Real Time Implementation of Security System Using Face Detection and Recognition

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Abstract—**In this paper, we present the real-time implementation of security system using face detection and recognition using FPGA Spartan 3AN evolution kit. The FPGA provides flexibility in both software as well as hardware in programmability and run-time re-configurability performance. It performs the real time user authentication i.e. face detection and recognition using the skin depth based Principle Component Analysis (PCA) algorithm. According to the comparison result the FPGA Spartan-3AN Evaluationkit triggers certain actions. The result is authentic means FPGA kit produces the signal to access the system else it produce the interrupt signal to stop the accessing the respective system and inform the respective owner about the unauthorized access via Multimedia Message Services (MMS) i.e. sending picture of unauthorized person with the help of GSM modem. If the respective picture is known to the owner then the owner sends a password for giving access to the person via SMS.**

Keywords—**FPGA Kit, PCA Algorithm, Face Recognition, Multi Media Service (MMS), GSM Modem.**

I. INTRODUCTION

In modern world, many new techniques such as biometric recognition technique, image processing technique, communication technique and so on, have been integrated into security systems. Traditional security systems rely on many sensors and cost a lot. Generally for implementation purpose consider the vehicle security system. When a vehicle is really lost, no more feedback is there to help people to find it back. The existing vehicle security system consists of alarm activation when the vehicle is being unauthorized. These alarms are often not noticed by the owner so it becomes tough to track vehicle thief. The main aim of this project is to offer an advance security system in auto motives, in which consists of a face detection subsystem, a GSM (Multi Media Service) modem and a controlled FPGA platform [1]. The face detectionand recognition technology [4, 5] has been widelydiscussed in relation to computer vision and patternrecognition. Numerous different techniques have beendeveloped owing to the growing number of real worldapplications. Biometrics consists of methods for uniquelyrecognizing humans based upon one or more intrinsicphysical or behavioral traits. The face detection subsystem (FDS) used here uses the optimized PCA algorithm based on skin depth.

It can detect faces in vehicle. The other modules FPGA evolution kit and GSM module are interface with computer. When the authorized person enters then the system is accessed to the person, if unauthorized person enters then the FPGA evolution kit activates the buzzer and the picture of unauthorized person image is send as MMS by GSM module to the owner. After seeing the MMS the authorized person may know the person then he sends a password to GSM modem. If the sender password is matched with the default one then the FPGA evaluation kit gives the access to the system i.e. vehicle.

The traditional system has following drawbacks are there

- Manual operation
- Easy stealing of the vehicle
- Communication difficulties
- High cost

In this proposed vehicle security system, FDS (**face detection subsystem**) isused to detect the face of the driver and compare it with the predefined face. For example, in the night when the car's owner is sleeping and some unauthorized person tries to access the car then the FDS obtains images by one tiny web camera which can be hidden easily in somewhere in the car. FDS compares the obtained image with the predefined images[3]. If the image doesn't match, then the information is send to the owner through MMS by GSM modem[4]. So now owner can obtain the image of the unauthorizedperson in his mobile. From this the owner identifies the unauthorized person.

Among the proposed method the GSM modules send the MMS, receiving the SMS and reading the SMS is done by AT (Attention) commands. The GSM module used here is manufactured by **wavecom**companyand its serial number is M1306B.

The FPGA Spartan 3ANevolution kit has the ability to re-program in the field to fix bugsmany numbers of times.Applications of FPGAs include digital signal processing, aerospace,defence systems and a growing range of other areas etc. The VHDL is the Hardware Description Language (HDL) used for programming the FPGA module. The FPGA 3AN kit

was programmed to implement in very advanced andcomplex application. In this project we try to implement the FPGA for the control platform for fully automated system. Here the VHDL program has only two states are proposed one for starting the vehicle i.e. accessing of vehicle and another stateis to activate buzzer to indicate unauthorized person's access.

The few advantages of proposed method is stated below

- Easy monitoring of the vehicle. .
- Photo of unauthorized person is sent to the owner.
- Low cost of implementation and less complexity.
- Improve security andsmarter than traditional ones.

The rest of this paper is organized as follows. Section IIdescribes the overview of the proposed method. The proposed Face detection algorithm, face recognition based on PCA, the GSM modem algorithm, the VHDL algorithm of FPGA evolution kit and experimental results are presented in Sections III, IV, V, and VIand VII respectively. Finally, the future scope and conclusion are drawn in Section VIII index.

II. OVERVIEW

The complete project is explained by taking the car as a vehicle. The face detection and recognition concept is applied to real-time car for unauthorized person's face detection and granting or stop the access of system (Biometrics) [2].The face detection architecture is designed using skin color information.

