Aryaman Gupta

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EDUCATION

- **Indian Institute of Technology (BHU)** — Varanasi, India
  Bachelor of Technology in Electronics Engineering; GPA: 9.47/10 — *November 2020 – May 2024*

SKILLS AND INTERESTS

- **Areas of Interest**: Safety Critical Control, Self Driving, Robotics, Computer Vision, Reinforcement Learning
- **Languages and Libraries**: Python, MATLAB, C++, X-Plane, Carla, OpenAI Gym, PyTorch, Tensorflow
- **Technologies**: ROS, ROS2, Deep Learning, Machine Learning, AutowareAI, Linux, Git, LaTeX

PUBLICATION

1. **Aryaman Gupta**, Kaustav Chakraborty, Somil Bansal, "**Detecting and Mitigating System-Level Anomalies of Vision-Based Controllers**", *Submitted to ICRA'24*   *[Link]*

2. **Aryaman Gupta**, Ali Mohamed Ali, Hashim A.Hashim, "**Deep Reinforcement Learning for Sim2Real Policy Transfer in VTOL-UAVs Offshore Docking Operations**", *Submitted to IEEE Transactions on Artificial Intelligence*

3. **Aryaman Gupta**, Sivala Deepak, Neha Sharma, Om Jee Pandey, "**Joint Node-Fault Prediction and Data Routing in SW-IoT Networks using Actor-Critic RL**", *In Preparation*

EXPERIENCE

- **University of Southern California** — Los Angeles, CA
  Research Internship | Prof. Somil Bansal — *May 2023 - Present*
  - **Goal:** Improve visual navigation policies by leveraging knowledge of their failure cases.
  - Prepared datasets containing failure samples labelled using **Backward Reachable Tubes(BRTs)**.
  - Trained an **Anomaly Detector** that detect system failures and trigger **Fallback Controller** for safety.
  - BRT failure volume decreased by 40% on testing environments unseen during classifier training.

- **Carleton University** — Ottawa, Canada
  Research Internship | Prof. Hashim Mohamed — *January 2023 - Present*
  - **Goal:** Develop docking mechanism for VTOL UAVs on offshore charging platforms using Deep-RL.
  - Built a custom environment for UAV landing with **JONSWAP** model-based hydrodynamic disturbances(waves) acting on the docking station making it oscillate on the water surface.
  - Implemented **DQN** and **PPO** algorithms to compare performance among value and policy-based agents.
  - Agents successfully learnt to initially accelerate downwards and then decelerate to land safely.

- **Indian Institute of Science** — Bengaluru, India
  Summer Research Internship | Prof. Bharadwaj Amrutur — *May 2022 - July 2022*
  - **Goal:** Develop decentralized multi-agent exploration and visual dynamic obstacle avoidance systems.
  - Implemented **Distributed RRT-Exploration** of unknown environments with multiple ground robots.
  - Performed real-time map updates using **3D Object Detection** on multiple infrastructure cameras and used **First-Order Gradient Descent** for optimizing obstacle's 3D real-world position for avoidance.
  - Developed ROS packages that can be configured and implemented on custom hardware testbeds.

- **Changwon National University** — Changwon, South Korea
  Research Internship | Prof. Oh-Seol Kwon — *March 2022 - July 2022*
  - **Goal:** Develop a deep learning architecture for efficient object detection in low-resolution aerial images.
  - Combined **Faster R-CNN, Edge Enhanced Network,** and **SRGAN** architectures for joint task.
  - Performed **End-to-End Training** of the entire pipeline, feeding detector's loss to SRGAN network.
  - Obtained testing accuracies of 95.5% on COWC and 83.2% on OGST datasets.

PROJECTS

- **Multi-Agent Warehouse Cleaning**
  - ○ **Goal:** Develop a Multi-Agent Coverage and Cleaning system for unknown terrains using ground robots. *[Link]*
  - ○ Built a swarm of **Omnidrive Robots** and mapped the terrains using **RRT-based Multi-Robot Exploration**.
  - ○ Distributed terrain among multiple agents by computing **Voronoi Cells** using **Fortune's Algorithm**.
  - ○ Used a polygon planner for computing **Boustrophedon Paths** for each agent for complete coverage.

