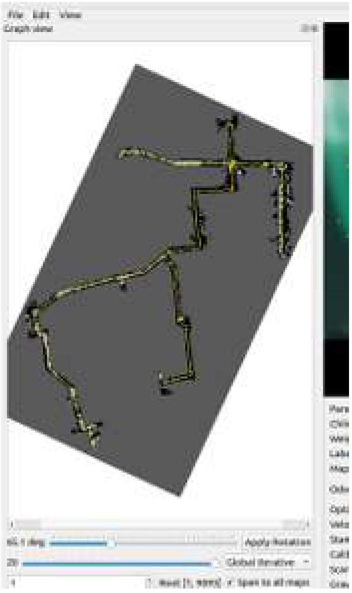
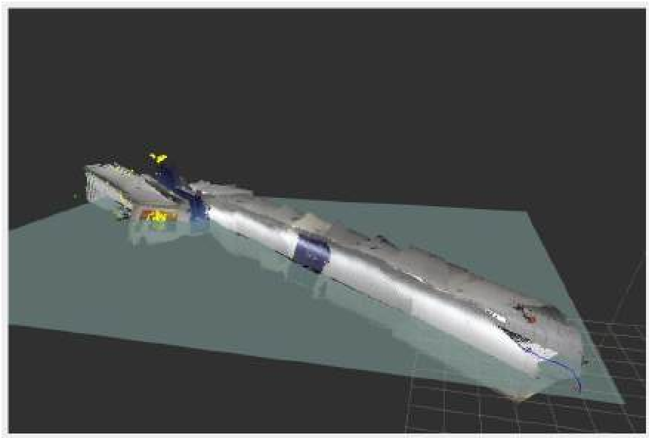
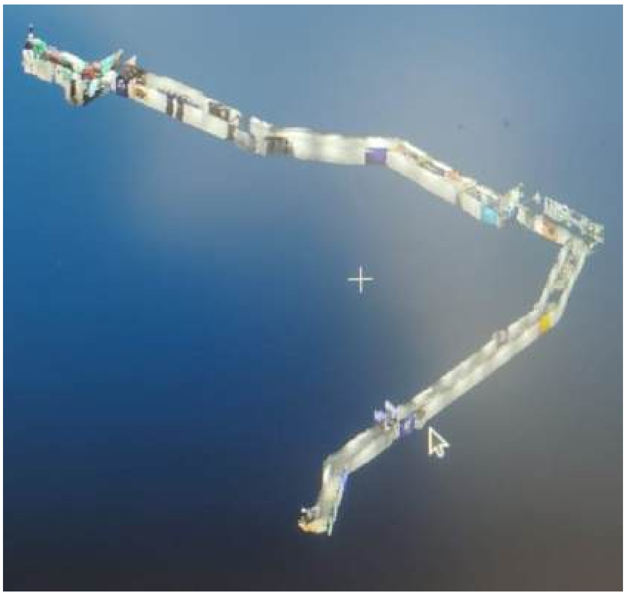
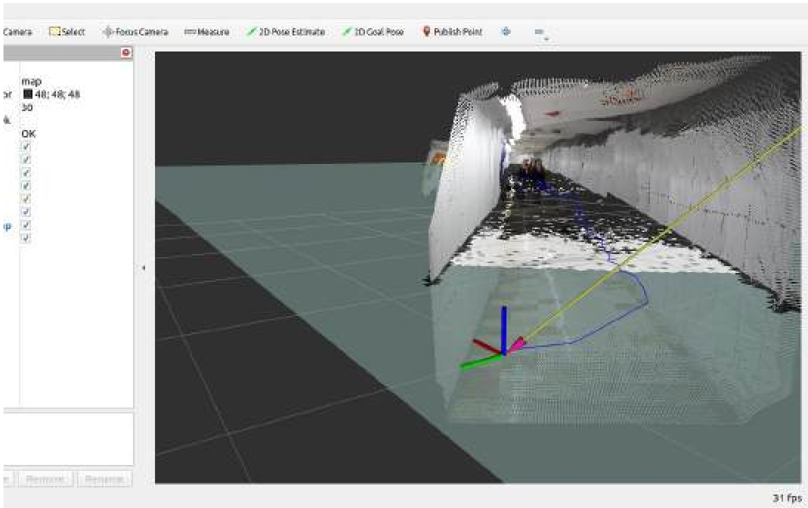
Underground Tunnel 3D Mapping

