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HOW ARTIFICIAL INTELLIGENCE IS USE TO DETECT EPILEPTIC EEG PATTERNS WITH PERFECTION?

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ABSTRACT

Misinterpretation and inaccurate diagnosis of EEG may also result from poor training and human error. Automated seizure detection systems, which are founded on artificial intelligence (AI), exhibit an extraordinary capacity to establish models for accurate diagnosis and interpretation. The utilization of AI offers a prospect to transform the healthcare sector by facilitating a collaborative approach between machines and humans in providing patients with precise and timely diagnosis and treatment.

Keywords: Artificial Intelligence, Deep Learning, Epilepsy.

I. INTRODUCTION

This article briefly discusses the use of AI algorithms for pattern detection in EEG for clinical diagnosis Epilepsy is a neurological disorder that may result in loss of consciousness, often accompanied by involuntary and uncontrolled movements Epilepsy, also referred to as a seizure disorder, is a neurological condition characterized by recurrent seizures. The disorder encompasses various types, with some cases having identifiable causes while others remain unknown. Epilepsy is a prevalent condition, affecting a significant portion of the population. According to the Epilepsy Foundation, it is estimated that approximately 1 in 26 individuals will develop epilepsy at some point in their lives. This disorder does not discriminate based on gender, race, ethnicity, or age, as it can affect people from all backgrounds. The symptoms of seizures can manifest in diverse ways. While some individuals may experience a loss of consciousness during a seizure, others may not. Certain individuals may exhibit a blank stare for a brief period, while others may undergo repetitive twitching of their limbs, known as convulsions or spasms. It is important to note that experiencing a single seizure does not necessarily indicate the presence of epilepsy. A diagnosis of epilepsy is typically made when an individual has had at least two unprovoked seizures occurring at least 24 hours apart. Unprovoked seizures lack a clear identifiable cause. The management of epilepsy often involves the use of medication or, in some cases, surgical intervention. These treatment methods can effectively control seizures for the majority of individuals with epilepsy. However, some individuals may require lifelong treatment, while others may eventually experience a cessation of seizures. In certain instances, children with epilepsy may outgrow the condition as they age.

II. METHODOLOGY

Aim in this article is to diagnose epilepsy EEG with perfection with the help of AI.

Artificial Intelligence

The capacity of a digital computer or computer-controlled robot to execute tasks commonly associated with intelligent beings is referred to as artificial intelligence. This term is frequently employed in the pursuit of creating systems that possess the cognitive processes that are characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience. Since the advent of the digital computer in the 1940s, it has been demonstrated that computers can be programmed to execute highly complex tasks, such as discovering proofs for mathematical theorems or playing chess, with remarkable proficiency. Nevertheless, despite ongoing advancements in computer processing speed and memory capacity, there are currently no programs that can match the full range of human flexibility across broader domains or in tasks that require extensive everyday knowledge. Conversely, some programs have achieved the performance levels of human experts and professionals in executing specific tasks, such that artificial intelligence in this limited sense is found in a diverse range of applications, including medical diagnosis, computer search engines, voice or handwriting recognition, and chatbots.

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How AI can help

The exponential increase in the number of patients annually underscores the imperative for automated seizure detection techniques utilizing EEG signals, given that the manual interpretation by neurologists is exhausting and inconvenient the identification of epileptic seizures through visual means poses a formidable challenge owing to the complex and dynamic characteristics of electroencephalogram (EEG) signals, which exhibit nonlinearity and Non stationarity. EEG signals can get corrupted by external disturbances or body movements like muscle movements, chewing or eye blinks can give rise to artifacts that pose challenges in their identification and analysis. Data may vary from person-to-person Statistical methodologies exhibit limitations in their ability to generalize and address a diverse range of these concerns. Conversely, artificial intelligence (AI) emerges as a suitable approach for resolving such challenges. The algorithm initially possesses predetermined knowledge about the system and acquires additional domain information through expert supervision. As the system adjusts its internal parameters, its performance progressively improves. By supplying the AI system with ample high-quality data and appropriately fine-tuning its parameters, its performance can be on par with that of the domain expert. But still AI can't replace human because there can be situation where cost of making mistakes is high such as surgeries where mistakes can lead to loss of life as previously mentioned, artificial intelligence (AI) systems encounter limitations in certain situations owing to their constrained capacity to comprehend the intricate framework of the human brain and its decision-making processes.

