Unlocking Electronic Lock using Biometrics

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Abstract—Being an engineering student, it often happens students have to carry a lot of things to college: mini drafter, project models, football, laptop et cetera. There is always a chance of breaking, losing these things while travelling to and from college. Students forget their assignments and submissions on their due dates. So out of curiosity we began wondering about possibility of having lockers in our college. How better it would be for students! All the unwanted stuff for the lecture can be stuffed inside the lockers till the time required. So this project aims at implementing a way to control electronic lock in the locker to unlock when the user has his identity identified by using biometrics. Biometrics is a growing research and development field. By using biometrics for user identity verification in our project we are encouraging ourselves to explore the field of biometrics which has tremendous potential in the near-future .

Keywords— *Biometrics, Face recognation, Face Detection, Eigenface, locker system*

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I. INTRODUCTION

With more and more people using the Internet and Computer technology in business, work and daily life, Information security has hit center stage of the digital era. Although information security is a complex challenge, user authentication (also called verification) is essential to the protection of information systems. Authentication is the first and most critical link in the information security chain. It is used to prevent unauthorized users from gaining access to systems and data resources. The objective is to enhance the level of system security by checking the user's identity.

Biometrics is a science that focuses on using measurable human physiological, behavioral, or genetic characteristics to reliably distinguish one person from another [1]
Physiological biometric traits are collected from direct measurements of the human body, which include fingerprints, hand geometry, retina, iris and facial images. On the other hand, behavioural biometric traits, such as signature, keystroke rhythms, gait pattern and voice recordings (which also has a physiological component), are measured by analyzing a specific set of actions of a person.
From another perspective, biometrics can be further defined as either active or passive, based on the level of user involvement when capturing the biometric traits. Passive biometrics does not require the user to actively submit a measurement, while active biometrics does need the cooperation of the user .

II. PROPOSED SYSTEM

Our vision is to create an efficient unlocking solution for electronic lock which can validate user identity using user's biometric data. The biometrics verification does not need big computers and servers as database. A laptop has enough processing power to carry out biometric verification using various algorithms. We have developed a user monitoring demonstration system with an off-the-shelf webcam running on either a laptop or desktop computer. It performs face detection and facial recognition. A locker system with servo mechanism is implemented which is very secure for college environment. The face is captured by the laptop webcam and that face is compared with the images in the database. If the image matches then a wireless signal is given to the aurdino via zigbee to the servo motor. The aurdino will control the motor of the locker and thus it will lock and unlock the lock of the locker.

III. LITERATURE SURVEY

Appearance-based methods-The templates in appearance-based methods are learned from the examples in the images. In general, appearance-based methods rely on techniques from statistical analysis and machine learning to find the relevant characteristics of face images. Some appearance-based methods work in a probabilistic network. An image or feature vector is a random variable with some probability of belonging to a face or not. Another approach is to to define a discriminant function between face and non-face classes. These methods are also used in feature extraction for face recognition and will be discussed later.Nevertheless, these are the most relevant methods or tools:ˆ
Eigenface-based. Sirovich and Kirby developed a method efficiently representing faces using PCA (Principal Component Analy. Their goal of this approach is to represent a face as a coordinate system. The vectors that make up this coordinate system were referred to as eigenpictures. Later, Turk and Pentland used this approach to develop a eigenface-based algorithm for recognition.

IV. FEATURES:

1) Input: The system captures images from a webcam. The software processes images of sizes up to 640x480 pixels in either 24-bit or 32-bit [2] These images are subsequently displayed, via a DirectX surface, to the user's screen in real-time. Note that the user has to be within a specified distance from the camera.

2) Face Detection: Images received from the camera are examined by a face detection algorithm. The locations of objects suspected to be human faces are recorded. Later, when a image is finally rendered to the monitor, a red rectangle (or other effect) encloses each supposed face. This algorithm cannot be expected to perform flawlessly.

Therefore, it is anticipated that this algorithm will mistakenly identify objects that are not actually faces. In an attempt to resolve this issue, the system examines more than one frame in order to determine if an object is likely a face or not, which is one of the advantages using video-based facial recognition. When an object presumed to be a face is discovered, the corresponding region in the previous frame is examined. If there were no faces found in that area in the previous frame, then the current object is unlikely to be a face. As a result, the object will not be recorded as a potential face. Conversely, if there had been a face present in that region, the likelihood that the current object represents a face is greater. In such a situation, the system assumes the object to be a human face.

