Analisis Spektroskopi Raman dari Sampel Jaringan Kanker Kolorektal: Pendekatan Machine Learning pada Komputer Klasik dan Kuantum = Raman Spectroscopic Analysis of Colorectal Cancer Tissue Samples: A Machine Learning Approach on Classical and Quantum Computers

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Abstrak

Penelitian ini menyelidiki penerapan spektroskopi Raman pada sampel jaringan kanker kolorektal menggunakan pendekatan machine learning pada komputer klasik dan kuantum. Kanker kolorektal, salah satu penyebab utama kematian akibat kanker, memerlukan metode diagnostik yang akurat dan efisien. Studi ini menggunakan data spektroskopi Raman dari penelitian sebelumnya dan mengimplementasikan algoritma machine learning seperti XGBoost, LightGBM, Fully Connected Neural Network (FCNN), Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM), dan Gated Recurrent Network (GRU) pada komputer klasik. Selain itu, penelitian ini juga memperkenalkan pendekatan baru dengan mengaplikasikan Hybrid Quantum Neural Network (QNN). Hasil penelitian menunjukkan bahwa model XGBoost pada komputer klasik mencapai F1-Score tertinggi sebesar 64,311%, sedangkan model Hybrid Classical-Quantum Classifier menunjukkan F1-Score terendah, sebesar 55.263%. Meskipun model Hybrid Classical-Quantum Classifier memperoleh skor terendah, penelitian ini menunjukkan potensi penerapan komputasi kuantum dalam meningkatkan akurasi diagnosis kanker kolorektal di masa depan. Namun, keterbatasan perangkat keras komputer kuantum saat ini menjadi kendala signifikan yang perlu diatasi melalui penelitian lebih lanjut.

.....This study investigates the application of Raman spectroscopy to colorectal cancer tissue samples using classical and quantum computer machine learning approaches. Colorectal cancer, one of the leading causes of cancer deaths, requires accurate and efficient diagnostic methods. This study utilizes Raman spectroscopy data from previous research and implements machine learning algorithms such as XGBoost, LightGBM, Fully Connected Neural Network (FCNN), Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM), and Gated Recurrent Network (GRU) on classical computers. In addition, this research also introduces a new approach by applying a hybrid quantum neural network (QNN). The results showed that the XGBoost model on classical computers achieved the highest F1-Score of 64.311%, while the Hybrid Classical-Quantum Classifier model showed the lowest F1-Score, at 55.263%. Despite the lowest score, this study shows the potential of applying quantum computing in improving the accuracy of colorectal cancer diagnosis in the future. However, the current hardware limitations of quantum computers are a significant obstacle that needs to be overcome through further research.