

QUANTIC Project

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Abstract: This work presents a hybrid quantum–classical approach to hazelnut image classification, experimentally comparing quantum and classical models, evaluating optimization strategies, and assessing current hardware limitations while highlighting the practical potential of quantum machine learning in vision tasks.

This project investigates hybrid quantum–classical machine learning for hazelnut image classification, focusing on the design and benchmarking of Variational Quantum Classifier (VQC) against classical CNN baselines. A curated dataset of hazelnut images belonging to three classes (Giresun, Ordu, Van) (Fig. 1) is preprocessed through dimensionality reduction and used to train both classical and hybrid models. The quantum component relies on variational quantum circuits embedded within classical pipelines, enabling evaluation under different optimization strategies, including gradient-based and gradient-free approaches. Experimental results show comparable classification accuracy between classical and hybrid models, as highlighted by the confusion matrix on the test set (Fig. 2), while revealing differences in convergence behavior, robustness, and computational cost. The study also analyzes scalability and feasibility constraints imposed by current NISQ hardware. Although real-device deployment remains limited, the results highlight the potential of quantum-enhanced learning for image classification and contribute to defining benchmarking methodologies.

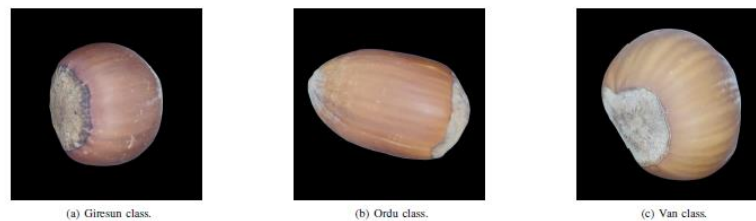


Fig. 1 Examples of hazelnut varieties (Giresun, Ordu, Van) used in the classification task.

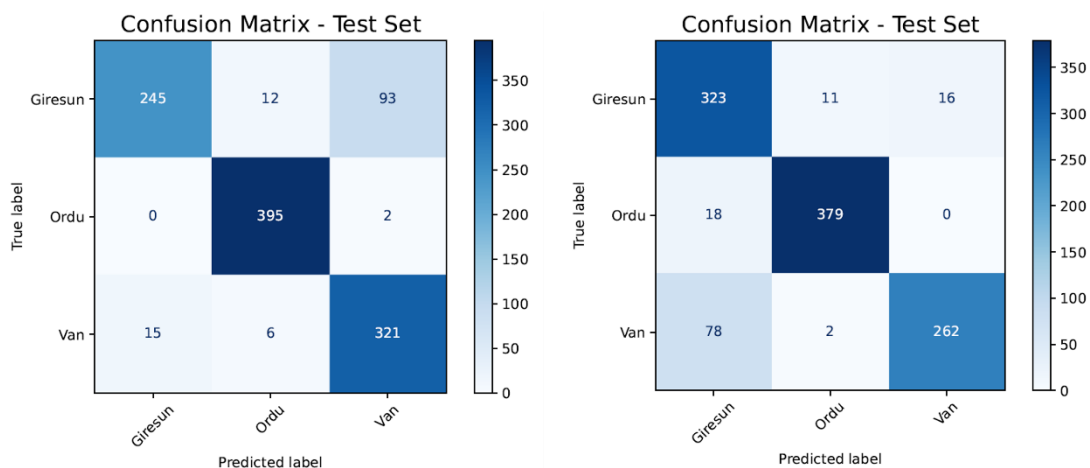


Fig. 2 Confusion matrices of classical model (left-side) Vs VQC (right-side) on test set.

References

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