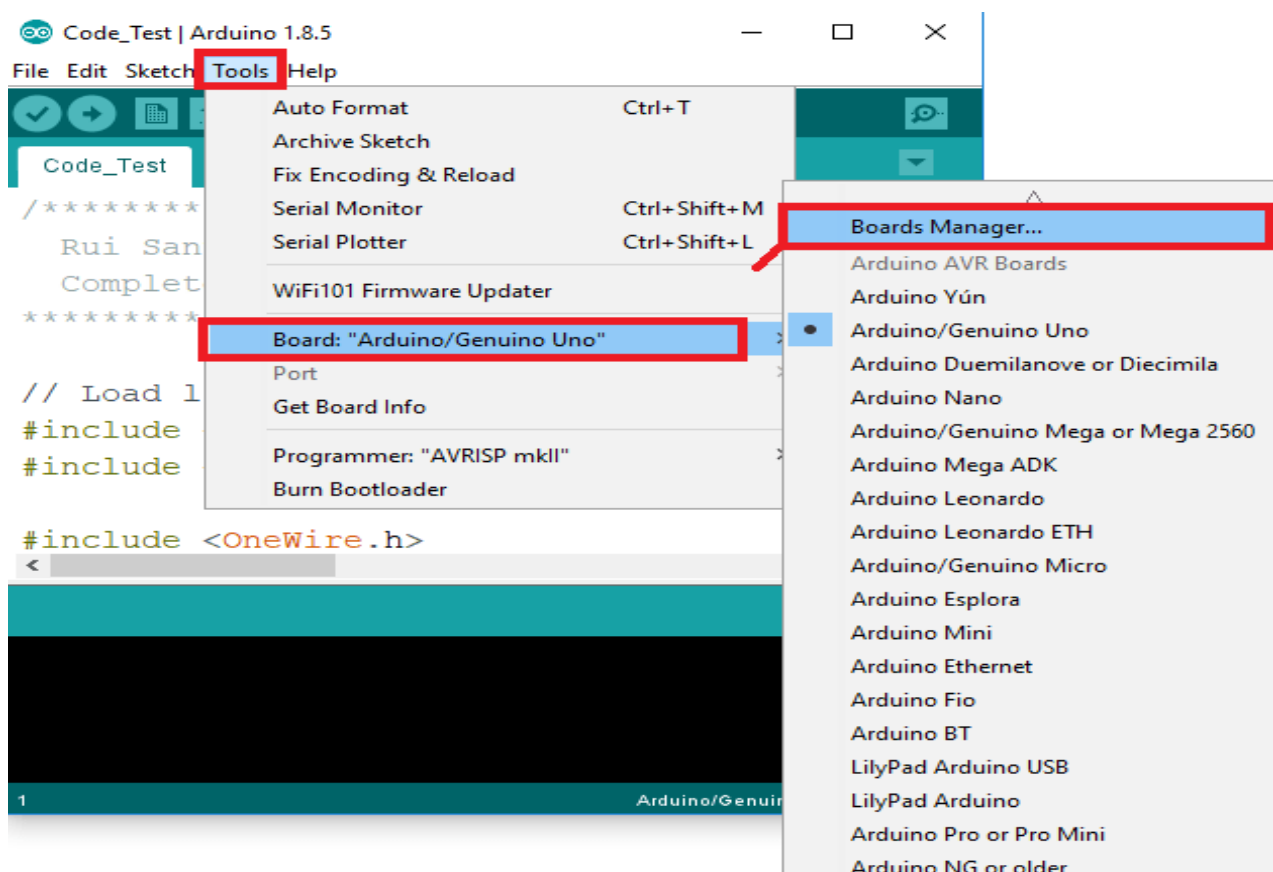


Fig 3.9:- Arduino Interface

2. Enter [https://dl.espressif.com/dl/package\\_esp32\\_index.json](https://dl.espressif.com/dl/package_esp32_index.json) into the “Additional Board Manager URLs” field as shown in the figure below. Then, click the “OK” button:

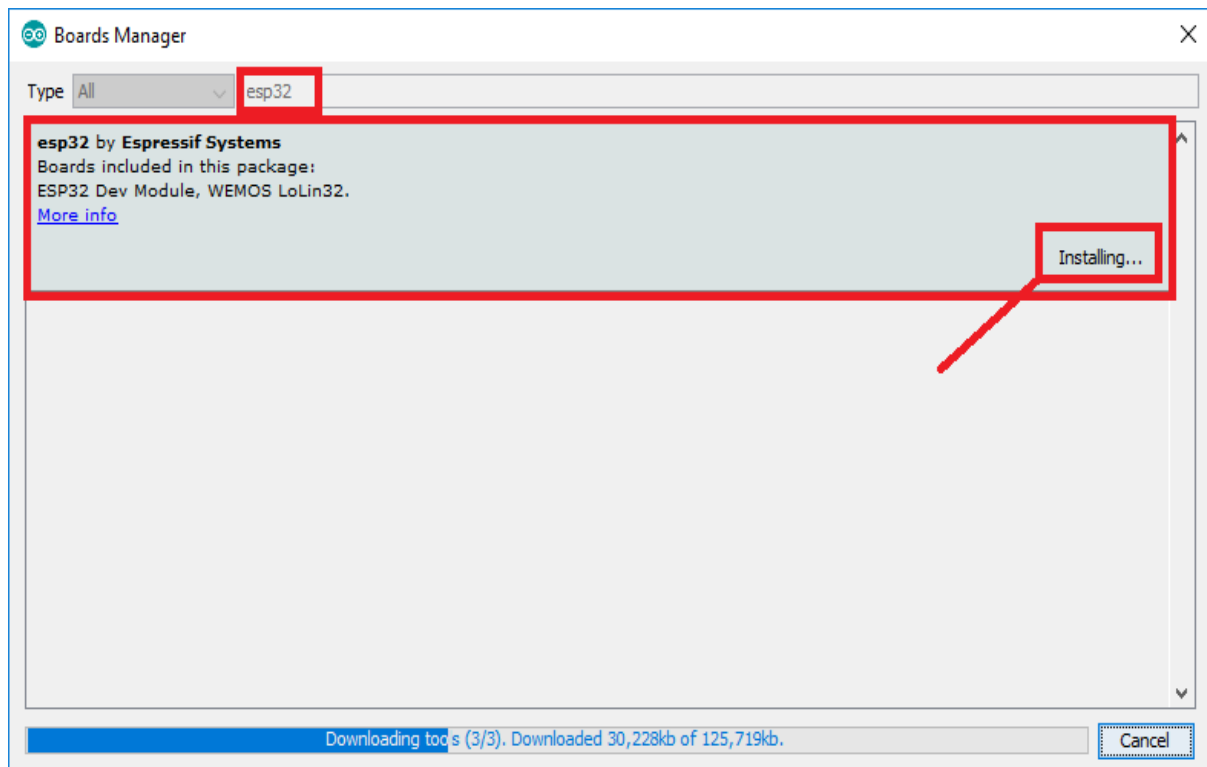


3. Open the Boards Manager. Go to **Tools > Board > Boards Manager...**





4. Search for **ESP32** and press install button for the “**ESP32 by Espressif Systems**”:



5. After installing we need to upload the camera server code. Uploading process explain in ‘Chapter-5’, ‘Discussion’ Section.

