

## Title : Cost-Effective IoT Based Company Building Face Recognition Security System Using Mobile Application

**Rahman Kazi Ashikur**  
Universiti Teknikal Malaysia Melaka  
b081910450@student.utm.edu.my

**Siti Nur Aissyah Binti Abdullah**  
Universiti Teknikal Malaysia Melaka  
b081910311@student.utm.edu.my

**Ahmad Ifran Bin Harman**  
Universiti Teknikal Malaysia Melaka  
b081910068@student.utm.edu.my

**Md Showkot Hossain**  
Universiti Teknikal Malaysia Melaka  
b012110028@student.utm.edu.my

**Md Israfil Hossain**  
Universiti Teknikal Malaysia Melaka  
b012110030@student.utm.edu.my

**Abstract:** In this research work a mobile application-based face recognition door lock system using mobile phone camera was developed. Implementation of the system is to reduce the system cost and increase the reliability of the system with high security. The system established communication between the hardware device with mobile application through IoT based system. For face recognitions TensorFlow algorithm with real time face recognition technique was used. Users need to login and add the picture to train the application, after that app will recognize the user automatically from the trained dataset and open the lock for the user.

**Key words:** Face recognition system; Smart door lock system; Mobile app-based face recognition; IoT based door lock; Low-cost face recognition door lock.

### Introduction

Face recognition has recently been a prominent topic in study, gradually replacing other biometric system security. A face recognition system is more practical to unlocking the door. Building access control systems is widely used in this technological era (Dwivedi et al. 2020). Usually, the handling access control of large organizations requires new visitors to register at reception area and receive a pass for the entrance. Most of the existing commercialized smart building security systems have many drawbacks in the way that NFC, RFID-based and even smartphone-based schemes can either lost, cloned, or misused by irresponsible individuals (Puthea, Hartanto, and Hidayat 2018). The limitations of existing systems also require some form of human intervention which may cause some inconvenience especially to the elderly and disabled who try to perform authentication. While the conventional method is still to be applicable, it does not utilize the technology that is available effectively. In pace with advancement of technology, smartphones have become an essential part of human life.

With the new advances in computing and communication techniques, many applications that previously required embedded systems running in a rather isolated manner can now be interconnected in an Internet of Things (IoT) world providing the end user a more integrated view of the whole system and new ways to interact with the environment. IoT has enabled a transition from smart devices to smart homes, towards smart organizations and smart cities, while new challenges and threats are to be answered and faced (Reddy et al. 2022), (Rodavia and Bernaldez 2016). The access control is such a typical interaction between a security system and people. Its purpose is to detect and recognize the presence of an individual, uniquely identify it using one or more authentication techniques, log the event in a database and authorize the access (Sruthy and George 2017).

A modern system in opening door locks with a face recognition system using a smartphone was introduced. The smartphone is the most useful item that has become part of life, people always bring it everywhere, and it is impossible to leave it. Using the face recognition system to open the door with a mobile application has higher security and make life more convenient. In this study (Agape and Postolache 2018), a mobile phone uses a facial recognition system to control the door lock, so that the user can enter without any card or key. It allows more people to avoid many time-wasting things and at the same time reduces the theft rate and reduces many costs. This system uses a wi-fi module to receive data from the firebase and a mobile application was used to recognize face, for face recognitions TensorFlow algorithm with real time face recognition technique was used.

### Problem Statement and research questions

There has been excellent work in the field of door locking systems due to their widespread application in everyday life. Yet, there are a lot of issues and challenges that need to be improved. Researchers are working hard to improve security with better techniques, which will reduce the size and cost of the locking system and improve the reliability and security.

Though, physical keys for door lock is one of the oldest ways, but an easy to make a copy. It never knows how many unauthorized copies are made or who is holding the keys. Whoever holds the key can easily access the premises, so the physical key lock system is not secure in terms of high security. Also currently, RFID sensors are used for door lock systems, this system also has defects such as can be easily lost or forgetting to bring an RFID card. As well as can be stolen RFID card and then by that card thief can access easily to the system premises.

