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Criminal Identification and Alert System

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ABSTRACT: The project aims to identify the criminals in any investigation department. The technique is to make a databasewhich already stores images of the criminals in the system along with their details and those images are segmented into many slices of eyes, hairs, lips, nose, etc. These images are again stored in another database record to identify the criminals since matching the images would prove the required point.When a person has to be identified the images stored in the database are compared with the existing details. The project also provides a very friendly environment for operator to easily identify criminals. The concept of Eigen faces is used to identify the faces. The basic aim of this project is to develop a method of face recognition that is fast, robust, reasonable, simple and accurate with an ease to understand algorithms and techniques

KEYWORDS: Principal component analysis, Eigen vector, Eigen faces, Biometrics.

I.INTRODUCTION

The sole motive behind the technology is making criminal identification easier and this project is a step towards achieving that goal.This paper brings together new algorithms and insights to construct a framework for robust and extremely rapid visual detection. In other face detection systems, auxiliary information, such as image differences in video sequences, or pixel colour in colour images, have been used to achieve high frame rates [1]. We developed a system that is very useful for any investigation department. The images captured from camera will be stored to the storage device through the processor. If some similarities are found in the photos, the website or web portal will send information and the department will get notified regarding the same.

In face recognition, the algorithm used is PCA (principal component analysis), MPCA (Multi linear Principal Component Analysis) and LDA (Linear Discriminant Analysis) in which we recognize an unknown test image by comparing it with the known training images stored in the database as well as give information regarding the person recognized.Face recognition can be applied for a wide variety of problems like human- computer recognition, criminal detection, image processing, film processing etc. Face detection is a difficult and challenging task so we need some real time application to detect the criminals around us. In order to do so we thought of implementing Eigen faces algorithm which was developed by M. Turk and A. Pentland in 1991.

II.SYSTEM MODEL AND ASSUMPTIONS

In the step of system design, the system estimates hardware resources required and the implementation choice of either hardware or software. In our system all the subsystems will be implemented on software and hardware. Face detection is the first step of face recognition as it automatically detects a face from a complex background to which the face recognition algorithm can be applied. But detection itself involves many complexities such as background, poses, illumination etc. There are many approaches for face detection such as, colour based, feature based (mouth, eyes, nose), neural network. The approach studied and applied in this thesis is the skin colour based approach. The algorithm is pretty robust as the faces of many people can be detected at once from an image consisting of a group of people.

The algorithm used for image matching are explained in detail as follows:

1. Principal component analysis (PCA):PCA involves a mathematical procedure that transforms a number of possibly correlated variables into a number of uncorrelated variables call led principal components, related to

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the original variables by an orthogonal transformation. This transformation is defined in such a way that the first principal component has as high a variance as possible (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it be orthogonal to the preceding components. It is the simplest approach which can be used for data compression and face recognition and it operates at a faster rate.PCA can be done by eigenvalue decomposition of a data covariance (or correlation) matrix or singular value decomposition of a data matrix, usually after mean centering (and normalizing or using Z-scores) the data matrix for each attribute [2].The results of a PCA are usually discussed in terms of component scores, sometimes called factor scores (the transformed variable values corresponding to a particular data point), and loadings (the weight by which each standardized original variable should be multiplied to get the component score) [3].

2. Multi linear Principal Component Analysis (MPCA): It is the extension of PCA that uses multi linear algebra and proficient of learning the interactions of the multiple factors like different viewpoints, different lighting conditions and different expressions the first step in developing anything is to state the requirements.MPCA is employed in the analysis of n-way arrays, ie a cube or hyper-cube of numbers, also informally referred to as a "data tensor". The MPCA solution follows the alternating least square (ALS) approach [4]. It is iterative in nature. As in PCA, MPCA works on centered data. Centering is a little more complicated for tensors, and it is problem dependent.

III. PRODUCT DESIGN STRATEGY.

To overcome the drawbacks that were in the existing system we developed a system that will be very useful for any investigation department. The images captured from camera will be directly transferred to receiving section via Wi-Fi module. If the matching of the photos are found, the website or web portal will send information and the department will get notified.

