THABSHEER JAFER MACHINGAL

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EDUCATION

Master of Science in Robotics Engineering, *Worcester Polytechnic Institute* *Dec 2023*
Relevant Coursework: Robot Dynamics, Robot Control, Artificial Intelligence, Computer Vision, Reinforcement Learning, Natural Language Processing, Motion Planning, Deep Learning
Bachelor of Technology in Mechanical Engineering, *Kerala Technological University, India* *2021*

SKILLS

- **Languages & Tools:** C++, Python, Javascript, SQL, CUDA, Docker, Git , Pytorch, TensorFlow, Keras, Caffe, Bash scripting, Gstreamer, FFMpeg, OpenCV, PCL, ROS, Unity, Solidworks, Blender
- **Techniques:** 3D Computer Vision (Optical Flow, SLAM, NeRF), Deep Learning, and Autonomous Robots

EXPERIENCE

Apex Microdevices Feb 2024 - present
Research Scientist - Machine Learning *Dayton, OH*

- Working on topological optimization using machine learning for the design of different metasurfaces across various applications.
- Working on Inverse design of metasurfaces and metalens by utilizing Generative adversial networks(GANs).
- Built a surrogate neural network model for designing a metasurface-based switchable mirror, reducing design time and computational resources.

Worcester Polytechnic Institute Aug 2023 - Dec 2023
Research Assistant *Worcester, MA*

- Working on a pivotal project on robotic waste sorting, focusing on the Object Rearrangement task at Manipulation & Environmental Robotics (MER) Lab, WPI.
- Pioneered the integration of the PCA algorithm and a novel density estimation method, which successfully charted trajectory planning for the Franka Emika robotic arm, facilitating efficient rearrangement of objects on conveyor belts.
- Established baseline metrics for the performance analysis of the rearrangement methods.
- Designed a method to generate random pile configuration for testing in simulation.

Agot May 2023 - Aug 2023
Computer Vision Intern *Pittsburgh, PA*

- Integrated and Deployed Computer Vision and AI features to open source Network Video Recorder.
- Implemented OpenAI's GLIP model for zero-shot learning, enabling the efficient detection of restaurant-related events and streamlining operational tasks.
- Built an end-to-end pipeline for training, testing of facial and pose embedding model for human ReID. Established baseline metrics for the ReID app.
- Rapidly mastered diverse industry tools, implementing U-Net for segmentation with Nvidia Tao, and deploying models via Google Vertex AI and Google Cloud, demonstrating adaptability and readiness to quickly learn and use new technology stack.
- Gained experience in networking with cameras, edge devices, and conducting training and inference on Nvidia Jetson devices.

Worcester Polytechnic Institute Jan 2023 - May 2023
Graduate Research Assistant *Worcester, MA*

- Enhanced point cloud tasks at VISLab with innovative encoder-decoder architectures. By blending high-performing techniques from literature and conducting an ablation study, maximized our model's performance.
- Surpassed the performance of many state-of-the-art methods by 10% in more than 5 categories within the ShapeNet benchmark.
- Implemented a loss function for hyperbolic neural networks, enhancing training efficiency and precision.

Inker Robotic Solutions Pvt Ltd June 2020 - August 2020
Robotics Intern *Thrissur, India*

- Developed algorithms and code for a collision-avoidance robot, leading to new firmware and mapping methods.
- Designed and implemented a five-degree-of-freedom robotic arm, gained proficiency in static analysis, kinematics, dynamics, and GUI design.

RELEVANT PROJECTS

Visual Inertial Odometry

- Implemented a robust stereo visual inertial odometry (VIO) system on a subset of the EuRoC dataset, which consists of stereo images and inertial measurement unit (IMU) readings from a moving camera. The system was able to accurately estimate the pose (position and orientation) of the camera in the 3D environment using a combination of visual and inertial cues.
- Utilized the Multi-State Constraint Kalman Filter (MSCKF) algorithm to handle non-linearities and improve the accuracy of the VIO system.

Semantic Mapping

- Built a high-definition map of a LIDAR point cloud using a variant of the Iterative Closest Point (ICP) algorithm from the KITTI-360 dataset. Colored the map with semantic labels obtained from RGB images using a semantic segmentation neural network and extrinsics between the sensors.

Buildings built in minutes: SfM and NeRF

- Implemented a structure from motion (SfM) algorithm using a sparse reconstruction approach to generate a 3D model of a scene from a series of calibrated 2D images. The algorithm was able to simultaneously estimate the camera poses for each image, providing a full 3D reconstruction of the scene.
- Implemented the NeRF (Neural Radiance Fields) algorithm on a lego dataset, consisting of 100 images of lego scenes captured from various viewpoints. Using deep learning techniques, the model was trained to synthesize realistic 3D models of the lego scenes from the 2D images.

Dynamic obstacle avoidance & path planning in a hospital environment

- Developed and compared three distinct motion planning and obstacle avoidance algorithms (D* Lite, Hybrid Potential-based PRM, and Spline-based Dynamic Window Approach) to determine the most effective method for use in hospital settings.
- Conducted simulations of the proposed solution within a virtual hospital environment using the Unity game engine.

Auto-Calib

- Implemented Zhang's method of camera calibration with non-linear optimization.

My Auto-Pano

- Generated panorama images using local feature descriptors and RANSAC for homography transformation.
- Trained a CNN, HomographyNet, to predict homography transformation between images.

Human Pose Estimation

- Implemented a human pose estimation system using the AlexNet architecture in TensorFlow and Keras.
- Collected and utilized over 5000 images from the FLIC dataset to train a CNN with a regressor, allowing for the successful prediction of human poses in real-world images.

Atari-Breakout(DQN)

- Built a deep reinforcement learning agent using the DQN algorithm to play the Atari Breakout game utilizing the OpenAI Gym framework and PyTorch.
- Achieved a collective reward of 78 and mean reward of 40 in testing after training the agent for over 15 million episodes.

Robust Trajectory Tracking for Quadrotor UAVs using Sliding Mode Control

- Designed and implemented a sliding-mode controller for the Crazyflie 2.0 quadrotor drone, focused on altitude and attitude control using ROS Noetic.
- Demonstrated the controller's ability to track a desired trajectory with desired waypoints.