DHRUVIL PARIKH

Boston, MA | parikh.dh@northeastern.edu | https://dmp1999.github.io/ | https://www.linkedin.com/in/dhruvil99/ | +1 (857) 318-6674

EXPERIENCE

Robotics Engineer, GreenSight Agronomics **05/2022 – 12/2022**

- Leveraged **U-Net** model with **Cross-Entropy Loss** to perform **semantic segmentation**, resulting in an **IoU score > 0.5**
- Conducted comprehensive research and evaluation of sensor technologies suitable for integration with a drone prototype, including Lidar, Radar, Sonar, UWB and Long-Range Radios for extremely **low SWAP-C** requirements to ensure optimal performance
- Devised an algorithm to **visualize lidar data** in three-dimension space with a resolution of 8x8 as per sensor design specifications
- Developed a script for **real-time ROS integration**, enhancing efficiency by **60%** in robustly **navigating uncertain environments**
- Spearheaded an entire process from **data exploration** to evaluating for **optimal model selection** achieving an accuracy of **96.47%**
- Demonstrated **indoor localization accurate to 3%** with utilizing ranging data obtained from ESP32 Ultra-Wide Band DW3000
- **Decreased latency by 83%** owing to implementation of **real-time transmission** of MAVLink telemetry over Long Range Radios

Co-Founder and CTO, AISafe Electronics Solutions **01/2020 – 07/2021**

- Conceptualized an intrusion detection product, coordinated within core team to pitch it to **DRDO** acquiring funding worth **$121,000**
- Enabled efficient interfacing of multiple cameras to **Raspberry Pi** eventually adding features for live streaming and taking snapshots
- Integrated Raspberry Pi to **piezo electric pads system** to capture a photo when **pressure is sensed** with an **accuracy of 100%**
- **Increased efficiency of OCR to 99.81%** as an application of Deep Learning to identify characters on a number plate of a vehicle

Associate Product Manager, ABC Power Systems **11/2018 – 12/2019**

- Received training on **product management**, **business strategy** and generating actionable **market research** insights for growth
- Assisted upper management in establishing **Vision, Core Purpose, Core Values and B.H.A.G.** to be followed for the **next decade**

Computer Vision Research Intern, SFR Medical **06/2020 – 09/2020**

- Improved state-of-the-art Optical Character Recognition technology with CNN for handwriting recognition by a **margin of 10%**
- Inspired Wound Classification Project using CNN to **identify nature** and **seriousness of a wound** from a **low-resolution image**

PROJECTS

Autonomous Driving System (Python, CARLA) **01/2023 – 04/2023**

- Employed **Error State – Extended Kalman Filter** incorporating IMU, GPS and Lidar data achieving **localization accurate to 1%**
- Developed vision algorithms for **object detection**, **tracking**, and **surface estimation** attaining a combined accuracy of 90%
- Implemented a **hierarchical motion planner** employing A*, finite state machines, conformal lattice planner, path planner, velocity profile generator, and a vehicle controller to navigate scenarios in CARLA with focus on **robustness to changes** in environment
- Researched and validated **operational design domains**, considering parameters such as speed limit, weather, and traffic conditions

Control System Wearable Robotics (OpenSim, MATLAB) **01/2023 – 04/2023**

- Conducted extensive research and analysis of **musculoskeletal dynamics** with help of OpenSim models exhibiting **crouch gait patterns** having **17 DOF**, focusing on activity of gastrocnemius, soleus, tibialis anterior, iliopsoas and other relevant muscle groups
- Developed a **mathematical model** of the **lower limb dynamics**, incorporating muscle-tendon properties, joint kinematics, ground reaction forces, IMU and EMG sensor data to **simulate and analyze behavior of ankle exoskeleton** in different gait scenarios
- Utilized MATLAB to design and implement a **phase-based controller** for an **ankle exoskeleton**, aimed at **enhancing gait performance** and **providing effective assistance** achieving an RMSE of **1.8752 for slow** and **1.5905 for normal** walking speeds

Stewart Platform for Motion Study in Surgical Robotics (MATLAB) **01/2023 – 04/2023**

- **Mimicked the movement of body** such as heartbeat, peristaltic motion or even breathing using a **6 DOF Stewart platform**
- Researched applications of using a Stewart platform in **Teleoperation**, **Imitation Learning, Surgical Cutting and Debridement**
- Analyzed performance of **LQR and MPC controllers** under varying operating conditions for **precise tracking** of body movements

Wearable Exo-Glove (C++, Arduino) **01/2023 – 04/2023**

- Engineered a device to assist in tasks requiring finger strength while maintaining dexterity to **improve** Hand-Grip Strength **by 27%**
- Modeled the control system in C++ with film-type pressure sensors, an electric motor, and a **PD controller** for **feedback control**

Path-Planning for Robotic Manipulator (MATLAB, RRT, PRM) **01/2023 – 04/2023**

- Implemented **Rapidly Exploring Random Tree** algorithm with **balanced sampling** and **steering strategies** for **rapid exploration** of the 4-DOF (Degrees Of Freedom) manipulator's high-dimensional configuration space, ensuring **collision-free path generation**
- Enhanced RRT* algorithm with **incremental rewiring** and **kd-trees** for accelerated nearest neighbor searches and improved path
- Incorporated B-Splines for **local path smoothing** within RRT to **refine kinematically feasible paths** while avoiding collisions
- Developed a **Probabilistic Roadmap (PRM)** with optimized graphs for **offline path precomputation** and **optimal path finding**
- Utilized **A* graph-search** algorithm within the PRM graph to obtain **optimal paths** for **precise manipulator motion planning**