6. Exit and Restart the Software.

## Chapter – 4: Design & Simulation

### 4.1. Block Diagram :-

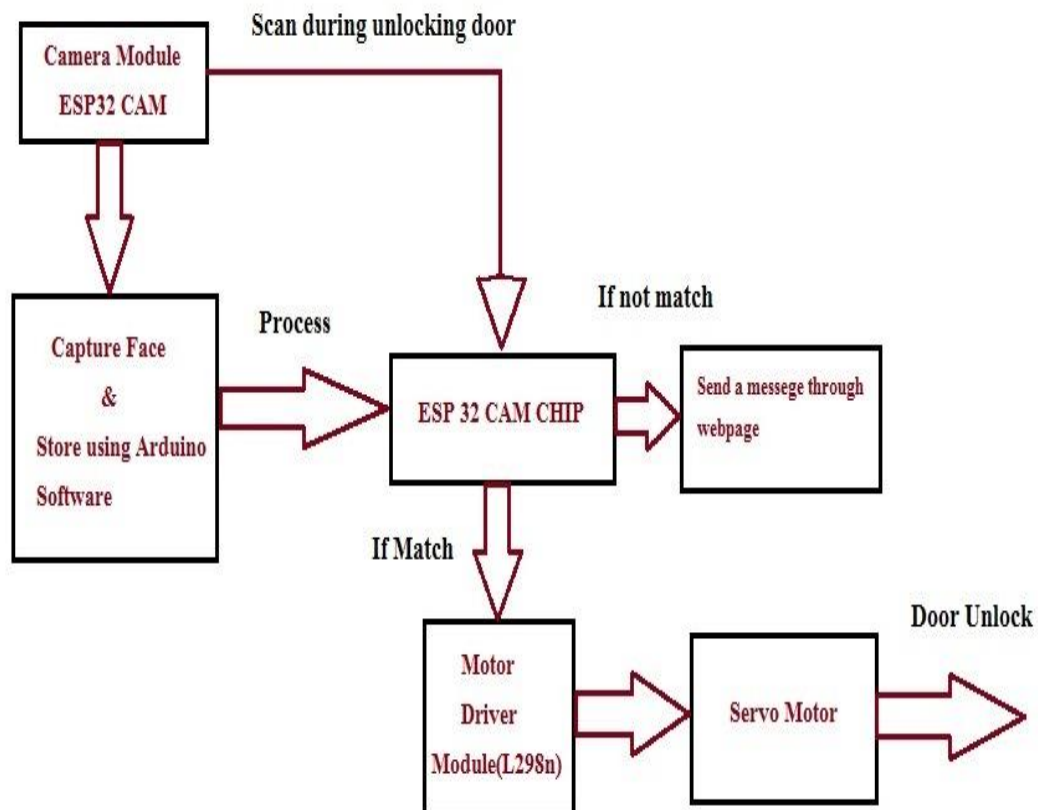


Fig. 4.1:- Block Diagram of Face Detection Door Unlock System

#### 4.2. Interfacing ESP32 Cam with USB TTL converter :-



Fig. 4.2. :- USB TTL Converter (CP2102)



