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Crime Detection Using Text Recognition and Face Recognition

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Abstract. With rapid growth and development in big towns and cities, the crime is also increasing at an alarming rate. Various cases of theft, stealing crimes, burglary, kidnapping, human trafficking etc. are left unsolved because the vehicle involved could not be identified accurately as it is not feasible for human eye to verify characters from license plate of fast moving vehicles. Many a times there is no identification of the person who was involved in criminal activities. To avoid such situation, we have proposed an effective crime detection system using Text and Face recognition technique. Such systems will be very effective at toll tax collection, parking system, airports, and Border crossings. Text Recognition can be used to identify number plate and face recognition can be used for criminal identification. The efficiency of the system depends on the quality, illumination and view of the image captured. This paper aims to provide better result both in terms of speed and accuracy than conventional methods in use relating to the text and face recognition process for criminal identification.

Keywords: ANN; ANPR; Backpropagation Algorithm; Crime Detection; OCR; PCA

1 Introduction

Number Plate recognition is one the applications of text recognition. The technique involves extracting numbers and alphabets from image captured. In recent years license plate recognition has been one of the instrumental techniques for vehicle investigation. It is can be applied at number of public places for gratifying some of the purposes like traffic safety enforcement ,toll tax collection [1] and car park system [2].Automatic Number Plate Recognition algorithms are generally divided in four steps: (1) Capturing Vehicle Image (2) Detection of Number Plate (3) Segmentation of character and (4) Recognition of Character.

Face recognition consists of identification of the human face by building a similar computational model. During the past few years, face recognition has received amplified consideration and has advanced the process of crime detection. A face recognition system consists of four steps: Detection, Alignment, Feature Extraction, and Matching. [3]

Text and Face Recognition Problems:

Detecting and recognizing faces are challenging due to a wide variability in poses, shapes, sizes and texture. The problems or challenges in face detection and recognition are listed as follow [4]:

- **Posture**: Facial pose depends on the camera angle at the time the image was captured.
- **Presence of structural components**: Structural components on face includes spectacles, moustache or beard. These components may have different types, shapes, colours and textures.
- **Facial emotions**: Emotions tend to change the facial features.
- **Obstruction**: A face may be somewhat blocked by someone else when the image is captured among mobs.
- **Image condition**: The condition of an image depends on the illumination and camera features which comprises of image quality.

2 Related Works

Many different authors and researchers have contributed in text and gace recognition in the past. Plate Recognition Using the Template Matching Method was proposed by M.I.Khalil [5] in 2010 in which he used 4 modules: Image acquisition, license plate extraction, segmentation & recognition of individual character. An Efficient Method of Vehicle License Plate Recognition based on Sliding Concentric Windows (segmentation technique) and Artificial Neural Network is proposed by Kaushik Deba, Md. Ibrahim Khana, AnikSahaa, and KangHyun Job [6]. Their method focused on extraction of number plate by finding vertical and horizontal edges from the vehicle. In 2010, SVM Based License Plate Recognition System was proposed by Kumar Parasuraman [7] in which he suggested two main approaches for applying SVM: one against all and one against one. He used mean shift method for number plate location and extraction. For segmentation he used histogram projection method on horizontal direction. A number plate region is located by using mean shift method and extracted; the histogram projection method in horizontal direction is applied for a simple segmentation only.

For face recognition, the distance vector approach between the facial features such as eyes, ear size was first used by A. Jay Goldstein, Leon D. Harmon and Ann B. Lesk [8]. The vector contained 21 subjective features with each one underlining to recognize faces. It involved pattern classification with respect to ear projection, weight, nose width. In 1973, Fischler and Elschanger [9] followed a similar approach using template matching to globally fit the facial characteristics. The fully automated face recognition was developed by Kenade [10] in 1973 on a computer system involving geometric parameters extracting sixteen facial features. The average successful identification matched an accuracy above 50%. In 1980's several techniques were improved measuring more enhanced subjective facial features and developed algorithms based on artificial neural networks. In 1986, L. Sirovich and M. Kirby [11] introduced eigen faces in image processing based on Principal Component Analysis. The central idea was to reconstruct images from lower dimensions without any loss in information. Finally, in 1922 Mathew Turk and Alex Pentland [12] introduced new algorithms on eigen faces for correct head detection and classification.

3 Methodology: Text and Face Recognition Algorithms:

3.1 Optical Character Recognition

Optical character recognition (OCR) [13] is a technique of categorization of optical patterns present in a digital image comprising of alphabets and numbers. The character recognition is accomplished over significant steps of segmentation, feature extraction and recognition. [14]. Fig. 1 shows Applications of OCR. One is Automatic Number Plate Recognition (ANPR).

