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Electroencephalogram Pathology Detection Using Deep Learning

Mohamed Aslam[1], K. Jaisharma[2], D. Mahalakshmi[3]
[1,2,3]*Department of Computer Science and Engineering, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Chennai, India*
aslam9042221356@gmail.com[1], jaisharmak.sse@saveetha.com[2], mahalakshmid.sse@saveetha.com[3]

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Abstract

Electroencephalologram or commonly known as the EEG scan is a test that is done on the brain. It is a readily available test providing proof how the brain functions over time. The EEG test is used to find disorders on the brain. It finds the type of disorder along with the location during seizure. Pathologies can affect brain signals so this paper combines the power of deep learning along with brain signals to detect the pathology. In this paper I propose an automated EEG analysis method by combining digital signal processing and neural network techniques, which will remove error and subjectivity, associated with manual analysis and identifies the existence of epilepsy seizure and brain tumor diseases. In this proposed system the raw EEG signals are processed into a spatio-temporal representation and this representation is fed into a convolutional neural network (CNN).

Keywords: *CNN, Deep Learning, Detection, EEG, Pathology, spatio-temporal*

1. Introduction

The advancement of artificial intelligence machine learning and deep learning has changed our day to day life by introducing many advanced systems that are lifesaving. Moreover IOT and cloud computing has increased the potential creating a revolution. A smart health care system uses the above technologies to predict the health of the user accurately. The most important feature of a health care system is accuracy and real-time processing. For patients who need immediate diagnosis and treatment it is necessary for the system to be accurate; otherwise serious problems and complications may occur even the life of the user may be endangered leading to death. In our case the signals acquired from the patients should be processed fast and it should also be accurate. Fortunately the technologies such as IOT,edge computing, cloud computing ML, deep learning help us achieve it.

The health sector is rapidly growing due to these advanced technologies. The revolutions in these fields have recently been the focus of research.

The IOT-cloud integration has led to development of low cost sensors which are used

November-December 2019
ISSN: 0193-4120 Page No. 5587 - 5591

in numerous medical applications. Similarly this system has combined digital image processing with neural networks to identify the existence of epilepsy seizures and brain tumor diseases The system uses multi wavelet transform for feature extraction from a EEG signal by decomposing it into a sub signal. Irregularities and unpredictable fluctuations from the decomposed signal are measured using approximate entropy. The decomposed signal is fed into a feed-forward neural network to classify the signal as normal, epilepsy or tumor signal.

2. Literature Survey

D. Puthankattil Subha et., al., The EEG (Electroencephalogram) signal demonstrates the electrical activity of the brain. They are profoundly irregular in nature and may contain helpful data about the mind state. Be that as it may, it is hard to get helpful data from these sign legitimately in the time space just by watching them. They are essentially non-straight and no stationary in nature. Hence forth, significant highlights can be extricated for the finding of various sicknesses utilizing propelled signal preparing systems. In this paper the impact of various occasions on the EEG signal, and distinctive digital processing techniques used to separate the concealed data from the signal are talked about in detail. Straight, Frequency area, time - recurrence and non-direct procedures like relationship measurement (CD), biggest Lyapunov example (LLE), Hurst type (H), various entropies, fractal dimension (FD), Higher Order Spectra (HOS), stage space plots and repeat plots are examined in detail utilizing a common typical EEG signal.[1]

Mohd ZaizuIlyas et.,al. Brain Computer-Interfaces (BCI) is a communication framework that empowers human cerebrum to collaborate with machines or gadgets without including physical contact by utilizing EEG signals created from mind movement. Determination of the preparing procedure of the EEG signals at each handling stage is essential to get the hearty BCI framework. The point of this paper is to address the different systems applied for BCI at each stage, for example, pre-preparing, highlight extraction and order arrange. This paper examined the favorable circumstances, inconveniences and current patterns of BCI at each stage. At long last, the underlying examination result at each BCI arrange [2]

