# SHASHWAT MUDUGUR ASHOK KUMAR

West Lafayette, Indiana

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## EDUCATION

**Purdue University**  — West Lafayette, IN, USA
*Master of Science in Autonomy and Robotics GPA: 3.76/4.0*  — *Aug. 2024 – (May. 2026)*
*Relevant Coursework: Embedded Systems, Autonomous Systems, Vehicular Cyber Physical Systems*

**Manipal Academy of Higher Education**  — Manipal, Karnataka, India
*Bachelor of Technology in Mechatronics, Minor in Electric Vehicle Technology*  — *Oct. 2020 – May 2024*

## SKILLS

**Languages** : C, C++ (Modern C++17), Python, IEC 61131-3(Codesys)

**Embedded Systems**: RTOS (FreeRTOS), Bare-Metal Programming, Cross-Compilation, ESP-IDF, CMSIS-HAL

**Communication Protocols**: CAN(J1939, NMEA2000, CanOpen), Ethernet(TCP, UDP), I2C, SPI, UART.

**Frameworks**: Docker, Linux, ROS2, Micro-ROS, Rviz, Gazebo.

## WORK EXPERIENCE

**Autonomy Intern**  — May 2025 – Present
*Applied Industrial Technologies*  — *St Louis, MO, USA*
- Architected complete autonomy stack for **GPS-guided** differential-drive agricultural robots: GNSS localization, **Bézier curve** trajectory generation with real-time optimization (bisection method, Lagrange interpolation), and **Pure Pursuit** path tracking achieving 45cm localization accuracy over 100m+ orchard row-following missions
- Integrated the autonomy stack with **LIDAR** based navigation along orchard rows and **RADAR**-based collision avoidance with deterministic timing on **ARMv7** controller via **CAN** bus, achieving less than **100ms latency**
- Developing Extended Kalman Filter (EKF) multi-sensor localization module fusing wheel encoder, IMU, and GNSS data via ROS2 Docker stack; targeting 2m accuracy in GNSS-denied agricultural environments.

**Robotics Firmware Engineering Intern**  — May 2024 – July 2024
*Algobotix*  — *Bangalore, Karnataka, India*
- Integrated MAVLink protocol in **C++** on **STM32** microcontroller to enable communication between the drone and ground station
- Designed a **ROS2 C++** node to interface with the **PX4** flight controller via XRCE-DDS to visualize drone telemetry in real-time ⍟ [GitHub](#)

**Embedded Research Intern - Bachelor's Thesis**  — Jan 2024 – May 2024
*Robert Bosch Center for Cyber-Physical Systems, Indian Institute of Science(IISc)*  — *Bangalore, Karnataka, India*
- Designed real-time drone flight controller using **ESP32** with **Micro-ROS** stack for motion capture laboratory experiments. ⍟ [GitHub](#)
- Implemented **FreeRTOS** scheduler to acquire Motion Capture System data and activate fail-safe mechanisms during communication loss
- Integrated MPU-6050 (via **I2C**) and Lidar (via **UART**) to enable autonomous safe landing under fail-safe conditions, programmed in **C and C++** using ESP-IDF.

**Systems Engineering Intern**  — June 2023 – Aug 2023
*Ola Electric*  — *Bangalore, Karnataka, India*
- Introduced **supercapacitors** into vehicle models to enhance regenerative braking performance and simulated the system using Gamma Technology Software, resulting in a **23%** increase in vehicle range
- Designed a flight controller using **Arduino** and **C**, implementing **PID** control for precise drone stabilization and integrating an MPU-6050 via **I2C** for real-time motion sensing.

**Electronics and Powertrain Engineer / Team Leader**  — Nov 2020 – May 2023
*Moto Manipal – Electric Superbike Team*  — *Manipal, Karnataka, India*
- Led the development and manufacturing of a 10kW PMSM-powered electric superbike for MotoStudent International, designing the Li-ion battery pack and performing powertrain modeling and range calculations using MATLAB/Simulink.
- Developed an interactive dashboard using **Python** and **RaspberryPi3** and collected data from the motor controller using **CAN (Controller Area Network)** communication along with data logging system for monitoring and analysis through **ESP32** controller ⍟ [GitHub](#)

## RESEARCH EXPERIENCE AND PROJECTS

**Gesture Controlled Robotic ARM**  — **C, FreeRTOS**
- Developed a gesture-controlled robotic arm using **MediaPipe** for real-time hand tracking, transmitting commands via **UART** to an **STM32** running **FreeRTOS**. Configured timers in **PWM mode** using **CMSIS and HAL** for precise servo control and deterministic task execution.

**Traffic Sign Classification using Cross Stage Partial Network** ⍟ [GitHub](#)  — **PyTorch, Python, Open CV , Matplotlib**
- Trained a traffic sign classification model on the **German Traffic Sign Recognition Benchmark** using **CSPNet** with **Mish** activation, boosting gradient flow and efficiency by 20% and achieving 87% accuracy with improved generalization.

**RRT* Path Planning and Following for Obstacle Avoidance on TurtleBot3** ⍟ [GitHub](#)  — **Python, ROS2, Rviz, Gazebo, Matplotlib**
- Implemented RRT* algorithm for path planning and graph construction using KD-Tree; implemented path generation and tracking using a **PID** controller with simulations in RViz and Gazebo environments

**A* Path Planning with PID Control on TurtleBot4 and Simulation on TurtleBot3** ⍟ [GitHub](#)  — **Python, ROS2, Rviz, Gazebo, Matplotlib**
- Developed and tested an A* path planning algorithm with **PID** control on TurtleBot4, achieving optimized navigation and trajectory following with obstacle avoidance.