Fig. 4.3. :- ESP32 CAM

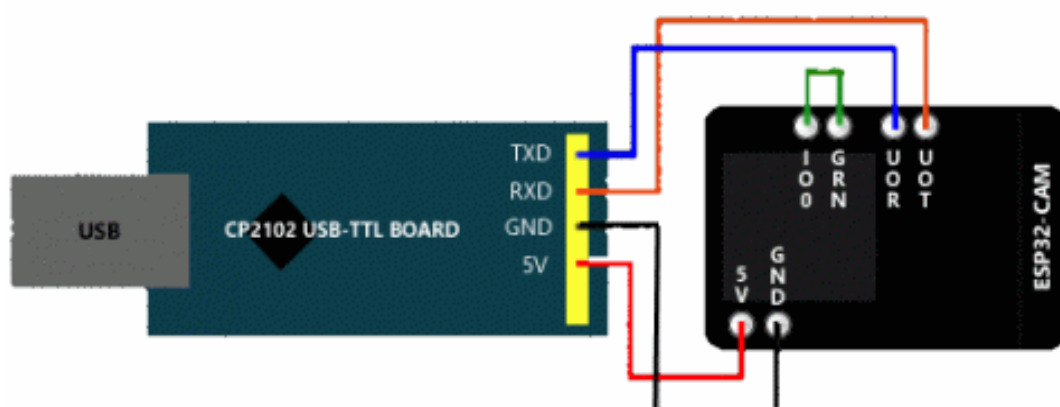


Fig. 4.4. :- Interfacing CP2102 with ESP32 CAM

### 4.3. Interfacing Motor Driver L298n with ESP32 CAM :-



L298n	ESP32 CAM
IN1	IO15
IN2	IO14
IN3	IO12
IN4	IO13

Table. 4.1.:- Interfacing Pin out table L298n and ESP32 CAM