Luzheng Bi et.,al., EEG-based mind controlled portable robots can fill in as ground-breaking aids for seriously impaired individuals in their day by day life, particularly to assist them with moving intentionally. In this paper, we give a far reaching audit of the total frameworks, key procedures, and assessment issues of mind controlled versatile robots alongside certain experiences into related future innovative work issues. We first survey and characterize different complete frameworks of mind controlled versatile robots into two classifications from the viewpoint of their operational modes. We at that point depict key methods that are utilized in these cerebrum controlled portable robots including the mind PC interface procedures and shared control systems. This depiction is trailed by an investigation of the assessment issues of mind controlled portable robots including members, errands and situations, and assessment measurements. We finish up this paper with an exchange of the ebb and flow difficulties and future research bearings [3]

Rajendra Acharya U et., al,. proposed that utilization of non-linear elements strategies to the physiological sciences showed that non-linear models are helpful for understanding complex physiological wonders, for example, unexpected advances and riotous conduct. Sleep

November-December 2019
ISSN: 0193-4120 Page No. 5587 - 5591

stages and supported changes of autonomic capacities, for example, temperature, circulatory strain, electroencephalogram (EEG), and so forth, can be portrayed as a disorderly procedure. The EEG signals are exceptionally abstract and the data about the different states may show up indiscriminately in the time scale. In this way, EEG signal parameters, separated and investigated utilizing PCs, are profoundly helpful in diagnostics. The sleep data analysis is completed utilizing non-linear parameters: relationship measurement, fractal measurement, biggest Lyapunov entropy, estimated entropy, Hurst example, stage space plot and repeat plots. These non-direct parameters evaluate the cortical capacity at various rest stages and the outcomes are classified.[4]

Mathius Baumert et.,al,. proposed the Identification of recurrent, transient annoyances in brain activity during rest, alleged cyclic alternating patterns (CAP), is of noteworthy enthusiasm as they have been connected to neurological pathologies. Top groupings include numerous, continuous cycles of phasic actuation (A-stages). Here, we propose a novel, automated framework abusing the dynamical, temporal data in electroencephalography (EEG) recordings for classifying the A-stages and their subtypes. Utilizing the recurrent neural network (RNN), significant data in the temporal conduct of the EEG is extracted. The programmed framework is furnished to manage the biasing issue of imbalanced dataset collections and utilizes cutting edge signal processing strategies to diminish between subject variety. To assess our framework, we applied chronicles from the openly accessible CAP Sleep Database on Physionet. Our outcomes show that the RNN improved the recognition exactness by 3-5% and the F1-score by roughly 7% on two data collections compared with a typical feed-forward neural system. Our framework accomplishes an affectability of roughly 76-78% and F1-score between 63-68%, essentially beating existing technologies. Also, its sensitivity for subtype arrangement of 60-63% (A1), 42-45% (A2), and 71-74% (A3) shows prevalent multi-class classification performance for CAP identification. Concluding, we have built up a completely automated superior CAP scoring framework that incorporates A-stage subtype classification. RNN classifiers yield a noteworthy improvement in accuracy and sensitivity contrasted with recently proposed frameworks [5]

3. Electroencephalography

Electroencephalography is a non invasive test in which many electrodes are placed on a L patient's scalp to record impulses from the brain also known as the brain waves. It is used to for testing patients with disorders in brain such as epilepsy, brain tumor. It is performed by employing a device that measures the patterns; fluctuations from the brain using the electrical impulses. The introduction of micro computer technology in medical field started a new revolution in encephalogram process. New methodologies in analyzing knowledge are emerging as the computing power increases. Among these neural networks are successful to review brain functions by multiple approaches. This paper presents the application of neural network in encephalogram. The encephalogram machine records the electrical activity of the brain as a series of lines or traces that corresponds to specific regions of the brain.It is a painless procedure that takes thirty to forty minutes.