III. MODELING AND ANALYSIS

What are the reasons behind the difficulties encountered in the visual inspection and interpretation of EEG?

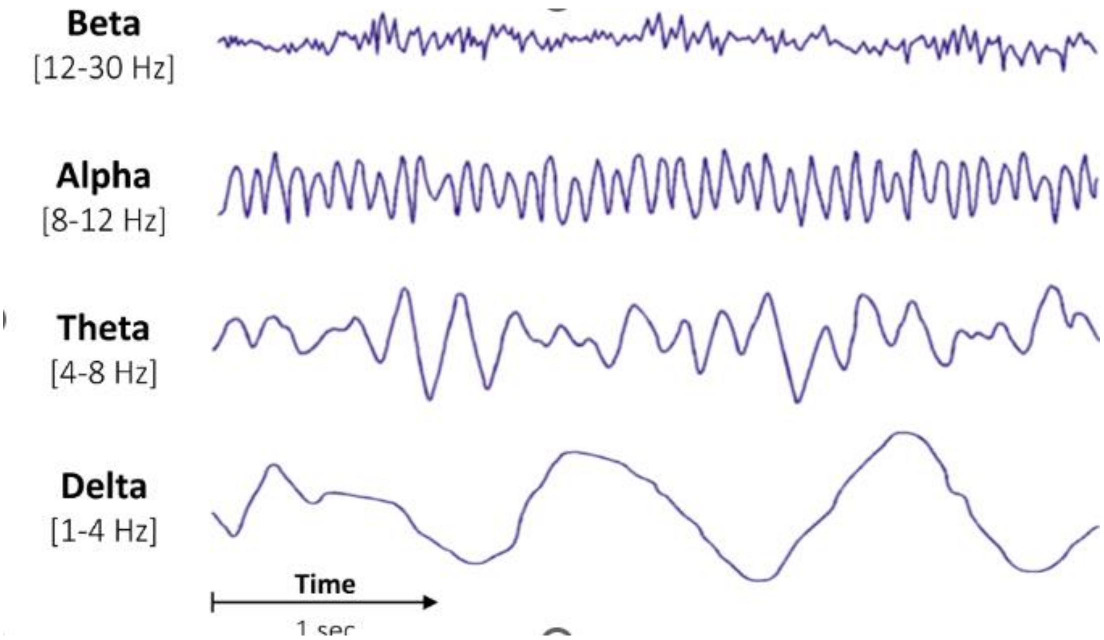

Image from: -https://raphaelvallat.com/images/tutorials/bandpower/brain_waves.png

Figure1: Types Of Waves

This study examines the behaviour of EEG signals through a visual experiment using waveforms (1-4 Hz, 4-8 Hz,8-12 Hz and 12-30 Hz).

EEG signals are nonstationary, making analysis challenging. The graph shows time in milliseconds on the x-axis and wave amplitude in microvolts on the y-axis. Breaking down the signal into smaller epochs using short-time Fourier transform (STFT) or wavelet decomposition can help with analysis.

The short-time Fourier transform (STFT) is a Fourier-based transform utilized to ascertain the sinusoidal frequency and phase content of localized sections of a signal as it evolves over time. The practical approach to computing STFTs involves dividing a longer time signal into shorter segments of equal length and subsequently computing the Fourier transform independently on each shorter segment. This process reveals the Fourier spectrum on each shorter segment. Typically, the changing spectra are plotted as a function of time, referred to

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as a spectrogram or waterfall plot, which is commonly employed in software-defined radio (SDR) based spectrum displays. Full bandwidth displays that cover the entire range of an SDR typically utilize fast Fourier transforms (FFTs) with 2^24 points on desktop computers.

