Human Face Detection & Recognition Using Raspberry Pi
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Abstract—Face detection is concerned with finding whether or not there are any faces in a given image and, if present, returns the image location and content of each face. Security and surveillance are the two important aspects of human being. In this paper we propose face detection and recognition system that will capable of processing images very fast while acquiring very high true positive face detection rate. Most face detection algorithms are designed in the software domain Band have a high detection rate, but they often require several seconds to detect faces in a single image, a processing speed that is insufficient for real-time applications. This paper describes a simple and easy hardware implementation of 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.

Keywords—Face Detection, Haar Like Feature, Yale Data Base, Principal Component Analysis, Histogram Equalization, Raspberry Pi Module.

I. INTRODUCTION
In associations, enterprises and many organizations are taking the whole participation utilizing RFID techniques, registers, Moodle based understudy ID recognizable proof and unique finger impression modules. In registers, the whole participation will be figured and reports will be assembled toward the end.

It requires greater investment for computation. RFID innovation disentangles customized remote utilizing advanced inactive and dynamic with distinguishing pieces of proof suitable purusers. In brief span, worth's of dispersion and usage for a RFID card based passage bunch framework can be fairly costly. An RFID based passage bunch framework has the capability of genuinely abusing human’s security or protection. RFID procedures at last impacts programming that permits each individual to be broke down by essential information base. This kind of condition will be under assault of programmers. In the event that the RFID per user and recipient are not legitimately coordinated then less read rate can happens. Biometric time and nearness framework is one of the most precise prerequisite in biometric innovation.

Unique finger impression acknowledgment based participation administration framework is a running field today, yet acknowledgment of singular unique finger impression from an arrangement of selected fingerprints is a period taking procedure. Most unique finger impression based participation frameworks store the fingerprints of a client in the unique mark module database. The unique mark framework does not uncover any information about the first unique mark of the client. This suspicion has now been appeared to be false; numerous calculations [6] have been expressed that can reestablish unique mark pictures from particulars layouts.

These biometric frameworks, RFID frameworks and Moodle based understudy ID recognizable proof frameworks are close to home recognizable proof frameworks utilized for participation administration frameworks and numerous security frameworks. In resulting days for any frameworks security, protection what's more, exactness are basically ascertaining parameters yet these frameworks are damaging security and off base. In this way, it is imperative to outline a framework with exceedingly secured and exact.

1. Open CV
Open CV 'open source PC vision library' is an open source picture preparing library made by Intel 8109 what's more, kept up by Willow carport accessible for C, C++, what's more, Python. OpenCV is need a compiler like DevC++, code squares, visual C++. In this paper
utilizes C++ dialect furthermore, DevC++ compiler. In OpenCV there are four modules. Predominantly utilized are CV: primary OpenCV capacities, picture handling calculations, vision calculations and highgui: GUI capacities, Image and Video I/O. Utilizing this OpenCV, we will stack pictures caught by camera. These pictures are in three configurations paired picture, dark scale picture and shaded picture. The hued picture contain R G B with pixel values containing 0-255. It has profundity of the picture with 8 bits and 3 channels. For stacking the picture utilizing Open CV, the taking after program is utilized.

2. Raspberry Pi
The raspberry pi 2 is a little Mastercard measured PC that attachments into screen, console or touch show. The Raspberry pi 2 display B is utilized as a part of this venture also, it gives six times the handling velocity of other past models. The raspberry pi 2 demonstrate B has Broadcom BCM2836 processor. BCM2836 is high fueled ARM cortex-A7 based quad-center processor and keeps running at recurrence of 900MHz with memory ability to 1Gbyte. It has 40 stick GPIO Header for interfacing the outside gadgets to speak with processor. The correspondence media's resembles I2C, CAN, SPI and in this extend GSM is utilized by direct association with TRX and RXI sticks in GPIO. It has quad USB ports, 10/100 BaseT Ethernet attachment, DSI Display connector, Micro SD card space, 5v Micro USB, HDMI port, CSI camera connector what's more, 4-shaft 3.5mm jack All of these are appeared in Figure ‘1.

