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# Brain-Inspired Computing in Healthcare Diagnostics

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## Abstract :

Brain inspired computing or neuromorphic computing is a revolutionary approach to artificial intelligence, it imitates structure and functionalities of the human brain. These systems offer efficient power consumption, real time responses as well as adaptability by utilizing neural networks, synaptic plasticity and event driven processing. They are highly suitable for healthcare diagnostics.

While traditional systems encounter numerous incidents of scrambling with higher computational requirements, delayed processing and low energy efficiency, brain inspired models, in contrast can analyse complex medical data such as EEG, ECG or other medical images with higher efficiency and intelligence. These systems have a wide array of applications in medical field, from early detection of neurological disorders to real time heart monitoring wearables.

This paper elaborates the foundations of brain inspired computing and its applications in healthcare diagnostics with advantages it offers. It also includes current limitations of these systems.

*Keywords* — **Machine Learning, Artificial Intelligence, Deep Learning, CNN**

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## Introduction :

In recent years, society has witnessed rising demand for faster, accurate and more energy efficient diagnostics, which has led to expansion of multiple advanced computer paradigms. One of which is Brain Inspired Computing (BIC), it is also referred to as neuromorphic computing. This field is highly inspired by human brain and its functions. Main aim of BIC is to replicate human brain's neural efficiency, adaptability and low energy consumption. Unlike mainstream AI models which rely on large datasets and cloud computing, BIC systems use Spiking Neural Networks (SNNs) and an event driven processing which replicates our neurons and synapses operations. These systems can process complex sensory data, identify patterns, and it can take decisions in real time, all of this with minimal energy requirement, these qualities make BIC highly suitable for healthcare applications. BIC's applications range from diagnosing neurological disorders from EEG to identifying cardiac abnormalities through portable ECG devices, it has shown positive chances of bringing transformative changes in how we monitor and diagnose health conditions. This paper will explain how BIC works, it's applications in healthcare diagnostics and it's future prospects.

## Working of Brain inspired computing:

Brain inspired computing is a field that aims to replicate the way our brain processes information. Traditional computing processes data in steps and in centralized manner, while brain inspired systems are designed to work in parallel and distributed manner, similar to neurons and synapses. One of the most vital concepts in this approach is the Spiking Neural Network (SNN). These networks process data by

  

simulating the way our neurons communicate with each other in our brain, through electric spikes. Unlike regular artificial neural networks that constantly send signals when certain criteria are met, which makes them abetter choice regarding power saving as well as more suited for real time processing.

In order to run these brain alike models, researchers utilize specialized hardware named neuromorphic chips. Examples include intel's Loihi, IBM's TrueNorth and SpiNNaker produced in UK. They were built to mimic human brain's architecture and to run complex computations using least amount of energy, its applications include wearable devices or portable diagnostic tools.

Overall, the aim of brain inspired computing is to create systems that are fast, adaptive and capable of learning, similar to human brain, making them ideal for use in health care diagnostics where real time processing is critical.Your paper must be in two column format with a space of 4.22mm (0.17") between columns.

## Applications in Healthcare Diagnostics:

Brain inspired computing is proving strong potential in revolutionizing how we identify, monitor, and manage health conditions. Because of it's real time processing and low power consumption, it is highly valuable in areas like wearable devices, early disease identification and remote diagnostic. Few key application areas are given below:

**Neurological Disorder Detection:**

Neurological condition such as epilepsy, Alzheimer's disease and Parkinson's disease can be challenging to detect in their early stage. Brain inspired systems, particularly SNNs have been used to analyse electroencephalogram (EEG) data for early detection of abnormal brain activity. These models can identify underlying patterns in brain signals that may go unnoticed by traditional systems, which offers a more precise diagnosis.

**Cardiovascular Health Monitoring:**

Wearable neuromorphic devices can process ECG data in real time to identify arrhythmias, heart attacks or any other cardiac issue, Neuromorphic chips allow this processing to happen locally, which results in reduced need of constant internet or cloud connectivity, this makes heart monitoring more efficient in isolated or rural areas

**Medical Image Analysis:**

Brain inspired computing can also improve analysis of medical images such as MRI, CT scans and X-rays. Neuromorphic models can be trained to recognize patterns related with tumours, fractures or infections more quickly and accurately. These systems may also provide more interpretable results, which makes them handy for assisting radiologist and other medical professionals in decision making.

## Benefits and Challenges:

Brain inspired computing offers numerous advantages making it highly suitable for healthcare diagnostics. However, BIC also has limitations which needs to be addressed before it can be fully adopted. Both pros and cons will be discussed below.

**Benefits:**

- **Low Power consumption:**

Neuromorphic chips require noticeably less amount of energy compared to traditional processors, which makes them ideal choice, especially where long term and efficient usage is prioritized.

- **Real time processing:**

Spiking neural networks and event driven architectures allow fast and real time analysis of biomedical data. This is critical for applications such as continuous heart or brain monitoring.

- **Biological Interpretability:**

Given that these systems mimic brain like processing, the outcomes sometimes can be straightforward to interpret in term of biological signals, especially in neurological applications

**Challenges:**

- **Limited Hardware Availability:**

Neuromorphic chips are not widely available or affordable which limits large scaled deployment.

- **Complex Training Process:**

  

Training spiking neural network is still in development. Compared to established deep learning models, SNN are difficult to train because of the discrete tendency of spikes.

- **Integration with Existing Systems:**

Current medical infrastructure is built for traditional computing. Integrating BIC solutions into hospitals will need them to have a massive upgrade in standards as well as compatibility layers.

## Conclusion:

Brain inspired computing is an intelligent modern approach which replicates how human brain functions, in order to achieve significant improvement in medical diagnostics, It's ability to process data in real time and to learn from patterns while managing to consume low energy makes it ideal for identifying diseases and monitoring patients. From wearable heart monitors to systems that detects brain disorders early, BIC is very promising. Although there are still challenges which might limit it's implementation, the future of BIC looks bright.

  