International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 04 | Apr -2017 www.irjet.net p-ISSN: 2395-0072

Security Alert Using Face Recognition

Aswathy Wilson [1], Arun J P [2], Jayakrishnan A[3]

[1] *Assistant Professor, Department of Computer Science and Engineering, Jyothi Engineering College, Kerala, India*
[2] *B. tech Final Year Students, Department of Computer Science and Engineering, Jyothi Engineering College, Kerala, India.*
[3] *B. tech Final Year Students, Department of Computer Science and Engineering, Jyothi Engineering College, Kerala, India.*

Abstract - *Security is one of the important requirements of homes and businesses which require biometric identification. This paper aims to identify a person through face recognition. Face recognition is very complex and multidimensional problem. Principal Component Analysis based on MATLAB is used for face matching decision. The system which converts facial images to feature characteristics of initial training database images is designed in MATLAB. Facial features are extracted from the face. Eigenvalues are calculated and represented as an Eigen vector. Using Euclidian distance method, an unknown face image and database image are compared. The recognized facial image has minimum Euclidian distance with the database images. When face is recognized by MATLAB Code it will send SMS to the authorized person using GSM module and an alarm will be running. Security system using MATLAB and Embedded system design is cost effective, reliable and highly accurate.*

Key Words: *Face recognition, PCA algorithm, Facial features, Eigenvectors, Euclidian distance, GSM module, Alarm.*

1. INTRODUCTION

Security is one of the at most requirements of homes and business .In today high technology environment, organizations are becoming more and more dependent on their information systems. Many organizations will identify information as an area of their operation that needs to be highly secured as part of their system of internal control. This paper aims to identify a person through face recognition and provide alert when the security is at risk. [1] Face recognition is one of the applications of image processing. Image processing method is that it will convert an image into digital form and perform some operations on the image, in order to get an enhanced image or to excerpt some useful information from it.[2] It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or attribute associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them.[3]

We can make advantage of image processing and face recognition in our CCTV cameras. Video surveillance and the analysis of the obtained footage is a process which needs a huge memory. Video surveillance using CCTV is now being used everywhere [4]. But the effective video surveillance is not implemented anywhere. The current practice of video surveillance is installing a camera and analyzing the footages which are stored. But with the same cost we can implement something better.[5] That is rather than analyzing the footages after the incident occurred, notify the authority of organization at the time of incident so that higher authority can take necessary action without any delay. The system introduced in this paper includes many features which is cost effective and more secured. In our system a camera is installed in the room which is to be secured. Along with the camera a PIR sensor is used so that there is no need of keeping camera turned on. So when human presence is detected by PIR sensor, camera turns on and start capturing the video.[6] From the frames obtained from the captured video human face is detected and facial features are extracted using Viola Jones algorithm. The image is compared with the image stored in the dataset as the reference image using PCA algorithm. [7] When the face is recognized a message is sent to the higher authority regarding the time and date of access. When face is not recognized an alarm will be played to notify the security guard about the unauthorized entry attempt. Also a message is sent to higher authority regarding the entry time and date.

2. SYSTEM ARCHITECTURE

System architecture defines the overall structure of the system which also defines the components used and the relationship between the components. The system consists of an embedded side and a software side. In embedded side we use a microcontroller (atmega328), PIR sensor, GSM module, Buzzer, Voltage regulator and a transformer. Software used is Matlab 2012.The software side and embedded sides communicate using RF Transmitter and Receiver.

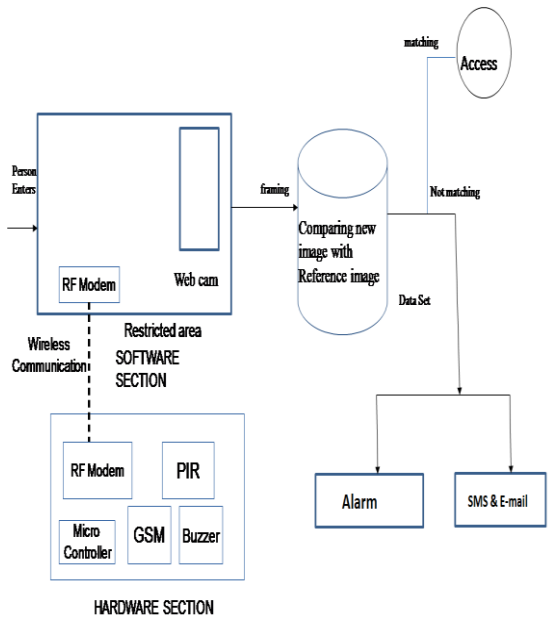

Fig-1. System Architecture Diagram

2.1 Microcontroller(atmega328)

The Atmel 8-bit AVR is a RISC-based microcontroller combines 32 kB ISP flash memory with read-write capabilities, 1 kB EEPROM, 2 kB SRAM, 23 general purpose input output lines, 32 general purpose working registers, 3 flexible timer/counters with compare mode, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit AD converter, programmable watchdog timer with internal oscillator, and 5 software selectable mode of power savings. The device operates between 1.8-5.5 volts. It achieves throughput approaching 1 MIPS per MHz.