November-December 2019
ISSN: 0193-4120 Page No. 5587 - 5591

Figure 1: EEG Graph for thirty to forty minutes of painless procedure

4. Convolution Neural Network

Convolution Neural network is a deep learning methodology that takes an image as a input and then assigns weights and biases which are learnable to each objects in the image which is used to differentiate each object from one another. The preprocessing done in CNN is lesser compared to other classification algorithms. Training a dataset using the algorithms the CNN is able to learn the characteristics.

A CNN is used to capture the spatial and temporal dependencies easily from an image through relevant filters. In others words the CNN is able to train and understand the characteristics of an image better. The architecture of a CNN is similar to the connectivity patterns of neuron in the human brain. Individual neurons respond to stimuli only in restricted region known as the Receptive field. A collection of receptive fields together cover the entire visual area

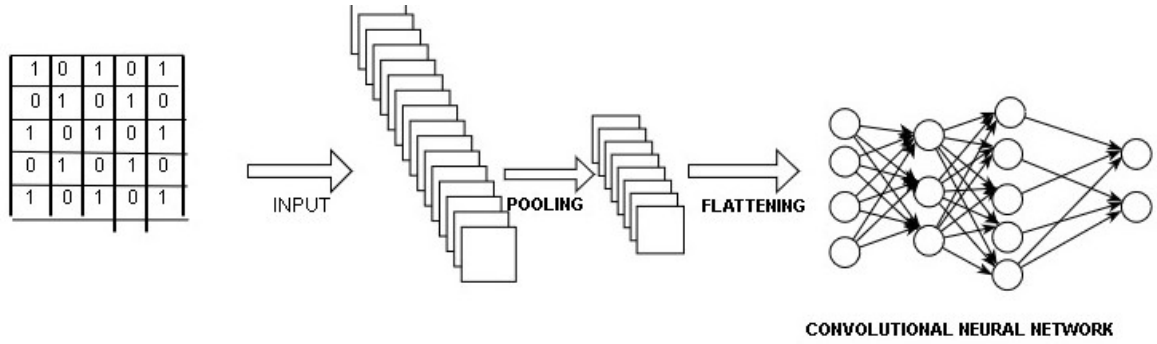

Figure 2: Schematic diagram of Convolution Neural Network

5. Conclusion

An EEG pathology discovery framework utilizing the CNN show is proposed. This paper implements a fusion based CNN model for detecting epilepsy using EEG scan. In this model AlexNet is used as a basic model to investigate and the whole EEG signal is preprocessed and fed into the CNN by dividing it into segments and fused later through MLP, the output displayed through the softmax layer. Experiments were performed on a freely accessible database. It appeared that the proposed framework with the combination accomplished the most noteworthy precision, and outranked other related systems.

References

[1] EEG Signal Analysis: A Survey D. Puthankattil Subha Paul K. Joseph Rajendra Acharya U. Journal of Medical Systems, December 2008

[2] A survey of analysis and classification of EEG signals for brain-computer interfaces: Mohd Zaizu Ilyas; Puteh Saad; Muhammad Imran Ahmad 2015 2nd International Conference on Biomedical Engineering (ICoBE)

[3] EEG-Based Brain-Controlled Mobile Robots: A Survey: Luzheng Bi; Xin-An Fan; Yili Liu IEEE Transactions On Human-Machine Systems, Vol. 43, No. 2, March 2013

[4] Non-linear analysis of EEG signals at various sleep stages: Rajendra Acharya U. Oliver Faust N.Kannathal TjiLeng Chua Swamy Laxminarayan Journal Computer Methods and Programs in Biomedicine archive Volume 80 Issue 1, October, 2005 Pages 37-45 Elsevier North-Holland, Inc. New York, NY, USA

[5] Automatic A-Phase Detection of Cyclic Alternating Patterns in Sleep Using Dynamic Temporal Information Simon Hartmann; Mathias Baumert IEEE 2018