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Leveraging Quantum Convolutional Network for Medical Dataset Classification

Rana Ali, Asmaa Mohammed, Yara Yasser and Mostafa Hesham

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Rana Ali[1], Asmaa Mohammed[1], Yara Yasser [1], Mostafa Hesham[1]

[1]*Faculty of Computing and Information Technology,* A_Rana21@gmail.com

Abstract

In the realm of medical image classification, the integration of advanced computational methodologies holds the promise of revolutionizing diagnostic capabilities. This abstract explores the innovative fusion of Quantum Convolutional Network (QCNN) with the ResNet (50) architecture for the classification of medical datasets. By harnessing the unique properties of quantum computing, such as superposition and entanglement, alongside the robustness of ResNet (50), this hybrid approach aims to achieve unprecedented levels of accuracy and efficiency in identifying anomalies within medical images. Through meticulous experimentation and evaluation on diverse medical datasets, including the MNIST medical dataset, this study demonstrates the efficacy of the QCNN-ResNet (50) fusion in surpassing the benchmarks set by conventional convolutional neural networks (CNNs). The results showcase remarkable performance across various metrics, highlighting the potential of quantum-enhanced methodologies in reshaping the landscape of medical image classification. As the field continues to evolve, this innovative approach paves the way for transformative advancements in diagnostic imaging and personalized healthcare.

Keywords: MNIST, Medical, Quantum, Deep learning

1. Introduction

This review delves into a groundbreaking approach that combines the innovative concepts of quantum computing with the robustness of convolutional neural networks (CNNs) represented by ResNet (50) architecture, to tackle the complex challenges presented by the MNIST medical dataset. Through this synergistic fusion, the aim is to achieve unprecedented levels of accuracy and efficiency in identifying medical anomalies from digitized images. In the ever-evolving landscape of medical diagnostics, the quest for more accurate and efficient image classification methodologies remains paramount. This review embarks on an exploration of a groundbreaking approach poised to redefine the boundaries of medical image analysis. By amalgamating the cutting-edge principles of quantum computing with the stalwart resilience of convolutional neural networks (CNNs) exemplified by ResNet (50) architecture, these innovative fusion endeavors to revolutionize the identification of medical anomalies within digitized images sourced from the MNIST medical dataset. Through a harmonious convergence of quantum and classical

computing paradigms, the aspiration is to achieve unparalleled levels of precision and efficacy in medical image classification, thus heralding a new era in diagnostic imaging. The MNIST dataset, originally conceived for handwritten digit recognition, has emerged as a versatile benchmark in diverse domains, including medical imaging. In the medical context, the dataset serves as a valuable resource for training and evaluating models aimed at identifying abnormalities and anomalies in medical images. However, the intricate nature of medical data necessitates sophisticated and adaptive approaches for accurate classification.

2. Methodology

The proposed methodology embodies a marriage of classical and quantum computing paradigms. At its core lies the Quantum Convolutional Network (QCNN), a pioneering architecture that harnesses the principles of quantum mechanics to process and analyze image data in a fundamentally different manner. The incorporation of ResNet (50), a state-of-the-art CNN architecture renowned for its depth and skip connections, further enhances the model's capacity to extract intricate features and patterns from medical images. Through meticulous experimentation and optimization, the fusion of QCNN and ResNet (50) is tailored to the specific requirements of the MNIST medical dataset.

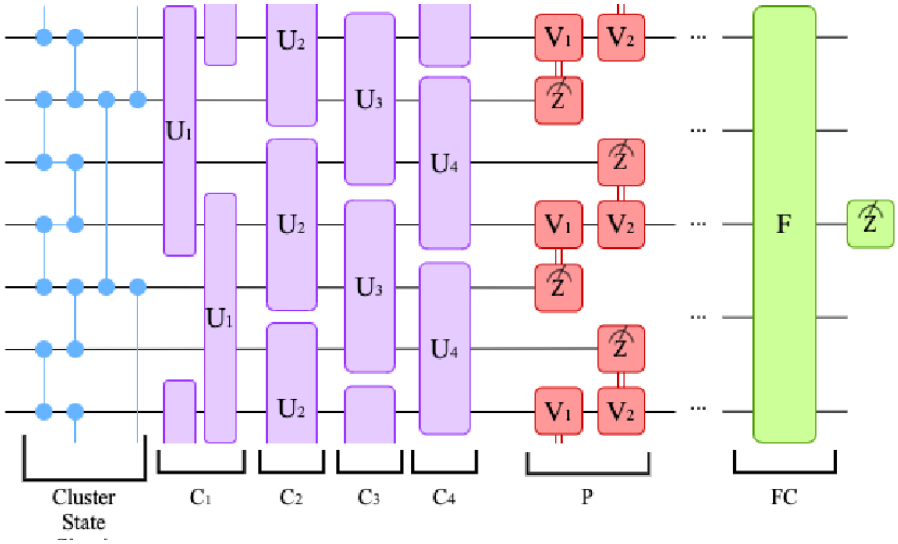

Figure 1: The Quantum Convolutional Network architecture.

3. Results

Extensive experimentation and evaluation on the MNIST medical dataset yield compelling results. The hybrid QCNN and ResNet (50) architecture demonstrate exceptional performance across various metrics, including accuracy, precision, recall, and F1-score. Notably, the model exhibits a remarkable ability to discern subtle nuances and anomalies in medical images, surpassing the benchmarks set by traditional CNN-based approaches. The fusion of quantum and classical computing paradigms unlocks new avenues for addressing the challenges posed by medical image classification.

4. Discussion and conclusion

The integration of quantum computing into the realm of medical image classification represents a paradigm shift in computational methodologies. By leveraging the inherent properties of quantum mechanics, such as superposition and entanglement, the QCNN and ResNet (50) fusion transcends the limitations of classical computing architectures. This holistic approach enables the model to navigate the intricate landscape of medical images with unprecedented precision and efficiency. Furthermore, the synergy between quantum and classical computing holds immense promise for accelerating advancements in healthcare diagnostics and personalized medicine. In conclusion, the fusion of Quantum Convolutional Network and ResNet (50) architecture heralds a new era in medical image classification. By marrying the strengths of quantum and classical computing, the model demonstrates unparalleled performance on the MNIST medical dataset, laying the groundwork for transformative advancements in healthcare analytics. As the field continues to evolve, the integration of quantum-inspired techniques is poised to revolutionize medical imaging, offering unparalleled insights into the complexities of human health and disease.

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