Point Cloud Registration and 3D Reconstruction (Python, C++, ROS, Rviz) **01/2023 – 04/2023**

- Implemented **ICP algorithm** on real-world Lidar data for **point cloud registration**, obtaining a **sub-millimeter** alignment accuracy
- Overcame point cloud ordering and noise limitations by employing **Gaussian noise modeling** and **outlier rejection**, achieving accurate alignment despite shuffled point order with an error below 0.5% using **robust point to plane correspondence** estimation
- Integrated the ICP registration module into mapping system, enabling **efficient 3D reconstruction** and **environment modeling**

Grasp Prediction Network (Python, Pybullet, Pytorch) **01/2023 – 04/2023**

- Implemented a **UNet** architecture with **MobileNet V3** backbone for **grasp detection** given top-down RGB images of the objects
- Achieved a **success rate of 50%** with a **validation loss of 2.69** after training the grasp prediction network for 30 epochs on CPU
- Retrained network after applying **data augmentation** techniques such as random translations and rotations to **generalize for spatial information**, jitter transformations and noise to make it **illumination invariant** resulting in an **improved success rate of 74%**

Face Recognition and Mood Detection (Python, SSD, SVM, CNN, Pytorch, OpenCV) **01/2023 – 04/2023**

- Trained a custom Single-Shot Multibox Detector and SVM model on LFW-Deepfunneled Dataset to achieve an accuracy of 98.96%
- Designed a CNN from ground-up for Mood Detection on Facial Expression Recognition dataset achieving an accuracy of 96.57%

- Focused on making these **algorithms extremely robust and lightweight** to enable seamless integration with different applications
- Programmed a user greeting application to register new faces **under four seconds** and greet the user tailored to their emotional state

Visual-Inertial SLAM with Loop Closure and Bundle Adjustment (C++, Python, ROS, ORB-SLAM3, Rviz) **01/2022 – 04/2022**

- Collaborated to demonstrate Visual, Visual-Inertial and Multi-Map SLAM with monocular, stereo and RGB-D cameras, using pinhole and fisheye lens models using **ORB-SLAM3** with **ROS** on autonomous car NUANCE, EuRoC, TUM-VI and Kitty Dataset
- Evaluated its performance against other state-of-the-art algorithms such as LeGO-LOAM and RTAB-Map in different scenarios
- Performed **Dead Reckoning** and **Velocity Estimation** predominantly with help of IMU data and using GPS as ground truth

3D Object Projection (C++, OpenCV) **01/2022 – 04/2022**

- Wrote functions in C++ for parsing and processing .obj files to **project complex virtual objects** such as a teddy bear using only face, edge, and vertex data, with **localized point projection** accurate to 1.5% onto a plane utilizing OpenCV for camera calibration

Real-time Object Detection (C++, OpenCV) **01/2022 – 04/2022**

- Built a system capable of identifying specific set of objects on a white surface with **translational, scale, and rotational invariance**
- Implemented algorithms from scratch in C++ for thresholding (HSV color space), grassfire growing and shrinking (Manhattan distance) for morphological operations, image segmentation, and feature extraction achieving an **accuracy of greater than 99%**

Image Super Resolution (C++, Python, OpenCV) **01/2022 – 04/2022**

- Accomplished Super Resolution on image using architectures SRCNN (**2x**), FSRCNN (**3x**), EDSR (**4x**), ESPCN (**4x**), LapSRN (**8x**)

Reconnaissance using Turtlebot3 (C++, Python, ROS, Gazebo, Rviz, Raspicam, Turtlebot3-Burger) **10/2021 – 12/2021**

- Designed an **autonomous system** to carry out **reconnaissance** in a **close and initially unknown** simulated disaster environments
- **Detected 12/15 Apriltags** and broadcasted precise **locations** while creating a complete **occupancy grid map** using SLAM

SKILLS

Languages and Frameworks:	Python, C++, MATLAB, PyTorch, TensorFlow, Keras, ROS, ROS2, Gazebo, Carla, Rviz
Tools and Technologies:	Machine Learning, Deep Learning, Computer Vision, SLAM, OpenCV, OpenCL, Open3D, PCL, ICP, Reinforcement Learning, Raspberry Pi, Arduino, MAVLink, Ardupilot, Q Ground Control, LoRa, UWB, Sensor Fusion, OpenSim, NLP, Git, Linux, Jira, Trello
Soft Skills:	Leadership, Management, Communication, Public Speaking, Content Writing

EDUCATION

Master of Science in Robotics **09/2021 – 08/2023**

Northeastern University, Boston, MA

Relevant Coursework: Wearable Robotics, Advanced Machine Learning, Pattern Recognition and Computer Vision, Robot Sensing and Navigation, Robot Mechanics and Control, Mobile Robotics, Robotics Science and Systems

Bachelor of Technology in Electronics and Communication Engineering **07/2017 – 05/2021**

Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat, India