Miheer Diwan

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Summary

Hi, I'm a robotics engineer leveraging classical computer vision and AI to bridge the sim-2-real gap in robotics.

Experience

Robotics Software Engineering Intern **Sept 2024 – Present**

Trossen Robotics *Downers Grove, IL*

- Developed a ROS 2 package using C++, PCL, and CUDA to efficiently process, denoise, and merge LiDAR and stereo camera point clouds, with configurable parameters for flexible deployment and adaptability to varying environments.
- Implemented RTAB-Map Visual-SLAM algorithm with for robust navigation in complex environments.
- Generated and optimized point clouds using the Oak-D Pro stereo camera to achieve precise detection of objects as small as 8 cm on the ground. Successfully integrated this functionality into the collision monitor stack for cost map creation.

Computer Vision Graduate Researcher **Aug 2023 – Dec 2023**

Perception and Autonomous Robotics (PeAR) Group, WPI *Worcester, MA*

Quadrotor Navigation in Uncharted Terrains | *Python, C++, ROS, Blender, PyTorch, OpenCV*

- 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 Controller for precise trajectory tracking and traversal of optimal trajectories.

Sim-2-Real Mini Drone Racing | *Python, PyTorch, OpenCV, Blender, Data Generation, Jetson Orin Nano* | *Github*

- Automated synthetic data generation in Blender with domain randomization and trained a custom neural network to segment windows in the real world with an accuracy of 92 %.
- Computed corners using segmentation masks and determined 3D window pose with Perspective-n-Point (PnP) algorithm.
- Deployed the algorithm on DJI TelloEDU with Jetson Orin Nano and achieved a latency of 10ms using TensorRT.

Autonomous Vehicles Graduate Researcher **May 2023 – Aug 2023**

Embedded Computing Lab, WPI *Worcester, MA*

LiDAR and Stereo point cloud segmentation | *PyTorch, OpenCV, PCL*

- Developed voxel-based obstacle segmentation algorithm for autonomous vehicles on the KITTI Stereo 2015 dataset.
- Employed RANSAC plane fitting to segment roads in KITTI point clouds and refined drivable regions with ICP.
- Estimated absolute depth from disparity maps and reconstructed 3D traffic scene using stereophotogrammetry.

Perception Stack for Autonomous Vehicles | *Python, PyTorch, OpenCV, Blender* | *Github*

- Used YOLOv8 and U-Net for Object Detection and Instance Segmentation of vehicles, traffic signs, and pedestrians.
- Trained Cross Layer Refinement Network (CLRNet) on TUSimple dataset with a 97.8 % accuracy to detect lanes.
- Processed per-pixel relative depth using Intel's MiDaS depth model, visualizing the results in a Blender simulation.

Featured Projects — *(Please check my Portfolio for more projects.)*

Visual Inertial Localization | *Python, OpenCV, Matplotlib* | *Github*

- Performed robust quadrotor pose estimation in 3D space by using Quadrotor Dynamics and Extended Kalman Filter.
- Improved prediction accuracy by using a vision-based observation model to get pose estimates from AprilTags.

Structure from Motion (SfM) | *Python, OpenCV, PyTorch* | *Github*

- Extracted and matched monocular camera image features using SIFT descriptors and RANSAC algorithm.
- Reconstructed 3D scene from images using SIFT features, epipolar geometry, triangulation, and Bundle Adjustment.

End-to-End Object Detection with DETR | *Python, PyTorch, OpenCV, Roboflow, Tensorboard*

- Created an end-to-end transformer-based object detection on a custom dataset using DETR-Resnet-50 and Roboflow.
- Integrated and fine-tuned DETR models for panoptic segmentation, achieving strong results on COCO datasets.

Education

Worcester Polytechnic Institute **2024**

Master of Science in Robotics Engineering *Worcester, MA*

Mukesh Patel School of Technology Management & Engineering

Bachelor of Technology in Mechatronics Engineering (Minor: Robotics & IoT) *Mumbai, India*

Skills

Software : Python, C++, ROS, ROS 2, Gazebo, CoppeliaSim, OpenCV, PyTorch, CUDA, TensorRT, NumPy, SciPy, Pandas, PCL, Open3D, scikit-learn, Matplotlib, MATLAB, Docker, Linux, Git, LaTeX, SolidWorks, Blender

Hardware : DJI Tello EDU, Jetson Orin Nano, Arduino, Raspberry Pi, Yaskawa Motoman MH5, Rapid Prototyping

Architectures : YOLO, CNN, R-CNN, VGG16, ResNet18, DenseNet, LSTM, TCN, HomographNet, Transformers, NeRF