Fig. 4.5. :- Motor Driver module L298n

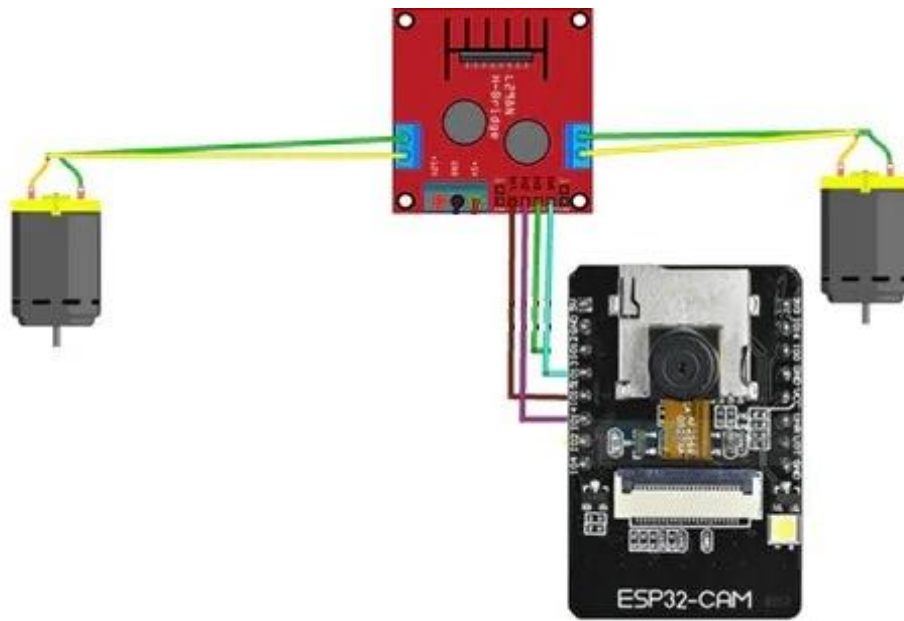


Fig. 4.6. :- Interfacing diagram of L298n with ESP32 CAM

#### 4.4. Working Flow Diagram :-

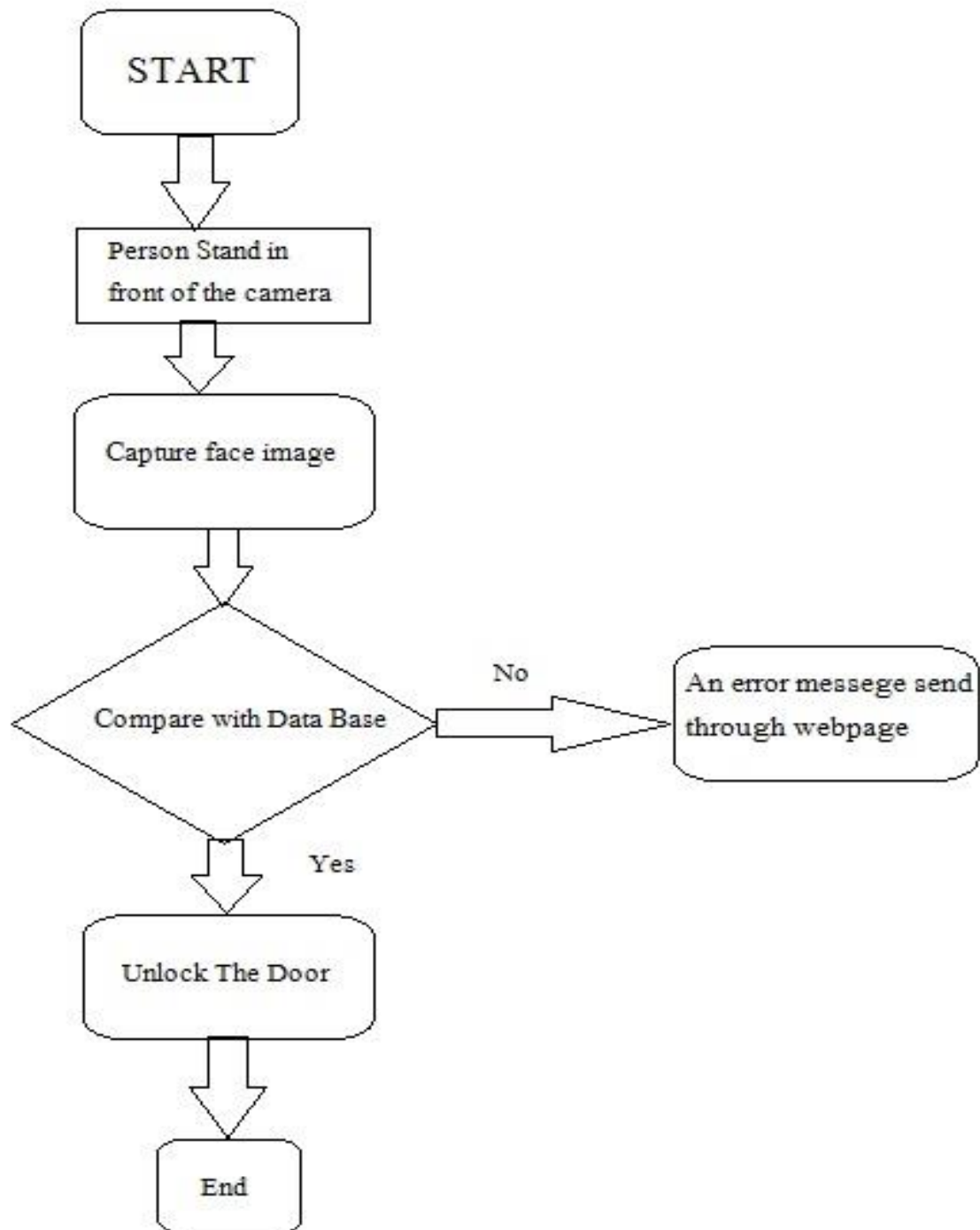
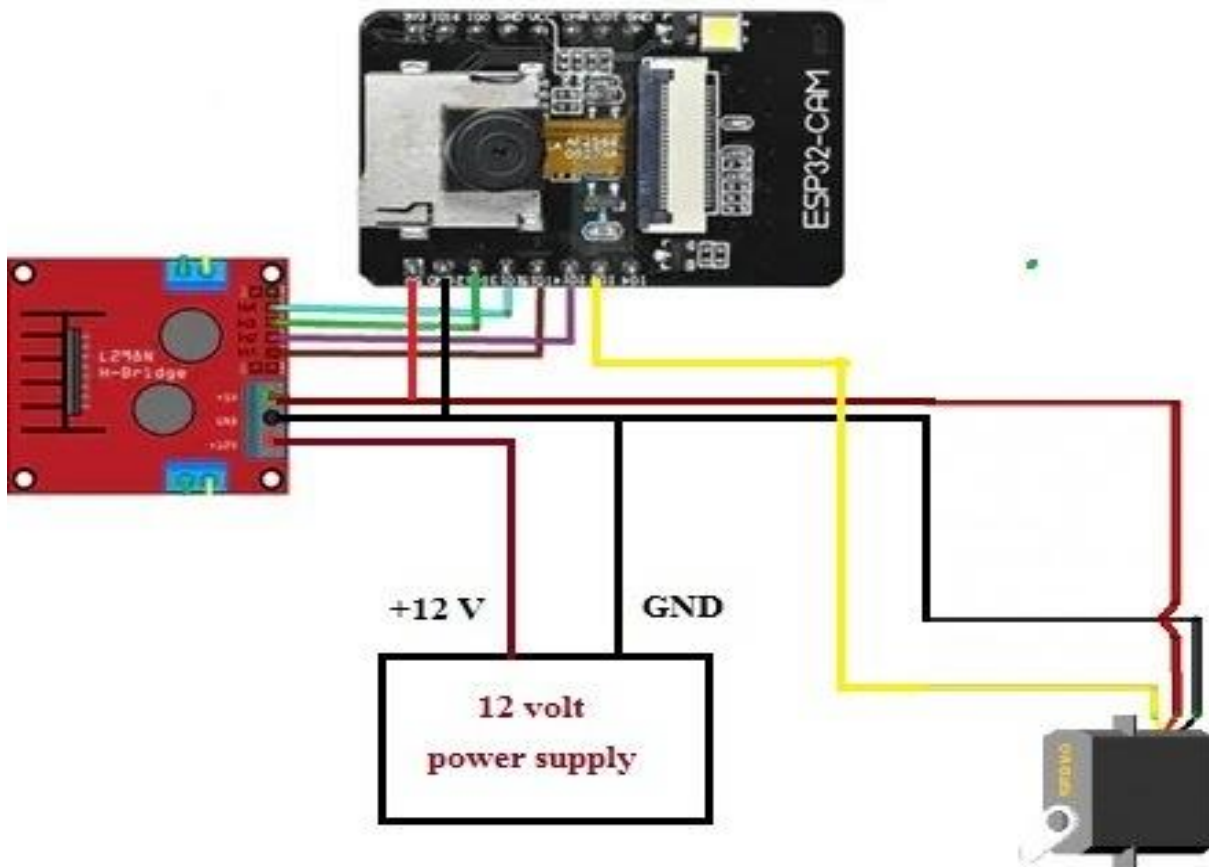


