Enhancement of Multi-Modal Biometric Authentication Based on IRIS and Brain Neuro Image Coding

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Abstract

The proposed method describes the current forensics and biometrics in a modern approach and implements the concept of IRIS along with brain and resolves the issues and increases the strength of Digital Forensics Community. It has enormous features in biometrics to enhance diverse security levels. A new method to identify individuals using IRIS Patterns with the brain wave signals (EEG) is proposed. Several different algorithms were proposed for detecting, verifying and extracting the deterministic patterns in a person's IRIS from the Eye. The extracted EEG recordings form the person's brain has proved to be unique. Next we combine EEG signals into the IRIS patterns a biometric application which makes use of future multi modal combination architecture. The proposed forensic research directions and argues that to move forward the community needs to adopt standardized, modular approaches for person identification. The result of each authentication test is compared with the user's pre-recorded measurements, using pattern recognition methods and signal-processing algorithms.

Keywords: Electrodes, Electroencephalography (EEG), Neuro Image Coding, IRIS Patterns & Brain Waves, Signal Processing.

1. INTRODUCTION

Neuro image coding is a concept of capturing the specific data from IRIS and the brain matches with the database confidentially. Biometric system consists of uniquely recognizing a person based upon one or more independent physical or behavioral characteristics [1]. Identity access management and access control are two major roles in the bio-metric system. Verification and identification are two major functional parts.

In verification mode the system performs a one to one comparison of the captured patterns with already stored database templates. In Identification the system performs a one to many comparisons with templates and produces the result may be positive or negative recognition [1], [2]. The biometric system is more complex so that it cannot be violated. But sometimes it is more expensive and requires more software and hardware resources. When a new authentication system is implanted, it is essential a judgment between simplicity, price and efficiency, as well as social acceptability [1], [2]. When a new authentication system is implanted, it is essential a judgment between simplicity, price and efficiency, as well as social acceptability [1], [2]. The Digital forensics communities present in these times are not at the satisfied level. Even though we use the Biometrics methods for identify and access controls in a confidential manner, the security lacks.

Unique Identification Authority of India (UIDAI) requires to connecting 2.4 Million eyes for Person Identification using IRIS biometrics in INDIA within five years.

The Existing biometrics community are hurdled with privacy and discrimination, cancelable biometrics, danger to owner of secured items and spoofing. The finger prints of people who work in chemical industries are sometimes diminished. The voice of people may change if they have pneumonia or bronchitis, illness, fatigue, pitch, surgery involving tampering with the vocal cord, or any combinations of them. Age can also cause changes in the voice. If the surrounding area is noisier this kind of identification cannot be foolproof. In the DNA molecular structures of only a few people have been identified at present. It will take enormous effort and time to identify to find out the type of DNA of people all over the world [1]-[3].

EEG signals of each individual differs they are not same even if they do the same work or task [5], [6]. The brain of each individual is unique our DNA and our life expressions will certainly have an impact on our brain structure. It can be said that even if the DNA of two persons are the same their life experiences will differ [4]-[6]. When even security is needed we can use this brain biometric in access control systems. Since it is unique now a days biometrics are used in access control systems to gain access to resources protected from everyone except you. We leave our finger prints everywhere which can be replicated and used to gain access to any security information. But no one can gain access to the brain structure because it is safely protected inside the skull. Our brain activities are changeable.

A test was conducted the brain waves were interpreted and recorded from 200 subjects by think simply the password. The results were analyzed brain signals shows that everyone's brain waves are a bit difference even when they think about the same thing from brain waves we can authenticate users it produced 95% success rate [5], [6]. But later it is proved that the recorded signals are integration of gamma activity which is related to IRIS and muscular movement of eye. IRIS is a protected internal organ and has cells that are directly connected to the brain. So the integration of IRIS and Brain wave signals (EEG) recognition biometric systems to become the leading technology in identity verification. This work deals with the basic research in the field of the person identification by means of IRIS and Brain wave signals (EEG) [15], [16].

Our future work is mainly focused to the analysis of personal EEG features, suitable feature extraction algorithms, other parameterizations as well as classification techniques in Both IRIS Patterns and Brain wave signals (EEG), The detailed analysis of the EEG database and Fusion technique with clear strategies. We started Experimental study with the verification of results published in our further extension.

2. PROPOSED MODEL

Biometric Sensors used to capture the specific patterns from the IRIS and Brain wave signals (EEG) matches with the database confidentially. IRIS recognition uses pattern recognition techniques based on the irides of an individual's eye.