3.1 PCA
Essential segment examination (PCA) was imagined in 1901 by Karl Pearson. PCA is a variable diminishment system and helpful when gotten information have a few repetition. This will come about into lessening of factors into more modest number of factors which are called Principal Components which will represent the most of the change in the watched variable. Issues emerge when we wish to perform acknowledgment in a high-dimensional space. Objective of PCA is to diminish the dimensionality of the information by holding as much as variety conceivable in our unique informational collection. Then again dimensionality diminishment infers data misfortune. The best low-dimensional space can be controlled by best primary parts.

The real preferred standpoint of PCA is utilizing it in eigenface approach which helps in lessening the span of the database for acknowledgment of a test pictures. The pictures are put away as their component vectors in the database which are discovered anticipating each what's more, every prepared picture to the arrangement of Eigen appearances acquired. PCA is connected on Eigen confront way to deal with decrease the dimensionality of a vast informational index.

3.2 Self Organisation Map
T. Kohonen presented the Self-Organizing Map (SOM) [1]. It is an unsupervised learning process, which takes in the conveyance of an arrangement of examples with no class data. It has the property of topology protection. There is an opposition among the neurons to be initiated or terminated .The outcome is that as it were one neuron that wins the opposition is terminated and is called champ takes all neuron. SOMs might be one-dimensional, two-dimensional or multidimensional, yet the most widely recognized ones are it is possible that one-dimensional or two-dimensional maps. The quantity of information associations relies on upon the quantity of credits to be utilized as a part of the order. The neuron with weights nearest to the information vector is announced the victor amid the preparation. At that point the weights of the greater part of the neurons in the area of the triumphant neuron are balanced by an sum conversely corresponding to the separation. It bunches and orders the informational index in view of the arrangement of qualities utilized. The calculation is outlined.

3.3 LBPH (Local Binary Pattern Histogram)
Neighborhood Binary Pattern (LBP) highlights has performed extremely well in different applications, including surface characterization and division, picture recovery and surface review. The first LBP administrator
marks the pixels of a picture by thresholding the 3-by-3 neighborhood of every pixel with the focus pixel esteem and considering the outcome as a parallel number. Figure 2 demonstrates a case of LBP estimation.

![LBP estimation example](image)

**Fig 2. Case of LBP estimation**

The 256-container histogram of the names figured over a picture can be utilized as a surface descriptor. Each container of histogram (LBP code) can be viewed as a smaller scale texton. Nearby primitives which are classified by these canisters incorporate diverse sorts of bended edges, spots, level territories, and so on.

3.4 HAAR Classifiers

The core basis for Haar classifier object detection is the Haar-like features. These features, rather than using the intensity values of a pixel, use the change in contrast values between adjacent rectangular groups of pixels. The contrast variances between the pixel groups are used to determine relative light and dark areas. Two or three adjacent groups with a relative contrast variance form a Haar-like feature. Haar-like features, as shown in Figure 1 are used to detect an image. Haar features can easily be scaled by increasing or decreasing the size of the pixel group being examined. This allows features to be used to detect objects of various sizes.

1. **Edge features**
   
   ![Edge features examples](image)

   **Fig. 3 Haar Classifiers**

   ![Haar Classifiers examples](image)

   Introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

II. LITERATURE REVIEW

Sonam Shukla, Pradeep Mishra suggested increasing the Accuracy of an Existing Fingerprint Recognition System Using Adaptive Technique, in this approach developer mainly focusing on Integrated Automated Fingerprint Identification Service (IAFIS) of the most famous police agencies. They extracted fingerprint pattern is characterized by a set of ridgelines that often flow in parallel, but intersect and terminate at some points. The uniqueness of a fingerprint is determined by the local ridge characteristics and their relationships. Main drawback of this model is this approach is not so apt for real time applications but the accuracy of system is highly adaptable. Most automatic systems for fingerprint comparison are based on minutiae matching. Le Hoang Thai and Ha Nhat Tam in 2010 suggested Fingerprint recognition using standardized fingerprint model, now a days, fingerprint recognition is one of the most Important biometric technologies based on fingerprint distinctiveness, in this approach they focused on improving the quality of fingerprint images. In fingerprint recognition process, the important step which affects on system accuracy is matching between template and query fingerprint. Many solutions are designed to increase this step’s accuracy these matching algorithms may be classified into three types: minutiae-based approach, correlation-based approach and feature-based approach. However, as analyzed, the score of these algorithms is not high (especially in case fingerprints are of the same finger but they are rotated or the intersection is too small). So, it’s Necessary to design a model to standardized fingerprint template in order to improve matching score. Mukesh Kumar Thakur, Ravi Shankar Kumar, Mohit Kumar, Raju Kumar suggested Wireless Fingerprint Based Security System Using Zigbee Technology. This approach functions based on the uniqueness of each person and it integrating the biometric device along with zigbee to transmit the information obtained in this approach they are using fingerprint extraction and matching algorithm and they maintaining the database to authenticate the person who approaching for the access through the online web page created in the local server. In recent years face recognition has received substantial attention from researchers in biometrics, pattern recognition, and computer vision communities. The machine learning and computer graphics communities are also increasingly involved in face recognition. This
common interest among researchers working in diverse fields is motivated by our remarkable ability to recognize people and the fact that human activity is a primary concern both in everyday life and in cyberspace. Besides, there is a large number of commercial, security, and forensic applications requiring the use of face recognition technologies. These applications include automated crowd surveillance, access control, mugshot hot identification (e.g., for issuing driver licenses), face reconstruction, design of human computer interface (HCI), multimedia communication (e.g., generation of synthetic faces), and content-based image database management. A number of commercial face recognition systems have been deployed, such as Cognate, Eyematic, Viisage, and Identix. Facial scan is an effective biometric attribute/indicator. Different biometric indicators are suited for different kinds of identification applications due to their variations in intrusiveness; accuracy, cost, and ease of sensing [9] (see Fig. 1(a)). Among the six biometric indicators considered in, facial features scored the highest compatibility, shown in Fig. 1(b), in a machine readable travel documents (MRTD) system based on a number of evaluation factors.

Global 2002 industry revenues of $601 million are expected to reach $4.04 billion by 2007, driven by large-scale public sector biometric deployments, the emergence of transactional revenue models, and the adoption of standardized biometric infrastructures and data formats. Among emerging biometric technologies, facial recognition and middleware are projected to reach $200 million and $215 million, respectively, in annual revenues in 2005.

Face recognition scenarios can be classified into two types, (i) face verification (or authentication) and (ii) face identification (or recognition). In the Face Recognition Vendor Test (FRVT) 2002, which was conducted by the National Institute of Standards and Technology (NIST), another scenario is added, called the 'watch list'.² Face verification (“Am I who I say I am?”) is a one-to-one match that compares a query.

### III. SYSTEM FUNCTIONALITY OR WORK FLOW

![Fig. 5 flow Chart](image)

- **Step 1:** Webcam: used for to take the Driver Face image.
- **Step 2:** The first stage of any vision system is the image acquisition stage. After the image has been obtained, various methods of processing can be applied to the image to perform the many different vision tasks required today.
- **Step 3:** The images used in the analysis are resized in different scales to determine how various sizes affect the recognition process. Different image sizes carry different information that’s why the best image size needs to be examined in details. The purpose of image resizing is to produce a lower data size, which hastens the processing time. The resize scale randomly varies from 0.1 to 0.9 value, which produces different image sizes. Fig 3 shows an example of image resizing with a scale of 0.5. Resizing the image to a small scale can lead to the loss of many important features, especially if the image texture is used.

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during classification. Fig 4 shows an example of the feature lost when the image is seized with a scale of 0.25.

Step 4: When converting an RGB image to grayscale, we have to take the RGB values for each pixel and make as output a single value reflecting the brightness of that pixel. One such approach is to take the average of the contribution from each channel.

