

Muhammad Anis

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Robotics researcher specializing in mobile robotics and autonomous navigation, with experience in developing and validating autonomous systems for industrial and research environments. Focused on reliable navigation, robot behavior, and real world implementation of mobile robot solutions

PROFESSIONAL EXPERIENCE

AALTO UNIVERSITY | Research Assistant | Autonomous Mobility Lab

May 2025 – Present

- Conducted research and development in autonomous mobile robotics, focusing on simulation, navigation, perception, control, and real-world validation.
- Developed an autonomous factory intralogistics system using the Neobotix ROX platform, including a Gazebo factory environment, Nav2 based navigation, lidar-based trolley detection, LQR-based alignment control, and real-robot testing.
- Created a complete digital twin of the ABB Flexley Tug T702 with integrated sensors, motion behavior, and simulation support in Gazebo and RViz to replicate real robot operation.
- Tested and evaluated path-planning algorithms using a MiR mobile robot platform for a CERN facility use case, focusing on navigation performance in structured industrial environments.
- Worked with ROS 2, Gazebo, RViz, Nav2, lidar point clouds, mobile robot kinematics, and feedback control for autonomous mobility applications.

PROJECTS

Developing a Tracking Based Autonomous Navigation System for Factories Intralogistics

- Developed and validated an autonomous navigation system for factory intralogistics using the Neobotix ROX Diff mobile robot platform, implementing the workflow in both Gazebo simulation and on the real robot platform.
- Integrated UWB-based sensing for coarse trolley localization with lidar point cloud processing to refine the trolley position and estimate its relative location with respect to the robot.
- Implemented an LQR-based control strategy to improve final approach accuracy and achieve precise robot alignment with the detected trolley location during docking task.

Developing a Digital Twin of the ABB Flexley Tug T702 Mobile Platform

- Developed a simulation ready digital twin of the ABB Flexley Tug T702 mobile platform, including robot geometry, sensor configuration, motion behavior, and physical properties for realistic operation in Gazebo.
- Integrated the robot model with ROS 2 and RViz to enable visualization, sensor data representation, motion testing, and validation of autonomous mobility workflows.
- Replicated the real robot's movement behavior in simulation by configuring the drivetrain, joints, sensors, and control interfaces to support testing before real-world deployment.

Comparison of Path-Finding Algorithms for Autonomous Navigation of Mobile Robots

- Implemented and evaluated A*, Dijkstra, and RRT path planning algorithms for autonomous mobile robot navigation in a CERN-inspired indoor environment.
- Tested the algorithms in simulation and on a physical robot, comparing path length, computation time, and explored nodes to assess navigation efficiency.
- Identified A* as the most balanced approach for the tested application, offering efficient computation while maintaining near-optimal path quality.

Building a Curious Robot, Hureka/ABB

- Developed an interactive human-robot collaboration system by integrating machine vision with an ABB IRB 2600 industrial robot.
- Implemented a Python-based gesture recognition pipeline using TensorFlow and OpenCV to identify human gestures and convert them into robot motion commands.
- Used ABB External Guided Motion (EGM) and RobotStudio to control real-time robot responses, enabling precise and responsive movement based on human interaction.

Modelling and Simulation of an Overhead Crane

- Developed linear and nonlinear dynamic models of an overhead crane in Simulink to analyze trolley position, velocity, rope angle, and system response under different operating conditions.
- Designed and implemented a PID controller to reduce load sway and improve crane motion stability during trolley movement.
- Implemented an LQR controller to optimize sway suppression and compare control performance against the PID-based approach.

Predicting Mobile Phone Prices Using Machine Learning Models

- Developed a Python-based machine learning model using NumPy to predict mobile phone price ranges based on technical specifications such as camera quality, processor performance, memory, battery capacity, and storage.
- Implemented and compared Logistic Regression and Support Vector Classifier models to classify mobile phones into different price categories.
- Optimized model performance using Categorical Cross-Entropy and Hinge Loss functions to improve classification accuracy and prediction reliability.

Modelling and Performance Comparison of Conventional, Hybrid, and Plug-in Hybrid Vehicles

- Designed and simulated vehicle powertrain models in Simulink for internal combustion engine, hybrid electric, and plug-in hybrid vehicle configurations.
- Evaluated vehicle performance under different standard driving cycles to compare energy consumption, fuel efficiency, power demand, and overall drivetrain behavior.
- Analyzed and compared the impact of different powertrain architectures on vehicle efficiency and dynamic performance under varying driving conditions.

EDUCATION

MSc Mechanical Engineering | Aalto University **2024-2026**
Major: Mechatronics

BE Mechanical Engineering| National University of Sciences and Technology (NUST), Islamabad **2017-2021**

AREAS OF EXPERTISE

- Python
 - Robot Studio
- C++
 - 3D Modeling
- ROS2
 - MATLAB and Simulink

Publication

- **Comparison of Path Finding Algorithm for Autonomous Navigation of Mobile Robots**
Presented : Proceedings of the 10th Baltic Mechatronics Symposium **May,2025**
- **Fatigue Analysis of Low-Pressure Steam Turbine Blades during Startup using Probabilistic Concepts**
Presented : International Conference for Advances in Mechanical Engineering, (ICAME), Islamabad, Pakistan **Aug,2021**