BRAIN COMPUTER INTERFACE FOR BIOMETRIC AUTHENTICATION BY RECORDING SIGNAL

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Abstract

Electroencephalogram(EEG) is done in several ways, which are referred to as brainwaves, which scientists interpret as an electromagnetic phenomenon that reflects the activity in the human brain, this study is used to diagnose brain diseases such as schizophrenia, epilepsy, Parkinson's, Alzheimer's, etc. It is also used in brain machine interfaces and in brain computers. In these applications wireless recording is necessary for these waves. What we need today is Authentication? Authentication is obtained from several techniques, in this paper we will check the efficiency of these techniques such as password and pin. There are also biometrics techniques used to obtain authentication such as heart rate, fingerprint, eye mesh and sound, these techniques give acceptable authentication. If we want to get a technology that gives us integrated and efficient authentication, we use brain wave recording. The aim of the technique in our proposed paper is to improve the efficiency of the reception of radio waves in the brain and to provide authentication.

Keyword

Related work, EEG brain signal, Brain wave, Overall projcet outline, System requirements.

1. INTRODCTION

The evolution of life technology has many requirements. The application of this technology on the ground includes obtaining permission for the person authorized to enter (all these methods depend on the pin technique or password to obtain permission from the system) as in banks, experimental laboratories, nuclear reactor, confidential data in computerized systems ... Houses Smart.As a result of the development of piracy in return for the weakness in the development of authentication techniques, the main purpose of which is to avoid the imbalance that occurs in this aspect.The best solution to avoid these problems is to follow a new approach as in our paper of these biometrics, As a result of the unique efficiency of this road for each user is more effective than others and less prone to the problems mentioned.

EEG is one way to measure brain waves of different-frequencies in human brain, By placing the electrodes in specific-places of the scalp (head) in order to identify and record brain waves. These recordings are a collection of the amount of waves produced by neurons, which are estimated in millions of interconnected and adjacent neurons. Here, it should be noted that the EEG is

Dhinaharan Nagamalai et al. (Eds) : CCSEIT, ICBB, DMDB, AIAP, CNSA - 2019
pp. 153-162, 2019. © CS & IT-CSCP 2019 DOI: 10.5121/csit.2019.90613

different from the location of the recording [1]. Biometrics is one of the fields of modern science that deals with the idea of exploiting the unique characteristics of man, quantifiable and quantifiable, in order to give the desired goal of verification of identity [2]. The final fact was that proving the benefits of using biometrics in authentication.

For authentication, many techniques biometrics have emerged, including: fingerprint, sound, face, iris and eye network, all of

which are commonly used in different areas of life for security and authentication purposes, Biometric measurements have pros and cons, one of the advantages is that brainwaves
provide the safety and safety advantage in a unique way compared to other biotechnologies, because if the fraudulent party attempts to produce the specific pattern that the authentication system needs to provide access to authentication, it will encounter many obstacles, including the system that will address the emotion of fear, fear and aggression to prevent access. Brain wave capture technology is performed through a brain-oriented sensor where the Brainsense headband is used as a Bluetooth through which we can capture brain signals (electrically charged beams), These packets are then transferred to the differential level unit LDU, Through Bluetooth then the process of extracting and processing these data coming from the brain through the use of a platform Matlab, and finally send the processed signal for authentication. By applying this technique we need you and i to put on our heads sensors, This will create a specific pattern of incoming brain waves in the differential level unit, this is what we will need at authentication, We can (user) determine the pattern of any combination of interest, brain rhythms, meditation, blink of the eye (Beta, , Delta, Gamma, Theta and Alpha), This authentication is only achieved if this pattern is created by the person being served. This distinguishes our proposed system from other techniques that we will refer to in Section 2.

2. RELATED WORK

Recently, there have been many techniques in the field of biometrics for the measurement and analysis of brain waves and was one of the most famous researchers in this field:

Marcel's [3] proposal is based on the use of spectral density of power as an advantage, and as a framework statistical based on Gaussian mixing models, Here the typical match is based on the (MAP) Maximum Model A Posteriori On the face and headset authentication, and the technique used to illustrate the possibilities of their method is done through the simulation using the results of protocols (train and test).

