

Taimoor Shabbir

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PROFILE

ASEP-certified Mechatronics and Systems Engineer with strong expertise in avionics, hardware-in-the-loop (HIL) testing, and systems integration. Experienced in building modular System Integration Labs (SIL), developing real-time embedded software in C++/Qt, and leading interdisciplinary robotics projects. Passionate about solving complex engineering challenges through Model-Based Systems Engineering (MBSE), robotics, and AI-driven autonomy.

RESEARCH INTERESTS

Robotics and Intelligent Systems, Hardware-in-the-Loop/Systems Integration, Systems Integration, Architecture, Surgical Robotics, Robotic Manipulation, Autonomous Navigation, Embedded Systems, Human-Robot Interaction

EDUCATION

National University of Sciences and Technology

Islamabad, Pakistan

Bachelors in Mechatronics Engineering (GPA: 3.56/4)

Sep 2019 – Jun 2023

Thesis: Development Of A Force Sensor Integrated Surgical Instrument For Telemanipulation Based Minimally Invasive Robotic Surgery

WORK EXPERIENCE

National Aerospace Science and Technology Park

Islamabad, Pakistan

Systems Engineer

Sep 2023 – Present

- Collaborated with the team for the development of a modular System Integration Lab (SIL), implementing systems engineering technical processes across the full V-model lifecycle.
- Developed a suite of modular tools to enable and streamline modular SIL development, integration, and system-level verification.
- Optimized lab operations by auditing support and maintenance workflows and delivering automation tools, reducing technician workload and turnaround time.

Micro Nano Robotic Technologies Lab, NUST

Islamabad, Pakistan

Undergraduate Research Student

Sep 2022 – Aug 2023

- Contributed to the “**Development of Nanomaterials-based Tactile Sensors for Tele-Manipulation in Robotic Surgery**” project.
- Designed and developed a **sensorized surgical grasper** with a flexible capacitive force sensor, achieving high sensitivity, decoupled force measurement, and real-time tactile feedback through a wearable haptic band for MIS.
- Managed the **operation, maintenance, and inventory** of lab equipment and consumables, ensuring an organized and well-functioning research environment.

National Centre of Robotics & Automation (NCRA), NUST

Islamabad, Pakistan

Intern

Jun 2021 – Aug 2021

- **Implemented and validated forward and inverse kinematics algorithms** for a 6-DOF UR5 robotic manipulator in MATLAB, enabling accurate motion simulation and visualization.
- **Explored mathematical modeling and analysis of robotic systems**, gaining hands-on exposure to applications across medical, agricultural, and manufacturing domains..

PUBLICATIONS

Sensorized Laparoscopic Surgical Grasper with Integrated Capacitive Force Sensor for Robot-Assisted Minimally Invasive Surgery

Muhammad Usman, Muhammad Rehan, **Taimoor Shabbir**, Mohsin I. Tiwana, Muhammad M. Saleem

Journal of Sensor Review, 2025. [0.1108/SR-09-2024-0765](#)

TECHNICAL SKILLS

Foundations: Robotics, Control Theory, Mathematics Systems Engineering Principles

Robotics & Control: Ubuntu, ROS, Gazebo, CoppeliaSim, MATLAB/Simulink, LabVIEW

Programming: C/C++, Python, Assembly, Qt Framework, MATLAB

Embedded Systems: AVR, ESP32, ATmega2560

Modeling & Simulation: SolidWorks, COMSOL, ANSYS Workbench, MBSE

Version Control & Tools: Git/GitLab, JIRA, IBM DOORS, Visual Studio

Communication Protocols: UART, SPI, I2C, RS-232/485, DDS, MIL-STD-1553B, UDP/TCP

ACADEMIC PROJECTS

- **Indigenous Automated Fruit Plucking Robot:** Designed and Developed a fully automated fruit plucking robot with optimized mechanical design, rapid prototyping, PID-controlled locomotion, & algorithmic improvements, achieving a 36% reduction in task completion time & a 90% improvement in plucking efficiency.
- **Autonomous Robot Navigation:** Developed an RRT-based autonomous car navigation simulation with dynamic obstacle avoidance and pathfinding visualization using Python.
- **Path Optimization Using Machine Learning for UR5 Robotic Arm:** Implemented a machine learning-based trajectory optimization system for the UR5 robotic arm, minimizing energy and time costs through regression models and dynamic visualization of robotic paths using MATLAB.

PROFESSIONAL EXPERIENCE

- **System Integration of Modular HIL Testbench:** Performed full integration by interfacing MUX-Bus emulator, subsystem simulators, stimulators, and the Data Acquisition & Control System (DACS) with the mission computer via MIL-STD-1553, DDS (UDP), and discrete I/O. Enabled synchronized subsystem communication and deterministic real-time test execution.
- **Data Acquisition & Control System (DACS):** Developed using C++ and object-oriented design with NI PXIe cards, DAQmx APIs, Qt-based UI, DDS, and XML configuration. Applied design patterns for modularity, maintainability, and scalable multi-subsystem coordination.
- **1553 Multiplex Bus Emulator (MBE):** Designed a MIL-STD-1553 compliant emulator in C++ with modular real-time message transfer between Bus Controller and Remote Terminals via DDS. Implemented ISF-based dynamic configuration, Qt GUI for monitoring, and middleware library for enhanced abstraction.
- **Connection Tracing Tool:** Digitized complex SIL wiring layouts with an interactive Qt-based interface that imports Excel data to auto-generate diagrams and tables. Reduced wiring fault isolation time from hours to seconds and ensured reusability across lab and aircraft configurations.

CERTIFICATIONS

Associate Systems Engineering Professional (ASEP)  – International Council on Systems Engineering (INCOSE)

E-LEARNING

- Modern Robotics (Course 1 & 2) – Coursera / Northwestern University
- Linux for Robotics – The Construct
- Supervised Machine Learning: Regression & Classification – Coursera
- Machine Learning with Python – Coursera / IBM
- Deep Learning Applications for Computer Vision – Coursera
- Data Analysis with Python – Coursera / IBM

AWARDS & ACHIVEMENTS

- **1st Runner-up, National Engineering Robotics Contest (NERC'22):** Led the team in the indigenous category of Pakistan's largest robotics contest.
- **Robotics & Automation Club Lead:** Organized and mentored cross-department students via robotics fundamentals and a series of programming (C/C++) workshops for robotics beginners.
- **Ignite National Technology Competition:** Secured funding in the Ignite National Technology competition.
- **Academic Excellence Award:** Recognized for achieving GPA > 3.5 in four consecutive semesters.