

## Smart Door Lock using Face Recognition

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**Abstract**— Artificial intelligence and machine learning are the buzz words in the industry as well as for research. The world is moving towards automation and a project in that field is a step closer towards it. The main idea of the project is to make smart door lock using face recognition. The face recognition is developed using artificial intelligence, image processing and machine learning. Based on the face that is recognized by the system it makes a decision based on what it has learnt. It decides whether to unlock the door or not. Machine learning is also used and implemented for the software to work efficiently. With the increase in the data set the efficiency will also increase. The system is shown and made to learn using different machine learning techniques. This project improves the security of homes and also makes it easier for segregation of the guests. Apart from this an app is used to send notifications to home owners so as to take appropriate actions. It is extremely useful as it solves one of the leading problems in the world.

**Keywords:** Machine Learning, Android, Artificial Intelligence, Face recognition

### I. INTRODUCTION

#### 1.1 Methodology

The project uses various different technologies for its successful working. It involves various hardware and software components. Let us discuss it one by one. The software technologies that it includes are

Android studio which is used for the making of the app which in turn is used for the front end and interaction with customers. The app is integrated with machine learning and artificial intelligence.

Artificial intelligence: Artificial intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and reacts like humans. It has become an essential part of the technology industry. Research associated with artificial intelligence is highly technical and specialized. The core problems of artificial intelligence include programming computers for certain traits.

Machine Learning: Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves. The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The primary aim is to allow the computers learn automatically without human intervention or assistance and adjust actions accordingly.

Image processing: Image processing is the use of computer algorithms to perform image processing on images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems.

#### IoT Components:

HC-05: HC-05 is the Bluetooth module which catches the instructions sent by the face recognition app and forwards it to Arduino Uno. HC-05 doesn't modify any contents of the instructions

Arduino Uno: Arduino Uno is the main board used for controlling the IoT components by processing the instructions sent by the face recognition app. The board receives the instructions via HC-05, processes it and decides, whether control signal needs be sent to the electric lock.

Electric lock: Electrical lock is operable in two ways:

- by the specific metal key
- by control signals from Arduino Uno

#### 1.2 MOTIVATION

Safety is an important part of everyone's life. Feeling and being safe in one's house is a major priority for everyone. Keeping this in mind we thought of this project. The motivation for this project was to increase security and also

make it effortless. This means that any individual can feel safe without putting in extra effort. The artificial intelligence helps in providing extra security by learning through machine learning. The face recognition system helps in gaining data. This is the training data for the machine learning system. Once that is done there is effortless opening and closing of the electric lock. The android app helps in the face recognition and also to send notification to the user. There are many other benefits of it which can be implemented in due time. These systems can be used for checking attendance in classrooms. This system can also help in entry and exit for corporations and companies instead of having biometric scanning or cards which can be duplicated. The chances of error are extremely low as everything is computerized and human intervention is at the basic level and minimal.

### 1.3 OBJECTIVE

Having the above mentioned motivations in mind, we had clear objectives for the system to be built. These were kept in mind to make the system effective, efficient and user friendly. The major objective of the project is to build an artificially intelligent system that is able to recognize different faces. This recognition is done through an app that implements a face recognition algorithm. After this recognition the machine that has learnt through machine learning algorithms decides if the electric lock on the door needs to be opened or not. In case it is new test data a notification is sent to the owner for appropriate action. The electric lock and other components are coordinated using an Arduino UNO. The android phone is connected to a Bluetooth module which in turn is associated with the Arduino UNO. The objective being clear here is to have successful locking and unlocking of the door in different cases.

## II. RELATED WORK

Through the research of a bunch of IEEE papers and a few other articles it is made evident that smart door locks using machine learning, face recognition and artificial intelligence has a great potential in research and it is used in many industrial applications.