At Northeastern University, I implemented a 3D mapping system for the university's extensive 16,000-foot tunnel network. Using the RTAB-Map SLAM algorithm and a ZED Mini stereo camera, I achieved accurate localization and mapping in a GPS-denied environment by leveraging RTAB-Map's loop closure detection and memory management. By integrating IMU and stereo vision sensors, I optimized data collection, resulting in 95% localization accuracy and the generation of high-resolution point clouds.

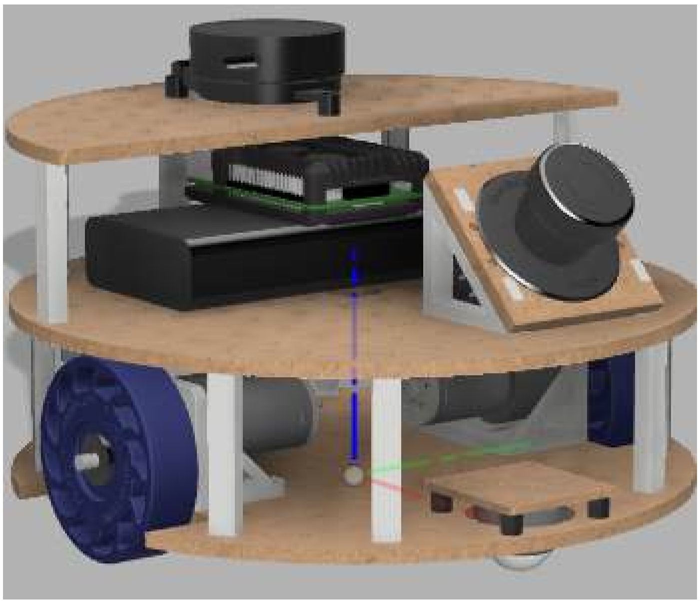








ROS2-Based SLAM Testing Robot



I am developing a robotics platform with ROS2 to test and compare various SLAM algorithms. The robot is equipped with a suite of sensors, including LIDAR, IMU, encoders, stereo cameras, and ultrasonic sensors, to ensure precise mapping and localization. I am also implementing CAN bus communication between ROS and the microcontroller, enabling efficient and reliable data exchange for real-time control and sensor integration.

