Muhammad Kashif (P.hD.)

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Education

01/2020–06/2023 **Ph.D. in Computer Science and Engineering**, Hamad Bin Khalifa University, Qatar
Major Courses: Learning From Data; Data Analytics; Advanced Deep Learning
Thesis: *Quantum Machine Learning on Noisy Intermediate-Scale Quantum Devices*
CGPA: 3.61/4.00

03/2018–12/2019 **M.Sc. in Electronics and Computer Engineering**, Istanbul Şehir University, Turkey
Major Courses: Embedded Systems Design; Machine Learning; Digital Circuit Design; Nano and Micro Electro-Mechanical Systems
Thesis: *A hardware-efficient elliptic curve accelerator for FPGA-based cryptographic applications*
CGPA: 3.71/4.00

02/2011–03/2015 **B.Sc. in Electrical (Electronics) Engineering**, COMSATS Institute of Information Technology, Abbottabad, Pakistan
Major Courses: Digital Logic Design; DSP; Electronics; Measurement & Instrumentation; Control; VLSI; Digital Systems; Industrial Electronics
FYP: *Design/Development of a Home Automation System using Raspberry Pi over Wi-Fi*

Awards and Honors

04/2025 **Best Researcher Award** at eBRAIN Lab, NYUAD (2024–2025)
01/2020 **Fully-funded scholarship** for Ph.D., Hamad Bin Khalifa University, Doha, Qatar
03/2018 **Fully-funded scholarship** for M.Sc., Istanbul Şehir University (TA/RA)
10/2017 **Outstanding Performance Award**, National Science Technology & Innovation Plan (KSA)

Professional Experience

08/2023–Present **Postdoctoral Research Associate/Research Team Lead**, New York University Abu Dhabi, UAE
Current Research and Responsibilities:

- **improving the trainability** of various **Quantum Neural Network** (QNNs) architectures including feedforward QNNs, Quantum Convolution and quanvolutional neural networks. The focus is mainly on mitigating challenges such as Barren Plateaus that leads to enhanced trainability
- **Analyzing and handling the quantum noise** in QML applications that involves (1) Investigating how quantum noise effects the training of different QNN models, (2) Harnessing quantum noise for effective training of QNNs
- **Addressing hardware limitations of NISQ devices**, particularly regarding qubit count constraints in executing deep QNNs. it typically involves exploring techniques that can allow us to execute large quantum circuits on NISQ (resource-constrained) devices
- Exploration and identification of areas where quantum computing can benefit machine learning and vice versa
- **Applications of quantum computing** in finance, including portfolio optimization, credit risk analysis and option pricing
- **Generative AI for Quantum**, which includes the development/fine-tuning of domain specific Large Language Models (LLMs) tailored for automated PennyLane (quantum programming library) code generation
- **Quantum and classical resource aware hybrid neural architecture search** where evolutionary search techniques are exploited to find best hybrid architectures that optimize both the performance and hardware cost
- **Supervising and mentoring undergraduate students** in quantum machine learning and quantum optimization algorithms.

03/2018–12/2019 **Research & Teaching Assistant**, Istanbul Şehir University, Turkey
Teaching: Undergrad labs; Physics problem sessions (60+ students).
Research:

- Design, development, implementation, optimization, and performance evaluation of efficient crypto processors based on elliptic curve cryptography
- High-level synthesis of that crypto processor using MATLAB
- Soft IP generation of optimized crypto processor and integration with Microblaze

02/2015–01/2018 **Research Engineer - Remote (3 projects)**, National Science, Technology & Innovation Plan (KSA)

(1) Model-based Design and Verification for Safety-Critical Embedded Systems

- The Objective was to develop a holistic model-based development methodology for embedded systems, where the system is designed at an abstract level and then automatically transformed to the low level
- *My Contribution* was the development of structural and behavioral models of various embedded systems in SysML like, Unmanned Aerial Vehicle (UAV), Intelligent Traffic Controller, Car Collision Avoidance System

(2) Hardware Implementation of Security Algorithms on FPGA

- Project Objective was to develop crypto-Processors which consume less hardware resources with high throughput. We focused on public Key Cryptography mainly Elliptic Curve Cryptography (ECC)
- *My Contribution* was hardware implementation of crypto processors and their optimization in terms of area and speed

