TOWARDS QUANTUM-ENHANCED MACHINE LEARNING FOR FRAUD DETECTION

A project report submitted in partial fulfilment of the requirements for the award of the degree of

MASTER OF TECHNOLOGY

in

COMPUTER SCIENCE & TECHNOLOGY

Submitted by

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DEPARTMENT OF COMPUTER SCIENCE AND SYSTEMS ENGINEERING

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CERTIFICATE

This is to certify that the project report entitled "**TOWARDS QUANTUM-ENHANCED MACHINE LEARNING FOR FRAUD DETECTION**" is the bonafide work carried out by **PEDADA HARIKA** with **Regd. No: 323206415012,** during the year 2023-2025, in partial fulfilment of the requirements for the degree of **MASTER OF TECHNOLOGY,** with a specialization in **COMPUTER SCIENCE AND TECHNOLOGY** from the department of **COMPUTER SCIENCE AND SYSTEMS ENGINEERING**, Andhra University College of Engineering(A), Andhra University, Visakhapatnam.

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DECLARATION

I declare that the report entitled "**TOWARDS QUANTUM-ENHANCED MACHINE LEARNING FOR FRAUD DETECTION**" has been done by me in partial fulfilment of requirements for the award of the degree of **MASTER OF TECHNOLOGY**, in **COMPUTER SCIENCE & TECHNOLOGY**, during the academic year 2023-2025, under the guidance of **"Dr. K. VENKATA RAMANA"**, Department of Computer Science and Systems Engineering, Andhra University College of Engineering(A), Andhra University, Visakhapatnam. I hereby declare that this project work has not been submitted to any other universities/institutions for the award of any degree.

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ACKNOWLEDGEMENT

It is with a great sense of satisfaction that I present "**TOWARDS QUANTUM-ENHANCED MACHINE LEARNING FOR FRAUD DETECTION**" in the form of a final project.

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ABSTRACT

The study explores how advances in machine learning methods for identifying credit card fraud might benefit from quantum computing. The primary objective is to evaluate how well a Quantum Convolutional Neural Network (QCNN) performs relative to a classical Convolutional Neural Network (CNN) to determine whether quantum models deliver superior outcomes. The selection of this research topic stems from the increasing complexity of financial fraudulent activities combined with traditional models' inability to manage extensive and imbalanced datasets. Quantum computing provides advantages such as parallel processing, superposition, and entanglement, offering improved computational performance for these tasks. The research began with the creation of a CNN model using conventional deep learning approaches, followed by the design of a QCNN model through quantum circuit simulations using a quantum framework. Both models were trained on identical datasets, and their learning patterns and results were comparatively analyzed. Observational results indicated that the quantum model exhibited superior pattern recognition and learning abilities when processing the data. The findings highlight the growing potential of quantum-enhanced machine learning in detecting complex financial fraud more accurately and efficiently. This advancement can significantly strengthen fraud detection systems used by banks, financial institutions, and cybersecurity applications. Moreover, the proposed framework can be extended to other domains involving imbalanced and high-dimensional data, such as healthcare diagnostics and cyber intrusion detection. Future work will focus on implementing QCNNs on real quantum hardware, optimizing circuit depth, and exploring hybrid quantum–classical models for scalable, real-world deployment.

Keywords: Quantum Machine Learning, Fraud Detection, Quantum Convolutional Neural Network, CNN, PennyLane, SMOTE.

LIST OF ABBREVIATIONS

Abbreviation	Full Form
AI	Artificial Intelligence
ML	Machine Learning
DL	Deep Learning
CNN	Convolutional Neural Network
QCNN	Quantum Convolutional Neural Network
QML	Quantum Machine Learning
Qubit	Quantum Bit
PCA	Principal Component Analysis
SMOTE	Synthetic Minority Oversampling Technique
ROC	Receiver Operating Characteristic
AUC	Area Under the Curve
TPR	True Positive Rate
FPR	False Positive Rate

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