FACIAL RECOGNITION ALERT SYSTEM

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ABSTRACT

Now a days security is a high concern at various places like home, bank, office, ATM etc. thus we have amalgamate our proposed system with idiosyncrasy. The proposed system "FRAS- Facial Recognition Alert System " detects face and recognizes the face of the person standing outside using Pi-Camera. If the detected face does not match the one saved in database then an alert along with image would be sent onto owner's mail account to verify identity. The proposed system scan through the unique identity (like Aadhar card) of the person to audit their authenticity. Once authenticated, the required action can be taken. Thus, the proposed system FRAS would be a complete solution towards secure system providing security against thefts and other attacks.

KEYWORDS: Face recognition, Raspberry Pi, Histogram Equalization, Haar Cascade Classifiers.

In present world, security is the high rated concern of everybody. People can go to every extent to safeguard themselves and their family. They hire security guards and install cameras to protect themselves from theft. But sometimes installing cameras is not sufficient. Hence, to ensure complete security, an integrated security system has been proposed known as FRAS- Facial Recognition Alert System for home, bank, office etc.

The proposed system works by identifying and recognizing the human face and then matching it with the information stored in database. If the image matches, then the person is authenticated else not.

Face recognition technique can be implemented via various approaches like [1]:

Template Matching Methods: Here various different pattern of human face is saved to identify facial expressions. The input image and saved image are matched for detection.

Appearance Based Methods: In this, the model or templates are generated from a set of training images. These generated images are then used for detection.

Knowledge Based Methods: This method includes the knowledge acquired to determine the facial features. The rules used for this method are used to capture the relationship between facial features.

Feature Invariant Approaches: In this approach detection of face starts with extraction of features and finding the face of person and then verifying it with the person. Different features exist during different pose or lighting conditions and this approach focuses on extracting facial features during different conditions [2].

Why Gray Scale Image?

In Gray Scale Image, the value of each pixel is single sample. This sample contains black and white intensity where black has weakest intensity and white has strongest intensity. After that gray scale image is converted into binary image. This method is called Binarization.

This provide high Security Solution to people. The proposed system will provide the ease to keep a check on every visitor and maintain a database. .

LITERATURE REVIEW

In [3], author tells that real time identification systems are important for security and surveillance purposes. Authors discussed that human identification can be performed by analyzing the biometric information, such as face, fingerprints, iris, palm prints etc. However, the fast and most effective solution is facial recognition because of easy implementation and low fraud detection rate.

In [4], author tells that most facial detection algorithms are designed in the software domain and have a high success rate, but these algorithms often require several seconds to detect face of the person [5]. Due to the complexity of mathematical methods involved in the algorithms, these algorithms generally use dimension reduction to improve computation performance but results in high cost. Therefore, authors discussed about use of hardware system such as Raspberry Pi for effective and low cost solution for face detection.

In [6], authors discuss that to recognize face, first step is to detect the face and then compare it to the set of known individuals present in the dataset to verify the identity of the person. Face recognition method can be classified as two main approaches [7]: Geometric

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approach and Holistic approach. In geometric approach, we analyze various features by means of their relationship. First step is preprocessing the input image to remove the noise, and then extraction of facial features such as eyes, mouth, nose etc., and then measurement of the geometric relationship between those facial points and conversion of the image into vector of geometric features. Holistic method use the global information instead the local information of the face. We represent the entire image with some small key values, derived from the pixel information of face images. Small key values help to uniquely differentiate individual faces.

In [8], author tells that designed system can be operated in two different sessions, first session to capture and creating the dataset and second session for identification and comparison of images in the dataset. Second session use Eigen face method of face recognition for finding the matches in the datasets.

PROPOSED ALERT SYSTEM

The proposed system consists of both hardware unit and software unit. A general block diagram for the proposed system is as shown below.

