

TEJAL ASHWINI BARNWAL

🌐 tejalbarnwal.github.io | ✉ tejalbarnwal@gmail.com | 🌐 github.com/tejalbarnwal | in [tejal-barnwal](#)

EDUCATION

Indian Institute of Technology Bombay

(Jul '19 - Aug '23)

Bachelor of Technology in Mechanical Engg, GPA: 8.22/10.0

Mumbai, India

- **Key Coursework:** Kinematics and Dynamics of Machines, Machine Design, Introduction to ML, Image Processing, Probability & Stochastic Models, Motion Planning, Design Optimization, NonLinear Control Theory
- **Achievements:**
 - **ROS Conference 2024**, held in Odense: Global Diversity Scholar & delivered a lightning talk 🎤
 - **Open-Source Contributions:** Engaging in projects like Ardupilot, adding & testing features

PROFESSIONAL EXPERIENCE

Newspace Research and Technologies | Robotics Software Engineer

(Aug '23 - Ongoing)

An aerospace based defence startup focused on military surveillance, logistics and disaster relief

Bengaluru, India

- **Precision Landing**
 - Customized Ardupilot Land mode for **aruco-based precise landing** on static and very slow-moving targets, achieving **20cm precision** with a 5 kg drone
 - Integrated a constant velocity-based **Kalman filter** (C++) and synchronized RTCP-derived image frame timestamps with drone odometry using ROS1
- **Vision-Based Interception:** Implemented **vision-based pure pursuit** guidance for drone target interception, attaining **2.0m accuracy** at speeds up to 15 m/s on a 2kg drone
- **General Vision-Based Navigation:** Developed vision-based navigation for high-velocity fly above and markerless landings, achieving **average 6m accurate landings** from 200m and 500m altitudes on 20kg and 40kg drones
- **Geometric Controller:** Implemented and validated a throttle and attitude rate geometric controller for a drone, enabling stable flight at speeds up to 7 m/s in both SITL and hardware
- **Gimbal Control:** Designed and tested a look-at feature for gimbal control, enabling the drone to orient the camera toward specific lat-long coordinates at speeds up to 10 m/s
- **Time Synchronization:** Adapted a driver to timestamp the on-board computer(Jetson based) with GPS time using Chrony, enabling time synchronization with Pixhawk via shared memory

Google Summer of Code – Open Robotics | Student Developer

(May '23 - Aug '23)

- Improved **ROS2** & Gazebo maritime simulation (VRX) performance via code refactoring & wave model integration

RESEARCH EXPERIENCE

TRACE Paw: Terrain Recognition And Contact force Estimation Paw 🎤

(May '22 - May '23)

Guide: Prof. Dr. Kostas Alexis, Autonomous Robots Lab (ARL)

NTNU, Trondheim, Norway

- Designed and **prototyped an open-source** 🎤, sensorized paw for legged robots, integrating Arduino Nicla Vision for real-time vision-based 3D force estimation (up to 150N) and audio-driven terrain classification
- Developed and deployed FCNN-based **TFLite** models and classical algorithms (PCA, blob detection & **optical flow**) on edge devices using **Micropython** and OpenMV for force analysis
- Implemented sensor fusion (LSM6DSOX IMU) for orientation tracking and tested flexible materials (TPU, EPU, Silicone) to optimize the compliant pad for accurate terrain interaction

PUBLICATION

- Aleksander Vangen, **Tejal Barnwal**, Jørgen Anker Olsen, Kostas Alexis, **Terrain Recognition and Contact Force Estimation Through a Sensorized Paw for Legged Robots**, *accepted at 21st International Conference on Advanced Robotics (ICAR), 2023*

STUDENT COMPETITIONS

The Robotic Charging Challenge | 11th InterIIT Tech Meet

(Feb '23)

Worked in a team of 8 to design a robotic arm capable of autonomously charging an electric vehicle

- **Ranked 2nd** across 23 IITs | Devised a 6-DOF robotic arm performing plug detection and move towards it
- Implemented joint space **trajectory planning** considering velocity limits using a trapezoidal velocity profile

Vision Based Obstacle Avoidance Drone | 9th InterIIT Tech Meet

(Mar '21)

Worked in a team of 8 to autonomously explore static cluttered environments & land on target after detection

- **Ranked 6th** across 23 IITs and devised a navigation pipeline with three layers of intelligence algorithms
- Developed **scan & survey pipeline** to negotiate dead ends inside ROS/Gazebo using **ArduPilot SITL**