The transmitter section is having USB camera, Raspberry-pi, GSM Module, Wi-Fi module and power supply which is shown in fig. 1. The USB camera will be turned on as per the instructions given by Raspberry-pi. The power supply of +5.1V is given to the transmitter. As the raspberry-pi is continuously working it needs consistent power supply. The camera will capture the image of detected face and send to processor. The program will keep matching the captured images with stored database of images. If the image is matched a message as “Criminal detected” will be printed on screen. The number of image will be noted in computer. As soon as the “Criminal detected” message is printed, the Raspberry-pi will send the image number along with message as “Criminal detected” on the registered phone number via GSM Module. At the same time, image will be transferred to the receiver section via Wi-Fi. The block diagram of the transmitter is shown in the fig. 1 which follows.

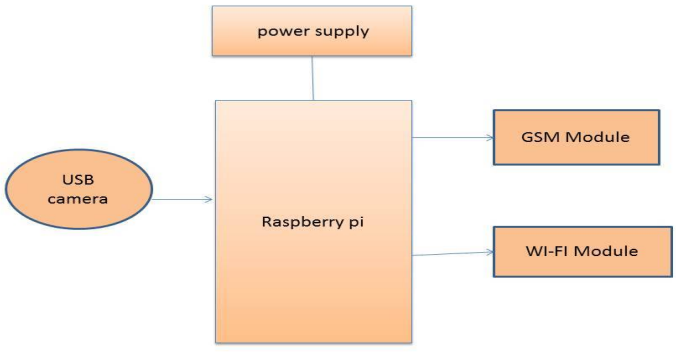

Fig 1: Transmitter Section

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Our approach treats face recognition as a two-dimensional recognition problem. In this scheme face recognition is done by Principal Component Analysis (PCA).Facial recognition technique is newly developed into two areas: facial metrics and Eigen faces. Facial metrics technology relies on the measurement of the specific facial features (the systems usually look for the positioning of the eyes, nose and mouth and the distances between these features)[5]. Face images are projected onto a face space that encodes best variation among known face images. The face space is defined by Eigen face which are eigenvectors of the set of faces, which may not correspond to general facial features such as eyes, nose and lips. The Eigen face approach uses the PCA for recognition of the images. The system performs by projecting pre extracted face image onto a set of face space that represent significant variations among known face images. Face will be categorized as known or unknown face after matching with the present database. If the user is new to the face recognition system then his/her template will be stored in the database else matched against the templates stored in the database. The variable reducing theory of PCA accounts for the smaller face space than the training set of face.

Biometrics is used in the process of authentication of a person by verifying or identifying that a user requesting a network resource is who he, she, or it claims to be, and vice versa. It uses the property that a human trait associated with a person itself like structure of finger, face details etc. By comparing the existing data with the incoming data we can verify the identity of a particular person there are many types of biometric system like fingerprint recognition, face detection and recognition, iris recognition etc., these traits are used for human identification in surveillance system, criminal identification. Advantages of using these traits for identification are that they cannot be forgotten or lost. These are unique features of a human being which is being used widely.

PCA is a variable reduction procedure and useful when obtained data have some Redundancy. This will result into reduction of variables into smaller number of Variables which are called Principal Components which will account for the most of the variance in the observed variable. Problems arise when we wish to perform recognition in a high-dimensional space. Goal of PCA is to reduce the dimensionality of the data by retaining as much as variation possible in our original data set. On the other hand dimensionality reduction implies information loss. The best low-dimensional space can be determined by best principal components.

The major advantage of PCA is using it in Eigen face approach which helps in reducing the size of the database for recognition of a test images. The images restored as their feature vectors in the database which are found out projecting each and every trained image to the set of Eigen faces obtained. PCA is applied on Eigen face approach to reduce the dimensionality of a large data set. The algorithm of working of PCA is shown in the below Fig. 2 as it shows how the images are obtained and are converted into positives and negatives before they are cropped accordingly.