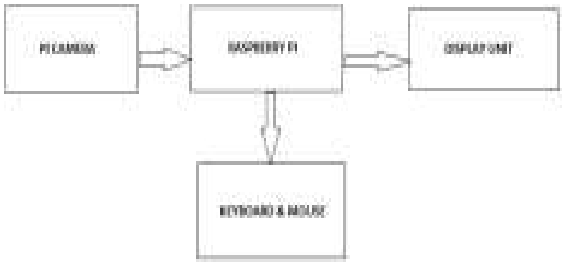

Figure 1: Block diagram of proposed system

The system consists of Raspberry Pi. We make use of Raspberry Pi 3 model which has a size specification as 85.60 mm x 56.5 mm x 17 mm. It has 1GB built in RAM with 4 USB ports and an Ethernet port. It also has a built in Bluetooth and WIFI facilities.

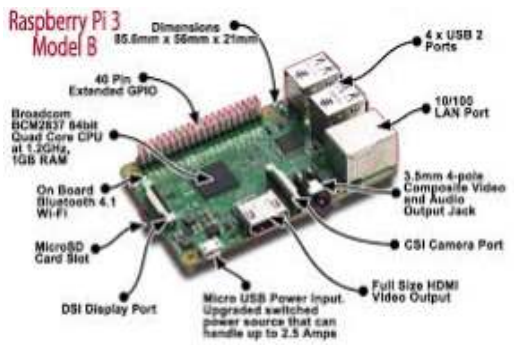

Figure 2: Raspberry Pi 3 Model B, as seen in [9]

The system is developed using Python Programming language. The system use OpenCV which is library of programming functions mainly aimed at real time computer vision i.e. to obtain information from digital images.

Need for FRAS?

There are various applications of facial recognition like home automation system, phone locking and unlocking, ATM, stadium etc. In order to recognize a face we first have to detect the face and then compare it with the one stored in database. Once the image is captured, next step is to convert the image into Gray Scale Image. Since the original captured image is colored thus it is important to convert the image into gray scale image.

Working Of FRAS

The eigenfaces approach to face recognition involves following steps:

1. Collect a set of characteristic face images of the known individuals. This set should include a number of images of each person, with some variation in expression and in the lighting(Say five images of ten people, so N=50).
2. Evaluate the (50 x 50) matrix M and find its eigenvectors and eigenvalues , choose the N' eigenvectors with maximum associated eigenvalues(Say N'=10).
3. Combine the normalized training set of images to produce eigenfaces.
4. For each available individual, calculate the class vector by taking mean of eigenfaces pattern vector calculated from images of original individual. Choose a threshold that defines a maximum allowable distance from any face class and a threshold that defines maximum allowable distance from face space.
5. For Each new face image to be identified, calculate its pattern vector, the distance to each known class and the distance to face space and classify image "unknown" if distance between face class is less than that of face space.
6. If the new image is classified as a known individual, this image may be added to the original set of familiar images and recalculate eigenfaces.

The following flowchart represents the working of the proposed model-FRAS:

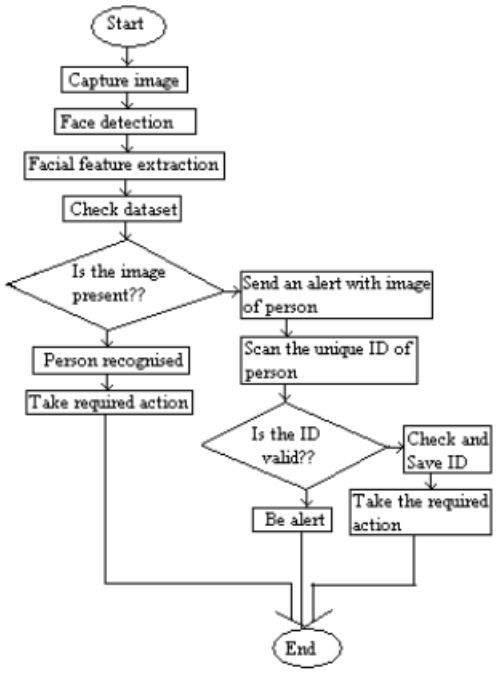

Figure 3: Flowchart representing FRAS functioning.

The following four- stage process illustrates the working of FRAS- Facial Recognition Alert System:

Working – A physical or behavioral sample is capture by the system during enrollment i.e. image is captured by Pi-Camera.

Extraction - Unique data i.e. facial feature like mouth, nose, eyes are extracted from the sample and a template/dataset is created.