Upon analysis of the signal in the frequency domain, frequencies deemed irrelevant are filtered out, and the inverse Fourier Transform is employed to regenerate the EEG signal in the time domain. Through the utilization of this methodology, a pristine EEG signal is retrieved, devoid of any extraneous noise. The mentioned techniques prove to be highly valuable in the development of an AI-driven system capable of delivering automated diagnoses. Following figure provides an initial depiction of the formulation of such a system

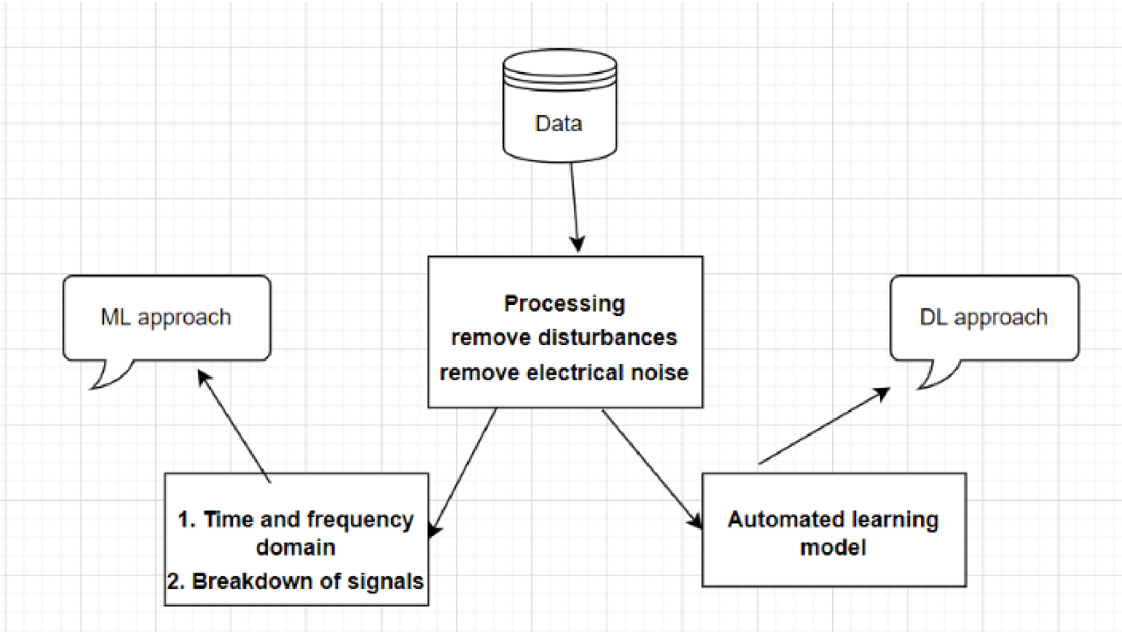

Figure 2: Dl And ML Approach

As depicted in the diagram, an AI-based diagnosis system typically consists of several stages. The first stage involves EEG acquisition, followed by preprocessing steps such as the removal of 50 Hz noise and artifacts. Subsequently, the system can adopt either a machine learning (ML) or deep learning (DL) approach. In ML, the EEG data is analysed using various methods such as time-domain, frequency-domain, or time-frequency analysis. The features extracted through these methods are then subjected to selection and classification. On the other hand, DL approaches have a comprehensive end-to-end structure that automatically performs both feature extraction and classification. Previous studies on automatic diagnosis systems for epilepsy have utilized the aforementioned components, as shown in Figure. While these systems contribute to the diagnosis and early detection of the disease, they are unable to replicate human interaction and empathy.

IV. RESULTS AND DISCUSSION

AI can't takeover because Artificial intelligence (AI) is not intended to replace the role of doctors. Instead, it is designed to complement and enhance their capabilities in providing healthcare services. AI technology can assist doctors in various aspects of their work, such as diagnosing diseases, analysing medical images, and suggesting treatment options. By leveraging AI, doctors can benefit from improved accuracy, efficiency, and access to vast amounts of medical knowledge. Ultimately, the goal is to empower doctors with AI tools that enable them to make more informed decisions and deliver better patient care. The task of visually examining and annotating lengthy electroencephalogram (EEG) records to identify intricate epileptic patterns is arduous, consumes significant time, and is prone to inaccuracies. However, artificial intelligence (AI) has the potential to automate this procedure by categorizing pertinent signal segments within the recorded EEG data

V. CONCLUSION

In the present landscape of epilepsy diagnosis, artificial intelligence (AI) can be leveraged through two distinct methodologies. The first approach involves the generation of visual representations, such as color-coded paradigms, which facilitate accurate diagnosis of the condition even for individuals with limited training.

Another option is to provide a detailed explanation of a fully automated analysis, which naturally involves more advanced methods than the previous one. The article does not indicate that artificial intelligence has the capability to replace medical professionals.

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