M. Poulos, et al [4] that the person's identity is treated as spectral information, which are extracted by the EEG, The authors of this idea performed a classification of neural networks using EEG data for healthy individuals in order to investigate experimentally between genetics information and EEG, this proves that this technique carries genetic information to identify the person.

Palaniappan R. [5] this researcher proposed a biometric authentication method that depends on the concept of the idea in binary stages, the method of extracting the feature involves all linear and non-linear measures give precision to the result, these results have shown combine the two-phase verification with the (EEG) provides tremendous potential as biometrics measures because they resist fraud, PCA is used to reduce the dimension in the properties vector, which works only with the most distinctive features because the features are repetitive

3. METHODOLOGY

3.1 EEG Brain Signal

EEG is used to measure brain waves from frequencies in the head region. These waves are obtained by placing electrodes according to the international measurement system 10-20 (the distance between the points landmark, namely the nasion, the inion, = “10” – “20” ٪) as in Fig. (1 (a,b)), which is used to detect and record pulses from the brain (Draw lines at intersections), through the distinct points are known where the position of poles result of the arrow formed by the intersections of the lines and the withdrawal of the corona at “10” or “20”%, this distance will be between nasion and inion [6] these recordings are the amount of contiguous and interrelated neurons. Here, it should be noted that the difference in the positions of the poles of the recording leads to the difference of EEG,[1], for more detailed description, see below:

1. Delta

The Delta rhythm is an oscillation activity that reaches 4 Hz. This activity tends to have slower waves and higher amplitude. The adults are seen in slow sleep wave, may occur most commonly throughout the scalp, while in newborns we notice that the delta rhythms are slow

2. Theta

Theta consists of a frequency range of 4 to 7 Hz. Theta can be observed in children during drowsiness or can be observed during the effects of older children, while the appearance of theta in adults is an abnormal activity, Here, it should be noted that changes in the theta of the scalp are hard to find without help (computational Methods of EEG raw effects) [7].

3. Alpha

Alpha oscillation activity ranges from 8 to 12 Hz, the first activity of the EEG is due to the researcher Hans Berger who called it (alpha wave), It is the basic posterior rhythm, it is also called alpha posterior rhythm, it should be noted here that this rhythm is seen in the side areas of the scalp, The capacity of alpha brain vibrations is large and can be seen clearly in raw traces EEG, this is done in (specific mental states), be well visible with closed eyes and weaken in the case of eye opening or exposure to exertion. This can be seen in Figure (2).

4. Beta

The frequency ranges here at the beta rhythm ranges from 14 to 30 Hz. This rhythm can be seen clearly in the physical sensory areas (Front, motor, parietal) regions. This activity is concentrated in the case of alertness [8].

5. Gamma

The frequency ranges in gamma ranges from 30 to 100 Hz. In this band, synchronization in neurons is very important for functional integration through brain regions, it is believed that gamma rhythms work on the association between different nerve groups for the purpose of generating cognitive function or kinetics [1], These functions include active information processing (identification of sensory stimuli), gamma activity can be recorded from the electrodes of the scalp and its frequency does not exceed (45 Hz) [9].

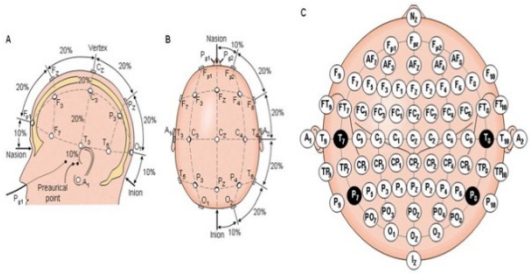

Figure 1. The (10-20) international-standard. (Jaakko Malmivuo. and Robert Plonsey. Bioelectromagnetism, Oxford University Press, 1995, WEB-version).

