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# Design and Implementation of the Smart Door Lock System with Face Recognition Method using the Linux Platform Raspberry Pi

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**ABSTRACT:** Privacy and Security are two universal rights and, to ensure that in our daily life we are secure, a lot of research is going on in the field of home security. House security matters and people always try to make life easier at the same time. That's why we put up with this project, Face Recognition Door Lock System. Facial recognition is a well-established process in which the face is detected and identified out of the image. We aim to create a smart door, which secures the gateway on the basis of who we are. We want to develop this system based on Raspberry-pi 3, to make the house only accessible when your face is recognized by the recognition algorithms from Open CV library and meanwhile you are allowed in by the house owner, who could monitor entrance remotely. By doing so, the system is less likely to be deceived: since the owner can check each visitor in the remote console, getting recognized by the camera using a photo won't work.

**KEYWORDS:** Raspberrypi, OpenCV, Linux, Smart Door Lock.

## I. INTRODUCTION

In this current time a lot of incident occurs like robbery, stealing unwanted entrance happens abruptly. So, the security does matters in this daily life. People always remain busy in their day-to-day work also wants to ensure their safety of their beloved things. Sometimes they forget to look after their necessary things like keys, wallet, credit cards etc. Without these, they are unable to access their home or any place they want. Traditional security system requires the user a key, a security password, an RFID card, or ID card to have access to the system. However, these security systems have deficiencies; for example, they can be forgotten or stolen from unauthorized people. As a result, there is a need to develop software that guarantees a higher security level is a template. One of the unique features of our brain is that it can think only in images not in words. Once you may forget to keep your Car's key but you will never forget to bring a face with you. God has given everyone a unique face. Face is the most important part of our body, so that it can reflect many emotions of a person. From a long year ago, we are using non-living thing (smart cards, plastic cards, PINS, tokens, keys) for authentication and to get grant access in restricted areas like ISRO, NASA, and DRDO etc. There are two types of biometric as physiological characteristics (face, fingerprint, finger geometry, hand geometry, palm, iris, ear and voice) and behavioral characteristics (gait, signature and keystroke dynamics). Sometimes your behavioral traits may change because of illness, fear, hunger etc. Face detection and recognition system is more cheap, simple, accurate and non-intrusive process as compare to other biometrics. The system will fall into two categories as face detection (1:1) and face recognition (1:N). In the face detection we have to classify between face versus non face region while in recognition process we have to compare that single face image with multiple images from the input image. In This work uses BCM2835 processor, popularly known as Raspberry pi Board. The core of the board is the above processor. It is a RISC processor based on ARM11. The board has special features like camera interface that make it suitable for real time image processing Open cv consists of huge number of inbuilt functions for image processing. It is under BSD license and hence libraries are free of proprietary cost. The full-fledged library functions simplify the complex mathematical operations. In today's world of connectivity and smart devices there is an urgent need to modify our existing day to day objects and make them smart, also it is not the era when we can blindly trust the old and conventional security measures, specifically speaking is our door locks. For face recognition, an image will be captured



by a pi camera and pre-processed by Raspberry pi like converting, re-sizing and cropping. Then face detection and recognition are performed. Once the face is recognized by the classifier based on a prestored image library, the image will be sent to a remote console waiting for house owner's decision. For the passcode part, users could enter or reset passcode through a keypad. Face recognition (FR) systems in real-world applications need to deal with a wide range of interferences, such as occlusions and disguises in face images. Compared with other forms of interferences such as non-uniform illumination and pose changes, face with occlusions has not attracted enough attention yet.

### ILSYSTEM MODEL AND ASSUMPTIONS

#### PROPOSED SYSTEM AND IMPLEMENTATION

The block diagram of Smart Door Lock System with Face Recognition Method using the Linux Platform Raspberry Pi. This system automatically detects the user face and detect the by recognizing their face. This system is developed by capturing real time human faces. The detected faces are matched against the reference faces in the dataset and detect the user. The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries. The original model became far more popular than anticipated, selling outside of its target market for uses such as robotics. Peripherals (including keyboards, mice and cases) are not included with the Raspberry Pi. Some accessories however have been included in several official and unofficial bundles.