S. Padmapriya and Esther Annlin KalaJames [1] say that “An improved face detection and recognition method based on information of skin color is proposed in this paper. Color is a powerful fundamental cue of human faces. Skin color detection is first performed on the input color image to reduce the computational complexity. Morphological operations are used and it gives a prior knowledge for face detection. Face is detected by Adaboost algorithm. AdaBoost learning is used to choose a small number of weak classifiers and to combine them into a strong classifier deciding whether an image is a face or not. Then, by using principal component analysis(PCA) algorithm, a specific

face can be recognized by comparing the principal components of the current face to those of the known individuals in a facial database built in advance.”

Rezaul Begg and Rafiul Hassan [7] say that “Many wonderful technological developments in recent years have opened up the possibility of using smart or intelligent homes for a number of important applications. Typical applications range from overall lifestyle improvement to helping people with special needs such as the elderly and the disabled to improve their independence, safety and security at home. Research in the area has looked into ways of making the home environment automatic and automated devices have been designed to help the disabled people. Also, possibilities of automated health monitoring systems and usage of automatic controlled devices to replace caregiver and housekeeper have received significant attention. Most of the models require acquisition of useful information from the environment, identification of the significant features and finally usage of some sort of machine learning techniques for decision making and planning for the next action to be undertaken. This chapter specifically focuses on neural networks applications in building a smart home environment.”

## III. PROPOSED WORK

### 3.1 Module design

The project consists of 4 different modules. They are:

1. The android app is used as the front end for the interaction with the customers. It takes the input. The input in this case is the face of the user. The action to be taken with the input is part of the next module.
2. The backend of the application registers a new face and also decides if the face image processed is a new face or a familiar face. Based on the conclusion action is taken of sending a notification or not.
3. The Arduino Uno is responsible for the actual operation of the door lock system. Based on the result of the previous model the door automatically opens if the face is familiar else it asks for further action from the owner of the house.
4. The final output is kept in the database for further use so that the application can take decisions on its own from the time onwards.

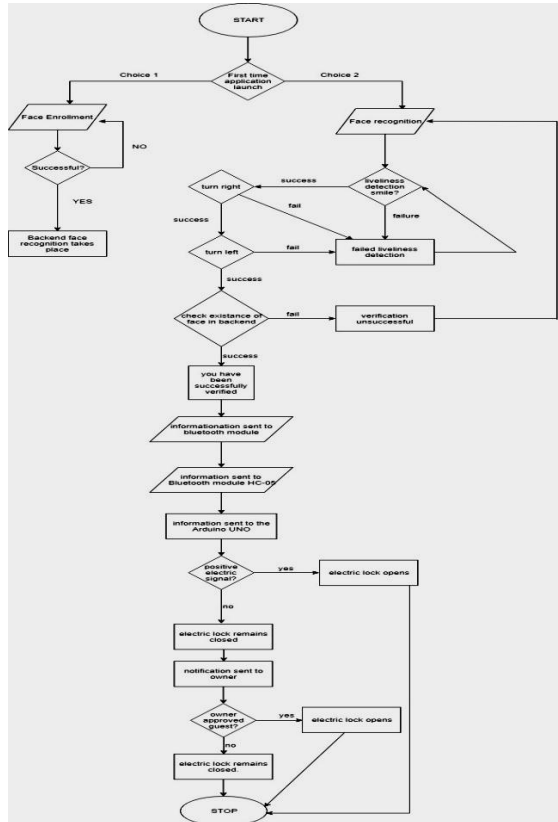


Fig 1. Block diagram

3.2 Working

Android app:

The android app is a basic app coded using android studio. The app is used to recognise the app user’s face. The app has two options. First option is that to register a face for first time users. This is done only to increase convenience for both the user as well as the machine learning algorithm. The second option is of scanning the face. One unique feature about this is that it asks for different angles of the face. This improves security as a photo cannot be used and processed. Once the face is scanned the next module is activated and comes into use.

The backend processing:

The processed image of the face is taken and run through the machine learning algorithm. There are two possible instances in such cases. One being that it is a new face. In such a case the system sends a notification to the owner for the appropriate action to be taken. Once that action is received it is forwarded to the next module. The second case is that it is a known face. In such cases the system has pre learned as to what has to be done. Based on what it has learnt it makes a decision and forwards that to the next module.