(3) Temporal Verification of Real-Time Systems

- Project Objective was to reduce the computational cost of the temporal testing process by approximating the expensive simulation model with a cheaper-to-run prediction model. The temporal testing time is reduced by predicting the execution times rather than actually running the application program on the target hardware or its simulator
- *My Contribution* was to implement different sorting algorithms in C language, which are then feeded to the genetic algorithm in Matlab

Skills and Expertise

Systems Design & Languages
- SysML (System Modeling Language) for system design
- MARTE (Modeling and Analysis of Real-time Embedded Systems) for system analysis

Software
- C/C++ for simulation / functional validation of embedded systems
- Python For Machine Learning algorithms in Scikit-Learn, Keras
- **Pennylane** for Quantum Machine Learning
- **Qiskit** for Quantum Algorithms Development
- UML (Unified Modeling Language) for software design
- MATLAB for algorithm development

HDLs
- System Verilog for digital design and verification (assertion based verification)
- Verilog HDL for digital design

EDA Tools
- Vivado Design Suite for RTL synthesis and integration of customized IPs with soft IP cores like Microblaze
- Xilinx 10.1 for synthesis of RTL code
- Cadence for Analog and Digital Circuits Design

Student (co) Supervisions

Name & Affiliation	**Level / Year**	**Project**
Jesse Roberta Mingue Njiki *Université Libre de Bruxelles*	Masters (2024–25)	Noise Mitigation Techniques for Reliable Quantum Neural Networks
Tasnim Ahmed *New York University Abu Dhabi*	Undergraduate (2023–24)	A comparative analysis of noise and robustness evaluation in Quantum Neural Networks

International Presentations/Talks

Date	Type	Conference Title	Venue
Dec 2024	Research paper	IEEE International Conference on Rebooting Computing (ICRC)	San Diego, USA
June 2025	Research paper	ACM/IEEE Design Automation Conference (DAC)	San Francisco, USA
Sep 2025	Research paper	IEEE Quantum Week, Quantum Computing and Engineering Conference (QCE)	New Mexico, USA

Professional Services

Role	Journal Name	Conference Name	Publisher
Reviewer	Engineering Applications of Artificial Intelligence	–	Elsevier
Reviewer	Advanced Quantum Technologies	–	Wiley
Reviewer	Neurocomputing	–	Springer
Reviewer	SoftwareX	–	Elsevier
Reviewer	–	IEEE Quantum Week (QCE)	IEEE
Reviewer	–	IEEE International Joint Conference on Neural Networks (IJCNN)	IEEE

Publications

Journals

J1 **M. Kashif** and M. Shafique, "Deep quanvolutional neural networks with enhanced trainability and gradient propagation," *Nature Scientific Reports*, 2025, https://www.nature.com/articles/s41598-025-06035-4?

J2 T. Ahmed, **M. Kashif**, A. Marchisio, M. Shafique, "A comparative analysis and noise robustness evaluation in quantum neural networks," *Nature Scientific Reports*, 2025. https://www.nature.com/articles/s41598-025-17769-6

J3 **M. Kashif** and S. Al-Kuwari, "ResQNets: A Residual Approach for Mitigating Barren Plateaus in Quantum Neural Networks," *EPJ Quantum Technology* 11(4), 2024, https://doi.org/10.1140/epjqt/s40507-023-00216-8.

J4 **M. Kashif** and S. Al-Kuwari, "The impact of cost function globality and locality in hybrid quantum neural networks on NISQ devices," *Machine Learning: Science and Technology* 4(1), 2023, https://doi.org/10.1088/2632-2153/acb12f.

J5 **M. Kashif** and S. Al-Kuwari, "The unified effect of data encoding, ansatz expressibility and entanglement on the trainability of HQNNs," *International Journal of Parallel, Emergent and Distributed Systems* 38(5), 362–400, 2023, https://doi.org/10.1080/17445760.2023.2231163.

J6 **M. Kashif** and S. Al-Kuwari, "Physical Realization of Measurement Based Quantum Computation," *IEEE Access* 11, 90105–90130, 2023, https://doi.org/10.1109/ACCESS.2023.3289005.

J7 **M. Kashif** and I. Cicek, "Design space exploration of hybrid quantum–classical neural networks," *Electronics* 10(23), 2980, 2021.

