Improving Face Recognition Rate with Preprocessing and Enhanced Viola Jones Face Detection Algorithm

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Abstract — Face recognition have the most important role in the computer vision. The quality of the image plays the important part in the security field. All humans have the unique facial features no one have the same as other peoples, so these features are used to identify the person. Many of the companies, security places are using face recognition system. A face represents the physical as well as behavioral features of a person. Video face detection not only used for biometric it’s used many of the security purpose. Using CCTV footage and surveillance cameras detect the particular person. The video converted into frames like an image and then the images are preprocessed using PSMF and HMF compared with PSNR techniques for removing the noise from an image. After completing pre-processing the particular face is detected using a viola Jones algorithm based on haar features.

Index Terms— Face recognition, Face Detection, Preprocessing, Viola jones Algorithm.

1 INTRODUCTION

For a long time, the problem of face recognition has been a challenging task in computer vision. Face biometric deals with the identification of a person from a database using facial features. Using the face of a person as an identifier is commonly used in a wide range of applications. Now a day’s it’s used for security of data in personal computers, mobile phones and so on. And it mainly used in providing security at hospitals, company, and border control airports etc. For the identification using facial biometrics, no one need to remember any password, but instead only needs the face of a particular person. In view of the fact that faces have natural features of people. So, face recognition is the convenient and user friendly biometric system. A video sequence consists of multiple frames. Video detection and surveillance is an emerging technology in the field of computer vision. Face recognition system just focuses on recognizing the face from video or still images.

Detection of a person with the help of video that may be captured through CCTV footage based on facial features. Video based face recognition system still have many challenges, such as image quality, video signal quality, visual scenes, and varying expression are some of the factors are major challenging in face recognition systems. The first step of a face recognition system is preprocessing. Image pre-processing takes the Signal Condition form such as noise removal, and normalization from the dissimilarity of pixel position or brightness, along with segmentation, location, or tracking of the face or its parts [9]. This process of recognizing a person is however dependent on image capturing from the devices such as, images, video cameras, surveillance cameras. The quality of image dependent on efficiency of camera, Camera and distance between the person, lightening conditions, whether the camera captured the person front face or not etc [1]. In this case pre-processing can give the better solution in face recognition system. In this work proposed a preprocessing technique for improving the accuracy of face detection and recognition. The second step of face recognition system is face detection. Based on the facial features an algorithm can easily identify the presence of a face in a video. Using enhanced viola Jones algorithm used to detect the face from an image based on facial features.

Main contribution of this research work:

- Input as video or surveillance. Convert the video as a frame for detection.
- To proposed the preprocessing technique for improving the recognition rate and reduce the noise from an image.
- To propose the face detection enhanced viola Jones algorithm. Crop the detected face.

This paper organized as follows: Section II explains about the related work already done by the previous researcher from the face recognition biometric system. It helps to motivate a new researcher. In section III describes what are all the material and methods are used this proposed work. Novelty method will be discussed in the proposed approach in section IV. Section V elaborates proposed approach techniques and result part. Finally section VI describes about concludes the work.

2 RELATED WORK

This section discusses about the various related works already done in preprocessing and also detection of face from the video in the field of face recognition system.

Nawaf Hazim Barnouti, observed the research study on increasing the brightness by adding 140 to each pixel further increases the recognition rate. Increasing the image brightness is efficient and gives significant result [2]. In this Preprocessing technique Image cropping. Image resize, brightness alteration are done. Increase the brightness by adding 140 to each pixel and at the same time resize the image using 0.3 scales will give...
the best recognition rates.

S. Anitha, Dr. V. Radha, based on this research the different preprocessing techniques like contrast adjustment, intensity adjustment, histogram equalization, binarization and morphological operation are used. These algorithms are evaluated using Peak Signal to Noise Ratio (PSNR) and Mean Square Error [MSE] [3].

Muhammad Sharif, Sajjad Mohsin, Muhammad Jawad Jamal, Mudassar Raza, observed the research study on illumination normalization preprocessing for face recognition system. This paper proposes two approaches such as, four segment approaches, two segment approaches [4]. The proposed technique is tested on Yale dataset and compared with Gamma correlation and Histogram equalization techniques. It gives the better result.

Alpika Gupta, Dr. Rajdev Tiwari, Researchers focused on detecting face images and locating the facial features in image. CMU and FERET images are taken as a dataset. Face detection is depend upon the face pattern which is used to match the face from the pattern recognition [5]. This paper proposed modified viola jones algorithm and detect the face from a particular image.

Bashir Muhammad and Syed Abd Rahman Abu-Bakar, This research presents a simple skin color segmentation based on HSV and YCbCr color models is used to extract the blocks of skin. Face detection algorithm in color images based on curvelet features. For classification task a trained SVM classifier using statistical features are used [6]. Based on this proposed work the result showed the proposed algorithm detects profile faces in color images.

P. S. Hiremath, Manjunath Hiremath, Observed the research study on developing the application of face detection and tracking of face in video sequence based on the fuzzy geometric face model and motion estimation. The face is detected by using feature extraction based on fuzzy geometric face model. The consecutive frames from a video and their optical flow are estimated, which is used to track the face from video sequence [8].

3 METHODS AND MATERIALS

This section describes the methods and materials needed for this research work. In section A explains about Preprocessing technique Peak signal to noise ratio (PSNR). And section B explains about enhanced viola jones face detection algorithm.

Preprocessing:

In this research Progressive Switching Median Filter, Hybrid median filter are compared with Peak signal to noise ratio (PSNR).

Progressive Switching Median Filter (PSMF):

PSMF is a median-based filter, its works in two stages. The first stage is an impulse detection algorithm it is used to create a sequence of binary flag images. These binary flag images are predicts the location of noise in the observed image [10]. The second stage is noise filtering is applied progressively through more than a few iterations.

