Quantum Machine Learning for Image Classification in Healthcare: Algorithms, Applications, and Future Prospects

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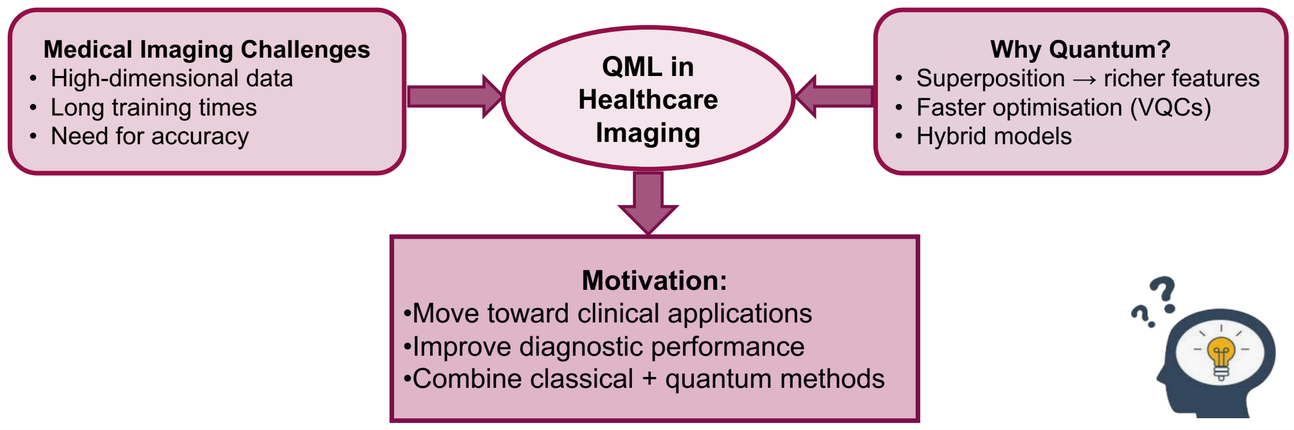
Abstract: Quantum Machine Learning (QML) goals to solve problems too complex for classical computers, enabling richer data representations, more efficient algorithms, and the ability to tackle large, high-dimensional datasets. In this work, we systematically review studies published between 2020 and 2025 that apply QML. Preliminary findings illustrate that most applications remain at the proof-of-concept step and are constrained by limited quantum hardware and dataset availability. The poster highlights current research directions, key challenges, such as limited quantum hardware and small, non-standardised datasets, and outlines opportunities for future clinical integration. Focusing on these areas will make it clear that QML provides valuable benefits for diagnostics, personalised care, and healthcare operations.

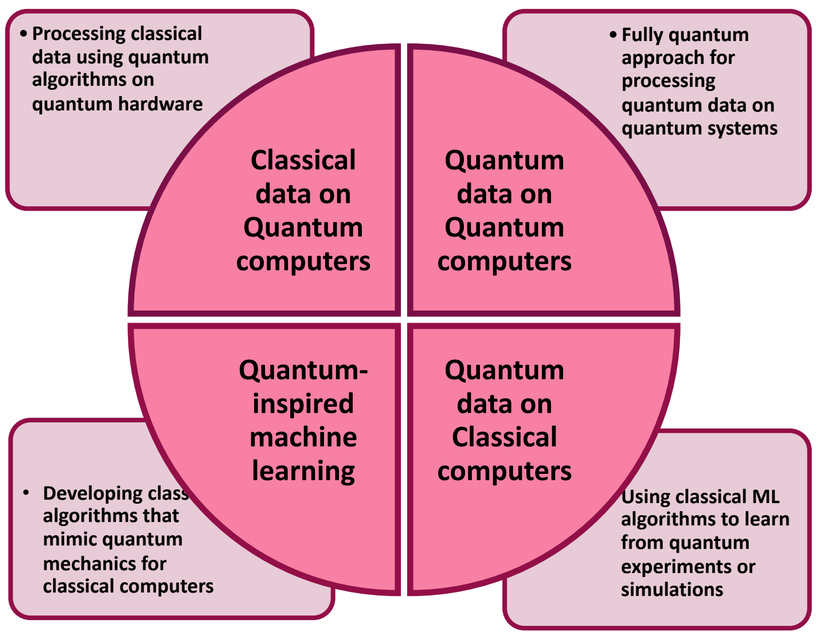
1 Background & Motivation

- Medical imaging generates high-dimensional data that challenges classical ML in terms of computation and generalisation.
- Quantum Machine Learning (QML) offers a different paradigm, using superposition and entanglement to create richer feature spaces and more efficient optimisation.



2 What Is QML?

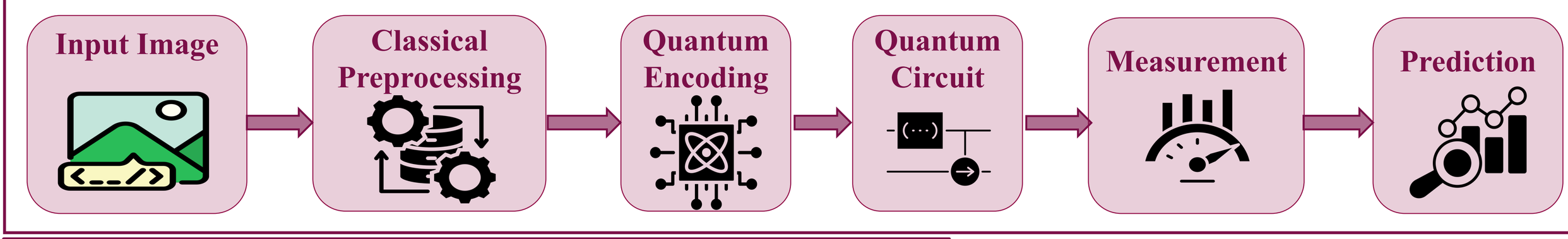
QML combines quantum computation with data-driven learning to build models such as variational quantum circuits (VQCs), quantum neural networks (QNNs), and hybrid quantum–classical architectures.



3 Why QML for Medical Image Classification?

Advantages

- High-dimensional feature spaces (superposition)
- Efficient optimisation through VQCs
- Expressive quantum neural models
- Better performance on small/noisy datasets
- Hybrid QML improves robustness



4 Research Landscape (2020–2025)

Trends (2020–2025)

- Field accelerating fast
- Hybrid + QNN highest
- QCNN increasing trend
- CT data dominant
- Cancer top focus

5 Key Challenges

6 Future Directions

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