Exhaustive Security System Based on Face Recognition Incorporated with Number Plate Identification using Optical Character Recognition

MUHAMMAD YASIR ZAHEEN*, ZIA MOHI-U-DIN**, ALI AKBAR SIDDIQUE***, AND MUHAMMAD TAHIR QADRI*

ABSTRACT

In recent times due to rise in terrorism, people need to live in a safer place where unidentified persons will not be allowed to enter in the premises. Securing of major areas is a vital issue that needs to be addressed for the intelligence and security agencies. At the surrounding of premises, CCTV (Close-Circuit Television) cameras are usually installed to identify the number plate from database by using OCR (Optical Character Recognition) algorithm. This method of security by identifying only vehicle without verifying the person inside it is usually causing serious security issues. Identification of a person is usually done through image processing by using Viola Jones algorithm and acquire the information of the facial components to create a dataset for machine learning. It is imperative to introduce such a system that will be capable to identify the person along with the number plate of vehicle from the stored database. In this research, a comprehensive security system based on face recognition integrated with the vehicle number plate is proposed. The combined information of both dedicated cameras is then transferred to the based station for identification. This system is capable, of securing premises from crime in a more enhanced way.

Key Word: Security System, Optical Character Recognition, Voila Jones Algorithm, Number Plate Recognition, Arduino Uno.

1. INTRODUCTION

With the increase in terrorism security agencies and high officials are using security systems for securing the territory of the restricted area. In addition to high officials, normal peoples need secure place to live a happy life. Usually special agency guards are hired for the securing of entering and exit gate of the boundary houses. Most of the people use CCTV camera for contineous live monitoring of the boundary and the entering doors to detect the intruders [1]. This footage is sometimes stored in data base for the identification of crime that has held previously. Some people use number plate detection using image processing and the barrier will allow only those cars to enter that are already registered in data base.

Authors E-Mail: (m_yasir89@hotmail.com, ziaofkun@gmail.com, ali124k@hotmail.com and mqadri@ssuet.edu.pk)
* Department of Electronics Engineering, Sir Syed University of Engineering & Technology, Karachi, Pakistan.
** Department of Biomedical Engineering, Sir Syed University of Engineering & Technology, Karachi, Pakistan.
*** Department of Telecommunication Engineering, Sir Syed University of Engineering & Technology, Karachi, Pakistan

During incoming of vehicle in the boundary, the identification of car along with its driver is an important concern as the driver may not be the relevant person who is allowed in the territory. The robber may deceive the security system and enter into the boundary by using the authentic car. Face Recognition through image processing is important Biometric system for identification of a person [2-3]. It is a suitable method of identifying a person with its unique gestures and facial expression through Viola Jones algorithm as it can recognize an accurate and high speed person [4-10]. In this way with the help of image processing a driver can easily be identified as every person has a unique gestures and facial expression by which he/she can be recognized.

Biometric technique of face recognition is extensively used because of its non-invasive nature. When the person is unaware being biometrically perceived an ideal face recognition system detects and identifies the features of human face. This method can help to find vicious person as they try to alter facial identity features of the face. Due to pose, expression, makeup variation in 2D (Two-Dimensional) face recognition suffers from poor identification in spite of broad research. The recognition of face using 3D facial surface and shape has increased the discriminating features due to increased dimensionality [11].

Automated security system is of great interest for researchers. Kevin et. al. [12] has proposed an automated security system that operated the entering doors. He designed and implemented an automated system that operated security gate using vehicle license plate recognition by Image processing that extracted character from license plate. A NN (Neural Network) is also used to perform better OCR [13]. Poorvi et. al. [13] presents a robust security system using license plate recognition. The system consists of four systematic steps that are preprocessing of captured image, extract the region of number plate, its segmentation for identification of character and last character recognition. Memon et. al.

14] proposed an algorithm to identify the characters of Sindhi language using OCR.