IRIS images are printed using a commercial printer and then presented at the IRIS sensor which is accepted and its identification can be duplicated. Since only alive people can make Brain wave signals (EEG), which is natural candidate for liveness detection it gives Anti Spoofing system design in existing unimodal IRIS biometrics.

The IRIS is the area of the eye where the pigmented or colored circle, usually brown or blue, rings the dark pupil of the eye [7], [8]. It includes the use of various techniques to either directly or indirectly images the structure, function or pharmacology of the brain.

A characteristic property of neuro imaging data is that they are acquired, processed and stored in digitized form. Without a clear strategy for enabling research efforts bio metrics build upon one another, but it will fall behind the market. In order to rectify this problem a new approach is suggested. Neuro Image Coding makes it possible that data processing, data analysis and data interpretation can be done on IRIS with Brain wave signals (EEG).

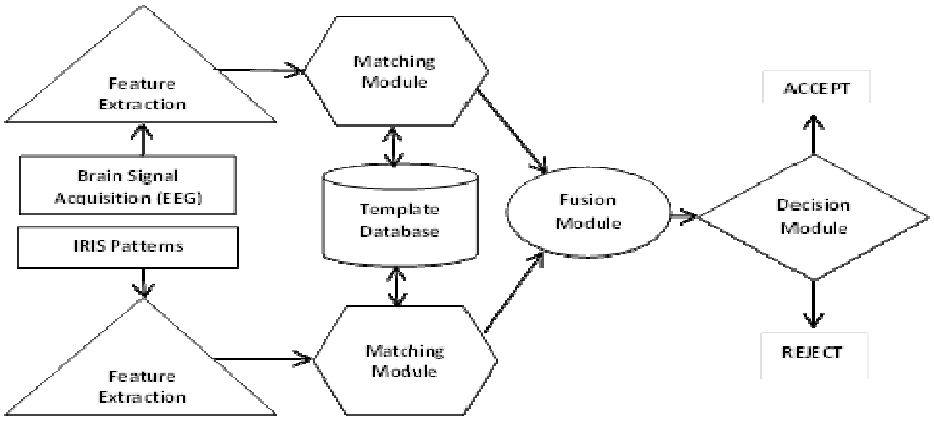

FIGURE:1 Block Diagram for IRIS & Brain Forensics

3. METHODLOGY

3.1. IRIS Recognition System

Extraction of the IRIS image is more complicated. Since IRIS is small in size and dark in colour. The IRIS patterns are differentiated by several characteristics including ligaments, furrows, ridges, crypts, rings, corona, freckles, and a Zigzag collarette. Stability is one of the key advantages of IRIS recognition and it is suitable for one - many identification. Veri Eye Standard SDK (IRIS Extractor, IRIS Matcher, IRIS Client, IRIS server, IRIS BSS) used to extract IRIS Patterns in the Effective Manner.

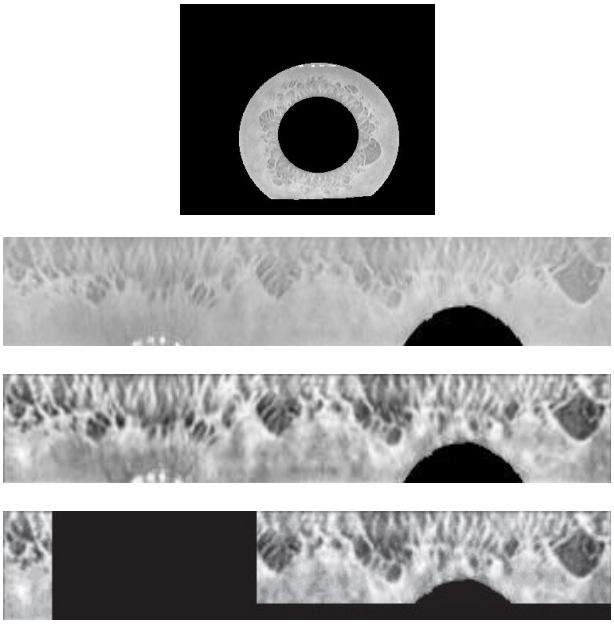

FIGURE: 2 IRIS normalization (a) Segmented IRIS image
(b) Rectangular IRIS image (c) Enhanced IRIS image
(d) Region of interest in IRIS image

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IRIS Patterns not only contains exact information from the eye, but also several unwanted parts. (Ex. Eyelid, pupil etc). Under some conditions brightness may not be same and eye to camera distance may change the size of IRIS. To get an IRIS free of noise, independent on illumination and size, IRIS image pre-processing is done. For the purpose of analysis, the original image needs to be pre-processed to obtain a segmented and normalized image, then its texture is analysed and encoded to form an IRIS Feature vector. Finally, we compare templates to estimate similarity between Irises [7].