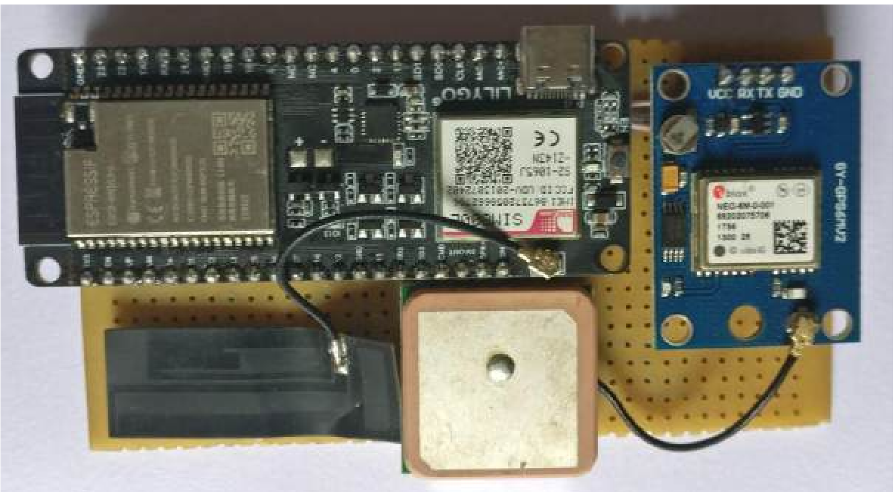
Plastic Antweight Combat Robot

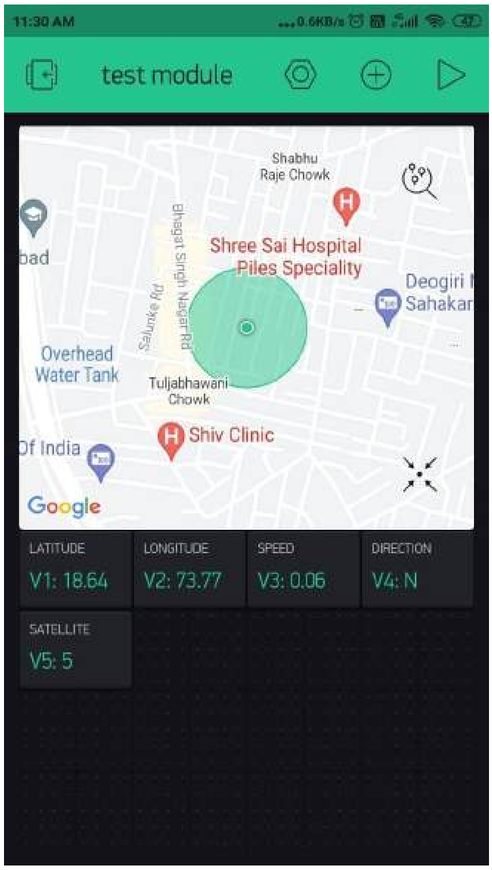
I am designing and building a Plastic Antweight combat robot to compete in Northeastern University Robotics' Plastic Ant League. The project focuses on lightweight design and competitive performance, utilizing 3D printing for custom components. Strategic design choices, such as a low center of gravity and modular features, enhance the robot's durability, stability, and combat efficiency.

ABU ROBOCON

As a key member of the ABU ROBOCON team at Rajarshi Shahu College of Engineering, I designed and manufactured robots for international competitions. Collaborating with students from various disciplines, I contributed to the development of multiple subsystems. I also mentored sophomore and junior teams, guiding them to achieve multiple top-10 finishes and earn a Best Design Award during the competition.

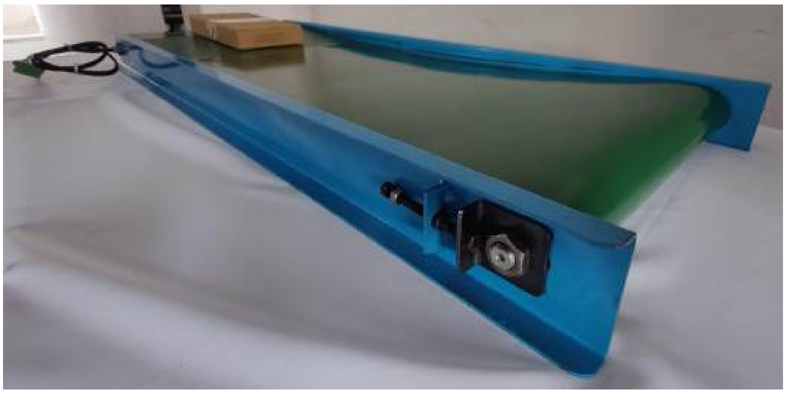
IoT Vehicle Tracking System





At Rajarshi Shahu College of Engineering, I developed an IoT-based vehicle tracking system using GPS and GSM technologies. By interfacing existing sensors, I reduced dependency on additional external components and decreased response time by 10%. I designed the controller board using an ESP32 microcontroller and successfully tested the GSM tracking system with an Android application.