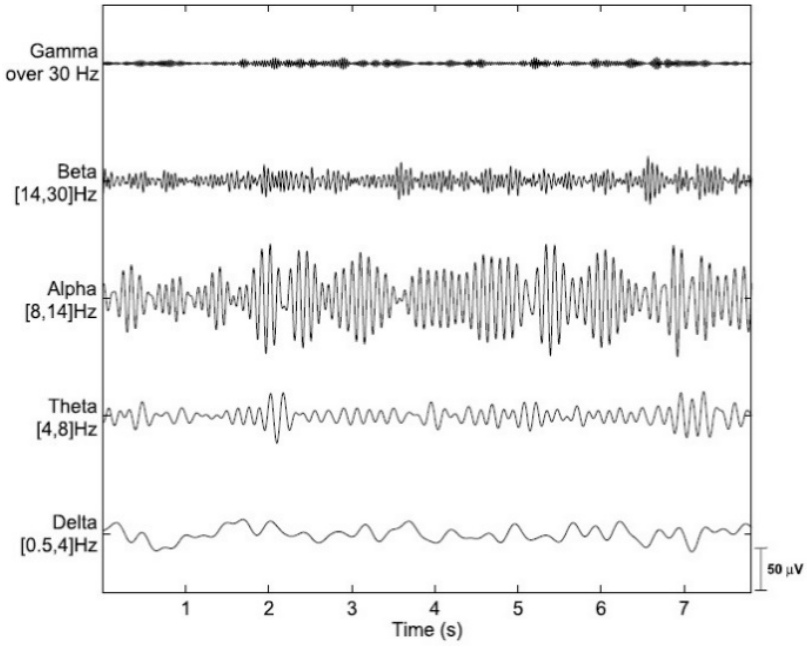

Figure 2: Brain-wave rhythms acquired using the protocol (resting with closed eyes)

3.2 Brain wave as biometric identifiers

EEG signals provide some characteristics that do not share the most common biometrics (see in table (1)), such as fingerprints, iris and face, which will use the EEG signal as biometric identification based on potential analysis and exciting effects on the design of the next-generation biometrics, Thus, EEG is very excellent for authentication as well as a hindrance to fraudsters [10,11]. Here we refer to the different characteristics of the biometric knowledge (comprehensiveness, performance, interdependence, permanence, acceptability and circumvention), where the EEG's biometrics are still in its primitive phase.

Table1 an overview of contributions to biometric identifiers

papers	protocol	Database	Channel	feature	Classifier	performance
Brigham and vijaya kumar [12]	Imagined Speech	6	128	Burg AR(2^{nd})	Support Vet. Mach	GAR=99.75 %
	VEP	120	64	Burg AR(4^{nd})	Support Vet. Mach	GAR=98.95 %
Poulos et al [13]	EC	4	1 (o2)	$\propto$ Spectrum	NN	GAR=81%-100% CRR=81%-95%
Poulos et al [14]	EC	4	1 (o2)	AR (8^{th}-12ve)	NN	GAR=72%-83%
He and wang [15]	Motion tasks	7	17	AR(7^{th}) on ICA	Naïve Bayes	HTER=12.1 %
Riera et al. [16]	EC	51	2 (FP1, FP2)	AR(100)&DFT MI&Coh.&CrossCorr.	Discriminant Anal.	EER=3.4%
Su et al. [17]	EC	40	1(FP1)	PSD	K-NN	CRR=95.98 %
Campisi et al. [18]	EC	48	3(T7,Cz,T8)	Burgs refl. Coeff.	Polynomial regression	CRR=96.98 %
La Rocca et al. [19]	EC/EO	9	3,5	Burgs refl. Coeff.	Linear classifier Fusion of bands	CRR=100%
Abdllah et al. [20]	EC/EC	10	4	AR	NN	CRR=97%
Das et al. [21]	VEP	20	20(occipital)	LDA	KNN	CAR=94%

