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Eeg Based Person Identification and Authentication Using BCI

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Abstract: *now a day, a wide variety of security system requires reliable recognizable scheme to either confirm or identify the person from a group. Due to the characteristics of EEG, it is very difficult to forge or copy the EEG signal. In this paper, for feature extraction-multiwavelet transforms are used. For classification, kNN method is used.*

Keywords: *EEG;biometric;person identification;k-nearest neighbor(kNN)*

I. Introduction

For generations, humans were thrilled and fantasized about the ability to make communication and interaction with machines through thought or to create a device that can mediate into person's mind and thoughts. BCI can be mainly used by physically disabled and challenged people to perform various activities, which improves the quality of life and make them to lead an independent life. Electroencephalography (EEG) is the electrophysiological monitoring technique to record electrical characteristics of human brain. It is typically a noninvasive. Mainly EEG signals are signals of biomedical origin. these waves contain more information about the brain response [1]. Human beings have made use of body characteristics like face, voice, fingers for thousands of years to recognize each other. A large and wide variety of systems uses reliable personal identification methods to either confirm or determine the identity of an individual for requesting their services Identification and authentication are two different processes, for authentication of a person it is necessary to identify the person. A biometric system may operate either in identification mode or authentication mode. The process of identifying the individuals from a group is called as identification mode. The process of confirming or denying the identity claiming of an individual is known as authentication mode Recently, researchers are focused on the biometrics system for prevent precious data or transaction from forgery. [2].Conventional biometric systems like 1)DNA 2)Finger print 3) Retinal or Iris scanning 4) Voice recognition etc., fails to satisfy the characteristics mainly universality, distinctiveness, permanence, collectability, acceptability, and circumvention[3]. Furthermore, brain signals are related to the subject's genetic information, making them unique for each individual and stable over time. Therefore, brain signals are more reliable and secure and have been proposed as an identification and authentication biometric [4].

This paper presents a general framework of EEG-based user identification and authentication. A single channel was used for noise reduction by Parks-McClellan filter and band pass filter. Multi-Wavelet transform is used for feature extraction and then k-nearest neighbor is adopted for classification. Three different scenarios are explained to emulate different cases in authentication. The rest of the paper is organized as follows: Section II gives a brief introduction of previously done work. Section III presents the system architecture and algorithms used in the proposed EEG-based authentication framework. Finally, we discuss the application scenarios and corresponding experimental results.

II. Literature Review

Now a day's EEG-based identification and authentication has been studied and the preliminary works have demonstrated that the EEG brainwave signals could be used for individual identification and authentication.

Sebastian Marcel et al, [5] investigated the use of brain activity as a new modality for person authentication and found few advantages like, it is confidential and it is very difficult to mimic .Nisargkumar Patel et al. [6] have proposed LVQ based method of classification for person authentication and identification which yielded the results upto 80%. EEG signals with Learning Vector Quantization neural network to classify an individual as distinct from other individuals with 72–80% success. Palaniappan et al. [7] showed visualizing a picture evokes perception and memory and it is our assumption that this level of neural activity between individuals would be different. Danilo P. Mandic et al. [8] proposed in their work that The EEG signals were recorded from subjects while being exposed to a stimulus, which consist of drawings of objects chosen from Snodgrass and Vanderwart picture set.

EEG-based biometry is an emerging topic and that it may open new research directions and applications in the future.

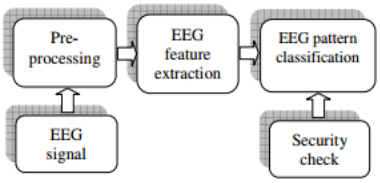

Fig 1: Design of proposed EEG based biometric system

III. Methodology

The main intention of this paper is to introduce a one of the best method for human identification for improve the security systems. Since everybody have unique EEG pattern which is universal and brain damage is rarely occurred.

A. Data Acquisition

During the process of data acquisition, twenty subjects of age, ranging from 19 to 25 participated in the experimental study using Enobio-8. The subjects were made to seat in a recycling chair or an easy chair that located in a sound proof RF shielded room. Measurements were taken from 8 channels which were placed on the experimental subject's scalp. These were sampled at a rate of 500 Hz. The electrode positions were done in accordance with the use of Standard Electrode Position Nomenclature Encephalographic Association (10-20 system). The EEG signals that were recorded from the subjects got exposed to stimuli. These stimuli consisted of a collection of pictures that were chosen from Snodgrass and Vanderwart picture set. The subjects were asked to count how many times a particular picture repeated in the stimulus set. Duration of the stimulus of every drawing was 300ms.The inter trial interval was 5.1 seconds.

