Study of Human Identification Techniques Fingerprint, Iris, Hair Pattern Recognition

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***Abstract*- Fingerprint identification makes use of the automated method of identifying or confirming the identity of an individual based on the distinguishing characters of two fingerprints.** Fingerprint identification **is one of the most recognized biometrics, and it is by far the most used biometric solution for authentication on computer systems. . Androgenic hair patterns are a stable biometric technology, Medical research results have implied that and also have advantage to overcome the lack of blood vessel patterns and skin mark patterns.** Iris recognition **is an automated method of biometric identification that uses mathematical pattern-identification techniques on video images of the irides of an individual's eyes, whose complex random patterns are unique and can be so bserved from some distance.This paper deals with the comparison of these methods.**

Keywords— Finger Print, Hair Pattern, Iris

I. INTRODUCTION

Biometric system where iris and retinal scanning are known as "ocular-based" identification technologies, meaning they rely on unique physiological characters of the eye for identification of an individual. Even though they both share part of the eye for identification purposes. It is a difficult task to identify persons and victims in images describing scene, especially when not even their faces nor any skin marks are observable and able to identify. To overcome this problem there is other proposed techniques like blood vessel patterns and skin mark patterns but they want high resolution images to visualize hidden blood vessels and absolutely detect skin marks as moles ,wart. [1] Also for forensic analysis, there is investigation in which hair are collected in crime scenes, but still now androgenic hair patterns in images were never studied for victim identification.[5] For use androgenic hair patterns in person identification, there is proposed an algorithm based on a Low resolution Images and neural network analysis. Fingerprint processing has three primary functions: enrollment, searching and verification. Among these functions,process which captures fingerprint image from the sensor plays an important part.

II. EASE OF USE

A. Finger print recognition

The three basic part of fingerprint ridges are the arch, the loop, and the whorl. An **arch** is a pattern or design where the ridge enters one side of the finger, then rises in the center forming an arch, and exits on the reverse side of finger. With a **loop** the ridge enters one side of the finger, then forms a curve, and exits on the same side of the finger from which it entered. Loops are the most common part in fingerprints. a **whorl** is the pattern you have when ridges form around a central point in circular way. Minutiae is to specific points in a fingerprint, these are the small details and parts in a fingerprint that are most important for fingerprint recognition. There are three main types of minutiae features: the ridge ending, the bifurcation, and the dot [4] The **ridge end point** is, as given by the name, the spot or place where a ridge ends. A **bifurcation** is the spot or part where a ridge splits or gets divided into two ridges. **Spots** are those fingerprint ridges, parts that are significantly smaller than other ridges.

Fig1 Ridge ending.

A fingerprint sensor is an electronic machine used to capture a digital image of the fingerprint pattern or design. The captured image is known as a live scan. This live scan part is digitally processed or worked out to create a biometric database (a collection of extracted features or characters which is stored and used for identification. Many technologies came in market and have been used which includes optical, capacitive, RF, thermal, piezoresistive, ultrasonic, piezoelectric, MEMS. This is an overview of some of the more commonly used fingerprint sensor technologies which are used for identification[2]

Fig 2 Bifurcation.

Fig 3 Short ridge (dot).

1) Optical

Optical fingerprint imaging involves taking a digital image of the finger print using visible or observable light. This type of sensor is, in fact, a specialized digital camera which contains many special features. The top layer of the sensor or machine, where the finger is placed on surface, is known as the touch surface of the device. Below this layer is a light-emitting layer of phosphor which illuminates .gets lightened the surface of the finger. The light reflected from the finger passes through the layer of phosphor to an array of solid state pixels a charge-coupled device which captures a visual image of the fingerprint, clicked on the instant. A scratched or dirty touch on surface can cause a bad image of the fingerprint, amd wont identify . A disadvantage of this type of sensor is the fact that the imaging capabilities or identification are affected by the quality of skin,marks on the finger. For eg, a dirty or marked finger is difficult to identify as the image is not clicked properly. Also, it is possible for an individual to erode or destroy the outer layer of skin part on the fingertips to the point where the fingerprint is no longer visible to the machine. It can also be easily fooled by an image of a fingerprint identification device if not coupled or matched with a "live finger" detector. However,like capacitive sensors, this sensor technology is not effected to electrostatic discharge damage.

Ultrasonic

Ultrasonic sensors make use of the principles and rules of medical ultrasonography in order to make visual images of the fingerprint taken at the instance. talking about optical imaging, ultrasonic sensors require very high frequency sound waves to penetrate or get inserted the epidermal layer of skin of finger print. The sound waves are made using piezoelectric transducers and then the reflected energy is also measured using piezoelectric materials. Since the dermal skin layer consist of the same characters and pattern of the fingerprint, the reflected wave measurements can be used to make an image of the fingerprint taken at the instance. This eliminates the need for clean,neat, undamaged epidermal skin and a clean sensing surface.LeEco was the first company to introduce this in android Smartphone.

