
“HUMAN FACE RECOGNITION SYSTEM USING RASPBERRY PI: A REVIEW”

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ABSTRACT: Face recognition is a basic task for applications such as face tracking, red-eye removal, face detection and face expression recognition. Face recognition is concern with finding a face in a given image data set or not and, if it is present, returns the image content of each face. Most of existing face detection algorithms consider a face detection as binary (two-class) classification problem. Even though it looks a simple classification problem, it is very complex to build a good face classifier. In this paper, we are going to study of human face recognition system that will capable of processing images very fast while acquiring very high true positive face detection rate using Raspberry Pi using various classifiers and algorithms. As per the comparative analysis, various face detection and recognition techniques has been developed which are used for different purpose with good positive result.

Keywords: Face Recognition, features extraction, Haar classifier, LBPH (Local Binary Pattern Histogram, Raspberry Pi.

1. INTRODUCTION

In modern digital era, for various kinds of application in many fields various biometric parameters are used, such as fingerprint scanning, eye bubble scanning, face recognition, voice recognition. But few of these are not much efficient or can be costly. Out of all these techniques, face detection and recognition is most commonly used for better security and authentication purpose as it is efficient than other authentication techniques. There are various platforms or tools available for image processing such as MATLAB, etc. MATLAB is widely used in image processing but it comes with some limitations e.g. we can't use MATLAB on small portable device it comes with some special system requirements. PC/Laptop is compulsory in case of MATLAB.

As Raspberry Pi is small portable device so using Raspberry Pi with the help of openCV, we can train image processing classifiers for the detection of human face and comparing detected image features with stored database of the authorized persons. If match found this means detected person is recognized and green bounding box is drawn around recognized face which will be labeled with that person's information and if no match found then detected face then red bounding box is drawn and labeled with Person Not Recognized. This provides us high detection and recognition rate with high accuracy.

2. OBJECTIVES

- 1) The main objective of this paper is to develop more accurate and face recognition system with true positive result.
- 2) Implementing LBP algorithm and Haar classifier together on small efficient portable device like Raspberry Pi for single purpose use we can process and detect face with good positive efficiency at high frame rate.
- 3) To develop portable system works implementable to any environment at low cost and less complex network.
- 4) This system helps to find unauthorized persons in any campus, industries, offices, etc.

3. BACKGROUND

As face detection and recognition gives better security so it is used widely in various applications. Different tools and platforms have been developed for this process. We have studied many references papers related to human face detection and recognition which explains different ways for face detection or recognition.

Krit Janard, et. al. [1] face detection in real-time is an essential procedure for achieving autonomous motion in telepresence robots. Author is addressing three contributions. First, the process to enabling the real-time face detection on Raspberry Pi's graphical processor is presented. Second, the development of an autonomous pan-tilt telepresence robot to follow an interlocutor face using

two Raspberry Pi-1 model B is demonstrated. Third, the evaluation on resource requirements when operating the robot in various scenarios is described. The results confirmed that vision-based autonomous motion can be added to low-cost telepresence robots with acceptable performance. Thus, making secure telecommunication via robots is viable with less budget constraint.

Pankaj R. Bhusari, et. al. [2] presenting the concept of 'Face Detection and Recognition' using Principal Component Analysis, Histogram Equalization, and Raspberry Pi Module. The main aspect of this is based on Principle Component Analysis. It uses Haar like features for detection and recognition of face from web cam or from stored images that will capable of processing images very fast while acquiring very high true positive face detection rate.

Timo Ahonen et. al. [3] presenting a novel and efficient facial image representation based on local binary pattern (LBP) texture features. As per this authors study the face image is divided into several regions from which the LBP feature distributions are extracted and concatenated into an enhanced feature vector to be used as a face descriptor. The performance of the proposed method is assessed in the face recognition problem under different challenges as per conclusion of author on the basis of experimental result.

