My First IEEE Conference Paper

IEEE

IEEE Photonics Society Bangladesh Chapter

CERTIFICATE

OF PRESENTATION

THIS IS TO CERTIFY THAT

Paper ID : 6630
Paper Title : QuReBrain: Quantum Data Re-Uploaded VQC for MRI Brain Tumor Classification

Author(s) : JM Tamimur Rahman, Ratul Hasan Rabbi, Moniruzzaman

has been successfully presented at **2026 IEEE 2nd International Conference on Quantum Photonics, Artificial Intelligence and Networking (QPAIN 2026)** held on 16-18 April, 2026 at IT Business Incubator, Chittagong University of Engineering and Technology (CUET), Chattogram, Bangladesh.

Organized By

IEEE Photonics Society Bangladesh Chapter

Prof. Dr. Nasrin Sultana	Md. Tabil Ahammed	Dr. Mainul Hossain
Conference Chair	Organizing Chair	Technical Chair

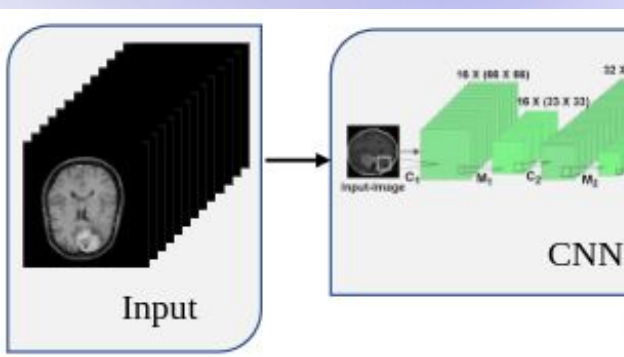
Paper Breakdown: QuReBrain - Quantum Data Re-Uploaded VQC for MRI Brain Tumor Classification.

Explained by
Ratul Hasan Rabbi

Connect With me :

Standard Medical AI is computationally heavy

Deep learning models like **CNNs** are excellent at detecting brain tumors from MRI scans, but they typically require **massive datasets** and **computational resources.**



- Quantum Machine Learning (QML) offers a **low-parameter** alternative
- However, current quantum hardware (NISQ era) is severely limited by **qubit counts** and decoherence. High-dimensional classical data usually cannot fit into these limited circuits without losing vital diagnostic information

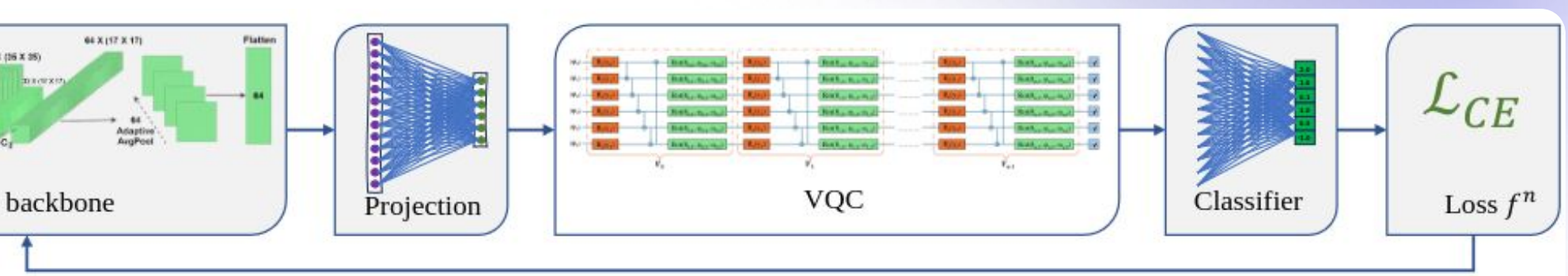
Explained by
Ratul Hasan Rabbi

Connect With me :

The Solution – QuReBrain Framework

We proposed a model that takes the best of both worlds.

- **Classical CNN Head:** A lightweight convolutional neural network is used strictly for feature extraction
- **Variational Quantum Classifier (VQC):** A **6-qubit** quantum circuit is used for the final classification of the tumor



The Data Re-uploading Strategy

How do we process complex MRI features with only 6 qubits? We expand the depth, not the width

- Instead of **adapting the hardware** to the image, we repeatedly **encode the classical data** across **multiple variational layers**
- This bypasses the **no-cloning theorem**, boosting the representational capacity of the quantum circuit without needing more physical qubits

Explained by
Ratul Hasan Rabbi

Connect With me :

Performance & The Journey Behind the Paper

The Results

We compared QuReBrain against standard classical architectures (ResNet, VGG16, MobileNet).

- **Accuracy:** Achieved **91.48%** precision on an MRI brain tumor dataset across four classes.
- **Efficiency:** Required only **26,694 trainable** parameters a fraction of the **millions** required by standard models like ResNet-34 or VGG16.
- **Speed:** Attained the lowest average inference latency at **10.35 ms**, proving its viability for resource-constrained environments.

Reflection & Acknowledgments

As my first research work, the learning curve was steep but incredibly rewarding, providing an invaluable introduction to the academic track

This work was fundamentally led by **Moniruzzaman sir**. His architectural vision and rigorous methodological guidance were the foundation of this research. I am deeply appreciative of his mentorship and for the opportunity to collaborate under his direction.

Explained by
Ratul Hasan Rabbi

Connect With me :