2.2 PIR sensor(Passive Infrared sensor)

The PIR sensor itself has 2 slots in it, each one is made by a special material that is sensitive to Infrared rays. The lens used here is not really doing much and so we see that the two slots can see out past some distance, basically the sensitivity range of the sensor. Both slots detect the same amount of IR, the medium amount radiated from the rooms and walls or outdoors, when the sensor is idle .When a warm body's like a humans and animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the body leaves the sensing area, the reverse happens; the sensor will generate a negative differential change. These change pulses are what is detected.

2.3 GSM module

GSM module 300 is used in this work.SIM300 is a widely used GSM modem around the globe, and more popular among students.SIM300 is a triband GSM modem being able to operate only in 900, 1800, 1900MHz band. It operates from 3.4V to 4.5V supply range. It consists of a DB9 port in order to communicate with the computer or with the micro-controller, a power jack, an integrated module, a connector and a micro strip antenna, an interface circuit of Max 232.

2.4 Buzzer

Piezo buzzers are mainly used across many major industries as a means for audible identification or alert. This larger, high decibel model product family is well suited for challenging audio alert purposes.

2.5 Voltage regulator

A voltage regulator is an electromechanical component which used to maintain a steady output of volts in a circuit. It does this by generating a precise output voltage of a preset magnitude that stays constant despite changes to its load conditions or input voltage.

2.6 *Transformer*

Voltage transformers are used in electric circuits in order to control or change the flow of electricity. Some circuits may need a step up transformer, some needs step down transformer.

3. WORKING

Suppose we have a confidential room where we have to restrict the entry of persons . That is we are giving the access of room to a single person. The system starts working when a person enters the room. PIR sensor installed along with the camera detects the human presence and turns on the camera. PIR will output a 1 when human presence is detected and a 0 otherwise. For the output 1 a symbol will be send to the software section (laptop) using a RF data modem . By receiving the symbol software section where we use Matlab programming environment starts acquisition. From the video captured face of the person is detected using viola jones. We will take snapshots using get snapshot function in Matlab. Comparison is done between the captured image and the reference image we created during the training. PCA algorithm is used for the comparison. When the face is recognized then the access time and date is sent to the higher authority. If not, then an SMS is sent using GSM modem. GSM modem SIM300 is used. Alarm is played using a buzzer. This is two levels of security. Apart from this an email attached

with the image of unrecognized face is send to the mail of higher authority.
System consist of 3 modules

A. Detection Module

In this module when a person enters a restricted area, PIR sensor detects the human presence and turns on the camera and starts capturing video. From the snapshots taken human face is detected using Viola Jones Algorithm.

B. Comparison Module

In comparison module, we will have a data set consisting of trained images. The image captured from the camera is taken and compared with the images in the dataset using PCA algorithm. If the two images matches then the alert module works.

C. Alert Module

In the case of matching the time of access and date of access is sent as SMS using a GSM modem. In the case of unrecognized image an alert is given through the buzzer and an SMS is sent using GSM modem regarding the time and date of access.

4. ALGORITHMS USED

4.1 Viola-Jones Algorithm

There are many types of detection and recognition algorithms created today. One of the most notable areas of research is the detection of faces or images and features is the Viola Jones Algorithm. The Viola-Jones Algorithm is divided into four stages. [8]

1) Haar Feature Selection: The first stage is the Haar Feature Selection. Haar features are similar to convolution kernels which are used to detect the presence of that feature in the input image. Each feature results in a single value which is calculated by subtracting the sum

2) Creation of integral image: The creation of integral image is an important stage, an image representation evaluates rectangular features in constant time, which gives them a considerable speed advantage over more sophisticated alternative features. Because each feature's rectangular area is always ´ adjacent to at least one of the other rectangle, it follows that any two rectangle feature can be computed in six array references, any three with eight and any four with nine. The integral image at location X and Y is the sum of the pixels above and to the left of X and Y inclusively. Since it is clear that high number of these rectangular haar features have to be evaluated each time Viola Jones have come up with a neat technique to reduce the computation rather than summing up all the pixel values under the black and white every single time. Thus, introducing the concept of integral image to find the sum of all pixels under a rectangle with just 4 corner values of the integral image[9] .

