Epileptic Seizure Detection Based on Bidirectional Gated Recurrent Unit Network

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Abstract- *Epilepsy is a chronic condition characterised by recurring, spontaneous seizures. If a person has two or more unprovoked seizures, they are diagnosed with epilepsy. Epilepsy seizures can be caused by a brain damage or a genetic predisposition, although the reason is often unknown. Overcoming the difficulty of accurately describing seizure occurrences in a broad and heterogeneous population of patients is thus a critical step toward clinical applicability. As a result of significant patient inter-variability in epileptic diseases, present technologies have difficulty generalising to unseen patients, and they frequently need to be fine-tuned to each patient. Several approaches have been developed to detect and forecast seizure events from EEG of epileptic patients collected mostly during short in-hospital monitoring with standard scalp-EEG or intracerebral electrodes, thanks to the rise of Deep Learning (DL) in the biomedical sector. Though some methods reported outstanding results, the majority used offline analysis with extensive pre-processing and manipulation of the EEG data, which is incompatible with the goal of online, long-term, low-power ambulatory operations. The difficulties in accurately detecting automated epileptic seizures with DL and EEG modalities are explored. The benefits and drawbacks of using DL-based approaches to diagnose epileptic seizures are discussed. Finally, the most promising DL models are proposed, as well as potential future research on automated epileptic seizure detection.*

Keywords- Deep Learning, CNN, ML, Unit Network

I. INTRODUCTION

Deep learning is a machine learning technique that teaches computers to do what comes naturally to humans: learn by example. Deep learning is a key technology behind driverless cars, enabling them to recognize a stop sign, or to distinguish a pedestrian from a lamppost. It is the key to voice control in consumer devices like phones, tablets, TVs, and hands-free speakers. Deep learning is getting lots of attention lately and for good reason. It's achieving results that were not possible before. In deep learning, a computer model learns to perform classification tasks directly from images, text, or sound. Deep learning models can achieve state-of-the-art accuracy, sometimes exceeding human-level performance. Models are trained by using a large set of labeled data and neural network architectures that contain many layers. Deep learning achieves recognition accuracy at higher levels than ever before. This helps consumer electronics meet user expectations, and it is crucial for safety-critical applications like driverless cars. Recent advances in deep learning have improved to the point where deep learning outperforms humans in some tasks like classifying objects in images. While deep learning was first theorized in the 1980s, there are two main reasons it has only recently become useful: Deep learning requires large amounts of labeled data. For example, driverless car development requires millions of images and thousands of hours of video. Deep learning requires substantial computing power. High-performance GPUs have a parallel architecture that is efficient for deep learning. When combined with clusters or cloud computing, this enables development teams to reduce training time for a deep learning network from weeks to hours or less.

II. IDENTIFY, RESEARCH AND COLLECT IDEA

Existing System

A variety of screening approaches have been proposed to diagnose epileptic seizures, using electroencephalography (EEG) and magnetic resonance imaging (MRI) modalities. Artificial intelligence encompasses a variety of areas, and one of its branches is deep learning (DL). The traditional methods are mainly based on feature engineering techniques which extract the corresponding features from EEG signals and then complete the detection based on the extracted features. These features include time-domain features, frequency-domain features [8, 9], and time-frequency-domain features. Once the features are extracted, EEG signals can be classified using a variety of classifiers. No matter what classifier is used, the quality of designed features will greatly affect the performance of epilepsy detection. In recent years, with the development of deep learning technology, many works have applied deep learning to perform epilepsy detection. Different from traditional feature engineering, deep learning methods automatically learn features from EEG signals and further complete detection tasks with an end-to-end manner without complicated manual feature design process and can achieve better performance than traditional methods in many scenarios. The EEG signal

input forms used by these deep learning methods are varied, including time-domain input, frequency-domain input, and time-frequency-domain input (including short-time Fourier transform (STFT) and wavelet transform). And implement Wavelet transform or Hilbert–Huang transform algorithm is used to analyse the frequency features of EEG signals. And also implemented various machine learning algorithm such as Support vector machine, random forest have exhibited different performance in distinguishing seizure EEG. Robustness and generalization ability of many classifiers are unsatisfactory when the testing data has a different probability distribution with that of the training data.