Comparison–The template/dataset is than compared with the new image taken by the Pi-Camera.

Matching - The system then decides if the feature extracted from the new sample matches or not with the one stored in the dataset.

If the template/dataset matches then the face is recognized by the system otherwise not. If the face is not recognized, an alert is send to owner via registered mail by the system as well as system may ask unrecognized person to provide unique identity like UIDAI-Aadhar Card for the verification purposes.

Templates are created by performing Histogram Equalization on the captured image. Histogram Equalization is a method of contrast adjustment using the image histogram.

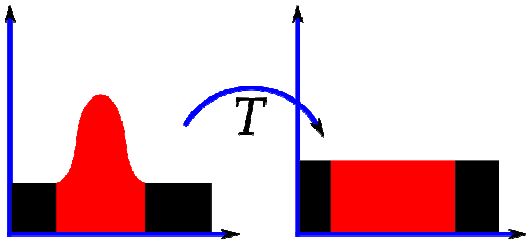

Figure 4: Histogram of an image before and after equalization, as seen in [10].

Haar Classifier is used for image calculation process.

WHAT IS HAAR-CASCADE CLASSIFIER?

Haar Classifier is generated by training few hundred sample views of a particular image, called positive examples, that are scaled to same size, and negative examples- arbitrary image of the same size. After a classifier is trained, it is applied to region of interest in an input image. The classifiers outputs as "1" if the region is likely to show the object (i.e., image), and "0" otherwise. Here the word 'cascade' means that final classifier consists of various simple classifier that are applied one after the other to the area of interest till the detected face is rejected or passed completely.

The algorithm uses given haar features:

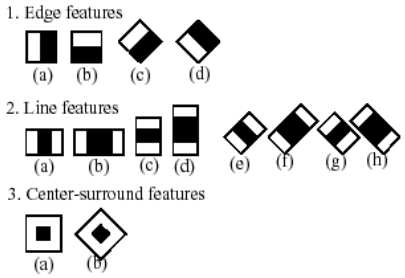

Figure 5. Features used by haar classifier, as seen in [11]

When any of these features is found, the algorithm allows face candidate to move on to the next stage of detection. A face candidate [12] is a rectangular part of the original image called sub-window. This sub-window is arranged to attain a variety of different size of faces. The algorithm uses an internal image [13] in order to process Haar features of face candidate in constant time. It uses a cascade of stages which is used to remove non-face candidate immediately.

Each stage contains different Haar features and each of these features is classified by Haar feature classifier.

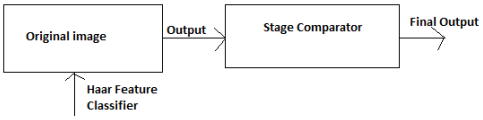

Figure 6: Haar classifier

Stage comparator [14] adds the output of the Haar features classifier and compares this value with a stage threshold to check if the stage should be passed or not. If all the stages are passed successfully then the face candidate is said to be a face.

WHAT ARE HAAR FEATURES?

Haar features [15] are digital image features used in face recognition. It considers neighboring regions at a specific location in a detection window, adds up the pixel intensifies in each region and calculates the difference between these sums.

Advantage- The main advantage is its calculation speed because to the use of integral images, a Haar feature of any size can be computed in constant time.

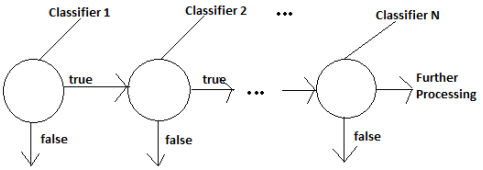

Figure 7: Cascade of stages.

RESULTS

We have proposed an integrated security solution system which works on facial recognition using Raspberry Pi and Pi-Camera. If the intruder is detected it will send an alert to the owner via mail to take required action. Thus it is mistakable for ATM, home, offices, stadiums, etc. to increase the security.

CONCLUSION

The biggest benefit and advantage of FRAS is that it can't be fooled by beards, makeups, etc. As it works by comparing facial marks and features with the already stored dataset. Authentication of the visitor is done via the image captured by camera and then scanning the unique ID (like "Aadhar Card") of the visitor. Thus, it is a one point security solution.

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