ANPR and Face based Recognition System

Rudresh M.D.
Associate Professor
Department of ECE,
Kalpataru Institute Technology,
Tiptur-572202, Karnataka,
India

Meghashree S.
Rajani S S
Students of Bachelor of Engineering,
Department of ECE,
Kalpataru Institute Technology,

Pavithra S.
Veena D
Students of Bachelor of Engineering,
Department of ECE,
Kalpataru Institute Technology,

ABSTRACT
This paper research work proposes automatic number plate and face recognition system. this research work first focusing for implementing a automatic number plate system based on optical character recognition and then face recognition system based on Principle Component Analysis(PCA) to standardize the faces illumination reducing in such way the variations for further features extraction; after developing both the system . In order to increase the security level this work proposes a automatic number plate and face recognition and verification system. The system is implemented on the entrance for security control of a highly restricted area like military zones or area around top government offices e.g. Parliament, Supreme Court and also in residential apartments, toll collections booths etc to avoid the security check at entrance of the gates. The developed system first captures the vehicle image and vehicles authorize persons such as owner or registered person's faces. Vehicle number plate region is extracted using the image segmentation in an image. Optical character recognition technique is used for the character recognition the resulting data is then used to compare with the records on a database. Once the number plate of authorize vehicle is identified and then faces of the persons verified by using face recognition system if face is also identified then vehicle can be allowed for restricted area otherwise not allowed. This work can be implemented and simulated in Matlab, and it performance is tested on real image and also tested on data base images. It is observed from the experimental results t that the developed system successfully detects and recognize the vehicle number plate images and faces of the authorize persons only.

Keywords
ANPR (Automatic Number Plate Recognition), Principle Component Analysis (PCA), Face recognition, Vehicle number plate, Image segmentation, Matlab.

1. INTRODUCTION
The Automatic Number Plate Recognition (ANPR) is a system designed to help in recognition of number plates of vehicles. This system is designed for the purpose of the security and it is a security system. This system also helps in the functions like detection of the number plates of the vehicles, processing them and using processed data for further processes like storing, allowing vehicle to pass or to reject vehicle. This system also helps to conduct the graphic images of the vehicles which can be further stored in the database in text format reducing size of data to be stored. Massive integration of information technologies into all aspects of modern life caused demand for processing vehicles as conceptual resources in information systems. This can be achieved by a human agent, or by special intelligent equipment which is be able to recognize vehicles by their number plates in a real environment and reflect it into conceptual resources. Because of this, various recognition techniques have been developed and number plate recognition systems are today used in various traffic and security applications, such as parking, access and border control, or tracking of stolen cars. Combining disparate information sources into a common recognition system has a Number Of advantages. Fused systems, in principle, perform better than single streams Systems Multichannel or multimodality systems can be more capable handling exceptions and may be tuned to operate in an "either/or" capacity to increase its usability.In the literature, many license plate detection algorithms have been proposed. Although license plate detection has been studied for many years, it is still a challenging task to detect license plates from different angles, partial occlusion, or multiple instances. License plate detection investigates an input image to identify some local patches containing license plates. Since a plate can exist anywhere in an image with various sizes, it is infeasible to check every pixel to locate it. Generally, it is preferable to extract some features from images and focus only on those pixels characterized by the license plate [1].The another paper reviewed that, it explains about different types of face detection approaches, like Knowledge based methods are developed on the rules derived from the researchers knowledge of human faces. Problem in this approach is the difficulty in translating human knowledge into well-developed rules. Featured-based methods: Invariant features of faces are used for detecting texture, skin color. But features from such algorithm can be severely corrupted due to illumination, noise and occlusion. Template matching: Input image is compared with predefined face template. But the performance here sufferers due to variations in scale, pose and shape. Appearance-based method: In template matching methods, the templates are predefined by experts. Whereas, the templates in appearance based methods are learned from examples in images. Statistical analysis and machine learning techniques can be used to find the relevant characteristics of face and non-face images [2].

2. SYSTEM DESIGN
System design aims to identify the modules that should be in the system, the specifications of these modules and to interact with each other to produce the desired results. The purpose of the design is to plan the solution of a problem specified by the requirements document. This phase is the first step in moving from problem to the solution domain. In other words, starting with what is needed design takes us to work how to satisfy the needs. The design of the system is perhaps the most critical Factor affecting the quality of the software and has a major impact on the later phases.