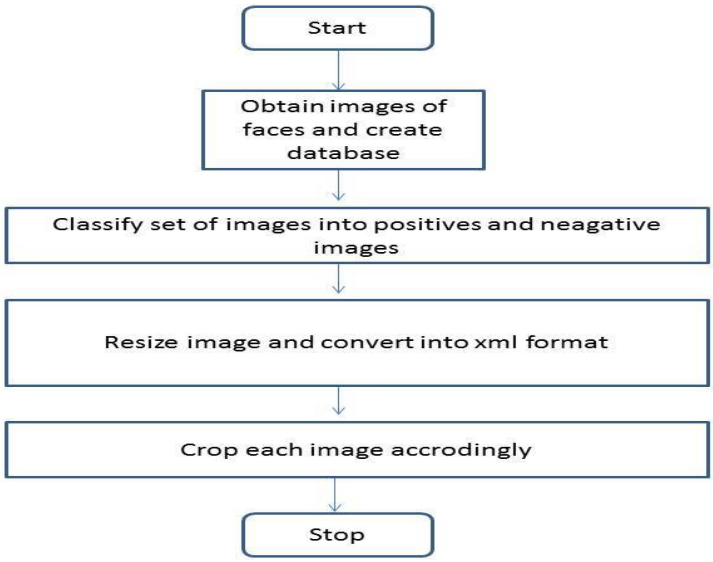

Fig 2: Flowchart of PCA

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The Eigen faces are Principal Components of a distribution of faces, or equivalently, the Eigen vectors of the covariance matrix of the set of the face images, where an image with N by N pixels is considered a point in N 2 dimensional space. Previous work on face recognition ignored the issue of face stimulus, assuming that predefined measurement were relevant and sufficient. This suggests that coding and decoding of face images may give information of face images emphasizing the significance of features.

Over the last few decade lots of work is been done in face detection and recognition [5] as it's a best way for person identification [6] because it doesn't require human cooperation [7] and a simple approach to extracting the information content in an image of a face is to somehow capture the variation in collection of face images. We wish to find Principal Components of the distribution of faces, or the Eigenvectors of the covariance matrix of the set of face images. Each image location contributes to each Eigen vector, so that we can display the Eigen vector as a sort of face. Each face image can be represented exactly in terms of linear combination of the Eigen faces. The number of possible Eigen faces is equal to the number of face image in the training set. The faces can also be approximated by using best Eigen face, those that have the largest Eigen values, and which thereforeaccount for most variance between the set of face images. The primary reason for using Fewer Eigen faces is computational efficiency.

In linear algebra, the eigenvectors of a linear operator are non-zero vectors which, when operated by the operator, result in a scalar multiple of them. Scalar is then called Eigen value (λ) associated with the eigenvector (X). Eigen vector is a vector that is scaled by linear transformation. It is a property of matrix. When a matrix acts on it, only the vector magnitude is changed not the direction.$AX = \lambda X$, where A is a vector function. $(A - \lambda I)X = 0$, where I is the identity matrix. This is a homogeneous system of equations and form fundamental linear
Algebra. We know a non-trivial solution exists if and only if-$Det(A - \lambda I) = 0$, where det denotes determinant. When evaluated becomes a polynomial of degree n. This is called characteristic polynomial of A. If A is N by N then there are n solutions or n roots of the Characteristic polynomial. Thus there are n Eigen values of A satisfying the equation. [2]

$AXi = \lambda iXi$, where i = 1,2,3,.....

if the Eigen values are all distinct, there are n associated linearly independent eigenvectors, whose directions are unique, which span an n dimensional Euclidean Space.

The working as a whole can be understood by the flowchart belowin the Fig. 3. It describes the process extensively about how the system works as a whole to detect the faces of the criminals. After the camera device is initialized alongside the GSM and Wi-Fi module, it captures the images and compares it with the stored data. If the face is matched it notifies the user about the findings and send the required data, otherwise displays a negative comment.

