

# 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

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**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

## Projects

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- **Indigenous Automated Fruit Plucking Robot:** Designed and Developed a fully automated fruit plucking robot with optimized mechanical design, rapid prototyping, PID-controlled locomotion, and algorithmic improvements, achieving a 36% reduction in task completion time and 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

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- **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 ADTL2 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

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

## E-Learning

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- 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 & Achievements

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- **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.