Face Recognition with Partial Face Recognition and Convolutional Neural Network

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ABSTRACT

Face is the major part of the human which provides the identification of the person. With the help of characteristics of the face, the face recognition system can be implemented. In traditional attendance system, the teachers call student and mark according to present and absent. These traditional techniques are time-consuming. In this paper, the smart machine learning based face recognition approach has been proposed. The database is created by capturing the faces of the authorized students. The face is detected using deep learning based approach. The cropped images then stored as a database with respective labels. The features are extracted using PCA algorithm and classi_ed using SVM and KNN. The proposed approach achieves the recognition rate of 98% for SVM and 92% for KNN algorithm. The proposed system is implemented in real time using Raspberry pi 3 board.

KEYWORDS*:* *Face Recognition, LDA, CNN, Deep Learning, Feature Extraction, Face Images*

I.INTRODUCTION

The face is our primary focus of attention in social intercourse, playing a major role in conveying identity and emotion. Although the ability to infer intelligence or character from facial appearance is suspect, the human ability to recognize faces is remarkable. We can recognize thousands of faces learned throughout our lifetime and identify familiar faces at a glance even after years of separation. This skill is quite robust, despite large changes in the visual stimulus due to viewing conditions, expression, aging, and distractions such as glasses, beards or changes in hair style.

Face recognition has become an important issue in many applications such as security systems, credit card veri_cation and criminal identi_cation. For example, the ability to model a particular face and distinguish it from a large number of stored face models would make it possible to vastly improve criminal identi_cation. Even the ability to merely detect faces, as opposed to recognizing them, can be important. Detecting faces in photographs for automating color _lm development can be very useful, since the e_ect of many enhancement and noise reduction techniques depends on the image content. The _rst step of human face identi_cation is to extract the relevant features from facial images. Research in the _eld primarily intends to generate su_ciently reasonable familiarities of human faces so that another human can correctly identify the face. The question naturally arises as to how well facial features can be quantized. If such a quantization if possible then a computer should be capable of recognizing a face given a set of features. Investigations by numerous researchers [3, 4, 5] over the past several years have indicated that certain facial characteristics are used by human beings to identify faces.

II. LITERATURE REVIEW

The various kinds of face detection techniques are available in literature some key contributions which are providing support for design and development of the accurate face training sets are needed with millions of labeled images. For some applications, such as near-infrared (NIR) face recognition, such large training datasets are not publicly available and difficult to collect. In this work, **Guosheng Hu et al. [13]** propose a method to generate very large training datasets of synthetic images by compositing real face images in a given dataset. Authors show that this method enables to learn models from as few as 10,000 training images, which perform on par with models trained from 500,000 images. Using this approach they also obtain state-of-the-art results on the CASIA NIR-VIS2.0 heterogeneous face recognition dataset. Biometric security systems based on facial characteristics face a challenging task due to variability in the intrapersonal facial appearance of subjects traced to factors such as pose, illumination, expression and aging. Hachim El Khiyari et al. [10] innovates as it proposes a deep learning and set-based approach to face recognition subject to aging. The images for each subject taken at various times are treated as a single set, which is then compared to sets of images belonging to other subjects. Facial features are extracted using a convolutional neural network characteristic of deep learning. This experimental result show that set-based recognition performs better than the singleton-based

approach for both face identification and face verification. Authors also find that by using set-based recognition, it is easier to recognize older subjects from younger ones rather than younger subjects from older ones.

III. SYSTEM MODEL AND ASSUMPTIONS

Prposed System

Typical structures of face recognition system consist of three major steps, gaining of face data, extracting face feature and recognition of face. Figure 1 shows typical structure of face recognition system in which subject under consideration given to the system for the recognition purpose this is consider being acquisition of face image. Later on feature is extracted from the image and finally it is given for the recognition purpose.