Step 5: Contrast is an important factor in any subjective evaluation of image quality. Contrast is created by the difference in luminance reflected from two adjacent surfaces. In other words, contrast is the difference in visual properties that makes an object distinguishable from other objects and the background.

Step 6: Filtering is a technique for modifying or enhancing an image. For example, you can filter an image to emphasize certain features or remove other features. Image processing operations implemented with filtering include smoothing, sharpening, and edge enhancement.

Step 7: The phase consists of capture image; Detect faces in the image, feature extraction, template comparison, declaration of matching template. The acquisition of face images can be done by acquiring the real time image. Haar classifier algorithm scans the image and creates a bounding box as returns for each detected face.

Step 8: A region of interest (ROI), is a selected subset of samples within a data set identified for a particular purpose.

Step 9: The first LBP administrator marks the pixels of a picture by thresholding the 3-by-3 neighborhood of every pixel with the focus pixel esteem and considering the outcome as a parallel number.

Step 10: Machine learning algorithms are often categorized as being supervised or unsupervised. Supervised algorithms can apply what has been learned in the past to new data.

IV. METHODOLOGY

1. Image Acquisition

The main phase of any vision framework is the picture securing stage. After the picture has been acquired, different strategies for handling can be connected to the picture to play out the wide range of vision assignments required today. Be that as it may, if the picture has not been gained palatably then the expected assignments may not be achievable, even with the guide of some type of picture improvement.

Fig. 6 block diagram

2. Pre-processing

While changing over a RGB picture to grayscale, we need to take the RGB values for every pixel and make as yield a solitary esteem mirroring the shine of that pixel. One such approach is to take the normal of the commitment from each channel: (R+B+C)/3. Be that as it may, since the apparent splendor is frequently ruled by the green segment, an alternate, more "human-situated", strategy is to take a weighted normal, e.g.: 0.3R + 0.59G + 0.11B.

An alternate approach is to give the weights access our averaging be reliant on the genuine picture that we need to change over, i.e., be versatile. A (fairly) straightforward go up against this is to frame the weights so that the subsequent picture has pixels that have the most difference, since pixel change is connected to the differentiation of the picture. In the applet over, the "ideal projection" figures how we ought to join the RGB diverts in the chose picture to make a grayscale picture that has the most change. [For the all the more actually propelled; we discover the weights by taking the important eigenvector of the specimen covariance framework of the RGB channels.

Picture improvement strategies have been broadly utilized as a part of numerous utilizations of picture preparing where the subjective nature of pictures is vital for human translation. Complexity is an essential calculate any subjective assessment of picture quality. Differentiation is made by the distinction in luminance reflected from two nearby surfaces. At the end of the day, complexity is the distinction in visual properties that makes a protest recognizable from different articles and the foundation. In visual discernment, differentiation is controlled by the distinction in the shading and shine of the protest with
different articles. Our visual framework is more delicate to differentiate than supreme luminance; in this manner, we can see the world comparatively paying little mind to the impressive changes in light conditions. Numerous calculations for achieving contrast upgrade have been produced and connected to issues in picture preparing. In this address we will discuss differentiate upgrade. Straight and non-direct change capacities, for example, picture negatives, logarithmic changes, control law changes, and piecewise straight changes will be talked about. Histogram process and histogram of four fundamental dim level attributes will be presented.

Separating is a strategy for adjusting or upgrading a picture. For instance, you can channel a picture to underscore certain components or evacuate different elements. Picture handling operations executed with separating incorporate smoothing, honing, and edge upgrade.

Sifting is a neighborhood operation, in which the estimation of any given pixel in the yield picture is dictated by applying some calculation to the estimations of the pixels in the area of the relating input pixel. A pixel's neighborhood is some arrangement of pixels, characterized by their areas with respect to that pixel. (See Neighborhood or Block Processing: An Overview for a general discourse of neighborhood operations.) Linear filtering is separating in which the estimation of a yield pixel is a direct mix of the estimations of the pixels in the information pixel's neighborhood.

