SPY SECURITY SYSTEM USING IMAGE PROCESSING

C.Thirumaraiselvi[1] Dr R.Sudhakar[2] Priyadharshini.G[3] Kalaivani.G[4]
Assistant Professor[1] Professor and Head[2] PG Scholar[3 4]
Dept of ECE[1 2 3]
Sri Krishna College of Engineering and Technology[1 3 4], Dr.Mahalingam College of Engineering and Technology[2]
Selvi_chand@gmail.com[1], sudha_radha2000@gmail.com[2], abipriya04@gmail.com[3]
kgkalai60250@gmail.com[4]

Abstract- **Now a days human-machine interaction is moving away from mouse and pen and is becoming pervasive and much more compatible with the physical world. In this project to establish fully secured system in ATM and other important territories like war fields we have designed an algorithm in mat lab. The signals of the controller Module are controlled by the Microcontrollers. Face detection is done by, the histogram based tracker which uses the PCA algorithm that provides the capability to identify an object using a histogram of pixel values. Our approach treats face recognition as a 2D recognition problem. Face images are projected onto a face space. The best changes among the face images are encoded by this face space. The face space is defined by eigen faces which are eigenvectors of the set of face images, which may not coincide with general facial features such as eyes, nose, and lips. The eigen face approach exercises the PCA for recognition of the images. The system performs by projecting pre extracted face image onto a set of face space that expresses the important changes among known face images. Face will be categorized as known or unknown face after comparing with the stored database.**

Key terms: **Principle Component Analysis, Eigen vectors, Eigen face**

I. INTRODUCTION

The need for maintain the security of information or physical property is becoming both increasing important and increasingly difficult in today's networked world. There are several crimes like credit card fraud, computer break-in by hackers or security breaches what we are hearing time to time in companies and government buildings. The criminals are taken advantages by conventional access control system such as keys, passwords, PIN numbers, ID cards etc where it does not have grant access by 'who we are' but 'what we have'. This means that they can easily authenticate us without knowing whether someone steals (or) able to access our data or our personal property any time they need. So, that recently a technology named "Biometrics" became available to allow verification of "true" individual identity. Some of physiological characteristic such as fingerprint or facial feature or some aspects of the person's behavior, like hand writing style or key stroke pattern , we can verify or recognize the identify a person by biological characteristic. When compare to behavioral category [keystroke, voice pattern], the physiological methods in biometric ID methods. Because of the physiological feature are not-alterable others than severe injury. But there may be some fluctuate in behavioral patterns such as stress, fatigue (or) illness. Though physiological factors are stable, the behavioral ID have advantages of non-intrusiveness.

In recent years, face recognition has been used in many wide applications. Identification and Verification are two main aspects of face recognition .The image of unknown person is matched with the gallery of known people in the identification task. The task of deny the identity claimed by the identified person is verified in verification task. The goal is to find whether the given two images are matched (or) not. Both identification and verification process are addressed in this paper. Face recognition under well-controlled acquisition condition is relatively mature and provide high rates in recognition though there are large number of image in the gallery.

In this paper we are using two face recognition algorithm namely Eigen face and Principal component analysis (PCA). By seeing the experimental results of proposed work, the efficiency of the images are very highly increased.

II. EXISTING METHOD

A. Minimization Approach for shape from shading

One of the older methods for recovering the surface gradient was the minimization approach for SFS (shape from shading). Each pixel in an image provides one gray value and each surface point provides two unknowns for surface gradients, there will be underdetermined system. To overcome this, two constraints are introduced namely brightness constraint and smoothness constraint. The brightness constraint requires that the reconstructed shape to produce the similar brightness as that of the input image at each surface point, whereas the smoothness constraint ensures a smooth surface reformation. To ensure a correct convergence, the initialization process is provided with the shape at the filling boundary. Since the gradient at the filling boundary has at least one infinite component, stereographic projection was used to transform the error function to a different space. Surface slopes are estimated from the iterative process and it was expressed in terms of linear combination of a finite set of orthogonal Fourier basis functions. The emphasize of integrability was done by projecting on non-integrable surface slope estimates onto the nearest integrable surface slopes. This projection was perfected by finding the nearest set of coefficients which satisfy integrability in the linear combination.

