# Muhammad Kashif, Ph.D.

Postdoctoral Research Associate (Center for Quantum and Topological Systems) and Research Team Lead (eBRAIN Lab), New York University (NYU) Abu Dhabi , United Arab Emirates

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## Career Highlights

- 2.5+ years of postdoctoral research experience in quantum machine learning and quantum algorithms
- Extensive experience in collaborative, externally funded research projects
- Publications in leading journals and top-tier conferences, including DAC, DATE, QCE, QAI, IJCNN etc
- Recipient of multiple research awards during postdoctoral tenure and other funded research projects
- Eexperience in mentoring and supervising undergraduate and graduate research projects

## Current Research Summary & Interests

I am a postdoctoral researcher specializing in hardware-aware quantum machine learning, focusing on bridging the gap between theoretical quantum models and their practical deployment on NISQ devices. My work spans variational quantum algorithms, hybrid quantum–classical architectures, and system-level optimization, with an emphasis on expressibility–trainability trade-offs, noise resilience, and resource-efficient design. I develop methodologies for co-designing quantum/QML algorithms and hardware-aware implementations. My long-term goal is to enable scalable, reliable, and application-driven quantum machine learning systems.

## Professional Experience

**Postdoctoral Research Associate, New York University Abu Dhabi (UAE)** Aug 2023–Present

- Leading research on hardware-aware QML and noise-resilient training of quantum neural networks (QNNs)
- Developed resource-aware neural architecture search frameworks optimizing accuracy–hardware cost trade-offs
- Conducted system-level analysis of quantum circuits including noise, connectivity, and compilation effects
- Developed analytical and hardware-calibrated quantum resource cost models
- Lead research on trainability enhancement for QNNs (barren plateau mitigation) across feedforward, quantum convolutional and Graph Recurrent QNN architectures
- Developing generative AI approaches for quantum code generation using domain-specific Large Language Models
- Benchmarking QML models for applications, such as finance, classification, Healthcare
- Investigating quantum algorithms (QAOA, VQE etc) for different real world applications (Path planning, Unit commitment, Robot Navigation etc)
- Supervising graduate and undergraduate research projects

**Research & Teaching Assistant, Istanbul Şehir University (Turkey)** Mar 2018–Dec 2019

- *Teaching:* Conducted undergraduate lab sessions and physics problem solving sessions (60+ students)
- *Research:* FPGA-based cryptographic accelerators (ECC) — design, optimization, and evaluation

**Research Engineer (Remote), Collaborative Projects, NSTIP (Saudi Arabia)** Feb 2015–Aug 2017

1. *Model-based design and verification of safety-critical embedded systems (SysML/MARTE):* The project 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, Intelligent Traffic Controller, Car Collision Avoidance System
2. *Hardware implementation and optimization of FPGA-based security algorithms:* The objective was to develop ECC-based crypto-processors with less hardware resources and high throughput. ***My Contribution*** was hardware implementation of crypto processors and their optimization in terms of area and speed
3. *Temporal Verification of Real-Time Systems:* The project objective was to reduce the computational cost of the temporal testing process where temporal testing time is reduced by predicting the execution times rather than actually running the application program. ***My Contribution*** was to implement different sorting algorithms in C language, which were then feeded to the genetic algorithm in Matlab

## Education

**Ph.D., Computer Science and Engineering, Hamad Bin Khalifa University (Qatar)** 2020–2023
Thesis: *Quantum Machine Learning on Noisy Intermediate-Scale Quantum Devices*

**M.Sc., Electronics and Computer Engineering, Istanbul Şehir University (Turkey)** 2018–2019
Thesis: *A hardware-efficient elliptic curve accelerator for FPGA-based cryptographic applications*

**B.Sc., Electrical (Electronics) Engineering, COMSATS (Pakistan)** 2011–2015
FYP: *Home Automation System using Raspberry Pi over Wi-Fi*

## Teaching and Student Supervision

- Teaching and mentoring experience in different universities, including Istanbul Şehir University Turkey and New York University Abu Dhabi, UAE
- Undergraduate and graduate education, including lab and problem solving sessions, and hands-on workshops
- *M.Sc. Thesis Co-Supervision:* Noise Mitigation Techniques for Reliable Quantum Neural Networks, Université Libre de Bruxelles (2024–2025)
- *B.Sc. Thesis co-Supervision:* Comparative Analysis of Noise and Robustness Evaluation in Quantum Neural Networks, New York University Abu Dhabi (2023–2024)
- Mentor, NYUAD Quantum Hackathon for Social Good (2024,2025,2026) (Link to List of mentors)
- Mentor, Quantum Computing Hackathon Pakistan (2026, 2nd Runner-Up) (Webpage Link)
- My work as research engineer at NSTIP lead to a new course development on Model based Systems Engineering, where I prepared tutorials and case studies.

