

**THAPAR INSTITUTE  
OF ENGINEERING & TECHNOLOGY**  
(Deemed to be University)

**F-Unclocker**

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**BE - Third Year - COE1**

**Project Team No - CPG29**

Under the Mentorship of

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**BE Third Year Capstone Project**  
**Mentor Consent Form**

CSED Group: COE -1 ( CPG 29 )			
Roll No	Name	Signatures	Broad Project Area
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NAME of Mentor: **Dr. Sanmeet Kaur**

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## Project Overview

This project consists of smart lock which can be unlocked using Face Recognition. The face is recognised using webcam in real time through web application which is connected to Raspberry Pi. In case of successful authentication, the raspberry pi commands the relay to unlock the lock & hence door. There is a depth sensing feature which finds the depth of the face and this prevents the face recognition software not to be tricked using picture on mobiles.

The project also includes website to grant or revoke access to the users. It would graphically display recognized users along with sound alert with the name of the person, like “Hey Abhishek, you can come inside” and “Access Denied”. Along this the interface would provide the user to set a username and password to associate with an account and configure the system. Configuring includes adding and administrator and owners. The administrator has the privileges of adding owners and bypassing the security in case the software doesn’t recognises the face. Along with this the administrator has the rights to provide entry to third person on one time basis or can be the same person as an owner remotely via the mobile application.

The project also consists of mobile application for both iOS and Android platforms which will be synced with the website. Through this user can log in by giving the details set initially. These credentials will be used to bypass the face recognition system in case the owner(administrator) is not recognised. The face recognition software uses transfer learning to incorporate new images to the deep learning model in case the software can’t recognise the owner due to change in face features.

This project also includes a feature to grant access rights to third person by the owner (one-time access feature). In this feature the third person when denied access can record voice message and send an access request to the owner via mobile application so that administrator grant real one-time access. This is useful to deal with emergency situations like fire when there is a need for urgent access to the room and the owner is not nearby.

## Need Analysis

Home Security is very crucial these days. This system provides easy to use face recognition which is also effective. Four in five Americans, or 81%, indicate that it's important that their security system is accessible remotely from a mobile device, computer or tablet. Twice a week, nearly a quarter of Americans misplace their house or car keys and more than half say that misplaced items regularly cause them to be late to work or school. Provide solution to problem of research labs in TIET where the keys of the room are with supervisor & students cannot access the apparatus directly in the absence of supervisor. This product address the problem of robbery by alarming the system when third person is trying to enter the premises. Also solves the problem of distant anonymous access through special permission grant feature.

This project also aims to provide solution to problem of research labs in campus of TIET where the keys of the room are with supervisor & students cannot access the apparatus directly in the absence of supervisor. Using this product supervisor can give access to selected students via web or application interface using which students can directly open lab. Proper database of entry/exit of students will be maintained on the server to ensure transparency. This product addresses the problem of robbery by alarming the system when third person is trying to enter the premises. The product along with solving the problem of remote access also solves the problem of distant access through special permission grant feature.

# Literature Survey

## Existing Technologies

### 1. *OpenFace*

This software consists of free and open source face recognition with deep neural networks. It includes taking pictures using computer vision, face detection, feature extraction and then face recognition.

### 2. *Depth Sensing Cameras*

This invention relates to a method and apparatus for sensing a three-dimensional (depth and illuminance) image of a scene. It is based on the inverse-square law relating the incident brightness on an area illuminated by a light point source, to its distance from the point source. In the preferred embodiment of the invention the scene is sequentially illuminated by more than one light point source each at a pre-calibrated location in the reference coordinate system. It is known to use various techniques to produce three-dimensional images, i.e., images containing information about the subject scene in three-dimensions. Three-dimensional imaging is of particular importance in the field of computerized imaging for sensing object shape, especially in artificial intelligence applications such as robotic object sorting, and in product dimensional inspection.

### 3. *Qualcomm Depth-Sensing Camera Technology Designed for Android Ecosystem*

This module program is built on the cutting-edge technology behind the Qualcomm Spectra embedded image signal processors (ISP) family.

