# DETECTION OF LIVER DISEASES USING QUANTUM MACHINE LEARNING

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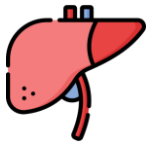
## Motivation

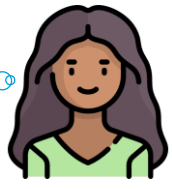
The **liver**, the body's largest gland, **supports vital functions** like nutrient processing, detoxification, and infection control. **Damage from viruses or toxins can lead to liver disease**, a serious and potentially **life-threatening condition**.



**Machine Learning (ML)** helps **detect liver disease** automatically **but struggles with imbalanced data and complex patterns**.

**SO...**

Why don't we use **Quantum Machine Learning (QML)**?



## Quantum Machine Learning

QML combines quantum computing with ML to **handle complex** and **imbalanced data**, providing alternative methods with potential computational benefits [1].

QML faces challenges: In the NISQ-era, **we aim to use as few qubits as possible** due to hardware limitations and noise.

**Hybrid classical-quantum models help overcome these limitations**

## Methodology

- Design of **hybrid QML** model with classical and quantum layers.
- Trained on classical **unbalanced Indian Liver Patient Dataset** (416 positive, 167 negative), **no class balanced applied**.
- Optimization via ***GridSearchCV*** (classical layers) and **manual tuning** (quantum layer).
- Trained using **Stratified 5-fold cross-validation**.

**Figure 1** shows our proposed model, labelled as **QML-L**.

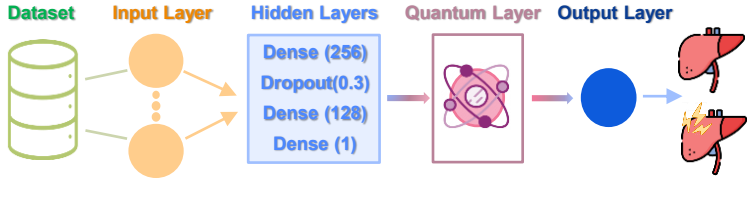
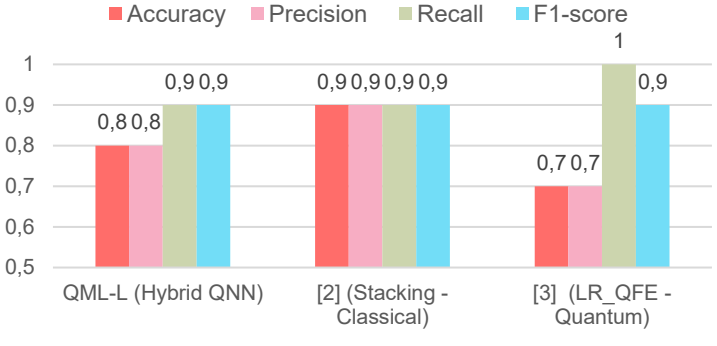



***Figure 1:*** *Proposed hybrid model QML-L.*

## Results

**Graph 1** compares the results of the proposed model with the best state-of-the-art classical and quantum models.




***Graph 1:*** *Proposed vs. classical and quantum models.*

**Table 1** indicates whether the models in Graph 1 used data balancing and shows the number of qubits and delay for the quantum models.

| Model | Balancing | Qubits | Delay |
|---|---|---|---|
| **QML-L** | **No** | **1** | **18** |
| [2] | Yes | N/A | N/A |
| [3] | No | 10 | 40 |

***Table 1:*** *Data balancing,qubit count, and delay for models in Graph 1.*

## Conclusions

The **QML-L** model achieves competitive results **without class balancing**, matching or exceeding state-of-the-art methods. Using only **one** qubit, it complies with NISQ-era limitations and shows strong potential for managing **imbalanced datasets**. These findings highlight the promise of quantum machine learning for real-world applications.

## References

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