Motor Driven Roller (MDR)



As a co-founder at RollNDrive Pvt Ltd, I designed a Motor Driven Roller (MDR) by integrating a customized planetary gearbox and a closed-loop brushless DC motor, significantly reducing conveyor system costs by 40% and minimizing downtime. Leveraging the MDR, I developed a modular conveyor system tailored for AGVs and AMRs, which improved scalability and efficiency in material handling while reducing energy consumption and system complexity. Additionally, I designed and marketed a custom motor controller for the MDR, collaborating with customers to streamline setup and simplify operational processes.

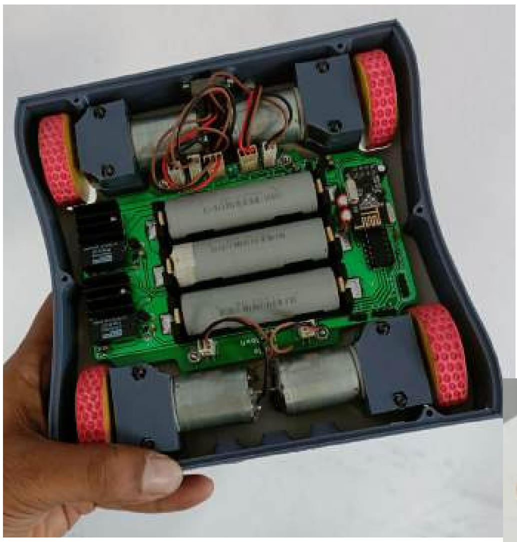
Mecano Sorter

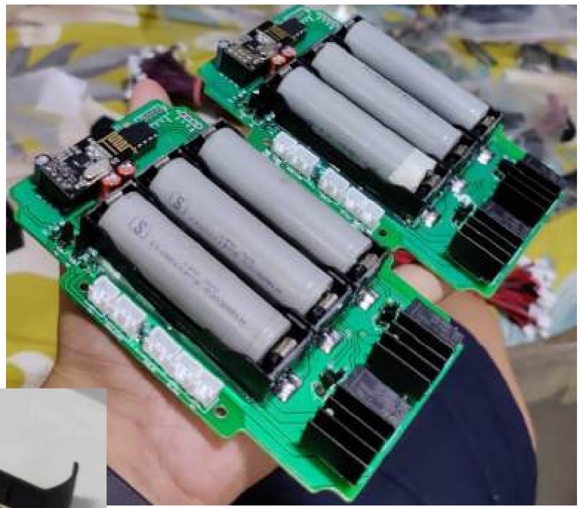
I designed and implemented a Mecanum wheel-based sorting system capable of routing parcels to one of three possible outputs from a single input conveyor. Utilizing the unique omni-directional capabilities of Mecanum wheels, I developed a precise control system to dynamically adjust parcel direction based on sorting logic. The sorter achieved a throughput of approximately 2,600 boxes per hour, significantly improving efficiency and reducing handling time in parcel sorting operations while enabling seamless integration into modular conveyor networks.

Custom Closed-Loop Brushless DC Motor Controller

I designed a custom closed-loop brushless DC motor controller to efficiently control a Motor Driven Roller (MDR) using encoder feedback for precise speed regulation. Unlike standard controllers that rely on PWM or communication protocols like RS232 and RS485, my controller introduced a unique digital pin-based control method, allowing users to set motor speeds easily without technical knowledge of complex protocols. By referencing a provided speed chart, users can adjust speeds by simply connecting input pins to positive logic, simulating switches for specific speed levels. The controller also featured robust safety mechanisms, including overvoltage, overcurrent, overtemperature, reverse voltage protection, and isolated inputs, ensuring reliable and secure operation across various industrial applications.