## Teaching Interests

Quantum Computing, Quantum Machine Learning, Machine Learning / AI, Optimization and Algorithms, Digital Systems Design, VLSI, Digital Logic Design, Microprocessors among other introductory courses in Computer Science and Engineering

## Awards

- Best Researcher Award, eBRAIN Lab, NYUAD, UAE (2024–2025)
- Fully-funded Ph.D. scholarship, Hamad Bin Khalifa University, Qatar (2020–2023)
- Fully-funded M.Sc. scholarship (TA/RA), Istanbul Şehir University, Turkey (2018–2019)
- Outstanding Performance Award, NSTIP, Saudi Arabia (2015–2017)
- First Prize in QInnovision World Challenge by Thales at Quantum Innovision Summit 2025, Dubai, UAE (Challenge Link)

## Professional Service and Leadership

- Reviewer: Advanced Quantum Technologies (Wiley), Engineering Applications of Artificial Intelligence (Elsevier), Computers & Electrical Engineering (Elsevier), Neurocomputing (Springer), SoftwareX (Elsevier), IEEE Quantum Week (QCE), IJCNN.
- TPC Member: 2026 IEEE International Workshop on Quantum Computing: Circuits, Systems, Automation, and Applications (QC-CSAA) Co-located with ISVLSI 2026.
- Co-organized special sessions and workshops at leading conferences, including IEEE IJCNN and IEEE Quantum Week (QCE).
- Co-organized "*Quantum Federated Learning for Fraud Detection*" challenge in Quantum Innovation summit 2025, Dubai, UAE (Challenge Link)

## Invited Talks and Conference Presentations

- ACM/IEEE Design Automation Conference (DAC), San Francisco, USA (June 2025)
- IEEE Quantum Week (QCE), New Mexico, USA (Sep 2025)
- IEEE International Conference on Rebooting Computing (ICRC), San Diego, USA (Dec 2024)

## Technical Skills

- **Quantum & QML:** PennyLane, Qiskit, IBM Quantum backends, hybrid QNNs, noise modeling, robustness, trainability/barren plateaus, expressibility analysis
- **ML & Software:** Python, NumPy/SciPy, scikit-learn, Keras/TensorFlow; benchmarking;
- **Optimization:** Resource-aware NAS, analytical/hardware-calibrated cost modeling, circuit depth/two-qubit gate minimization
- **Additional Skills:** C/C++, MATLAB; Verilog/VHDL; FPGA/Vivado

## Journal Publications

J15 **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?

J14 T Ahmed, **M Kashif**, A Marchisio, M Shafique, Quantum Neural Networks: "A Comparative Analysis and Noise Robustness Evaluation", ***Nature Scientific Reports***, 2025. https://arxiv.org/abs/2501.14412

J13 **M. Kashif** and S. Al-Kuwari, "ResQNets: A Residual Approach for Mitigating Barren Plateaus in Quantum Neural Networks", ***EPJ Quantum Technology***, 2024. https://doi.org/10.1140/epjqt/s40507-023-00216-8.

J12 **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***, 2023. 10.1088/2632-2153/acb12f.

J11 **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***. 10.1080/17445760.2023.2231163

J10 **M. Kashif** and S. Al-Kuwari, "Physical Realization of Measurement Based Quantum Computation," ***IEEE Access***, 2023. 10.1109/ACCESS.2023.3289005.

J9 **M. Kashif** and I. Cicek, "Design space exploration of hybrid quantum–classical neural networks," ***Electronics***, 2021. https://www.mdpi.com/2079-9292/10/23/2980

J8 **M. Kashif** and I. Cicek, "Field-programmable gate array (FPGA) hardware design and implementation ofa new area efficient elliptic curve crypto-processor," ***Turkish Journal of Electrical Engineering and Computer Sciences***, 2022. https://doi.org/10.3906/elk-2008-8

J7 M. Rashid, M. Imran, **M. Kashif** and A. Sajid, "An Optimized Architecture for Binary Huff Curves With Improved Security," ***IEEE Access***, 2021. 10.1109/ACCESS.2021.3090216.