It is imperative to introduce such a system that will be capable to identify the person along with the number plate of vehicle. For ideal automated security system person recognition is very important along with the vehicle identification. In recent times, face recognition is very commonly used biometric technique with several applications. Like, in attendance marking, public record authentication, safety and other security systems. Finger print, palm-print and signature is also used for biometric identification but they require user's complete attention and additional time as compared to face identification which requires less user attention (Patil et. al. [11]). So a system that can incorporate number plate identification along with identification of driver will be ideal for the security systems.

This research proposes an exhaustive security system based on face recognition incorporated with number plate identification using optical character recognition. The system has two different dedicated cameras for the better security of the restricted area. The first camera will capture an image of the number plate and the other will capture an image of the driver for further processing. Voila Jones algorithm is used to identify the face and then extract the facial components for centroid calculation thus creating a data set for machine learning and the number plate is recognized through OCR. The combined information is transferred to the base station where it will be compared with the database and identify whether the person driving the vehicle really owns it. If an unknown person tries to enter the restricted area by using an authentic car, the system will instantly block that person at the entrance gate and an alert is generated to inform the concerned authority so they may take any preemptive measures to neutralize the threat if need arises.

2. SYSTEM SOFTWARE MODEL

Fig. 1 represent the software flow control of the proposed system. After system initialization, both cameras located

at the main gate will capture their respective images for both face and number plate. As soon as the car triggers the Infra-Red sensor both cameras will capture the images. Camera-1 will capture an image of the person driving the car and apply VJ Algorithm to detect the drivers face in an image, and Camera-2 will capture an image of the number plate. Facial organs are detected from the image acquired by Camera-1 using computer vision toolbox, then the distances between the organs are calculated like the distance between the left and right eye, distance between left eye and nose, distance between left eye and mouth, distance between right eye and nose, distance between right eye and mouth and the distance between nose and mouth. Camera-2 captures an image of the number plate and identifies its number using OCR algorithm.
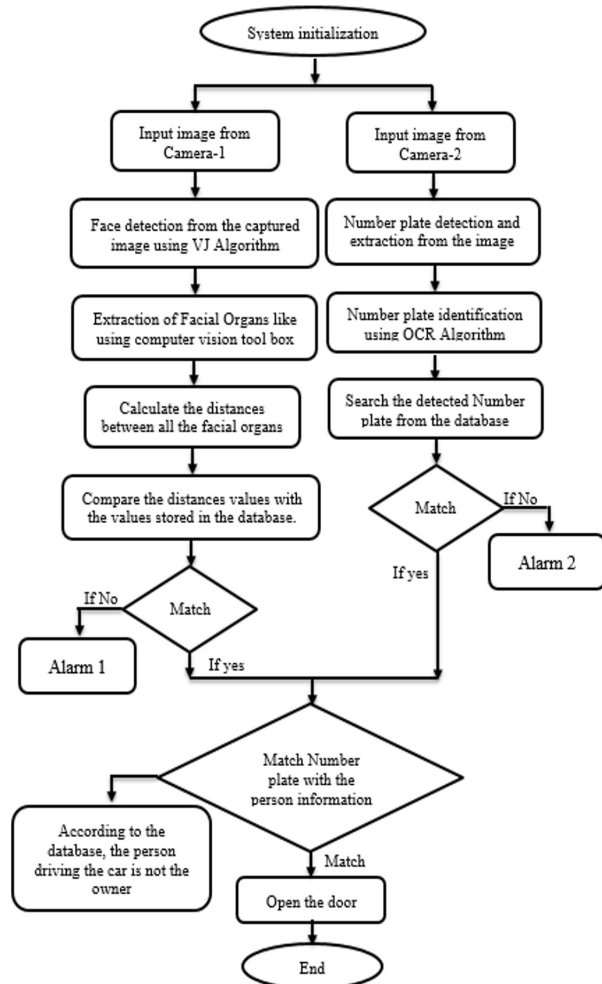