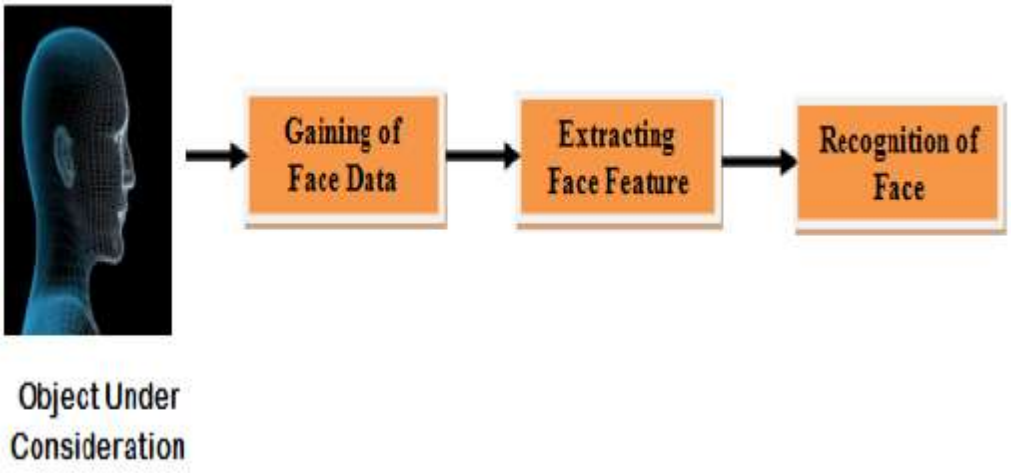


Figure 1: Face Recognition Systems

Once the features are extracted and selected, the next step is to classify the image. Appearance-based face recognition algorithms use a wide variety of classification methods Such as PCA, LDA. In classification the similarity between faces from the same individual and different individuals after all the face images in database are represented with relevant features. Sometimes feature extraction & recognition process done simultaneously.

(i) Gaining of Face Data

Acquisition and Processing of Face Data is first step in the face recognition system. In this step face images is collected from different sources. The sources may be camera or readily available face image database on the website. The collected face images should have the pose, illumination and expression etc variation in order to check the performance of the face recognition system under these conditions. Processing of face database require sometimes otherwise causes serious affect on the performance of face recognition systems due changes in the illumination condition, background, lighting conditions, camera distance, and thus the size and orientation of the head. Therefore input image is normalized and some image transformation methods apply on the input image [7].

(ii) Extracting Face Feature

Feature extraction process can be defined as the process of extracting relevant information from a face image. In feature extraction, a mathematical representation of original image called a biometric template or biometric reference is generated, which is stored in the database and will form the basis (vector) of any recognition task.

