Recognition and identification schemes for the development of Eigen feature extraction based iris recognition system

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***Abstract*—There are various Iris recognition and identification schemes known to produce exceptional results with very less errors and at times no errors at all but are patented. Many prominent researchers have given their schemes for either recognition of the development of Eigen Feature Extraction and then identifying it from a set of available database so as to know who it belongs to. The Iris Recognition System is preferred algorithms for feature extraction of Iris image and is used to provide a solution which achieves better results which are encouraging.**

In this research work a proposed methodology is developed in which main focus is on the recognition and identification schemes for the development of Eigen Feature Extraction based Iris Recognition System this methodology includes the concept of feature extraction based iris recognition. But the technique which is proposed in this work is bit different from the traditional ones. Proposed work includes the Eigen feature extraction algorithm which gives quit efficient as compared with earlier solely working algorithms.

***Keywords*—Recognition, Iris and Eigen**.

I. Introduction

Iris recognition is an automated method of biometric identification that uses mathematical pattern-recognition techniques on video images of the irides of an individual's eyes, whose complex random patterns are unique and can be seen from some distance. In other words Iris recognition is a method of identifying people based on unique patterns within the ring-shaped region surrounding the pupil of the eye. The iris usually has a brown, blue, gray, or greenish color, with complex patterns that are visible upon close inspection. Because it makes use of a biological characteristic, iris recognition is considered a form of biometric verification. Therefore, Iris recognition is the process of recognizing a person by analyzing the random pattern of the iris (Figure 1). The automated method of iris recognition is relatively young, existing in patent only since 1994. The iris is a muscle within the eye that regulates the size of the pupil, controlling the amount of light that enters the eye. It is the colored portion of the eye with coloring based on the amount of melatonin pigment within the muscle (Figure 2).

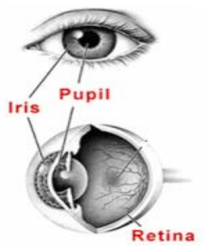

Figure 1: Iris Diagram[2]

Figure 2: Iris Structure.[3]

Figure 1

Although the coloration and structure of the iris is genetically linked, the details of the patterns are not. The iris develops during prenatal growth through a process of tight forming and folding of the tissue membrane.4 Prior to birth, degeneration occurs, resulting in the pupil opening and the random, unique patterns of the iris.5 Although genetically identical, an individual's irides are unique and structurally distinct, which allows for it to be used for recognition purposes.

Not to be confused with other, less prevalent, ocular-based technologies, retina scanning and eye printing, iris recognition uses camera technology with subtle infrared illumination to acquire images of the detail-rich, intricate structures of the iris externally visible at the front of the eye. Digital templates encoded from these patterns by mathematical and statistical algorithms allow the identification of an individual or someone pretending to be that individual.[1] Databases of enrolled templates are searched by matcher engines at speeds measured in the millions of templates per second per (single-core) CPU, and with remarkably low false match rates.

Many millions of persons in several countries around the world have been enrolled in iris recognition systems, for convenience purposes such as passport-free automated border-crossings, and some national ID systems based on this technology are being deployed. A key advantage of iris recognition, besides its speed of matching and its extreme resistance to false matches, is the stability of the iris as an internal, protected, yet externally visible organ of the eye.

In iris recognition, the identification process is carried out by gathering one or more detailed images of the eye with a sophisticated, high-resolution digital camera at visible or infrared (IR) wavelengths, and then using a specialized computer program called a matching engine to compare the subject's iris pattern with images stored in a database. The matching engine can compare millions of images per second with a level of precision comparable to conventional fingerprinting or digital finger scanning.

In order for iris recognition to provide accurate and dependable results, the subject must be within a few meters of the camera. Some control mechanisms must be implemented to ensure that the captured image is a real face, not a high-quality photograph. The ambient lighting must not produce reflections from the cornea (the shiny outer surface of the eyeball) that obscure any part of the iris. The subject must remain stationary, or nearly stationary, with respect to the camera, and must not be hostile to the process. Certain types of contact lenses and glasses can obscure the iris pattern.

II. IRIS RECOGNITION APPLICATIONS

The two major applications of iris recognition are identification and access control, though these are not mutually exclusive concepts and one is often used for the other. Identification involves the use of an initial image captured by an iris scanner, which is saved in a database, and then can be used to identify that person again later. This type of technology is already being used to more quickly identify passengers and personnel for aircraft and at border crossings, as well as for identification of children. Uses of iris recognition in access control typically involve the use ofbiometric scanners that require an iris scan to allow access to a computer system or to open a door.

