FIDA HUSSAIN

Mechatronics & Control Engineering Student
Lahore, Pakistan | +92 312 4489925 | fida57840@gmail.com | LinkedIn | GitHub | Portfolio

PROFILE SUMMARY

Mechatronics and Control Engineering student with hands-on research experience in robotic manipulation, human-robot collaboration, intelligent control, and computer vision. Experienced in developing real-time robotic systems using Franka Emika Panda, ROS2, and Python/C++. Currently working on CASCADE, a proactive human-robot collaboration system combining human intention prediction, anticipatory task allocation, and collision-aware execution. Interested in humanoid robotics and intelligent systems that can safely anticipate and collaborate with humans.

RESEARCH INTERESTS

Humanoid Robotics | Proactive Human–Robot Collaboration | Human Intention Prediction | Embodied AI and Robot Learning | Safe Physical Human–Robot Interaction | Intelligent and Compliant Robot Control

EDUCATION

University of Engineering and Technology (UET), Lahore Expected July 2027
B.Sc. Mechatronics and Control Engineering — CGPA: 3.717 / 4.00

PROJECTS

CASCADE — Collaborative Anticipatory Stacking with Collision-Aware Dynamic Execution 2025 – Present
Final Year Project | Franka Emika Panda | ROS2 | RGB-D Vision | LSTM / Transformer Models | Human Intention Prediction

- Developing CASCADE, a proactive collaboration system on the Franka Emika Panda that anticipates human actions during shared assembly tasks instead of only reacting to them.
- Building an RGB-D hand-tracking perception pipeline and a custom manipulation dataset (target: 60–100 participants, ~20 trials each) covering reaching, grasping, transporting, placing, retracting, and idle; investigating LSTM and Transformer models for intention prediction.
- Designing anticipatory task allocation so the robot works on a complementary component, with assembly-sequence monitoring and automatic recovery from misplaced parts.
- Implementing collision-aware execution in ROS 2 using proximity-based safe, caution, and critical zones (speed reduction, trajectory modification, or stopping).

Real-Time Image Colorization & Enhancement System 2024
Python | OpenCV | Deep Learning (Caffe) | PyQt5 | GUI Development

- Built a hybrid image processing system combining OpenCV colormap-based false colorization with a deep learning model for realistic image colorization, with an interactive PyQt5 GUI for real-time preview and adjustment.

ML-Based Condition Monitoring System for a Vertical Drill Machine 2025
Multi-Sensor Fusion | Arduino | Python | XGBoost, Random Forest, SVM, Decision Tree | Real-Time Dashboard

- Designed a 4-sensor monitoring system (current, vibration, temperature, humidity) sampling at 20 Hz via Arduino, with sensor-specific signal conditioning (low-pass, moving average, exponential moving average filters).
- Built a physics-based phase-detection algorithm and a 35+ feature sliding-window extraction pipeline (statistical, temporal, and cross-sensor features) from raw sensor data.
- Trained and compared XGBoost, Random Forest, SVM, and Decision Tree classifiers across multiple feature sets to classify tool condition into 8 categories, achieving 98% test accuracy with XGBoost.
- Deployed a dashboard with live health scoring, model confidence, and maintenance recommendations; validated on unseen data.

End-to-End Data Science Pipeline with Interactive Dashboard 2025
Python | Scikit-learn | Regression, Classification & Clustering | Streamlit | Feature Engineering

- Built a full ML pipeline on a 19,700+ record sensor dataset: data cleaning, feature engineering, and a scikit-learn pipeline to predict continuous energy consumption (Wh) via regression.
- Built classification models (Logistic Regression, Random Forest) and K-Means clustering (with PCA) to categorize and profile consumption patterns; deployed all results in an interactive Streamlit dashboard.

CanSat Competition — National Sensor Fusion & Landing Prediction System 2024
IMU | Magnetometer | Barometer | GPS | Sensor Fusion | Real-Time State Estimation

- Secured 5th position nationwide (all Pakistan) in the CanSat competition organized under SUPARCO.
- Fused IMU, magnetometer, barometer, and GPS data into a real-time inertial frame for attitude and position tracking.
- Developed a predictive algorithm to estimate satellite landing location and time within the first 5 seconds of descent.

