Face Detection and Gender Classification using Facial Features

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Abstract: *Face Recognition is the most important part to identifying people in biometric system. It is the most usable biometric system. This paper focuses on human face recognition by calculating the facial features present in the image and recognizing the person using features. In every face recognition system follows the preprocessing, face detection techniques. In this paper mainly focused on Face detection and gender classification. They are performed in two stages, the first stage is face detection using an enhanced viola jones algorithm and the next stage is gender classification. Input to the video or surveillance that video converted into frames. Select few best frames from the video for detecting the face, before the particular image preprocessed using PSNR. After preprocessing face detection performed, and gender classification comparative analysis done by using a neural network classifier and LBP based classifier.*

Keywords: *Face recognition, Preprocessing, Face detection, Viola jones, Gender classification, neural network*

I. INTRODUCTION

Face recognition system is one of the most needed technologies in the field of computer vision. Now a day's face recognition plays major role in security. Many image analysis methods used for security systems, authentication systems and searching of person etc.FR system mainly used for finding a person. Each and every face image has separate uniqueness. Face recognition is used in a large amount of applications because it has the high performance, accuracy and safety compared with other kind of biometric systems, it does not require any physical interaction, and used any type of images like still to still images, video to still images. Using this recognition process identification of person is easy and recognizes the person just by capturing an image. In this recognition system perform the operations such as Preprocessing, Face Detection, Feature Extraction and gender classification. Give the input as CCTV video or image. If the input is video is converted into frames then after converting frames, the selected frame is preprocessed.

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In image processing the first stage is preprocessing, it is the most important step to reduce the noise from an image. Image preprocessing performed the noise removal and normalization from the dissimilarity of pixel brightness along with segmentation and tracking of the face or its parts. Because of the quality of an image based on the efficiency of the camera, it may behave the distance between the person and camera. That's why the images are preprocessed before starting the recognition process. Face Detection is the second stage of the recognition system. For using face detection identify the person from captured images. After completing preprocessing step the detection process is performed to detect the person and whether the camera captured the person face or not. Then the detected face is cropped. After face cropping want to identify the image of the person is male or female. Here the gender is classified for recognizing the person. From the database image and then the captured image are want to match, if the gender is classified the identification of a person is easy to find, Gender classification is to reduce the search space [9].so the gender classification also done by the face recognition system using Convolutional Neural Network (CNN) classifier and compared with Local Binary Pattern (LBP) based classifier.

Main contribution of this research work: Input as image, video or surveillance. Convert the captured video as a frame.Develop the preprocessing method for improving the recognition rate. To implement the face detection technique using a viola jones algorithm and gender classification algorithms compared with CNN and LBP This paper organizes as follows: section II explains about the related work already done by previous researcher from this particular domain. In section III, it describes what are the materials and methods used for this proposed work. Novelty method will be discussed in the proposed approach technique, Section IV. Section V elaborates about the discussion and results part. Finally section VI conclusion describes about concludes of the work with possible future enhancement.

II. LITERATURE REVIEW

Alpika Gupta, Dr. Rajdev Tiwari, research build a face detection using viola jones algorithm.The study present a novel and simple model approach based on a mixture of techniques and algorithms in a shared pool based on viola jones object detection framework algorithm combined with geometric and symmetric information of the face parts from the image in a smart algorithm [1].

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Anushri Jaswante Dr. Asif Ullah Khan Dr. Bhupesh Gour, observed the research study on gender classification based on facial features using neural network. Researcher particularly focused SVM, Threshold Adaboost, LBP+SVM, Back Propagation Neural Network, for face detection, feature extraction and gender classification. They used hundred male and female images as a dataset. In this research gender is classified on the basis of distance between eye brow to eye, eyebrow to nose top, nose top to mouth, eye to mouth, left eye to right eye, width of nose, width of mouth by using the Artificial Neural Network [2]. This system obtained a low complexity and classified all the images into males and females.

Sarthak Gupta, focused on various classification algorithms such as Functional Trees, AdaBoost, J48Random forest, Naïve bayes, used to predict the gender as either male or female [3]. Compared with other algorithms functional trees algorithm produce better accuracy and find the person whether male or female.

Eman Fares Al Mashagba, observed the research study on real time gender classification system using TDNN is described according to BFGS training algorithms and used for gender, age classification and human identification, based on global geometric facial features [4]. Create own video sample for the dataset and process the extraction parts and classify gender using global geometric facial features achieves a high classification rate in the training set for all application, as well as for gender classification, age classification, and human identification in the testing set.