Nowadays, face recognition is used to unlock the door of high-security systems. But the cost and system reliability are not satisfactory. This project work aims at reducing the components used in face recognition-based locking systems and at the same time able to minimize the system cost with improved output quality. The key issue for face recognition-based security system used external camera internal data management system which increases the

cost of the system. But we need a more convenient and low-cost system with better security. In this situation, face recognition based on a mobile application is more efficient and cost-effective compared with existing technology.

The main purpose of this project is to implement a mobile application for a face-recognition-based door lock security system with low cost and higher security systems.

### Solutions and the impact of innovation

This project work mainly focused on developing a mobile application for face recognition which will be used for the door lock systems. The significant output of this work is to develop a mobile application which will use a mobile camera and reduce the cost and improve the reliability of the door lock system compared to a conventional lock system.

A facial recognition door lock can decrease the strangers' unauthorized access to the premises by using intelligent face recognition utilizing mobile applications. With this system can be possible to solve security problems.

If using a mobile application-based face recognition system, no need to worry about carrying a door key or RFID card also no need to think about bringing a door key and losing the key. To open the door, the owner only needs to open the phone application and then need to verify his face using the application. If the face matches with the database face, the door will open automatically.

Also, there is no work conduct using mobile application for face-recognition based door lock system.

### Research Methodology

First need to login to the application and register the user by their specific picture on database and need to train those pictures using face recognition algorithm which is TensorFlow algorithm. When the system recognize the user face, username will show on apps and lock will open. If the system does not recognize the face, then a buzzer will open, which will alert that someone tried the unauthorized access. Fig. 1 shows the working principle for the system.

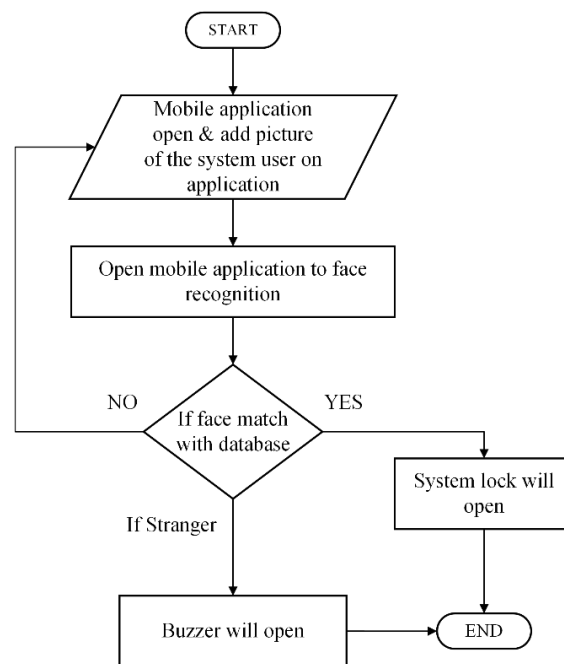


Figure 1. Working flow of the application

After login to the application and open camera, system recognize user face, username will show on application after that that data will send to firebase which show Alarm:0, Door:1 and shows name: X in that case ESP8266 D4 pin will high, and door lock will open. When face recognize unknow than firebase data will be Alarm:1, Door:0 and name: Unknown. In that case ESP8266 D2 pin will high, and buzzer will open. Figure. 2 shows the working flow diagram of the proposed mobile application.

