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Iris Based De-duplication Technology

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Abstract— Iris recognition is the most accurate of the top three biometrics: fingerprints, facial recognition, and iris recognition. Iris recognition has a false accept rate of 1 in 1.2 million for one eye (1 in 1.44 trillion for two eyes) regardless of database size [1]. Iris recognition is the easiest one among biometrics related with the eye. It works with simple CCD camera and does not need direct contact between user and capturer. In addition, it has pattern comparison potential over the average the human iris is an annular region between the black pupil and the white sclera. Irises reveal rich and complex features and differ from human to human. Even, right and left irises are different from each other; this situation is also valid for twins. The iris begins to form in the third month of gestation and structures creating its pattern are largely complete by the eighth month, although pigment accretion can continue until two years old age. After two - year-old age, there is no change in iris features through whole life. The iris has the great mathematical advantage that its pattern reliability among different persons is enormous in comparison with other biometrics. The Iris of a person is stable throughout a person's life (From the age of two year till death); the physical characteristics of the Iris do not change with age, diseases or environmental conditions. Hence one time enrolment is enough for a person during his lifetime.

Keywords— ***Iris, hamming distance, iriscode, De-duplication.FAR,FRR.***

I. INTRODUCTION

Iris recognition technology combines computer vision, pattern recognition, statistical inference, and optics. Its purpose is real-time, high confidence recognition of a person's identity by mathematical analysis of the random patterns that are visible within the iris of an eye from some distance. Because the iris is a protected internal organ whose random texture is stable throughout life, it can serve as a kind of living passport or a living password that one need not to remember but can always present. Because the randomness of iris patterns [Figure1] has very high dimensionality, recognition decisions are made with confidence levels high enough to support rapid and reliable exhaustive searches through national-sized databases [2]. Unlike another less prevalent ocular based technology called iris scanning, Iris recognition uses latest camera technology, with harmless infrared illumination which is passed into the eye for a second then it is converted into a digital template. De-duplication is the processing of the biometric data of citizens to remove instances of multiple enrolments by the same citizen. During de-duplication, matching the biometrics of a citizen is done against the biometrics of other citizens to ensure that the same person is not enrolled more than once. This will ensure that each person will have a unique identity.

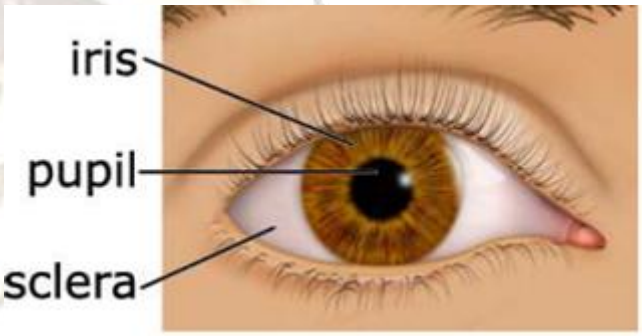

Figure 1 Bitmap Iris Image.

II. IRIS DE-DUPLICATION STEPS

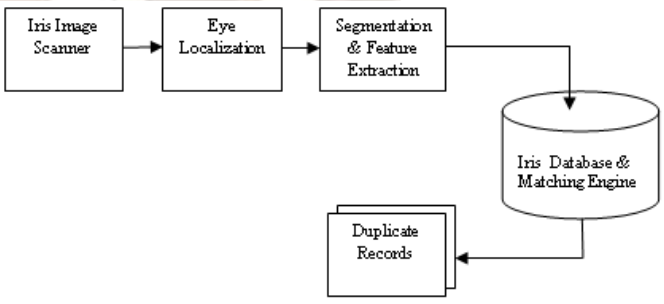

Figure 2. Iris Deduplication Process

The process of capturing an iris and storing into an iris database for deduplication is made up of three steps:

1. Capturing the image
2. Defining the location of the iris and optimizing the image
3. Storing and comparing the image for 1: N match.

1. Capturing the Image

The image of the iris can be captured using a standard camera using both visible and infrared light and may be either a manual or automated procedure. The camera can be

positioned between three and a half inches and one meter to capture the image. In the manual procedure, the user needs to adjust the camera to get the iris in focus and needs to be within six to twelve inches of the camera. This process is much more manually intensive and requires proper user training to be successful. The automatic procedure uses a set of cameras that locate the face and iris automatically thus making this process much more user friendly. A typical block diagram of iris based de duplication is shown in Figure2.

