

An Automated Anti-Theft and Misuse alerting System for ATMs

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Abstract: *In this paper we intend to implement a real time face detection system in ATMs to avoid robbery and attacks occurring inside the ATM. The whole operation is programmed in a Raspberry pi board which is a combination of SoC with GPU based architecture. The User has to pass through a security camera check placed at the ATM entry. The camera detects the face features and matches the captured image with the trained Haar features using an image processing module. After confirming that the user is not wearing any masks or helmet it opens the Entry door for the user to access the ATM. Vibration sensors are placed, one on the entry door and other on the ATM machine to trigger an alarm just in case a break-in occurs. ATM doors will be closed using a DC Motor and then a message will be sent to the nearby police station and to the corresponding bank through the GSM. The image processing tasks is completed using the SimpleCV and OpenCV libraries developed by Intel, which is compatible with the Raspberry Pi board. The whole operation is programmed in a raspberry pi board which can be used for Independent Functions.*

Keywords: *ATM, Face Detection, Haar Classifier, GSM, Raspberry pi, SimpleCV, Viola-Jones Algorithm.*

I. Introduction

In today's technically advanced world, autonomous systems are gaining rapid popularity. As the social computerization and automation has increased, credit and debit cards have become popular with wider use of ATMs. They simplify financial and banking activity. However the theft and attacks occurring in ATMs has been rising in proportion to the ratio of spread out of automation devices. Those crimes for the financial organization have been increased gradually from year 1999 to 2003, a bit decreased in 2004 which then increased again from the year 2005. The case related to theft and robbery in ATMs have been increased gradually during past 12 years which even includes attacks on customers inside the ATM. The manufacturers are the developing security features for their products by introducing advanced technologies to avoid thefts.

Usually, biometric and non-biometric methods are used to provide such security features. In non-biometric methods, personal ID and password are used to identify the person, where in the possibility of theft remains. Biometric methods involve no such possibilities, because, they employ techniques such as voice recognition, signature recognition, retinal recognition, iris recognition, fingerprint recognition and face recognition. These methods are sophisticated and costlier. Our project is intended to reduce these crimes by implementing simpler yet secure method of accessing ATMs.

II. Haar Classifier Algorithm for Face Detection

The face detection algorithm proposed by Viola and Jones is the basis of our design. Face detection proposed by Viola and Jones's is the most used face detection method based on statistical methods for rapid frontal face detection system using Haar-like features. Viola and Jones devised an algorithm, called Haar Classifiers, to rapidly detect any object, including human faces, using AdaBoost classifier cascades that are based on Haar-like features and not pixels. The face detection algorithm looks for specific Haar features of a human face. When the chosen features match, the algorithm allows the candidate to pass through to the next stage of detection.

The three main parts of this algorithm are:

- Integral Image, which allows very fast feature evaluation.
- Classifier function which is built using small number of important features.
- The method of combining the classifiers in a cascade structure to increase the speed of the detector by focusing on the promising regions of interest.

2.1 Integral Image

The integral image is defined as the summation of the pixel values of the original image. The value at any location (x, y) of the integral image is the sum of the image's pixels above and to the left of location (x, y).

2.2 Haar Features

Haar features are composed of either two or three rectangles. Face candidates are scanned and searched for Haar features of the current stage. The weight and size of each feature and the features themselves are generated by the learning algorithm- AdaBoost. Each Haar feature has a value that is calculated by taking the area of each rectangle, multiplying each by their respective weights, and then summing the results. The area of each rectangle is easily found using the integral image. The coordinate of the any corner of a rectangle can be used to get the sum of all the pixels above and to the left of that location using the integral image. By using each corner of a rectangle, the area can be computed quickly.

2.3 Haar Classifier

A Haar classifier uses the rectangle integral to calculate the value of a Haar feature. The Haar classifier multiplies the weight of each rectangle by its area and the results are added together. Several Haar classifiers compose a stage. A stage accumulator sums all the Haar classifier results in a stage and a stage comparator compares this summation with a stage threshold. The threshold is also a constant obtained from the AdaBoost algorithm. Each stage does not have a set number of Haar features. Depending on the parameters of the training data individual stages can have a varying number of Haar features.

2.4 Cascade

The Viola and Jones face detection algorithm eliminates face candidates quickly using a cascade of stages. The cascade eliminates candidates by making stricter requirements in each stage with later stages being much more difficult for a candidate to pass. Candidates exit the cascade if they pass all stages or fail any stage. A face is detected if a candidate passes all stages. This process is shown in Figure 1

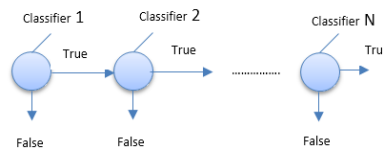


Figure 1: Cascaded of stages. Must pass all the stages to detect Face

III. System Design

The proposed security system have the capability of capturing a live video stream, detect any faces in the frame and recognize the face using a face detection algorithm. Our system comprises of two main sections. First is the decision making section which uses the face detection algorithm to detect the facial features of the user. The Second section is the controlling section which comprises of PIC Microcontroller and other supporting components. The block diagram of our system is illustrated in fig 2.

