International Journal of Engineering & Technology, 7 (2.7) (2018) 187-192

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research Paper

Implementation of security system for bank using open CV and RFID

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Abstract

Security is one of the major concerns in banking sector where we can adapt the latest techniques like face recognition and RFID we can provide better security policies. In this paper we have proposed a model with two major security techniques. The First method provides security for the locker room door by face recognition using OpenCV. Face recognition is a particular type of biometric system that can be used to analyze the obtained information and identify the user uniquely by the trained images. In this proposed model the images of customers are trained. A Microsoft Lifecam HD-3000 is placed outside the locker room. This camera detects the human face using Haar Cascade Classifier and recognizes a customer using LBPH Algorithm. If a trained customer tries to enter then door is unlocked. The customer name is uploaded to cloud. The second method provides security to the cashier cabin by using MFRC522 RFID Module which is very easy to access which consumes less time and more secured compared to the existing system. When an authorized tag is recognized the door is unlocked for certain time period and the userid is uploaded to the cloud. By using these two techniques we can provide security for locker room and cashier cabins in any banking sector.

Keywords: *Face Detection; Face Recognition; Haar Cascade Classifier; LBPH Algorithm; Open CV; RFID Module.*

1. Introduction

A Bank is a financial organization where money transfer, business transactions, ATM, credit card are some tasks that are performed daily. Banks plays a vital role in deciding the financial position of the country. Banks create deposit by accepting deposits from the persons. Some customers store their valuables like Golden Ornaments, money and surety or property documents in the bank lockers either for the purpose of safety or for the purpose of getting loan. It is the wealth of the customers. So these lockers and the locker room door should be safe. Bank should provide robust security and guarantee for the customers for their lockers. In this modern era, there is a tremendous change in the technology day by day. There is some advancement in the online banking system like we have personal banking, mobile banking etc. So transactions can be done in just a few clicks. But the bank is the place where updated technology is still not in use to that extent. There may be some irresponsible persons in the bank because of which the bank security can be preached. In order to provide security much better systems can be used instead of following the regular approach.

2. Existing work

In general two locker keys are used to unlock the bank lockers. One of the key will be with the bank official of the branch and the other key will be with the customer who is having a locker in the bank. There may be a chance of locker key being misplaced and someone can use duplicate keys to open the locker. This will be a drawback to the existing locker system. The locker room will be unlocked using key only so here also there is scope for security preaching. There is no much security for the locker room door also. Whatever money the customers deposit in the bank through cash, almost the money will be there with the cashier. In some banks, there is no proper secure system for allowing only cashier to his/her cabin. There may be a chance of unauthorized people trying to enter the cabins with some wrong intension. No proper security is provided to the cashier. In banks there will be CCTV cameras which will be monitoring continuously who is entering and leaving the bank. There is a chance of these cameras being hacked or put some sticker or an obstacle to hide the view.

Blessed Joshua.A, Jenita Grace.J and Allan Mary George have proposed Open CV Pattern Based Smart Bank Security System with Theft & Identification Using Android [1] in 2nd International Conference on Applied and Theoretical Computing and Communication Technology (iCATccT) 2016. This proposed system has RFID tag authentication, a camera installed to capture the pattern password of the user with the help OpenCV to authenticate and to recognize the pattern is provided for banking and password entry through mobile here Bluetooth is used for this communication. After completing all these steps locker is opened, the information about this process is sent using GSM to the bank manager.

Yongxiang Wu has proposed Research on bank intelligent video image processing and monitoring control system based on OpenCV [2]. Based on human detection, movement monitoring and behavior judgment, this article designs a financial institution clever video picture processing and monitoring manage system that is primarily based on OpenCV and the device now realizes real-time monitoring and alarm within region efficaciously, however it also improves the conventional video surveillance system, offering protection for banks.

Suad Haji and Asaf Varol's proposed paper on Real Time Face Recognition System (RTFRS) [3] in 4th International Symposium on Digital Forensics and Security. In preference to the usage of a bankcard, a camera set up on the ATM will capture the customer

faces and evaluate them with those of the snap shots of the account holder in the database of bank to affirm client identity. Eigen and LBP Algorithms were used in order not effecting accuracy. Jignesh J.Patoliya and Miral have proposed Face Detection based ATM Security System using Embedded Linux Platform [4] in 2nd International Conference for Convergence in Technology (I2CT) 2017. If the face is not detected properly, it warns the user to modify him/her well to come across the face. Nevertheless the face isn't detected well the device will lock the door of the ATM cabin for security. As soon as the door is lock, the device will automatic generates 3 digit OTP code. The OTP code may be sent to the watchman's registered mobile wide variety via SMS using GSM module that is linked with the Raspberry Pi. Watchman will enter the generated OTP which is interfaced with the Pi Board.