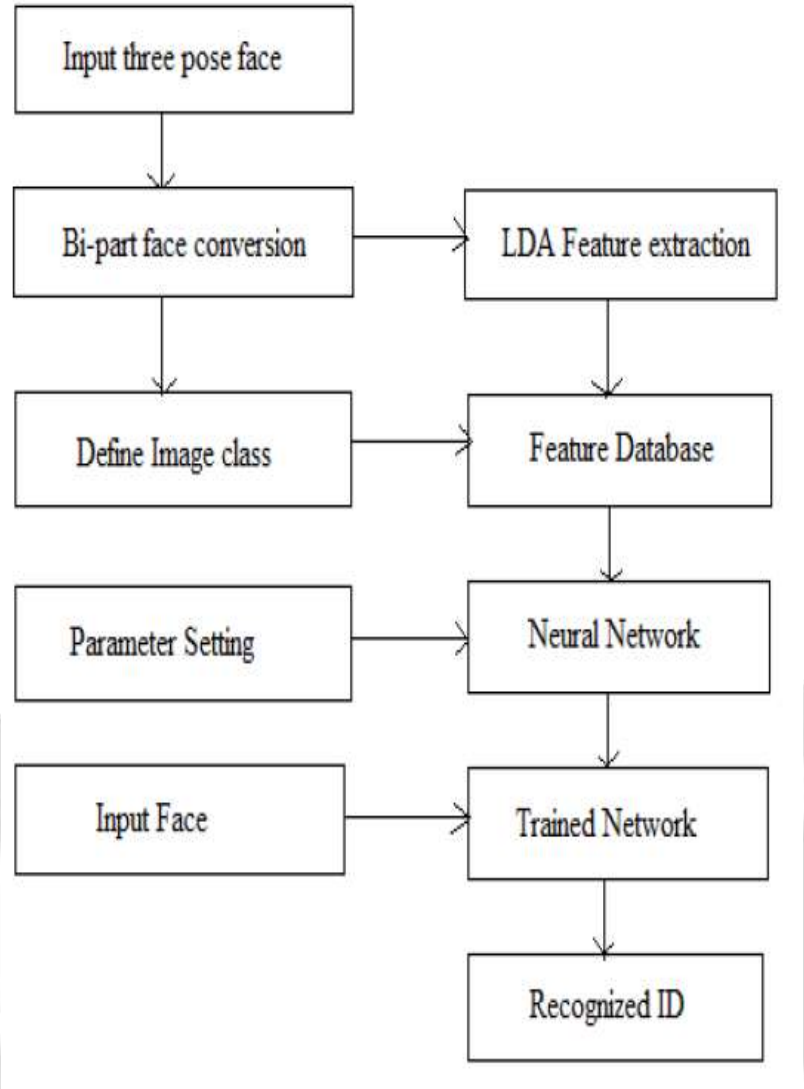


Figure 2: Proposed Work Flow

Deep learning provides a natural way to obtain feature representations from data without relying on hand-crafted descriptors. In this paper, Xue-wen Chen et al. [12] propose to learn deep feature representations using unsupervised and supervised learning in a cascaded fashion to produce generically descriptive yet class specific features. The proposed method can take full advantage of the availability of large-scale unlabeled data and learn discriminative features (supervised) from generic features (unsupervised). It is then applied to multiple essential facial regions to obtain multi-channel deep facial representations for face recognition. The efficacy of the proposed feature representations is validated on both controlled (i.e., extended Yale-B, Yale, and AR) and uncontrolled benchmark face databases. Experimental results show its effectiveness.

Face Recognition

Face recognition is becoming an active research area spanning several disciplines such as image processing, pattern recognition, computer vision, neural networks, cognitive science, neuroscience, psychology and physiology. It is a dedicated process, not merely an application of the general object recognition process. It is also the representation of the most splendid capacities of human vision. Face recognition has been one of the most interesting and important research fields in the past two decades. The reasons come from the need of automatic recognitions and surveillance systems, the interest in human visual system on face recognition, and the design of human-computer interface, etc [4].

