

## Smart Lock System

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**Abstract** - Now a days, as the technology going on rapidly in the sense of advancement, security turns into major issues. So rather than doing complicated things it is better to have smart system in every technology. This project consists of smart lock system for the security purposes. For multimode as well as normal mode operations this system is designed. Smart Lock system is required in corporate organization, Banks, administration, government office, and in lab security also. This all the respective areas contains sensitive information of users and common public hence smart lock system provides security to them. Smart lock system is an advanced technology and easy to interface with totally cost-effective implementation.

**Key Words:** face detection, recognition, telegram, solenoid lock

### 1. INTRODUCTION

Now a days, security is the major aspect in that place where advance technologies are used. In home, companies, laboratories or any other sensitive area where user's information is stored that may be stolen by someone therefore smart lock system reduces this kind of attacks.

This project consists of face detection by using Haar Cascades and face recognition using LBPH algorithms. To sense presence of the person in surround to the sensitive area or not, for that Ultrasonic Sensor is used. For comparing the upcoming person whether it is authenticated or not for that database is created which includes pre-storages images of face samples.

From that pre-storages images of face samples, system is always comparing the all faces which are detected by the Pi Camera which is used in the system for taking live images of persons.

With the system is working on real time application and not to limit this system here itself with making more smarter also added with smart app Telegram through which image is send to administrator.

To prevent unauthorized access, trespassing and intrusion "Smart Lock System" is designed. There are common targets where something wrong activity can take place as in corporate office, laboratories, financial

organization, academic libraries etc. One can want to gain some sensitive information by stealing user IDs, phone number, bank details, password. The purpose of smart lock system is to provide solution to overcome such miss happening and to secure the respective information. This system works on two steps of authentication consisting two biometrics. This will prevent an unauthorized entry from any of the unauthorized individual.

### 2. Literature Survey

In society we remember every people around us by their face because face put unique identity, hence face plays important role in order to recognition of individual. Firstly, face is converted into the digital image and then determination of location and size will be done. Face detection have different challenges and application. There are two types of face detection techniques are feature based and image-based approach. In feature-based approach face will extract from image and match with database and in knowledge-based approach will tries to match training and testing images. [1]

As for detected face, recognize that is play most important role cause without that system is none of use. So, for face recognition different kinds of algorithms are used and algorithm have two-part,1) face detection and normalization 2) face identification. There are two types of algorithm that are fully automatic and partially automatic. The recognition is based on wavelet coefficient further computed on elastic graph. Face is implemented on 2D elastic graph in geometric model. In window shifted over image and DCT will fed to 2D Hidden Markov Model. [2]

Electromagnetic Lock is worked on the principle of Electromagnetism. By using that Electromagnetism principle in locking system, there are two types of locking devices which are 'fail safe' and 'fail secure'. Fail safe will remain locked when lock is de-energized whereas fail secure will get unlocked. This system made up of using electromagnet and GSM. Microcontroller compares password enter by person, if password is correct then microcontroller provides signal to unlock door and vice-versa condition. [3]

### 3. Proposed System

#### 3.1 Hardware Requirements:

##### 3.1.1. Raspberry Pi 3B+:



Fig -1: Raspberry Pi 3B+

Just like we have a computer or laptop this is also one kind of credit card size pocket computer. This device is compatible to almost every task that can we do with normal specification of computer.

Raspberry Pi (RPi) is the heart and brain of our project system in which it will perform all kinds of operation.

##### 3.1.2. Ultrasonic Sensor:



Fig -2: Raspberry Pi 3B+

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns.

With this best kind of feature, we used this for measuring distance on depending on that some others programs are also depends.