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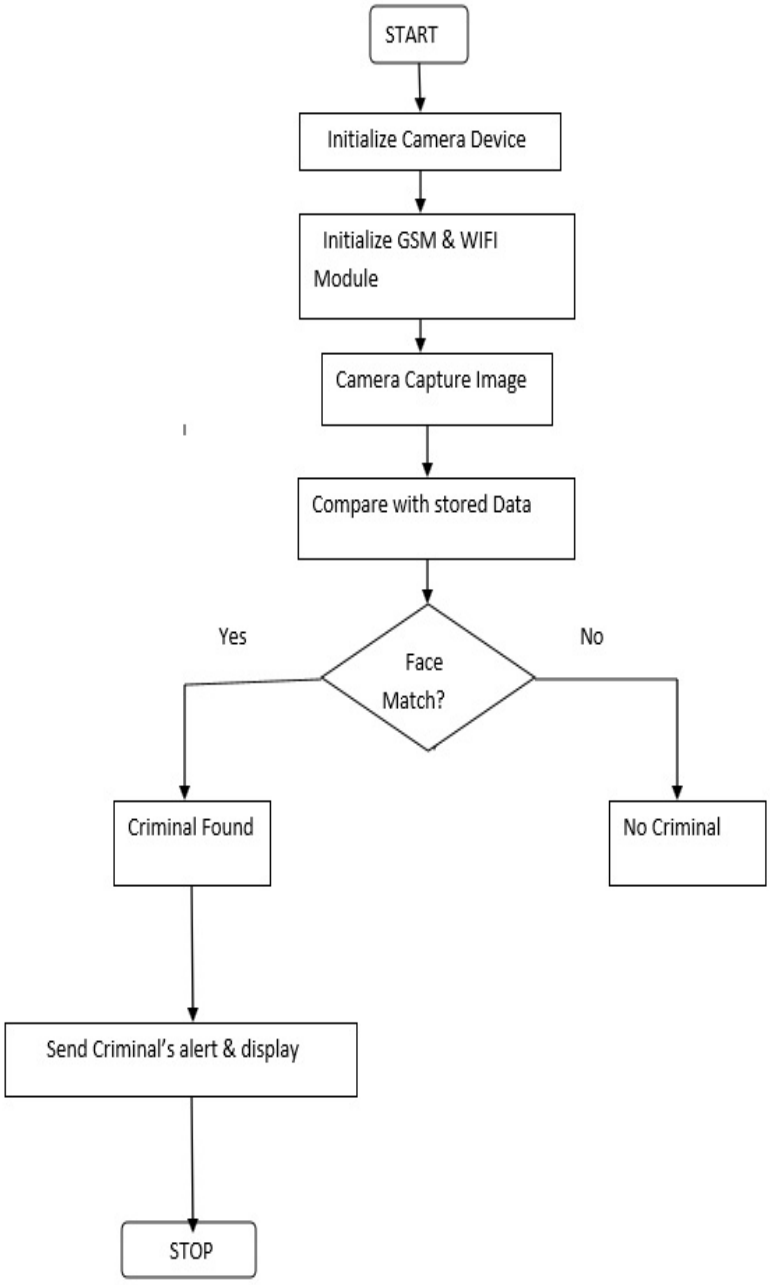

Fig 3: Flowchart of the system

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IV. RESULT AND DISCUSSION

Database for different set of conditions is maintained. Ten different expressions for ten different people thus creating a 10x10 that is equal to 100 different set of Face images. Rotated images in left and right direction and different illumination conditions are also considered while making the training set. Size variations in input face image can also change the output therefore input images by varying their size are also taken for recognition.