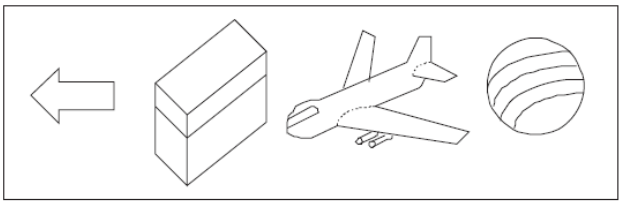

Fig 2: Some examples of Snodgrass & Vanderwart picture set

B. Pre-Processing

From the waveform that we obtained after performing the visual evoked potential test is the raw EEG signals which contains lot of noises and artifacts because the signals changed very rapidly. After signal or data acquisition phase, EEG signals are to be pre-processed. Signal pre-processing is the process of removing noise and artifacts from original signals and reconstruct these EEG signals. Signal pre-processing step is also known as Signal Enhancement phase. To eliminate the unwanted signals, artifacts, noise from the recorded EEG samples during data acquisition phase, each of the EEG samples has to be passed through a finite impulse response filter (FIR). This linear filter is designed by making use of Parks-McClellan algorithm which is an example for band-pass filter. Parks-McClellan FIR filter is used which shows discontinuities at head and tail of its impulse response due to its equiripple nature. The EEG data wave consists of delta (0-3Hz), theta (3-7Hz), alpha (8-13Hz), beta (13-30Hz) and gamma (above 30Hz). So a bandpass FIR filter of 2-20 Hz is applied to the EEG signal.

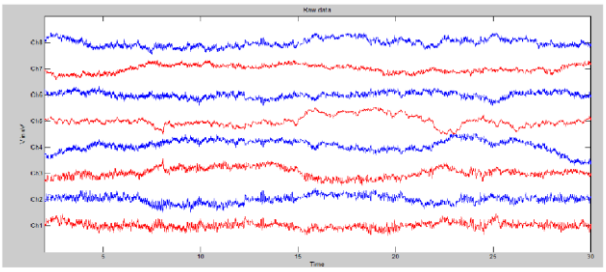

Fig 3: Raw EEG data

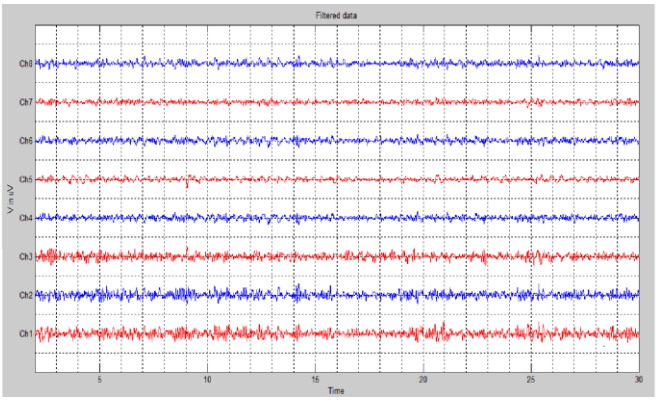

Fig 4: Filtered EEG data

C. Feature Extraction

Feature extraction is an essential process for separating the desired output from the given EEG signal pattern. The purpose doing the feature extraction is that classification is easy with the essential features that are extracted. The filtered signals are then wavelet decomposed to 6 levels using Daubechies 14 wavelet. Six levels are sufficiently enough to extract all the five EEG bands-delta, theta, alpha, beta and gamma for each person. Wavelet features for accepted widely and are utilized because of high discriminating properties in the active band for a particular condition of EEG (delta, theta, alpha, beta, and gamma). Wavelet decomposition helps to give coefficients in these particular band areas, which clearly specifies the brain signal. We made use of wavelet decomposed band coefficients to represent the signal and in reducing the dimension of statistical parameters feature matrix which have been selected.

Here we have five statistical parameters -Variance, Standard deviation, Entropy, Kurtosis, Skewness and 5 nodes for each subject, and then we have 5*5=25 features for each subject.

D. Classification

Like feature extraction, classification phase is also important and crucial part because it is highly dependent on feature extraction. Classification is the method of checking the identity of input vectors which has been stored in the database. To choose the most useful classifier for a set of features, the property of the classifier has to be chosen accordingly. After the completion of collecting the useful features, the main aim is to check whether the person is authorized or unauthorized. This has to be done by using a suitable classifier. The chosen classifier should be able to know the relation between features and the biometric EEG samples (authorized or unauthorized) which is a part of the EEG signal. In the project, for the classification of the EEG signals, K-Nearest Neighbor algorithm (kNN) is used. 10 cases were tested to see their performance and which one had the best result.