3.2. Brain Wave Acquisition

The human brain is the center of the human nervous system and it monitors and regulates the body's actions and reactions. It continuously receives sensory information, and rapidly analyses these data and then responds to the actions and functions. The electrodes used to measure electrical brain activity it is further amplified and stored on a memory device. The software presents the stimuli (Software for Data Acquisition), collects the EEG data, and analyses the data.

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Type	*Frequency*	*Use*
Delta	*<4 Hz*	*Occur during sleep, coma*
Theta	*4-7 Hz*	*Correlated with emotional stress*
Alpha	*8-12 Hz*	*Reduce amplitude with sensory stimulation or mental imagery*
Beta	*12-36 Hz*	*Can increase amplitude during intense mental activity*
Mu	*9-11 Hz*	*Diminishes with movement or intention of movement*
Lambda	*Sharp, Jagged*	*Correlated with visual attention*
Vertex	*-*	*Encephalopathy*

TABLE:1 Brain Waves signals and its Frequencies

EEG is usually by placing a number of electrodes to the scalp surface collected. There are several varieties commonly used electrodes silver tube electrodes, needle electrodes and adhesive electrodes, this system uses silver tube electrode in order to achieve the scalp with EEG measurement devices connection. Brain signal acquisition circuit includes EEG amplification, filtering, A / D conversion and USB interface circuit of four parts. It revealed by a specific pattern in the EEG (Electroencephalography).

This methodology tracks and records the Brain wave signals (EEG). Small metal discs with thin wires (electrodes) are placed on the scalp, and then send signals to a computer to track the Brain wave signals (EEG). Brain patterns forms different wave shapes that are commonly measured by 0.5 to 100 μV in amplitude. Usually EEG is 100 times lower than ECG signals. By means of Fourier transform power spectrum from the raw EEG signal is derived. In power spectrum contribution of sine waves with different frequencies are visible. Although the spectrum is

continuous, ranging from 0 Hz to one half of sampling frequency, the brain state of the individual may make certain frequencies more dominant.

Brain wave signals (EEG) also have some artifacts and EEG can carry many unwanted signals from brain. So the pre-processing is essential. For example [8]
• Interference from electronic equipment the 50 or 60Hz power supply signals,
• Electromyography (EMG) signals evoked by muscular activity,
• Ocular artifacts, due to eye movement or blinking.

Those unwanted components may bias the analysis of the EEG, and may lead to wrong conclusions. We have several modern techniques to reduce such artifacts, but each of those approaches has its own pros and cons. On a more fundamental level, however, it is clear that in order to reliably extract artifacts, one need to know how brain signals generally look like, and what information content they encode. Therefore, as our understanding of brain signals improves, it should become less difficult to detect and remove artifacts [8].

3.3. Feature Extraction

The IRIS Extractor, electrodes can read the IRIS patterns and Brain wave signals (EEG) respectively. Feature extraction should be defined with some invariant properties, Ability of discriminate pattern classes of interest, robust to noise, occlusion, Low measurement of cost and real time and lead to simple decision making strategies [9],[17]. In feature extraction image is classified by various algorithms and it will be visually recognized for unique patterns which is used for enrollment [10].
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The experiment was conducted using data acquired in our labs for IRIS Patterns using Fuzzy Neural Network Algorithm can extract rules that yield much higher accuracy and robustness. Neural learning algorithm is applied for IRIS Classification, neural network especially for this task would be time consuming and selecting another wavelet would be more appropriate [12]. The IRIS recognition rate of Fuzzy Neural Network was 99.25%.

3.4. Matcher

The biometric matching system contains Pattern matching and the decision modules. The newly sensed biometric data will be first processed like the enrollment data, and the system will generate the pattern templates from the data. The pattern matching module compares the newly generated templates with those in the bio metric database and calculates match scores for final decision. If the matching score is higher than the predetermined threshold, the system identifies/verifies it.

In the matching module Binary coding scheme is used to obtain the feature vector into a binary code. Binary code-words converted into binary numbers. Boolean vectors or Binary numbers are always easier to compare and to manipulate in both IRIS and Brain. In order to code the feature vector we first observed some of its characteristics and all the vectors that we obtained have a maximum value that is greater than 0 and a minimum value that is less than 0.