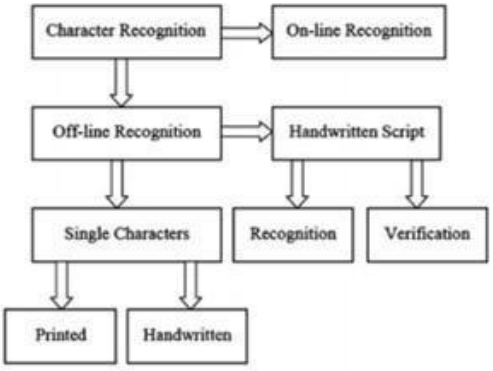

Fig. 1. Different Areas of OCR application

Steps used in ANPR System:

ANPR System consists of four steps as shown in Fig. 2, these are image acquisition, license plate extraction, character segmentation, and character recognition.

1). Image Acquirement:

The first step includes procuring an image i.e. receiving an image using the digital camera connected to the computer. These captured images are in RGB format and then processed for the number plate extraction.

2). Image Pre- Processing:

The image captured by camera needs some pre-processing as it contains an optical system distortion, system noise, lack of exposure or unwanted motion of camera or vehicle etc. which lowers the image quality. Thus, Image preprocessing is conversion from RBG to grayscale. It also removes noise and improves border for correct brightness.

3). Plate Localization:

The initial phase in plate localization involves determining the size of the number plate. The algorithm requires determining the rectangular regions in the number plate popularly called as Region of interest (ROI). For this purpose, Sobel vertical edge detection is used to detect that number plate [15].

4). Character Segmentation:

The result of the previous step yields a binary image. To effective achieve the purpose of number plate detection each number must be segmented separately. It is accomplished by character segmentation [16]. This step involves segmentation of each character of image as a discrete image. Character segmentation is completed using Vertical projection analysis [17]

5). Character Recognition:

The character recognition phase consists of two steps:

a) Character normalization and feature extraction:

Segmented characters have difference in size. In this phase, all the characters are normalized to previously defined height (Vertical Length) in pixel. As the characters always have different width (Horizontal Length), each character image is normalized to a size of 32 X 32, by image mapping technique.

b) Character classification: Using SVM and Neural Networks

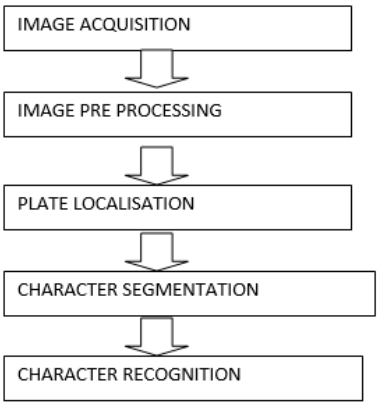

Fig. 2. Steps involved in number plate recognition

3.2 Face Recognition

Face recognition involves a one-many matching by comparing the image of query face with a database of pre-stored images of faces and find out the identity of query face as shown in Fig. 3.

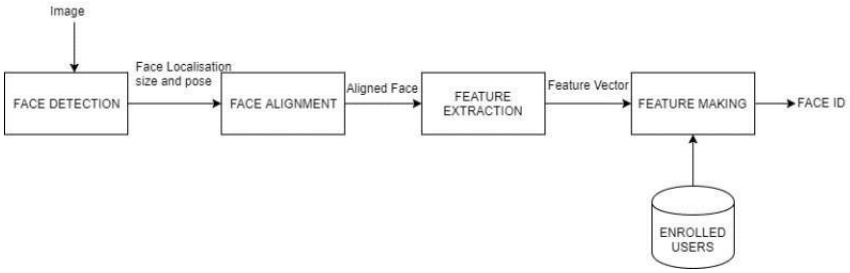

Fig. 3. Steps involved in face recognition

It is a three step process which include detection of face, feature extraction and face classification.

1). **Face Detection**: In face detection step (also known as face localization) a raw image is captured and position of face in that image is extracted from the background. Noise is removed from the image. If the image is taken in controlled environment then simple edge detection technique is sufficient. [18].Initially image was converted into grey scale [19] but now work also being done to recognize faces on the basis of skin color [20].

If the image of face is captured in controlled background with suitable illumination and pose then face detection is simple. The face in the image is detected and prepared for classification in the following steps:

1. The input image which is captured from a digital camera and is often colored is converted into grey-scale image.
2. Noise is removed from the image.
3. The image is cropped to fit the dimensions of the images that are stored in the database.