3.3 Overall Project Outlıne

In this paper the mechanism of communication with brain waves is done through the RF receiver, and receivers with different inputs and outputs, In the input section of this design is a dedicated sensor for the brain wave, in addition to a transmitter and a unit to analyze the level and then a unit to process data received from the brain, the idea behind this technique is to begin analyzing the recorded brain wave signals. Since the human brain consists of millions of adjacent and interconnected neurons, so the patterns of interaction between these neurons will be represented as thoughts and emotional states. According to human thoughts in the brain, this pattern will change and thus produce different electrical waves, these electrical waves are sensed by the brain wave sensors and then converted to packets which are transferred via Bluetooth, After the data arrives at the LAU (Level analyzer unit (see in fig. 4)), which begins to work on the extraction and processing of the signal through the use of the Matlab laboratory platform and obtain authentication by specifying the authorized entry, this can be seen in Fig (3),Here the initial data is received, processed and then verified whether this preset pattern has been created or not, The auditor's unit reports that the pattern of the brain wave generated by the user matches a predefined pattern of the system or no.

The checker module in this paper works to receive serial data from the LAU (Level analyzer unit), it is an error correction device and is also used to provide authentication at both levels, in this way, the authorized pattern is established, the LAU confirms the information and is retrieved to the checker module. After the user accepts the brain wave authentication this will ask for a password or pin, this is acceptable if both pins and brain waves are identical to the authorized data, this is illustrated in Fig. (5), the checker consists of serial data receiver and ARM processor. This is connected to a touch screen and the processor with an LCD is interface.

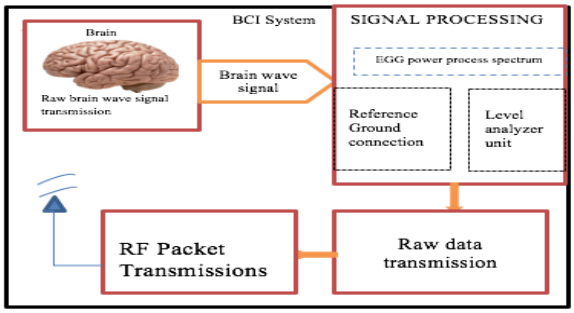

Figure 3: Diagram Interface System (BCI)

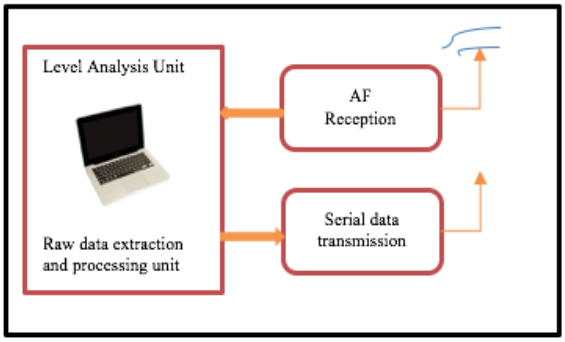

Figure 4: Diagram level analysis unit

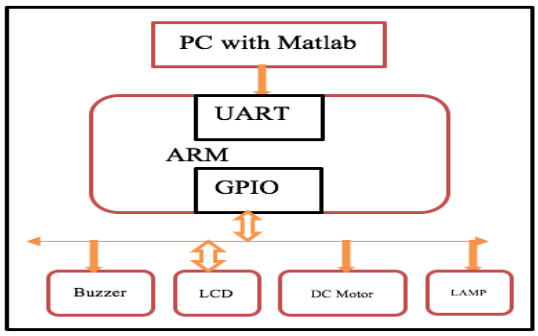

Figure 5: Diagram checker module

4. SYSTEM REQUIREMENTS

4.1 Required Hardware

- Brainsense or ARM (Ipc2148)
- Alaram unt
- Sensor brain wave
- LCD for Display

- Switches
- Light
- Gsm modem
- Motor

4.2 Required Software

- KEIL IDE (Compiler)
- Flash Magic (Programmers)
- Orcad Design
- Embedded c: Language
- Matlab 2013(32bit)