Fig. 4.7. :- Flow-Chart Diagram of the project

#### 4.5. Circuit Diagram :-



**Fig. 4.8. : - Circuit Diagram of Face Detection Door Unlock System**

## Chapter -5:- Result & Discussion

### 5.1. Output:-

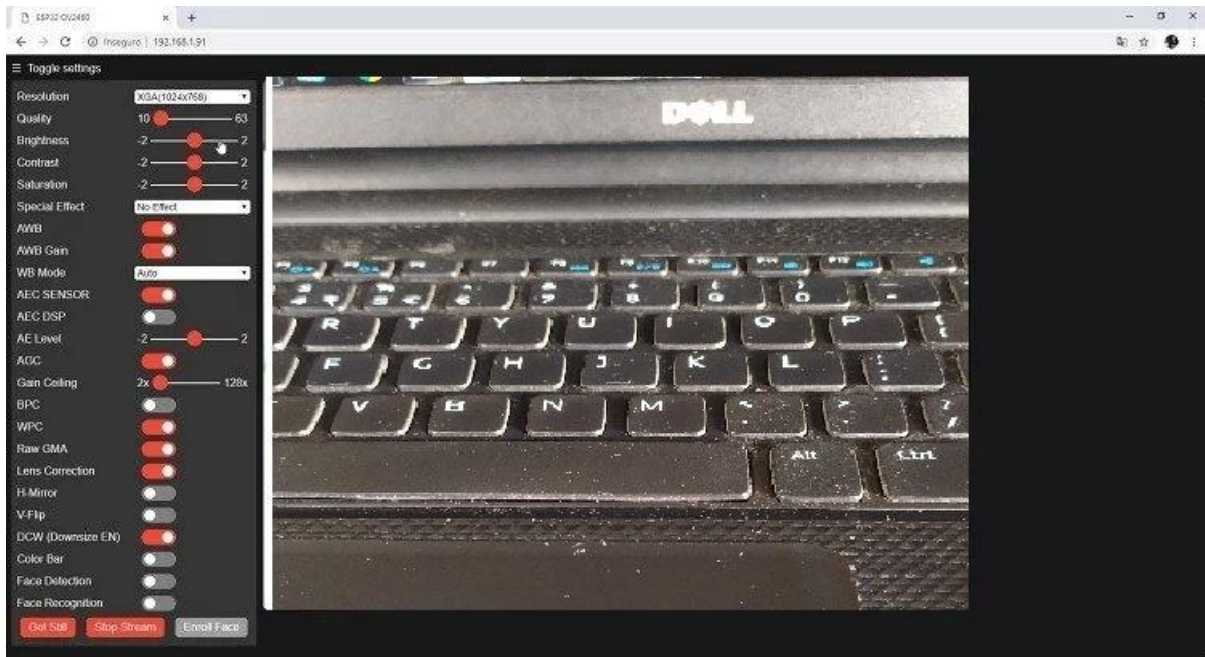


Fig. 5.1. : - Testing Sample of ESP32 CAM module

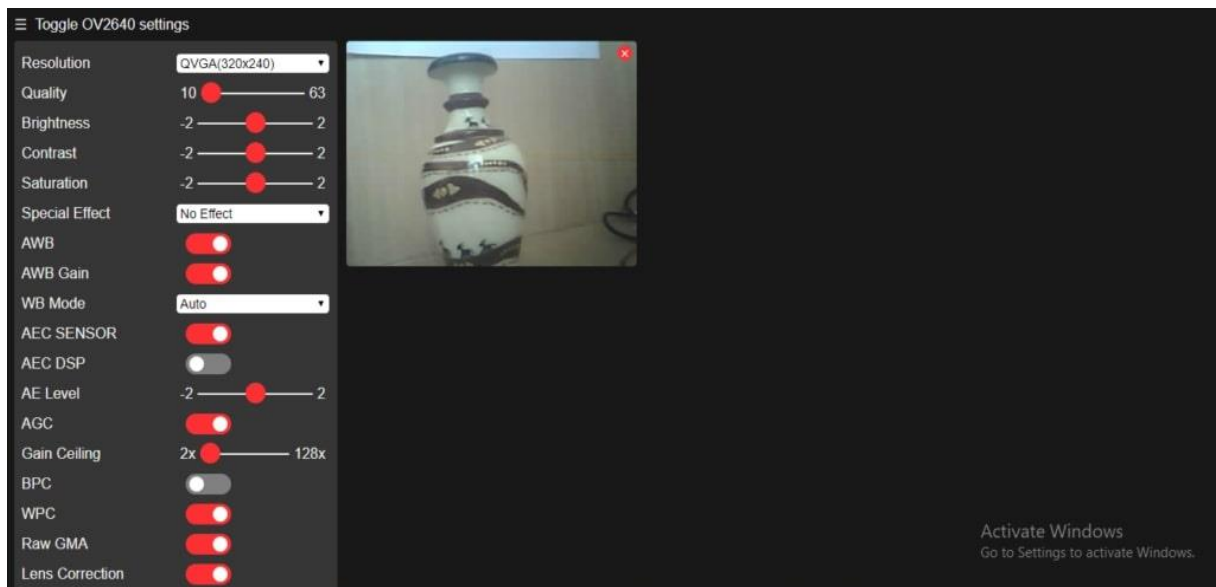


Fig. 5.2. : - Testing Sample 1 of ESP32 CAM module

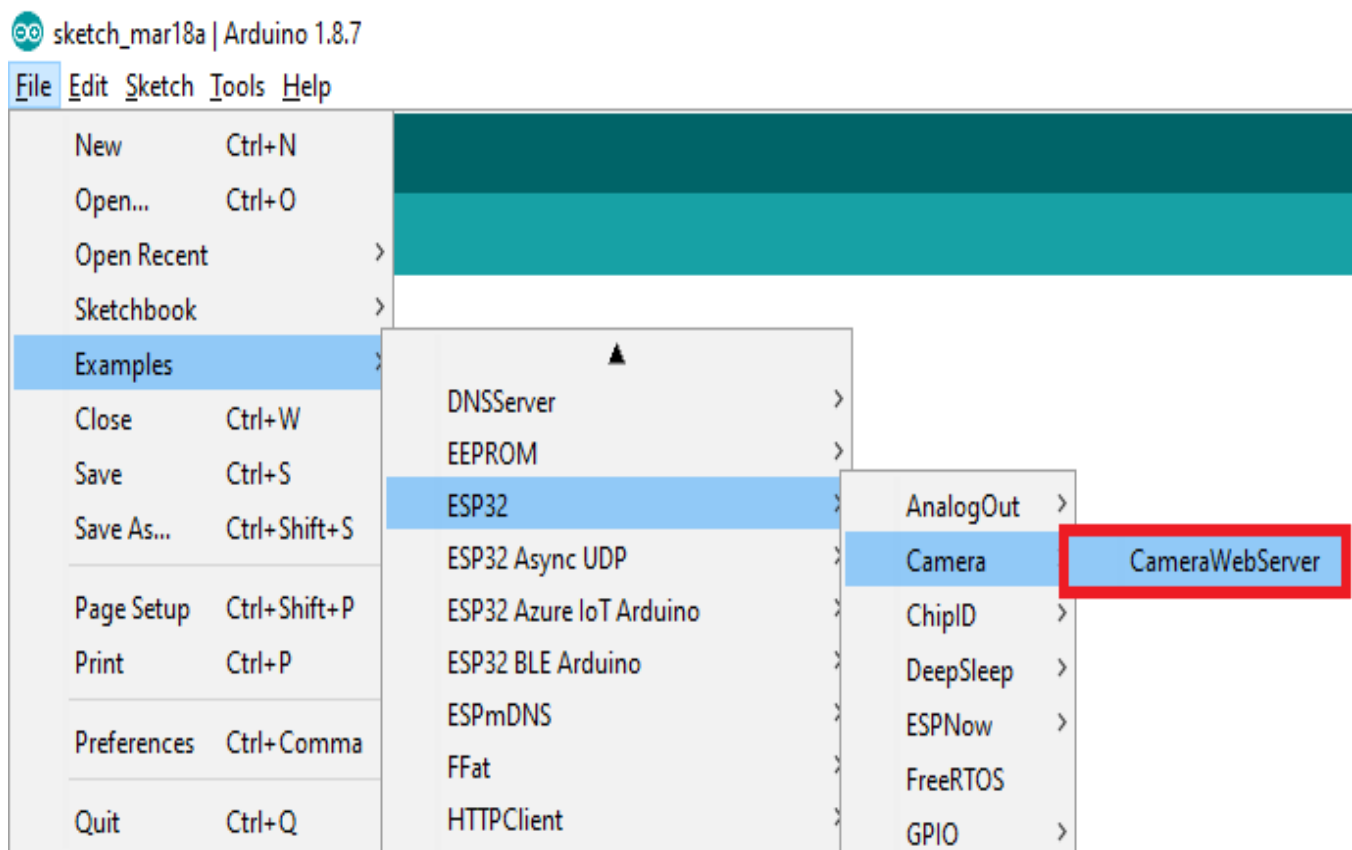
## 5.2. Discussion:-

### Working with ESP32 CAM:-

Inclusion of ESP 32 library in Arduino IDE, we have include the camera webserver program. Selection of 'Boards', we need to write the camera program to our software. In chapter 3, we had briefly discussed about the steps need to follow to include the ESP32 Library in our Arduino Software. In this discussion, we are discussing steps after that.