2. Defining the Location of the Iris and Optimizing the Image

Once the camera has located the eye, the iris recognition system then identifies the image that has the best focus and clarity of the iris. The image is then analyzed to identify the outer boundary of the iris where it meets the white sclera of the eye, the pupillary boundary and the centre of the pupil. This results in the precise location of the circular iris as shown in figure 3. The iris recognition system then identifies the areas of the iris image that are suitable for feature extraction and analysis. This involves removing areas that are covered by the eyelids, any deep shadows and reflective areas.

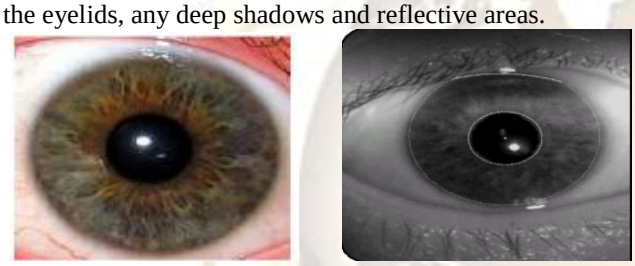

Figure 3: Iris & its circular Iris Location.

3. Storing and Comparing the Image for 1.N match

Once the image has been captured, an algorithm uses to filter and map segments of the iris into hundreds of vectors. The 2-D Gabor filter is for finding simply the "what" and "where" of the image. These algorithms also take into account the changes that can occur with an iris, for example the pupil's expansion and contraction in response to light will stretch and skew the iris. This information is used to produce what is known as the IrisCode, which is a 512-byte record. This record is then stored in a database for future comparison. When a comparison is required the same process is followed but instead of storing the record it is compared to all the IrisCode records stored in the database. The comparison also doesn't actually compare the image of the iris but rather compares the hexadecimal value produced after the algorithms have been applied. In order to compare the stored IrisCode record with an image just scanned, a calculation of the Hamming Distance is required. The Hamming Distance is a measure of the variation between the IrisCode record for the current iris and the IrisCode records stored in the database [4]. Each of the 2048 bits is compared against each other, i.e. bit 1 from the current IrisCode and bit 1 from the stored IrisCode record are compared, then bit 2 and so on. Any bits that don't match are assigned a value of one and bits that do match a value of zero. Once all the bits have been compared, the number of non-matching bits is divided by the total number of bits to produce a two-digit figure of how the two IrisCode records differ [Figure2]. For example a Hamming Distance of 0.20 means that the two IrisCode differ by 20%.With all biometric systems there are two error rates that need to be taken into consideration. False Reject Rate (FRR) occurs when the biometric measurement taken from the live subject fails to match the template stored in the biometric system. False Accept Rate (FAR) occurs when the measurement taken from the live subject is so close to another subject's template that a correct match will be declared by mistake. The point at which the FRR and the FAR are equal is known as the Crossover Error Rate (CER). The lower the CER, the more reliable and accurate the system is. In iris recognition technology, a Hamming Distance of .342 is the nominal CER. This means that if the difference between a presented IrisCode record and one in the database is 34.2% or greater then they are considered to have come from two different subjects. During recognition mode, this comparison has to occur between the IrisCode record from the live subject and every IrisCode stored in the database before the live subject is rejected. The following table1 shows the probabilities of false accept and false reject with iris recognition technology:

Hamming Distance	False Accept Probability	False Reject Probability
.28	1 in 10^{12}	1 in 11,400
.29	1 in 10^{11}	1 in 22,700
.30	1 in 6.2 billion	1 in 46,000
.31	1.in 665 billion	1 in 95,000
.32	1 in 81 million	1 in 201,000
.33	1 in 11 million	1 in 433,000
.34	1 in 1.7 million	1 in 950,000
.35	1 in 295.000	1 in 2.12 million
.36	1 in 57,000	1 in 4.84 million
.37	1 in 12,300	1 in 11.3 million

Table 1: Hamming Distances & Error Probabilities.