S.Ravi S.Wilson, researcher builds a Face Detection with Facial Features and Gender Classification Based on Support Vector Machine. That is a set of related supervised learning methods used for classification. Support vector machine accepts the facial feature image pixels as its input [5]. The predictable threshold determines the gender of the face contain in the given input image is a Male or a Female.

III. METHODS AND MATERIALS

This section describes the methods and materials needed for this research work. In section A describe about preprocessing technique using Peak signal to noise ratio (PSNR). Section B describes about enhanced viola Jones face detection algorithm. And section C explains the gender classification using neural network classifiers and LBP classifier.

Preprocessing

In this preprocessing method using switching median filter, Hybrid median filters and both are compared with PSNR (Peak Signal to noise ratio) technique.

A. Progressive Switching Median Filter (PSMF):

Progressive median-based filter, it works in reduction of noise, this method is improved version of switching median filter. In PSMF there are two stages. The first stage is impulse detection. It is used to create an order of binary flag images [6]. These flags of binary images are predicting the location of observed noise images. Another stage is noise filtering is used in more than a few iterations progressively.

B. Hybrid median filter:

Hybrid median filter consequent of median filter which conserve edges better than a square kernel median filter because it is a three-step ranking operation [7]. Hybrid median filter is a non linear class filter; it easily reduces the impulse noise. Compared the hybrid median filter with basic median filter, hybrid one has the better result of corner preserving characteristics. And then for improving accuracy purpose the both PSMF, HMF techniques are compared with PSNR, PSNR got the best result.

C. Peak Signal to Noise Ratio:

Peak signal to noise ratio is a commonly used preprocessing technique in image processing to compare two images that based on mean square error rate (MSE). Subtract the original image from the restored image using mean square error. All the values are a Square and divided by the total number of pixels. Every element would be square because it is elements by elements squaring. Calculating single value by adding the all rows and columns, then divide the output by the total number of pixels.

$$MSE = \frac{\sum_{i,j}\left(Y(i,j) - \hat{Y}(i,j)\right)^2}{MXN}$$

In calculating Mean Square Error the original image takes as x and then the restored image take as a y. The total number of pixels which is stored in MXN.

$$PSNR = 10 \log_{10}\left(\frac{Peak\ Signal^2}{MSE}\right)$$

In calculating Peak Signal to Noise Ratio, Mean Square Error already obtained above and then calculates the log value.

Face Detection

Face detection is the most important step in face recognition application. To recognize a face, first detect the face and then compare it with a set of known individuals present in a database to verify the person [8].In face detection viola jones proposed a novel approach to rapid object detection. Most modern algorithm is based on the viola jones object detection framework, which is based on haar cascade. A cascade is a series of haar-like features that are combined to form classifiers. In this work proposed an enhanced viola jones algorithm. The efficiency of the viola jones algorithm can be extensively improved by first generating the integral image.

$$||(y,x) = \sum_{p=0}^{y}\ \sum_{q=0}^{x} y(p,q)$$

Viola- jones detector:

1. Calculating the integral image.
2. Haar-like features- simple rectangular features that achieve just above arbitrary.
3. Adaboost learning algorithm creates a small set of only the best features to create more efficient classifiers.
4. Cascade filter-discards negative windows near the beginning to focus more computational time on possible positive windows.

Haar-like features:

Haar features are applied on face images to find out the whether the image is face or not. Basically every human faces are having the some similarities; this reliability may be matches using haar features. These features are viewed as a kernel which is used for edge detection method. Simple features provide just above random accuracy. Each feature is a difference calculation of the white area minus the dark area.

Integral image:

In the integral image every block is the summation of the previous block. Point of origin is upper left corner, meaning previous block are defined as those above and to the left.

Constant evaluation using an integral image

a) Edge feature
b) Line feature
c) Four-rectangle feature

Adaboost:

Adaboost tries out multiple weak classifiers over several rounds, selecting the best weak classifier in each round and combining the best weak classifier to create a strong classifier.

