Tejal Ashwini Barnwal | **190020122**
Mechanical Engineering | **B.Tech.**
Indian Institute of Technology, Bombay | **Gender: Female**

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Examination	University	Institute	Year	CPI/%
Graduation	IIT Bombay	IIT Bombay	2021	8.42
Intermediate/+2	Maharashtra State Board	Pace Junior Science College, Nerul	2018	89.54
Matriculation	CBSE	New Horizon Public School, Panvel	2016	10.00

- Pursuing a Minor degree at the department of **Systems and Control Engineering**, IIT Bombay

Academic Achievements

- Awarded **Branch Change** to Mechanical Engineering for exemplary academic performance in first year *('20)*
- Secured **98.40 percentile** in JEE Advanced and **99.67 percentile** in JEE Main entrance examination *('19)*
- Felicitated with **Times NIE Student of the Year** award among the top 300 scorers across Mumbai *('17)*

Research Project

Precision Agriculture with quadrotors *(May '21 - Ongoing)*
Guides: Prof. Hemendra Arya and Prof. Arpita Sinha *Systems and Controls Department, IIT Bombay*

- Created custom URDFs and crop-field like gazebo environment and carried out autonomous way-point navigation to perform **raster scan** on Gazebo using **PX4 SITL** while using **MAVROS** for communication
- Studied the PX4 developer's documentation & implementing **sliding mode control** on Pixhawk flight stack

Competitions

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 | Devised navigation pipeline with three layers of intelligence algorithms
- Implemented **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 121** 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

Winner - 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

- Implemented omni-wheel drive and PD controller to reduce steering latency & performed goal-to-goal navigation
- Studied **Breadth-First Search** algorithm to debug and optimize the maze-solving algorithm at speed

The Hilti SLAM Challenge | IROS Workshop *(Sept '21 - Ongoing)*
Worked in team of 3 to estimate trajectories on sequences from the given dataset recorded with handheld device

- Understood visual inertial odometry and applied **ORB-SLAM3** on monocular camera and IMU sensor feed
- Calibrated Kannala-brandt camera model using datasheet & IMU noise parameters using imu utils on bag files

Key Projects

SeDriCa | Unmesh Mashruwala Innovation Cell *(May '21 - Present)*
Working in a 20+ member team aiming to develop a self-driving car capable of transversing on Indian roads

- Part of **Decision-Making** subsystem that makes high-level driving decisions for the **self-driving car**
- Conceptualizing and implementing pipeline to tackle **traffic signs**, **intersection handling** & **lane changing**
- Ideating on a **behaviour tree** based architecture to plan the sequence of high level driving maneuvers

Seasons of Code | Web & Coding Club (WnCC), IIT Bombay *(Apr '21 - Jul'21)*

- **Facial Expression Recognition**
  - Constructed a **deep convolution neural network** to recognize facial expressions from **7 categories**
  - Trained FER dataset from Kaggle in **Keras** to achieve **74%** training accuracy and **66%** test accuracy
  - Applied **Haar Cascades** for face detection in real-time video streams and image data using **OpenCV**
- **Instance Segmentation - Self Driving Cars**
  - Performed **transfer learning** with state-of-the-art network architecture−**Mask RCNN** and tailored it for specifically **8 categories**, fine-tuned the model to reduce the average loss by **50%**
  - Integrating the trained model with **CARLA** and employed **CvBridge** to obtain camera sensor data

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 wireless communication between Raspberry Pi and multiple ESP32s

Adaptive Control of Autonomous Vehicle | *Course Project* *(Feb '21 - Apr '21)*
Guide: Prof. Srikant Sukumar *Systems and Control Department, IIT Bombay*

- 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

Oculus - Institute Technical Summer Project (ITSP) *(May '20 - June '20)*
Developed an assistive document reader, dictator and Wikipedia search platform to aid visually impaired

- Implemented image transformion and edge detection using **OpenCV** and performed OCR using Tesseract
- Utilized **gTTS** to convert extracted text to speech & Google Speech API to enable voice type and voice search

Other Technical Activities

- **Mentored** a team of 4 freshmen for a project based on Robotics and Image Processing in ITSP *('21)*
- Ideated termite-inspired robotic system to emulate construction using Lego bricks for **Bio-mimicry GC** *('20)*
- Developed a **touchless elevator control system** by building an MIT App Inventor app as UI and interfaced RPi with 8X8 LED Matrix to display scrolling numerals using local HTTP server for communication *('20)*
- Built an Arduino based autonomous **Line-Follower** robot capable of following a given path *('19)*
- Built **RC Plane** out of depron and employed a circuit involving ESC, servo, LiPo Battery & BLDC motor *('19)*
- Programmed PlutoX drones (by DronaAviation) to control it using surrounding temperature *('21)*
- Developed a sound-light synchronised **Xyloband** using OpAmps and filter circuit in an event by ERC *('20)*
- **Delivered session** on Serial Communication Protocols in embedded systems in a summer course registered by **200+ students** with TinkerCAD simulations and framed practice assignments for better understanding *('21)*
- Introduced Python to **1000+ students** in the course **PyCK** hosted under WnCC, IIT Bombay *('21)*

Technical Proficiency

Languages	Python, C++, MATLAB, Markdown
Softwares & Tools	SolidWorks, Abaqus, Simulink, EAGLE, Gazebo, AutoCAD, Git
Frameworks & Libraries	ROS, Tensorflow, Keras, OpenCV, Pandas, NumPy LaTeX
Electronics	Raspberry Pi, Arduino, Node MCU, ESP32

Key Courses Undertaken

Mechanical	Solid Mechanics, Fluid Mechanics, Engineering Graphics and Drawing, Thermodynamics, Structural and Strength of Materials, Heat Transfer*
Electrical and Controls	Introduction to Electrical and Electronics Circuits, Mathematical Structures for Control, Signal and Feedback Systems, Linear and Non-Linear systems*, Adaptive Control Theory*, Microprocessors and Automatic Control*
Computer Science and Mathematics	Calculus, Linear Algebra, Computer Programming and Utilisation, Numerical Analysis, Deep Learning Specialization, Data Structures and Algorithms

**to be completed in Fall 2021*

Position of Responsibility

Convener | Electronic and Robotics Club (ERC), Institute Technical Council *(May '20 - Apr '21)*
Part of a 15+ member team that conceptualises and organises 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

Extracurriculars

- Successfully completed a year-long training in **Fine Arts** under National Sports Organization(NSO)
- Volunteered in **Kaladarshan** (annual photography and fine arts exhibition of IITB) for ideating theme, creating art installations, road painting and contributed five sketches to be put up in exhibition
- Received training for **6 years** in **painting**, and secured distinction by Bangiya Sangeet Parishad, Calcutta
- Awarded distinction in **Kathak** by Akhil Bharatiya Gandharva Mahavidyalaya Mandal, Mumbai
- **Curated content** for TechTuesday-initiative promoting tech by **Techfest** on the **3.1M+ FB follower** page