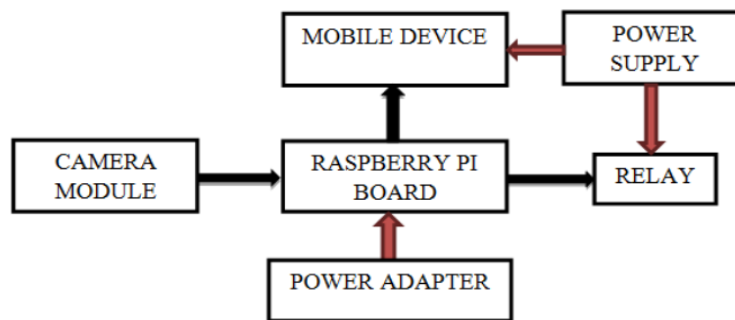


Fig1: Block diagram of Proposed System

**The main blocks of this project are:**

- 1.Camera Module
- 2.Raspberry pi board
- 3.Power adapter
- 4.Relay
- 5.Mobile Device

The above block diagram gives an overview of the project in the pictorial form. With the help of block diagram, we will create pre model of the project and analyse the function of the project.

#### **Camera module:**

Camera module is Pi camera interfacing to the raspberry pi module. Its resolution is 5-megapixel and still picture resolution 2592 x 1944, Max image transfer rate 1080p: 30fps, this Pi camera module is used for captures an image and send captured image to the Raspberry pi module. At the first-time camera module captures 6 images to create a database of the authorized person as a train faces then secondly take a test face or live captured image to compare with train faces (Data base).



Fig2. Camera Module

**Raspberry Pi:**

The Raspberry Pi works in the open-source environment: it runs Linux (diverse distribution), and its principle supported working system, Raspbian, is open source and runs a suite of open-source programming. The Raspberry Pi Foundation adds to the Linux part and different other open source extends just as releasing its very own lot programming as open source. Here Raspberry pi is being used as a main controller to derive other features like face reorganization and detection which we are doing in our project.

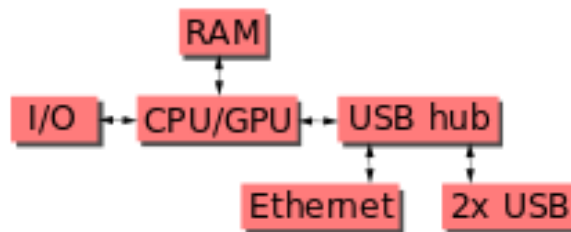


Fig3:Block Diagram of Raspberry pi

**Webcam:**

Webcam software enables users to record a video or stream the video on the Internet. As video streaming over the Internet requires much bandwidth, such streams usually use compressed formats. The maximum resolution of a webcam is also lower than most handheld video cameras, as higher resolutions would be reduced during transmission.



Fig4:Webcam

**Mobile Device:**

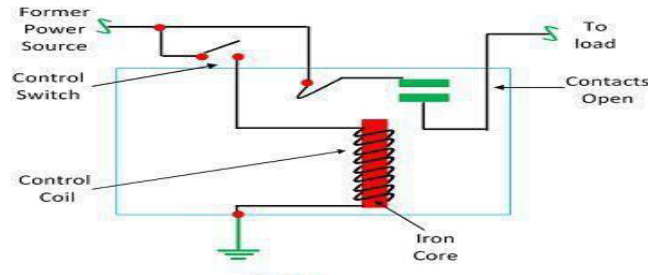
It is used to sending a message to the authorities after comparison output is positive or negative. If output is positive then "Person Identified!!DOOR OPENS!!"message send to the authority person otherwise send "UNKNOWN PERSON IS TRYING TO UNLOCK THE DOOR". mobile device is connected to the Raspberry pi board via RS 232 to USB convertor. It operates on Single supply voltage 3.4V – 4.5V.





**Relay:**

This magnetic field moves the relay armature for opening or closing the connections. The small power relay has only one contacts, and the high-power relay has two contacts for opening the switch. The inner section of the relay is shown in the figure below. It has an iron core which is wound by a control coil. The power supply is given to the coil through the contacts of the load and the control switch. The current flows through the coil produces the magnetic field around it. Due to this magnetic field, the upper arm of the magnet attracts the lower arm.