Then the smoothness constraint is replaced with the integrability constraint to overcome the slow convergence and also which indicates that the intensity gradients of the reconstructed image and the input image are proximate to each other in both the x and y directions.

B. Propagation Approach

A characteristic strip in an image is the line along which the surface depth and orientation can be computed. The shape information is propagated at same time along the characteristic strips outward, assuming no crossover of adjacent strips. The direction of characteristic strips is described as the direction of intensity gradients. In order to get a dense shape map, new strips have to be admitted when neighboring strips are not close to each other.

It has been observed that the shape of surface can be restored from singular points instead of the filling boundary. Based on this idea it is solved using numerical method.

C. Local Approaches

Local approach reconstructed the shape information from the intensity and its first and second derivatives. It is assumed that the surface is locally spherical at each point. Under the same spherical assumption, the slant and tilt of the surface in the source of light coordinate system is computed by using the first derivative of the intensity.

D. Linear approach

This approach used the linear approximation of the reflectance concern in terms of the surface gradient and applied a Fourier transform to the linear function to get a nearest form solution for the depth at each point. The discrete approximation of surface is applied and then linear approximation of reflectance in terms of depth is employed. This algorithm reconstructed the depth at each point.

E. 3D Morphable approach

This model is generally employed from a set of 3D laser-scanned heads. To reduce the artifacts, the scans are first registered in a dense point-by-point correlation, by using an optical-flow algorithm. The principle component analysis which is a statistical signal processing techniques are applied on the shape and texture features of the training samples in order to acquire a feature subspace. The feature subspace that includes the shape and texture feature vectors can be glanced as a generic 3D face model. Given that the model, a rational human face can be expressed as a convex combination of the shape and texture vectors. A method is presented for face recognition against variations in pose, ranging from frontal to profile views, and beyond a wide range of illuminations, that including cast shadows and specular reflections. To narrate for these variations, the algorithm simulates the method of image formation in 3D space, 3D shape and texture of faces from single image. The main aim of recognition algorithms is to separate the characteristics of a face that are determined by the elemental shape and texture of the facial surface, from the random conditions of image generation. This approach estimates all 3D scene parameters which automatically include head position and orientation, focal length of the camera, and illumination direction. This approach increases robustness and reliability of the system.

F. Structure from Motion

Structure-from-motion (SFM) is a prominent approach to retrive the 3D shape of an object when numbers of frames for a sequence of images are available. Given a set of observations of 2D feature points, SFM can evaluate the 3D structure of the feature points. This method can be used to factorize the rigid and non-rigid 3D structure of objects from a set of 2D point tracks. Earlier the factorization approaches to recover the shape of rigid objects from an orthographic camera. There is an alternative optimization method by introducing extra constraints and forcing the deformation to be as small as possible.

III. PROPOSED METHOD

A. Principle Component Analysis

PCA is used to measure the data in terms of principal components i.e., in which direction the data is more variance and spread out. It is variable decrement procedure and useful when obtained input data has some tautology and best low dimensional space can be determined. It is stated as reducing large number of variables into small number of variables. In high dimensional space there always arises a problem for performing recognition. The main aim of PCA is to minimize the dimensionality of the data by recovering the original data as much as possible. Information loss is caused because of reduction in dimensionality. Eigen face approach is the major advantage of PCA which helps in decreasing the size of the database for recognition of test images.

The images are stored in the form of the feature vectors in the database for matching trained image with the set of obtained Eigen faces. Then the dimensionality is reduced by applying the eigen face approach – PCA.

