

Bio-Signal and Generative AI

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ABSTRACT

Since the pandemic, a tremendous amount of research has been conducted on the bio signals and detection of any symptoms early on. Catching symptoms early using the bio-signals would enable early detection, preventive care in some cases, and the potential to create a cure plan for the individual. There are many ways in which the bio-signals can be detected and processed meaningfully. These data would help the individual and be used to train the biosignal-based models. Having these models generate large amounts of data trained on this dataset would enable the detection, diagnosis, and preventive cure more efficiently than ever.

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Introduction

In the last couple of years, there has been tremendous momentum to use Generative AI-based techniques in the medical field along with other fields. Various data from different biosensors, such as electroencephalograms, EEG, temperature sensors, galvanic sensors, and blood pressure monitors, are used, to name a few. These sensors can form a body sensor network (BSN), which generates real-time data on the various signals connected through the network. These data would be transmitted to the host to train the large models of such data. These data models would have details such as heart rate, blood pressure, and others. During the monitoring of anything that happens to the person, the BSN will have the data before and after any incident that occurs to the individual. Recording the data would help learn about the signal changes before any significant incident. This data set from multiple individuals would help to train and transform the large models. Models that contain these data sets will help determine the root cause and find ways to mitigate it.

Bio Signals

Signals are everywhere inside and outside the human body. Capturing these signals is a topic presented here, particularly the signals inside the human body. These signals can be classified into two categories. One is captured using various sensors such as electroencephalogram probes, temperature sensors, heart rate monitors, pulse oximeters, etc. Other categories would require a method where samples of bodily fluids are taken and used to get detailed information about the status. The current paper will discuss the first category, where different signals are captured and processed to determine the body's current status. Each signal has a unique pattern of telling us about the current status or what is happening with the individual. P. Rathod et al. used the technique to capture signals such as galvanizing, heart rate, blood oxygen,

and temperature sensors to capture these signals using a single board computer and transmit over the wifi [1]. M. Altini et al. used such a network to collect the data stream over the network using Radio waves [2]. J. Duan et al. used similar sensors to capture the raw ECG data using the ADC; It was later transmitted using an RF module to the host interface to get it processed [3]. Similarly, V. Ronghe et al. used various sensors to capture these signals; their review paper used temperature, blood pressure, oxygen level, and pulse rate sensors [4]. In another study, Hoi-Jun Yoo et al. used ultra-low power sensors to capture the ECG signals coming from an individual. Similar to others, signals were transmitted using an RF wave [5].

In all scenarios presented above, biosignals are captured by putting them on an individual to capture the signals and then converted into meaningful data. The data generated from each sensor is then transmitted over to the host via wireless communication for further diagnosis. These signals provide very crucial information about the individual who is wearing them. This data set offers crucial real-time details on chronic diseases [5]. It can be used to monitor an individual under care in a hospital or at home. Many chronic diseases would be observed in real-time using these sensor data, and their caretakers would be informed. In some chronic diseases, patients do not have any bodily movements. During this scenario, such data would be beneficial in determining what is happening and what the patient is experiencing.

Generative AI

Generative AI (GAI) is an inclusive term that can be used in every field where large models can be helpful. GAI is a perfect way to improve various aspects of the medical field. Critical patient care and preventive planning are the focus areas in the current paper. Still, in a broad sense, many sections of the medical world would benefit from the advancement in GAI, such as hospitals, medical device manufacturers, research institutions, pharma companies, and specialty clinics. As described by M. Kuzlu et al., OpenAI,

an example of Generative AI (GAI), was the most praised and sophisticated neural network at the time. Where it could create any visual and textual content without any human intervention; they have discussed various applications such as precision medicine, Clinical Decision Support, and Digital Twins of the GAI in the medical field [6].

Just focusing on chronic diseases such as cardiovascular Disease (CD), Alzheimer's Disease (AD), and many more, M. Mahyoub et al. have found out during their research that GAI would be tremendously helpful in early detection and prompt treatment to follow [7]. Over time, based on sufficient data set collection, it would be used to evaluate further what data and which variables make sense to form a baseline for chronic disease diagnosis. Many GAI and Deep Learning methods were proposed to diagnose AD and CD with the addition of computer-aided diagnosis (CAD). With the help of the data and the CAD, applying the GAI can be very beneficial in determining and predicting chronic disease with the most accurate accuracy. S. Liu et al. proposed a similar method to the AD diagnosis using deep learning. They shared that they conducted the AD diagnosis using a multi-class classification without prior knowledge [9].

Using the GAI, many datasets generated using various sensors are analyzed to remove the irrelevant, same, noise, or repetitive information from the data; in a way, GAI would help to clean the data so that it can make sense and train the model with concise and precise data. In this mode, the data can have a couple of stages to learn the pre-training and the final sampling stage for the predictive process. It can also process and train the data in a manner that can be used to get information based on any individual's symptoms with just a couple of data points.

The Fusion

As discussed earlier in the Bio Signals and Generative AI sections, there are many use cases in the medical field to infuse biosignals with generative AI. There are many cases, such as the preventive care of a person and early prediction of diseases based on symptoms. The cocktail of the dataset, trained by the GAI, would be a perfect mix for early detection, preventive care, and finding the root cause of any issues at a very early stage for any routine or chronic disease. Adding signals and AI can be helpful in every aspect of the medical field. It can help hospitals have suggestions based on the history of similar symptoms so that pharmaceutical companies can research more comprehensively where the data is repetitive and can be used to further the research based on the active data set. At the same time, it would be instrumental in an area where patients with specific disabilities can be attended to by the caretaker is based on the biomarkers and signals.

Fusion of these data would make more sense when it has the information and the use case joined by a common cause. Currently, Machine Learning is used in various capacities in the biomedical field, although it has yet to be widely used to utilize its full potential. Such fusion has very high error susceptibility and requires a massive data set to train and make itself usable once trained.

Hiccups

There are many ways GAI in the BioSignal and health domain would be more suitable in a general sense, but at the same time, it can have severe complications while storing the dataset. There would be different signals to collect the data, which would come from an individual providing this dataset to some form of

authority to make good use of the data. While collecting the data, the individuals provided their personal information. To maintain utmost privacy, this data has to be disregarded and cleared up before being added to the larger datasets to train the model. This would be one of the most critical issues while generating the dataset. It looks difficult to remove personal data, but possible to remove it once it has attained a certain level of accuracy. It would be wise to train the model to remove personal data if it is ever found in the dataset.

Conclusion

In the midst of the pandemic, many things were learned and used to diagnose the disease in a way previously deemed impossible. Hence, it is obvious to use frameworks that help humankind in any way possible. GAI and other frameworks are more like assistive frameworks to help understand the extensive data collected over time and ensure the data set is clean and functional. In the long run, I see many applications in the fields spreading to more areas, but in the biomedical field, it is more valuable than others. Most fields focus on improving the user's experience in their day-to-day life. In contrast, it improves earlier predictions and treatments in the medical field and, if detected well enough, saves lives.

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