Diagnosing Dysarthria by Leveraging Quantum Machine Learning

2025 Quantum Machine Learning REU Program

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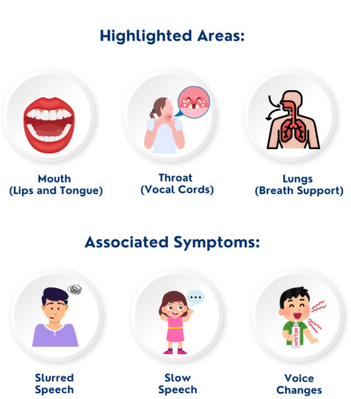
RESEARCH BACKGROUND/DESCRIPTION

- Dysarthria is a common speech disorder in Parkinson's Disease that affects speech [1].
- Current diagnostic methods are subjective and resource-intensive.
- Quantum Machine Learning (QML) offers advantages via quantum principles.



RESEARCH OBJECTIVES/PLAN

- Develop a QML-based pipeline to detect dysarthria.
- Extend the QML framework to other speech impairments.

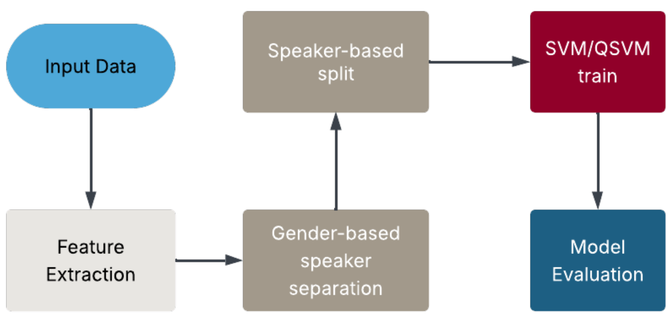


Figure 1 – Proposed *QML Pipeline.*

METHODS

- Extract features from speech segments.
- Perform gender-based speaker separation and split
- Train a nonlinear SVM and QSVM.
- Evaluate performance using confusion matrix and ROC curve.

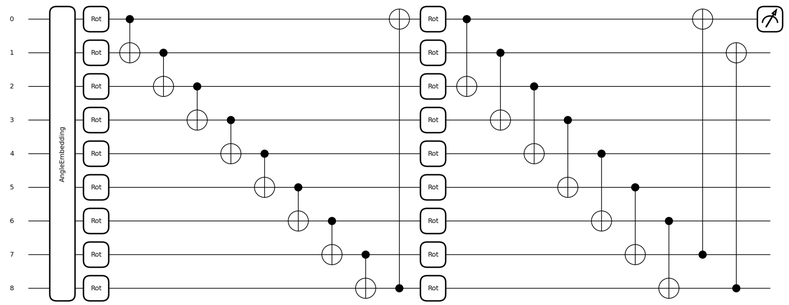


Figure 2 – *Quantum Circuit.*

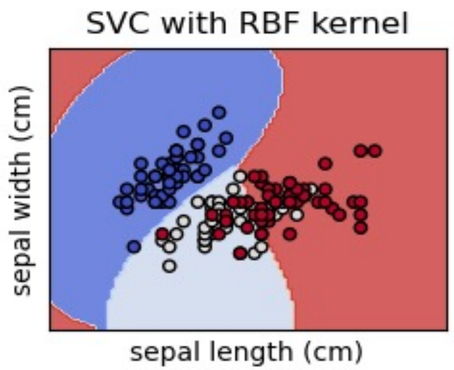


Figure 3 – *SVM visualization.*

REFERENCES

[1] C. Zhang, C. Gong, and Y. Sui, "Dysarthria Detection with Deep Representation Learning for Patients with Parkinson's Disease," in Proc. 46th IEEE Int. Conf. Engineering in Medicine and Biology Society (EMBC), 2024, pp. 1–4.
[2] E. Gibney, "IBM's quantum computer: A glimpse of the future," *Nature*, Nov. 2021. [Online]. Available:

EXPERIMENTAL RESULTS

- Initial classical model yields promising classification performance (ROC AUC ~0.73)
- Confusion matrix shows acceptable true positive and true negative rates on holdout speakers.

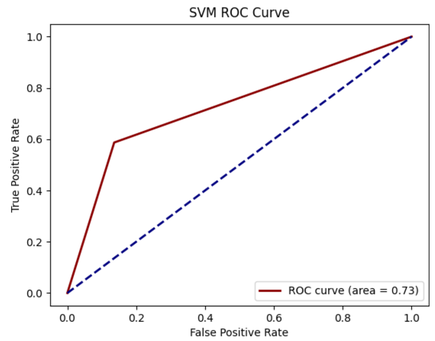


Figure 4 – ROC curve of proposed model.

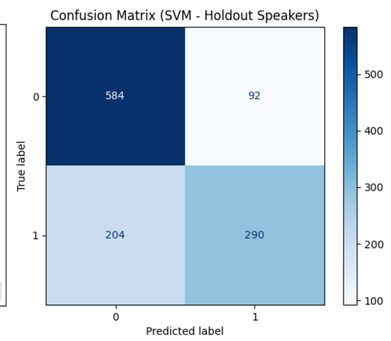


Figure 5 – Confusion Matrix of proposed model.

CONCLUSIONS

- QML has strong potential to enhance detection of dysarthria
- Initial classical results validate the pipeline
- The project lays groundwork for broader applications in speech diagnostics.

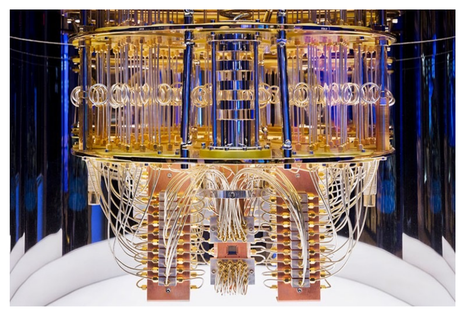


Image 1 – *Quantum Computer [2]*

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