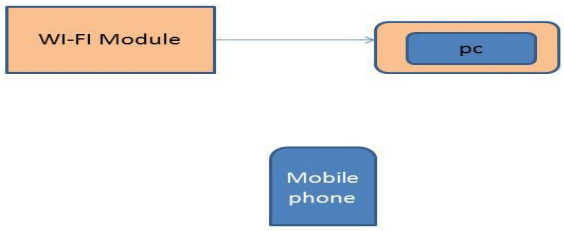

Fig 4: Receiver section

The above Fig. 4 is the working of receiver which is essential to retrieve the results on the screen. The Wi-Fi module can distribute the required data on both the computer screen and mobile thus making the system robust. On the based observations of PCA algorithm and raspberry-pi processor image matching can be effectively done with less operating time and latency since Raspberry Pi has 700 MHz frequency. The objective of developing project is achieved. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using advanced Processor with the help of the growing technology is used. This system will overcome workload for department. This will also help to concentrate on minor crime cases .There is no centralized system for tracking criminals with quick response in India.It is possible to achieve powerful pattern classification performance despite the simplicity of the operation involved [8]. So overall this system will be useful for finding out the criminal with less efforts. Face recognition has always been a very challenging task for the researches. On the one hand, its applications may be very useful for personal verification and recognition. On the other hand, it has always been very difficult to implement due to all different situation that a human face can be found [9].

The fig. 5 results are the actual figures from the screen on which our project was tested. It keeps on scanning through a set of images until the required parameters are matched as it can be seen in the figure. 5.

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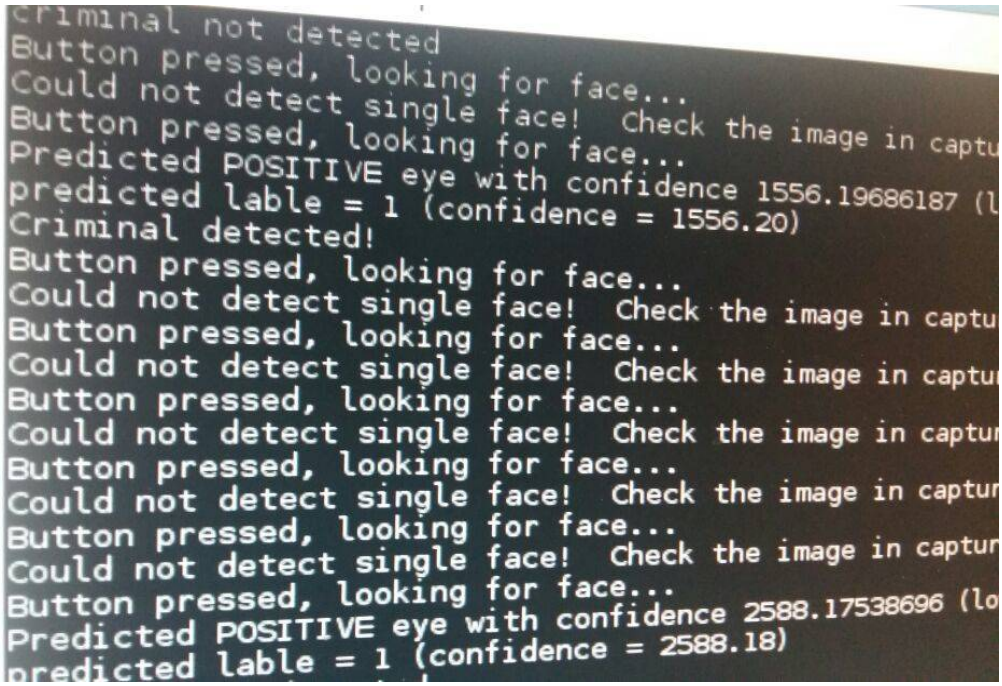

Fig 5: Results on the screen

VI.CONCLUSION

The project satisfactorily detects the criminal faces that can be helpful for the police sector in the society. We have presented an approach for face detection which minimizes computation time while achieving high detection accuracy.But this technique can be again modified and improved and thus can be beneficial for many other purposes for the betterment. We should be able to detect criminal photos of any size in the future. Also, by selecting any one cropped part of the criminal, the full image of the criminal could be recovered along with the details. The system has vast applications in medical identification, criminal records, banks and office securities if improved.

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