J8 **M. Kashif** and I. Cicek, "FPGA hardware design and implementation of a new area-efficient elliptic curve crypto-processor," *Turkish Journal of Electrical Engineering and Computer Sciences* 29(4), 2021, https://doi.org/10.3906/elk-2008-8.

J9 M. Rashid, M. Imran, **M. Kashif**, A. Sajid, "An Optimized Architecture for Binary Huff Curves With Improved Security," *IEEE Access* 9, 88498–88511, 2021, https://doi.org/10.1109/ACCESS.2021.3090216.

J10 M. W. Anwar, M. Rashid, F. Azam, A. Naeem, **M. Kashif**, W. H. Butt, "A Unified Model-Based Framework for the Simplified Execution of Static and Dynamic Assertion-Based Verification," *IEEE Access* 8, 104407–104431, 2020, https://doi.org/10.1109/ACCESS.2020.2999544.

J11 M. Rashid, S. A. B. Shah, M. Arif, **M. Kashif**, "Determination of worst-case data using an adaptive surrogate model for real-time system," *Journal of Circuits, Systems and Computers* 29(01), 2050005, 2020.

J12 M. W. Anwar, M. Rashid, F. Azam, **M. Kashif**, W. H. Butt, "A model-driven framework for design and verification of embedded systems through SystemVerilog," *Design Automation for Embedded Systems* 23, 179–223, 2019.

J13 M. Imran, M. Rashid, A. R. Jafri, **M. Kashif**, "Throughput/area-optimized pipelined architecture for elliptic curve crypto processor," *IET Computers & Digital Techniques* 13(5), 361–368, 2019.

J14 M. W. Anwar, M. Rashid, F. Azam, **M. Kashif**, "Model-based design verification for embedded systems through SVOCL: an OCL extension for SystemVerilog," *Design Automation for Embedded Systems* 21, 1–36, 2017.

Conferences

C1 **M. Kashif**, A. Marchisio, M. Shafique, "Computational Advantage in Hybrid Quantum Neural Networks: Myth or Reality?", In 2025 62nd ACM/IEEE Design Automation Conference (DAC). https://ieeexplore.ieee.org/abstract/document/11132906

C2 **M. Kashif**, M. Shafique, "Position Paper: Quantum Neural Networks - A Paradigm Shift in AI or a Theoretical Promise?", 2025 International Joint Conference on Neural Networks (IJCNN), Rome, Italy, doi:10.1109/IJCNN64981.2025.11227994.

C3 **M. Kashif**, S. Khalid, A. Marchisio, N. Innan, M. Shafique, "FAQNAS: FLOPs-aware Hybrid Quantum Neural Architecture Search using Genetic Algorithm", ***Accepted*** at 2025 IEEE Design Automation and Test in Europe (DATE) Conference, Italy. https://arxiv.org/abs/2511.10062

C4 **M. Kashif**, M. Shafique, "HQNET: Harnessing Quantum Noise for Effective Training of Quantum Neural Networks in NISQ Era", ***Accepted*** at IEEE QAI, 2025. https://ieeexplore.ieee.org/document/11132906

C5 A. Marchisio, E. Sychiuco, **M. Kashif**, M. Shafique, "Cutting is All You Need: Execution of Large-Scale QNNs on Limited-Qubit Devices", ***Accepted*** at IEEE QAI, 2025. https://arxiv.org/abs/2412.04844

C6 A. Basit, M. Shao, H. Asif, N. Innan, **M. Kashif**, A. Marchisio, M. Shafique, "QHackBench: Benchmarking LLMs for Quantum Code Generation Using PennyLane Hackathon Challenges", ***Accepted*** at IEEE QAI, 2025. arXiv:2506.20008

C7 J. Kaldari, **M. Kashif**, S. Al-Kuwari, M. Shafique, "ResQGRNN: Quantum-Compatible Residual Learning for Graph RNNs", ***Accepted*** at IEEE QAI, 2025.