A webcam is placed within the car, in which the video frames will be recoded and then from the recorded video frames image is captured. Then from the captured image the face of the person will be detected using face detection algorithm and recognized by using face recognition algorithm PCA .If the person is not the authorized person, the car motor will not start and it will immediately intimate the authorized person regarding the unauthorized person details by sending the MMS to his/her mobile through GSM modem [4] and activates the buzzer by FPGA kit. If the person is authorized the car motor will run and it shows the authorized access and the complete block diagram is shown below [1].
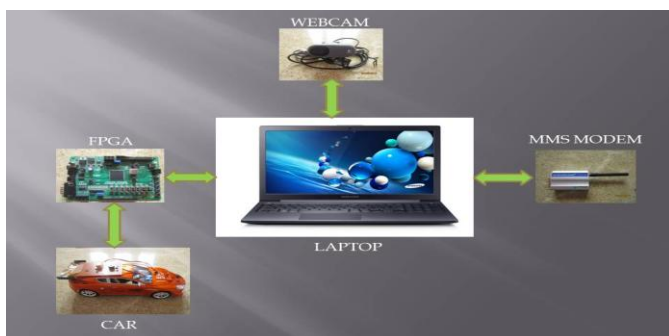

Fig.1 A complete block diagram of real time implementation of vehicle locking system.

III. FACE DETECTION BASED ON SKIN INFORMATION

Color is the powerful fundamental cue of human faces. The skin color distributes in every color space. The identification of facial features in image is so complicated that's why we choose skin color is as a basic identifier because we can easily identifies the skin in image by the threshold values. By directly identifying the facial components is more complex than identifying skin color in the image, that's why we use skin color phenomenon to identifying the face. Once the face is identified then we can easily extract the facial features from the image.

A DIFFERENT COLOUR SPACES

Color information is the most effective feature and it is widely used in image processing. There are many color spaces , including the commonly used are RGB, LUV, LAB,XYZ, YUV, YIQ, HSV, HIS and GLHS and so on. Generally, the RGB color space is not suitable for constructing accurate skin color models due tithe high correlation between the three components. Here for detecting the face we use LAB color spacing.

B PROPOSED ALGORITHM

The complete proposed algorithm is stated below stages [1].

1) Taking the input as RGB image from the database.

2) Convert RGB color space to LAB color space.

   Corm = make form('srgb2lab');
   J = applycform(I,cform);

3) Apply the graythresh function to A and B plains to get the threshold level of the plains.

4) Based on the threshold values of the plains A and B the plains images A and B convert to binary images.

5) By multiplying two binary images values the respective bounding area (BB2) of the face is obtained.

6)By the following condition the face bounding region positionis identified

p=BB2(1,k)*BB2(1,k+1);
   If p>mx & (BB2(1,k)/BB2(1,k+1))<1.8
   mx=p;
    j=k;
   end

     Here
          P   =Connected objects in image
   mx   =Initial value=0

BB2   =Bounding box region

And the threshold value is 1.8 becauseto find the bounding box that has the largest aspect ratio less than 1.8.

7) Based on j value the face is recognized in the input image

8) The obtained face is scaled to predefined scale for comparison of images.

IV. FACE RECOGNITION BASED ONPCA

From the concept of PCA algorithm, the specific face can berecognized by comparing the principal components of thecurrent face to the database images present in advance. The detailed procedure of PCAalgorithm is described below [1] [3].

•First, the build a database of authorized person's image.

•Second, each image is decomposed into coplanar, horizontal,vertical and diagonal matrix by discrete wavelet tansform using haarfunction.

•Third, calculate the energy values of these matrixes.

•Finally, Calculate the Euclidean distance betweenquery image to the training database imagesin database, the test image will be classified byusing the nearestEuclidean distance.

V. GSM MODEM

A GSM module is a wireless modem that works with aGSM wireless network. Mainly used for the Multi Media Service (MMS) in this project. A wirelessmodem behaves like a dial-up modem. A GSMmodem can be an external device or a PC Card(specially used for laptop systems). Typically, anexternal GSM modem is connected through a serialcable or a USB cable. Like a GSM mobile phone, aGSM modem requires a SIM card from a wireless carrier in order to operate.

It sends the MMS by ActiveXperts software SMS and MMStoolkit software. By using the VB code the ActiveXperts software sends MMS. The GSM module receives SMS and read by AT(Attention) commands. Some commands are shown below

AT+CIMR= Reading the message

AT+CIMS = Sending the message

and

AT+CIMI = Getting IMEI number

Etc.