3. Proposed Work

Now-a-days in the bank a key is used for unlocking the locker room door. This key can be duplicated and anyone can access the locker room. If they have locker key it can be misuse. This is the main drawback of using key for unlocking. So in our paper we are implementing locker room door security using OpenCV. The images of the customers who have locker account are trained to the camera. Camera is installed/placed outside the locker room. Whenever a person tries to enter locker room, the Haar Cascade Classifier detects human being. By using Local Binary Pattern Histogram (LBPH) Algorithm we are recognizing the customer with the trained images. If the camera recognized the trained image then the door will automatically unlock for the customer to enter the locker room. In order to provide security for the cashier cabins, we are using MFRC522 RFID module along with NodeMCU. The cashier should display/show their tag to the MFRC522 Module. If it is authorized tag then the door is unlocked for the cashier cabin. OLED screen used to display user id, status of the door i.e., unlocked or locked and countdown. By doing like this there is no scope of unauthorized people to enter the cashier cabin. So the money in the cashier cabins will be safe. This system is capable of providing more security for both cashier cabins and for locker room.

4. Block diagram

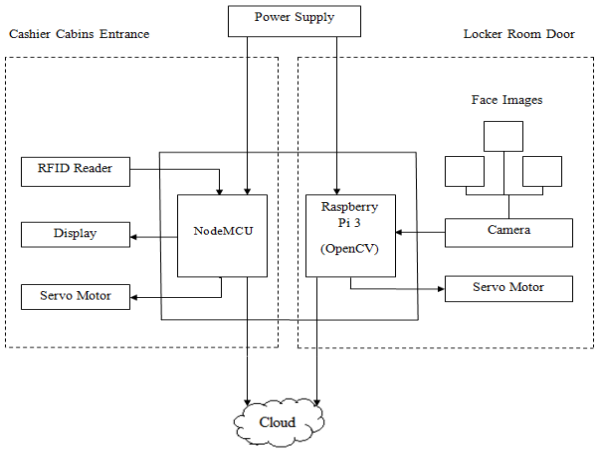

Fig 1: Block diagram of the proposed model

In this Security system, we have 2 main methods which are applied for locker room security by using Raspberry Pi 3 board. Raspbian Jessie and OpenCV are installed to MicroSD Card and inserted to Raspberry Pi board. Face images are trained to data set. Microsoft Lifecam HD-3000 camera is used for monitoring. The purpose of camera is to detect and recognize human faces using OpenCV. A servo motor is used to lock and unlock door. It is controlled by pi board. The information of the customer name who is trying to enter the locker room is updated to the cloud along with the time and date. Second is security for cashier cabins. We are using NodeMCU devkit. RFID, Display, Servo motor are connected to NodeMCU. Arduino IDE is used for NodeMCU programming and language used is Embedded C. RFID Reader is used recognize User id. Display used to show the door is locked or unlocked i.e., the status of door. Servo motor is used to unlock or lock the cashier cabin door. The user id of employee who unlocked the door at what time is updated to the cloud.

5. Component description

5.1 Raspberry Pi

Fig 2: Raspberry Pi 3 Board

In our paper, we are using Raspberry Pi 3 Model B. This uses a Broadcom BCM2837 System on Chip with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor with 512 KB shared L2 cache. Microsoft Lifecam HD 3000 is connected to an USB port of Pi board. The board contains a slot for Micro SD card which stores the operating system and data. We are programming Raspberry Pi using Python.

5.2 Camera

Fig 3: Microsoft Lifecam HD-3000 Webcam

We are using Microsoft Lifecam HD-3000 for the purpose of identifying human faces. This camera has 720p 16:9 Sensor and Built-in microphone. This camera is connected to the Raspberry Pi board and installed outside the locker room door.

5.3 Power supply

The power supply is used to provide correct current and voltage from source. This circuit used to convert the 230V AC supply into 5V DC. The main microcontroller will supply power to the interfacing devices which are connected to it. Raspberry Pi 3 and NodeMCU works at a power supply of 5V which is powered by micro USB supply.

