

RUTUPARNA RATNAKAR KULKARNI

Mechatronics & Robotics Engineer

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PROFILE

Mechatronics and Automation Engineering student with a multidisciplinary focus on **robotics, autonomous systems, controls, perception, mechanical design, and simulation**. Hands-on experience spanning **industrial robotics, autonomous underwater vehicles, computer vision, biomimetic mechanisms, CFD, ROS 2, embedded systems, and mathematical modeling**. Experienced in cross-functional engineering through international robotics competitions, industrial internship, research, and student-led robotics development.

EDUCATION

Vellore Institute of Technology, Chennai
B.Tech. in Mechatronics and Automation Engineering

2023 – 2027
CGPA: 8.6/10

EXPERIENCE

Kawasaki Robotics India Pvt. Ltd.
Robotics R&D Systems Intern

May 2026 – July 2026
Coimbatore, India

- Worked on **industrial robotic vision systems**, focusing on camera-based perception, coordinate transformations, calibration, and integration of vision systems with robotic platforms.
- Worked with **ROS 2 TF/TF2** for understanding and validating coordinate relationships between cameras, robot frames, and other reference frames in robotic workflows.
- Used **RViz2, Foxglove, ROS 2, computer vision, and simulation** tools for visualization, debugging, sensor integration, and validation of robotic perception workflows.
- Gained exposure to industrial robotic-arm applications and the integration of perception, coordinate frames, and robot-system software in manufacturing environments.

Dreadnought Robotics – International Student Team
Mechanical Head

Sep 2025 – Present
VIT Chennai

- Lead the mechanical development and system integration of an **Autonomous Underwater Vehicle (AUV)** for international underwater robotics competitions.
- Responsible for **CAD architecture, hull design, structural layout, propulsion integration, sealing and waterproofing strategies**, and mechanical subsystem development.
- Coordinate interfaces between **mechanical, electronics, embedded, software, and autonomy teams** to ensure system-level integration of the vehicle.
- Contribute to hydrodynamic analysis, simulation planning, mechanical validation, and design decisions for autonomous underwater operation.

Electra Enterprises
Summer Industrial Intern – Electrical & Control Systems

May 2025 – Jun 2025
Pune, India

- Worked on manufacturing, testing, and fault analysis of **transformers and servo voltage stabilisers**.
- Gained practical exposure to **servo control mechanisms, control PCBs, relays, protection circuits, and industrial wiring**.
- Observed industrial testing and troubleshooting practices for electrical and control-system equipment.

PROJECTS

Autonomous Underwater Vehicle (AUV) | ROS 2, Gazebo, CAD, CFD, Controls

Jul 2024 – Present

- Designed a modular AUV architecture covering **hull design, propulsion layout, structural integration, sealing, and system-level control architecture**.
- Performed **hydrodynamic CFD analysis** to study vehicle behaviour and support mechanical design and stability decisions.
- Developed a **ROS 2 and Gazebo-based simulation roadmap** for testing navigation, stability, sensing, and system behaviour prior to physical prototyping.
- Worked on the integration of mechanical, electrical, embedded, sensing, and autonomy subsystems for a competition-oriented autonomous marine platform.

Aranyaksha – Biomimetic Ornithopter | Mechanism Design, Kinematics, System Integration

Oct 2025 – Present

- Designed a biomimetic flapping-wing ornithopter intended for **silent wildlife surveillance**.
- Focused on **mechanism architecture, kinematic analysis, flapping motion, actuation strategy, and mechanical integration**.
- Developed the system to the detailed design stage, with further prototype development dependent on available fabrication resources.

GearDefectDetector | Python, OpenCV, YOLOv8, Computer Vision

2025

- Developed a computer-vision workflow for automated **gear-defect detection** using YOLOv8 and OpenCV.

- Worked across dataset preparation, image preprocessing, model training, object detection, and vision-based inspection.
- Explored automated visual inspection as an industrial quality-control application combining machine learning with manufacturing systems.