**Fig 5: Relay module**

**servo motor:**

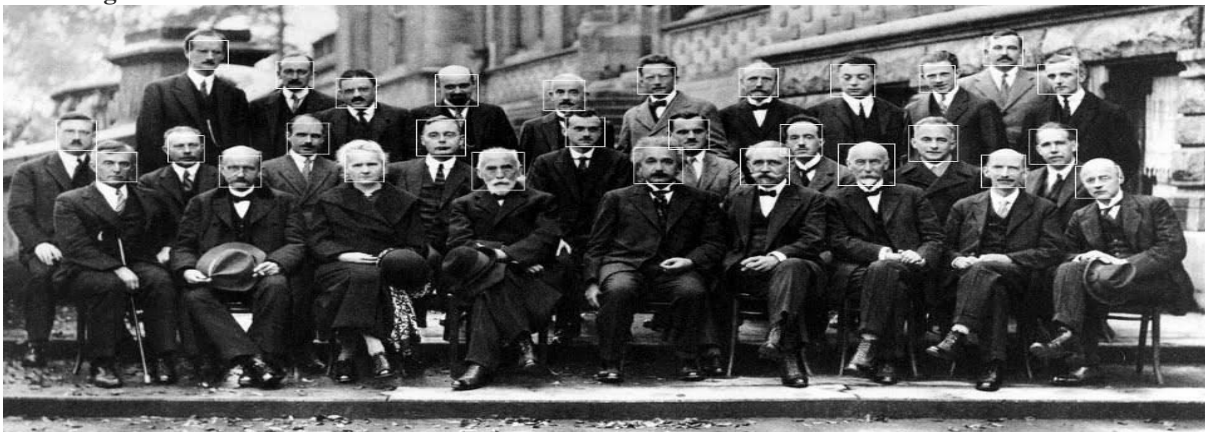
A servo motor is an electrical device which can push or rotate an object with great precision. If you want to rotate an object at some specific angles or distance, then you use servo motor. It is just made up of simple motor which run through servo mechanism.



**Fig 6: Servo motor**

**Software Description**

**LBPH algorithm**



**Fig 7:LBPH Algorithm**



Human beings perform face recognition automatically every day and practically with no effort. Although it sounds like a very simple task for us, it has proven to be a complex task for a computer, as it has many variables that can impair the accuracy of the methods, for example: illumination variation, low resolution, occlusion, amongst other.

In computer science, face recognition is basically the task of recognizing a person based on its facial image. It has become very popular in the last two decades, mainly because of the new methods developed and the high quality of the current videos/cameras.

**Face Detection:**

A Haar-like component considers neighbouring rectangular areas at a specific region in an area window, adds up to up the pixel controls in each locale and figures the differentiation between these totals. This refinement is then used to request subsections of a picture. An instance of this would be the revelation of human appearances. For the most part, the districts around the eyes are darker than the extents on the cheeks. One instance of a Haar-like component for face acknowledgment is thus a plan of two neighbouring rectangular locales over the eye and cheek ranges.

**Face Recognition:**

To capture the images, we are using open cv with raspberry Pi. After detecting the face, the process of extraction is done along with resizing the image. Then, the process of saving the extracted image is carried out. After saving the image the real time training is done, in which the respective names of the images are trained for correct analysis of the person. Finally, the faces of person will be saved in folder with the names of the persons.