Disadvantages

- Time complexity is high
- Does not support large datasets
- Accuracy is less
- Only support labelled datasets

Proposed System

Epilepsy is one of the world's most common chronic severe non-communicable brain disorders, and seizures can strike anyone at any age, regardless of gender or ethnicity. Epilepsy patients face numerous challenges in their daily lives. They must use appropriate caution in order to cope with this sickness. When a seizure happens, it can cause injury or even put the patient's or others' lives in danger, especially if they work in the heavy machines industry or drive automobiles. Electroencephalogram (EEG) signals are largely employed in epilepsy research to track brain abnormalities caused by seizures. Electroencephalography (EEG) is a practical, straightforward, and non-offensive technology for examining and analyzing brain activity in epilepsy patients. This can be done in two ways: manually or automatically. It's difficult and time-consuming to detect an expert's seizure and length in an EEG recording. To review EEG recordings for one seizure client, hours to days of data are frequently required. If an automatic seizure detection system is available, clinicians may be able to save time by examining EEG data instead of performing an offline diagnosis. As a result, automatic seizure detection is extremely important. A brief review of proposed and adopted approaches for identifying seizures in EEG recorded signals is presented in this work. A study on deep learning and feature extraction methods, detection methods using convolutional neural networks, and a review on detection methods using deep learning methods are the two categories of research whether it is seizure or non-seizure.

Advantages

- Time and complexity is reduced
- Handle the large datasets
- Accuracy is high
- Multiple EEG frequencies are identified

SOFTWARE SUMMARY

FRONT END

PYTHON

Python is an interpreted high-level programming language for general-purpose programming. Created by Guido van Rossum and first released in 1991, Python has a design philosophy that emphasizes code readability, notably using significant whitespace. It provides constructs that enable clear programming on both small and large scales. In July 2018, Van Rossum stepped down as the leader in the language community. Python features a dynamic type system and automatic memory management. It supports multiple programming paradigms, including object-oriented, imperative, functional and procedural, and has a large and comprehensive standard library. Python interpreters are available for many operating systems. CPython, the reference implementation of Python, is open source software and has a community-based development model, as do nearly all of Python's other implementations. Python and CPython are managed by the non-profit Python Software Foundation. Rather than having all of its functionality built into its core, Python was designed to be highly extensible. This compact modularity has made it particularly popular as a means of adding programmable interfaces to existing applications. Van Rossum's vision of a small core language with a large standard library and easily extensible interpreter stemmed from his frustrations with ABC, which espoused the opposite approach. While offering choice in coding methodology, the Python philosophy rejects exuberant syntax (such as that of Perl) in favor of a simpler, less-cluttered grammar. As Alex Martelli put it: "To describe something as 'clever' is not considered a compliment in the Python culture."Python's philosophy rejects the Perl "there is more than one way to do it" approach to language design in favour of "there should be one—and preferably only one—obvious way to do it".

Python's developers strive to avoid premature optimization, and reject patches to non-critical parts of CPython that would offer marginal increases in speed at the cost of clarity.[When speed is important, a Python programmer can move time-critical functions to extension modules written in languages such as C, or use PyPy, a just-in-time compiler. CPython is also available, which translates a Python script into C and makes direct C-level API calls into

the Python interpreter. An important goal of Python's developers is keeping it fun to use. This is reflected in the language's name a tribute to the British comedy group Monty Python and in occasionally playful approaches to tutorials and reference materials, such as examples that refer to spam and eggs (from a famous Monty Python sketch) instead of the standard for and bar.

BACK END

MySQL is the world's most used open source relational database management system (RDBMS) as of 2008 that run as a server providing multi-user access to a number of databases. The MySQL development project has made its source code available under the terms of the GNU General Public License, as well as under a variety of proprietary agreements. MySQL was owned and sponsored by a single for-profit firm, the Swedish company MySQL AB, now owned by Oracle Corporation.

MySQL is a popular choice of database for use in web applications, and is a central component of the widely used LAMP open source web application software stack—LAMP is an acronym for "Linux, Apache, MySQL, Perl/PHP/Python." Free-software-open source projects that require a full-featured database management system often use MySQL.For commercial use, several paid editions are available, and offer additional functionality. Applications which use MySQL databases include: TYPO3, Joomla, Word Press, phpBB, MyBB, Drupal and other software built on the LAMP software stack. MySQL is also used in many high-profile, large-scale World Wide Web products, including Wikipedia, Google(though not for searches), ImagebookTwitter, Flickr, Nokia.com, and YouTube.

III. WRITEDOWNYOUR STUDIESANDFINDINGS

IMPLEMENTATION

Software testing is a method of assessing the functionality of a software program. There are many different types of software testing but the two main categories are dynamic testing and static testing. Dynamic testing is an assessment that is conducted while the program is executed; static testing, on the other hand, is an examination of the program's code and associated documentation. Dynamic and static methods are often used together.