Cascade classifier:

Haar cascade consist of a series of weak classifier. If an area exceeds a single classifier go to the next classifier, otherwise area does not match.
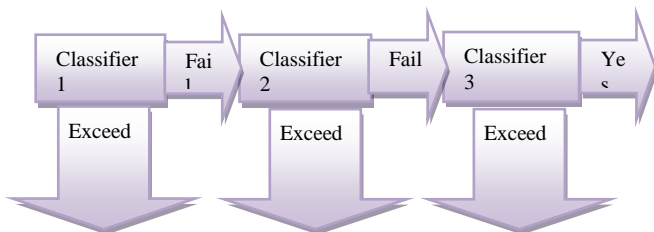
**Fig 1: Performance of cascade classifier**

Gender Classification

In any face gender classification techniques the first step is face detection. Once all the facial features are extracted, a classifier has been trained which can classify as a male or female. In this paper neural network has been used for gender identification [1]. Convolutional neural network compares the image piece by piece. The piece that it looks for are called features. Finding rough feature matches, in roughly the similar point in two images, CNN gets the better similarities than whole-image matching Local binary pattern based classifier which can classify the facial feature well [10]. In this method compute the histogram of LBP. In these two methods CNN classifier and LBP, CNN got the better result compared with LBP based classifier.

IV. PROPOSED APPROACH:

This research paper, CCTV video dataset was created as own dataset. The video is converted into frames from all the frames selects the best few frames for preprocessing using Peak signal to noise ratio technique. This preprocessing technique mainly focused on the noise reduction. After the preprocessing, the enhanced viola jones algorithm was

implemented to get the detection of face image from the frame. Then perform comparative analysis of neural network algorithm and local binary pattern based classifiers are used for the classification of gender, here identifying the detection of a person is male or female. The implementation work will be carried out through Matlab. The below figure explains about the implementation process.
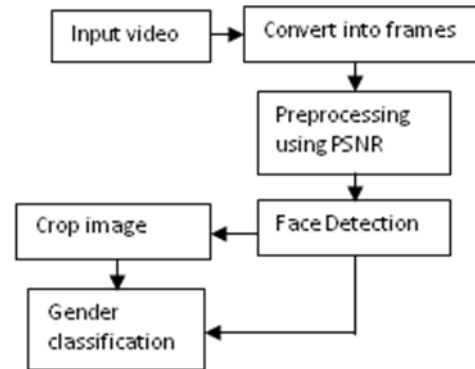
Fig 2: System flow diagram

Processing Steps:

1. Get the video from CCTV or Surveillance.
2. Preprocessing using Peak signal to noise ratio and also compared with PSMF and HMF.
3. Face Detection using an enhanced viola jones algorithm.
4. Gender classification with convolutional neural network.

V. RESULT DISCUSSION

This section discusses about the experimental analysis of implementing algorithms of PSNR. Viola jones faces detection algorithm and convolutional neural network classifier compared with LBP. And result section discusses about the results of face detection and gender classification using face images. The following figures show the detection and classification of gender steps.
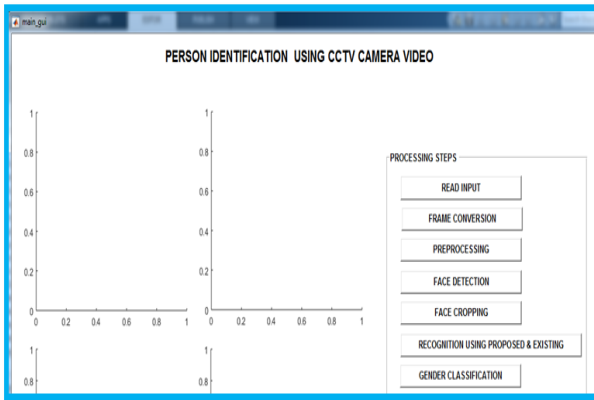
Dataset Description:

Dataset was created as own. Dataset description was explained in the below table.
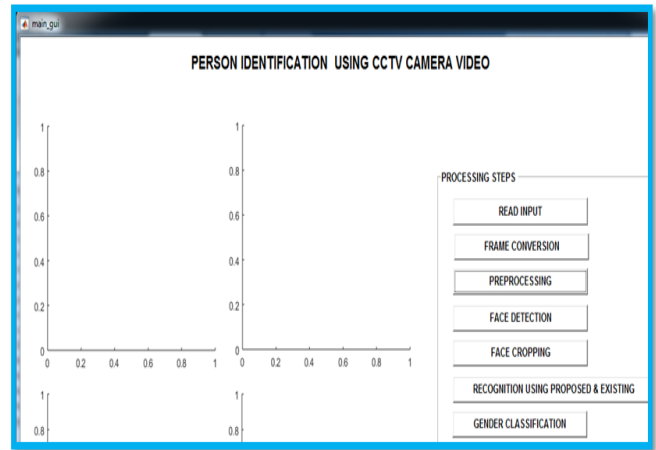
Table1: Dataset Description