- Intelligent Picking Robot** | Flipkart Grid 2.0-Robotics Challenge (Jun '20 - Aug '20)
 Worked in a team of 5 on an autonomous robotic arm capable of picking and transporting items in a warehouse
- Among the **top 2%** teams qualified for Level 3 out of 6000+ teams registered for Level 1 from all over India
 - Designed a **4-DOF robotic manipulator** & visualized pick and place on RViz using **MoveIt** framework
- International Micro-mouse Challenge** | Techfest, IIT Bombay (Dec '20)
 Simulated an autonomous bot using ROS & Gazebo to solve an unknown maze in the shortest time possible
- Bagged **1st position** and implemented **omni-wheel** drive and PD controller to reduce steering latency
 - Designed an **breadth-first search** based planning algorithm while incrementally building a maze representation

KEY TECHNICAL PROJECTS

- SeDriCa** | Unmesh Mashruwala Innovation Cell, IIT Bombay (May '21 - May '23)
 Participating in **self-drive challenge** of Annual Intelligent Ground Vehicle Challenge(IGVC)' 23
- Led Decision-Making and Localization** sub-divisions and developed pipelines for road driving scenarios
 - Implemented custom-made **Finite State Machine** based behavioural architecture using ROS1 Action Servers
 - Developed vehicle sensor plugins and task-specific environments to self-drive simulation stack on Gazebo Classic
- Precision Agriculture with Quadrotors** (May '21 - Nov '21)
 Guides: Prof. Hemendra Arya and Prof. Arpita Sinha Systems and Controls Department, IIT Bombay
- Performed autonomous **raster scan** on custom crop-field Gazebo world using **PX4 SITL** and **MAVROS**
 - Implemented **sliding mode control(20Hz)** on MATLAB/Simulink & studied PX4 developer's documentation
- Institute Mess Digitization Project** | Institute Technical Council, IIT Bombay (Dec '20 - Apr '21)
 Digitized institute mess to replace mess cards with student ID Cards reducing the workload of mess workers
- Developed an in-house product prototype to be deployed in all the institute messes used by **10k+ students**
 - Conceptualized a **Master/Slave** architecture (R-Pi/ ESP32) and integrated it with RC522 **RFID** reader
 - Employed **MQTT** protocol to establish communication between **Raspberry Pi 3B** and multiple ESP32s

COURSE PROJECTS

- Adaptive Control of Autonomous Vehicle** | SC617: Adaptive Control Theory (Nov '21)
- Implemented dynamic 2D bicycle model to capture vehicle motion in normal driving conditions
 - Designed an adaptive back-stepping controller and carried out simulations using MATLAB/ Simulink
- Motion Planning with Turtle-Bot** | SC627: Motion Planning of Autonomous Vehicles (Apr '23)
- Implemented and validated algorithm Bug1 and Potential Field Algorithm with hardware deployment
- Optimization of Drone Delivery Routes** | AE755: Optimization for Engineering Design (Apr '23)
- Implemented Simulated Annealing from scratch for TSP with energy, capacity & pickup/delivery constraints
- Instance Segmentation - Self Driving Cars** | Seasons of Code, WnCC, IIT Bombay (Jul'21)
- Performed transfer learning on Mask RCNN for vehicle detection and integrated it with CARLA simulator

TEACHING & LEADERSHIP ROLES

- Convener** | Electronic and Robotics Club (ERC), Institute Technical Council (May '20 - Apr '21)
 Part of a 15+ member team that conceptualizes and organizes events for tech enthusiasts in the Institute
- Conducted club orientation and a 2-day **Arduino Basics Workshop**, attended by **100+ freshmen**
 - Contributed articles on Occupancy Grid Mapping, Kalman Filter and ROS to the '**ERC Wiki repository**'
 - Organised '**ER101**'- a 7 week series of sessions on design and development of a robotics manipulator
 - Delivered a talk** on Kinematics & Dynamics of a 2-DOF manipulator with MATLAB demonstrations
- Python is Cool, Kids** | **Student-run Summer Course** 🐍 (Summer '21)
- Volunteered to conduct a summer course for **Practical Python Programming**, consisting of interactive live lectures, assignments and guided projects, with **1000+ enrollments**

EXTRA CURRICULAR ACTIVITIES

Technical	<ul style="list-style-type: none"> Developed an assistive document reader, dictator & wikipedia search platform for visually impaired Built touchless elevator control system with RPi and 8X8 LED Matrix using local HTTP server
Cultural	<ul style="list-style-type: none"> Volunteered in Kaladarshan (annual photography and fine arts exhibition) for road painting Awarded distinction in Kathak by Akhil Bharatiya Gandharva Mahavidyalaya Mandal, Mumbai
Mentorship	<ul style="list-style-type: none"> Delivered a session on Serial Communication Protocols in embedded systems to 200+ students, using TinkerCAD simulations and practice assignments Guided 9 freshmen for a project based on Robotics and Image Processing for Summer