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# Anti Theft Mechanism Through Face recognition Using FPGA

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## ABSTRACT

The use of vehicle is must for everyone. At the same time, protection from theft is also very important. Prevention of vehicle theft can be done remotely by an authorized person. The location of the car can be found by using GPS and GSM controlled by FPGA. In this paper, face recognition is used to identify the persons and comparison is done with the preloaded faces for authorization. The vehicle will start only when the authorized person's face is identified. In the event of theft attempt or unauthorized person's trial to drive the vehicle, an MMS/SMS will be sent to the owner along with the location. Then the authorized person can alert the security personnel for tracking and catching the vehicle. For face recognition, a Principal Component Analysis (PCA) algorithm is developed using MATLAB. The control technique for GPS and GSM is developed using VHDL over SPTRAN 3E FPGA. The MMS sending method is written in VB6.0. The proposed application can be implemented with some modifications in the systems wherever the face recognition or detection is needed like, airports, international borders, banking applications etc.

**Keywords :** PCA; FPGA; GPS; GSM

## 1 INTRODUCTION

Nowadays everywhere in the world automotive accidents and thefts are being increased. The manufacturers are attaining the security features of their products by introducing advanced technologies to avoid the thefts particularly in the case of cars. However, car thefts are increasing in number day by day. Usually, biometric and non-biometric methods are used to provide such security features required. In non-biometric methods, personal ID and password are used to identify the person, wherein 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. Of these, face recognition and detection systems are more sophisticated.

This paper deals with design and development of a real time face recognition system using FPGA as control platform. This system can recognize the person who enters the car and it checks whether he/she is authorized or not. When unauthorized person operates the vehicle, the GPS and GSM modules which are attached to the system will send the location and person's image through MMS/SMS to the owner. The camera which is installed at the ignition unit of the car will capture the photograph of the person and the system compares the same with the photos of the authorized persons in the database in different postures, to check whether it is the image of the authorized person or not. The Principal Component Analysis (PCA) algorithm [1] is used for face recognition with fixed back ground (white in color). The PCA converts a number of possibly correlated variables into number of uncorrelated variables called Principal Components related to the original variables by using statistical methods.

PCA is a dimensionality reduction technique which is used for compression and recognition problems. Figure1 shows the components of the proposed system.

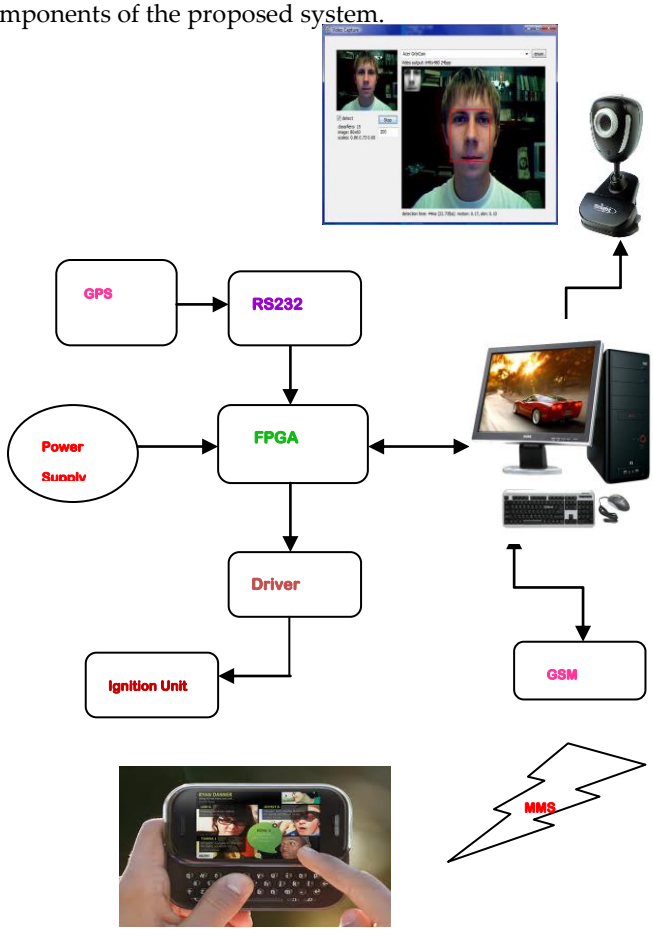

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Figure 1 Components of the Proposed System.

## 2 Literature Survey

### 2.1 Face Recignition and detection

There are many algorithms used in face recognition and detection, and many more are being developed. PCA is the best and mostly used algorithm in face recognition [2]. It is used for compression and to overcome many of the recognition queries like pose variations, illumination etc[3]. The Linear Discriminate Analysis (LDA), Independent Component analysis (ICA) and some other systems are developed by combining different algorithms. PCA is also known as "Eigen faces" algorithm. The main idea is to de-correlate data in order to highlight differences and similarities by finding the principal directions (i.e. the Eigen vectors) of the covariance matrix of a multidimensional data. A part of the great efficiency of the PCA algorithm is to take only the "best" eigenvectors in order to generate the subspace ("*Face Space*") where the gallery images will be projected onto, leading to a reduction of dimensionalities[1][2].