2.1 ANPR and Face Biometric Based System

Figure 2 shows the overall Block diagram of ANPR and Face Biometric Based system. ANPR and Face Biometric Based system consists of face and number plate capturing and input stage, feature Extraction stage. Matching and Decision making Stage and controlling stages. Shown in Figure 1;

2.1.1. Face and Number plate input stage

Face is the most common and popular biometric trait that has been used over the years to make a person recognition. Facial recognition has its own flaws. The most prominent of such flaw is that the face can easily be disguised or even obstructed by hair, glasses, hats, face plastic surgery, etc. This reduces the reliability of face biometric security to a great extent. Face biometric is also sensitive to changes in lighting, expression, and poses. Finally, the face keeps on changing over time and this can be another problem. in this work we uses ORL database face images and captured face images are used for testing the performance of face recognized system similarly for testing the performance of number plate algorithms widely used database images are used in this project .

2.2.2. Feature Extraction techniques

Features are the attributes or values extracted to get the unique characteristics from the image. When the input image data to an algorithm is too large to process, i.e., redundant, then the input data will be transformed into reduced representation set of features is called as feature extraction. Feature extraction involves simplifying the amount of resources required to describe a large set of data accurately. Analysis with a large number of variables generally requires a large amount of memory and computation power or a classification algorithm

2.2.3. Template Database

System database module is used by the biometric system to store the biometric templates of the enrolled users. The enrollment module is responsible for enrolling individuals into the biometric system database. During the enrollment phase, the biometric characteristic of an individual is captured which may or may not be supervised by a human depending on the application. A quality check is generally performed to ensure that the acquired sample can be reliably processed by successive stages. In order to facilitate matching, the input digital representation is further processed by a feature extractor to generate a compact but expressive representation, called a template.Face template databases contain the templates (or feature vectors) of face and that collected, feature extracted and stored during enrolment phase. These templates are used to compare with the feature vector obtained during authentication phase to determine whether the claimed person is genuine or imposter. Similarly for Number plate database is created by storing the ASCII value of number and character of number plate in OCR recognition algorithm.

2.2.4. Matching and Decision Stage

Matching is a process of comparing input biometric sample against the templates stored in the database. A comparison is done between input face template and face templates stored in the database using Euclidean distance approach. Similarly, a comparison is done for number plate recognition by comparing detected and identified number plate ASCII value with stored ASCII values of the database. And decision is taken depending upon the obtained results of matching stage and the send a command signal to microcontroller to perform the desired operation. The feature extraction stage and matching and decision stages can be implemented by MATLAB software

2.2.5. Controlling Stage

The controlling stage consists of microcontroller Block, stepper motor which is used for controlling gate open or close and hardware circuits Buzzer or LEDs for indicating Authorize vehicle/persons. Microcontroller which is used in system decision is ARDUINO ATMEGA328 which is used for receiving command from matching and decision making stage controls the hardware circuits of stepper motor and LEDs or buzzer.