Capacitance

Capacitance sensors use principles or characters involved with capacitance in order to take fingerprint images at the device. the sensor array of pixels each which act as one plate of a parallel-plate capacitor, the dermal layer (which is electrically conductive come as the other plate, and the epidermal layer which is non conductive work as a dielectric.

The iPhone 6 a uses a capacitance technology fingerprint sensor which makes security better.

a) Passive capacitance

A passive capacitance sensor makes use of the principle above to form an image of the fingerprint patterns on the device on the dermal outer layer of skin. Each sensor pixel is used to measure the capacitance at that finger print point of the array. The capacitance differs between the ridges and valleys part of the fingerprint for the fact that the volume between the dermal outer layer and sensing element of sensors in valleys contains an air gap to measure. The dielectric constant of the epidermis layer and the area of the sensing element of sensors are known values which needs to be calculated. The measured capacitance values which are then used to distinguish between fingerprint ridges and valleys part to identify.

b) Active capacitance

Active capacitance sensors use a charging cycle to make use of a voltage to the dermal skin before the measurement part takes place in the device. The application of voltage charges the effective capacitor is that the electric field conducted between the finger and sensor part follows the pattern of the ridges in the dermal outer skin layer. In the next part the discharge cycle,involves the voltage across the dermal layer and sensing element is compared against a reference voltage and differences are made out in order to calculate the capacitance for sensing. The distance values which we discovered before are then calculated mathematically, and then used to form an image of the fingerprint pattern. Active capacitance sensors measure the ridge part patterns of the dermal skin layer like the ultrasonic methods discussed before. Again, this method serve as advantage as it eliminates the need for clean,neat, undamaged epidermal skin and a clean sensing surface. Matching and identification algorithms are used to compare previously stored templates or databases of fingerprints against candidate at the instance fingerprints for

authentication purposes. In order to do this either the original image must be directly compared with the candidate image or certain features must be compared.

Iris recognition

Retinal scanning in which retina is scanned is a different, ocular-based biometric process technology which uses the unique patterns or design form by it on a person's retina blood vessels and is often confused with iris recognition which uses iris for recognition. Iris recognition makes use of video camera technology with subtle near infrared illumination to acquire images of the detail-rich, intricate structures and characters of the iris which are visible externally to the device. Digital templates or databases encoded from these patterns by mathematical and statistical algorithms allow the identification and recognition of an individual or someone pretending to be that individual can be identified. Databases of enrolled templates as fixed before 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 and un identified.

Several hundred persons in many countries around the world have been enrolled or registered in iris recognition systems for convenience purposes which can be used as passport-free automated border-crossings and some national ID programs. The main advantage of iris recognition, besides its speed of matching, effectively identifying and its extreme resistance to false matches, is the stability of the iris part of eye as an internal and protected, yet externally visible organ of the eye.

The iris of the eye has been said as the ideal part of the human body which can be used for biometric identification for several reasons:

It is an internal organ that is well protected against any external damage and wear or protected by a highly transparent and sensitive membrane. This makes it different from it from fingerprints, which can be difficult to recognize after years of certain types of manual labor which erodes the finger tips. The iris is mostly characters by flat, and its geometric configuration is only controlled or defined by two complementary muscles can be given as (the sphincter pupillae and dilator pupillae) that control or manages the diameter of the pupil. This makes the iris shape far more predictable and smooth than others, for instance, that of the face.

The iris has a fine texture that like fingerprint identification determined randomly during embryonic gestation. As Like the fingerprint, it is very difficult (if not impossible) to prove that the iris is unique for identification. However, there are so many factors to consider that go into the formation of these textures (the iris and fingerprint) that the chance of false matches or wrong person identification for either is extremely low. Even genetically identical individuals or twins (and the left and right eyes of the same individual) have completely independent iris textures which can be used to identify. An iris scan is similar to taking a photograph process and can be performed from about 10 cm to a few meters away normally. There is no need for the person being for identification to touch any equipment or device that has recently been touched by a stranger, thereby restricting an objection that has been raised in some cultures against fingerprint scanners which they avoid to use, where a finger has to touch a surface, or retinal scanning, where the eye must be brought very close to an eyepiece (like looking into a microscope) needs not to touch any device.[3]

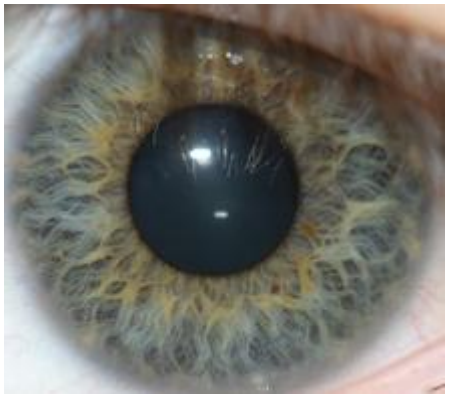

Fig 4 Visible light reveals rich pigmentation details of an Iris by exciting melanin, the main coloring component in the iris.