J6 M. W. Anwar, M. Rashid, F. Azam, A. Naeem, **M. Kashif** and W. H. Butt, "A Unified Model-Based Framework for the Simplified Execution of Static and Dynamic Assertion-Based Verification," ***IEEE Access***. 10.1109/ACCESS.2020.2999544.

J5 M. Rashid, S. A. B. Shah, M. Arif, and **M. Kashif**. "Determination of worst-case data using an adaptive surrogate model for real-time system," ***Journal of Circuits, Systems and Computers***, 2020. doi.org/10.1142/S021812662050005X

J4 M. Waseem Anwar, M. Rashid, F. Azam, **M. Kashif**, and W. H. Butt. "A model-driven framework for design and verification of embedded systems through SystemVerilog," ***Design Automation for Embedded Systems***, 2019. doi.org/10.1007/s10617-019-09229-y

J3 M. Imran, M. Rashid, A.R. Jafri, and **M. Kashif**. "Throughput/area optimised pipelined architecture for elliptic curve crypto processor," ***IET Computers & Digital Techniques***, 2019. doi.org/10.1049/iet-cdt.2018.5056

J2 M. Waseem Anwar, M. Rashid, F. Azam, and **M. Kashif**. "Model-based design verification for embedded systems through SVOCL: an OCL extension for SystemVerilog," ***Design Automation for Embedded Systems***, 2017. doi.org/10.1007/s10617-017-9182-z

J1 R. Ahmad, **M. Kashif**, N. Innan, M. Shafique, "Quantum vs. Classical Machine Learning: A Benchmark Study for Financial Prediction", ***Under Review*** in ***Quantum Machine Intelligence***, 2025. arXiv:2601.03802

## Conference Publications

C34 **M. Kashif**, A. Marchisio, M Shafique, "Closing the loop: Resource-aware Hybrid NAS Guided by Analytical and Hardware-Calibrated Quantum Cost Modeling ", ***Accepted*** in IEEE/ACM Design Automation Conference ***(DAC)***, Long Beach, CA, USA, July 2026. arXiv:2603.00625

C33 **M. Kashif**, M Shafique, "Late Breaking Results: Hardware-Aware Compilation Reshapes Trainability in Variational Quantum Circuits", ***Accepted*** in IEEE/ACM Design Automation Conference ***(DAC)***, Long Beach, CA, USA, July 2026. arxiv.org/abs/2604.16527

C32 **M. Kashif**, *et.al.,* "FAQNAS: FLOPs-aware Hybrid Quantum Neural Architecture Search using Genetic Algorithm", ***Accepted*** in IEEE Design Automation and Test in Europe ***(DATE)***, Verona Italy, April 2026. https://arxiv.org/abs/2511.10062

C31 **M. Kashif**, *et.al.,* "Design Space Exploration of Hybrid Quantum Neural Networks for Chronic Kidney Disease", ***Accepted*** in 2026, IEEE International Joint Conference on Neural Networks ***(IJCNN)***, Maastricht, the Netherlands, June 2026. https://arxiv.org/abs/2604.13608

C30 T. Ahmed, A. Marchisio, **M. Kashif**, *et.al.,* "GAT-QNN: Genetic Algorithm-Based Training of Hybrid Quantum Neural Networks", ***Accepted*** in 2026, IEEE International Joint Conference on Neural Networks ***(IJCNN)***, Maastricht, the Netherlands, June 2026. https://arxiv.org/abs/2604.15048

C29 A Basit, H Asif, N Innan, M Shao, **M Kashif**, A Marchisio, M Shafique, "A PennyLane-Centric Dataset to Enhance LLM-based Quantum Code Generation using RAG", **Accepted** to ***IJCNN***. https://arxiv.org/abs/2503.02497

C28 **M. Kashif**, A. Marchisio, M. Shafique, "Computational Advantage in Hybrid Quantum Neural Networks: Myth or Reality?," IEEE/ACM Design Automation Conference, ***(DAC)***, San Francisco, USA, June 2025. https://doi.org/10.1109/DAC63849.2025.11132906

C27 **M. Kashif** and M. Shafique, "Hqnet: Harnessing quantum noise for effective training of quantum neural networks in nisq era", IEEE International Conference on Quantum Artifical Intelligence, ***(QAI)***, 2025. https://doi.org/10.1109/QAI63978.2025.00066