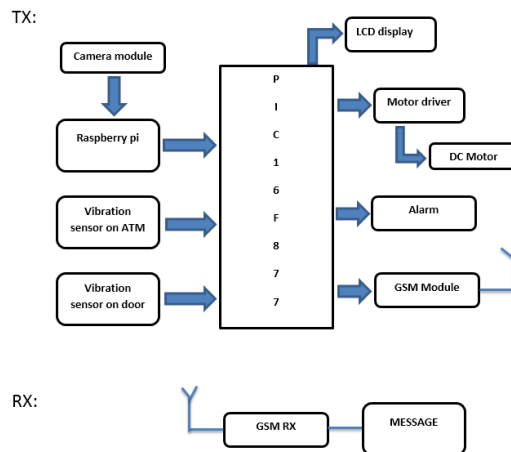


Figure 2. Block diagram of our system

3.1 Hardware description:

The important hardware modules are briefly described.

3.1.1 Camera module

The camera module here used is a webcam to acquire the image of user who is standing near the ATM entry. The Webcam is fixed in a rigid location for capturing the face of the person.

3.1.2 Raspberry Pi (model b)

Raspberry Pi board is a miniature marvel, packing considerable computing power into a footprint no larger than a credit card. The processor at the heart of the Raspberry Pi system is a Broadcom BCM2835 system-on-chip (SoC), which includes a 700 MHz ARM1176JZF-S processor, Video Core IV GPU, and RAM. It has a Level 2 cache of 128 KB, used primarily by the GPU, not the CPU. It has 26 GPIO pins. This board runs the face detection algorithm and provides the results for further operation.

3.1.3 PIC 16F877A

PIC 16F877A is a 40-pin, 8-bit microcontroller based on RISC architecture. Its operating frequency is 20MHz. It has 8Kb flash memory and EEPROM data memory of 256 bytes. Its instruction set contains only 35 instructions and have both parallel and serial communications. Many pins have dual operation and it is easy to interface with external components. Here the pic microcontroller is used for control operation following the face detection result of raspberry pi.

3.1.4 Vibration Sensor

This sensor works on the principle of piezoelectric effect. As the transducer is displaced from the mechanical neutral axis, creates strain within the piezoelectric element and generates voltages. If the assembly is supported by its mounting points and left to vibrate “in free space” the device will behave as a form of vibration sensor. Sensor Value 500 roughly corresponds to 0g acceleration. Acceleration will deflect the sensing element up or down, causing Sensor Value to swing either way. In the system we will be using a vibrating sensor (piezoelectric transducer) to find vibration from ATM machine and the door.

3.1.5 GSM

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization

Group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz's. A GSM modem is a wireless modem that works with a GSM wireless network. Wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. The working of GSM modem is based on commands, the commands <CR> character. For example, the dialing command is ATD<number>; ATD3314629080; here the dialing command ends with semicolon. The AT commands are given to the GSM modem with the help of PC or Controller. The GSM modem is serially interfaced with the controller with the help of MAX 232.

IV. Implementation

4.1 Training of Haar cascade classifier:

For this project around 500 positive images and 1000 negative images were taken as sample datasets in-order to train the Face, Eye and Mouth Classifiers.

In this algorithm, first the image is acquired by the webcam for processing. Then the Haar cascade file face.xml is used to search and detect the faces in each individual frame. If no face is detected then another frame is acquired. If a face is detected, then a region of interest is marked within the face. This region of interest contains the eyes and mouth. Defining a region of interest significantly reduces the computational requirements of the system

4.2 Working:

The process starts right from capturing the image of the person standing near the entry way or door. The camera module is placed in such a way to get the clear picture of the user. The captured image is then analyzed with the help of Haar cascade classifier algorithm which runs in Raspberry pi.

The captured image is analyzed for Haar features. The face detection algorithm detects the Haar features in the captured image and compares it with the trained data set. If the Haar features are matched then a signal is sent to the PIC microcontroller through the GPIO pins of raspberry pi module. The pic microcontroller upon receiving the TRUE signal from raspberry pi, checks whether vibration sensor is ON. If the input from the vibration sensor is true then Door is locked, if not the pic microcontroller drives the dc motor to open the door.

The image of every user entering the ATM is stored in the memory unit of Raspberry pi with date and time of their entry. This images can be used by the police in case of robbery occurs. If the vibration sensor on the door or ATM machine is triggered the door will be automatically closed and SMS alert will be sent to both the officials and the police control room. The alarm placed in the ATM booth will be triggered and alerts the public around the area. The original setup of proposed model is shown in figure 3.

