Face Authentication Using Quantum Neural Networks

Title: Face Authentication Using Quantum Neural Networks

Theme: Quantum Computing

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Abstract:

In recent days, Biometric authentication has emerged as a widely adopted technology in the security field and user authentication. Biometrics makes measurement and analysis of people's unique characteristics. The unique nature of biometric data offers a secure and convenient way of providing security.

One of the evolving and convenient fields of biometrics is Facial Recognition. The main challenge in existing face recognition methods was that when an individual has some severe injury or some facial deformities, it potentially causes inaccuracies in the face authentication. Such inaccuracies can result in the misinterpretation of facial data, leading to incorrect prediction of the user's facial data and providing misinformation.

Our idea is to make a face recognition system using a quantum neural network that takes feedback every time from the verified user. So any changes in the user's face will be identified and again trained using the current image captured.

This makes a Classical-Quantum Hybrid approach for optimised use of quantum neural networks. Using PCA and ICA algorithms the datasets can be created and passed onto the quantum neural network for training the data. This approach makes use of the qubit more efficiently.

Problem Statement:

There are many sources using face recognition as a biometric authentication like prisons, hospitals, and airports border control. Here the problem may be that any injuries or deformities in the facial features may not be detected and later the face may not be recognised. This limitation may compromise the effectiveness of the authentication process and include the risk of unauthorised access, the effect on patient data in healthcare, etc. These challenges are crucial for maintaining the integrity of security measures. So our solution provides a continuous learning neural network algorithm to train the face datasets.

Introduction:

Quantum Face Authentication is a security software that uses biometric face authentication to more accurately improve the identification of facial features by continuous learning and feedback mechanism using quantum neural networks. The system ensures up-to-date and accurate identification.

This dynamic approach enhances the security and also optimises the user experience using the quantum neural network offering a seamless authentication for the user.

The Hybrid Quantum-Classical Approach of Quantum Neural Networks is to make minimal use of Qubits efficiently. The Classical Principal Component Analysis (PCA) and Independent Component Analysis (ICA) are used for feature extraction from the face image and data is sent to the neural network for training the dataset.

Existing Solution:

The Conventional face recognition system creates a 3D model of a face and implements refining algorithms to enhance the robustness of facial feature detection using many machine learning algorithms. These algorithms might be very complex and time-consuming.

However, despite these advancements, challenges remain in achieving a high degree of accuracy and adaptability in the presence of injuries or deformities. The complexity of facial anomalies requires a more innovative and adaptive approach.

So there is a very strong need for a quantum application with a quantum neural network to make use in the face authentication field that improves security.

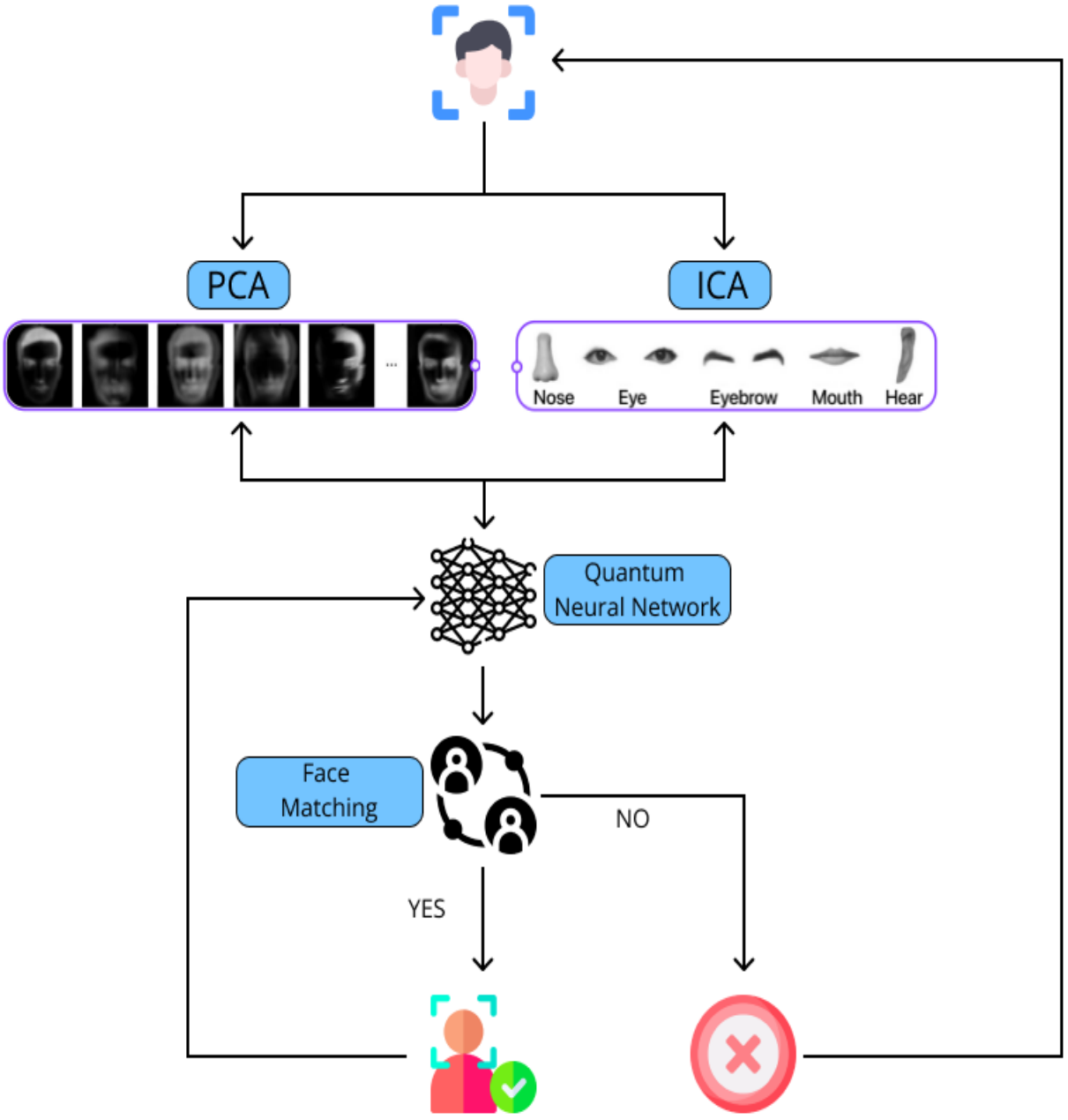
Solution:

- The objective of our project is to make a face authentication system using Quantum neural networks.
- The first step is to detect the face using classical Principal Component Analysis (PCA) and make use of Independent Component Analysis (ICA) for feature extraction.
- The second step is to train the model using a quantum neural network.

Now whenever the user authenticates for every successful login the feedback is sent to the neural network and the dataset is trained again.

By providing the hybrid approach in quantum machine learning qubits can be effectively used and make the quantum circuit more effective.

Architecture:



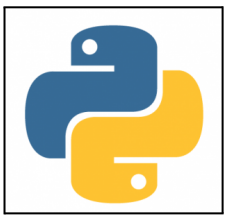
Process Flow:

1. The User makes a sign-up with his face
2. Using Classical Principal Component Analysis and Independent component analysis facial features are extracted.
3. The data is passed to the quantum neural network and model is been created and
4. Whenever the user is authenticated and verification is successful the model will take feedback and train with it.
5. If verification is not successful the model will not take feedback and starts scanning again.

Technical Stack:

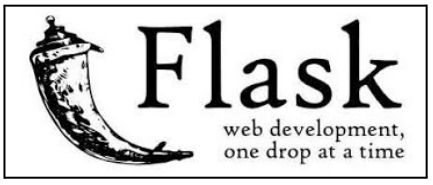
1. Python

Python is a versatile, high-level programming language widely used for various purposes. It offers an open-source module for interacting with quantum simulators.



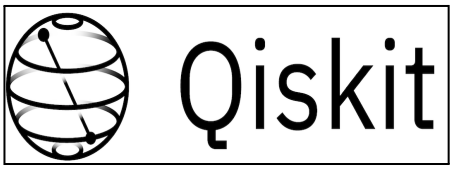
2. Flask

Flask is a web application development framework employed as a backend to retrieve data for facial recognition.



3. Qiskit

Qiskit, written in Python, serves as a library enabling the utilisation of IBM's quantum systems and hardware across diverse applications in quantum computing.



4. Numpy

Numpy, a Python library, delivers robust and flexible array computations, mathematical functions, and tools catering to multiple scientific domains. Its primary application lies in efficient array handling.

Expected Outcome:

The implementation of the Quantum Face Authentication system is expected to have improved accuracy and significantly less time in training the quantum neural network model. The feedback algorithm added to the neural network model will have a continuous learning of the person's face dataset that in turn shows an improved accuracy over regular changes in facial features.

References:

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  https://arxiv.org/abs/2303.05860
- Quantum Neural Networks for Face Recognition Classifier: https://www.sciencedirect.com/science/article/pii/S1877705811017450