C26 **M. Kashif** and M. Shafique, "Position Paper: Quantum Neural Networks-A Paradigm Shift in AI or a Theoretical Promise?", IEEE International Joint Conference on Neural Networks, ***(IJCNN)***, 2025. https://doi.org/10.1109/IJCNN64981.2025.11227994

C25 **M Kashif**, S Khalid, N Innan, A Marchisio, M Shafique, "Evaluating Quantum Amplitude Estimation for Pricing Multi-Asset Basket Options", IEEE International Conference on Quantum Artificial Intelligence (***QAI***), 2025. https://doi.org/10.1109/QAI63978.2025.00076

C24 **M. Kashif**, **et.al.,**, "Alleviating barren plateaus in parameterized quantum ML circuits: Investigating advanced parameter initialization strategies," IEEE Design Automation and Test in Europe, ***(DATE)***, Valencia, Spain March 2024. https://doi.org/10.23919/DATE58400.2024.10546644

C23 **M. Kashif** and M. Shafique, "The dilemma of random parameter initialization and barren plateaus in variational quantum algorithms", IEEE International Conference on Rebooting Computing, ***(ICRC)***, 2024. https://doi.org/10.1109/ICRC64395.2024.10937003

C22 **M. Kashif**, E. Sychuico, M. Shafique, "Investigating the Effect of Noise on the Training Performance of Hybrid Quantum Neural Networks", IEEE International Joint Conference on Neural Networks ***(IJCNN)***, 2024. https://doi.org/10.1109/IJCNN60899.2024.10651363

C21 **M. Kashif** and M. Shafique, "NRQNN: The Role of Observable Selection in Noise-Resilient Quantum Neural Networks", In: Grid, Cloud, and Cluster Computing; Quantum Technologies; and Modeling, Simulation and Visualization Methods. CSCE 2024. Communications in Computer and Information Science, vol 2257. Springer. https://doi.org/10.1007/978-3-031-85884-0_10.

C20 **M. Kashif** and S. Al-Kuwari,"Demonstrating Quantum Advantage in Hybrid Quantum Neural Networks for Model Capacity", IEEE International Conference on Rebooting Computing (***ICRC***), San Francisco, CA, USA, 2022, pp. 36-44, https://doi.org/10.1109/ICRC57508.2022.00011.

C19 **M. Kashif** and S. Al-Kuwari, "Qiskit As a Simulation Platform for Measurement-based Quantum Computation," 2022 IEEE 19th International Conference on Software Architecture Companion (***ICSA-C***), Honolulu, HI, USA, 2022, pp. 152-159, https://doi.org/10.1109/ICSA-C54293.2022.00037.

C18 **M. Kashif**, I. Cicek and M. Imran, "A Hardware Efficient Elliptic Curve Accelerator for FPGA Based Cryptographic Applications," 2019 11th International Conference on Electrical and Electronics Engineering (***ELECO***), Bursa, Turkey, 2019, pp. 362-366, https://doi.org/10.23919/ELECO47770.2019.8990437.

C17 J. Kaldari, **M. Kashif**, S.Al-Kuwari, M. Shafique, "ResQGRNN: Quantum-Compatible Residual Learning for Graph Recurrent Neural Networks", IEEE International Conference on Quantum Artificial Intelligence (***QAI***), 2025. https://doi.org/10.1109/QAI63978.2025.00026.

C16 N. Innan, **M Kashif**, A Marchisio, YS Gan, F Barbaresco, M Shafique, "QUAV: Quantum-Assisted Path Planning and Optimization for UAV Navigation with Obstacle Avoidance", IEEE International Conference on Quantum Artificial Intelligence (***QAI***), 2025. https://doi.org/10.1109/QAI63978.2025.00040.

C15 N. Innan, **M.Kashif**, **et.al.,** "Next-generation quantum neural networks: Enhancing efficiency, security, and privacy", 2025 IEEE 31st International Symposium on On-Line Testing and Robust System Design (IOLTS), https://ieeexplore.ieee.org/abstract/document/11116981

C14 A. Marchisio, E. Sychiuco, **M. Kashif**, M. Shafique "Cutting is All You Need: Execution of Large-Scale Quantum Neural Networks on Limited-Qubit Devices", IEEE International Conference on Quantum Artificial Intelligence (***QAI***) , 2025. https://doi.org/10.1109/QAI63978.2025.00058.