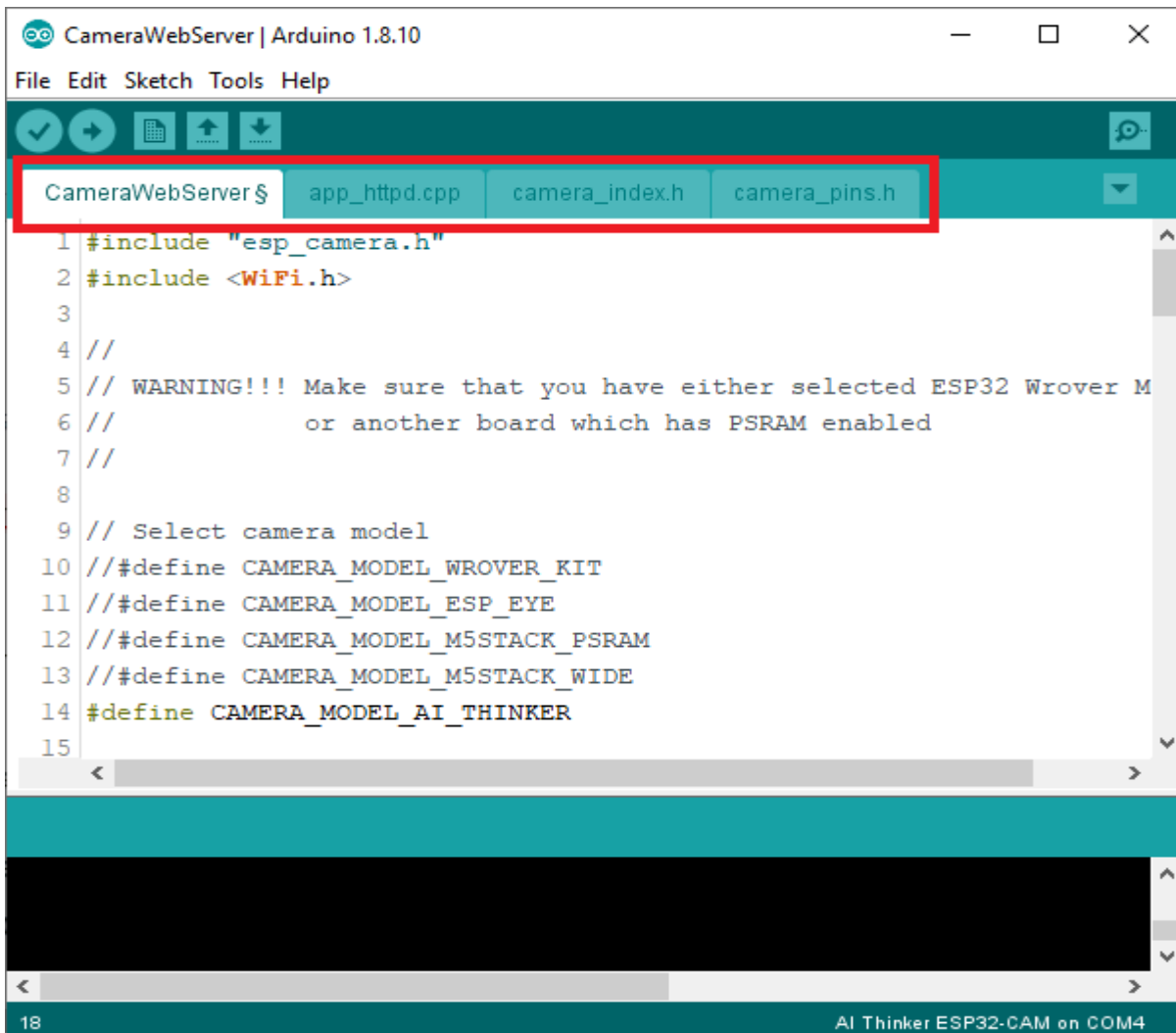
#### 5.2.1. CameraWebServer Example Code

In your Arduino IDE, go to **File > Examples > ESP32 > Camera** and open the **CameraWebServer** example.





The following code will come after selecting 'CameraWebserver' option



```
CameraWebServer | Arduino 1.8.10
File Edit Sketch Tools Help

CameraWebServer$ app_httpd.cpp camera_index.h camera_pins.h

1 #include "esp_camera.h"
2 #include <WiFi.h>
3
4 //
5 // WARNING!!! Make sure that you have either selected ESP32 Wrover M
6 //           or another board which has PSRAM enabled
7 //
8
9 // Select camera model
10 // #define CAMERA_MODEL_WROVER_KIT
11 // #define CAMERA_MODEL_ESP_EYE
12 // #define CAMERA_MODEL_M5STACK_PSRAM
13 // #define CAMERA_MODEL_M5STACK_WIDE
14 #define CAMERA_MODEL_AI_THINKER
15
```

18 AI Thinker ESP32-CAM on COM4

Before uploading the code, we need to insert our network credentials in the following variables:

```
const char* ssid = "WIFI_SSID";
const char* password = "WIFI_PASSWORD";
```

Then make sure that the ESP32 CAM we have that is right module. In this case, we're using the AI-THINKER Model.



So, comment all the other models and uncomment this one:

```
// Select camera model
//#define CAMERA_MODEL_WROVER_KIT
//#define CAMERA_MODEL_ESP_EYE
//#define CAMERA_MODEL_M5STACK_PSRAM
//#define CAMERA_MODEL_M5STACK_WIDE
#define CAMERA_MODEL_AI_THINKER
```

After doing all the settings, we have upload our code to ESP32 chip. Before uploading we have to assure the interfacing connection between **ESP32-CAM** and **USB TTL converter (CP2102)** should same as the diagram mention in **Fig. 4.4, page no.-17**. After that following steps should be followed-

- 1) Go to **Tools > Board** and select **AI-Thinker ESP32-CAM**.
- 2) Go to **Tools > Port** and select the COM port the ESP32 is connected to.
- 3) Then, click the upload button to upload the code.



When you start to see these dots on the debugging window as shown below, press the ESP32-CAM on-board RST button.

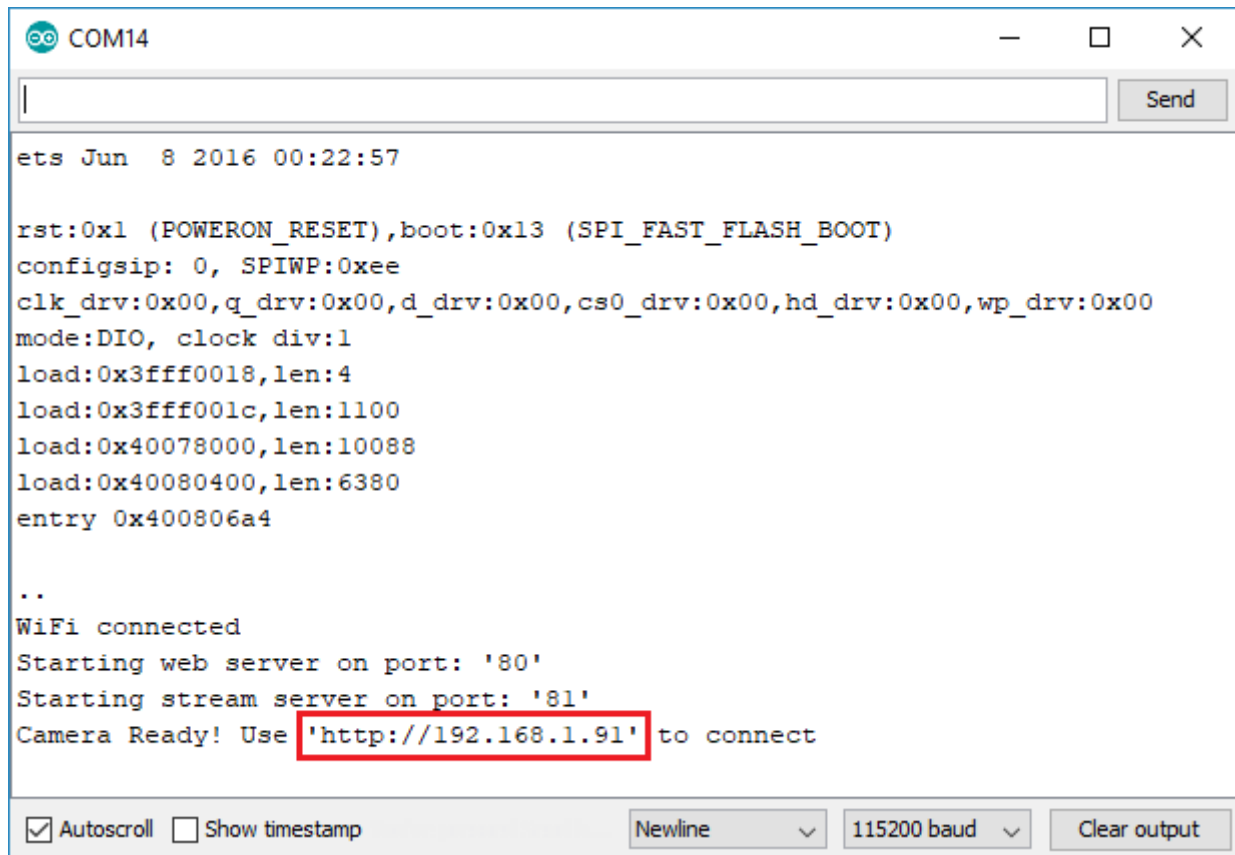
```
esptool.py v2.6-beta1
Serial port COM10
Connecting.....
```