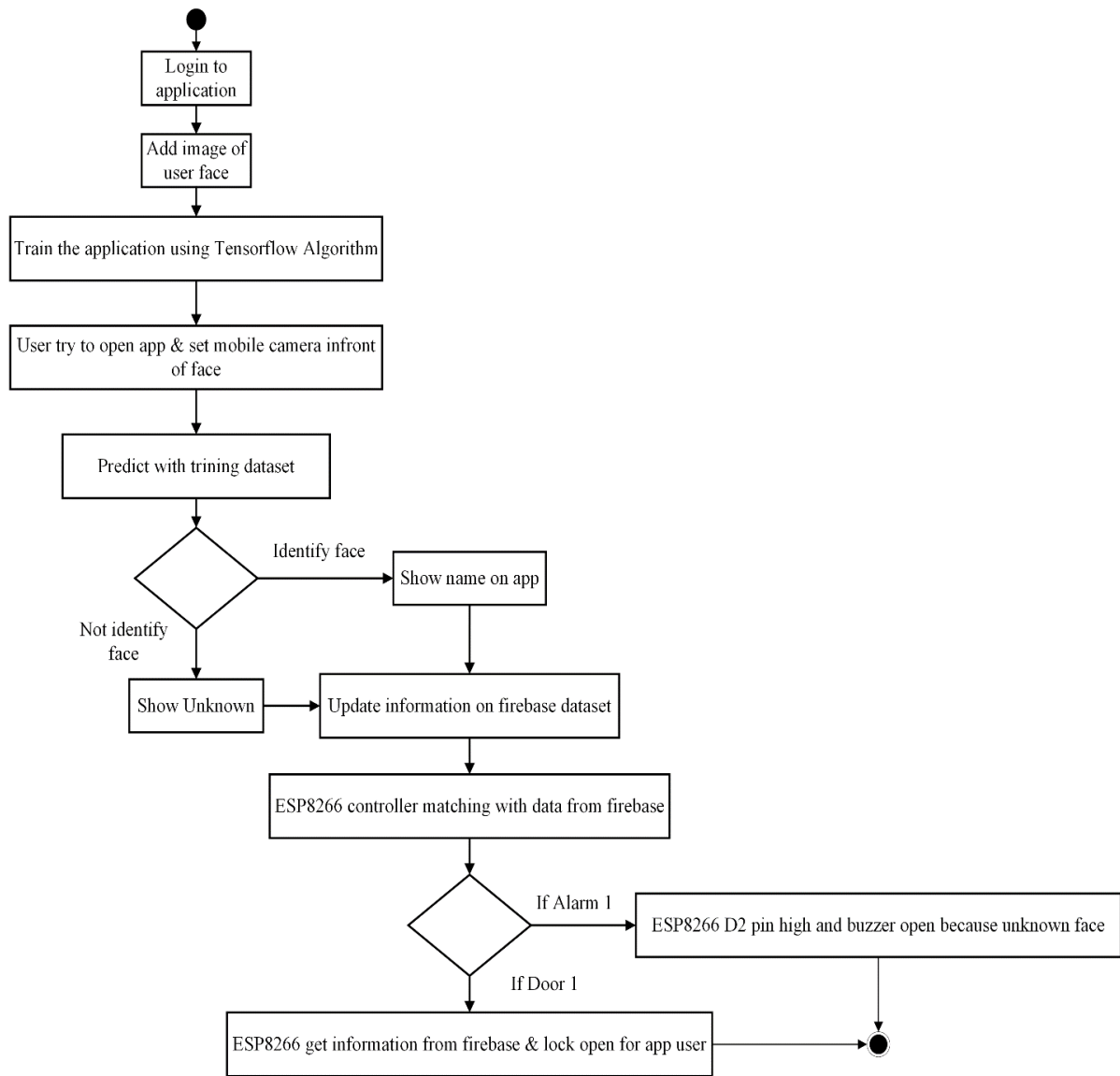


Figure 2. Application workflow diagram

### Expected Result

The major findings are outlined as follows:

- A new type of mobile application will be developed in the face recognition-based door lock industry.
- The results obtained will produce lower system error during the recognition process.
- A low-cost door lock system will be developed with high security and reliability.
- The application will work with hardware smoothly during the recognition process.

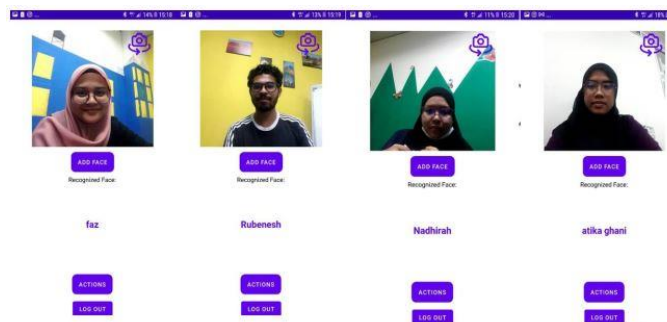
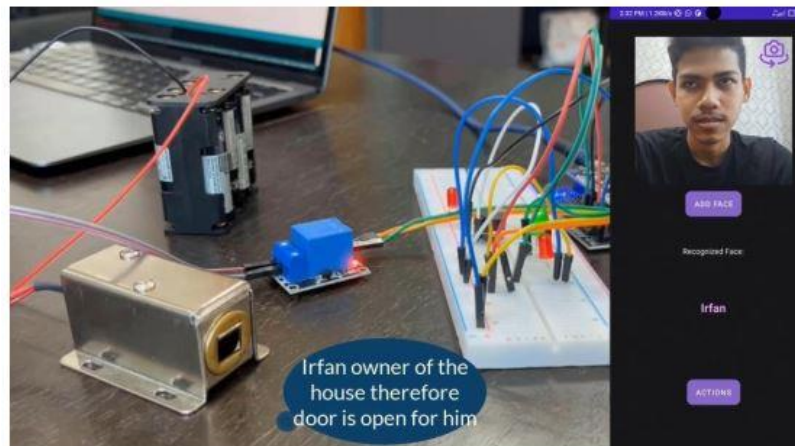