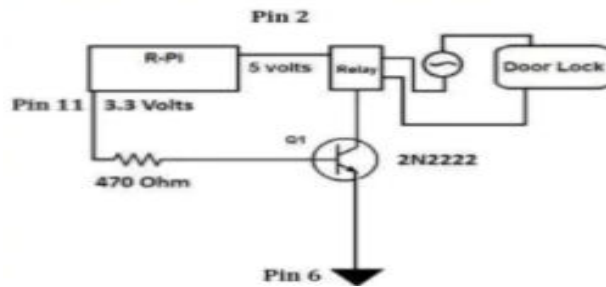


Fig 8: face recognition system for door unlocking

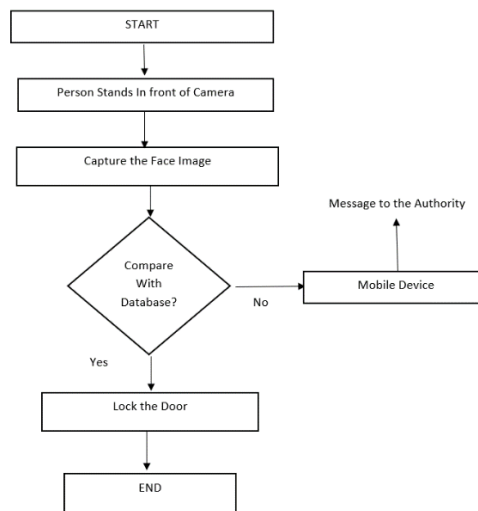


Fig 9: Flowchart of this project



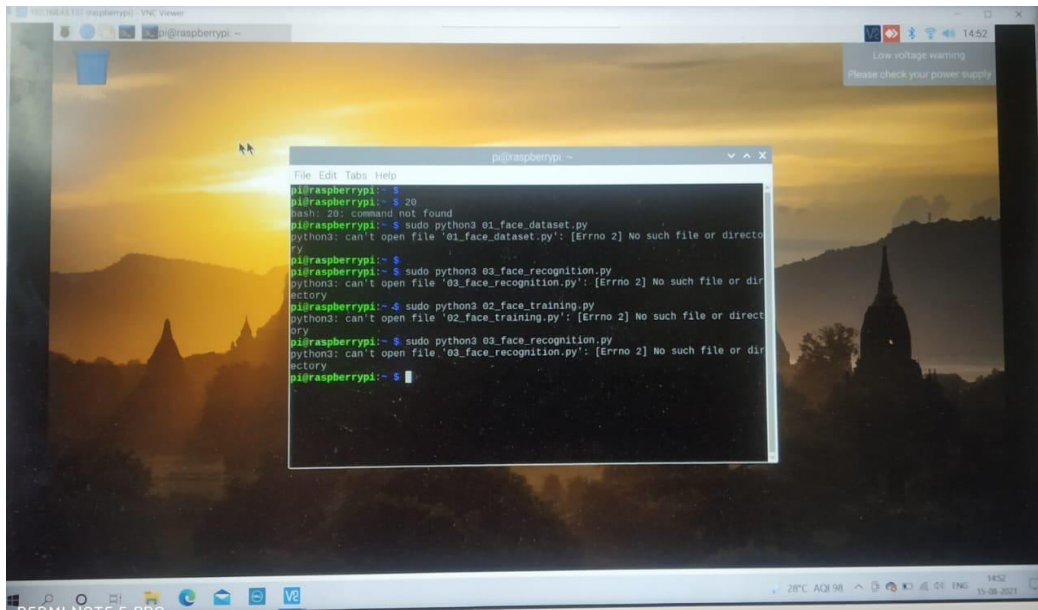


Fig12: Screenshot of Face detection

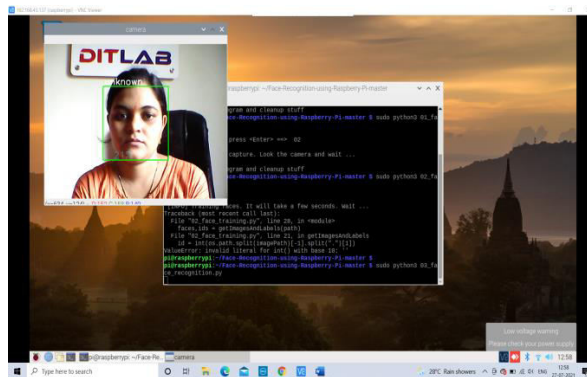
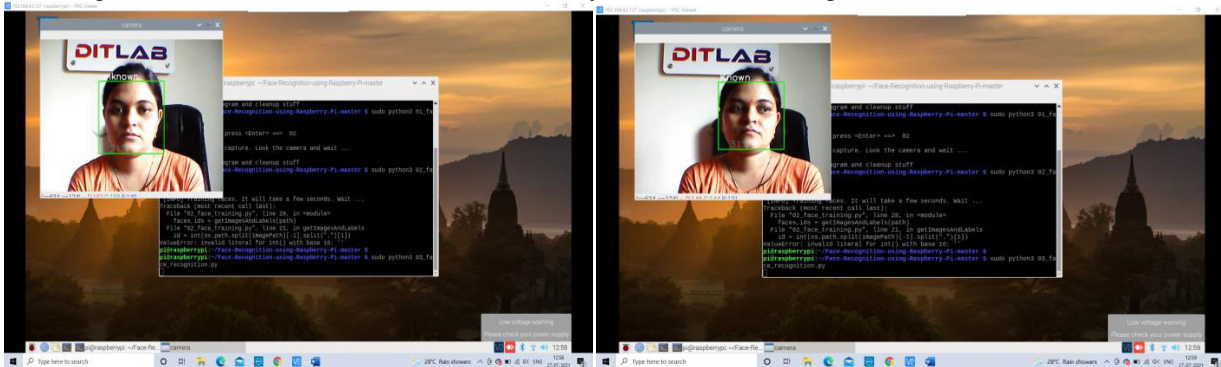


Fig13:Screenshot of Face Recognition

V. CONCLUSION AND FUTURE SCOPE

The output for Design and Implementation of Smart Door Lock System with Face Recognition Method using Linux Platform Raspberry Pi is shown below. fig shows the complete prototype implementation of the proposed system Below fig shows the screenshot of Smart Door Lock System with Face Recognition.