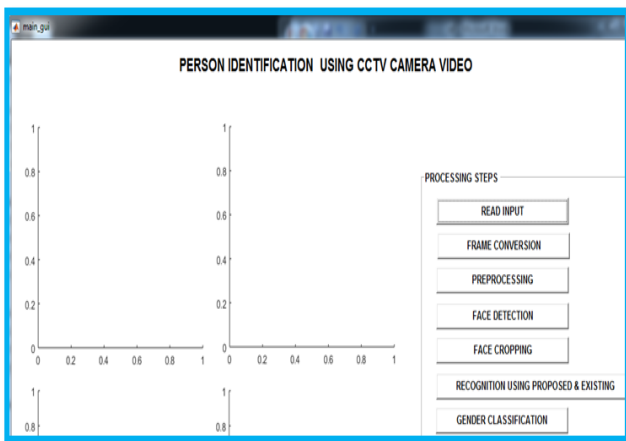| Dataset Name	Number of frames	Number of selected frames	Number of Detected face
CAM-01	24 frames	1	1
CAM_03	24 frames	1	1
CAM_6	24 frames	1	1

Fig 3: Face Detection and Gender classification processing steps
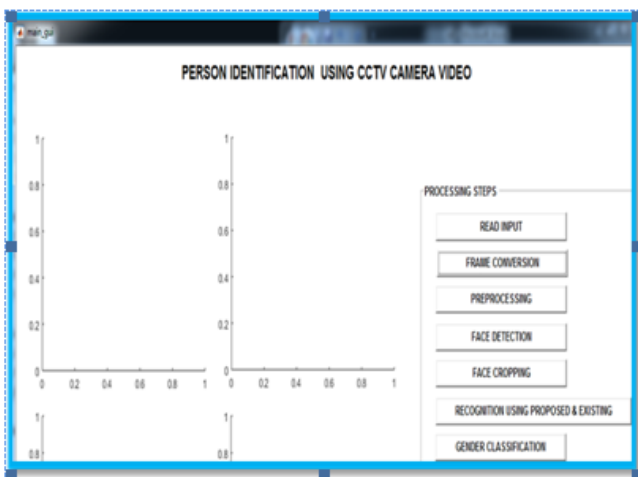Figure 3 shows the processing steps for face detection and gender classification in GUI window

Fig 4: Read input for frame conversion
Figure 4 shows the reading of input, here video or surveillance to give as an input, after it will convert into number frames.
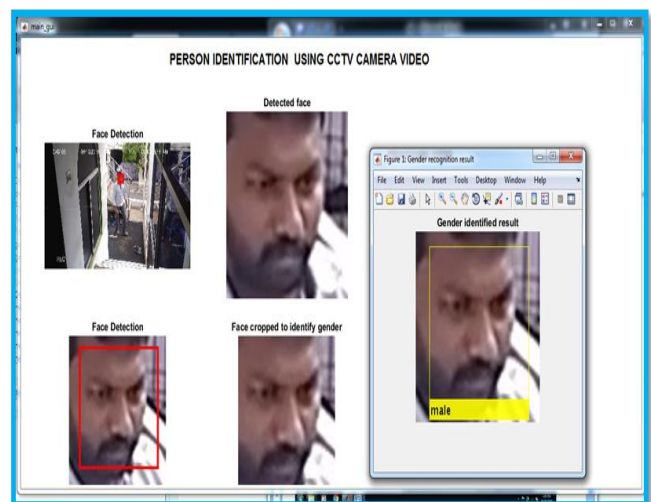

Fig 5: Frame Conversion
Here frame number of frames are converted that based on a video length in this dataset 24 frames are converted.