Figure 3: Successfully recognize the users.



**Figure 4: Apps detect the user and open the door lock.**

## Finding and discussion of the project

In recent years, there has been significant hype about mobile phone applications. Most businesses already build their application for better customer service and to make the workflow smoother. Understanding the difficulties and developing smart strategies to overcome them are critical. There is some quality aspects listed below that might be faced with the development of the application.

- Overall recognition process with mobile phone application and hardware could be taking longer time based on internet.
- Recognition with low light can be challenging sometimes.
- Using face mask, sunglasses unable to detect.
- Using Sunglasses sometimes cannot detect the face.
- Long distance more than 3.57 meter unable to detect perfectly.
- Secure data processing from cloud data base to hardware could be challenging in terms of data security.

Hence the system is effective yet simple to use solution for security. Apps able to recognize Clear face without cap, eyeglasses, face mask system able to recognize 98.12%. System able to recognize with face mask only 7.54%. This system relay not working with face mask and in dark mode. Moreover, this apps is still had lots of potential for real life applications, further research is needed on the algorithm to detect with glasses and musk, also have scope to improve for low light detections.

## Commercialization potential

Because of affordability, fast internet, and smartphones, there has been a significant increase in mobile phone application development in recent years. With the advancement of technology and hardware, especially in mobile phones, there is no denying that mobile applications play an important role in the industry by enhancing productivity and quality of work.

- Better security in industry premises with known employees, with a face recognition system, is one of the key contributions of this application.
- Reducing the system cost for door lock security system compared to the existing system, by utilizing user mobile phone.
- Making the face recognition process faster and easier for users, in terms of large-scale use like industry use.

## Acknowledgement

We are grateful for all kind of support from Universiti Teknikal Malaysia Melaka.

## References

- Agape, Alexandru, and Mihai Postolache. 2018. "Internet-Enabled Access Control System Using a Mobile Application." Pp. 244–49 in *22nd International Conference on System Theory, Control and Computing (ICSTCC)*.
- Dwivedi, Abhishek Dhar, Himalaya Gupta, Siddhant Tomar, and Deepak Jaiswal. 2020. "Android Based Flat Security System - the Digital Unlocking and Locking System Based On." *International Journal of Engineering Applied Sciences and Technology* 5(2):192–96.
- Puthea, Khem, Rudy Hartanto, and Risanuri Hidayat. 2018. "A Review Paper on Attendance Marking System Based on Face

- Recognition." *Proceedings - 2017 2nd International Conferences on Information Technology, Information Systems and Electrical Engineering, ICITISEE 2017 2018-Janua*:304–9. doi: 10.1109/ICITISEE.2017.8285517.
- Reddy, Kondamu Yashaswini, Ardha Jyothsna Reddy, K. Bhanu Prakash Reddy, and B. Srinivasa Rao. 2022. "IoT Based Smart Door Lock System." *International Research Journal of Modernization in Engineering Technology and Science* (06):4468–74.
- Rodavia, María Rosario D., and Orlando Bernaldez. 2016. "Web and Mobile Based Facial Recognition Security System Using Eigenfaces Algorithm." Pp. 86–92 in *IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE)*.
- Sruthy, S., and Sudhish N. George. 2017. "WiFi Enabled Home Security Surveillance System Using Raspberry Pi and IoT Module." *2017 IEEE International Conference on Signal Processing, Informatics, Communication and Energy Systems, SPICES 2017 1–6*. doi: 10.1109/SPICES.2017.8091320.