### 4. *Project Oxford*

The Microsoft Project Oxford Face API allows developers to access and integrate the face recognition and detection functionality of Microsoft Project Oxford. Some example API methods include analysing faces, retrieving face information, and managing people and groups of people. Microsoft Project Oxford offers a collection of APIs and SDKs for developers to add intelligent features to their applications. Detect one or more human faces in an image and get back face rectangles for where in the image the faces are, along with face attributes which contain machine learning-based predictions of facial features. The face attribute features available are: Age, Emotion, Gender, Pose, Smile and Facial

Hair along with 27 landmarks for each face in the image. The cloud-based Face API provides developers with access to advanced face algorithms. Microsoft Face algorithms enable face attribute detection and face recognition. Learn how to analyse content in different ways with our quick starts, tutorials, and samples. Search and identify faces. Tag people and groups with user-provided data and then search those for a match with previously unseen faces. Easily find similar-looking faces. Given a collection of faces and a new face as a query, this API will return a collection of similar faces. Organise many unidentified faces together into groups, based on their visual similarity.

## **Objectives**

- To make working prototype of F-Unlocker using all the required hardware and software.
- To improve overall accuracy of the face recognition system using more optimised algorithms.
- To incorporate depth sensing in the module so that camera cannot be faked by showing the picture of an authorised person.
- To make Web interface along with mobile application in both android & iOS platforms to offer complete solution.
- To make the hardware more compact using Raspberry Pi Zero W Development board.

## Methodology

- Face Detection-: Real Time face detection will be done using external webcam

### *Face Recognition-:*

- Posing and Projecting Faces-: To do this, we are going to use an algorithm called face landmark estimation. There are lots of ways to do this, but we are going to use the approach invented in 2014 by <sup>[1]</sup>Vahid Kazemi and Josephine Sullivan. The basic idea is we will come up with 68 specific points (called landmarks) that exist on every face—the top of the chin, the outside edge of each eye, the inner edge of each eyebrow, etc. Then we will train a machine learning algorithm to be able to find these 68 specific points on any face.



Fig. 1 landmark estimation of face.

- Encoding Faces-: The solution is to train a Deep Convolutional Neural Network, instead of training the network to recognize pictures objects, we are going to train it to generate 128 measurements for each face.
- Finding the person's name from encoding. -: After repeating this step millions of times for millions of images of thousands of different people, the neural network learns to reliably generate 128 measurements for each person. Any ten different pictures of the same person should give roughly the same measurements. Machine learning people call the 128 measurements of each face an embedding. The idea of reducing complicated raw data like a picture into a list of computer-generated numbers comes up a lot in machine learning (especially in language translation). The exact approach for faces we are using was invented in 2015 by researchers at Google but many similar approaches exist.
- Commanding relay: As soon as face gets recognized, Raspberry pi will send signal to relay to open the door lock.



## Work Plan

Table 1: work plan

S.No	Activity	Month	July			August			September				November				December		
		Week No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Face Detection and Feature Extraction	Plan																	
		Actual																	
2	Face Recognition	Plan																	
		Actual																	
3	Web Application Development	Plan																	
		Actual																	
4	Hardware Interfacing	Plan																	
		Actual																	
5	Modifications and Testing	Plan																	
		Actual																	
6	Mobile Application Development	Plan																	
		Actual																	
7	Results Evaluation	Plan																	
		Actual																	
8	Final Report	Plan																	
		Actual																	

## Project Outcomes

- Raspberry Pi based face recognition system connected to relay to lock/unlock the door.
- Web application with face recognition software and adding recognised persons and to display messages and alerts.
- Mobile application for Android and iOS to use from remote location and access the account.