Proposed System Architecture

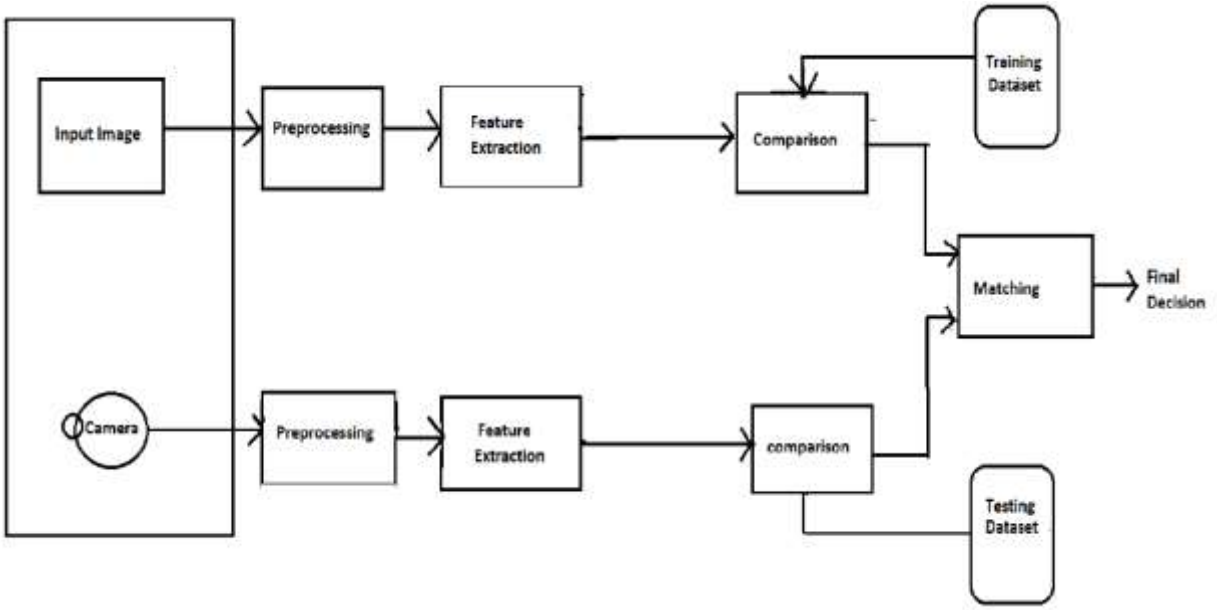


Figure. 3 Proposed System Architecture

MNIST or Modified National Institute of Standards and Technology database is a huge database which is most commonly used for training algorithms like ours for image processing. It was created by "re-mixing" the samples from NIST's original datasets. The particular reason to use MNIST as dataset is because MNIST is a huge dataset, containing over 60,000 training images and 10,000 testing images. This provides us with a plethora of options and comparisons to be made to test the system. By implementing deep learning and a layered neural network [4], we are trying to reduce the error in identification of faces. If there are some inaccuracies or error, the deep belief network will learn from it as we are implementing it will greedy layer wise learning approach. The same shall reduce the error or inaccuracies greatly and the system is supposed to work more efficiently and accurately than other facial recognition system.
The system should detected the variance in skin colour and should be able to recognize and identify the faces even with angular rotation [4].

IV ANALYSIS AND RESULTS

The results of the proposed face recognition system are evaluated using qualitative and quantitative analysis.

Qualitative Analysis
The aim of qualitative analysis is a complete, detailed description. No attempt is made to assign frequencies to the linguistic features which are identified in the data, and rare phenomena receive (or should receive) the same amount of attention as more frequent phenomena. Qualitative analysis allows for fine distinctions to be drawn because itis not necessary to shoehorn the data into a finite number of classifications. Ambiguities, which are inherent in human language, can be recognized in the analysis.

In this approach, the database of different people is created by taking number of samples provided in Table . The images are captured in different environment with different facial position.

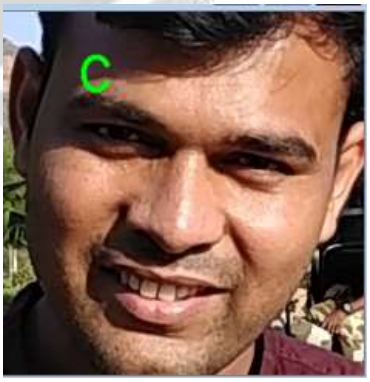
Table . Database Distribution

Sample No.	Total No. of samples	Training samples	Testing Samples
1	899	745	154
2	3972	3498	474

3	2925	2575	350
4	3999	3404	595

The step of results of the proposed face recognition system is as shown in Table.

Table. Qualitative Analysis

Label	Input Image	Output Image
A		
B		
C		

Quantitative Analysis

In quantitative research, the approach is to classify features, count them, and even construct more complex statistical models in an attempt to explain what is observed.Findings can be generalized to a larger population, and direct comparisons can be made between two corpora, so long as valid sampling and significance techniques have been used. Thus, quantitative analysis allows us to discover which phenomena are likely to be genuine reactions to the behavior of a language or variety, and which are merely chance occurrences. The more basic task of just looking at a single

language variety allows one to get a precise picture of the frequency and rarity of particular phenomena, and thus their relative normality or abnormality.

The quantitative analysis of the proposed system is calculated using the accuracy parameter. The accuracy of the face recognition system is given as

$$Accuracy = \frac{No.\ of\ Faces\ correctly\ Detected}{Total\ No.of\ Samples}$$

The training accuracy of the proposed face recognition model is as shown in Fig. 5.1. and respective loss is as shown in Fig.