Hybrid median filtering (HMF):

Hybrid median filter is a filter of non linear class, it easily reduce the impulse noise as preserving edges. Compared with basic median filter the hybrid has better corner preserving characteristics. For improving detection accuracy the PSFM and HMF techniques are compared with PSNR, PSNR got the better result compared with other techniques.

PSNR:

Peak signal to noise ratio is a commonly used image processing technique to compare two images. That based on Mean Square Error (MSE). Using mean square error subtracts the original image from the restored image. Square all the values and divided by the total number of pixels, it is elements by element squaring, every element would be squared. Calculating single value by adding all the rows all the columns and divide the output by the total number of pixels.

\[ MSE = \sum_{i,j} (Y(i,j) - \hat{Y}(i,j))^2 / MXN \]

In calculating MSE the original image take as x and then the restored image take as y. the total number of pixels which is stored in MXN.

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

In calculating PSNR, MSE already obtained above and then calculate log value.

Face Detection:

Face Detection is computer technology being used in variety of applications that identifies the faces in a digital image. In this research implement modified viola jones algorithm to detect the face image from a video the viola jones algorithm is a first ever real time face detection algorithm. Characteristics of viola jones algorithm which make it a good detection algorithm and high detection rate and also it have low false positive rate. It’s a real time algorithm and only face detection algorithm.

The efficiency of viola jones algorithm can be significantly increased by first generating the integral image.

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

The image integrals of area PQRS calculated as:
\[ || (YP,XP) + || (YQ,XQ) + || (YR,XR) + || (YS,XS) \]

Haar features:

Using haar features are applied on face image, to find out the image whether face image or not. Basically all human faces are having some similar properties this regularity may be matches using haar features. These features simply viewed as kernals which used for edge detection.

Haar features are similar to these convolution kernels which are used to detect the presence of that features in the
given image. Each haar features is the weighted sum of 2-D integral of small rectangular areas attached to each other. The weights may be take values either +1 or -1. Black region represent +1, the white region represent -1.

**Integral Image:**

In an integral image the pixel value \((x,y)\) is the sum of the pixel \(x,y\) above and to the left of \((x,y)\) [7]. Integral images allows for calculating the sum of all pixels inside any given rectangle using only four values at the corners of the rectangle.

![Integral Image Diagram](image)

**Fig 1:** Image area integration using integral image

- Here, let \(P, Q, R, S\) be the values of the integral image at the corner of a rectangle.
- The sum of original image values contained by the rectangle can be computed: \(\text{sum} = S - Q - R - P\), here only three additions are required for any size of a rectangle.

**Adaboost:**

Adaboost is a machine learning algorithm is used to eliminate the redundant features and finding the best features from all the others. Then those features are creating a weighted combination of all these features, which is used to evaluating and deciding any given window has a face image or not.

Each of the chosen features are accepted to be included if they can at least perform improved than random guessing. These features are also called weak classifier. The adaboost build a strong classifier as a linear combination of this weak classifier.

**Cascading:**

The basic principle of viola jones face detection algorithm. A cascade classifier is used which is composed of stages each containing a strong classifier. So all the features are grouped into several stages where each stage has certain number of features.

The trade of the each stage is used to determine whether a given sub window is definitely not a face or may be a face. If any one of the stage if it fails, a given sub window is immediately discarded as a not face.

**4 PROPOSED APPROACH**

This research paper, video dataset create own. The video is converted into frames, and then the selected frames are preprocessed using proposed technique. After completing the impulse detection and noise filtering the particular face is detecting using enhanced viola jones algorithm, using haar features to identify that particular image have the face image or not, if that image could not find a face again go to the select frame function then select another frame for further process. adaboost used for removing redundant features in an image. Once the face is detected then view the crop the face.

![System Flow Diagram](image)

**Fig 3:** System flow diagram
5 RESULTS AND DISCUSSION

Dataset description:
The dataset is taken from CCTV footage is created an own dataset. Dataset description was explained in below table. The input video converted into 24 frames, in that frames selected one best frame for detecting the face.

Table1: Dataset Description

<table>
<thead>
<tr>
<th>Dataset Name</th>
<th>Number of frames</th>
<th>Number of selected frames</th>
<th>Number of Detected face</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAM_03</td>
<td>24 frames</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CAM_05</td>
<td>24 frames</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CAM-6</td>
<td>24 frames</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

In this result section discuss about the results of removing noise using preprocessing techniques based on PSNR and face detection using enhanced viola jones algorithm.

Fig 4: Screenshot of processing steps for face detection, GUI window created in matlab
The above figure explains the process of preprocessing and face detection steps.

Fig 5: Screenshot of preprocessing

Fig 6: Rate of peaksnr

Fig 7: Screenshot of face Detection

Fig 8: Screenshot of Cropped face
Table 2: Accuracy of existing and proposed viola jones algorithm

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Accuracy %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viola jones algorithm</td>
<td>88%</td>
</tr>
<tr>
<td>Enhanced viola jones algorithm</td>
<td>96%</td>
</tr>
</tbody>
</table>

In this table shows accuracy of both algorithms, the enhanced viola jones algorithm produce better result compared with existing algorithm.

Fig 9: Accuracy of enhanced algorithm

The overall accuracy is intended by the following true /positive rates.

Accuracy = \( \frac{TP+TN}{TP+TN+FP+FN} \times 100\% = 96\% \).

6 Conclusion

In this paper dealt with face detection from video or surveillance camera. The research focused on improves the recognition rate in face recognition system and the proposed work is proposed PSNR preprocessing technique and enhanced viola jones algorithm. From the experimental analysis and results, proposed algorithm yields high accuracy. In future this work continues to extract the features and recognize the persons.

REFERENCES