Swathi V et. al. [4] implementing the simple and easy hardware for face detection system using Raspberry Pi, which itself is a minicomputer of a credit card size and is of a very low price. The system is programmed using Python programming language. Both real time face detection and face detection from specific images, i.e. Object Recognition, is carried out and the proposed system is tested across various standard face databases, with and without noise and blurring effects. Efficiency of the system is analyzed by calculating the Face detection rate for each of the database. The results reveal that the proposed system can be used for face detection even from poor quality images and shows excellent performance efficiency.

Md. Abdur Rahim et. al. [5] author has detected and recognized face using LBP. Main objective is to increase accuracy of detected face by extracting exact parameter of face for more efficient comparison. As face detection is widely used in many applications for proper authentication and authorization purpose. It has become very important aspect to recognize face with higher efficiency with good frame rate. Face representation represents how to model a face and determines the successive algorithms of detection and recognition. The most useful and the face and is used to measure similarities between images.

Sarabjit Singh et. al. [6] LBP is a base concept for face recognition and parameter extraction as LBP is really a very powerful method to explain the texture and model of a digital image. Therefore it was ideal for feature extraction in face recognition systems. A face image is first split into small regions that LBP histograms are extracted and then concatenated in to a single feature vector. In this paper, authors evaluate facial representation predicated on

statistical local features, Local Binary Patterns, for facial expression recognition.

Timo Ahonen, et. al. [7] focused on LBP for features extraction for face recognition. In this paper, face recognition which considers both shape and texture information to represent face images. The face area is first divided into small regions from which Local Binary Pattern (LBP) histograms are extracted and concatenated into a single, spatially enhanced feature histogram efficiently representing the face image. Experiment results show that this scheme is superior using various methods (PCA, Bayesian Intra/extrapersonal Classifier and Elastic Bunch Graph Matching) on FERET tests which include testing the robustness of the method against different facial expressions, lighting and aging of the subjects. In addition to its efficiency, the simplicity of the proposed method allows for very fast feature extraction.

Rajashree Tripathy et. al. [8] implement "a real time Face detection and tracking using Haar Classifier through Raspberry Pi which is a combination of SoC. SimpleCV and OpenCV libraries are used for face detection and tracking the head poses position. From the captured image features are extracted for comparison for face detection. The main objective of this is to detect face from HD streaming video. The result was computed by using computer vision, SimpleCV and OpenCV. With the advancement the real time face detection in remote monitoring is helpful for building many efficient industrial and commercial applications.

R. Padilla et. al. [9] use Haar Cascade Classifiers for face detection, recognizing an individual by the face is an easy task for humans; it is a challenge for vision-based automated systems. In the past years a lot of effort has been made in the field of face detection. The human face contains important features that can be used by vision-based automated systems in order to identify and recognize individuals. Face location, the primary step of the vision-based automated systems, finds the face area in the input image provided to system. As per author, evaluation of these classifiers will help researchers to choose the best classifier for their particular need. This work focuses of the evaluation of face detection classifiers minding facial landmarks.

G. Senthilkumar et. al. [10] image capturing technique in an embedded system based on Raspberry Pi. The author is considered the requirements of image capturing and recognition algorithm, Raspberry Pi processing module and its peripherals, implementing based on this platform, finally actualized Embedded Image Capturing using Raspberry Pi system. As per authors result it useful embedded computing can extract information from images without need for an external processing unit devices used to make results available to other devices for further processing or for any other applications.

As per results by author shows that designed system is fast enough to run the image capturing, recognition algorithm, and the data stream can flow smoothly between the camera and the Raspberry Pi board.

Sander Soo [11] Object detection is an important feature the help of a Haar-cascade classifier. The benefits of object detection is however not limited to someone with a doctorate of informatics. Instead, object detection is growing deeper and deeper a helping wherever needed. In this paper, the main focus will be on the case study of a vehicle detection and counting system and the possibilities it will provide in a semi-enclosed area both the statistical kind and also for the common man. The goal of the system to be developed is to further ease and augment the everyday part of our lives. With the use of Haar cascade classifier, object

detection becomes efficient and worthy for image processing.