### 2.2 Field Programmable Gate Array (FPGA)

A reconfigurable FPGA is used for multipurpose applications while other platforms like DSP processors and microcontrollers are application specific[4][7]. The main advantages of FPGA are high performance, short time to market, cost effective solution, reliability and long term maintenance. To interface with video processing, communication applications, image processing applications, embedded module facilities are available within FPGA. FPGA will increasingly be the preferred choice for implementing DSP applications[1]. With increasing device density, audacious challenges become feasible and the integration of embedded architectures is significantly improved. In video processing, the impressive evolution of algorithms and new techniques dramatically increase the complexity of algorithms[4]. This computational aspect is crucial for many real-time applications for which the programmable devices like SPATRAN 3E FPGA become the best option. The Xilinx software is most useful when compared with Altera, Lattice, Actel products etc.[8] For our implementation Xilinx 10.1 VHDL language is used.

### 2.3 GPS Module

The Global Positioning System (GPS) is used to find the location of the vehicle[7]. Two main categories of GPS car tracking solutions are *passive systems* and *real time systems*. Passive systems store the gathered data in their internal memory and this can be accessed when the unit connected to the base. Real-time system sends the data at regular intervals to the database and the user can read it through the system. Other systems can deliver data directly to the user cell phone on demand.

### 2.4 GSM Module

Global System for Mobile communication (GSM) is an architecture used for mobile communication. GSM module in our system establishes communication between the vehicle and the user [7].

The multimedia messaging service is used to send all messages. Visual Basic 6.0 is used to code the module for transfer of pictures through GSM network. MMS messages can be sent via a GSM modem.

## 3 Design Flow

### 3.1 Process of PCA

PCA algorithm involves face recognition and it compares the input image/face with images/faces in the database with fixed background such as white in color. The images/faces in the database are called authorized images/faces and the input image/face is called as unknown/unauthorized image/face. Ten images are stored in our database for testing purpose. The Eigen vectors are calculated from the images and the threshold values are determined. By using Euclidian distance between threshold values of authorized and unauthorized faces corresponding images are compared and persons will be identified accordingly. The PCA algorithm is shown in Figure 2.

### 3.2 Benefits of PCA

- The reduction in the dimension of the data.
- No data redundancy, as components are orthogonal.
- Complexity of grouping the images can be reduced.
- Used for criminal investigation.
- Entrance control in buildings, access control for computers, for Automated Teller Machines, at the post office, passport verification, and identifying the faces in a given databa

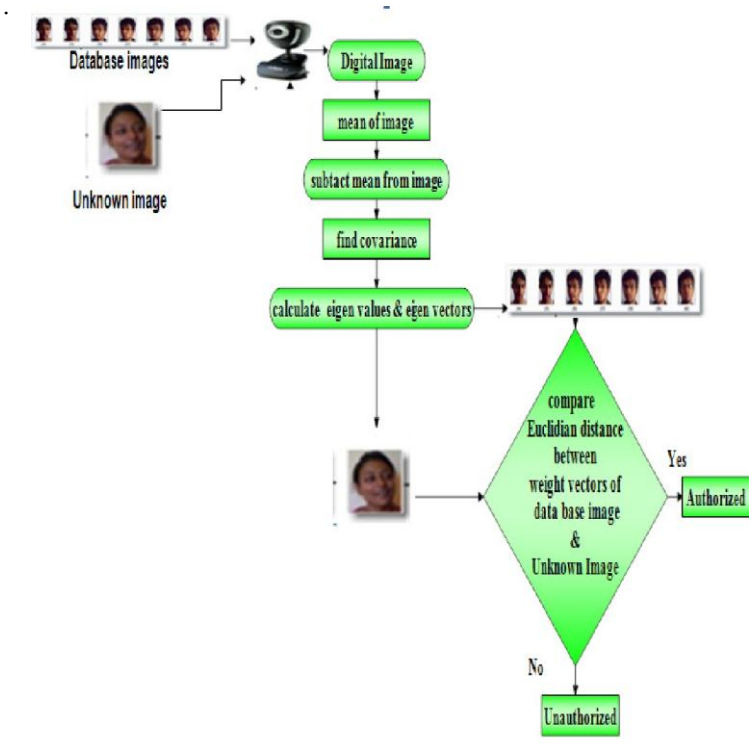

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Figure 2 The PCA algorithm used

### 3.3 PCA Features

- PCA computes mean, variance, covariance, and correlations for large data set.
- PCA computes and ranks the principal components and their variances.
- Automatically transforms data sets.PCA can analyze datasets up to 50,000 rows and 200 columns.