F1 DRS Aerodynamic Simulation | *CFD, Mathematical Modeling, Simulation* 2025

- Investigated aerodynamic behaviour of an F1-inspired **Drag Reduction System (DRS)** configuration using computational fluid-dynamics simulation.
- Used mathematical and simulation-based analysis to study aerodynamic effects and support engineering design decisions.

Smart Pneumatic Device for CPR | *Mechatronics, Pneumatics, Control* 2025

- Developed a concept for an automated pneumatic compression system designed to assist CPR through controlled mechanical actuation.
- Integrated mechanical design, pneumatic actuation, sensing, and control-system concepts into a mechatronic architecture.

Smart Solar-Powered Irrigation System | *Embedded Systems, Automation* 2024 – 2025

- Developed a smart irrigation concept integrating solar power, sensing, automated actuation, and control for efficient agricultural water management.

Techfest “Cosmoclench” Robotics Project | *Robotics, Mechanical Design, Control* 2024

- Built and deployed a competitive robotics system for a national-level technical competition.
- Contributed to **mechanical design, system integration, rapid prototyping, and control implementation** under competition constraints.

Embedded & Robotic Systems Projects | *Embedded Systems, Controls, Electronics* 2024 – Present

- Worked on a range of mechatronic prototypes including **HUD systems, smart glasses, smart helmet, animatronics, and robotic platforms**, integrating mechanical, electronic, embedded, and software components.
- Explored mathematical simulation and system modelling for **DC motors, robotic manipulators, mobile robots, AUVs, and other dynamic systems**.

TECHNICAL SKILLS

Robotics & Autonomous Systems: ROS 2, Gazebo Harmonic, RViz2, Foxglove, TF/TF2, Robot Simulation, System Integration, Sensor Integration, Autonomous Navigation

Controls & Systems: PID Control, State-Space Modeling, Feedback Control, System Dynamics, Mathematical Modeling, Sensor Fusion, Control-System Simulation

Mechanical Engineering: SolidWorks, CAD/CAM, Mechanism Design, Kinematic Analysis, Structural Design, Product Development, CFD, Hydrodynamic Analysis

Perception & AI: Python, OpenCV, YOLOv8, Machine Learning, Computer Vision, Image Processing, Sensor Data Processing

Embedded & Electronics: Embedded C/C++, Microcontrollers, PCB Fundamentals, Relays, Protection Circuits, Industrial Wiring

Programming & Software: Python, C++, MATLAB, Git, GitHub, Ubuntu Linux, VS Code, Jupyter, Numerical Simulation

Simulation & Engineering Tools: MATLAB/Simulink, Gazebo, Webots, SolidWorks, CFD, Mathematical Simulation, Digital Twin Concepts

LEADERSHIP & ACHIEVEMENTS

- **Mechanical Head – Dreadnought Robotics:** Lead mechanical development and cross-functional system integration for the team’s autonomous underwater robotics platform.
- **SAUVC 2026 – Sanya, China:** Qualified for the **Singapore AUV Challenge (SAUVC)** as part of Dreadnought Robotics with an autonomous underwater vehicle.
- **IEEE Oceanic Engineering Conference 2026 – Sanya, China:** Received the **Innovation Award** for the team’s underwater robotics work and innovative engineering approach.
- **TAU Autonomy Competition (TAC) 2026 – Stavanger, Norway:** Qualified for the international autonomous systems competition as part of Dreadnought Robotics.
- **Techfest – IIT Bombay:** Participated in national-level technical and robotics challenges, contributing to rapid prototyping, mechanical design, and system integration.
- **Smart India Hackathon (SIH):** Participated in the national-level innovation challenge, contributing to technical problem-solving and prototype development.
- **Associate Treasurer – Rotaract Club of VIT Chennai:** Supported budgeting, fund management, and coordination of student-led initiatives.

PATENTS & PUBLICATIONS

- **Publication:** *An Augmented Reality Enabled Mobile Decision Support System for Intelligent Crop Recommendation and Yield Estimation*, published in *Results in Engineering*, 2026. DOI: [10.1016/j.rineng.2026.110853](https://doi.org/10.1016/j.rineng.2026.110853).
- **Patent Application:** Collaborative patent application in engineering and technology. **Indian Patent Application No.: 202641093239.**