FIG. 1. SOFTWARE FLOW CONTROL

All this acquired information about the distances are basically the testing data for the trained classifier to identify the person behind the wheel and after identification of the person the number plate recognition is performed using OCR. The software will search the database to match the information about the distances and the number plate acquired. If there is a match, then it will further process the information and identify that whether the person actually owns the car according to the database and if not it will generate a message that the person in the car is not an owner. Image processing of both the images captured by camera-1 and camera-2 is performed using MATLAB. Software developed will match the number plate with the distances information acquired and check it weather the person in the car is an owner, and if there is no match then a message will be displayed on an LCD (Liquid Crystal Display) 'That the person driving the car is not an Owner'. OCR detects the number plate in 1.38 seconds and the output of the tested data is acquired in 1.34 seconds, the process of cross match took 0.61 seconds. The total time it took for the conformation of a person and a car is about 3.33 seconds which is quite acceptable in real time applications such as this one. This time can be easily reduced by utilizing different platforms. The purpose of utilizing VJ algorithm and haar cascade is to extract the features to train the data and also for such application like feature extraction VJ algorithm and Haar cascade are used.

3. SYSTEM HARDWARE MODEL

Fig. 2 represent the hardware block model of the proposed system incorporated with both cameras. ARDUINO Uno is utilized for controlling the barrier interfaced with the servo mechanism. IR (Infra-Red) Sensors are placed in the proximity where car needs to stop for image capture, they serve as a guide line for the driver to park the car within the given IR guided parameter.

As soon as the car stops and parks in the designated area, a message on an LCD will appear saying 'look to your right for image capture' and both Cameras-1 and 2

will capture their respective images of face and the number plate. If the person in the image matches with the car a signal will be generated though RF Transceiver to inform the ARDUINO that there is a match and open the barrier.

4. RESULTS

In Table 1, a sample of database is displayed of the centroid distances calculated between the facial components. It represents the set of information for an individual person to train the classifier and for each person 50 images were captured in both high and low visibility lighting for better identification. The tested information significantly reduced in low visibility condition, it only achieved 45% accuracy in these conditions. This information is used to train the classifier and implement the concept of supervised learning with the given features and labels, here the labels are the names of the people and the features are the distances between the facial component centroids. For the designed algorithm, it is imperative for a person to properly tilt his or her face towards the camera in order to capture an image of the whole face. The system is designed for the restricted areas

FIG. 2. HARDWARE BLOCK MODEL

and for security reasons it is imperative for an incoming person to co-operate with the authorities regardless of his condition and properly tilt his face towards the camera. Names of the people are also included for person identification when the values of the distances match with the values from an input image. Here LE stands for left eye, RE stands for right eye. Table 2 represents the database for number plate storage along with the name of a person who owns the car.

Fig. 3 represents the images captured for training the software to identify the centroids after detecting the facial features and determine the distances between each of them. All the information that it gathers regarding the distances are stored in the database. Slight modification is done in the software to tackle the correlated information with precision and match the distances values with 0.15 index precision, which means if the values of an acquired image data is correlated with the one in the database, in this case assume that the data of Mr. Ali Akbar Siddique is correlated. According to the database LE-RE distance is 27.87mm and LE-Nose is 31.39mm etc. and the acquired image distances are calculated to be 27.71mm for LE-RE and 31.3mm for LE-Nose. In such case the acquired values within 0.15 bound in either greater or less quantity, so the software will recognize the person from the acquired image as Mr. Ali Akbar Siddique.

Fig. 3 represent the images acquired to create the database. It is basically a sample database, and for one individual person a lot of images were captured to identify the person in the image with the one in the database and all the centroid distances values were found to be within the 0.15 bound. That is the reason to adjust the bound value and incorporate it in the software for flexibility.