The Arduino Uno:

This is a crucial module. It is connected to the smart phone

via Bluetooth. The result of the previous module is sent to the Smartphone from which the hardware receives the input. The Bluetooth module then transfers the instructions to the Arduino Uno. The Arduino Uno is in turn connected to an electric lock system.

The final output:

The action that is transferred from the Arduino Uno to the electric lock I performed. The lock either opens or stays closed based on the instruction that is provided. If the face is familiar and already learned by the application them the lock opens. Else based on the owners action the lock is operated. This action is also learnt for later reference.

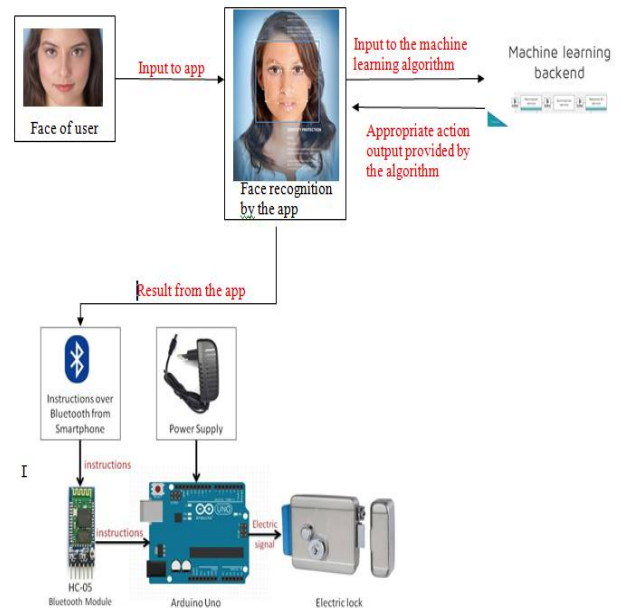


Fig 2. Overview of operation

3.3 THE HARDWARE SETUP



Fig 3. Hardware setup

The hardware part of the project consists of a HC-05 which a Bluetooth module. It also consists of an Arduino UNO and an electric lock. These components send various instructions among each other. The Bluetooth of the android smart phone sends the required result after face recognition and applying the machine learning algorithms. The instruction is received by the Bluetooth module HC-05 and sent to the Arduino UNO. The Arduino UNO processes the instruction received and then uses the processed information to send an electric signal to the electric lock. Based on the electric signal received by the Arduino UNO, the electric lock either opens or stays closed. In this way the hardware components play a major role in the fulfillment of the objective of the system and project.

#### IV. HARDWARE AND SOFTWARE REQUIREMENTS

HARDWARE REQUIREMENT	SOFTWARE REQUIREMENT
<ol style="list-style-type: none"> <li>1. HC-05 Bluetooth module</li> <li>2. Android phone</li> <li>3. Arduino UNO</li> <li>4. Electric lock</li> </ol>	<ol style="list-style-type: none"> <li>1. Android studio</li> <li>2. JAVA</li> <li>3. Face recognition algorithms</li> <li>4. Machine learning algorithms</li> </ol>

#### V. CONCLUSION

In Conclusion the app is able to recognize different faces and conclude its familiarity. Based on its familiarity it decides upon the action to be taken. The app is useful where security is a major concern. It can also be used to increase ease. Big firms and companies can use it to increase security and also keep track of employees. There were various

difficulties that were faced during the completion of the project. Some of them included the compilation of the code, execution of app and integration with the hardware. These obstacles were overcome with many hours of work and referring to many different papers and articles. Trial and error also helped in arriving at the required outcome.

#### VI. FUTURE ENHANCEMENTS

The project can be enhanced further to do an array of functions that can improve it further, they are:

1. Recognize emotions so that the mood of the guest can be predicted.
2. Face recognition with liveliness can have added features.
3. It can be used as an attendance tracking system
4. It can also include alarms and other such warnings in case of preachment.

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