##### 3.1.3. Pi Camera:



Fig -3: Raspberry Pi 3B+

Pi Camera is like eye for our system from which we can keep capturing images of known and unknown persons. The Raspberry Pi camera module can be used to take high-definition video, as well as stills photographs. The camera module is very popular in-home security applications

##### 3.1.4. i2c Display:

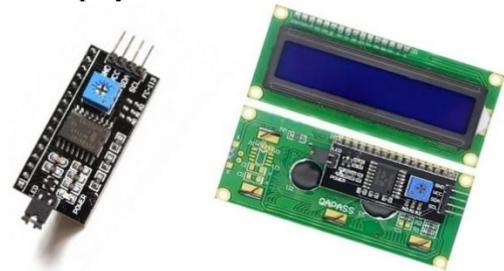


Fig -4: i2c Display

Display means nothing but it has to work as "Display" whatever i/p will provide to that. So, if you have noticed that for normal any display module (here we used 16x2) some numbers are pins used. Now to become that complexity as minimum and not putting extra load on RPi we use that i2c module interfacing with display module. From these kinds of advantages and saving the RPi's GPIO pins we used this.

##### 3.1.5. Solenoid Lock:



Fig -5: Solenoid Lock

As name itself is Smart Lock System means obviously, we required a lock to make system secured. But to make system smarter, here instead of using traditional locking system Solenoid Lock is use with basis of principle of Electromagnetism [3]. This locking system will turn ON and OFF depending on conditions provided to make door open or put in locked conditions. This solenoid lock will operate in different locking voltages. In this, it is working on 12V DC supply.

#### 3.2 Software Requirements:

##### 3.2.1. Raspbian Buster OS:

To run any program, it needs an Operating System (OS) with help of this different programs, applications can be performed. RPi official developers are provides different kinds of OS to run on RPi. Installation and guide of that is available on their official site. [7]

##### 3.2.2. Thonny IDE:

Python IDE is ad free and open source programming software but Thonny is an integrated development environment for Python that is designed for beginners. It supports different ways of stepping through the code, step-by-step expression and evaluation.

### 3.2.3. NumPy:

NumPy is nothing but 'Numerical Python' which is a core library for calculation of scientific computing, n-dimensional array, algebra.

Command to install NumPy in RPi as follow:  
`pip install numpy`

### 3.2.4. OpenCV:

OpenCV is nothing but 'open source computer vision'. This library is used for real time computer vision-based application.

As the system is based on 'face detection' and 'face recognition' so for that making all computing fulfill and compiling code all required libraries are present in OpenCV module. Haar and LBPH these libraries used for detection and recognition respectively.

Command to install NumPy in RPi as follow:  
`pip install opencv-python`

### 3.2.5. Telegram:

Now a days use of social media is increased and with use of this making some smatter projects which can be used in real world. For that here in this project with help of Telegram app sending the live image of detected person is makes easy due to API of Telegram.

Command to install this module in RPi is as follow:

`pip install python-telegram-bot`

Now how to use of this bot and how to create that all is available on Telegram official website.[8]

### 3.3 Block Diagram:

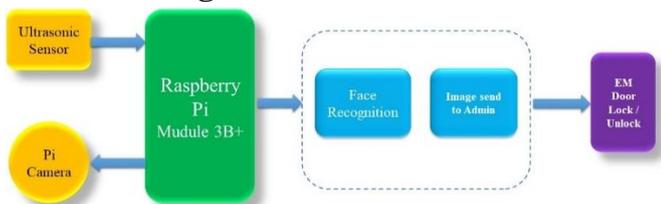


Fig -6: Block Dig. of Smart Lock System

In very first, Ultrasonic Sensor produce waves with Trigger pin and to measure distance that reflected waves will reflected back from object and give input to Echo pin so that with help of this Trigger and Echo pin Ultrasonic sensor is able to measure the distance between sensor and object. Here in this project, Ultrasonic sensor is measuring the distance continuously but as soon as if distance is less than 50 cm then it should stop detection and switch to next operation

Now after becoming distance is less than 50 cm, next operation is Face Detection and Recognition. For this, camera module Raspberry PI Camera will get activated and looking for the surrounding that is their person present or not.

In this mode of operation if person is already known to the system, then system will show the name of

that person and captured the image also. As soon as the image is captured it will store in system and send to the administrator through telegram. But in case if person is not known to the system, then system will show that it is unknown to the system and captured the image of unknown person and saved in system. As soon as the image is captured it will store in system and send to the administrator through telegram.

Now it will proceed for the next application that to open solenoid lock for opening the door or not. For authenticated door will get open and closed for unauthenticated.