Fig. 4 is an image captured by Camera-1 for the identification of the person in the driver seat. The centroid distances were calculated and found to be 25.13mm for LE-RE, 33.98 for LE-Nose, 40.1mm for LE-Mouth, 34.2mm RE-Nose, 39.89mm for RE-Mouth and 18.93mm for Nose-Mouth. All acquired values closely resemble the values
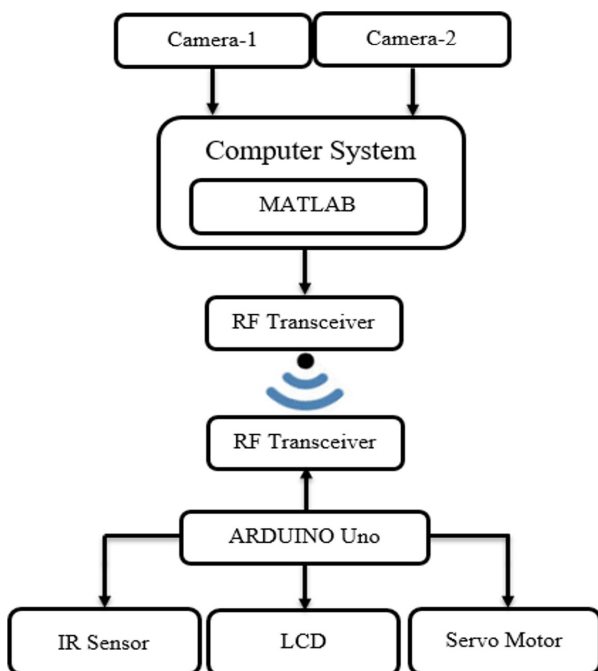
in the database for Mr. Shafiq and they all are within 0.15 bound with the database values. In this case software we recognize a person in an acquired image as Mr. Shafiq and the look for the number plate number of a car that he owns. When it identifies the number plate number from an image acquired from Camera-2, it will match that number plate with the one that belongs to Mr. Shafiq. If it matches, then the barrier will open and let the car in otherwise an alert will be generated that the person in the car is not the owner.

TABLE 1: CENTROID DISTANCES STORED IN THE DATABASE

Person	Centroid Distances					
	LE-RE (mm)	LE-Nose (mm)	LE-Mouth (mm)	RE-Nose (mm)	RE-Mouth (mm)	Nose-Mouth (mm)
Ali Akbar	23.87	31.39	37.09	31.66	37.01	18.35
M. Shafiq	25.22	34.05	40.23	34.11	39.98	19.01
Fahad Farooq	22.08	30.53	38.35	30.87	38.01	16.71
M.Yasir	27.12	38.43	44.71	38.31	44.74	21.62
Zain	26.33	36.21	42.29	35.98	42.58	20.43
Noman	23.99	30.02	35.89	30.09	35.75	18.69
Habib	24.10	30.41	36.79	29.79	36.69	18.58
Tahir	23.65	29.73	35.81	29.78	35.79	18.47
Safwan	24.42	31.01	38.00	30.91	38.04	18.68
Umair	26.75	36.51	43.44	36.48	43.31	20.75
Tanveer	22.14	29.80	36.19	29.81	36.24	16.74
Sharjeel	25.33	34.01	39.96	34.30	39.90	19.33
Yousuf	26.27	37.11	43.88	37.32	43.81	20.47
Nabeel	26.31	34.43	33.94	34.29	33.99	20.73
Rizwan	27.02	36.32	43.01	36.21	43.28	21.01
Abid	23.50	32.59	38.96	32.54	38.59	17.99
Irfan	27.66	37.13	44.92	37.19	44.97	21.56
Asif	24.02	33.41	39.18	33.49	39.48	18.31
Ismail	28.71	36.86	42.81	36.80	43.00	22.8
Rehan	23.33	30.83	36.80	30.77	36.54	17.79
Sarrang	28.84	37.11	44.10	37.33	44.20	22.6
Faizan	25.04	33.62	39.62	33.69	39.91	19.03
Salman	25.69	33.82	40.10	33.88	40.00	19.79
Saqib	28.01	38.54	44.94	38.41	44.81	22.02
Murtaza	26.38	35.00	42.05	34.89	42.00	20.19

TABLE 2 SAMPLE DATABASE FOR NUMBER PLATE STORAGE ALONG WITH THE OWNER NAME

Person	Number Plate
Ali Akbar Siddique	ABC123
Muhammad Shafiq	ALP503
Fahad Farooq	KCC122