B. Eigen face approach

It is suitable and efficient method to be used in face recognition because of its simplicity, speed and learning capability. It is the appearance based approach for the face recognition. Eigen face method is speed and easy learning method so that it is used as adequate and efficient method for face recognition. It is a set of eigen vectors that are used in computer vision problem. This method seeks to capture the variation in a collection of face images that is refer to an appearance based approach for face recognition. Thus the faces are encoded and compared using this information in holistic manner. The eigen faces are found by using principal components of several distributions of faces. Here the images with N by N pixels are considered a point in N 2-dimensional space where the eigen vectors are taken covariance matrix. Face stimulus are ignored in the previous work on face recognition since they assume there will be relevant and sufficient measurement. By extracting the relevant information of a face image and encoding with the faces that are in database. In this proposed work , the eigen vector of the covariance matrix are found for set of face images are found foe set of face images by using principal component analysis. Here each image location contributes to each eigen vector so that it is displayed in linear combination of eigen faces. The number of face image in the training set will be equal to possible eigen faces. From all possible eigen faces, those who have the largest eigen values are taken into account to find the variance between set of face images. Eigen faces are used because it has high computational efficiency.

C. Eigen values and Eigen vectors

The eigenvectors of a linear operator are non-zero vectors which, when operated by the

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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.

$AX_i = \lambda_i X_i$, where i = 1 ,2,3,.....n

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.

E. Eigen Face Space

The Eigen vectors of the covariance matrix AA^T are AX^iwhich is denoted by U^i. U^iresembles facial images which look ghostly and are called Eigen faces. Eigen vectors correspond to each Eigen face in the face space and discard the faces for which Eigen values are zero thus reducing the Eigen face space to an extent. The Eigen faces are ranked according to their usefulness in characterizing the variation among the images.

A face image can be projected into this face space by

$\Omega_k = U^T(\Gamma_k - \Psi)$; k=1,....,M, where $(\Gamma_k \Psi)$ is the mean centered image.

Hence projection of each image can be obtained as Ω_1 for projection of $image_1$ and Ω_2 for projection of $image_2$ and hence forth.

Recognition Step

The test image, Γ, is projected into the face space to obtain a vector, Ω as

$$\Omega = U^T(\Gamma - \Psi)$$

The distance of Ω to each face is called Euclidean distance and defined by

$\epsilon_k^2 = ||\Omega - \Omega_k||^2$; k = 1,,M where Ω_k is a vector describing the $k^t h$face class. A face is classified as belonging to class k when the minimum $_k$ is below some

chosen threshold Θ_c. otherwise the face is classified as unknown.

Θ_c, is half the largest distance between any two face images:

$\Theta_c = (1/2)max_{j,k}||\Omega_j - \Omega_k||$; j,k = 1 ,.....,M

We have to find the distance between the original test image Γ and its

reconstructed image from the Eigen face Γ_f

$\epsilon^2 = ||\Gamma - \Gamma^f||^2$, where $\Gamma^f = U * \Omega + \Psi$

If $\epsilon \geq \Theta_c$ then input image is not even a face image and not recognized.

If $\epsilon < \Theta_c$ and $\epsilon_k \geq \Theta$ for all k then input image is a face image but it is

recognized as unknown face.

If$\epsilon < \Theta_c$ and $\epsilon_k < \Theta$ for all k then input images are the individual face image

associated with the class vector Ω_k.

SIMULATION RESULTS

Matlab 2011a is used for coding. A colored face image is converted to grey scale image as grey scale images are easier for applying computational techniques inimage processing.


(a)


(b)

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Figure 1: (a) A colored face image. (b) Grey scale face image

A. Training Set

Template for different set of image 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 a input face image can also change the output therefore input images by varying their size are also taken for recognition.

Fig 2. A single face image for ten different expressions

B. Testing Conditions

Figure 3. Image in reduced light intensity

Expression- When an expression of a person is changed the orientation of face organs are changed according to it thus changing the feature vectors accordingly. Therefore a changed expression alters the recognition procedure. Illumination- Different intensity of light on face may change the recognition just as bright light causes image saturation. Size variation- If the size of image is varied the recognition may alter accordingly.