3) Adaboost Training : The third stage is called the Adaboost training stage .As stated previously there can be approximately 160,000+ feature values within a detector at 24x24 base resolution, which is needed to be calculated. But it is to be understood that only few set of features will be useful. [10]

4) Cascading Classifiers: The last stage is basically the cascading classifiers stage. The basic idea of the Viola-Jones face detection algorithm is to examine the detector many times through the same image each time with a new size [15]. Even if an image contains one or more feature it is obvious that an excessive large amount of the evaluated sub-windows would still be negatives. So the algorithm should concentrate on discarding non-feature object quickly and spend more time on probably feature regions. Hence because of more computation cost a single strong classifier formed out of linear combinations of all best features is not good to evaluate on each window because of more computation cost. Therefore, a cascade classifier is composing of stages each containing a strong classifier is used. So all the features are grouped into some stages where each stage has certain number of features. The job of each stage is used to determine whether a given sub window definitely the feature you might be looking for or not. A given sub window is immediately discarded as not a feature if it fails in any of the stages.

4.2 PCA Algorithm

Step 1: Create a training set and load it.
For example if have M images, each of these images will be of size M*N.

Training the Recognizer

Step 2: Convert face images in training set to face vectors.
PCA won't work on images, so we need to convert it into a vector form. So we need to cover all the face images into face vector form.

Step 3: Normalize the face vectors
There will be common features that all the images will be sharing, so normalization aims in avoiding those common features. After normalization each face vector will be left with its unique feature.

Steps for normalization:

1) Calculate average face vector : φ

All the images in training set share common feature with average face

2) Subtract the average face vector from each face vector to get the normalized face vector

$$\Phi_i = \Gamma_i - \Psi$$

Step 4: Calculate the Eigen vectors

For that firstly we need $_i$ to calculate the covariance matrix C

$$C_1 = A * A^T$$

$$A=[\Phi_1,\Phi_2,\Phi_3,\Phi_4,.....\Phi_M]$$

A will be size of $N^2 * M$

C will be size of $N^2 * N^2$ matrix

The principle behind PCA based face recognition was to train each image in the training set as a linear combination of K selected Eigen faces.

K<=M

Step 5: Reduce the dimensionality of the training set

We need to find K Eigen vectors from N2 Eigen vectors. This requires lot of calculations, because there are lot of Eigen vectors and each are of bigger dimensions.

So we do dimensionality reduction. This is done by calculating Eigen vectors from a covariance with a reduced dimensionality.

We reversed the covariance matrix so that the dimension got reversed. Firstly it was $N^2 * N^2$, now it was m * m. This reduces the covariance matrix dimensions.

$$C_1 = A * A^T$$

i.e, $C_1 = N^2 * M \quad M * N^2$

$$C_2 = A^T * A$$

i.e, $C_2 = M * N2 \quad N^2 * M$

Finding K Eigen vectors would easy from this reduced matrix because the number of Eigen vectors are lesser and size of each Eigen vectors are also small.

Step 6: Calculate the eigenvectors from Covariance matrix

Step 7: Select K best Eigen faces such that K < M and can represent the whole training set.

Selected Eigen faces must be the original dimensionality of the face vector space.

Step 8: Convert lower dimensional K eigenvectors to original face dimensionality.

$$U_i = A * V_i$$

U_i is the Eigen vector in higher dimension space and

V_i is the Eigen vector in lower dimension space.

By using this formula we could select K Eigen faces in lower dimensionality and then map them back to original dimensionality. This would save lot of computation and noise

Step 9: Represent each face image a linear combination of all K eigenvectors

For each face in the training set we represent it as a linear combination of these K Eigen faces plus the average image. We had subtracted the average face so we need to add it back, i.e. adding back the features we removed.

Weights represent the proportions of the Eigen faces

$$\Omega = [\omega_1, \omega_2, \omega_3,.....\omega_k]$$

Weight vectors are the result of PCA algorithm. It has finally represented each image in the training set in the form of K Eigen faces.