3) Face Segmentation: The position of a face computed by the face detection module is not accurate. A more precise location is necessary for good performance of the face matching. The size of a user's face appearing in a video frame also varies depending on the distance of the user from the web camera. Therefore, the face image must be normalized to a standard size. There are some features in face images that may change from day to day. For example, the hairstyle can change significantly from one day to another. In order to reduce the effects of such dynamic features, a standard elliptical region with a fixed aspect ratio is used to extract the face region, which we refer to as a face segment.

4) Face Matching: A successful method for face recognition is the Eigenface approach . A face space is created by a number of eigenfaces that are a set of eigenvectors. To improve the performance of the eigenface method, it is important to have a good alignment between the live and stored face images. It means that the nose has to be in the middle; the eyes have to be at a stable vertical position; and the scale of the face images must be normalized. A significant portion of our efforts was put into addressing these issues. An elliptical facial region extracted from a video frame is matched against the facial models stored in a database. Each face image is first converted to a vector. This vector is projected onto the eigenfaces through inner product calculations. Each face produces a weight vector. The Euclidean distance between two weight vectors is used to measure the similarity between the two faces. This distance is then mapped to a normalized matching score.

V. EIGENFACE APPROACH:

Eigen Values and Eigen Vectors:

In linear algebra, the eigenvectors of a linear operator are non-zero vectors which, when operated on by the operator, result in a scalar multiple of them. The scalar is then called the eigenvalue (λ) [3][4]associated with the eigenvector(X). Eigen vector is a vector that is scaled by a linear transformation. It is a property of a matrix. When a matrix acts on it, only the vector magnitude is changed not the direction.

$$AX=\lambda X \qquad (3.1)$$

Where Ais a Vector function.

1) Calculations of Eigen Values and Eigen Vectors:

By using (3.1), we have the equation,

$$(A-\lambda I)X=0 \qquad (3.2)$$

Where I is the n x n Identity matrix. This is a homogeneous system of equations, and from fundamental linear algebra, we know that a nontrivial solution exists if and only if

$$\det (A-\lambda I)=0 \qquad (3.3)$$

Where det() denotes determinant. When evaluated,becomes a polynomial of degree n. This is known as the characteristic equation of A, and the corresponding polynomial is the characteristic polynomial. The characteristic polynomial is of degree n. If A is n x n, then there are n solutions or n roots of the characteristic polynomial. Thus there are n eigenvalues of A satisfying the equation,

$$AX_i=\lambda X_i \qquad (3.4)$$

Where i=1, 2, 3....n

If the eigenvalues are all distinct, there are n associated linearly independent eigenvectors, whose directions are unique, which span an n dimensional Euclidean space.
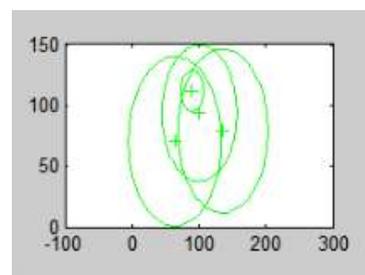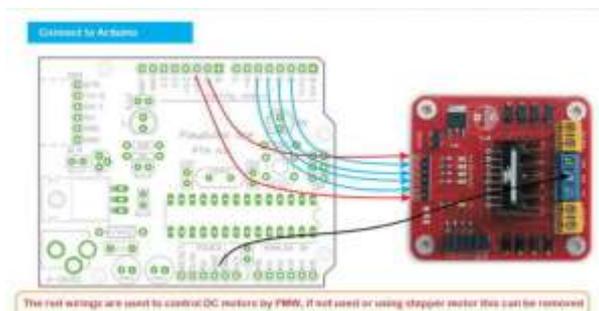

Fig. Eigen vectors of the image

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VI. SYSTEM DESIGN:

The MATLAB code of face detection will pe send to Aurdino Kit wirelessly and Aurdino will trigger the Servo motor. The Servo Motor will rotate 180 degrees will will indicate unlock of the locker. The connections are as shown in figure below.

VII. FUTURE IMPLEMENTATION

This system can be further implemented in a tablet or mobile devices by using wireless system. This allows the user to lock and unlock a door with a Wi-Fi range available. The major components of such system will require the Latest Arduino Board, Servo Motor and Wi-Fi(IEEE 802.11b/g/n) standard protocol for wireless communication which combines and forms an activity along with the open source Software and Hardware with embedded device will complete the task.

VIII. References

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