### 3.4 Flow Chart:

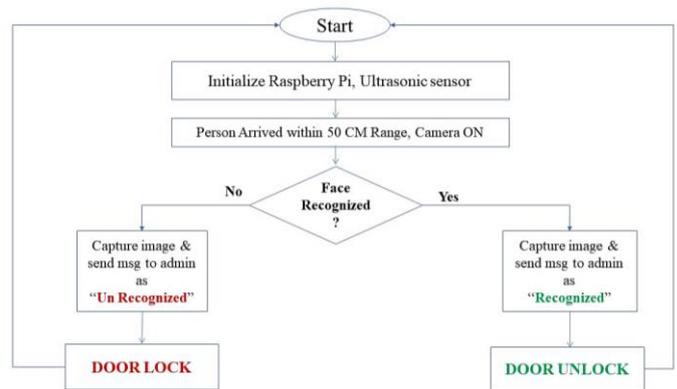


Fig -7: Flow Chart of Smart Lock System

### 3.5 Algorithms:

The system is totally combinedly based on the Artificial Intelligence (AI) and Machine Learning (ML). Here we are using face detection and recognition methods for Smart Lock System.

For this, different kinds of algorithms are used. Like for face detection Knowledge based, feature invariant approaches, Template matching, Appearance based, Haar Cascade Classifier. And for recognition Eigen faces, Local Binary Patterns Histograms (LBPH), Fisher faces, Scale Invariant Feature Transform (SIFT), Speed Up Robust Features (SURF), etc.

Object detection is a powerful instrument but it's difficult to detect an object on computer vision-based approach. But Haar Cascade is a machine learning object detection algorithm. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. So, for these different features are used known as Haar Features like edge feature, line feature, four-rectangle feature, etc. are used. OpenCV offers pre-trained Haar cascade algorithms, organized into categories (faces, eyes and so forth), depending on the images they have been trained on. From all of these features for face detection, Haar Cascade Classifier is most commonly and popularly used. [4][5][6]

With help of Haar Cascade Classifier facial images are extracted, cropped, resized, and for better

operation working on the RBG color operation, images are converted into grayscale. Face recognition algorithm is responsible for finding characteristics which best describe the image. Local Binary Pattern (LBP) is a simple and very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. Radius, Neighbors, Grid X and Y these are main four parameters used in LBPH operation. By training the algorithm and applying LBPH operation face recognition operation is performed. [4][5][6]

### 3.6 Output Result:



Fig -8: Face Detection and Recognition Result

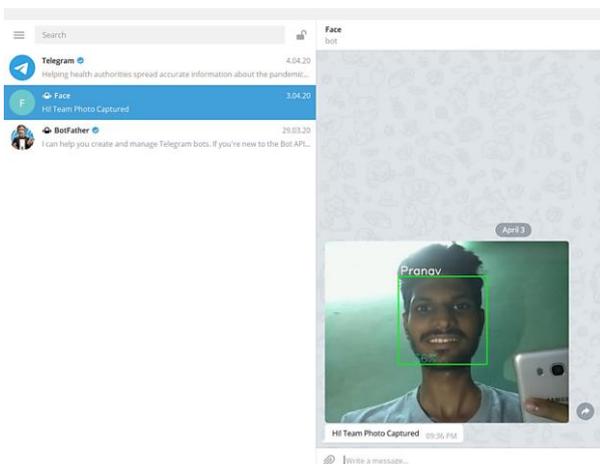


Fig -9: Image send to admin through Telegram

### 4 Conclusion:

A secured and user-friendly system has been developed for authentication using well known algorithms and software. The Smart Lock System is useful for students, professor as well as corporate officers to keep their sensitive information be confidential. Instead of making personal verification this system will help to check whether upcoming user is from our area of zone or not. Therefore surely this will make sense of use in everywhere.

### 5 Future Scope:

Here in this project, the system is implemented with only based on facial recognition for general purpose security for laboratory.

As the system have only one authentication so to make system more secured some additional authentication can be added like fingerprint, OTP (One Time Password), etc. With help of this system can make more secured

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