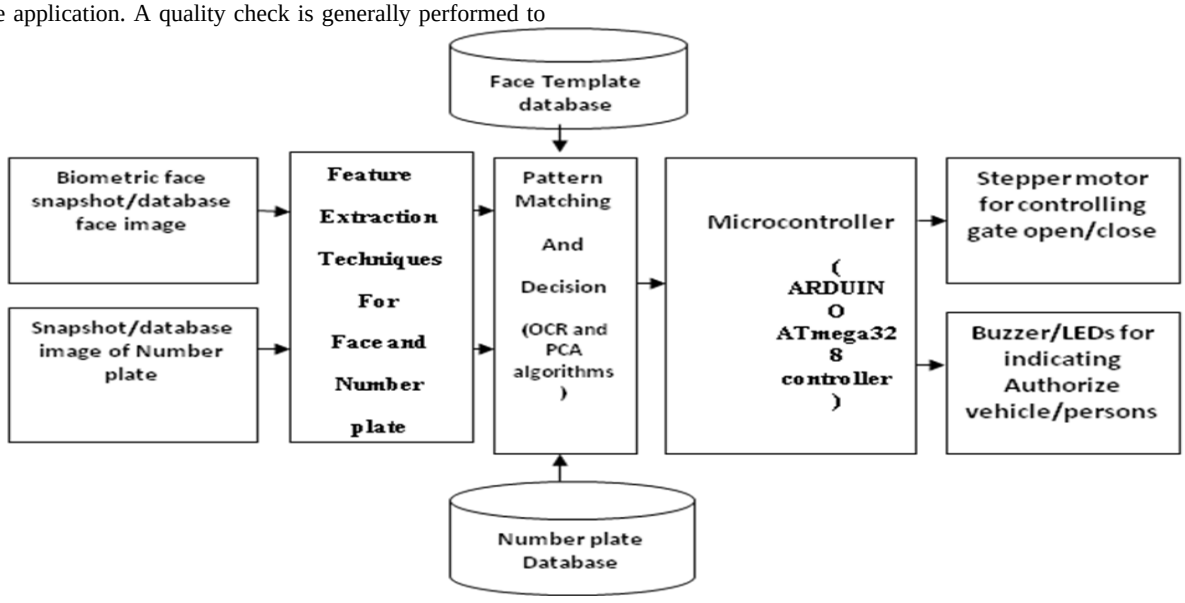

Fig 1: ANPR and Face Biometric Based system

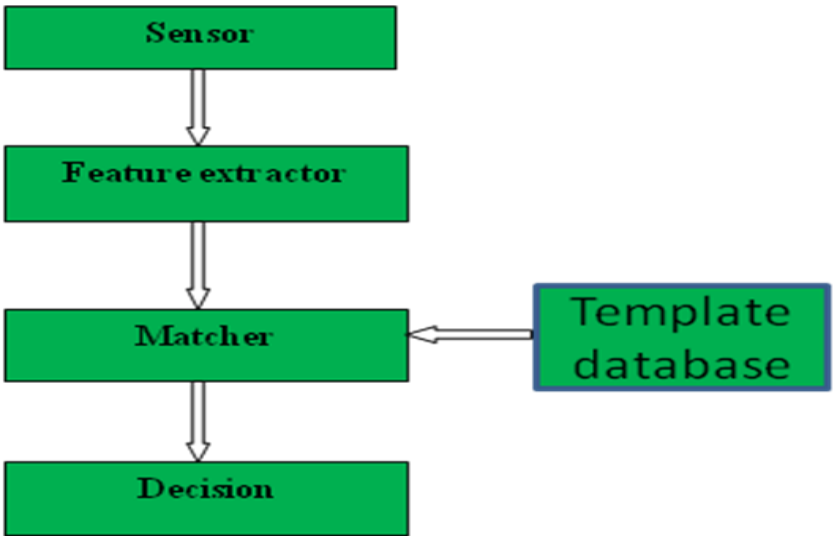

Fig 2 Working flow Diagram

3. METHODOLOGY

In order to increase security level at the entrances of the gates and also avoid the entering the unknown persons with known vehicles or in some cases imposters will come with known name plate with known vehicles because anybody can easily uses same name plate of registered vehicles with other vehicles. Due this reason to avoid this draw back this Paper work proposes combined system based on number plate and faces of vehicles driving persons. In ANPR and face Recognition system along with number plates, face of vehicles authorized persons are also used to identify the vehicles in various traffic and security applications, such as parking, toll collections places at the highways, access and border control, or tracking of stolen cars and such systems are installed at the important places like parliament, apartments, government offices to avoid the entering of unauthorized persons inside the restricted places with the known vehicles.

When a vehicle enters an input gate, number plate and faces authorized personnel is automatically recognized and compares with the stored database if this datas are matches then gate of entrances are automatically open otherwise not open. If the only vehicle number is recognized by the system and face is not recognized then buzzer will sound to indicate the unknown person is come with the known vehicle. And also black-listed number is not given permission. For example, this technology is used in many companies to grant access only to vehicles of authorized personnel. In this ANPR and Face Recognized system implementation work uses optical character recognition algorithm for recognizing number plate and Principal component Analysis for recognizing faces of persons, and for controlling hardware gate mechanism we uses arduino microcontrollers for recognizing command sent by ANPR and Face Recognition system, and then this will controlling the hardware mechanism of gate for switch on the buzzer when unauthorized persons enter or came with the known vehicle. For implementation of above project work we use most popular MATLAB Software.

Sensor module: this component is for acquiring the biometric data.

Feature extraction module: the data obtained from the sensor is used to compute a set of feature vectors.

Matching module: the feature vectors generated via the previous component are checked against those in the template.

Decision making module: to accept or reject the claimed identity or to establish a user's identity.