Brian O'Connor et. al. [12] an efficient algorithm for face recognition with the use of Local Binary Pattern and random forest. This paper mainly focused on modified local binary pattern, which combines both the sign and magnitude features for the improvement of facial texture classification performance, is applied. Also, RF is used to select the most important features from the extracted feature sequence.

4. COMPARATIVE ANALYSIS

Sr. No.	Title	Authors	Method/Technique Used	Advantages	Limitation
1	Accelerating Real-time Face Detection on a Raspberry Pi Telepresence Robot	Krit Janard, Worawan Marurngsith	Viola-Jones detector, Haar classifier, LBP algorithm Raspberry Pi 1B Robot	[1] all telepresence robot operations [2] Real time face detection	Requires higher bandwidth for faster communication which affects cost
2	Real Time Face Detection and Recognition System	Pankaj R. Bhusari, Vrushali G. Raut	PCA Algorithm, Haar features	[1] Real time faces detection and recognition very efficiently. [2] calculation speed is high	Sometimes in real time image capture in dark region get noisy.
3	Face Description with Local Binary Patterns: Application to Face Recognition	Timo Ahonen, Abdenour Hadid, and Matti Pietikainen	LBP component-based face recognition	novel and efficient facial representation	image blurring caused by imaging device
4	Raspberry Pi Based Human Face Detection	Swathi.V, Steven Fernandes	Histogram Equalization.	[1] high efficiency [2] In poor quality images, Image detection is very efficiently	Various noises may affect detected image
5	Face Recognition using Local Binary Patterns (LBP)”	Md. Abdur Rahim, Md. Najmul Hossain, Tanzillah Wahid & Md. Shafiul Azam	LBP, Pattern recognition, histogram, feature vector	LBP covering various features of face parameters for detection and recognition	Difficult to understand
6	A Face Recognition Technique using Local Binary Pattern Method	Sarabjit Singh, Amritpal Kaur, Taqdir	LBP histogram, Local Binary Patterns, Feature Extraction, LBP code.	Covering every feature of face for detection	Image detection is based on environment condition
7	Face Recognition with Local Binary Patterns	Timo Ahonen, Abdenour Hadid, and Matti Pietikainen	PCA, Bayesian Intra/extra personal Classifier and Elastic Bunch Graph Matching	[1] Very fast feature extraction.	-----
8	Real-time Face Detection and Tracking Using Haar Classifier on SoC	Rajashree Tripathy, R N Daschoudhury	Cascade Haar classifier, Viola Jones Algorithm, OpenCV	[1] Works with less CPU resource [2] Performs at shorter time.	Gives too many false positives.

5. METHOD

We can implement a system using LBP, Haar Classifier and Viola-Jones algorithm Python language as programming language on Raspberry Pi 3 model B for Human face recognition in real time for true positive face detection and recognition with higher efficiency. LBP extracts features of human face and calculates region of interest for recognition purpose. Recognized face is shown with Green Bounding Box with information of that person and not recognized person with Red Bounding Box with Not Recognized label.

6. CONCLUSION

LBP is really a very powerful method to explain the texture and model of a digital image. Haar Classifiers for face detection and recognition is very efficient tool for features extraction and for image processing. Python language is very easy language for the system programming used especially. Raspberry Pi is small sized portable credit card sized low cost device with good specifications for efficient for human face detection and recognition efficiently with low cost and less complex system. Using LBP with Haar classifier on Raspberry Pi makes an efficient system for human face recognition in real time with true positive result. In this paper, we studied human face recognition system that will capable of processing images very fast while acquiring very high true positive face detection rate using Raspberry Pi using various classifiers and algorithms.

7. APPLICATIONS

Human face recognition system can be used in different fields such as

- 1) In school colleges for attendance purpose.
- 2) In industries, offices, factories, restricted areas for entrance of authorized persons only.
- 3) In highly secured laboratory or in research center for authentication and authorization of permitted member only.

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