Fig 6: Preprocessing
In Preprocessing the selected best frame is preprocessed for a detection purpose, to increase the quality of image and reduce the impulse noise etc.
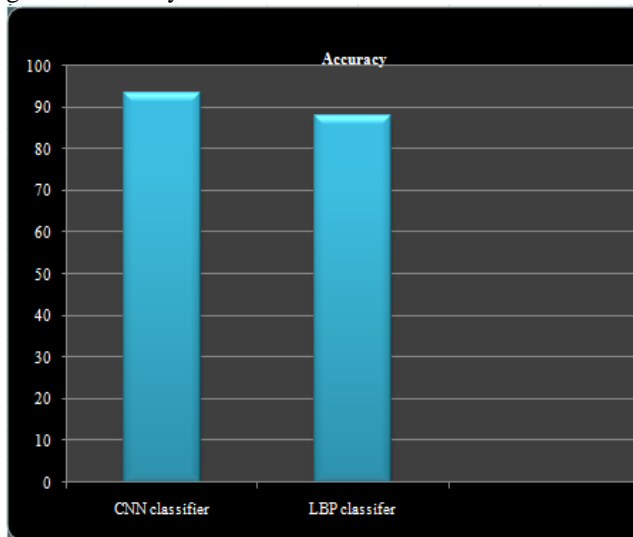

Fig 7: Face Detection

Fig 8: Classifying gender for detected person
In gender classification to identify whether the detected person is male or female.
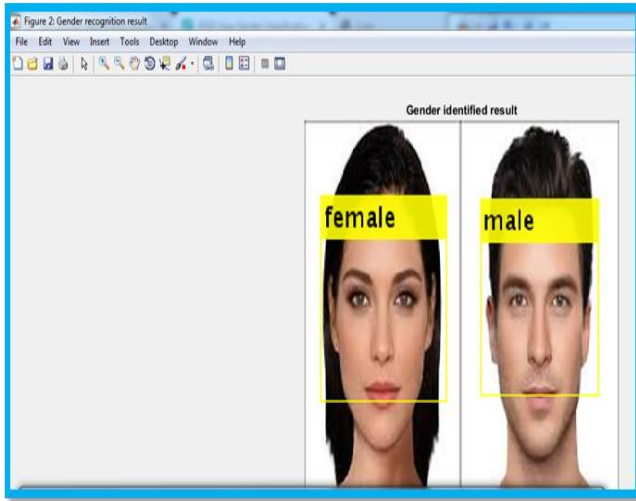
Fig 9: Another sample for gender classification

In this above screenshot the male and female both images are used, here the gender classification techniques fined the gender correctly.

Fig 10: Comparative analysis accuracy of gender classification result

The overall accuracy is intended by the following true /positive rates.Accuracy= (TP+TN)/ (TP+TN+FP+FN) =93.6% accuracy for CNN classifier and 88 accuracy for LBP based classifier.

VI. CONCLUSION

In this paper dealt with face detection and gender classification from video images. Face recognition system is one of the most used biometric systems in the field of computer vision. It is used to identify the person from CCTV footage or still images many of the security places are used face recognition technologies. In this research focused on recognizing the person from a video or surveillance. And find the face of a detected person is male or female using comparative analysis of convolutional neural network and LBP based classifiers. In the future work the same process continues to recognize the person from the video.

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AUTHORS PROFILE

G.Kavitha is pursuing Ph.D research scholar in the Department of Computer Science, Periyar University, Salem. She received B.Sc(Software Engineering) degree in Anna University in the year of 2012 and received MCA degree in Anna University in the year of 2015. Her Area of research is image processing, She published Three international journals and Presented two international conferences.

Dr. I. Laurence Aroquiaraj is working as an Assistant Professor in The Department of Computer Science, Periyar University, Salem. His Educational Qualifications includesM.Sc., M.Tech., M.Phil., M.C.A., and Ph.D in Computer Science. He has fourteen years of Teaching and Research experience. He also has a three year of Industrial experience. His main area of Research is Medical Image Processing. He is also much interested in the areas including Data Mining, Internet Technologies and Networking. He attended fourteen International Conferences. A total of ten Conferences, Seminars and Workshops are organised by him. Overall forty three research papers are published by him in International Journals and Conference Proceedings. Total twenty three National Journals and Conference Proceedings are published by him. He is a member of Professional Bodies such as CSI (Life Member), IEEE, IAENG, IET Image Processing, Elsevier-ACI, IRG-IJCT and IJCII. He has extended his guidance to hundred and four M.C.A. and twenty M.Sc. (Computer Science) students. He also guided thirty-four M.Phil., (Computer Science) scholars. Eight Ph.D. (Computer Science) scholars are pursuing their research work under his guidance. He immensely worked on UGC funded project entitled, "Early Detection of Breast Cancer from Mammogram Using Soft Computing Techniques".

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