3.1 Principal Component Analysis (PCA)

A Number of feature extraction and recognition algorithms have been applied to facial images. For this project work images data were transformed using the principal component analysis (PCA) PCA also known in the literature as Eigen faces is a statistical method that reduces the dimensionality of an input data while retaining the majority of the variance in the dataset. PCA was invented by Karl Pearson. It involves a mathematical procedure that transforms a number of possibly correlated variables into a smaller number of uncorrelated variables called principal components. PCA is used to reduce the dimensionality of the data while retaining as much information (but no redundancy) as possible in the original dataset. It is a simple method for extracting relevant information from huge data set. It is a powerful tool for analyzing data.PCA involves the calculation of the Eigen value decomposition of a data covariance matrix or singular value decomposition of a data matrix, usually after mean centering the data for each attribute. Steps involved in of a PCA are principal components are explained as below:

A 2-D facial image of size L×L can be represented as 1-D vector by transforming each row (or column) into a long vertical vector. Let M be the number of vectors of size N (L × L), p_j's be the pixel values and i =1… M.

$$Xi=[p_1 \ldots p_N]^T \quad (1)$$

The images are mean centered by subtracting the mean image from each image vector. Let m represent the mean image which is N×1.

$$\boldsymbol{m}=\frac{1}{M}\sum_{i=1}^{M} x_i \quad \textbf{(2)}$$

And let w_i be defined as mean centered image where i = 1, 2… M

$$w_i = x_i - m \quad (3)$$

In the next step, the covariance matrix C is calculated using:

$$C = \frac{1}{M}\sum_{i=1}^{M} w_i w_i^T \quad (4)$$

Now the eigenvectors e_i and the corresponding Eigen values λ_i are calculated. From the above M eigenvectors, only k should be chosen corresponding to largest Eigen values. The eigenvectors of the highest Eigen values describe more characteristic features of an image. Using the k eigenvectors e_k and i=1…M, feature extraction computed by PCA is as follows:

$$F_i = e_k^T (x_i - m) \quad \mathbf{(5)}$$

Where F_i is the feature vector of image *i*. Now identification can be performed. After projecting a new image into the Eigen space we get its feature vector F_{inew}. Now calculate the distances between new image and each known image using any one of classification techniques.

3.2. Matching

Matching is a process of comparing input biometric sample against the templates stored in the database. A comparison is done between input face template and face templates stored in the database using Euclidean distance approach as shown in the equation 5.24..

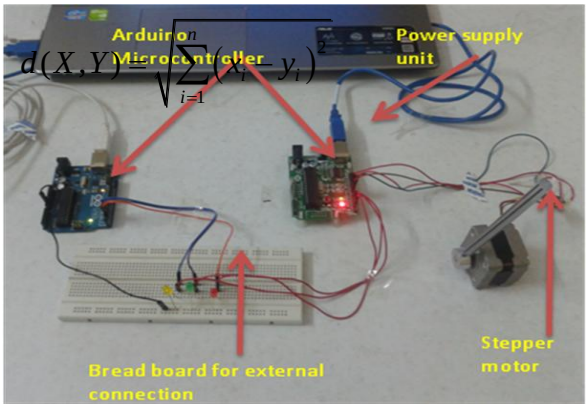

Fig 3: Experimental Setup

Where x_i and y_i are the feature vectors of input image and database template respectively, *n* is the number of test images. These distances are called as scores. Minimum of these scores is the Matching Score (MS). The matching scores at the output of the individual matchers may not be homogeneous, i.e., the scores of individual matchers need not be on the same numerical scale and may follow different statistical distribution. Due to these reasons, score normalization is essential to transform the scores of the individual matchers into a common domain prior to combining them

4. EXPERIMENTAL RESULTS

4.1. Experimental Setup

In this section, the results obtained from the different condition like identifying the vehicle number plate, Face recognition etc can be discussed. This section also explains about communication between the Matlab environment and Arduino controller. The setup of the experiment is shown in Figure 3 below.