Iris recognition is a process by which a camera takes a photograph of a person's iris, which is the structure that surrounds the pupil of the eye. This image is then used to generate a mathematical identifier unique to that person and his or her iris. Such methods are less intrusive than retinal scanners that can shine infrared light into a person's eye, and are more unique than fingerprint identifiers.

One of the most common applications of iris recognition is in identification for a number of different purposes. Once someone has his or her iris scanned initially, then an identifier for that person is generated that is unique to him or her. This identifier is based upon the structures of the iris, which does not change due to aging and is unique even between identical twins and triplets.

Iris recognition for identification can then be used to quickly and securely identify individuals. Crew and personnel working in airports or on airlines can use this type of identification to more quickly and easily establish identity at security checkpoints. Iris recognition has also been used at busy borders in Europe and other areas, to allow people who frequently cross international borders to do so more easily. Identification through this type of recognition can also be used for tracking prisoners in law enforcement and military bases, as well as for children who can then be more easily looked for in case they go missing.

Access control is the other major application of iris recognition that has been used so far, and it usually relies first on identification. A doorway, for example, may be locked and can only be unlocked through proper recognition of approved individuals, usually through biometric scanners that can be used to recognize irises of those individuals. Computer systems can be similar regulated, by requiring a scanner to recognize the iris of an authorized user before allowing decryption and access to a system. These types of iris recognition security systems are becoming increasingly affordable and are likely to be developed and deployed further as the technology becomes more accessible.

III. METHODOLOGY

- Firstly an dataset of static iris images will be used for the recognition purpose
- Next step is to format the dataset images for the feature extraction
- Eigen feature extraction algorithm is used for extracting the matching features for classification
- The features are further pass to creating a network for training so that when testing is done we have to extract the features of dataset which will reduce the time consumption
- Next step is to select the testing image of can say to give the iris image for matching
- User will select the image which is to be tested
- Same feature extraction of Eigen is applied on testing image so as to convert the image in same format as its database is.
- These feature are pass to database created of images in dataset and evaluate the matching criteria
- Finally system will decide that whether image is matched or not
- Same will be executed many times so as to calculate the accuracy of system

OBJECTIVES

1. Development of Eigen feature extraction based iris recognition system
2. Check the recognition rate of proposed system
3. Analysis of obtained results of proposed system

IV. ADVANTAGES OF IRIS RECOGNITION TECHNOLOGY

The physiological properties of irises are major advantages to using them as a method of authentication. As discussed earlier, the morphogenesis of the iris that occurs during the seventh month of gestation results in the uniqueness of the iris even between multi-birth children. These patterns remain stable throughout life and are protected by the body's own mechanisms. This randomness in irises makes them very difficult to forge and hence imitate the actual person.

In addition to the physiological benefits, iris-scanning technology is not very intrusive as there is no direct contact between the subject and the camera technology. It is non-invasive, as it does notuse any laser technology, just simple video technology. The camera does not record an image unless the user actually engages it. It poses no difficulty in enrolling people that wear glasses orcontact lenses. The accurateness of the scanning technology is a major benefit with error rates being very low, hence resulting in a highly reliable system for authentication.

Scalability and speed of the technology are a major advantage. The technology is designed to be used with large-scale applications such as with ATMs. The speed of the database iris records are stored in is very important. Users do not like spending a lot of time being authenticated and the ability of the system to scan and compare the iris within a matter of minutes is a major benefit.

In this research work a proposed methodology is developed in which main focus is on iris identification enhancement this methodology includes the concept of feature extraction based iris recognition. But the technique which is proposed in this work is bit different from the traditional ones. The approach which is proposed in this thesis work is Eigen feature extraction with addition of neural network for iris recognition. The main advantages of this algorithm are

1. More efficient and easy to understand
2. Fast recognition and matching ability
3. Input data changes acceptability
4. Intelligence system integrity

V. EIGEN FEATURE EXTRACTION

EIGEN VALUES AND EIGENVECTORS: An Eigenvector of a square matrix A is a non-zero vector v that, when the matrix multiplies v, yields a constant multiple of v, the latter multiplier being commonly denoted by λ. That is: $Av = \lambda v$ (Because this equation uses post-multiplication by, it describes a right Eigenvector). The number λ is called the **Eigen value** of A corresponding to v. If 2D space is visualized as a piece of cloth being stretched by the matrix, the Eigenvectors would make up the line along the *direction* the cloth is stretched in and the line of cloth at the center of the stretching, whose direction isn't changed by the stretching either. The Eigen values for the first line would give the *scale* to which the cloth is stretched, and for the second line the scale to which it's tightened. A reflection may be viewed as stretching a line to scale -1 while shrinking the axis of reflection to scale 1. For 3D rotations, the Eigenvectors form the axis of rotation, and since the scale of the axis is unchanged by the rotation, their Eigen values are all 1. In analytic geometry, for example, a three-coordinate vector may be seen as an arrow in three-dimensional space starting at the origin. In that case, an Eigenvector v is an arrow whose direction is either preserved or exactly reversed after multiplication by A. The corresponding Eigen value determines how the length of the arrow is changed by the operation, and whether its direction is reversed or not, determined by whether the Eigen value is negative or positive.

