Hybrid Quantum Computing Enhances Histopathological Cancer Detection Accuracy

The application of quantum machine learning in healthcare has opened new avenues for accurate and efficient diagnostics. This article explores a groundbreaking study that focuses on histopathological cancer detection using a hybrid quantum computing approach. By leveraging the power of multiple transfer learning models and variational quantum circuits (VQC), the study aims to enhance the accuracy and performance of cancer detection techniques.

Background

Histopathological cancer detection involves examining tissue samples under a microscope to identify cancerous cells. Traditional methods can be time-consuming and sometimes yield inaccurate results due to human error.

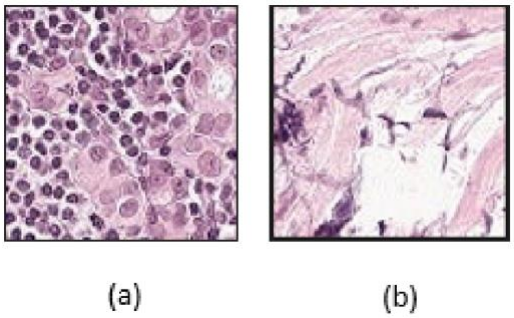


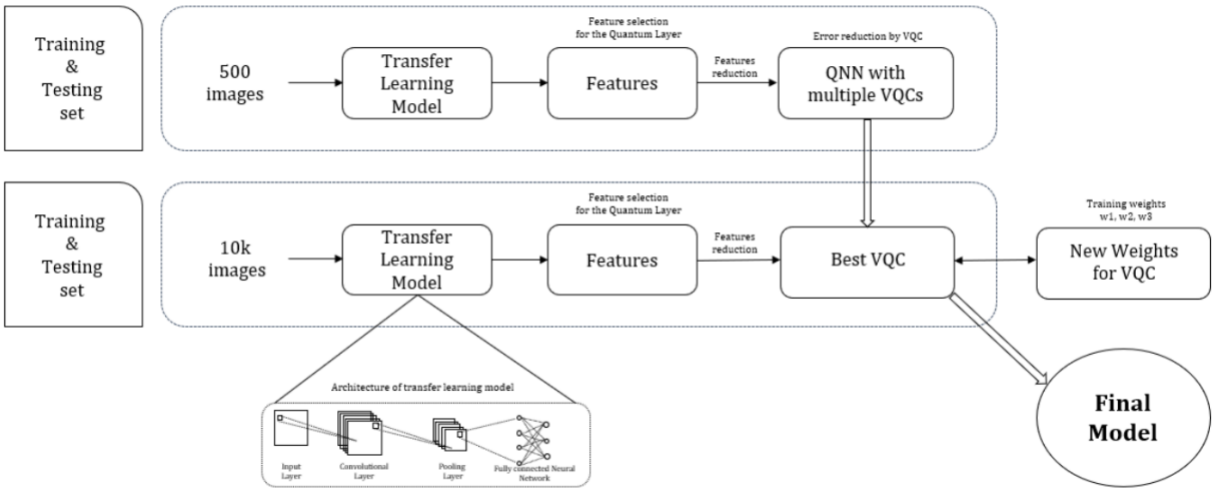
Fig. 1: Data (image) Samples: (a) non-cancerous image (b) cancerous image.[1]

Machine learning has proven to be a valuable tool in improving the accuracy and speed of cancer detection, and the introduction of quantum computing to this field has further advanced these capabilities.

The Study

The study presents a hybrid quantum computing model that combines the power of classical transfer learning models and variational quantum circuits to accurately detect cancerous cells in histopathological images.

[1] B. Baral, R. Majumdar, B. Bhalgamiya and T. D. Roy, "Evaluating Quantum Machine Learning Approaches for Histopathological Cancer Detection: Classical, Hybrid Simulation, and IBM Quantum Computing," *2023 IEEE International Conference on Quantum Computing and Engineering (QCE)*, Bellevue, WA, USA, 2023, pp. 238-239, doi: 10.1109/QCE57702.2023.10222.



The models used in this study include ResNet18, VGG-16, Inception-v3, and AlexNet. By using multiple transfer learning models, the researchers aimed to provide a comprehensive comparative analysis of their performance, ultimately selecting the best performing model for histopathological cancer detection.

Results and Findings

The results of the study demonstrated that the hybrid quantum and classical (HQC) model using ResNet18 outperformed the other models, achieving a prediction AUC of approximately 0.93. This indicates a high level of accuracy and confidence in the model's ability to detect cancerous cells. Furthermore, when analyzing 1000 images, the HQC model provided a slightly better accuracy (0.885) than the classical approach (0.88).

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Model	Images	Acc	AUC	VQC	Exp	Qbits
Classical CNN	5000	76.10	0.82	N/A	N/A	N/A
Classical CNN2	10000	79.10	0.88	N/A	N/A	N/A
Classical ResNet18	1000	88.00	0.95	N/A	N/A	N/A
Classical ResNet18	10000	89.90	0.96	N/A	N/A	N/A
Hybrid CNN	10000	59.95	N/A	6	0.011	4
Hybrid ResNet18	1000	88.50	0.93	1	1.431	4
Hybrid VGG 16	1000	55.00	0.77	2	1.078	5
Hybrid Inception v3	1000	79.50	N/A	3	1.007	5
Hybrid AlexNet	1000	63.00	0.67	4	0.201	7
Hybrid ResNet18	5000	83.80	0.90	5	0.201	7
Hybrid ResNet18	10000	82.35	0.90	1	1.431	4
HQC ResNet18	10000	84.30	0.90	6	0.011	4

Implications and Conclusion

This groundbreaking study highlights the potential of hybrid quantum computing in enhancing the accuracy and performance of histopathological cancer detection. By combining classical transfer learning models with variational quantum circuits, the researchers were able to improve the accuracy of cancer detection, potentially reducing the need for invasive procedures and improving patient outcomes.

As quantum computing technology continues to evolve, we can expect to see further advancements in the field of healthcare, particularly in diagnostics and personalized medicine. The success of this study in histopathological cancer detection serves as a promising example of how quantum machine learning can be harnessed to improve the lives of patients and revolutionize the medical industry.

[1] B. Baral, R. Majumdar, B. Bhalgamiya and T. D. Roy, "Evaluating Quantum Machine Learning Approaches for Histopathological Cancer Detection: Classical, Hybrid Simulation, and IBM Quantum Computing," *2023 IEEE International Conference on Quantum Computing and Engineering (QCE)*, Bellevue, WA, USA, 2023, pp. 238-239, doi: 10.1109/QCE57702.2023.10222.