

RUBAB AJMAL

Rochester, NY

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WORK EXPERIENCE

Robotics Engineer

Calvary Robotics

Mar 2023 – Ongoing

Webster, NY

- **Perception Sensors:**

- * Implemented intrinsic and extrinsic calibration methods for LiDAR and Camera mounted on a robot arm.
- * Developed a calibration method using least squares optimization to refine extrinsic calibration results obtained from traditional methods, such as hand-eye calibration, achieving an accuracy of 1mm.
- * Developed a ROS-based pipeline for processing unorganized point clouds, incorporating techniques for denoising and sharp feature detection.
- * Created object detection methods leveraging geometrical features for precise object localization in 3D space.
- * Implemented advanced point cloud registration techniques for precise system calibration.

- **ROS/Behavior Tree:**

- * Developed a [ROS-based system architecture](#) utilizing behavior trees for reliable and deterministic task execution.
- * Developed perception pipelines, integrated various sensors and servos for mechanical system control, and sent control commands to the robot to pick and place objects with 3mm overall accuracy.
- * Integrated safety sensors and implemented handshake protocols with the PLC to manage safety circuits and control mechanical systems.

- **MoveIt:**

- * Created a URDF model and configured MoveIt with a Kuka robot in a dynamic planning scene.
- * Developed drivers in collaboration with Kuka that sent trajectory waypoints from MoveIt to Kuka robot for motion execution.
- * Conducted trajectory optimization for high-speed, smooth, and efficient motions of the robot to achieve an overall cycle time of 45 seconds.
- * Developed a calibration method using least squares to remove any kinematic model discrepancies between the actual Kuka robot and the URDF model.

Research Assistant

University of Florida

Jan 2021 – Dec 2022

Gainesville, FL

- Developed a state estimation method for navigation of agricultural robots in GPS-denied environments, enhancing the accuracy and robustness of existing state estimation algorithms by tightly coupling camera, IMU, and GPS data through nonlinear batch optimization.
- Extracted localization information from camera images by identifying vanishing points using semantic segmentation with a convolutional neural network (CNN).
- Fused camera data with pre-integrated IMU measurements for local pose estimation and combined this with DGPS receiver data for global pose estimation.
- Validated the method by comparing pose estimation results with RTK-GPS measurements.

Production Planner

Tetra Pak

May 2018 – Mar 2020

Lahore, Pakistan

- Planned and scheduled customer orders, conducted monthly capacity and forecast analysis, managed demand leveling, and participated in shop floor improvements as an SAP ECC Super User.

Maintenance Engineer

Tetra Pak

Jun 2017 – Apr 2018

Lahore, Pakistan

- Ensured smooth operation and reliability of Slitting Machines, performed time-based maintenance, and led key projects including replacing obsolete Parker VFDs with Siemens VFDs and monitoring torque motor reliability.

Manufacturing Intern

Bulleh Shah Packages

Jun 2015 – Jul 2015

Kasur, Pakistan

- Completed 'Time and Motion' study of Package Folding Process to improve overall efficiency and developed a simple mechanical tool to speed up folding and gluing of packages.

KEY ACADEMIC PROJECTS

Autonomous Navigation of ClearPath Husky

Aug 2021 – Ongoing

- Calculated robot odometry in agriculture rows by fusing IMU, wheel encoders, and camera data using an **Extended Kalman Filter**. Implemented the **ROS Navigation Stack** for autonomous navigation in the fields.
- Improved odometry by integrating localization information from CNN-based semantic segmentation with IMU and wheel encoder data using a **nonlinear optimization method**.

Cotton Harvesting Robot | ASABE 3rd Prize

Mar 2022 – Jul 2022

- Designed a cotton-picking robot for the ASABE competition, focusing on navigation. Developed navigation algorithm by fusing **LiDAR and IMU** data using an Extended Kalman Filter and mapping the field with the **Iterative Closest Point (ICP)** algorithm.

Anomaly Detection in Torque Motor

Apr 2018 – Dec 2018

- Developed a **machine learning model** with fully connected layers to predict torque motor current based on twelve process values. Continuously compared predicted and actual current to detect anomalies in the torque motor.

Quadcopter Control through PID

Sep 2016 – Aug 2017

- Achieved attitude and altitude control of a quadcopter using a PID controller, tested and tuned in real-time on a frame with brushless DC motors and a Raspberry Pi controller.

EDUCATION

University of Florida

MS Agricultural Robotics

Jan 2021 – Dec 2022

Florida, US

University of Engineering and Technology

BS Mechatronics and Control Engineering

Oct 2013 – Aug 2017

Lahore, PK

GRADUATE COURSEWORK

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|----------------------------|--------------------------|--|
| • Computer Vision | • Numerical Optimization | • Pattern Recognition and Machine Learning |
| • Advanced Control Systems | • Data Diagnostics | |

TECHNICAL SKILLS

Robotic Platforms: Fanuc Robots, Kuka Robot (Integration with Moveit2 through RSI communication)

Programming: C++ (Advanced), ROS2 (Moveit2, Navigation Stack), Optimization tools (Ceres, Nlopt), Behavior Tree

Developer Tools: Visual Studio, Git, Linux, Ansible

Electronics and Embedded Systems: Jetson Nano, Arduino, Raspberry Pi, Ardupilot Flight Controller, Ouster 3D Lidar, ZED Stereo Camera, Hokuyo 2D Lidar, Microsoft Kinect Camera, Real-Sense Camera, DGPS, RTK-GPS

Mechanical Design: Solidworks

Documentation: LaTeX

CERTIFICATIONS

Self Driving Car Engineer Nanodegree - Udacity

State Estimation and Localization for Self-Driving Cars - Coursera

Learn Advanced C++ - Udemy