

Hirmay Sandesara

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EXPERIENCE

- **Ahmedabad University** Ahmedabad, India
Research Assistant Sep 2023 - Present
 - Developed a **multi-dimensional framework** for **nonlinear optimal control** problems under the mentorship of Dr. Alok Shukla and Dr. Prakash Vedula, addressing challenges through canonical quantization and constraint Hamiltonian derivation.
 - Designed and implemented a customized **Variational Quantum Algorithm (VQA)** for non-Hermitian systems, specifically broken-PT symmetric systems, overcoming limitations of conventional approaches and exploring intricate mechanisms.
 - Implemented mathematical formulations and coding framework for the modified VQA, utilizing Python libraries such as PennyLane, Qibo, and SciPy, along with Mathematica for generalizing functions and optimizing solver methods. Anticipating pre-print publication soon.
- **Mentee** Remote
Qiskit Advocates Mentorship Program Apr 2023 - Present
 - Developed a **Quantum Reinforcement Learning (QRL)** framework, specifically implementing the Proximal Policy Optimization (PPO) algorithm within an environment created using QuTech's 'qgym' package, to address the evolution of **complex quantum open systems**. Mentored by IBM Researchers Abhijit Mitra and Dr. Vaibhav Kumar.
 - The framework addresses three key challenges: approximating non-Hermitian systems into unitary operators, ensuring generality by training the agent to handle a diverse range of open-quantum systems, and designing a smart reward policy to simultaneously enhance accuracy and reduce depth.
- **Ahmedabad University** Ahmedabad, India
Teaching Assistant Jan 2023 - May 2023
Courses: Computer Networks and Advanced Statistics
Responsibilities:
 - * Conducted tutorials and supervised labs.
 - * Was a **substitute instructor** for three weeks where I taught topics regarding Inter-networking, End-to-End Protocols, Controlled Experiments, Correlation and Regression, Chance Variability, and Sampling.
 - * Provided guidance and support to **more than 190 students** in their learning.*Achievement:*
 - * Received a [Dean's letter of appreciation](#) for exceptional dedication and contributions to teaching.
- **Artificial Brain** Remote
Quantum Computing Intern Jul 2022 - Dec 2022
 - Developed and co-authored a white paper titled "[Space Sustainability using Quantum Computing](#)," focusing on leveraging quantum computing techniques such as **QAOA algorithms**, quantum annealing, and optimization methods to address challenges related to space debris.
 - Additionally, contributed to the formulation of a **quantum scheduling algorithm** for Earth Observation Satellites and collaborated in the development of [a quantum optimization algorithm](#) aimed at maximizing the Sharpe ratio for portfolio management on D-Wave systems.
- **Mentor** Remote
IBM Quantum Challenge Fall 2022 Nov 2022
 - Assisted participants with tasks and ensured their comprehension of relevant topics.

EDUCATION

- **Ahmedabad University** Ahmedabad, India
Bachelor of Technology in Computer Science and Engineering; GPA: 3.73/4 Jul 2019 - May 2023
[Rank: 2/140](#)
Dean's Recognition List Awardee, *Graduated with certificate of highest excellence*
- **Qiskit Global Summer School** Remote
Score: 100 per cent 2020, 2022
 - Attended the two-week intensive program on two occasions, with a focus on quantum computing and an emphasis on quantum simulation, especially in quantum chemistry applications, aimed at empowering future quantum researchers and developers.

ACHIEVEMENTS

- [QHack Open Hackathon 2024](#)
 - Won [third prize](#) in Seeing the Future Challenge.
 - Won AWS' "Top 3 Prize" and will receive mentorship opportunity with Michael Brett, Global Lead for Quantum Technologies Business Development at AWS.
- Winner, QRISE 2024's Classiq Challenge
- [IBM Certified Associate Developer - Quantum Computation using Qiskit v0.2X.](#)
- [Qiskit Advocate](#)
- Dean's Recognition Certificate (2020-21 and 2021-22): Awarded for outstanding academic performance.
- IBM Quantum Challenge [2020](#) and [2021](#) by successfully completing all challenges and earning Advanced badges.
- Qiskit Challenge India: Demonstrated proficiency by achieving perfect scores in all challenges.

SELECTED PROJECTS

- ['NISQ algorithm for simulating open-quantum systems'](#) Team - 4, Mar 24
QHack Open Hackathon 2024 *Remote*
 - I led the team "Quantum.Questers" in developing a Python-based framework for simulating open-quantum systems, specifically tailored for Noisy Intermediate-Scale Quantum (NISQ) devices. Implemented shallow-depth Parameterized Quantum Circuits (PQCs) inspired by Universal Quantum Algorithms to address the absence of existing VQA frameworks for specialized problems.
 - We introduced enhancements to increase robustness and usability, with a focus on implementing PQCs with low depth for initial state preparation and time evolution. Conducted extensive testing of the state preparation method using both arbitrary and real-world Alzheimer's data through parallelized optimization computations, leveraging NVIDIA's CuQuantum library, and exploring the effectiveness of cat qubits ("EMU:15Q:LOGICAL_EARLY").
- ['Implementation of the Zero Noise Extrapolation method'](#) Individual, Apr 24
QOSF Screening Task *Remote*
 - Implemented Zero Noise Extrapolation (ZNE) which is a popular quantum error mitigation technique, as part of a screening task for the Quantum Open Source Mentorship program.
 - Developed 'DepolarizingNoiseModel' class and functions in Python for scaling noise levels and applying unitary folding to Qiskit circuits.
 - Applied various extrapolation methods (linear, quadratic, polynomial, exponential, power) to achieve zero-noise limit and compared mitigated and unmitigated results.
- [Hamiltonian simulation of coupled classical harmonic oscillators](#) Team - 3, Apr 24
Classiq QRISE 2024 Challenge *Remote*
 - I led the team "Classiq Entanglers" in simulating coupled classical oscillators on a quantum computing platform, based on the algorithm by Babbush et al., aiming for scalability to showcase practical demonstration on a 70+ qubit system, potentially achieving quantum supremacy.
 - Developed and implemented state preparation approaches, Hamiltonian formation techniques, and quantum circuit generation strategies, documented in notebooks to achieve fidelity measurement and Hamiltonian time evolution analysis.
 - Generated code for Hamiltonian simulation using Classiq's platform, allowing user customization of parameters like masses and spring constants, and included documentation on manual derivation of Hamiltonian.
- **Open-Source Contributions**
 - Working on a contribution for preparing uniform quantum superposition states based on the algorithm by Alok et al. for [Qiskit's Circuit library](#).
 - Co-authored a subsection on Grover's algorithm chapter in the [Qiskit Textbook](#).
 - Collaborated with co-author Frank Harkins to fix a bug in [Qiskit Terra](#).
 - Translated over 5,000 words of [Qiskit's educational material](#) into Hindi.
- **Other Projects**
[Quantum Counting Algorithm](#), [VQE for an arbitrary matrix with noise](#), [Internet Radio using IP Multicast](#), [Cache Pipelining with three levels of 4-way Set-Associative method](#) and [LRU algorithm implementation](#), [The Movie Database \(IMDB\)](#).

PROGRAMMING SKILLS

- **Languages:** Python, Mathematica, MATLAB, Julia, C, C++, PostgreSQL, HTML
- **Tools/Libraries:** Qiskit, PennyLane, NumPy, SciPy, Qibo, SymPy, QuTiP, Matplotlib, PyTest, Git, LaTeX, Flask