5.4 Servo motor

Fig 4: Tower pro micro servo motor

In our application, in order to unlock the door, we are using SG 90 micro servo motor. This motor is tiny with high output power and servo can approximately rotate 180 degrees. We can use any servo code, library or hardware to control the servo. The motor has three horns and hardware. The three pins are Ground, 5V, Signal. Its operating voltage is 4.8V, operating speed is 0.1s/60 degree. Its stall torque is 1.8 kgf·cm. This motor is connected to Raspberry Pi for providing Locker door security and NodeMCU for providing Cashier cabin security. These connections are shown in Table 1.

Table 1: Connecting Motor with Raspberry Pi and NodeMCU

Motor Horn (Color)	Raspberry Pi	NodeMCU
GND (Brown)	Pin 6	Gnd
5V (Red)	Pin 4	Vin(5V)
Signal (Orange)	Pin 3	D0

5.5 NodeMCU

Fig 5: NodeMCU ESP8266 Wifi Development Board

NodeMCU is an open source IoT platform and a single-board microcontroller. NodeMCU was developed by ESP8266 Open-source Community. It works on XTOS Operating system and it powered by USB. It has 128kBytes Memory, storage of 4Mbytes. RFID is connected to NodeMCU. So it controls Servomotor and display accordingly. We are using Arduino IDE to program it and language used is Embedded C.

5.6 RFID Module

RFID is Radio Frequency Identification. RF waves are electro-magnetic in nature. RF waves propagate at the speed of light and they have the frequency range of about 3KHz to 300KHz. The radio frequency of the electromagnetic spectrum is used to identify an object, animal or person uniquely. In this paper, we are using MFRC522 Module.

Fig 6: RFID system

This RFID Reader MFRC522 should be connected to NodeMCU as shown in Table 2.

Table 2: Connections for MFRC522 to NodeMCU interface.

MFRC522	NodeMCU
3.3 V	3V3
RST	D3
GND	GND
MISO	D6
MOSI	D7
SCK	D5
SDA	D4

5.7 OLED Display

Fig 7: OLED Display

OLED stands for Organic light emitting diode. We are using 0.96" Yellow white 4 Pin 128X64 OLED Display Module. In our model we are using OLED screen to display status of the door i.e., unlocked or locked message, the userid, countdown in seconds till when the door will be opened. . The OLED screen should be connected to NodeMCU as shown in Table 3.

Table 3: Connections for OLED to NodeMCU interface.