3. Face Detection
Open CV as of now give a calculation to find confronts in still picture and recordings stream as specified in segment III. Haar classifier calculation checks the picture and makes a bouncing box as returns for each distinguished face. The element extraction in face location is finished by limiting of the qualities of face parts (i.e., eyes, mouth, nose and so on) in a picture. In different terms, the component extraction is a stage in face identification and acknowledgment where the framework finds certain focuses on the countenances, for example, corner and focal point of the eyes, tip of the nose, mouth and so forth. It breaks down spatial geometry of differential component of a face. Consequence of this breaking down is an arrangement of layout produced for each face. The format comprises of a lessened arrangement of information which speak to the constant face identified in limited box. The format examination is finished with the layout put away in the database. Two stages are there in this stage ID and confirmation. These two term ID to distinguish the face continuously video and check application for face acknowledgment which investigate of this paper. The last period of face identification is to proclaim the most elevated coordinating score brought about the past stride. The setup will decide how the application ought to carry on in view of the coveted security and operational thought.

4. Region of Interest
A region of interest (often abbreviated ROI), is a chosen subset of tests inside a data set identified for a specific purpose. The idea of a ROI is usually utilized as a part of numerous application ranges. For instance, in medical imaging, the limits of a tumor might be characterized on a picture or in a volume, with the end goal of measuring its size. The endocardial outskirt might be characterized on a picture, maybe amid various periods of the cardiovascular cycle, for instance end-systole and end-diastole, with the end goal of surveying heart work. In geographical data systems (GIS), a ROI can be taken truly as a polygonal determination from a 2D outline. In computer vision and optical character acknowledgment, the ROI characterizes the borders of a protest under thought. In numerous applications, typical (literary) marks are added to a ROI, to depict its substance in a conservative way. Inside a ROI may lie individual points of intrigue.

5. LBPH (Local Binary Pattern Histogram)
Neighborhood Binary Pattern (LBP) highlights has performed extremely well in different applications, including surface characterization and division, picture recovery and surface review. The first LBP administrator marks the pixels of a picture by thresholding the 3-by-3 neighborhood of every pixel with the focus pixel esteem and considering the outcome as a parallel number. Figure demonstrates a case of LBP estimation.

6. Machine Learning Predict
The process of machine learning is similar to that of data mining. Both systems search through data to look for patterns. However, instead of extracting data for human comprehension -- as is the case in data mining applications -- machine learning uses that data to detect patterns in data and adjust program actions accordingly. Machine learning algorithms are often categorized as being supervised or unsupervised. Supervised algorithms can apply what has been learned in the past to new data. Unsupervised algorithms can draw inferences from datasets.

V. EXPERIMENTAL RESULT
Raspberry Pi has enough power for HD video and image manipulation, and can be connected to the Arduino board. Connected to Raspberry Pi, Arduino can be used as a control unit while Raspberry Pi processes video images.
Raspberry Pi features include Bluetooth and Wi-Fi wireless technologies and this is the shortcut to display images directly on the Android device.

VII. FUTURE SCOPE

Using raspberry pi the current project can be modified by an Infrared camera interfacing it can be used in Smart Surveillance Monitoring security system which any type of public security is using Living body detection or spying, Also it can be used in Attendance system of the class, Also some profound applications can be implemented using interfacing of Raspberry pi and Arduino UNO board like sensor application of smartcard swapping, finger detection, alcohol detection, agriculture humidity sensing, Temperature sensing using web server, and many more.

VIII. CONCLUSION

A face detection system using Raspberry Pi was developed. The system was programmed using Python programming language. Both Real time face detection and face detection from specific images, i.e object recognition, was carried out. The proposed system was tested across various standard face databases such as At&T, Caltech, Indian Face Database, JAFFE, YALE B, Face94, Face95, Face96, Grimace etc with and without noise and blurring effects. The efficiency of the system was analyzed in terms of face detection rate. The analysis revealed that the present system shows excellent performance efficiency and can be used for face detection even from poor quality images.

REFERENCES