4.3 Application

- Application Biometrics
- Application LAU (Level analyzer unit)
- Application Online verified
- Application Home
- Application Record

5. RESULTS

To conduct a test work for our proposed technology, headbands (Brainsense) are placed on top of the person and preferably selected locations from the head such as the areas where the frequencies are concerned in order to facilitate signal reception. The signal reception process is initiated by the LAU (Level analyzer unit) Data-extraction requires the use of the Matlab-platform, Here the data extraction process, which is done through the headband (Brainsense), Equip with the process of processing with thinkgear.dll and a library In order to extract data. Fig. (6) a screenshot shows the received signal strength (Attention and Blink strength), While fig. (7) a screenshot of the graph shows brain signals in Matlab.

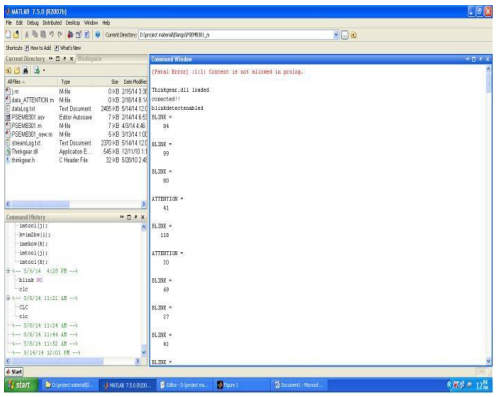

Figure 6:Screenshot shows the received signal strength level

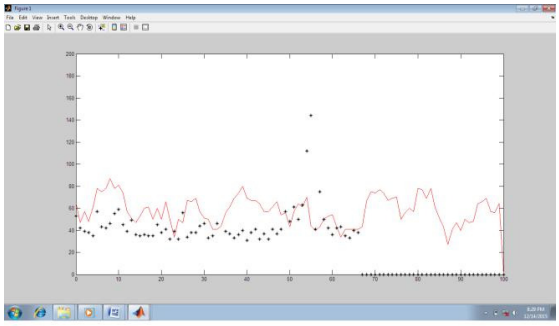

Figure 7: Screenshot of the graph shows brain signals in Matlab

6. CONCLUSİON

This paper contains the details of receiving the waves released from the brain and then analyzed and recorded through a brain wave sensor.

After the brain wave measurement unit receives raw data from the source (brain), the processes begin to be analyzed and then recorded, which will provide bi-level authentication using biometrics, in this technique brain waves are used as biometrics measurements, so that the enumeration of the biometrics ideas is done to generate the authentication process, the main characteristics of the EEG were illustrated in the section III, The mechanism used to compare the biometric scale of the brain waves to obtain authentication and its efficiency with other biometrics, here highlights the importance of using the biometrics scale. The great benefit of all this is that the computer interface used to read and record brain ideas is a blessing to provide an independent environment for many people to get away from manual control and replace it with thinking.

7. ACKNOWLEDGMENT

The author's wild like to thank Anbar University (www.uoanbar.edu.iq) Anbar-Iraq for the support in the prevent work.

The author's wild like to thank Mustansiriyah University (www.uomustansiriyah.edu.iq) Baghdad-Iraq for the support in the prevent work.

REFERENCE

[1] Electroencephalogram.PDF,15 July 2007.

[2] Wenjie Xu, Cuntai Guan, Chngeng siong . rangana- tha,m.thulasidas,jiankang wu,"high accuracy of classi- fication of eeg signal,"icpr,17th international confe- rence on patter recognization(ICPR' 04)PP.391-394

[3] Marcel, S., & Millán, J. D. R. (2007). "Person authentication using brainwaves (EEG) and maximum a posteriori model adaptation." Pattern Analysis and Machine Intelligence, IEEE Transactions on, 29(4), pp. 743-752.

[4] Poulos, M. Rangoussi, N. Alexandris, A. Evangelou, M. (2001). "On the use of EEG features towards person identification via neural networks." Informatics for Health and Social Care, 26(1), pp. 35-48.

