A Review on the Electroencephalography Control Structures for Pattern Recognition

Dr. Natarajan S[1] and Dr. S Saravana Kumar[2]

[1]Professor, Department of Computer Science, School of Informatics, Wolaita Sodo University Ethiopia

[2]Assistant Professor, Department of Computer Science, Karpagam Academy of Higher Education, Coimbatore

[1]sivnatarajan@gmail.com , [2]saravanan.msc16@gmail.com

Abstract — The research proposes an Exploratory study of simple and efficient movement classification technique for Electroencephalography control schemes on brain fingerprinting. The pattern recognition using Electroencephalography is analysed in detail in this work. Most brain fingerprinting using Electroencephalography control studies on brain waves have shown good performance. The Control generated can be acceptable or unacceptable. As an analysis, in this work, focus is made on efficient pattern recognition on the Electromyography for the application (human) brain fingerprinting. The signal is neural signals which gathered from the sensor of Electroencephalography Recording site can be used as input to decide the brain signal. The Signals were segmented and features were extracted with time domain feature extraction methods. The feature considered is various gestures. The control scheme is modelled with supervised and unsupervised learning mechanism for muscle configurations. In this work, detailed analysis various control mechanism for pattern recognition and classification carried with merits and demerits using fuzzy logic control. The pattern recognition through control scheme will be capable distinguishing the source to improve the classification performance in controlling functioning in the brain fingerprinting. The outcome of this study encourage in modelling the new control scheme with novel ensemble classification technique for brain fingerprinting application to any king brain waves.

Keywords— Electroencephalography, Pattern recognition techniques, signal processing, Fuzzy logic

1. Introduction

Electroencephalography is used for monitoring electric activity in the brain by placing the electrode on the scalp. EEG measures the voltage fluctuations within the neuron of the brain. It is externally powered which can be controlled with electrical signals generated naturally by own neuron [1]. EEG waveform is classified into different frequency bands (alpha, beta, theta, delta and gamma waves). In general, it can be assumed that the slowest brain rhythms are dominant during an inactive state and the fastest are typical of information processing performance. Biometric authentication systems based on EEG signals have gained the attention of many researchers and witnessed a significant development. Although EEG signals are generated from the electric field produced by complex wiring of neurons of the cortex, that is, belong to the physiological traits, they can be categorized as behavioral biometric traits if they are recorded based on visual or emotional stimuli. The analysis is carried out in following activities or process:

- Electroencephalography Signal Conditioning
- Electroencephalography Signal pre-processing
- Electroencephalography feature Extraction
- Electroencephalography dimensionality Reduction if required by the classification or pattern recognition algorithms
- Electroencephalography pattern Classification

The rest of the survey paper is organized into the following sections, section 2 discusses about methods of the Electroencephalography signal processing for controlling of joint activity through brain fingerprinting. Section 3 discusses the aim of the proposed model and finally section 4 is discussed with conclusion.

2. Review of Methods and Analysis

The Electroencephalography signals is taken is controlled using set of supervised and unsupervised machine learning algorithms such as

- Linear Regression
- Gaussian mixture model
- Artificial Neural Network
- Genetic Algorithm
- Hidden Markov model
- Fuzzy logic

Among this familiar algorithm, other optimized and novel algorithm defined to enhance the accuracy of the classification for pattern recognition and response time of the joint activity.

2.1. Analysis of pattern recognition using Electroencephalography signals

Pattern recognition may identify repeatable patterns of muscle activations and employed for discriminating the pattern of muscles obtained through Electroencephalography. Usually Electroencephalography signals are transformed into features and placed as feature vectors. Pattern recognition is possible for Stationary Electroencephalography signal which uses the supervised learning model whereas recognition of non-stationary Electroencephalography signals uses the unsupervised learning which makes it difficult to extract the features.

2.2.1. Analysis of the pattern recognition error in deploying the large Electroencephalography

- It induces the differentiation in the neuron movement analysis for joint contraction
- It may cause patient discomfort
- It leads to high hardware and computational Cost.

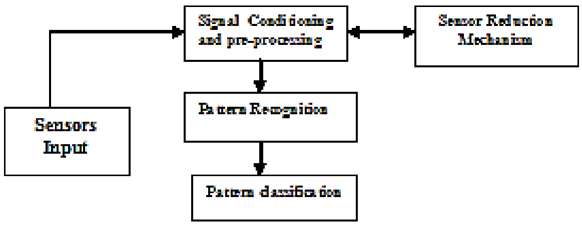

Figure 1- Layout of the Brain Fingerprint Controlling using Electroencephalography (EEG)

The figure 1 describes the general layout of Electroencephalography controlling scheme using EEG signal. Among the model, pattern recognition and classification process gains more weight.

2.2.2 Filtering Mechanism for EEG signals using statistical analysis

EEG signal is filtered against the noise and different limb function using the statistical analysis. Statistical analysis of EEG signal is through ARMA model [3] which is derived from Kalman filter, it detects the finite number of parameters that varying in the signal ranges. The signal ranges which actuates the limb movements has to considered and other signal can be eliminated as considering it as noise. The EEG frequencies which are about 30 Hz imply the neuron movements. But Kalman filter is not suitable for unsupervised classification and pattern recognition.