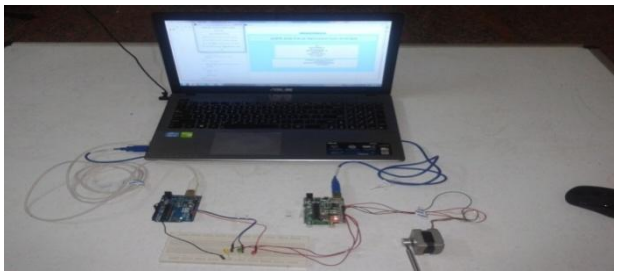

Figure 4 Hardware set up

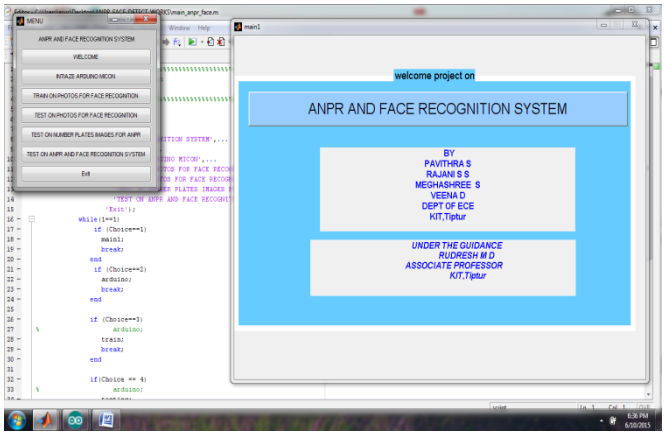

Fig 5 Project welcome page

Communication between the Matlab environments to arduino environment. Another microcontroller is used to provide power supply to stepper motor; here stepper motor is interfaced to arduino controller. Stepper motor acts as toll gate for open and close. Bread board in the figure is used to provide external connection. Results obtained from the this project work as shown below;