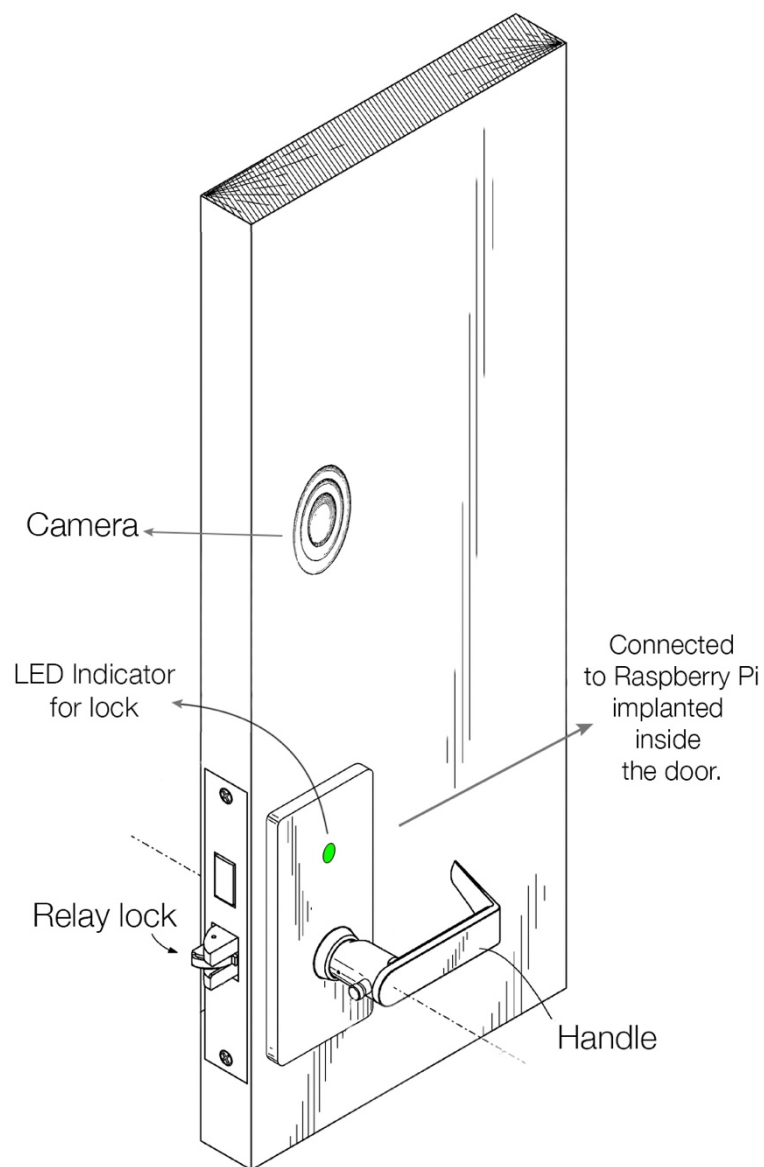


Fig. 2 Initial schematic of the product

## Individual Roles

Table 2: individual roles

Processes	Abhishek Salwan	Abhishek Handa	Ajay Jindal
Face Recognition	✓	✓	✓
Raspberry Pi	✓	✓	✓
Django Web App		✓	✓
Mobile Application	✓		
Documentation	✓	✓	✓

## Course Subjects

Table 3 : Course subjects with codes

Information Management System	UCS304
Data structure & Algorithms	UCS406
Advanced data structure & Algorithms	UCS616
Machine Learning	UML501
Deep Learning	UCS742
Computer vision	UCS522
Data Analytics & Visualization	UCS633
Engineering Design	UCS617

## References

- [1] V. Kazemi and J. Sullivan, "One millisecond face alignment with an ensemble of regression trees," *2014 IEEE Conference on Computer Vision and Pattern Recognition*, Columbus, OH, 2014, pp. 1867-1874.
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- [5] Zhao, W., Chellappa, R., Phillips, P. J., & Rosenfeld, A. (2003). Face recognition: A literature survey. *ACM computing surveys (CSUR)*, 35(4), 399-458.
- [6] Viola, P., & Jones, M. J. (2004). Robust real-time face detection. *International journal of computer vision*, 57(2), 137-154.