III. ADVANTAGES OF IRIS DE-DUPLICATION

The physiological properties of irises are major advantages to using them as a method of authentication. One of the most important advantages of using Iris as a Biometric is the lower effort, lesser infrastructure (servers, database licenses, data center infrastructure etc) required for de-duplication, whereas finger print Deduplication requires more than 50 times infrastructure and more human effort. Another related cost that is normally overlooked is the infrastructure maintenance cost for running such as huge data center like, manpower, power consumption, annual maintenance costs for hardware and software etc.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 not use any laser technology, just simple video technology. The accurateness of the scanning technology is a major benefit with error rates being very low, hence resulting in a highly reliable system for identification. Scalability and speed of the technology are a major advantage. The speed of the database iris records are stored in is very important.

IV. DISADVANTAGES OF IRIS DE-DUPLICATION

As with any technology there are challenges with iris recognition. The iris is a very small organ to scan from a distance. It is a moving target and can be obscured by objects such as the eyelid and eyelashes. Subjects who are blind or have cataracts can also pose a challenge to iris recognition, as there is difficulty in reading the iris [9]. The camera used in the process needs to have the correct amount of illumination. Without this, it is very difficult to capture an accurate image of the iris. Along with illumination comes the problem with reflective surfaces within the range of the camera as well as any unusual lighting that may occur. All of these impact the ability of the camera to capture an accurate image. The system linked with the camera is currently only capturing images in a monochrome format. This results in problems with the limitations of grayscale making it difficult to distinguish the darker iris colourations from the pupil. Although there is minimal intrusiveness with iris recognition, there is still the need for cooperation from subjects to enroll in the system and undergo subsequent authentication scans. Enrolling a non-cooperative subject would prove very difficult indeed. Inadequate training of users at the initial enrolment period will cause problems both at the initial enrolment time and subsequent authentications. Frustrated users will not help make the system any easier to use and will not be accepted by users as a convenient authentication method. Communication with users plays a major part in implementing such a system successfully.

V. APPLICATIONS OF IRIS DEDUPLICATION

The most obvious use of iris recognition technology is within the computing environment. Users are only able to access the systems they have privileges to access and it's very difficult for someone to replicate an iris for authentication. The technology can not only be used for securing log on but also in areas such as file and directory access, web site access and key access for file encryption and decryption. In a network environment, a system may be configured to compare the live template to the stored template and if a match is found then the user's access privileges are passed back to the client. In other implementations, after a match is found, the server returns a username and password to the client, which then transmits this information to the network server to allow access to the systems the user has privileges to Enterprise applications are also being worked on in the areas of e-commerce, healthcare applications for medical records protection, insurance and brokerage transactions. Mounting a scanner by the access door and authenticating people via their iris is a good method of ensuring only those whose templates are in the database for computer room access are actually allowed in. This helps to alleviate problems associated with swipe card access where some systems have to be manually programmed with specific card numbers and robust processes need to be in place to ensure access lists are regularly reviewed. Swipe cards are also easily lost, stolen or borrowed. Iris recognition is also being utilized or considered in other areas of daily life. ATMs are a major area where iris recognition is being trailed. This would reduce the requirement for customers to produce identification, bank books, account numbers etc and would result in faster transaction times that leave the bank teller with more time to concentrate on the level of service provided to the customer.

Iris De-duplication can be used to eliminate duplicate user of public distribution system by making the database of entire population of beneficiaries. The speed of the matching engine is more important for handling the more than one billion database of the population of the country like India. Iris based deduplication is one of the best choice to meet the speed and accuracy for removing the duplicate records in population database.

VI. CONCLUSION

The uniqueness of the iris and low probability of a false acceptance or false rejection all contribute to the benefits of using iris de-duplication technology. It provides an accurate and secure method of authenticating users, is a non-intrusive method and has the speed required to minimize user frustration when accessing systems. Users no longer have to worry about remembering demographic details and system administrators no longer need to worry identity of users disclosing demographic details like name, father name, date of birth, address, etc. that can be easily duplicated. If a two-factor authentication system is implemented, for example iris recognition with a smart card, then the strength of authentication increases and provides another part to defense in depth for the individuals. Presently Unique Identification Authority of India (UIDAI) is making biometric database by using iris based deduplication to eliminate the duplicate enrollee in the entire Indian Population database [3].

VII. REFERENCES

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