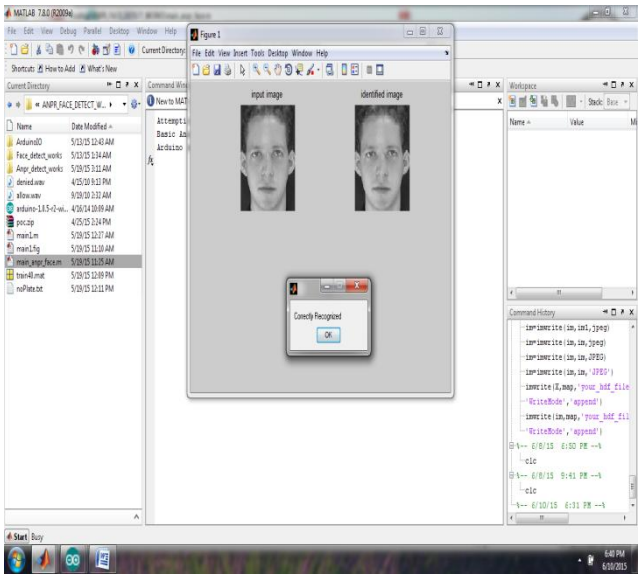

Fig 6 Correct Face Recognition result output window

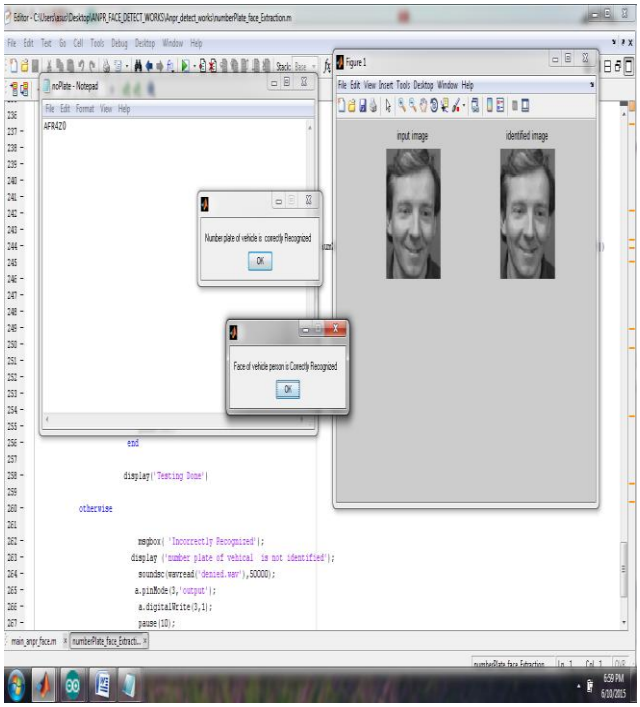

Fig 7 Correct vehicle number Plate Recognition result output window

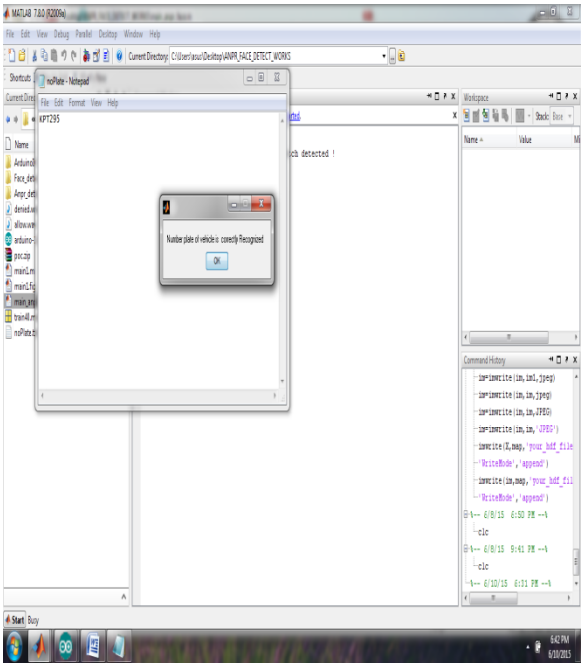

Fig 8 Correct Face and Number plate Recognition system Result Output window

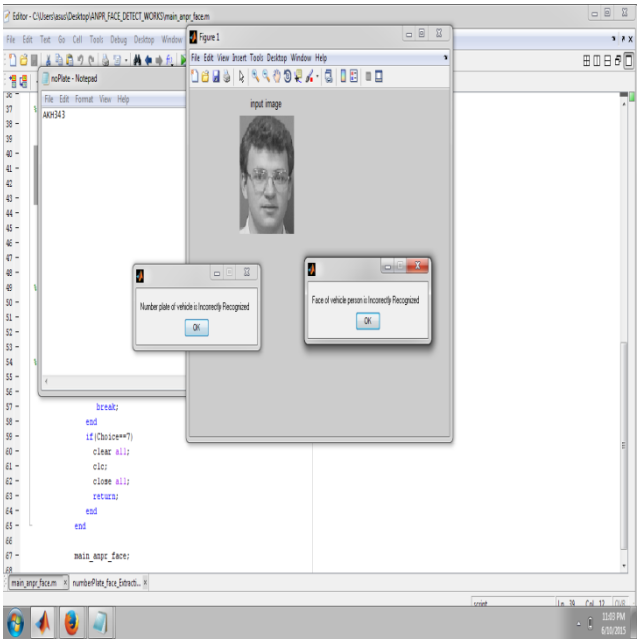

Fig 9 In Correct Face and vehicle number plate result Recognition output window

5. RESULTS DISCUSSION

In this section we have discussed the results obtained from Automatic Number Plate Recognition and Face Recognition system. From figure 5 shows the welcome page window showing authors name and also GUI testing selection window like face recognition, number plate recognition etc can be displayed. Figure-6 shows correct face recognition system when vehicle enters into the input gate, if the face image captured at input of the gate does not matches with data base image, then system will shows that face is not correctly recognized, thereby it will not opens the gate to entry of the vehicle .similarly figure-7 indicates the correct number plate recognition captured by the vehicle. Figure-8 shows the correct recognition of the face and number plate recognition of system. Means that both face and number plate are matched with data base. Thereby allowing the vehicle inside the gate Figure-9 shows incorrect recognition of face and vehicle number plate where the captured images does not matches with stored at the data base, hence vehicle entry is rejected

6. CONCLUSION

In this project, new approaches for Number Plate and face based security System is Implemented. This project work proposes the combined approach of ANPR and face based Recognized System before implementing this system we first implemented direct methods such as ANPR system and Face Based biometric system and tested with faces and number plate images. In order to increase the security level at entrances of gates of restricted areas. it means easy transit through the toll gates and for avoiding repeated and hectic security checks at mall parking entrance and society gates. In this paper work presented techniques for license plate recognition with OCR algorithm and face recognition with PCA approach. The experiment has been done in MATLAB to show the basic process of the Image processing for number plate and ORL database image and real time images.

7. REFERENCES

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8. AUTHOUR PROFILE

Rudresh M D, Associate Professor of Department of Electronics and Communication Engineering, Kalpataru Institute of Technology Tiptur,karnataka, He has more than 3 years Industrial Experience and 12 years of teaching Experience, He guided more than 15 projects for PG and UG Students from past 10 years. His research areas of interest are DSP, Speech Processing, Image Processing,EmbeddedSystem, and Biomedical Signal Processing and has depth knowledge of Microcontrollers, microprocessors and DSP processors Cu rrently pursuing PhD at JNTU Hyderabad.