Fuzzy Approach to Classify the EEG Signals

The fuzzy Approach is used to improve the classification performance to the EEG signals [6]. The feature are initially classified based Time and segment feature are passed into fuzzy classifier for feature training, the pattern and structure will be generated to the EEG signals, the structure can be considered as fuzzy rules , it is capable handling more no of subject (amputees) . Fuzzy classifiers are contradictory which detect and classify the signals accurately. The Fuzzy classifier generate the feature such as mean absolute value (MAV), mean absolute value slope (MAVSLP), number of zero-crossings (ZC), slope sign changes (SSC), and wave length or wave complexity (WC).

EEG control system based Forearm orientation extraction and classification using Sparse Principle component analysis

Surface EEG signals collects various feature set to ensure maximum separation between the movements of neurons. The different class is determined for pattern recognition; function is triggered based on the feature identification from the feature collected. The feature collected in the model is purely based on forearm orientation muscle configuration which is collectively called as neuromuscular activity. In this model, the classification of the function is carried out using sparse principle component analysis [7]. Usually feature set of the EEG signal is represented in the time scale or Time frequency.

Adaptive pattern recognition based EMG exploration

It can be considered as Supervised or unsupervised models but it reduces the frequent retraining session for pattern recognition with high accuracy and reduced classification error in the EEG signals. Instead adaptation paradigm that monitors the entropy associated with each classification decision and recalculates the classifier boundaries whenever the entropy is sufficiently low to ensure correct classification. Entropy of the classification = $-\sum_{k=1}^{k} p(n)$

Where p(n) is the probability of class

After continuous retraining, it produces correct class. Entropy is a measure of the confidence of a classification (decision) as a function of the probability that a feature set belongs in each class.

The Surface EEG patterns are gathered from brain, and it segmented after pre-processing and dimensionality reduction using novel unsupervised ensemble pattern classifier. The pattern classifier has to be equipped with pattern recognition mechanism and pattern separation technique to map the important brain or nerve contraction to generate the joint function. The System should generate the high Accuracy and reduced computational complexity

Brain waves for automatic biometric-based user recognition.

Brain signals have been investigated within the medical field to study brain diseases like epilepsy, spinal cord injuries, Alzheimer's, Parkinson's, schizophrenia, and stroke among others. Despite the broad interest in clinical applications, the use of brain signals has been only recently investigated by the scientific community as a biometric characteristic to be used in automatic people recognition systems. However, brain signals present some peculiarities, not shared by the most commonly used biometrics, such as face, iris, and fingerprints, with reference to privacy compliance, robustness against spoofing attacks, possibility to perform continuous identification, intrinsic liveness detection, and universality. These peculiarities make the use of brain signals appealing.

Future Solution

The Brain fingerprinting using Fuzzy approach is optimized using genetic algorithm. Genetic algorithm is metaheuristic algorithm. It determines the candidate solution for data recognition in iterative process.

Conclusion

This Work contributes to the review of the literatures for the effective control scheme for EEG in order to improve the pattern recognition and classification accuracy. The Analysis is focused on the comparative study of the both supervised and unsupervised classification patterns in the EEG. Finally control system for brain fingerprinting should be carried with performance factor considering high classification accuracy and less response time.

REFERENCES

[1] La Rocca, D., Campisi, P., Vegso, B., et al.: ‘Human brain distinctiveness based on EEG spectral coherence connectivity’, IEEE Trans. Biomed. Eng., 2014, 61, (9), pp. 2406–2412

[2] Liu, S., Bai, Y., Liu, J., et al.: ‘Individual feature extraction and identification on EEG signals in relax and visual evoked tasks’. Biomedical Informatics and Technology, 2014, pp. 305–318

[3] P. Anokhin, G. van Baal, C. van Beijsterveldt, E. de Geus, J. Grant, and D. Boomsma, “Genetic correlation between the P300 event-related brain potential and the EEG power spectrum,” Behavior Genet., vol. 31, no. 6, pp. 545–554, 2001.

[4] P. Zietsch, J. L. Hansen, N. K. Hansell, G. M. Geffen, N. G. Martin, and M. J. Wright, “Common and specific genetic influences on EEG power bands delta, theta, alpha, and beta,” Biol. Psychol., vol. 75, no. 2, pp. 154–164, 2007

[5] Nguyen, P., Tran, D., Huang, X., Sharma, D.: ‘A proposed feature extraction method for EEG-based person identification’. Int. Conf. on Artificial Intelligence (ICAI 2012), Las Vegas, USA, 2012

[6] Liew, S.H., Choo, Y.H., Low, Y.F.: ‘Fuzzy-rough nearest neighbour classifier for person authentication using EEG signals’. IEEE Conf. on Fuzzy Theory and its Applications (iFUZZY), Taipei, Taiwan, 2013, pp. 316–321

[7] Sabarigiri, B., Suganyadevi, D.: ‘The possibilities of establishing an innovative approach with biometrics using the brain signals and iris features’, Res. J. Recent Sci., 2014, 3, (3), pp. 60–64

[8] Kostílek, M., Šťastný, J.: ‘EEG biometric identification: repeatability and influence of movement-related EEG’. IEEE Int. Conf. on Applied Electronics (AE), 2012, pp. 147–150