PREDICTING LUNG CANCER WITH AL-ENHANCED BREATH ANALYSIS: FEATURE-SELECTED ENSEMBLE MODELS OF VOC BIOMARKERS

ABSTRACT

The advancement of digital medicine, particularly in diagnostics using complex biomarkers like Volatile Organic Compounds (VOCs), relies heavily on sophisticated machine learning models such as Convolutional Neural Networks (CNNs) and Spiking Neural Networks (SNNs). However, the computational intensity and substantial memory footprint of these models often hinder their deployment in resource-constrained clinical settings. This work addresses the critical bottleneck of memory efficiency in neural networks for medical applications. We propose a memory-centric optimization framework specifically designed for CNNs and SNNs. By re-architecting data flow, optimizing synaptic weight storage, and employing advanced sparsification techniques, our approach significantly reduces memory consumption and energy usage. This enables the development of "Efficient Brains"—high-performance, low-power neural networks that facilitate faster training and inference, making advanced AI diagnostics more accessible, scalable, and practical for point-of-care digital medicine.

EXISTING SYSTEM

The existing system for AI-driven digital medicine diagnostics typically relies on the direct application of standard neural network architectures, such as CNNs, and the emerging use of SNNs in their baseline forms. These systems are designed with a primary focus on achieving maximum predictive accuracy, often at the expense of computational resource consumption**.**

Disadvantages of the Existing System:

1. Prohibitive Memory Footprint: Standard CNN and SNN models require storing millions of parameters and activations. This large memory demand makes it difficult to deploy these models on embedded systems, FPGAs, or mobile devices used in point-of-care diagnostics, limiting their accessibility.
2. High Energy Consumption: The extensive data movement between memory and processing units in von Neumann architectures, combined with dense computations, leads to significant power draw. This is unsuitable for battery-operated medical devices intended for prolonged use.

3. Limited Scalability and Speed: The computational burden results in longer inference times, preventing real-time analysis. Scaling these models to handle more complex data or multiple data streams, as seen in multi-source VOC analysis, becomes impractical due to exponentially growing resource requirements.

PROPOSED SYSTEM

The proposed system is a memory-centric optimization framework for neural networks, engineered to create "Efficient Brains" for digital medicine. It fundamentally rethinks how CNNs and SNNs manage memory to minimize footprint and energy use while maintaining high diagnostic accuracy.

Advantages of the Proposed System:

1. Dramatically Reduced Memory Consumption: Through techniques like weight pruning, quantization, and efficient encoding of spikes in SNNs, the proposed system significantly compresses the model size. This enables the deployment of sophisticated AI models on hardware with strict memory constraints.
2. Enhanced Energy Efficiency: By minimizing data movement and leveraging the event-driven nature of optimized SNNs, the system drastically reduces power consumption. This facilitates the development of portable, battery-powered diagnostic tools that can operate for extended periods.
3. Maintained High Performance with Faster Inference: The memory-centric design allows for more efficient use of memory bandwidth and computational cores, leading to lower latency and faster inference times. This supports real-time analysis of medical data, a critical requirement for timely clinical decision-making.

SYSTEM REQUIREMENTS

- **H/W System Configuration:-**
- Processor - Pentium –IV
- RAM - 4 GB (min)
- Hard Disk - 20 GB
- Key Board - Standard Windows Keyboard
- Mouse - Two or Three Button Mouse
- Monitor - SVGA

SOFTWARE REQUIREMENTS:

- **Operating system** : Windows 7 Ultimate.
- **Coding Language** : Python.
- **Front-End** : Python.
- **Back-End** : Django-ORM
- **Designing** : Html, css, javascript.
- **Data Base** : MySQL (WAMP Server).