The following sequence applies to both process enrollment and recognition:

1. Capturing iris image. The camera acquires or takes an an image from the iris of the eye, lighting is mostly done with Near Infrared (NIR) light as with NIR as there is less noise in the image due to reflections when compared to visible light. Also NIR light does not cause harm or discomfort to the subject or the person doing it.

2. Findin/detecting iris in the image. One of the challenging and difficult part of iris recognition is for the algorithm finding the concentric circular outside boundaries of pupil and iris of eye.most part of the iris is covered by eyelids or eyelashes, which even more complicates this step for identification.

3. Converting image. The set of pixels which cover the iris part on the image are then transformed into a bit pattern that preserves/saves required information for template comparison but allows faster identification of a person

When a subject/person tries to authenticate or identify himself, the generated IrisCode from iris is compared with template stored in the database. A test of statistical information independence determines whether the IrisCode resulting from the scan and a stored IrisCode template are from the same iris. The important fact is that most governments have invested in other biometric technologies as fingerprint recognition, iris recognition as well as patent limitations have led to the fact that less progress was made on commercial developments than could have been possible for identification.

However a number of vendors in market already have made iris recognition solutions, these are mostly targeted at governments or large corporations. A few vendors are listed hereunder: a spin-off of LG electronics , a company specialized in large scale security solutions based on iris

recognition Iris recognition is said to have a very low FER (Failure to Enroll Rate), i.e. the smallest group of people which can not use the technology.

Hair pattern

Identification of human body in low resolution images using hair pattern Medical research results have implied that androgenic hair patterns are a good and smooth biometric trait and have ability to overcome the weaknesses of skin mark patterns and blood vessel patterns. This project finally develops a powerful system to identify persons and victims and link different cases based on non-facial skin in images describing specimens.[5]

$$G(x, y, \lambda mk, \theta k, \sigma m, \gamma) = \frac{\gamma}{2\pi\sigma_m^2} exp\left(-\frac{x'^2 + \gamma y'^2}{2\sigma_m^2}\right) \cos\left(\frac{2\pi x'}{\sigma_{mk}}\right)$$

where $x' = x \cos\theta_k + y \sin\theta_k$ and $y' = -x \sin\theta_k + y \cos\theta_k$ are the rotated coordinates with orientation $\theta_k = k\pi/8, \lambda_{mk}$

denotes the wavelength of the sinusoidal component, σ_m is the standard deviation of the elliptical Gaussian window along x' direction, γ is the spatial aspect ratio, $m \in \{1, \ldots, M\}$ and $k \in \{1, \ldots, K\}$ are the scale and orientation indexes respectively .To enhance robustness against brightness variation, the direct current (DC) component In total, $M \times K$ real parts of Gabor filters with zero DC are applied to the preprocessed images.Let $I(x, y)$ be a preprocessed image and $G_{rd}(x, y, \lambda_{mk}, \theta_k, \sigma_m, \gamma)$ be a real part of a Gabor filter with zero DC. The filter response $F_{\lambda mk,\theta k,\sigma m,\gamma}(x, y)$ can be obtained from,

$$F_{\lambda mk,\theta k,\sigma m,\gamma}(x, y) = G_{rd}(x, y, \lambda_{mk}, \theta_k, \sigma_m, \gamma) * I(x, y)$$

where $*$ denotes an operation of a two-dimensional convolution.

It used Artificial Neural Network (ANN) for classification purpose. In machine learning, ANNs use statistical learning algorithms which are inspired from biological neural networks and are used to estimate or approximate functions that can depend on many number of inputs which are generally unknown. ANNs are given as systems of interconnected "neurons" which can calculate values from many inputs, and are capable of machine learning as well as pattern recognition. ANN is basically an interconnected group of nodes which is similar to vast network of neurons in brain. Each node represents an artificial neuron and an arrow represents a connection from output of one neuron to the input of other neuron.After being weighted and transformed by a function, the activations of these neurons are passed on to other neurons in the next layer. This process is repeated till an output neuron is activated. This determines which character was read. In ANN, simple artificial nodes, known as "neurons" are connected together to form a network this mimics or copies a biological neural network. In neural networks, the activation function represents the rate of action potential firing in the cell. An action potential is a short lasting event in which the electrical membrane potential of cell rises or falls rapidly following a consistent trajectory.

III. CONCLUSION

Here in this paper we have studied three types of identification process : fingerprint ,iris & hair pattern . all of these recognition techniques have advantages over one another. moreover a better security system can be designed involving all.

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