VI. FPGA SPARTAN 3AN KIT

A Field-programmable Gate Array (FPGA) is an integrated circuit designed to be configured by the customer or designer after manufacturing—hence it is called "field-programmable". The FPGA configuration is generally specified using a hardware description language (HDL). FPGAs can be used to implement any logical function that an ASIC could perform. The ability to update the functionality, partial re-configuration of the portion of the design offer advantages for many applications in FPGA's.

Here the FPGA kit is programed by VHDL language and the VHDL code write on the bases of authorized and unauthorized i.e. two states. If person is authorized it represents state 1 and if person is unauthorized represents state 2. The state 1 represents the starting of car motor and state 2 represents the buzzer activation. The respective data sends in asynchronous mode having start bit 0 and stop bit 1 having data between start and stop bits travels from computer to FPGA kit and it has bound rate of 5200 i.e. every 5200 the data bit can change. Based on the bound rate the data is received in FPGA kit.

VII. EXPERIMENTAL RESULTS

In the section III the proposed face detection algorithm'soutputted images are shown below
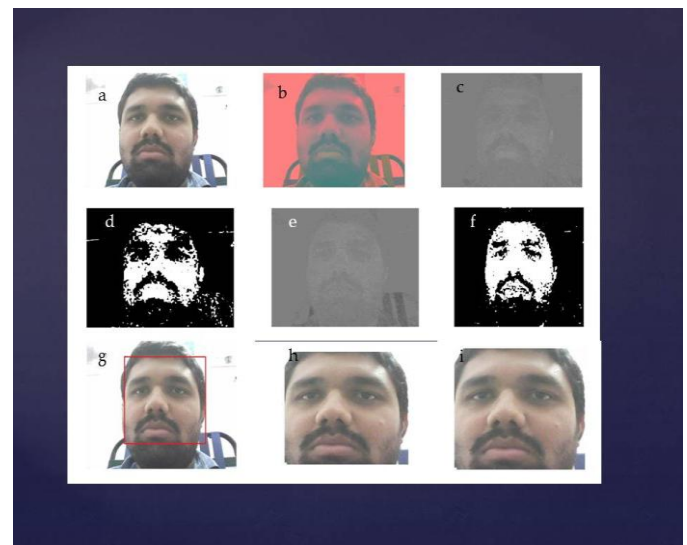

Fig.2 a)input image b)LAB colour space image c)A plane image d)A plane binary image based on threshold value e)B plane image f)B plane binary image based on threshold value g)identification of face h) crop of face part from image i)cropped image is resized to predefined dimension

In this project, the real time face recognition is performed using the PCA method with the helpof web camera.
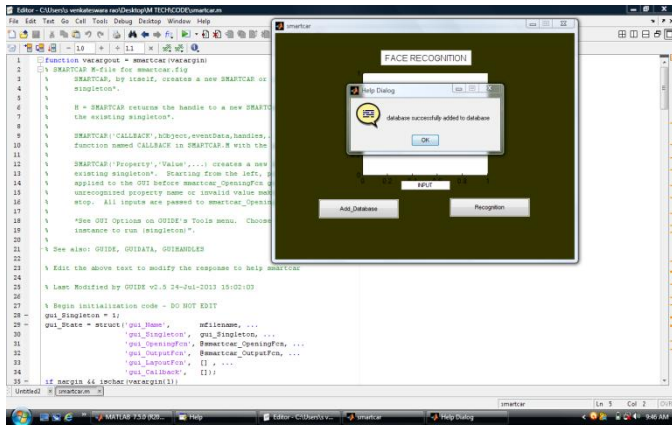The results of the PCA algorithm are shown in below figures.
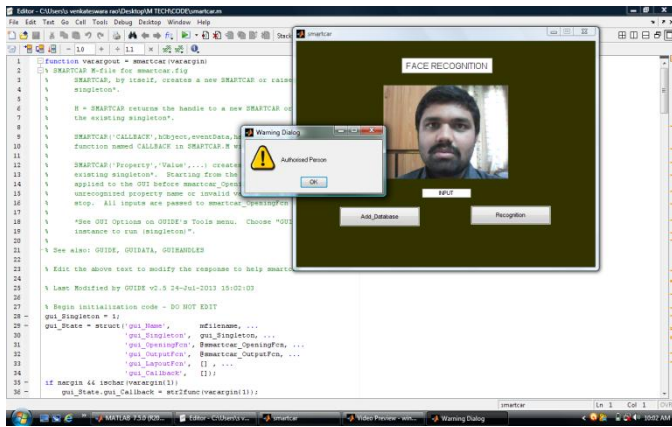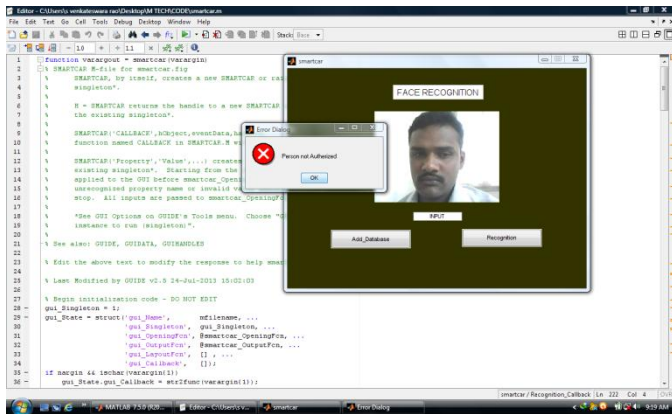
Fig.3 Adding the database images.