Testing is a set activity that can be planned and conducted systematically. Testing begins at the module level and work towards the integration of entire computers based system. Nothing is complete without testing, as it is vital success of the system.

I. Testing Objectives:

There are several rules that can serve as testing objectives, they are

1. Testing is a process of executing a program with the intent of finding an error
2. A good test case is one that has high probability of finding an undiscovered error.
3. A successful test is one that uncovers an undiscovered error.

If testing is conducted successfully according to the objectives as stated above, it would uncover errors in the software. Also testing demonstrates that software functions appear to the working according to the specification, that performance requirements appear to have been met.

There are three ways to test a program

1. For Correctness
2. For Implementation efficiency
3. For Computational Complexity.

Tests for correctness are supposed to verify that a program does exactly what it was designed to do. This is much more difficult than it may at first appear, especially for large programs.

Tests used for implementation efficiency attempt to find ways to make a correct program faster or use less storage. It is a code-refining process, which reexamines the implementation phase of algorithm development. Tests for computational complexity amount to an experimental analysis of the complexity of an algorithm or an experimental comparison of two or more algorithms, which solve the same problem.

The data is entered in all forms separately and whenever an error occurred, it is corrected immediately. A quality team deputed by the management verified all the necessary documents and tested the Software while entering the data at all levels. The development process involves various types of testing. Each test type addresses a specific testing requirement. The most common types of testing involved in the development process are:

• Unit Test.
• Functional Test

• Integration Test

Unit Testing

The first test in the development process is the unit test. The source code is normally divided into modules, which in turn are divided into smaller units called units. These units have specific behaviour. The test done on these units of code is called unit test. Unit test depends upon the language on which the project is developed. Unit tests ensure that each unique path of the project performs accurately to the documented specifications and contains clearly defined inputs and expected results.

Functional Testing

Functional test can be defined as testing two or more modules together with the intent of finding defects, demonstrating that defects are not present, verifying that the module performs its intended functions as stated in the specification and establishing confidence that a program does what it is supposed to do.

Integration Testing

In integration testing modules are combined and tested as a group. Modules are typically code modules, individual applications, source and destination applications on a network, etc. Integration Testing follows unit testing and precedes system testing. Testing after the product is code complete. Betas are often widely distributed or even distributed to the public at large in hopes that they will buy the final product when it is released.

IV. CONCLUSION

Every electrode on the skull produces different numerical measurements; it is very important and difficult to choose the most effective and good characteristics, because it is worth noting that previous researchers have put in a lot of effort to locate the most beneficial features for accurate categorization. Some researchers, on the other hand, have combined two or more criteria to achieve excellent seizure classification accuracy. Energy, skewness, and entropy are frequently recognised as the most widely utilised features; nonetheless, optimising the feature vector is necessary to lower the classifier's workload while maintaining accurate results. It is really difficult to determine which classifier is the most optimal, so to sum up, classifiers are tested and assessed using numerous datasets. Earlier research scientists used a variety of methodologies, including SVM, KNN, and ANN, according to the literature. The fundamental drawback of these classifiers is that they are unable to provide adequate explanations for hidden model patterns and logic principles. According to the literature, CNN algorithm produces high accuracy results for seizure detection. In future, we can extend the framework to implement other deep learning algorithm to improve the accuracy in seizure prediction and also include EEG sensors with real time implementation.

REFERENCES

[1] Zhang, Yanli, Rendi Yang, and Weidong Zhou. "Roughness-length-based characteristic analysis of intracranial eeg and epileptic seizure prediction." International Journal of Neural Systems 30.12 (2020): 2050072.

[2] Zarei, Asghar, and Babak MohammadzadehAsl. "Automatic seizure detection using orthogonal matching pursuit, discrete wavelet transform, and entropy based features of EEG signals." Computers in Biology and Medicine 131 (2021): 104250.

[3] Faust, Oliver, et al. "Automatic identification of epileptic and background EEG signals using frequency domain parameters." International journal of neural systems 20.02 (2010): 159-176.

[4] Riaz, Farhan, et al. "EMD-based temporal and spectral features for the classification of EEG signals using supervised learning." IEEE Transactions on Neural Systems and Rehabilitation Engineering 24.1 (2015): 28-35.

[5] Craley, Jeff, et al. "Automated inter-patient seizure detection using multichannel convolutional and recurrent neural networks." Biomedical Signal Processing and Control 64 (2021): 102360.