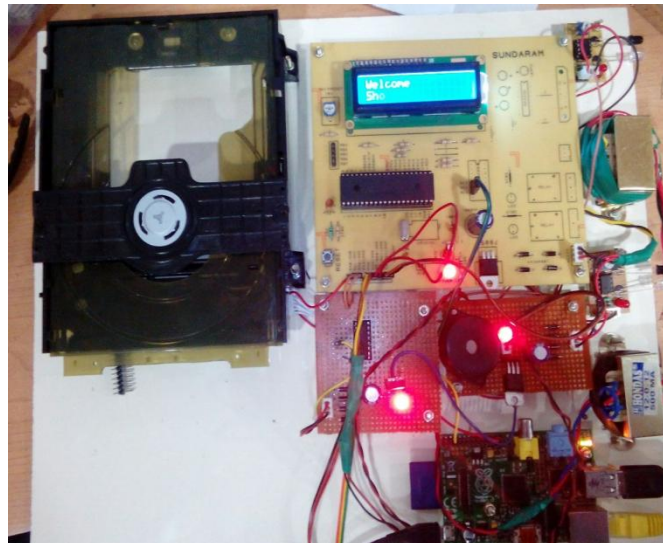


Figure 3. Original setup of proposed model

The process flow diagram shown in figure 4 shows the clear picture of how the entire system works.

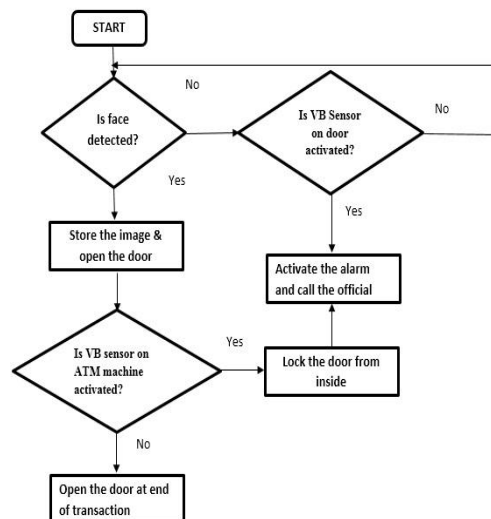


Figure 4. Flowchart of the entire process

V. Result

The result of face detection algorithm is shown in Figure 5. The frames extracted from the video. Sometimes, the algorithm produces more than one result even though there is only one face in the frame. In that case, the post processing has been used. If the detector provides more than one rectangle, which indicates the position of the face, the distance of center points of these rectangles has been calculated. If the distance is smaller than a pre-set threshold, the average of these rectangles will be computed and set as the final position of the detected face.

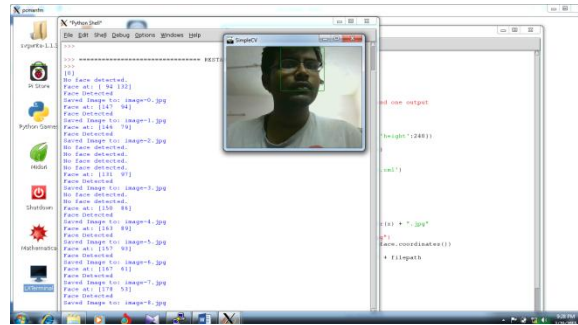


Fig 5. Face detected which shows a green rectangle around the face.

When the face is detected the door opens automatically and displays the message “FACE DETECTED DOOR OPENS” in the LCD display. It is shown in figure 6.

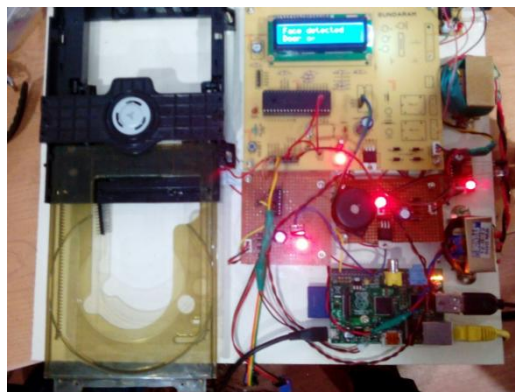


Figure 6. ATM door opens when face detected.



Figure 7. Face not detected.

When face is partially covered or fully covered the face is not detected and the ATM door will not be opened. When there is a person inside the ATM the door will not open and shows the message “full wait”.

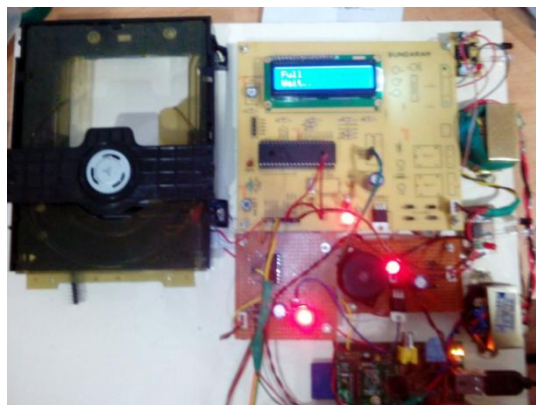


Figure 8. When the ATM is occupied the door will not open.

VI. Conclusion

In this paper we implemented a real time face detection system in ATMs to avoid robbery and attacks occurring inside the ATM. The algorithm presented in this paper forms the basis of many 'Real Time System' which gives highly accurate results in less time. The system has been developed with a special motive that it will prevent not only the robbery but also attacks on person's present inside the ATM.

Thus our system provides an easy and efficient access resulting in reduced theft environment. ATM rooms will be more secured on implementing our proposed methods as our experimental results are promising.

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