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Topic of Research	:	**sHARf: A Smart Human Activity Recognition Framework**

Findings

Keywords: Human Activity Recognition, Edge Intelligence, Internet of Things, Cloud Computing, Big Data Analytics, Neuromorphic computing

Human Activity Recognition (HAR) is a rapidly evolving field that aims to develop techniques and systems for the automatic identification, understanding, and classification of human activities based on sensor data. This abstract outlines the significant contributions and findings of the thesis titled "sHARf: A Smart Human Activity Recognition Framework," which presents a comprehensive framework for long-term activity recognition by integrating modern cutting-edge technologies such as IoT, big data analytics, cloud computing, and edge computing. The primary objective is to monitor lifestyle and promote smarter living by accurately recognizing and understanding human activities.

The research in the thesis begins with an in-depth exploration of HAR through Scientometric analysis of the published literature. The published papers were classified using Vosviewer into six major themes, from which 193 papers related to activity recognition frameworks were selected for systematic review using Kitchenham principles. The systematic review reveals various HAR techniques and examines their potential and challenges in integration with emerging technologies such as IoT, big data, and cloud computing for long-term monitoring.

The thesis addresses several challenges in activity recognition by proposing innovative models and architectures. A notable contribution is the development of a Lightweight Deep Learning Model designed for edge devices. By combining Shallow Recurrent Neural Networks (RNN) with Long Short-Term Memory (LSTM), the model enables real-time activity recognition on resource-constrained edge devices. Extensive testing on publicly available datasets demonstrates that this model outperforms existing techniques, effectively bridging the gap in computation-intensive deep learning algorithms.

Additionally, the thesis introduces a user-personalized and edge-optimized framework to optimize activity recognition on edge devices. This framework incorporates a lightweight module called Edge Intelligence (EI) to reduce network traffic to the cloud, thereby minimizing energy consumption. The framework also includes a novel Max Score Pooling (MSP) algorithm that provides user-specific and optimized features. When combined with the MSP-optimized Decision Tree (MSP-DT) classifier, the framework achieves real-time activity recognition in the Spark environment. The experiments show high accuracy and a significant reduction in transmitted data, demonstrating the framework's efficiency and robustness.

Another challenge addressed in the thesis is the handling of missing values in sensor data. The proposed Missing Value Imputation Model (lp-RNN) is specifically designed for edge devices. By utilizing Jacobian optimization, the model imputes missing values based on available data patterns and context. Evaluation using real-world HAR datasets showcases superior imputation accuracy while minimizing computational overhead.

The thesis also explores the potential of Neuromorphic Computing and Quantum Computing for HAR application development, recognizing the expected growth in data generated by smart tracking devices. The research investigates their application in activity recognition on edge devices and large-scale cloud-based analysis. Comparisons with state-of-the-art models using public datasets provide insights into their performance and capabilities, indicating the potential of these emerging technologies to handle the increasing data processing demands.

To further enhance real-time HAR on edge devices, the thesis presents a novel Lightweight and Energy-Efficient Neuromorphic-Inspired CNN (niCNN) architecture. This architecture includes a shallow CNN, equivalent spiking network conversion, threshold balancing, and edge deployment. Experimental evaluation demonstrates high accuracy, low inference latency, low memory utilization, and reduced energy consumption compared to baseline CNN models.

In summary, the research underscores the potential of combining IoT, big data, and cloud computing to enhance HAR applications. It addresses key challenges such as computational efficiency on edge devices, handling missing sensor data, and optimizing network traffic. By exploring the capabilities of Neuromorphic and Quantum Computing, the thesis paves the way for future advancements in the field, ensuring that HAR systems can keep pace with the growing data generated by smart tracking devices.

Overall, the integrated framework, lightweight models, and efficient architectures presented in the thesis mark significant advancements in HAR. The findings demonstrate that leveraging these technologies can lead to more accurate, cost effective, efficient, and real-time recognition of human activities, ultimately promoting smarter living and personalized care in various domains such as healthcare, sports, fitness, and smart environments.