Taimoor Shabbir

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Education

- **National University Of Sciences and Technology** NUST, Islamabad
  Bachelors in Mechatronics Engineering; ***GPA: 3.56/4*** *Sep 2019 – June 2023*
  - **Thesis:** : Development Of A Force Sensor Integrated Surgical Instrument For Telemanipulation Based Minimally Invasive Robotic Surgery

Experience

- **National Aerospace Science and Technology Park | 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, including a C++/Qt Data Acquisition & Control System (DACS), a MIL-STD-1553B Multiplex Bus Emulator, and software simulators, 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 | 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 procedures.
  - Managed the **operation, maintenance, and inventory** of lab equipment and consumables, ensuring an organized and well-functioning research environment.
- **NATIONAL CENTRE OF ROBOTICS & AUTOMATION, NUST | 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.

Publication

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

Muhammad Usman, Muhammad Rehan, **Taimoor Shabbir**, Mohsin Islam Tiwana, Muhammad Mubasher Saleem, Muhammad Ameer Hamza

Journal of Sensor Review, 2025.

Technical Skills

- **Foundations:** Strong grounding in robotics, mathematics, control theory, and systems engineering principles
- **Robotics & Control:** Ubuntu, ROS, Gazebo, CoppeliaSim, MATLAB/Simulink (control design), LabVIEW
- **Programming & Development:** C/C++, Python, Assembly, Qt Framework
- **Embedded Systems:** AVR, ESP32, ATmega2560
- **Modeling & Simulation:** SolidWorks (CAD), COMSOL, ANSYS Workbench
- **Version Control & Tools:** Git/GitLab, JIRA, IBM DOORS, Visual Studio
- **Communication Protocols:** UART, SPI, I2C, RS-232/485, DDS, MIL-STD-1553B, UDP/TCP

Academics Projects

- **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.
- **Sensorized Integrated Surgical Instrument:** Designed and developed a sensorized laparoscopic grasper with a novel flexible capacitive force sensor, enabling force component decoupling and real-time haptic feedback through a wearable band, validated via FEM simulations and electromechanical optimization for enhanced surgical precision.
- **Optimization and Simulation of a Cart-Pendulum System:** Developed and optimized a dynamic control system for a cart-pendulum setup, incorporating simulation, trajectory optimization, and visual animation in MATLAB, to achieve precise pendulum tip positioning under constraints.

Certifications

- **Associate Systems Engineering Professional (ASEP) certified by the International Council on Systems Engineering (INCOSE)**

E-Learning

1. Modern Robotics, Course 1: Foundations of Robot Motion 2. Modern Robotics, Course 2: Robot Kinematics
3. Linux for Robotics 4. Supervised Machine Learning: Regression and Classification 5. Machine Learning with Python
6. Deep Learning Applications for Computer Vision 7. Machine Learning Introduction 8. Data Analysis with Python

Honors and Awards

- **1st Runner-up Robotics Contest:**: Led the team in the indigenous category of Pakistan's largest robotics contest; National Engineering Robotics Contest 2022 (NERC'22).
- **Robotics and Automation Club (RAC)**: Organized and mentored 50+ cross-department students via robotics fundamentals and a series of programming (C/C++) workshops for robotics beginners.
- **Project Funding Competition** : Secured funding in the Ignite National Technology competition
- **Academic Excellence Award**: Received this award from NUST for consistently achieving 3.5 above GPA in three consecutive semesters.