### 5.2.2. Getting the IP address:-

After uploading the code, disconnect GPIO 0 from **GND**.

Open the Serial Monitor at a baud rate of 115200. Press the ESP32-CAM on-board Reset button.

The ESP32 IP address should be printed in the Serial Monitor.



The screenshot shows a Serial Monitor window titled 'COM14'. The output text is as follows:

```
ets Jun  8 2016 00:22:57

rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0018,len:4
load:0x3fff001c,len:1100
load:0x40078000,len:10088
load:0x40080400,len:6380
entry 0x400806a4

..
WiFi connected
Starting web server on port: '80'
Starting stream server on port: '81'
Camera Ready! Use 'http://192.168.1.91' to connect
```

The IP address '192.168.1.91' is highlighted with a red box. At the bottom of the window, there are controls for 'Autoscroll' (checked), 'Show timestamp' (unchecked), 'Newline' (dropdown), '115200 baud' (dropdown), and 'Clear output' (button).

When the above window open, we have to copy the ULR link (in the above picture its is 'https://192.168.1.91) and paste it in our own made HTML webpage. Output is mention in the 'Chapter 5', page no.-21.

## **Chapter – 6: Application & Future Work**

### **6.1. Application:-**

- This simple circuit can be used at residential places to ensure better safety.
- It can be used at organizations to ensure authorized access to highly secured places.
- With a slight modification this Project can be used to control the switching of loads through password.
- It is used to send SMS to the owners mobile when somebody entered the home without permission.
- The developed system can also be used to in industrial and commercial applications such  
As offices, warehouses and other areas where some areas are reserved for authorized Personnel only or other places where safety and precautions are of primary concerns.
- It can also be used in vending machine and in smart attendance system.
- Devices can be controlled from long distances.
- Economical design.
- With the ever-increasing demand for speed and the growing number of cyber-attacks, having fast and accurate technology is key.
- Facial recognition technology provides verification that is convenient, quick, and accurate. Although possible, it is very difficult to fool facial recognition technology, which makes it beneficial in helping prevent fraud.

## 6.2. Advantage:

- Pick-proof: Because there is no place for a key with these locks, they prevent break-ins because burglars are unable to pick or 'bump' the lock. Criminal's methods of breaking and entering are improving and the majority of criminals can pick an ordinary key lock.
- We won't have to carry around a large set of keys and they will be less likely to be lost or stolen. Also, if we are a landlord, we don't have to give residents keys or replace them if we lose them.
- Control: In a company building, you can control and restrict who goes into what part of the building. Also residents and landlords of apartments and flat, can control who can enter their room with one PIN code and it reduces the risk of anything getting stolen. It is incredibly easy to change the PIN code whenever you like.
- The combination door locks from The Workplace Depot have over 8,000 possible code combinations with a simple code change facility.
- Aesthetically Pleasing: Door locks can come in a range of stylish colors that look smart and professional. At The Workplace Depot, we sell mechanical digital door locks in a choice of 3 colors, brass, chrome and satin chrome.
- Perfect for the elderly or disabled: The extra investment into a door lock could bring massive advantages to those who are unable to get to the door quickly and/or who struggle with keys.
- Most of the time, integratable facial recognition tools work pretty flawlessly with the existing security software that companies have installed. And they're also easy to program for interaction with a company's computer system.
- Most of the time, integratable facial recognition tools work pretty flawlessly with the existing security software that companies have installed. And they're also easy to program for interaction with a company's computer system.

### 6.3. Disadvantage:

- Keep the PIN code safe and the lock clean: Only tell the code to people who we trust, as we don't want a code to our property to be local news. When the lock has been used a few too many times, the coating may start to come away or mucky fingerprints may start to occur on the buttons. Keep the lock maintained and clean to stop unwanted people finding out the code.
- Power Failure: Some digital door locks are powered by electricity, if your house or building has a power failure, then the door lock will not work which restricts you from entering the building. Buying a mechanical or battery powered lock will not affect you if there is a power failure.
- Limit the PIN Code Length: Digital Door Locks will be much more secure if they are only 4 digits long. Purchase a quality lock that you can change the PIN code on, don't buy locks that are provided with a PIN code because people can find out the code.
- If there is no proper internet connection, then live streaming will not happen.
- Difficulties with data processing and storing, Difficulties with data processing and storing.
- The identification process is also under great pressure of the surveillance angle that was responsible for the target's face capturing. To enroll a face through the recognition software, the multiple angles are being used - profile, frontal, 45-degree, etc. But to generate a clear template for the face, you'll need nothing less than a frontal view. The higher resolution photo has and the more direct its angle is the more accurate resulting matches would be.
- There are concerns that biometrics are progressing too rapidly for regulators, legislators, and the judicial system to set up standardized rules and precedents around their use.

#### **6.4. Future Scope:**

- Using Node MCU Esp32 the current project can be modified by an Infrared camera interfacing it can be used in Smart Surveillance Monitoring security system which any type of public security is using Living body detection or spying, Also it can be used in Attendance system of the class, Also some profound applications can be implemented using interfacing of Raspberry pi and Arduino UNO board like sensor application of smartcard swapping, finger detection, alcohol detection, agriculture humidity sensing, Temperature sensing using web server, and many more.
- Internet of households where we can attach other devices of house with internet.
- Industrial automation and control through internet.
- Automated fire exit systems can be build.
- Improvement in the security issues in highly restricted areas.