2). **Feature Extraction**: Feature extraction is performed. Instead of directly comparing the query face with the images of faces available in database, we reduce the dimensions of the image and then we compare it with the database. It removes redundant information. It also reduces complexity and computational power. It is done by PCA, LDA or a combination of both the techniques. Eigen faces are generally used in case of face recognition using PCA. After applying PCA, LDA is applied for further dimensionality reduction.

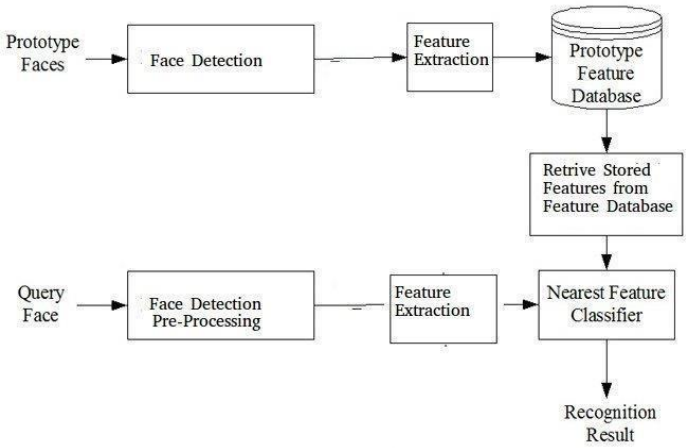

Fig. 4. Feature Extraction in face recognition

3). **Face Classification**: In the final step classification is done to obtain a match for the query image of face. The query face is compared with the faces already registered in the database. If the query face matches with any face then that face is the output of this step. It is the classification algorithm used in the final step that decides efficiency of the system. So in our paper we will specifically focus on this.

Different algorithms involved in face recognition:

A. PRINCIPAL COMPONENT ANALYSIS (PCA)

Turk and Pentland first used PCA for recognizing human faces [21]. Eigen face method was used but it doesn't work well in case of poor illumination. Later PCA was combined with Linear Discriminant Analysis (LDA) to improve performance [22]. In [23] a detailed study was presented in which frontal face images were filtered by Gabrol filter and PCA as used to reduce the dimension of filtered feature vectors and then feature extraction was done using LDA.

B. SUPPORT VECTOR MACHINE (SVM)

They are useful in face recognition. SVM was successfully applied by Vapnik [24]. Main advantage is that it provides better generalization performance over traditional neural network but It cannot be used in case of missing entries in feature space.

C. ARTIFICIAL NEURAL NETWORK (ANN):

Multi-Layer Perceptron (MLP) is now used for face recognition. It involves feed forward learning algorithm. It is simple and shows better efficiency in supervised pattern matching. It was used for face recognition with feed forward neural network [25]. Convolution neural network proposed in [26] was shown to be more powerful than MLP [27, 28]. PCA was combined with CNN and better classification results were obtained. [29].

4 Proposed Method

The method consists of combining the features of text and face recognition, performing real time analysis and then matching with the required database.

For text recognition, we will follow Neural Network Approach as shown in Fig. 5.

A. BACK PROPOGATION ALGORITHM:

The back propagation is an extensively used algorithm, and it can map non-linear processes. It is a feed forward network with multiple hidden layers. The principal architecture in a back propagation network consists of three layers. It can have multiple hidden layers without any constraints. Back propagation is an organized method for training multilayer artificial neural networks. It is highly practical mathematical model. Using neural network has benefits from current correlation and statistics template techniques [30] that allow being steady to noises and some position modifications of characters on license plate. It is essential for the network to be trained on all required

data (36 characters).Now build a program that reads the sequence of characters for validation of network, to cut each character and resize it and put the result [31].

The sequence of steps can be assembled as follows

a) Segmentation of the plate
b) Analyzing the processed segments for brightness and excluding the faulty zones
c) Applying the feature extraction algorithm on each segments.
d) Analyzing the dimensions of segments and classifythem.

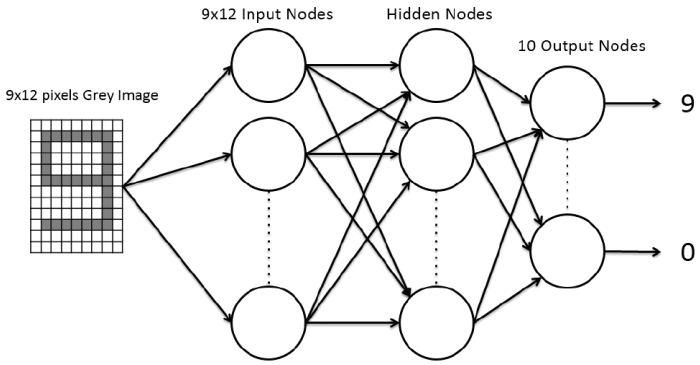

Fig. 5. Character Recognition using Neural Network

For face recognition, we will follow a hybrid approach consisting of PCA, LDA and Artificial Neural Network. The basic approach is shown in Fig. 6 below:

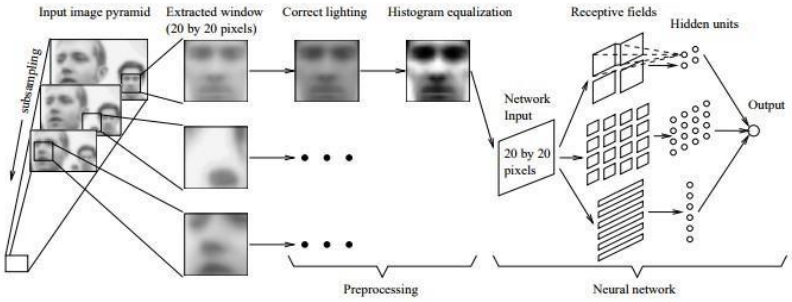

Fig. 6. Face Recognition using Neural Network

Pre-processing, Principal component analysis, Linear Discriminant Analysis and Back Propagation Neural Algorithm are the major implementations for face recognition. Pre-processing is done for two purposes:

a) Reduction of noise and convolute effects of intrusive system,

b) To alter the image into a different space so that it can be easily exploited for further classification.

The algorithmic steps for face detection:

a) Preprocessing the face image
b) Dimensionally reduction by PCA.
c) Feature Extraction by LDA.
d) Classification using Neural Network.

Fig. 7 shows the face detection steps.

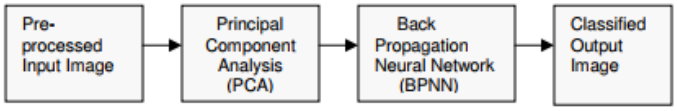

Fig. 7. Process for Face Detection

The final step consists of matching the output with the desired record present in the vehicle registration database and criminal records database. Both the techniques will have a holistic approach in crime detection.

The final workflow is shown in Fig.8:

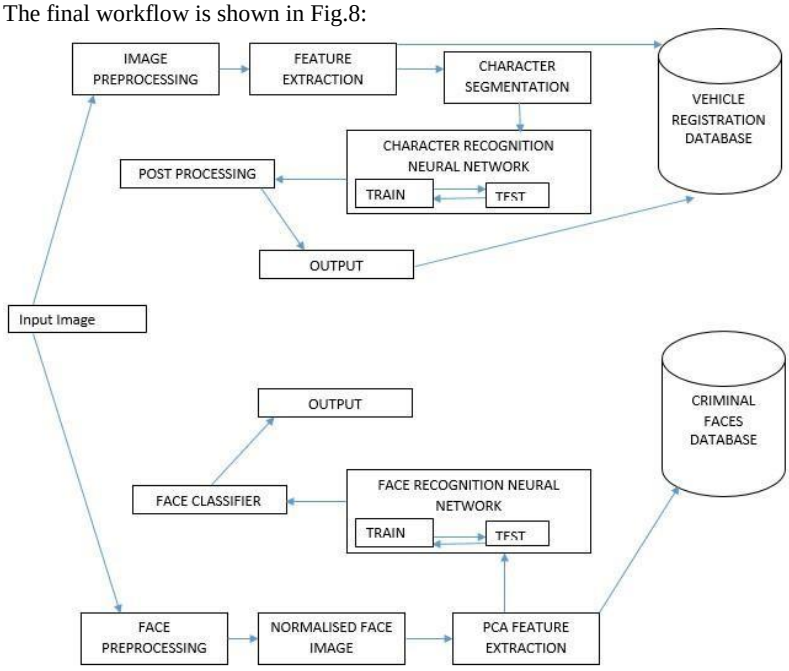

Fig. 8. Flow Diagram for Proposed Method

5 Conclusion

The text and face recognition method proposed in this paper will achieve real time accuracy with minimal errors. The output generated by the system using machine learning approach will help identify fake vehicle registrations and criminals on comparison with the database records. A neural network helps achieve higher accuracy rates in real time irrespective of the image conditions. The proposed method has been derived from previously applied research methods and will set to prove beneficial in crime detection.

6 Future Scope

The accuracy of text and face recognition is based upon pose, illumination, emotions, facial components and image quality. Certain features need to be incorporated in the system to process real time images at faster rate with high precision. Another aspect of the research includes, developing a model which if trained on given criminal record dataset can predict the face sketch of a criminal based upon features fed as input by a witness.

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