Beam Balancing System — Dual BLDC Motor Attitude Control 2024
PID Control | MPU6050 IMU | TM4C123GH6PM | Embedded C

- Designed and implemented a closed-loop PID controller to balance a rigid beam at commanded angles between -20° and +20°.
- Used MPU6050 IMU sensor data fused with gyroscope readings for stable real-time attitude estimation.
- Demonstrated robust disturbance rejection against asymmetric weight imbalances of 10–20 g.
- Implemented dual-motor drive control logic on a TM4C123GH6PM microcontroller in C.

EXPERIENCE

Robotics Research Intern — Human-Centered Robotics Lab (HCR-L), UET Lahore Jul 1 – Sep 7, 2026
ROS2 | MoveIt | Pinocchio | AprilTag Vision | Franka Emika Panda

- In a team of three, built a full-stack manipulation pipeline on the Franka Panda, from simulation to ROS2 hardware deployment, using Pinocchio for inverse kinematics and MoveIt for motion planning.
- Developed a calibrated perception pipeline with an external overhead camera and AprilTag-based object detection, enabling autonomous pick, place, and stacking of cubes with precise spatial accuracy.
- Extended the system with color-based object detection for a vision-driven Tic-Tac-Toe application, with real-time game-state perception and move execution.
- Represented HCR-L at the Indus RAS Expo 2026, Islamabad.

Instructor & Organizer — Human-Centered Robotics Bootcamp (Project BRIDGE) Jul 22 – Aug 5, 2026
UET Lahore | HCR-L | MuJoCo | ROS2 | Franka Emika Panda

- Prepared the bootcamp from 22 July: built a GitHub repository with a clear README for independent setup, plus pick-and-place and obstacle-avoidance demos for the Panda in MuJoCo simulation.
- Delivered the 3-day bootcamp (3–5 August) under the EU co-funded BRIDGE project to professors from partner institutes, covering the ROS2 introduction, robotic manipulation, dynamic collision avoidance in simulation, and an introduction to the Panda arm.
- Mentored participants through hands-on project work and a hardware demonstration using Franka Desk; recognized with a Certificate of Appreciation.

Semester Project — Impedance Control of Franka Emika Panda (7-DOF) Feb 2026 – Jun 2026
UET Lahore | ROS2 | libfranka | C++ | Genetic Algorithms | Sensor-based Calibration

- Designed and implemented a real-time Cartesian impedance controller (1 kHz) on the Franka Panda using ROS2 and libfranka, including analytical forward kinematics and Jacobian-based torque mapping.
- Built a hand-guiding and trajectory replay module with waypoint recording, gravity/Coriolis compensation, and a custom keyboard-driven operator interface for real-time control.
- Applied a genetic algorithm to jointly optimize stiffness/damping, cutting final tracking error to 3.10 mm (60% better than default).
- Added a multi-tier real-time safety system (torque, error-growth, and oscillation aborts) for safe automated hardware testing.

Research Intern — Swarm Robotics, Embedded Systems Lab, UET Lahore Summer 2024 (2 months)
Crazyflie Nano-Quadrotors | Motion Capture | Localization & Sensor Data Analysis

- Operated a Crazyflie nano-quadrotor swarm (Flow Deck, Loco Positioning) for autonomous indoor flight, capturing 6-DOF motion data with motion capture as ground truth.
- Performed quantitative trajectory comparison between reference, motion-capture ground truth, and onboard IMU estimates to characterize localization error.

TECHNICAL SKILLS

- **Programming & Tools:** Python, C, C++, Git/GitHub
- **Robotics:** ROS2, MoveIt, Pinocchio, MuJoCo, libfranka, Impedance/PID Control, MATLAB
- **AI / Machine Learning:** Scikit-learn, Pandas, NumPy, Matplotlib, Streamlit, Deep Learning (Caffe)
- **Computer Vision:** OpenCV, AprilTag & Color-Based Detection, Image Processing
- **Embedded Systems:** Embedded C, Arduino, TM4C123GH6PM (Tiva C), MPU6050 IMU

CERTIFICATIONS & ACTIVITIES

- Python for Everybody (U. Michigan) | Prompt Engineering for Everyone (IBM) | Ethics in AI (LinkedIn Learning)
- Head of Technical Team, Mechatronics Club | Co-Head, Robotics Team, IEEE/IET (UET Lahore) | 1st place in two robotics competitions