OLED Display	NodeMCU
Vcc	3V3
GND	GND
SCL	D1
SDA	D2

6. Data Flow

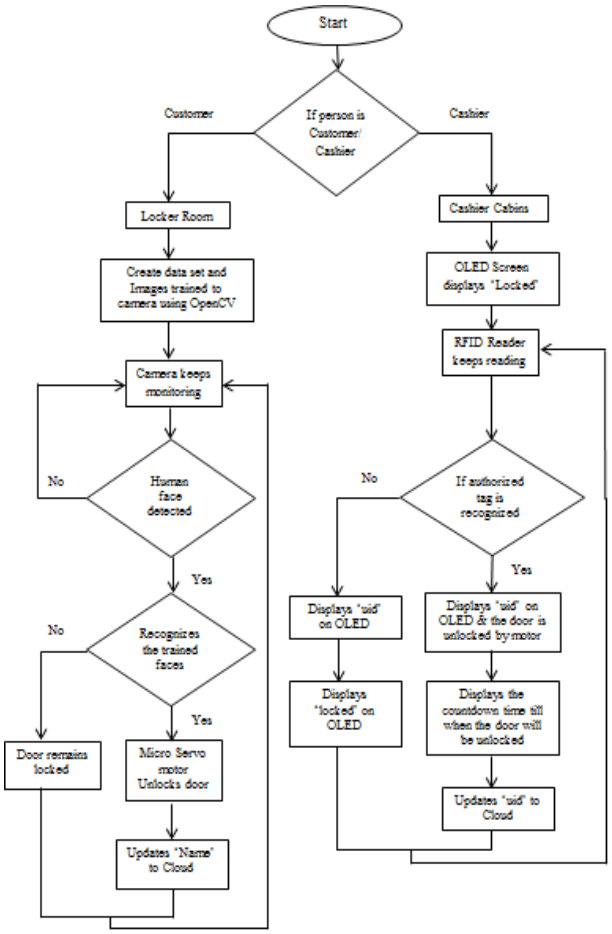

Fig 8: Flow chart explaining the process

For locker door security a Microsoft Lifecam HD-3000 and Micro Servo motor SG90 are connected to Raspberry Pi 3 board. Create a data set with the images of the customers who have locker accounts. These images are trained to camera using OpenCV. Camera is placed outside the locker room. When camera is monitoring, it checks for the human face. It detects human face using Haar Cascade Classifier. If human face not detected then it keeps monitoring. If human face detected then it performs face recognition using Local Binary Pattern Histogram (LBPH). LBPH works like this: it makes the human face into a 3*3 matrix pixels. It takes the center pixel and compares it with the neighboring pixels. If the intensity of the center pixel is greater than or equal to neighbor pixel, then just consider 1 and 0 otherwise. In the end we will get binary number like 11011011 for each pixel. So with 8 neighboring pixels we will get 2^8 possible combinations which are called as Local Binary Patterns or LBP codes.

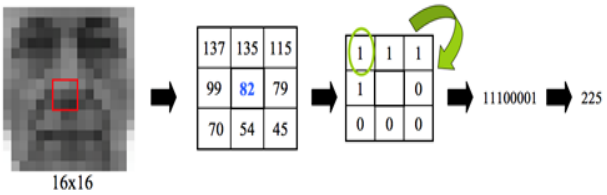

Fig 9: Binary to Decimal Conversion

Using Binary to Decimal Conversion, convert each LBP into a decimal number then make a histogram of all those decimal values. In the training data set we will have one histogram from each face i.e., if we have 50 images in the training data set then LBPH will extract 50 histograms after training. And these are stored for later recognition. Algorithm keeps track of which histogram belongs to which person.

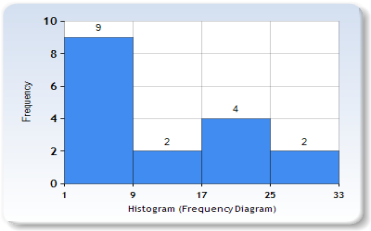

Fig 10: Histogram

If a trained face is recognized then SG90 Micro servo motor unlocks the door and updates the customer name along with the time to the cloud. If not the door remains locked. Irrespective of door being locked or unlocked, the camera keeps monitoring.
To provide security for cashier cabins, we are using RFID System. RFID reader, servo motor, OLED Display are connected to NodeMCU. We are programing NodeMCU using Embedded C language. OLED Screen displays 'Locked' message. RFID Reader and Transponder or Tag are the main components of RFID System. The tag consists of an Antenna, electronic microchip. RFID Reader has three subcomponents RF Module, control unit, antenna coil. RFID reader keeps producing high frequency electromagnetic field. Whenever a tag is placed near reader, the chip in the tag gets powered and it sends message back to reader. It uses a load manipulator technology. The power consumption of reader antenna is affected by switching ON and OFF of the load at the antenna of the tag. These changes in voltage drop will be detected as 1s and 0s. This power consumption is measured as voltage drop. This is how data is transferred from target to reader. Reader keeps reading for tag, whenever authorized tag is recognized then 'user id' is displayed on Screen and door is unlocked by the motor. Then the countdown starts running till when the door is unlocked. The 'user id' is updated to the cloud. If authorized tag is not detected, then also user id is displayed on screen. It displays 'locked' message on OLED screen and cabin door remains locked. This process continues. This is how security is provided for both locker room and cashier cabins.

7. Result Analysis

Door is opened when an authorized tag is recognized by the RFID reader and the status of door is displayed on OLED screen. Then the user id is uploaded to the cloud.

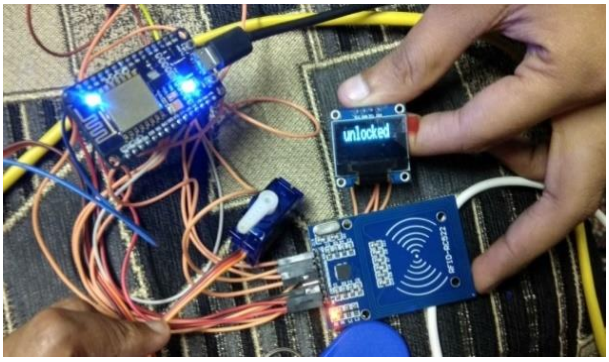

Fig 11: Door unlocked when authorized tag is recognized and unlocked message is displayed on OLED screen.