below

Fig.6 GSM sending form

Fig.4 Identification of authorized person

Fig.7 MMS output form in mobile and reply with password if person is known to owner

The Fig.6 shows the VB form of modem, status and responses of GSM modem and Fig.7 showsMMS of unauthorized person receiving to the owner and if the owner knows the person, he sends a password to the system for giving permission to the respective person i.e. '113636'.

Fig.5 Identification of unauthorized person

The figure 3 indicates the adding of images into the database for the comparing with query image, figure 4 indicates the query is image matched with the images in data base i.e. authorized person and the figure 5 indicates the query image is not matched with the database images hence it indicates the unauthorized person.
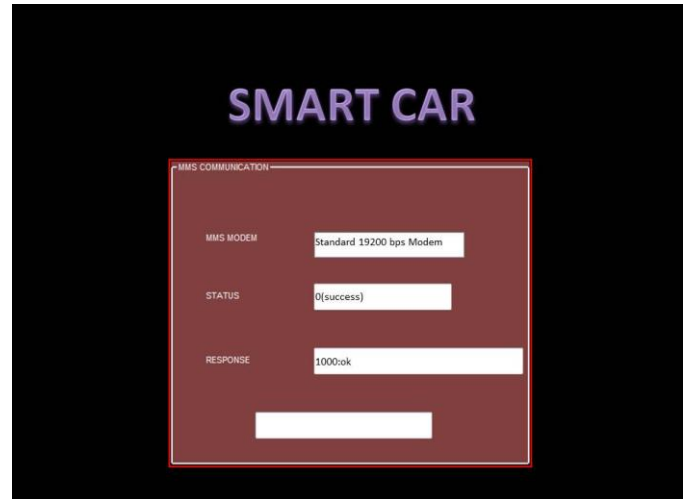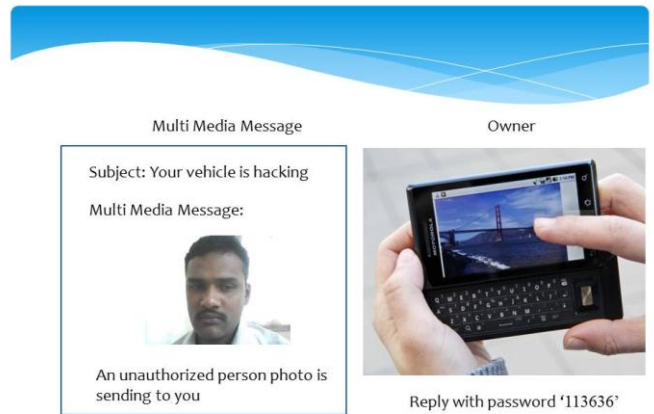The GSM modem output virtual basic form is shown

VII FUTURE SCOPE

Here we implemented real time vehicle security system using face detection and recognition. The accuracy of face detection algorithm is increased by using the Precision Face Detection and Recognition based on Fusion ofDiscernment Techniques [6] due to the fusion of more than two techniques in face detection and recognition and the exact location of vehicle is finding out by connecting the GPS module to the

system for location finding purpose.

IX. CONCLUSION

In this paper, we implemented the vehicle security system based on FPGA controlled platform, in order to provide a highsecurity and comparing with traditional vehicle security system, it doesn't need any sensor so that cost muchless. It is used to keep the eye on the car at all the time, if the vehicle is stolen then with the thief image we capture the thief and also control the vehicle.

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