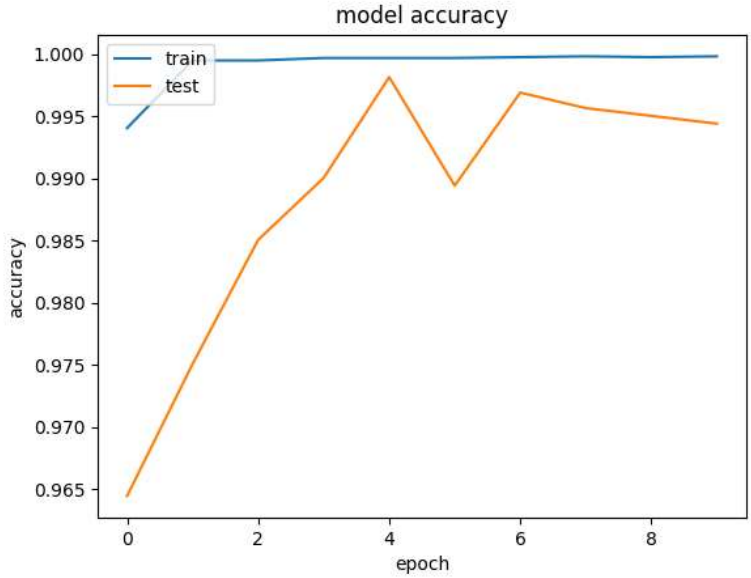


Fig. Model Accuracy Plot

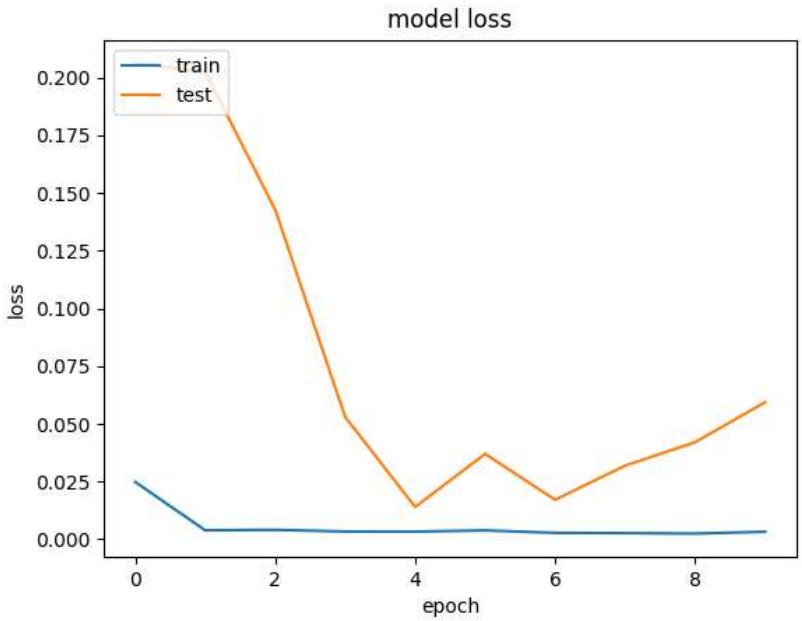


Fig. Model Loss Plot

From the above graphs it is observed that the accuracy of the plot is increasing with increase in epoch. The highest accuracy of the model is achieved at 9th epoch as well as the loss is decreasing.

V. CONCLUSION

The face recognition is a subject of machine learning and pattern recognition. That is frequently used for various different applications for authentication and secure access control due to their uniqueness. The proposed work is dedicated to design and implement a face recognition model that accept the partial or complete face images in order to recognize the face class. In this context the three step process is proposed to work where in first phase the face images are partitioned into multiple face parts this step is termed here as the pre-processing of images. Secondly the images are processed for feature extraction thus the LDA algorithm is proposed to implement. While running the algorithm, the inputs will be given to the system, where it will make the comparisons. The results that will be yielded will prove that the proposed algorithm can detect faces accurately and can provide accurate results in detecting the faceswith varying skin colours. It can also detect the rotated faces accurately.

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