

VIMARSH SHAH

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EDUCATION

Birla Institute of Technology and Science - Pilani, Goa
B.E. (Hons) Computer Science Engineering, MSc. (Hons) Physics

CGPA: 8.14/10
2022 - 2027 (expected)

PUBLICATION & PREPRINTS

Understanding Infrastructure Drift in Federated Learning Systems
Accepted at Student Research Symposium, 31st IEEE International Conference on HiPC

October, 2024
[\[Link\]](#)

EXPERIENCE

Data, Systems and HPC (DaSH) Lab
Undergraduate Researcher

BITS Goa
August 2024 – Present

- Researching federated learning under [Prof. Arnab K. Paul](#), focusing on identifying and mitigating infrastructure drift in distributed FL workloads.
- Investigating optimization techniques to improve model performance and prevent infrastructure drift in heterogeneous cluster & non-IID datasets. Developing an aggregation algorithm focused on preventing model drift for non-IID data.

CSIR: CEERI (Central Electronics Engineering Research Institute)
Research Intern

Pilani, India
May 2024 – July 2024

- Developed an automated drone-based leachate site detection system under the guidance of [Dr. Kaushal Kishore](#) using segmentation models for detection and alignment of the drone at the point of interest to collect samples. Implemented and tested in simulation and hardware.
- Worked on various Reinforcement learning techniques for indoor drone navigation & exploration in unknown environments, applying virtual repulsive and attractive potential fields and other rewards. Compared different algorithms like DDPG, SAC, TD3 and PPO.
- Integrated Intrinsic Curiosity Module (ICM) for exploration, achieving total reward increases by aligning intrinsic and extrinsic rewards. [\[Technical Report\]](#)

PROJECTS

Snakebot: Modular snake robot | [Source Code](#) & [Poster](#)

January 2024 – Present

- Developed a modular, wheel-less robot with 2 degrees of freedom (DoF) per segment, and working on implementing of specific gait patterns for inchworm and serpentine locomotion.
- Supervising the design of a scalable, daisy-chainable PCB based on the RP2040 microcontroller, for modular expansion and inter-segment communication with serial protocol and independent power management for each module.

Kratos: Mars Rover Team | [Source Code](#) & [Website](#)

September 2023 – Present

- Ranked 6th in [International Rover Challenge '24](#) and 3rd in Arm task. Scored **93/100** points in [University Rover Challenge](#) SAR submission and qualified for onsite finals.
- As part of the Controls subsystem, developed an open-loop control system for the Life Detection assembly and implemented a closed-loop PID control system for 5 DoF robotic arm.
- Migrated the electronics stack to a newer platform by designing a custom PCB based on ESP32 family of microcontrollers.
- Integrated an array of environmental and gas sensors (VOC, CO₂, methane) for the Life Detection module.

Vulcan: Humanoid Robot | [Source Code](#) & [Poster](#)

April 2023 – Present

- Integrated various Large Language Models (LLMs) with computer vision models for real-time facial expression analysis and speech recognition. Integrated with hardware movement of eyelids, eyeballs and mouth systems.
- Developed a real-time image processing pipeline for combining image feeds from both cameras in each eye, followed by image stitching, and feature-based object classification on the stiched image.

Team Moonshot | [Source Code](#)

November 2023 – August 2024

- Developed an autonomous lunar rover capable of traversing Moon-like terrain while avoiding obstacles. Used ROS, RTABMap, and other custom algorithms for non-GPS localization and mapping.
- Implemented frontier-based exploration for efficient area coverage and integrated use of tracking and depth camera for accurate obstacle detection and avoidance.
- Developed a 3-DoF robotic arm with simple CV based payload detection, inverse kinematics to calculate the joint angles, and autonomous pick-and-place capabilities for collection and cache storage of the payload.
- Participated in [ISRO Robotics Challenge-URSC 2024](#) and secured a **top 20** place among 1200+ registered teams.

Independent Projects

- **Micrograd implementation in C:** A simple implementation of autograd engine in C, which can be used to train an MLP. [\[Code\]](#)
- **Pruning & Sparsity Experiments:** Implemented fine-grained and channel-based pruning on VGG-16, achieving 86% reduction with iterative pruning and finetuning on CIFAR-10 dataset (without any loss in performance). [\[Code\]](#)
- **Implementation of a VAE and analysis with different sampling techniques:** Constructed a VAE for MNIST dataset, compared latent space sampling from Normal, Gaussian and Beta distribution to qualitatively analyze generation quality. [\[Code\]](#)
- **Softmax variations in CNNs:** Analyzed the impact of different implementations of Softmax on ResNet classifier on CIFAR-10. Found that log-variants demonstrate superior performance and faster convergence. [\[Report\]](#)
- **Transformer Implementation:** Implementation of Transformer block as mentioned in “Attention is All You Need” using PyTorch, including multi-head attention and positional encoding mechanisms. [\[Code\]](#)
- **FinanceGPT:** A financial data query and answering system using vector embeddings, Langchain, and FAISS to extract insights from annual reports of BSE-listed companies’, deployed using Flask. [\[Code\]](#)
- **Fine-tuning an LLM:** Finetuned an TinyLlama using Low Rank Adaption for function calling. [\[Model on HF\]](#)

LEADERSHIP

Electronics & Robotics Club | *Research Head*

April 2024 – Present

- Overseeing the technical direction of projects as the Research Head for the student-run robotics club (ERC), guiding over 80 students in achieving research-oriented goals. Projects under my supervision include the SpiderBot, SnakeBot, robotic arm, drone automation, Vulcan, and a quadruped robot. [\[Website\]](#)
- Developed a ROS2-based robotics hackathon utilizing BITS Goa’s map for pathfinding and navigation in Gazebo. [\[Problem Statement\]](#)
- Started a new PCB design mini-project for club inductions, focusing on custom motor driver creation to teach fundamental electronics and PCB design principles.

Sandbox Innovation Labs | *Committee Member*

January 2024 – Present

- Member of student committee responsible for managing the student run fabrication and prototyping lab of our university. [\[Website\]](#)

TECHNICAL SKILLS

Languages & Frameworks: Python, C, Java, ROS, Gazebo, Pytorch, OpenCV

Tools: GIT, Kicad, Autocad, Fusion360

Others: Deep Learning, Arduino, Raspberry pi, ESP32, STM32, Linux

Relevant Coursework: Computational Physics, Statistical Mechanics, Quantum Mechanics I/II, Object-oriented Programming, Digital Design, Discrete Structures, Computer Programming, Linear Algebra, Differential Equations, Classical Mechanics, Non-Linear Dynamics and Chaos, Physics of Semiconductor Devices