In abstract linear *algebra*, these concepts are naturally extended to more general situations, where the set of real scalar factors is replaced by any field of scalars (such as algebraic or complex numbers); the set of Cartesian vectors $\mathbb{R}^n$ is replaced by any vector space (such as the continuous functions, the polynomials or the trigonometric series), and matrix multiplication is replaced by any linear operator that maps vectors to vectors (such as the derivative from calculus). In such cases, the "vector" in "Eigenvector" may be replaced by a more specific term, such as Eigen function, Eigen mode, "Eigen face", or "Eigen state". Thus, for example, the exponential function $f(x) = e^{\lambda x}$ is an Eigen function of the derivative operator, $'$, with Eigen value λ, since its derivative is $f'(x) = \lambda e^{\lambda x} = \lambda f(x)$.

The set of all Eigenvectors of a matrix (or linear operator), each paired with its corresponding Eigen value, is called the Eigen system of that matrix.[2] Any multiple of an Eigenvector is also an Eigenvector, with the same Eigen value. An Eigen space of a matrix A is the set of all Eigenvectors with the same Eigen value, together with the zero vectors. An Eigen basis for A is any basis for the set of all vectors that consists of linearly independent Eigenvectors of A. Not every matrix has an Eigen basis, but every symmetric matrix does. The terms characteristic vector, characteristic value, and characteristic space are also used for these concepts. The prefix Eigen- is adopted from the German word *Eigen* for "own-" or "unique to", "peculiar to", or "belonging to" in the sense of "idiosyncratic" in relation to the originating matrix. Eigen values and Eigenvectors have many applications in both pure and applied mathematics. They are used in matrix factorization, in quantum mechanics, and in many other areas.

Eigenvectors and Eigen values of a real matrix

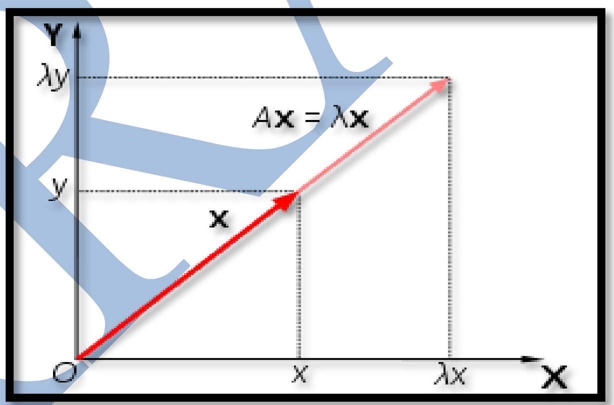

FIG. 3. Matrix A acts by stretching the vector x, not changing its direction, so x is an Eigenvector of A.

In many contexts, a vector can be assumed to be a list of real numbers (called *coordinates*), written vertically with brackets around the entire list, such as the vectors *u* and *v* below. Two vectors are said to be scalar multiples of each other (also called parallel or collinear) if they have the same number of coordinates, and if every coordinate of one vector is obtained by multiplying each corresponding coordinate in the other vector by the same number (known as a *scaling factor*, or a *scalar*). For example, the vectors

$$u = \begin{bmatrix} 1 \\ 3 \\ 4 \end{bmatrix} \quad \text{and} \quad v = \begin{bmatrix} -20 \\ -60 \\ -80 \end{bmatrix}$$

are scalar multiples of each other, because each coordinate of v is −20 times the corresponding coordinate of u. A vector with three coordinates, like u or v above, may represent a point in three-dimensional space, relative to some Cartesian coordinate system. It helps to think of such a vector as the tip of an arrow whose tail is at the origin of the coordinate system. In this case, the condition "u is parallel to v" means that the two arrows lie on the same straight line, and may differ only in length and direction along that line. If we multiply any square matrix A with n rows and

