



**Department of Electrical and Computer Engineering  
North South University**

## **Senior Design Project**

**Hybrid Approach in Quantum Generative Adversarial Network**

**Arabindo Das Himu      ID#1831592642**

**Supervised by:**

**Dr. Mahdy Rahman Chowdhury**

**Associate Professor**

**Department of Electrical and Computer Engineering**

**Spring, 2023**

# LETTER OF TRANSMITTAL

July, 2023

To

Dr. Rajesh Palit  
Chairman,  
Department of Electrical and Computer Engineering  
North South University, Dhaka

**Subject: Submission of Capstone Project Report on “Hybrid Approach in Quantum Generative Adversarial Network”**

Dear Sir,

With due respect, we would like to submit our **Capstone Project Report on “Hybrid Approach in Quantum Generative Adversarial Network”** as a part of our BSc program. The report deals with design of a Generative Adversarial Network based on combination of classical and quantum architecture. This project is very important in terms of showing the capabilities of machine learning in quantum computing combined with classical counterpart. I tried to the maximum competence to meet all the dimensions required from this report.

I will be highly obliged if you kindly receive this report and provide your valuable judgment. It would be our immense pleasure if you find this report useful and informative to have an apparent perspective on the issue.

Sincerely Yours,

.....  
Arabindo Das Himu  
ID#1831592642  
ECE Department  
North South University, Bangladesh

# APPROVAL

Arabindo Das Himu (ID #1831592642) from the Electrical and Computer Engineering Department of North South University, has worked on the Senior Design Project titled “Hybrid Approach in Quantum Generative Adversarial Network” under the supervision of Dr. Mahdy Rahman Chowdhury partial fulfillment of the requirement for the degree of Bachelors of Science in Engineering and has been accepted as satisfactory.

## Supervisor’s Signature

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**Dr. Mahdy Rahman Chowdhury**

Associate Professor

Department of Electrical and Computer Engineering

North South University

Dhaka, Bangladesh.

## Chairman’s Signature

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**Dr. Rajesh Palit**

**Professor**

Department of Electrical and Computer Engineering

North South University

Dhaka, Bangladesh.

# DECLARATION

This is to declare that this project is my original work. No part of this work has been submitted elsewhere partially or fully for the award of any other degree or diploma. All project related information will remain confidential and shall not be disclosed without the formal consent of the project supervisor. Relevant previous works presented in this report have been properly acknowledged and cited. The plagiarism policy, as stated by the supervisor, has been maintained.

Students' names & Signatures

**1. Arabindo Das Himu**

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## ACKNOWLEDGEMENTS

I would like to express their heartfelt gratitude towards my project and research supervisor, Dr. Mahdy Rahman Chowdhury, Associate Professor, Department of Electrical and Computer Engineering, North South University, Bangladesh, for his invaluable support, guidance and advice pertaining to the experiments, research and theoretical studies carried out during the course of the current project and also in the preparation of the current report.

I would also like to extend my gratitude to Syed Emad Uddin Shubha and Deponker Sarker Depto, research assistants of Dr. Mahdy Rahman Chowdhury, who helped me with the basics and provided invaluable support throughout this project.

Furthermore, I would like to thank the Department of Electrical and Computer Engineering, North South University, Bangladesh for facilitating the research. I would also like to thank my friends and their loved ones for their countless sacrifices and continual support.

# ABSTRACT

## **Hybrid Approach in Quantum Generative Adversarial Network**

This project explores the application of quantum computing techniques in the domain of generative adversarial networks (GANs) for image synthesis, specifically targeting the well-known MNIST dataset of handwritten digits. Leveraging TensorFlow Quantum (TFQ), this research delves into hybrid quantum-classical architectures, combining the power of quantum circuits with classical deep learning models. This project aims to demonstrate the potential of quantum GAN in generating synthetic images. This study's methodology includes data encoding, quantum circuit design, and classical optimization. The experimental results showcase the ability to generate fake samples. Compared with the classical counterpart, the project shows an improvement in generating samples over multiple epochs. But after running 100 epochs, the hybrid version that uses both quantum circuits and classical neural network shows a decreasing point in improvement compared to the classical counterpart that was able to improve over time without a decreasing point of improvement. While the current development on this project shows the capability of generating fake samples, further research is necessary to increase its performance and overcome the relative issues. And this tells us the potential usage of real-world applications that can be done with the capability of quantum computing on machine learning in generative tasks.