C8 A. Basit, M. Shao, M. H. Asif, N. Innan, **M. Kashif**, A. Marchisio, M. Shafique, "PennyCoder: Efficient Domain-Specific LLMs for PennyLane-Based Quantum Code Generation", ***Accepted*** at IEEE QCE, 2025. https://arxiv.org/abs/2507.19562

C9 N. Innan, **M. Kashif**, A. Marchisio, Y. S. Gan, F. Barbaresco, M. Shafique, "QUAV: Quantum-Assisted Path Planning and Optimization for UAV Navigation with Obstacle Avoidance", ***Accepted*** at IEEE QAI, 2025. https://arxiv.org/abs/2508.21361

C10 **M. Kashif**, S. Khalid, N. Innan, A. Marchisio, M. Shafique, "Evaluating Quantum Amplitude Estimation for Pricing Multi-Asset Basket Options", ***Accepted*** at IEEE QAI, 2025. https://arxiv.org/abs/2509.09432

C11 N. Innan, **M. Kashif**, A. Marchisio, M. Usman, M. Shafique, ***Accepted*** at 2025 Quantum Engineering Sciences & Technologies for Industry and Services (QUEST-IS), Paris France.

C12 A. Marchisio, M.U. Hafeez, N. Innan, M. Kashif, M. Shafique, Q-PORT: Quantum Portfolio Optimization with Resource-Efficient Encoding and Scalability Analysis, ***Accepted*** at 2025 Quantum Engineering Sciences & Technologies for Industry and Services (QUEST-IS), Paris France.

C13 **M. Kashif**, M. Rashid, S. Al-Kuwari, M. Shafique, "Alleviating Barren Plateaus... Parameter Initialization Strategies," *DATE*, Valencia, 2024, https://doi.org/10.23919/DATE58400.2024.10546644

C14 **M. Kashif**, E. Sychiuco, M. Shafique, "Investigating the Effect of Noise... HQNNs", *IJCNN*, 2024, https://doi.org/10.1109/IJCNN60899.2024.10651363

C15 **M. Kashif**, M. Shafique, "NRQNN: The Role of Observable Selection in Noise-Resilient QNNs", *CSCE 2024*, CCIS 2257, Springer, https://doi.org/10.1007/978-3-031-85884-0_10

C16 K. Zaman, T. Ahmed, **M. Kashif**, M. A. Hanif, A. Marchisio, M. Shafique, "Impact of Quantum-Specific Hyperparameters on HQCNNs", *CSCE 2024*, CCIS 2257, Springer.

C17 **M. Kashif**, M. Shafique, "Random Parameter Initialization and Barren Plateaus in VQAs", *ICRC*, San Diego, 2024, https://doi.org/10.1109/ICRC64395.2024.10937003

C18 K. Zaman, A. Marchisio, **M. Kashif**, M. Shafique, "PO-QA: Portfolio Optimization using Quantum Algorithms", *IEEE QCE*, 2024, https://doi.org/10.1109/QCE60285.2024.00166

C19 **M. Kashif**, S. Al-Kuwari, "Demonstrating Quantum Advantage in HQNNs for Model Capacity," *ICRC*, San Francisco, 2022, https://doi.org/10.1109/ICRC57508.2022.00011

C20 **M. Kashif**, S. Al-Kuwari, "Qiskit as a Simulation Platform for Measurement-Based Quantum Computation," *ICSA-C*, Honolulu, 2022, https://doi.org/10.1109/ICSA-C54293.2022.00037

C21 M. Imran, **M. Kashif**, M. Rashid, "Scalar multiplication in ECC over GF(2^{163}) on FPGA," *ICICT*, Karachi, 2015, https://doi.org/10.1109/ICICT.2015.7469484

C22 M. Zahoor, F. Azam, M. W. Anwar, N. Yousaf, **M. Kashif**, "UML profile for service discovery in ECB," *CISIS 2019*, Springer.

C23 **M. Kashif**, I. Cicek, M. Imran, "A Hardware Efficient Elliptic Curve Accelerator...," *ELECO*, Bursa, 2019, https://doi.org/10.23919/ELECO47770.2019.8990437

C24 M. Rashid, M. W. Anwar, F. Azam, **M. Kashif**, "Expressing SystemVerilog assertions in MBSE," *ICISA 2016*, Springer.

C25 M. Rashid, M. W. Anwar, F. Azam, **M. Kashif**, "Model-based requirements and properties specifications...," *SoSE*, Kongsberg, 2016, https://doi.org/10.1109/SYSOSE.2016.7542917

ArXiv

A1 H. Asif, A. Basit, N. Innan, **M. Kashif**, A. Marchisio, M. Shafique, "PennyLang: Pioneering LLM-Based Quantum Code Generation with a Novel PennyLane-Centric Dataset," https://arxiv.org/abs/2503.02497

References Available upon request.