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Tanmay Ghai

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ABOUT ME

Master's student in Mobile Robotics at Universität Bonn with a background in Mechatronics and Automation. Experienced in ROS2-based autonomous systems, SLAM, and robot control. Currently working on frontier-based Active SLAM for object search and whole-body control for the Unitree G1 humanoid robot. Passionate about building intelligent robotic systems and contributing to applied robotics research.

EDUCATION AND TRAINING

Master of Science

Universität bonn [09/2025 – Current]

City: Bonn | **Country:** Germany | **Field(s) of study:** Mobile Robotics

Bachelor of Technology

Vellore Institute of Technology [09/2020 – 08/2024]

City: Chennai, Tamil Nadu | **Country:** India | **Field(s) of study:** Mechatronics and Automation | **Final grade:** 8.11 CGPA

LANGUAGE SKILLS

Mother tongue(s): Hindi

Other language(s): English | German

PROJECTS

[04/2026 – Current]

Active SLAM-Based Object Search and 3D Reconstruction

- Developed a ROS2/Nav2-based frontier explorer for autonomous map exploration using TurtleBot3 in Gazebo simulation
- Implemented BFS-based frontier detection, goal blacklisting, and dynamic obstacle avoidance
- Debugged and resolved critical issues including timer stacking, blocking action server calls, and hardcoded orientation causing wall collisions
- Integrated map saving and return-to-home behavior upon exploration completion
- Part of a team project supervised by Luca Lobefaro, Universität Bonn, with progress reviews by Prof. Cyrill Stachniss.

[05/2026 – Current]

Whole-Body Control for Humanoid Robot - Unitree G1

- Implemented stable standing balance on the Unitree G1 humanoid robot using TSID (Task Space Inverse Dynamics)
- Set up full simulation environment using MuJoCo and Pinocchio for rigid body dynamics
- Achieved stable standing with near-zero velocity norm as Phase 1 milestone
- Supervised by Shahram Khorshidi, Universität Bonn.

[01/2024 – 04/2024]

Robotic Dog for Search and Rescue Operations

- Developed a quadruped robotic dog for hazardous search and rescue operations, integrating thermal imaging and object detection to identify survivors in low-visibility environments.
- Designed and fabricated a custom 3D-printed robotic frame, optimizing stability and maneuverability for navigating complex terrains.

- Implemented inverse kinematics-based locomotion control, enabling stable gait generation and remote teleoperation via a WiFi-based interface.
- Integrated a MLX90640 thermal camera and YOLOv8 object detection model for real-time situational awareness and autonomous hazard detection.
- Processed sensor data using computer vision techniques and machine learning algorithms, enhancing rescue mission efficiency.

[08/10/2023 – 08/12/2023]

IoT-Based Condition Monitoring & Predictive Maintenance System

- Developed a real-time condition monitoring system for an air compressor, integrating accelerometers and temperature sensors to track vibration and temperature fluctuations.
- Utilized ThingSpeak for real-time data visualization, logging sensor data and triggering automated alerts when threshold values were exceeded.
- Implemented predictive maintenance by identifying pattern deviations, enabling proactive fault detection and anomaly analysis.
- Overcame challenges related to sensor calibration, ESP8266-ThingSpeak integration, and latency issues to improve system reliability.

[03/2023 – 04/2023]

Human Following Robot

- Designed and developed an autonomous robot capable of following a human subject using ultrasonic and infrared sensors for motion tracking.
- Integrated an Arduino Uno with an L293D motor driver to control DC geared motors, enabling real-time navigation and obstacle avoidance.
- Implemented a sensor fusion approach to ensure accurate tracking while minimizing external interference.
- Built a modular chassis to accommodate potential upgrades such as camera-based tracking, voice recognition, and WiFi connectivity.

[09/2022 – 10/2022]

Face Recognition Attendance System

- Developed a real-time facial recognition-based attendance system for classrooms using Python's Face Recognition library and OpenCV.
- Implemented machine learning techniques, including Support Vector Machines (SVM), for accurate face classification and recognition.
- Designed an automated attendance logging system, eliminating the need for manual roll calls and improving efficiency.
- Optimized the model for high accuracy and low false positives, ensuring reliable identification even under varying lighting and facial orientations.

[05/2021 – 07/2021]

Quadcopter Drone

- Designed and developed a remotely controlled quadcopter using Arduino Uno, brushless motors, and electronic speed controllers (ESCs).
- Integrated an RF transmitter and receiver for wireless control, enabling stable flight and maneuverability.
- Implemented PID-based flight stabilization, optimizing motor speeds for smooth altitude control and directional movement.
- Engineered a lightweight frame to enhance flight efficiency and durability.
- Successfully tested and calibrated the drone for manual remote operation, ensuring precise throttle, pitch, roll, and yaw control.

SKILLS

Python (computer programming) / C++ / ROS2 (Robot Operating System) / NAV2 / Gazebo (Robotics simulator) / MuJoCo / Pinocchio / TSID / machine learning / Frontier based Exploration / Graph SLAM / 3D Mapping / C / OpenCV / Raspberry Pi / Arduino / ESP Family / Sensors & Actuators / Linux / Solidworks / ANSYS

INTERNSHIPS

[06/2024 – 09/2025]

Process Management and Automation Intern- Metalogics India

- Contributed to the development and setup of an automated production line, working closely with engineers to ensure smooth integration into the existing manufacturing system.
- Supervised and coordinated with labor teams, ensuring work **aligned** with planned schedules while maintaining product quality.
- Operated industrial machinery including laser cutting and paper cutting machines, gaining hands-on experience in automated production processes.

[06/2023 – 07/2023]

Solid State Physics Laboratory - Research Intern - DRDO

- Worked with MEMS sensors and actuators, gaining insights into their applications in precision systems.
- Studied the mechanical properties and dynamic behavior of cantilever beams, applying concepts to MEMS-based designs.
- Designed and analyzed microstructures using SolidWorks and ANSYS, validating results through computational simulations.
- Developed and simulated a MEMS-based crab-shaped accelerometer, optimizing its sensitivity and performance for real-world applications.
- Explored MEMS device modeling and simulation using COMSOL Multiphysics and CoventorWare, enhancing proficiency in finite element analysis (FEA) and multiphysics simulations.

CERTIFICATIONS

[15/02/2024 – 24/03/2024]

Robotics Automation and Software Simulation in AI

- Completed a 30-day industrial training program focused on robotics automation, software simulation, and AI-driven control systems.
- Gained hands-on experience in robotic simulation tools, AI-based automation, and real-world industrial applications.

WORKSHOP

[24/09/2021 – 23/10/2021]

ROBONETICS - Tech Analogy

- Participated in a robotics workshop focused on robotics implementation and applications, conducted by Tech Analogy.
- Gained hands-on experience in robotic systems, automation, and control mechanisms.

EXTRACURRICULAR ACTIVITIES

[05/2021 – 05/2022]

Mechanical and Automation team, HUMANOID CLUB

- Member of the Humanoid Club's mechanical and automation team, gaining introductory exposure to CAD modeling and mechanical design using SolidWorks.

[04/2014 – 04/2020]

Junior diploma in Tabla

- Have been playing Tabla for 9+ years and earned a Junior Diploma in Tabla, showcasing proficiency in Indian classical percussion.

[05/2015 – 05/2020]

Indian Orchestra Team, GD Goenka public school

- Represented the Indian orchestra team and secured two zonal victories in classical percussion performances.