### 3.4 Steps of PCA

1 Get database set of images and then find mean of the images
2 Find the difference between mean image and each of database images.
3 Find covariance matrix of the matrix obtained from step 2 for this covariance matrix.
4 Find Eigen values and Eigen vectors, and then find Eigen faces with larger Eigen values.
5 Find out weight vector using this Eigen faces
6 For new/unknown image also the process will be echoed from step 1to3 and then find out weight vector for test image.
7 Now find Euclidian distance between weight vectors of unknown image and database images.
8 If this distance is less than threshold then test image is considered to be in database and hence authorized, otherwise unauthorized.

The experimental results during the above process are shown Figure3. It is implemented by MATLAB 7.5. The Fig 3.1 & 3.2 shows GUI window in the beginning of the process and the database image files. Fig. 3.3 & 3.7 shows the authorized and unauthorized persons. The Fig 3.4 & 3.8 depicts the process of comparison in PCA process. The Fig 3.5 shows the comparison with database images. Finally the Fig 3.6 & 3.9 shows the recognition of authorized and unauthorized persons respectively.

### 3.5 GPS and GSM Modules

There is no much difference between mobile phones and GSM/GPRS modems in terms of SMS transmission rate, since the determining factor for the SMS transmission rate is the wireless network.[7] A GSM modem can be an external modem device or it is integrated in the system of FPGA. To simplify configuration, the Now SMS/MMS Gateway will communicate with the device via this driver. An additional benefit of utilizing this driver is that you can use Windows diagnostics to ensure that the modem is communicating properly with the computer. The SMS/MMS gateway can simultaneously support multiple modems, provided that the computer hardware has the available communications port resources. To define which modems are to be utilized by the gateway, select the **"SMSC"** tab from the gateway configuration dialog: If no modems are yet to be defined, only the **"Add"** button will be available on this dialog. Select **"Add"**, and then "**GSM Phone or Modem** "to display a list of available modem drivers on your computer. Select an available modem and press the **"Test and Add Modem"** button. The gateway will then attempt to initialize the modem, and confirm that the modem supports the necessary interfaces to send and receive SMS messages. The modem will only be added to the configuration if the gateway confirms that it can properly communicate with the modem.

The GPS data allows the receiver to calculate its position. Each GPS satellite transmits radio signals that enable the GPS receivers to calculate where its (or your vehicles) location on the Earth is, and convert the calculations into geodetic latitude, longitude and velocity [7]. A receiver needs signals from at least three GPS satellites to pinpoint your vehicle's position. GPS receivers commonly used in most vehicle tracking systems can only receive data from GPS satellites. They cannot communicate back with GPS or any other satellite. A system based on GPS can only calculate its location but cannot send it to central control room.

## 4 Experimental Results

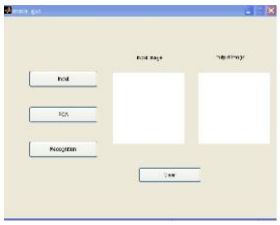


Fig. 3.1

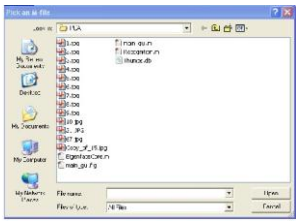


Fig. 3.2

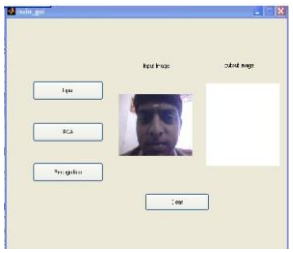
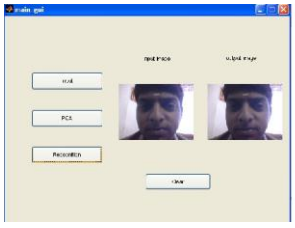


Fig. 3.3

Fig. 3.4



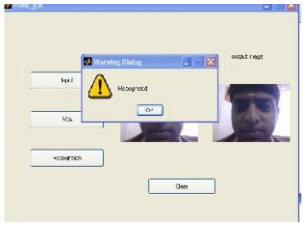


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Fig.3.5 Fig. 3.6

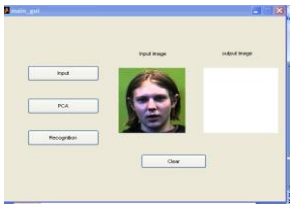

Fig. 3.7 Fig.3.8

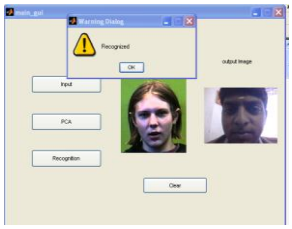

Fig. 3.9

Figure 3 Experimental results

## 5 CONCLUSIONS

In this paper a remote control system based on Global System for Mobile (GSM), Global Positioning system(GPS) and FPGA is introduced. The system is suitable for a real time monitoring in car security, controlling and avoiding theft with face recognition and detection. The system has been designed and implemented in hardware using VHDL and Xilinx SPATRAN 3E FPGA. GSM/GPS has been used for the sending MMS and knowing location of the car. By using suitable camera (3D camera) all face recognition troubles like poor light and background conditions, pose variations etc., will be covered. With the adoption of standards and community awareness, this technology will become more and more acceptable**.**

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