

EDUCATION

Worcester Polytechnic Institute (WPI), MA, US
Master of science, Robotics engineering, GPA 4/4

December 2023

Related courses

WPI: Vision-based Robotic Manipulation, Computer Vision

National Institute of Technology Kurukshetra (NIT KKR), India
Bachelor of Technology, Mechanical engineering, CGPA 8.56/10

May 2021

SKILLS

Languages: Python, C++, MATLAB, Simulink, XML, HTML, YAML, SQL

Software: ROS, Gazebo, Unity, Git, rviz, Visual Studio, Pycharm, Solidworks, Linux

Cloud Services: AWS cloud 9, GCP compute engine, Docker

Artificial Intelligence: Linear Regression, Logistic Regression, SVM, kNN, K-Means, Naive Bayes, CNNs

Packages: OpenCV, PCL, NumPy, Pandas, Matplotlib, TensorFlow, Pytorch, Moveit

RELEVANT PROJECTS

Social Navigation

March-May 2023

- Conducted comparative analysis of Human Aware Navigation against A*+DWA and Dijkstra+TEB planning methods.
- Performed performance evaluations of each method within a Unity environment, treating moving humans as obstacles.
- Optimization efforts resulted in Human Aware Navigation achieving an optimal average minimum distance of 0.89 and average path length of 11.41.

Sliding Mode Control

May 2023

- Implemented Robust Trajectory Tracking on Quadrotor UAVs utilizing Sliding Mode Control.
- Enhanced controller efficiency, enabling Crazyflie Quadrotor to adhere to a pre-set 3D path in Gazebo.

2D-SLAM

December 2022

- Implemented Gmapping with ROS1 for custom robot in Gazebo simulation
- Tuned the AMCL localization package and the move_base navigation package parameters for the custom robot

A Hybrid Deep learning Architecture for Lane detection, Deep learning, WPI

December 2022

- Developed a hybrid deep learning architecture for lane detection utilizing SegNet as a backbone, leveraging both CNN and RNN structures via PyTorch
- Achieved highest F1-score of 0.910 with SCNN_SegNet_ConvLSTM2 architecture

A* search in an ASCII board

April 2022

- Implemented A* search algorithm using C++ OOP to plan a path through obstacles in an ASCII board
- Developed an admissible heuristic function, leveraging Manhattan distance for efficient 2D coordinate navigation.

Grasping Assuming Symmetry, Directed Research, WPI

November 2021-December 2021

- Developed comprehensive point clouds for YCB datasets objects via a C++ program, enhancing data from incomplete RGBD sensor captures.
- Implemented statistical outlier removal filter to refine original point cloud.
- Utilized PCL library's PCA package in C++ to identify object symmetry planes and mirror incomplete point clouds, creating complete object models.
- Optimized object models using Poisson surface reconstruction, producing watertight triangular meshes for improved grasp planning and collision detection.

Object tracking using YOLOv3 and Deep Sort, Computer Vision, WPI

November 2021

- Detected vehicles, traffic signals, traffic lights, and humans in images and videos using YOLOv3
- Adapted Open Images Dataset for YOLOv3 training on Google Compute Engine.
- Achieved 51.47% mAP on the test dataset
- Applied Deep Sort with Python Tensorflow and YOLOv3 weights for video object tracking.

Scara Robot, Foundations of Robotics, WPI

November 2021

- Created a Scara robot using URDF to simulate the robot in Gazebo.
- Implemented forward and inverse kinematics solver for the Scara robot using a ROS node in C++ which subscribes to joint states
- Achieved accurate position of the end-effector of the robot using the C++ node which reads the joint angles of the robot
- Verified the end effector pose by the inverse kinematics solver which gives back the same joint angles.

Vision-Based Robotic Manipulation, Vision-Based Robotic Manipulation, WPI

October 2021

- Collaborated in a team of two to manipulate an object on a table using the grippers of a panda robot in Gazebo simulation using Moveit and PCL
- Created a ROS program in C++ to use the Point cloud images of the scene captured by the RGBD sensor on the robot
- Applied the RANSAC algorithm of the PCL to segment the object and fit a plane to the object point cloud.
- Calculated the center points and the normal of the object plane using PCL so that the gripper can grasp and lift the object after frame transformations using the tf2 package of ROS

PROJECTS

Visual Servoing, Vision-Based Robotic Manipulation, WPI

September 2021

- Implemented a visual servoing algorithm in Python using OpenCV for a 2 DOF robot in Gazebo simulation using ROS
- Developed an algorithm to use four-point features (the centers of the circles with different colors) on a custom object to make the robot's camera converge on top of the object from different positions.

Image feature detection, Vision-Based Robotic Manipulation, WPI

September 2021

- Modeled a custom object and a robot with a camera using URDF file to spawn it in Gazebo
- Utilized Canny edge detection, Harris corner detection, Color thresholding, and Hough circle Python functions on the images received from the robot's camera using ROS to find the features of the object

Grasp Quality, Vision-Based Robotic Manipulation, WPI

August 2021

- Created a Matlab program to calculate the most stable position of a 5th force vector on a 2D rigid rectangular body for a planar grasp by a robot's end-effector
- Calculated the stability of the fifth contact point on the rigid body using three different grasp quality metrics in the Matlab program

Neural Network Classification

July 2020

- Used MNIST Fashion Dataset to classify different clothing using TensorFlow on Google Colab
- Achieved 88% accuracy of three layer Neural Network on test MNIST fashion dataset

EXPERIENCE

Autonomy software Intern, Danfoss Power Solutions, Minnesota, USA

May 2023 -Present

- Developed and implemented a gradient descent path smoother algorithm to refine the path generated by the hybrid A* algorithm, resulting in improved navigation accuracy and overall system efficiency.
- Conducted rigorous bug-finding and testing of the hybrid A* algorithm, utilizing C programming language, enhancing the algorithm's robustness and reliability under various operating conditions.

Intern, Maruti Suzuki Power Train, IMT Manesar, Haryana, India

January 2020-March 2020

- Collaborated on the creation of safety instruction sheets using Microsoft PowerPoint, enhancing operator adherence.
- Conducted daily quality inspections of engine cylinder block and head using MOS-K and metrology instruments.
- Optimized assembly line efficiency by identifying and reducing time wastage, and balancing workload using Time Study techniques.
- Ensured consistent quality of engine head and block by maintaining up-to-date tool life records.

ADDITIONAL EXPERIENCE

Graduate Learning Assistant, Mathematical Sciences Department, WPI

August 2021-Feb 2022

- Assisted students in learning Calculus III course concepts
- Graded HW submissions for Calculus III course

ACTIVITIES

- **Member**, VEXU Robotics Club, WPI, USA Nov 2021- Feb 2022
- **Member**, Lawn Tennis Team, NIT KKR, India July 2017-July 2021