[5] Palaniappan, R. (2008). "Two-stage biometric authentication method using thought activity brain waves." International Journal of Neural Systems, 18(01), pp. 59-66.

[6] E. Bas¸ar. Brain Function and Oscillations: Integrative brain function. Neurophysiol- ogy and cognitive processes. Springer series in synergetics. Springer, 1999. ISBN 9783540643456.

[7] W. Klimesch, "Theta band power in the human scalp EEG and the encoding of new information," Neuroreport, vol. 7, no. 7, pp. 1235-1240, 1996.

[8] Bressler SL. The gamma wave: a cortical information carrier? Trends Neurosci 1990;13:161–162.

[9] Patrizio Campisi and Daria La Rocca, "Brain Waves for Automatic Biometric-Based User Recognition", IEEE Transactions on Information Forensics and Security, Vol. 9, No. 5, pp 782-800, May 2014.

[10] J. Klonovs, C. Petersen, H. Olesen, and A. Hammershoj, "ID proof on the go: Development of a mobile EEG-based biometric authentication system," IEEE Veh. Technol. Mag., vol. 8, no. 1, pp. 81–89, Mar. 2013.

[11] Abd et al. "Biometrics detection and recognition based-on geometrical features extraction", In Proceedings of the IEEE 2018 International Conference on Advance of Sustainable Engineering and its Application (ICASEA). Date of Conference: 14-15 March 2018. Date Added to IEEE Xplore: 04 June 2018, INSPEC Accession, Number: 17807703, DOI: 10.1109/ICASEA.2018.8370956.

[12] K. Brigham and B. V. Kumar, "Subject identification from electroen- cephalogram (EEG) signals during imagined speech," in Proc. IEEE 4th Int. Conf. BTAS, Sep. 2010, pp. 1–8.

[13] M. Poulos, M. Rangoussi, and N. Alexandris, "Neural network based person identification using EEG features," in Proc. IEEE Int. Conf. Acoust., Speech, Signal Process., vol. 2. Mar. 1999, pp. 1117–1120.

[14] M. Poulos, M. Rangoussi, V. Chrissikopoulos, and A. Evangelou, "Person identification based on parametric processing of the EEG," in Proc. 6th IEEE Int. Conf. Electr., Circuit Syst., Sept. 1999, pp. 283–286.

[15] C. He and Z. J. Wang, "An independent component analysis (ICA) based approach for EEG person authentication," in Proc. 3rd ICBBE, 2010, pp. 1–10.

[16] A. Riera, A. Soria-Frisch, M. Caparrini, C. Grau, and G. Ruffini, "Unobtrusive biometric system based on electroencephalogram analy- sis," EURASIP J. Adv. Signal Process, vol. 2008, 2008.

[17] F. Su, H. Zhou, Z. Feng, and J. Ma, "A biometric-based covert warning system using EEG," in Proc. 5th IAPR Int. Conf. Biometrics ICB, 2012, pp. 342–347.

[18] P. Campisi et al., "Brain waves based user recognition using the 'eyes closed resting conditions' protocol," in Proc. IEEE Int. WIFS, Nov. 2011, pp. 1–6,

[19] D. La Rocca, P. Campisi, and G. Scarano, "On the repeatability of EEG features in a biometric recognition framework using a resting state protocol," in Proc. BIOSIGNALS, 2013, pp. 20–2.

[20] R. Paranjape, J. Mahovsky, L. Benedicenti, and Z. Koles, "The elec- troencephalogram as a biometric," in Proc. Can. Conf. Electr. Comput. EngComput., 2001, pp. 1363–1366.

[21] K. Das, S. Zhang, B. Giesbrecht, And M. P. Eckstein, "Using Rapid Visually Evoked Eeg Activity For Person İdentification," İn Proc. Annu. Int. Conf. Ieee Eng. Med. Biol. Soc., Sep. 2009, Pp. 2490–2493.

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