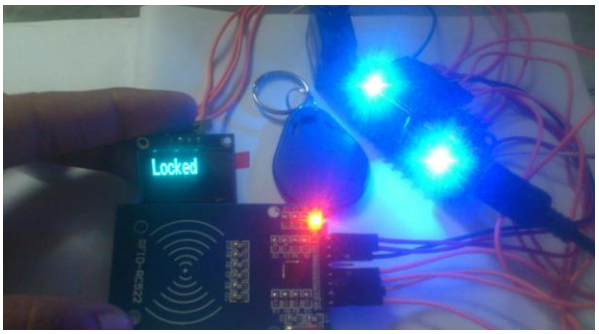

Fig 12: Door locked and locked message is displayed when unauthorized tag is recognized

The data that is uploaded to the cloud is represented in the form of graph. The X-axis represents the Card number and Y-axis represents the Date & Time. The red dots representing the userid.

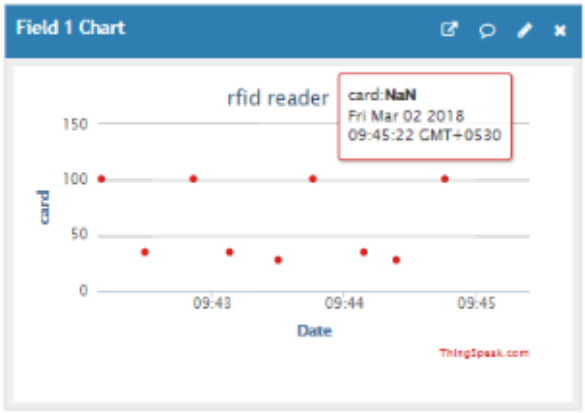

Fig 13: data in cloud

The data is stored in the cloud in the form of Excel sheet also. Column created_at represents the date and time at which the card is accessed, entry_id represents the serial number and field1 represents the userid who is accessing.

	A	B	C
1	created_at	entry_id	field1
2	2018-03-02 04:12:	1	101
3	2018-03-02 04:12:	2	35
4	2018-03-02 04:12:	3	101
5	2018-03-02 04:13:	4	35
6	2018-03-02 04:13:	5	28
7	2018-03-02 04:13:	6	101
8	2018-03-02 04:14:	7	35
9	2018-03-02 04:14:	8	28
10	2018-03-02 04:14:	9	101
11	2018-03-02 04:15:	10	28
12	2018-03-02 04:15:	11	neeraja

Fig 14: Data in Excel sheet of cloud

The Hardware setup for face recognition are Microsoft Lifecam HD 3000 and Raspberry Pi. The Hardware setup is shown in Fig 15.

Fig 15: Hardware setup for face recognition

Fig 16 showing the face recognition where im window showing face in rectangle box which is used for matching, OUTPUT window showing face recognition with label and python shell showing the name of customer.

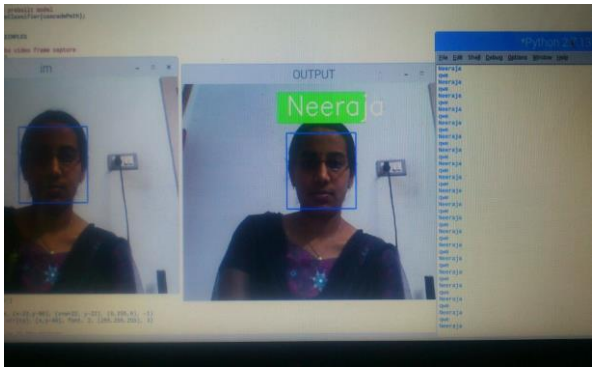

Fig 16 : Face Recognition with label

8. Conclusion

In this paper, we have proposed two techniques which provide better security for customers and employees by using OpenCV and RFID. These techniques can be applied to locker room and cashier cabins, by this both customers and employees are benefited. This can be easily implemented for any banking sector by which the customers can access their locker room through Face recognition which is implemented by using LBPH Algorithm. This work can be further extended for Home security and Military weapons room security as well.

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