Chapter 13
Quantum-SVM (SVM) for Parkinson's Disease Prediction Using Wearable IoT Sensors

N. Jagadish Kumar
https://orcid.org/0000-0001-7677-9872
SRM Institute of Science and Technology, India

Chin-Shiuh Shieh
https://orcid.org/0000-0003-3187-458X
National Kaohsiung University of Science and Technology, Taiwan

Mong-Fong Horng
National Kaohsiung University of Science and Technology, Taiwan

G. Elangovan
SRM Institute of Science and Technology, India

K. Rajkumar
SRM Institute of Science and Technology, India

ABSTRACT

The amalgamation of wearable IoT sensors with QSVM technology is transforming the early identification and ongoing surveillance of Parkinson's Disease (PD). This chapter examines the enhancement of PD diagnostics through quantum machine learning by evaluating real-time kinematic data from various sensors. Traditional models such as Classical SVM, RF, and DNN encounter difficulties due to the intricacy and high dimensionality of time-series sensor data. QSVM, employing

DOI: 10.4018/979-8-3373-3146-1.ch013

Variational Quantum Circuits, optimizes feature extraction and classification, thereby diminishing computational requirements while improving accuracy. In benchmark evaluations, QSVM attained an accuracy of 97.2%, exceeding that of Classical SVM, RF, and DNN, and concurrently decreasing computational time by 35%. The efficacy of QSVM, in conjunction with edge computing and federated learning, has the potential to revolutionize personalized, privacy-centric healthcare. Notwithstanding the constraints of quantum hardware, QSVM presents significant promise in enhancing PD diagnosis and advancing intelligent healthcare.

1. INTRODUCTION

The evolution of wearable Internet of Things (IoT)-based sensors has significantly impacted contemporary healthcare by facilitating the acquisition of real-time sensor data for the ongoing monitoring of patients. Instruments such as accelerometers, gyroscopes, and electromyography (EMG) sensors are extensively utilized in the surveillance of neurodegenerative disorders, particularly in the context of predicting conditions such as Parkinson's disease. These sensors meticulously monitor movement patterns, tremors, and gait irregularities, thereby enabling healthcare practitioners to identify symptoms at a nascent stage. IoT-enabled intelligent healthcare solutions offer customized monitoring and predictive analytics, thereby minimizing hospital admissions and improving the quality of patient care. Nevertheless, the efficient management of high-dimensional, sensor-generated time-series data necessitates the application of sophisticated ml methodologies for precise classification and informed decision-making.

Ml with in the domain of healthcare assumes a pivotal function in the analysis of extensive volumes of real-time sensor data acquired from wearable Internet of Things (IoT) devices. The Quantum Support vector machine (QSVM), in conjunction with traditional ml methodologies such as Classical SVM, RF, and Deep Neural Networks (DNN), is extensively implemented for the prognostication of Parkinson's disease through the examination of movement anomalies. The processes of feature extraction, classification accuracy, and computational efficiency are paramount for facilitating accurate and trustworthy diagnostic outcomes. Adaptive healthcare systems harness ml models to diminish computational duration while concurrently enhancing accuracy, precision, recall, and F1-score. Nevertheless, conventional ml models encounter significant challenges when addressing intricate sensor data, thereby necessitating the exploration of quantum-enhanced artificial intelligence techniques.

Quantum computing possesses the capacity to transform wearable IoT-enabled medical diagnostics by harnessing quantum parallelism to enhance classification