Now if an unknown input face is to be recognized then

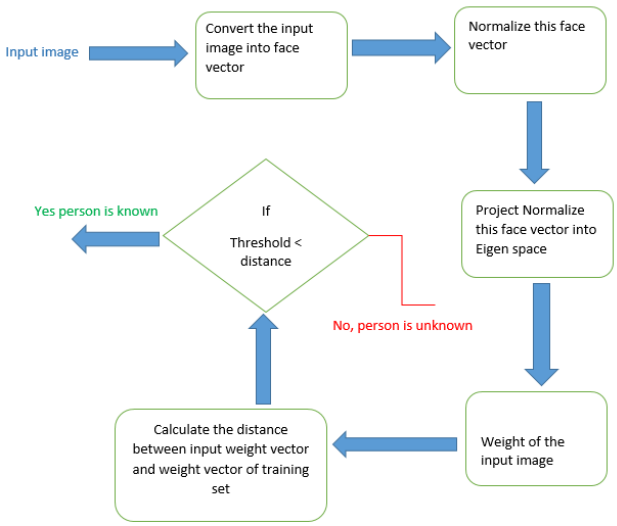

Fig- 2. Recognizing an Unknown Face

5. FEATURES OF THE SYSTEM

- More reliable and scalable
- Provides two levels of security
- Lifetime of camera can be increased.

6. ADVANTAGES OF THE SYSTEM

- Our system works on real time.
- Main overhead of a surveillance system is the need of high storage space to store the footage. We solve this problem by including a PIR sensor so that camera turns on and store the footage only during the incident.
- Alert is given by two means, via SMS and using alarm. So in case if security guard is not there at the time of incident, higher authority can take necessary action using the SMS received.

7. CONCLUSION

We have many security options now. Technology is now a big part of our society and our foreseeable future, hence security is being an inevitable part. A system with 3 levels of security is implemented here. Even though many systems are available with many security options, a system with 3 levels of security at low cost is worth. Face recognition is the technology adopted here. Since face recognition can be done using Viola jones algorithm and PCA algorithm system is efficient. Use of Matlab environment for the software side ensures the simplicity of system. Along with these advantages efficient memory management makes this project relevant and social.

REFERENCES

[1] B. K. P. Mehul K Dabhi, Face detection system based on viola - jones algorithm, International Journal of Science and Research (IJSR),Volume 5 Issue 4, April 2016.

[2] L. D. Hoang Minh Phuong, Extraction of human facial features based on haar feature with adaboost and image recognition techniques, IEEE, 2012.

[3] D. R. T. Alpika Gupta, Face detection using modified viola jones algorithm, International Journal of Recent Research in Mathematics Computer Science and Information Technology Vol. 1, Issue 2, 2014.

[4] C. Jie Zhu, Real time face detection system using adaboost and haar-like features, 2nd International Conference on Information Science and Control Engineering, 2015.

[5] M. G. F. Husni Teja Sukmana, Prototype utilization of pir motion sensor for real time surveillance system and web-enabled lamp automation. IEEE Asia Pacific Conference on Wireless and Mobile, 2015.

[6] P. S. S. Vadiraj. M, VinayRaghavendra. R, Face recognition based attendance monitoring system, IEEE Asia Pacific Conference on Wireless and Mobile, 2015.

[7] K. S. B. Sapana K. Mishra, Human motion detection and video surveillance using matlab, International Journal of Emerging Research in Management and Technology, vol:5,issue:5, 2016.

[8] K. J. E. Ma. Christina D. Fernandez, "Simultaneous face detection and recognition using viola-jones algorithm and artificial neural networks for identity verification," IEEE, 2014.

[9] Chin Hong Low, Ming Kiat Lee, Frame based object detection - an application for traffic monitoring, IEEE, 2010.

[10] M.Gopi Krishna, A. Srinivasulu, Face detection system on adaboost algorithm using haar classifiers, International Journal of Modern Engineering Research (IJMER)2012.

[11] K. R. Kumar and V. Srimadhavan., Security system with face recognition, sms alert and embedded network video monitoring terminal, International Journal of Security, Privacy and Trust Management (IJSPTM) Vol 2, No 5, October, 2013.

[12] S. K. G. Vijayendra R, Identifying objects using rf transmitters and receivers, and retrieving data using gsm, IEEE, 2010.

[13] S.J.D.A.Janeera., Real-time fire detection, alerting and suppression system using live video surveillance, Imperial Journal of Interdisciplinary Research (IJIR) Vol-2, Issue-7,2016.

[14] A.P.M.M.S. Asst. Prof. S B Dhekale, Smart home safety and security system automated with alerts through gsm mobile phone, 3rd international confernce on electrical, electronics engineering trents, communication, optimazation and science, 2016.

[15] B. K.H.Venkateswara Reddy, Automated video surveillance system with sms alert, International Journal Of Engineering And Computer Science ISSN:2319-7242 Volume1 Issue 3 Dec, 2012.