(a) ALI AKBAR

(b) CROPPED IMAGE OF ALI AKBAR FOR TANNING

(c) EXTRACTION OF FACIAL COMPONENTS FOR ALI AKBAR

(d) M. SHAFIQ

(e) CROPPED IMAGE OF M. SHAFIQ FOR TANNING

(f) EXTRACTION OF FACIAL COMPONENTS FOR M. SHAFIQ

(g) FAHAD FAROOQ

(h) CROPPED IMAGE OF FAHAD FAROOQ FOR TANNING
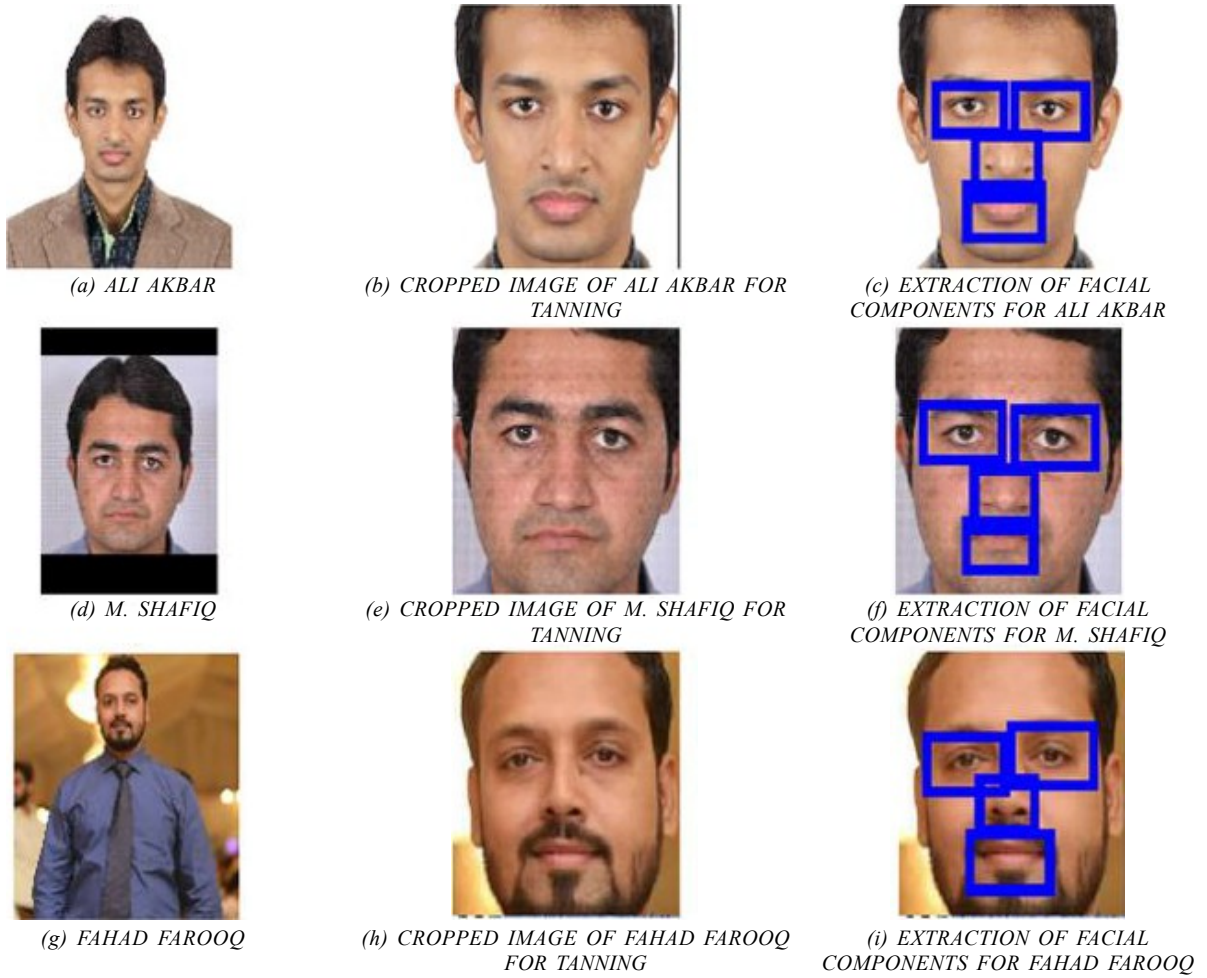
(i) EXTRACTION OF FACIAL COMPONENTS FOR FAHAD FAROOQ

FIG. 3.