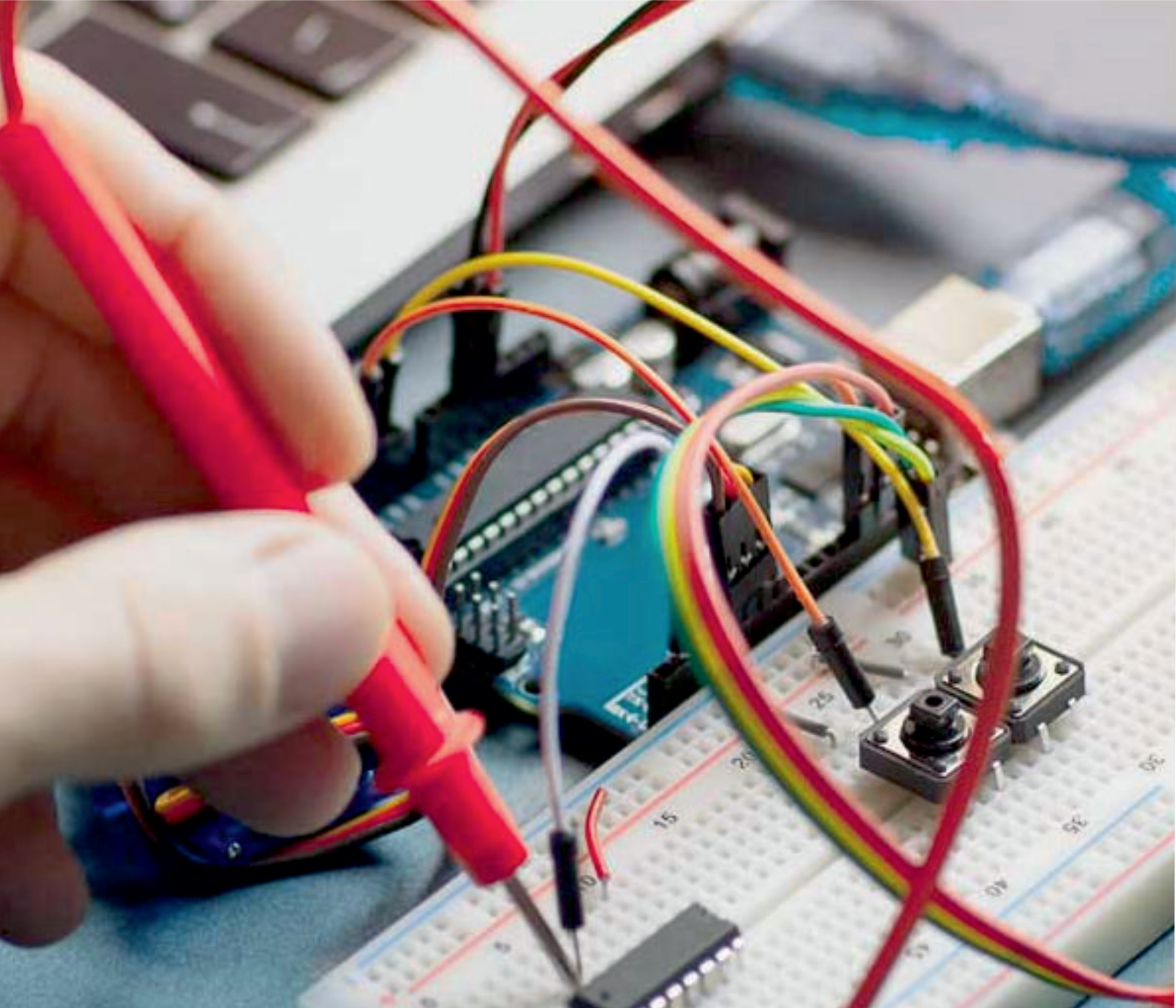


## VI. CONCLUSION

There is high accuracy in recognizing house owner faces and it could realize sending the matched face image to another Raspberry Pi in time and give a good output. And it takes a little bit time to recognize. At all, we all are satisfied to build it implemented a Smart Door Lock system with a seamless integration of a cloud backend, an on-board logical unit like the Raspberry Pi, and a user-friendly mobile application. We made sure that the requests and users' information is secure by using Microsoft's Cloud and their App Services tool. an image of the finished Smart Lock system mounted on the mentioned platform. It can be concluded that automated door lock system in home using human face recognition technique works quite well. Certainly, it can be improved for yielding a better result particularly by paying attention in feature extraction or recognition process. This improvement may help the recognition process become more robust.

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