## **Chapter – 7: Conclusion**

### **7.1 Conclusion:**

In this proposed door access system by using face recognition the images are stored in a data base. This system is used door lock access for Residential and Commercial Purposes. Here we have designed a highly secured door locking system by using Node MCU ESP32.

The plan of the Face acknowledgment framework utilizing Raspberry pi can make the littler, lighter and with lower control utilization, so it is more advantageous than the PC-based face acknowledgment framework. In light of the open source code, it is more liberated to do programming advancement on WINDOWS. The Hardware costs around Rs.1000 and the software utilized in Pi is free of cost. We utilize Local Binary Patterns Histogram algorithm for the face recognition prepare. Additionally Alarm will ring for unauthorized access. The created plan is shoddy, quick, and profoundly dependable and gives enough adaptability to suit the prerequisites of various frameworks.

This paper has presented a face recognition security system using Raspberry Pi. HTML and OpenCV was used to implement the feature extraction and classifier, in which we Used Eigen face and XAAMP. The prototype design for real world implementation has been elaborated, in which the output of face recognition algorithm will lock or unlock the magnetic Lock placed at the door using relay circuit. We have discussed the limited processing capability of NODE MCU esp32 which affect the image resolution to be captured, processing time, as well as Memory and power management. The recognition rate was found to be around 90% when Tested with three persons. This proposed system could be connected using Internet to the Smart home system for the added security capability. Further research includes optimization of Hierarchical image processing, use different features extraction and classifier, or use parallel Raspberry Pi clusters to speed up the computation.



## **Chapter – 8: Reference**

### **8.1. Reference:**

- Hteik Htar Lwin, “Automatic Door Access System Using FaceRecognition” in International journal of scientific & technology research volume 4, Issue06, June 2015, ISSN2277-8616.
- Nikolaos Stekas, “Face recognition using Local Binary PatternsHistograms (LBPH) on an FPGA-basedSystem on Chip (SoC)” inIEEE International Parallel and Distributed Processing Symposium Workshop, 2016.
- Ahmet Özdil, “A Survey on Comparison of Face RecognitionAlgorithms),”unpublished.
- The OpenCV Library [Dr. Dobb’s Journal of Software Tools, G.Bradski, 2000]
- Shrikrishna Jogdand1, Mahesh Karanjkar,“Implementation of Automated Door AccessingSystem with Face Design and Recognition,” in IJSR,ISSN: 2319-7064.
- Anoop Mishra “Embedded Image Capturing & Digital Converting Process using Raspberry pi System interfacing and Comparison of Generation 2 verses Generation 1 models in Raspberry pi” in IJCSIT, Volume. 6, 2015, 1798-1801.
- Ole Helvig Jensen, Kongens Lyngby, “Implementing the Viola-Jones Face Detection Algorithm” in IMM. DTU, IMM-M.Sc.: ISBN 87-643-0008-0, ISSN 1601-233X.
- [https://docs.zerynth.com/latest/official/board.zerynth.nodemcu\\_esp32/docs/index.html](https://docs.zerynth.com/latest/official/board.zerynth.nodemcu_esp32/docs/index.html)
- <http://ijarece.org/wp-content/uploads/2017/04/IJARECE-VOL-6-ISSUE-4-240-243.pdf>

## **Chapter – 9: Appendix**

### **Coding:**

#### **AUDRINO CODING:**

```
#include "esp_camera.h"
```

```
#include <WiFi.h>
```

```
//
```

```
// WARNING!!! Make sure that you have either selected ESP32 Wrover  
Module,
```

```
//      or another board which has PSRAM enabled
```

```
//
```

```
// Select camera model
```

```
#define CAMERA_MODEL_WROVER_KIT
```

```
//#define CAMERA_MODEL_ESP_EYE
```

```
//#define CAMERA_MODEL_M5STACK_PSRAM
```

```
//#define CAMERA_MODEL_M5STACK_WIDE
```

```
#define CAMERA_MODEL_AI_THINKER
```

```
#include "camera_pins.h"
```

```
const char* ssid = "ADMIN";
```

```
const char* password = "1234";

void startCameraServer();

void setup() {
    Serial.begin(115200);
    Serial.setDebugOutput(true);
    Serial.println();

    camera_config_t config;
    config.ledc_channel = LEDC_CHANNEL_0;
    config.ledc_timer = LEDC_TIMER_0;
    config.pin_d0 = Y2_GPIO_NUM;
    config.pin_d1 = Y3_GPIO_NUM;
    config.pin_d2 = Y4_GPIO_NUM;
    config.pin_d3 = Y5_GPIO_NUM;
    config.pin_d4 = Y6_GPIO_NUM;
    config.pin_d5 = Y7_GPIO_NUM;
    config.pin_d6 = Y8_GPIO_NUM;
    config.pin_d7 = Y9_GPIO_NUM;
    config.pin_xclk = XCLK_GPIO_NUM;
    config.pin_pclk = PCLK_GPIO_NUM;
    config.pin_vsync = VSYNC_GPIO_NUM;
    config.pin_href = HREF_GPIO_NUM;
```

```

config.pin_sscb_sda = SIOD_GPIO_NUM;
config.pin_sscb_scl = SIOC_GPIO_NUM;
config.pin_pwdn = PWDN_GPIO_NUM;
config.pin_reset = RESET_GPIO_NUM;
config.xclk_freq_hz = 20000000;
config.pixel_format = PIXFORMAT_JPEG;
//init with high specs to pre-allocate larger buffers
if(psramFound()){
    config.frame_size = FRAMESIZE_UXGA;
    config.jpeg_quality = 10;
    config.fb_count = 2;
} else {
    config.frame_size = FRAMESIZE_SVGA;
    config.jpeg_quality = 12;
    config.fb_count = 1;
}

#if defined(CAMERA_MODEL_ESP_EYE)
    pinMode(13, INPUT_PULLUP);
    pinMode(14, INPUT_PULLUP);
#endif

// camera init
esp_err_t err = esp_camera_init(&config);

```

```

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

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

#if defined(CAMERA_MODEL_M5STACK_WIDE)
    s->set_vflip(s, 1);
    s->set_hmirror(s, 1);
#endif

WiFi.begin(ssid, password);

while (WiFi.status() != WL_CONNECTED) {
    delay(500);

```

```
Serial.print(".");  
}  
Serial.println("");  
Serial.println("WiFi connected");  
  
startCameraServer();  
  
Serial.print("Camera Ready! Use 'http://");  
Serial.print(WiFi.localIP());  
Serial.println("' to connect");  
}  
  
void loop() {  
// put your main code here, to run repeatedly:  
delay(10000);  
}
```