FIG. 4. (a) INPUT IMAGE FOR FACIAL RECOGNITION OF M. SHAFIQ
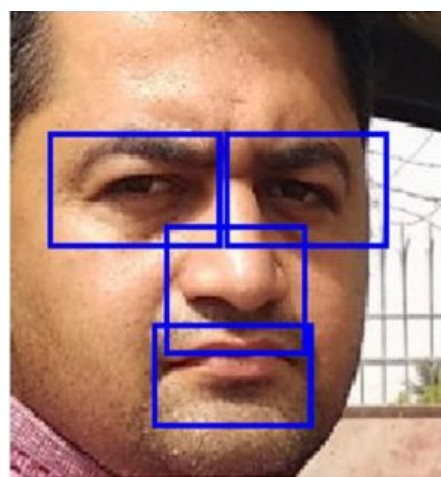
FIG. 4. (b) FACIAL COMPONENT DETECTION OF M. SHAFIQ

Fig. 5 is another image acquired for the identification and the centroid distances calculated for it are 28.27mm for LE-RE, 36.7mm for LE-Nose, 43.21mm for LE-Mouth, 36.45 for RE-Nose, 44.02 for RE-Mouth and 20.05 for Nose-Mouth. The acquired values of centroid distances are not present in the database, so in this case an alarm will be generated and the person will not be allowed to enter the premises.

Fig. 6(a) is an input image captured by Camera-2 for number plate detection. When the image is captured, software will identify the region of interest like yellow color in this case. Whole yellow region containing the number plate serial is cropped as shown in Fig. 6(b) and filtered by implementing morphological operation. This image acquired after filtration is converted into binary format as displayed in Fig. 7(a). The detected output is displayed in Fig. 7(b) on notepad.

FIG.6. (a) NUMBER PLATE IMAGE CAPTURED FROM CAMERA-2

FIG. 5. (a) INPUT IMAGE FOR FACIAL RECOGNITION OF M. YASIR

FIG.6. (b) EXTRACTED NUMBER PLATE IMAGE FROM

FIG.7. (a) FILTERED IMAGE FOR OCR APPLICATION
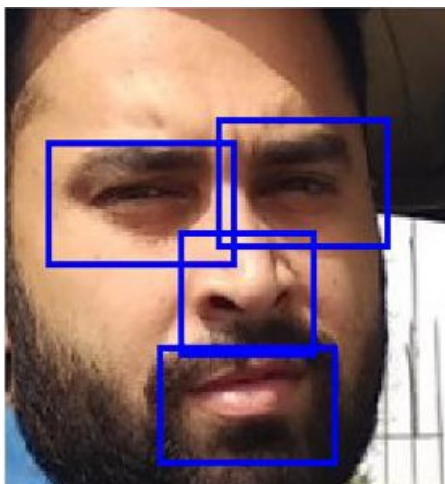
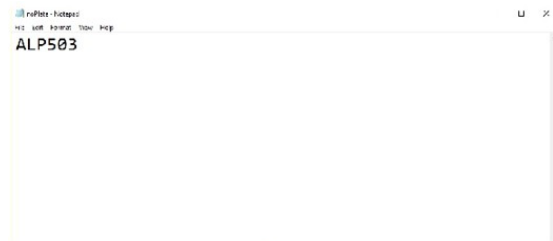*FIG. 5.(b) FACIAL COMPONENT DETECTION OF M. YASIR*

FIG.7. (b) NUMBER PLATE IDENTIFIED USING OCR

5. CONCLUSION

Security is a complex issue in these days and for that reason technology plays an important role to prevent any security based issues. The proposed system utilizes minimum hardware thus reducing the overall cost and also provide about 83% accuracy in identifying the person in the car. OCR algorithm detected the number plate and matched with the information gained from the centroid distances of the facial organs. Proposed system successfully identified the person in the car from the provided database and matches the car number plate with the person. This system is tested in all environments given the proper visibility condition because its accuracy reduces to 40% when there is no proper light to capture an image of a person.

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