$n$columns by such a vector v, the result will be another vector $w = Av$, also with $n$rows and one column. That is,

$$\begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_n \end{bmatrix} \text{ is mapped to } \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix} = \begin{bmatrix} A_{1,1} & A_{1,2} & \ldots & A_{1,n} \\ A_{2,1} & A_{2,2} & \ldots & A_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ A_{n,1} & A_{n,2} & \ldots & A_{n,n} \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_n \end{bmatrix}$$

where, for each index i, $w_i = A_{i,1}v_1 + A_{i,2}v_2 + \cdots + A_{i,n}v_n = \sum_{j=1}^{n} A_{i,j}v_j$ In general, if $v_j$are not all zeros, the vectors $v$and Avwill not be parallel. When they *are* parallel (that is, when there is some real number λsuch that $Av = \lambda v$) we say that $v$is an **Eigenvector** of A. In that case, the scale factor $\lambda$is said to be the **Eigen value** corresponding to that Eigenvector.In particular, multiplication by a 3×3 matrix Amay change both the direction and the magnitude of an arrow $v$in three-dimensional space. However, if $v$is an Eigenvector of A with Eigen value λ, the operation may only change its length, and either keep its direction or flip it (make the arrow point in the exact opposite direction). Specifically, the length of the arrow will increase if $|\lambda| > 1$, remain the same if $|\lambda| = 1$, and decrease it if $|\lambda| < 1$. Moreover, the direction will be precisely the same if $\lambda > 0$, and flipped if $\lambda < 0$. If $\lambda = 0$, then the length of the arrow becomes zero.

An example

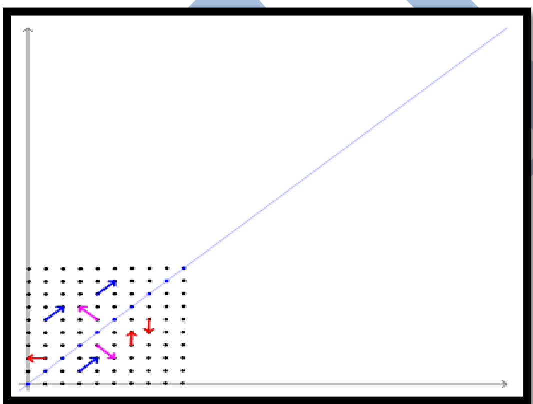

FIG. 4 An example of transformation matrix

The transformation matrix $\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$preserves the angle of arrows parallel to the lines from the origin to $\begin{bmatrix} 1 \\ 1 \end{bmatrix}$(in blue) and to $\begin{bmatrix} 1 \\ -1 \end{bmatrix}$(in purple). The points that lie on a line through the origin and an Eigenvector remain on the line after the transformation. The arrows in red are not parallel to such a line, therefore their angle is altered by the transformation. See also: An extended version, showing all four quadrants. For the transformation matrix

$$A = \begin{bmatrix} 3 & 1 \\ 1 & 3 \end{bmatrix}, \text{the vector } v = \begin{bmatrix} 4 \\ -4 \end{bmatrix}$$

is an Eigenvector with Eigen value 2. Indeed,

$$Av = \begin{bmatrix} 3 & 1 \\ 1 & 3 \end{bmatrix} \begin{bmatrix} 4 \\ -4 \end{bmatrix} = \begin{bmatrix} 3 \cdot 4 + 1 \cdot (-4) \\ 1 \cdot 4 + 3 \cdot (-4) \end{bmatrix} = \begin{bmatrix} 8 \\ -8 \end{bmatrix} = 2 \cdot \begin{bmatrix} 4 \\ -4 \end{bmatrix}.$$

On the other hand the vector

$v = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ is *not* an Eigenvector, since

$$\begin{bmatrix} 3 & 1 \\ 1 & 3 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 3 \cdot 0 + 1 \cdot 1 \\ 1 \cdot 0 + 3 \cdot 1 \end{bmatrix} = \begin{bmatrix} 1 \\ 3 \end{bmatrix},$$

and this vector is not a multiple of the original vector v. Therefore, the vectors $[1, 0, 0]^T$ and $[0, 0, 1]^T$ are Eigenvectors of Acorresponding to the Eigen values 1 and 3 respectively. (Here the symbol Tindicates matrix transposition, in this case turning the row vectors into column vectors.)

VI. CONCLUSIONS&FUTURE SCOPE

To best the recognition and identification schemes for the development of Eigen Feature Extraction based Iris Recognition System for biometric security or matching applications our proposed algorithm, is quit efficient as compared with earlier solely working algorithms. We conferred associate improved task programming rule supported the essential Eigen features extraction and database creation algorithms for the task programming in recognition with the achieving the objective of fast detection and accuracy enhanced technology development. The results show that the new methodology based mostly task programming rule not solely may be able to get higher resources utilization, however additionally has the flexibility to accurately recognition task performing capability.

As a future scope many other matching or feature extraction algorithms can be combined with the approach given in this thesis so as to provide some additional feature as rotation less matching. Overall conclusion is that our proposed work is effective and less time consuming and providing better recognition rate with respect to traditional approaches.

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