- **UAV Swarming**
  - ○ **Goal:** Develop UAV Position Control using PID controller and implement Swarm Motion of multiple drones. *[Link]*
  - ○ Used ArUco marker and Time of Flight(TOF) Lidar sensor for pose estimation with Kalman Filter for correction.
  - ○ Implemented **Cascaded PID** for 3D position control and Python-based socket communication for manual control.
  - ○ Used **Flocking Algorithm** for a swarm motion of drones in PyBullet simulation software.

- **Multi-Purpose Household Robot (Supervised by Prof. Shyam Kamal, IIT BHU)**
  - ○ **Goal:** Design a Compact Ground Robot that can perform household tasks like Cleaning and Child-Care. *[Link]*
  - ○ Designed a **CAD** model and integrated ROS pckages for **Exploration, Navigation**, and **Coverage**.
  - ○ Used **Computer Vision** for tasks like threat detection and child following for child care in households.
  - ○ Fabricated hardware using **Jetson Nano** and **STM Microcontroller** and used **Intel Realsense** for perception.

- **UAV Guided UGV Navigation**
  - ○ **Goal:** UAV-assisted Exploration of mountainous terrains and UGV Navigation in snow-covered roads. *[Link]*
  - ○ Performed UAV Localization by fusing IMU and GPS data using **Extended Kalman Filtering**.
  - ○ Used **U-Net** for segmenting roads and **Frontier Exploration** on UAV for mapping using RGBD data.
  - ○ Obtained UGV odometry using UAV camera feed and traversed the terrains through waypoint following.

- **Small World IoT Networks (Supervised by Prof. Om Jee Pandey, IIT BHU)**
  - ○ **Goal:** Introduce Small-World Phenomenon in Wireless Sensor Networks and Detect Faulty Sensor Nodes. *[Link]*
  - ○ Implemented **Actor Critic** methods for introducing long-range links in network (topology optimization).
  - ○ Prepared faulty sensory nodes dataset and used **DBSCAN** algorithm for detection after comparison.
  - ○ Performed data routing and observed increased network lifetime and throughput with reduced latency.

RELEVANT COURSEWORK

- **Academic Courses**: MA-101(Real Analysis), MA-102(Linear Algebra), MA-202(Probability and Statistics), CSO-102(Data Structures and Algorithms), CSO-332(Ubiquitous Computing), CSO-458(Soft Computing)
- **Online Courses**: ML and DL Fundamentals by Andrew NG, RL Specialization by UoA, Computer Vision by Stanford

ACHIEVEMENTS

- Among **Top-15** students selected across India for the **IUSSTF-Viterbi Scholarship 2023** to pursue a fully-funded summer research internship at the USC Viterbi School of Engineering.

- Selected for **DAAD-WISE Scholarship 2023** to pursue Research Internship in German Public Institutes.

- Selected for **Mitacs GRI Scholarship 2023** to pursue Research Internship in Canadian Institutes.

- Stood **Second** in **All Indian Institutes of Technology Robotics Association 2021 Challenge** among all prestigious institutions in India for maximum coverage of warehouse using multiple agents.

- Among **Top-10** winners in **National Robotics Competition** for developing a consumer-oriented innovative household robot capable of doing household chores and baby care.

- Stood **First** in **Labyrinth**, a ROS based Perception and Path Planning event in Technex, IIT(BHU).

- Secured **All India Rank 2400** in JEE Advanced Examination 2020 among one million applicants.

LEADERSHIPS AND COMMUNITY INVOLVEMENTS

- **Technical Lead** of **RoboReG**, a student research group working on Intelligent Robotics at IIT(BHU).

- **Senior Member** of **Robotics Club**, where I guide juniors and help in conducting events at IIT(BHU).

- **Member** of **Research Community**, where I manage resources and promote research at IIT(BHU).

- Conducted Robowars and Pixelate events in Technex, the Techno-Management Fest of IIT(BHU).