C13 T. Ahmed, A. Marchisio, **M. Kashif**, M. Shafique, "Noisy hqnns: A comprehensive analysis of noise robustness in hybrid quantum neural networks", IEEE International Joint Conference on Neural Networks (***IJCNN***), 2025. https://doi.org/10.1109/IJCNN64981.2025.11229153

C12 A Basit, M Shao, H Asif, N Innan, **M Kashif**, **et.al.,**, "QHackBench: Benchmarking Large Language Models for Quantum Code Generation Using PennyLane Hackathon Challenges", IEEE International Conference on Quantum Artificial Intelligence (***QAI***), 2025. https://doi.org/10.1109/QAI63978.2025.00056.

C11 A Basit, M Shao, MH Asif, N Innan, **M Kashif**, **et.al.,**, "PennyCoder: Efficient Domain-Specific LLMs for PennyLane-Based Quantum Code Generation", IEEE Conference on Quantum Computing and Engineering (***QCE***), 2025. https://doi.org/10.1109/QCE65121.2025.10324.

C10 N. Innan, **M. Kashif**, **et.al.,**, Quantum Amplitude Estimation in Practice: A Case Study in Option Pricing. International Conference on Quantum Engineering Sciences and Technologies for Industry and Services. (***QUEST-IS***) 2025. https://doi.org/10.1007/978-3-032-13852-1_35

C9 A. Marchisio, M.U. Hafeez, N. Innan, **M. Kashif**, Shafique, M, "Q-PORT: Quantum Portfolio Optimization with Resource-Efficient Encoding and Scalability Analysis", International Conference on Quantum Engineering Sciences and Technologies for Industry and Services. (***QUEST-IS***) 2025. https://doi.org/10.1007/978-3-032-13852-1_34

C8 K. Zaman, T. Ahmed, **M. Kashif**, **et.al.,**, "Studying the Impact of Quantum-Specific Hyperparameters on Hybrid Quantum-Classical Neural Networks", In: Grid, Cloud, and Cluster Computing; Quantum Technologies; and Modeling, Simulation and Visualization Methods. CSCE 2024. Communications in Computer and Information Science, vol 2257. Springer. https://doi.org/10.1007/978-3-031-85884-0_11

C7 K. Zaman, A. Marchisio, **M Kashif**, M Shafique, "PO-QA: A Framework for Portfolio Optimization using Quantum Algorithms", **IEEE Quantum Week**, Quantum Computing and Engineering (***QCE***), 2024, https://doi.org/10.1109/QCE60285.2024.00166

C6 M. Imran, **M. Kashif**, M. Rashid, "Hardware design and implementation of scalar multiplication in elliptic curve cryptography (ECC) over GF(2163) on FPGA," 2015 International Conference on Information and Communication Technologies (***ICICT***), Karachi, Pakistan, 2015, https://doi.org/10.1109/ICICT.2015.7469484.

C5 M. Zahoor, F. Azam, M. Waseem Anwar, N. Yousaf, and **M. Kashif**. "A UML profile for the service discovery in the Enterprise Cloud Bus (ECB) framework." In Complex, Intelligent, and Software Intensive Systems: Proceedings of the 13th International Conference on Complex, Intelligent, and Software Intensive Systems (***CISIS***), Springer International Publishing, 2020. https://doi.org/10.1007/978-3-030-22354-0_25

C4 M. Rashid, M. Waseem Anwar, F. Azam, and **M. Kashif**. "Exploring the platform for expressing SystemVerilog assertions in model based system engineering." In Information Science and Applications (ICISA) 201, Springer 2016.

C3 M. Rashid, M. W. Anwar, F. Azam and **M. Kashif**, "Model-based requirements and properties specifications trends for early design verification of embedded systems," 2016 11th System of Systems Engineering Conference (***SoSE***), Kongsberg, Norway, 2016. 10.1109/SYSOSE.2016.7542917.

C2 M. Attallah, N. Innan, **M.Kashif**, M. Shafique, "Investigating Different Barren Plateaus Mitigation Strategies in Variational Quantum Eigensolver", **Submitted** to **IEEE Quantum week Quantum Computing and Engineering Conference**. arXiv:2512.11171

C1 J. Njiki, . Innan, A. Marchisio, **M. Kashif**, *et.al.,* "Robustness Evaluation of Hybrid Quantum Neural Networks under Noise Models via System-Level Error Mitigation", ***Submitted***, . https://arxiv.org/abs/2604.17515

***Full list:*** *Google Scholar*

## References

Available on request