MIHEER DIWAN

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Education

Worcester Polytechnic Institute   **May 2024**
Master of Science in Robotics Engineering — GPA: 3.87   *Worcester, MA*

Mukesh Patel School of Technology Management & Engineering, NMIMS University
Bachelor of Technology in Mechatronics Engineering (Minor: Robotics & IoT) — GPA: 3.46   *Mumbai, India*

Experience

Graduate Researcher, *Perception and Autonomous Robotics (PeAR) Group*   **Aug 2023 – Dec 2023**
- Developed a **Generative**, **Procedural environment** for quadrotor simulation and learning using Blender software.
- Employed **RRT*** algorithm and **Minimum Snap Trajectory** generation to navigate a dense, simulated forest.
- Designed a **Model Predictive Control** for precise trajectory tracking and traversal of optimal trajectories.

Graduate Researcher, *Embedded Computing Lab*   **May 2023 – July 2023**
- Developed the **perception stack** for autonomous vehicles with camera images, **LiDAR** point clouds and **Voxel Grids**.
- Estimated absolute and relative depth using both **Stereo Photogrammetry** and **Intel's MiDaS depth model**.
- Used **YOLOv8** for **Object Detection** and **Instance Segmentation** for road vehicles, traffic signs, and pedestrians.
- Detected lanes on **custom dataset** with a 97.8 % accuracy using Cross Layer Refinement Network (**CLRNet**).

Control Systems Intern, *NMIMS University, Mumbai*   **June 2021 – Nov 2021**
- Conducted comprehensive research, exploring and analyzing multiple non-linear methods for BLDC motor speed control.
- Constructed a closed-loop model for **sensorless control** of BLDC motors using Back-EMF and zero-crossing detection.

Projects

Sim2Real Mini Drone Racing | *JETSON Orin Nano, PyTorch*
- Deployed algorithm on **DJI TelloEDU** drone for autonomously detecting and navigating windows and arbitrary gaps.
- Trained a custom deep-learning network using only simulated data and **domain randomization** to segment windows in the real world with an accuracy of **92 %** and determined the 3D pose with Perspective-n-Point (PnP).
- Leveraged **Optical Flow** and Spatial Pyramid Network (SPyNet) to navigate arbitrarily shaped gaps in walls.

Classical and Deep Visual Inertial Odometry (VIO) | *Sensor Fusion, State Estimation, Kalman Filter*
- Implemented "Robust Stereo VIO for Fast Autonomous Flight" paper for a state-of-the-art sensor fusion using **MSCKF**.
- Fused camera images and IMU data using **LSTM** based network to perform state estimation in real time.

Structure from Motion (SfM) | *Multi-View Geometry, Triangulation*
- Extracted and matched monocular camera image features using SIFT descriptors and **RANSAC** algorithm.
- Calculated the Fundamental matrix and the Essential matrix based on **Epipolar geometry** constraints and leveraged camera triangulation to determine camera poses ensuring adherence to Cheirality Condition.
- Performed **3D scene reconstruction** by refining camera poses using Bundle Adjustment and the Visibility matrix.

Neural Radiance Fields (NeRF) and Gaussian Splatting | *Volume Rendering, CUDA Optimization*
- Implemented the original NeRF method to synthesize novel views by optimizing a continuous volumetric scene function.
- Evaluated performance against SOTA Gaussian Splatting for **real-time** radiance field rendering on **custom dataset**.

Camera Calibration | *Corner Detection, Feature Extraction*
- Devised a robust camera calibration algorithm using Zhang's method to estimate camera intrinsics and extrinsics.
- Predicted distortion coefficients and minimized distortion errors of the camera, employing **Non-linear optimization**.

Skills

Robotics : Dynamics, Controls, Computer Vision, Machine Learning, Aerial Robots, Advanced Robot Navigation
Software : Python, C++, Java, ROS/Gazebo, PyTorch, OpenCV, TensorFlow, MATLAB, Docker, Git, SolidWorks
Machine Learning Tools : CNN, ResNet18, DenseNet, LSTM, TCN, HomographNet, Regression, Clustering, NLP

Leadership Experience

Co-Head: Design & Simulation Department, Team Technotix, MPSTME   **2019 – 2021**
- Headed a team of 15 people to develop two mobile robots: Arrow-Shooting robot and Ball-Throwing robot.
- Fabricated a custom swerve drive mechanism for the robots which provided **30 %** increase in the speed of the robots.
- Secured **India National Finalist** positions in ABU Robocon 2020 and 2021, with a flawless score in the Design Phase.