IV. Experiment Results

In the experiment, three different application scenarios are used that may be involved for user authentication.

Scenario 1: **Side-by-side identification of all the subjects**

The purpose of the side-by-side method was to improve the accuracy of identifying all the subjects. In side-by-side method several smaller size training datasets were made based on different combinations of different subjects. Then sub-models were built after training these small size datasets.

Scenario 2: **Identify one subject from all the other subjects**

This scenario was to evaluate the performance of how accurately it can identify one subject from others. The training dataset was combined by all the data from the training dataset of one specified subject and randomly selected the same size data from the same dataset of all the other subjects.

Scenario 3: **Identify a small group of subjects from the others**

This scenario was to simulate the case that the authentication system may allow a small group of individuals (for e.g., authorized personnel) to access the system. We tested two cases: allowing 2 persons to have access or 3 persons to have the access. The training set of this type was to select all the training data for the allowed individuals and also the same size training data of other people which were chosen randomly.

V. Results and Discussion

Table 1 showing results for Scenario 1

Participant	Output expected	Result obtained	Result
1	Authorized	Unauthorized	Fail
2	Unauthorized	Unauthorized	Pass
3	Unauthorized	Unauthorized	Pass
4	Unauthorized	Unauthorized	Pass
5	Unauthorized	Unauthorized	Pass
6	Unauthorized	Unauthorized	Pass
7	Unauthorized	Unauthorized	Pass
8	Unauthorized	Unauthorized	Pass

Table 2 showing results for Scenario 2

Participant	Output expected	Result obtained	Result
1	Authorized	Authorized	Pass
2	Authorized	Authorized	Pass
3	Authorized	Authorized	Pass
4	Unauthorized	Authorized	Fail
5	Authorized	Authorized	Pass
6	Authorized	Authorized	Pass
7	Authorized	Authorized	Pass
8	Authorized	Authorized	Pass
9	Authorized	Authorized	Pass
10	Authorized	Authorized	Pass

Table 3 showing results for Scenario 3

Participant	Output expected	Result obtained	Result
1	Authorized	Unauthorized	Fail
2	Unauthorized	Unauthorized	Pass
3	Unauthorized	Unauthorized	Pass
4	Unauthorized	Unauthorized	Pass
5	Unauthorized	Unauthorized	Pass
6	Unauthorized	Unauthorized	Pass
7	Unauthorized	Unauthorized	Pass

To evaluate the performance of each scenario, we used the Correct Classification Rate (CC_{rate})
Correct Classification Rate (CC_{rate}) = (Ct/T_n)*100
C_t=total number of correct classifications, T_n= total number of testing trials.

Scenario 1: Side-by-side identification of al l the subjects, in which we considered 8 samples out of which 7 samples, showed correct results. This scenario is having the accuracy
of 88.88%

Scenario 2: Identify one subject from all the other subjects
In this case, 10 samples were used for testing out of which 9 samples showed us accurate results with an accuracy of 90%.

Scenario 3: Identify a small group of subjects from the others
7 samples were considered for testing this scenario, out which 6 showed correct results. This scenario had worst accuracy of 85.71%.

VI. Conclusion

In this paper we focused on the study of how to use EEG signals for identification and authentication. Parks-McClellan FIR filter was used for filtering of raw EEF signals. Multi-wavelet transformation method was used in feature extraction. We also tested three application scenarios of which identify one subject from all the other subjects showed us best results when compared to other two scenarios.

References

[1] Brain computer interface and its types - a study Anupama. H.S, N.K.Cauvery , Lingaraju.G.M
[2] An Introduction to Biometric Recognition-Anil K. Jain
[3] Brainwave based authentication system- Pinki Kumari, Dr. Abhishek Vaish
[4] Exploring EEG-based Biometrics for User Identification and Authentication-Qiong Gui, Zhanpeng Jin, Wenyao Xu
[5] Person Authentication using Brainwaves (EEG) and Maximum A Posteriori Model Adaptation-Sebastian Marcel, José del R. Mill ´an
[6] LVQ based person identification system -Nisargkumar Patel, Prof. V.V. Shete, Ashwini Charantimath
[7] Improving visual evoked potential feature classification for person recognition using PCA and normalization- Ramaswamy Palaniappan, K.V.R. Ravi
[8] EEG Based Biometric Framework for Automatic Identity Verification- Ramaswamy palaniappan, Danilo P. Mandic