If “Coefficient (Coef)” is the feature vector of an image than the following quantization scheme converts it to its equivalent code-word:

- If Coef (i) < 0 then Coef (i) = 0
- If Coef (i) >= 0 then Coef (i) = 1

The next stage is to compare two code-words to find out if they represent the same person or not [12].

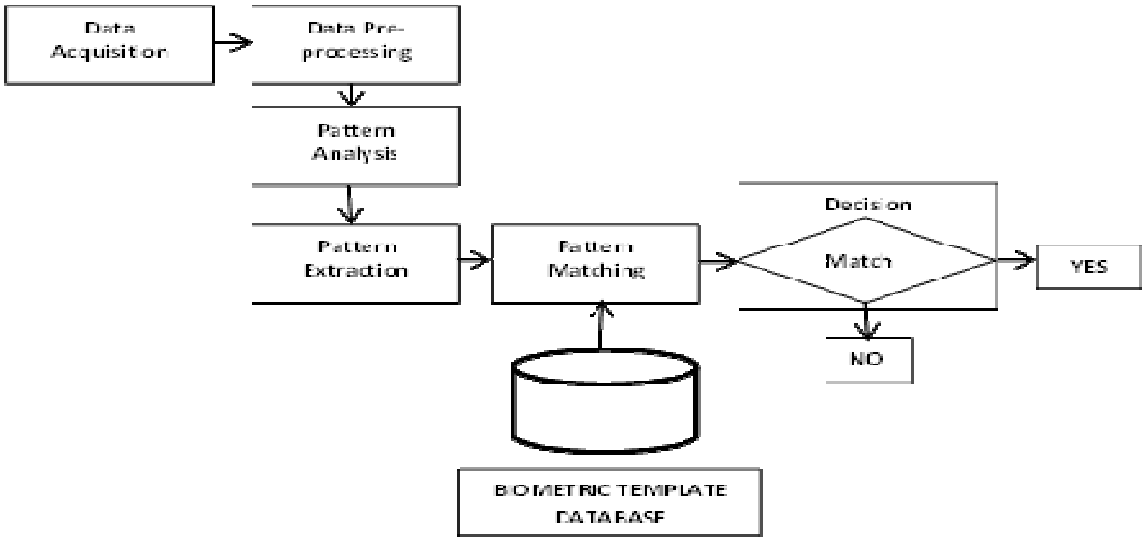

FIGURE: 3 Matching Module

3.5. Template Database

The template that is created and stored is not the biometric data itself but instead the results from some kind of analysis and summary of the biometric data. These templates contain the unique characteristics of a user's biometric information, and they are the master copies that each future data acquisition would be compared to.

3.6. Matching Score Level Fusion

Matching score level fusion is one of the important biometric information fusion strategies, because matching scores are easily available and because they retain sufficient information to distinguish genuine matching from impostor matching. Multi biometric system divided into different subsystems each subsystem exploits one biometric trait to produce a matching score. Then these matching scores are normalized and integrated to obtain the final matching score is used for the final decision will give the authentication to the users [12]-[14].

4. RESULTS AND DISCUSSIONS

These methods can be triggered into different security levels such as secret services, military forces, police and criminal justice, especially in the frame of "homeland security", associated fears, concerns are that brain imaging may be used for "mind-reading" or reading the people's private thoughts and feelings, in the sense of polygraph, even without their consent and co-operation.

The nation's biggest threat is information piracy. The IRIS and brain biometrics can pave way to identify a sophisticated technical based solution to overcome information piracy. Airports, banks, military, commercial applications, enterprise-wide network security infrastructures, government IDs, secure electronic banking, investing and other financial transactions, and offices with documentation like passport, driving license, are required Highly secure identification and personal verification solutions. Thus Neuroimaging enrich the Digital Forensics Community with the help of Biometrics. IRIS and Brain recognition technology combines computer vision, the following results shows that IRIS, Brain wave signals (EEG) and its purpose is real time high confidence recognition.

The Proposed Identification Method	IRIS	Brain Wave Signals(EEG)	Fusion
EER of the proposed method (%)	3.21	4.16	2.12

TABLE: 2 COMPARISON OF THE MATCHING PERFORMANCES

5. CONCLUSION

This paper will establish the digital forensics community and resolve the issues facing the digital forensics. IRIS and Brain has enormous features in biometrics to enhance diverse security levels and more secure than other biometric technologies. It helps to develop new tools, techniques, and methodologies in lie detection, crime detection and to detect the record of specific terrorist act or any incident stored in the brain and to intensify brain related methodologies in future. These ideas strongly suggest its future application in brain imaging studies.

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