C. Face Recognition Using Eigen Faces

Face Image Testing

A test image for recognition is tested by comparing to the stored data set.

Figure 4. 200 × 200 image as input

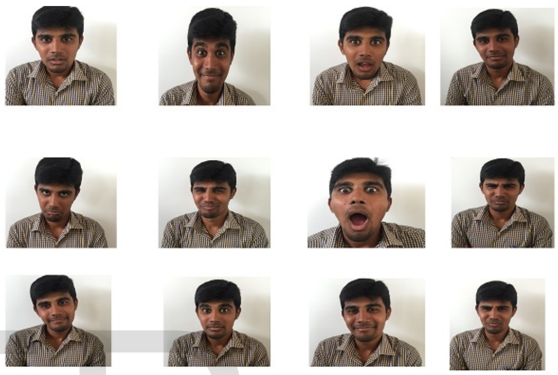

Figure 5. 3X4 set

Mean Face

Mean face is obtained by $\Psi/M)\sum_{i=1}^{M}\Gamma_i$= (1 where $\Gamma_1, \Gamma_2, \Gamma_3, \ldots, \Gamma_n$ are training set images and hence mean centered images are also evaluated by $\Phi_i = \Gamma_i - \Psi$ for further computations.

Figure 6. Mean face

Eigen Face

The eigenvectors corresponding to the covariance matrix define the Eigen face which has a ghostly face like appearance and a match is found if new face is close to these

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images.

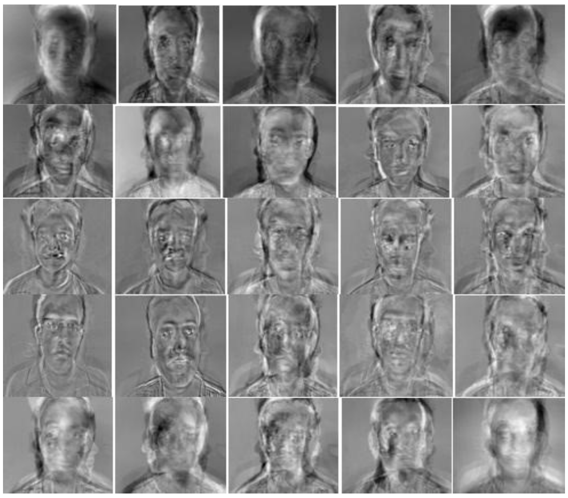

Fig. 7. Eigen face ranked according to usefulness

Fig 7. Face recognition result

Six different images for each mentioned condition were taken to test for ten different people. Light intensity is tried to keep low. Size variation of a test image is not altered to much extent. We can observe that normal expressions are recognized as face efficiently because facial features are not changed much in that case and in other cases where facial features are changed efficiency is reduced in recognition.

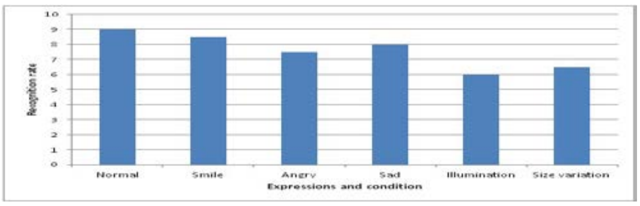

Fig 5.2: Output for different expressions and conditions

CONCLUSION

In this paper the face recognition using PCA and Eigen vectors approach design has been implemented by using MATLAB software. The designed method has worked for different input images under different conditions. The method has successfully identified the human face by matching the input query image and the image stored in database. However the system faces a problem that is change in recognition rate is not applicable. The future work is to fix this problem and make the system to be adaptable for the change in recognition. The system should be capable of withstanding the several cryptographic attacks.

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