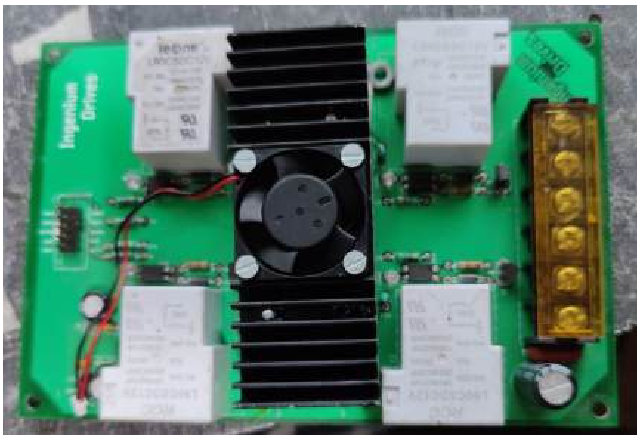
All-in-One Custom Motherboard for Robotics Applications

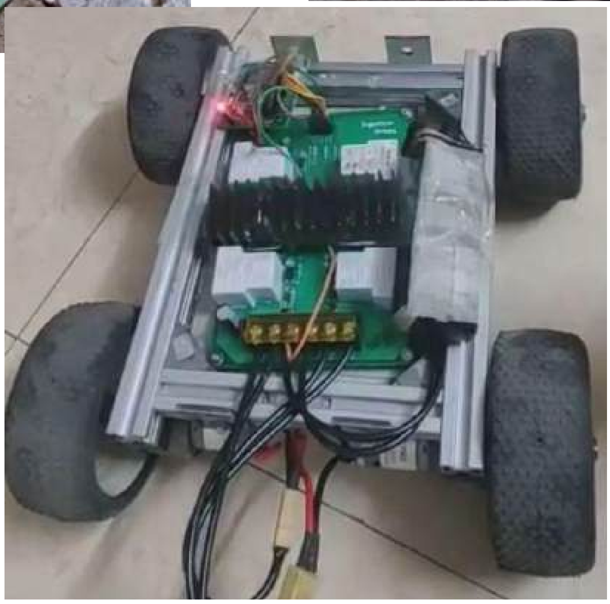




I developed a versatile custom motherboard designed for small robots used in Robot Sumo and Robot Soccer competitions. The motherboard integrates a built-in battery, battery management system, motor driver, microcontroller, and communication module, providing a compact and efficient solution for robotics applications. Additionally, I designed a remote control with encrypted communication to ensure secure and interference-free operation. This encryption ensures that each robot responds exclusively to its paired remote, even when multiple robots operate simultaneously in the same environment. The design enhances performance, reliability, and scalability in competitive robotics scenarios.

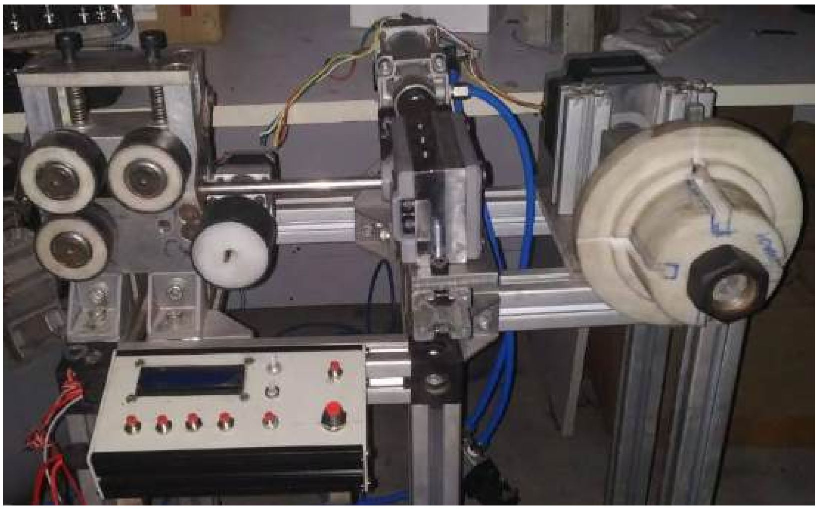
Custom Motor Controller Board for High-Powered Brushed DC Motors





I designed a custom motor controller board tailored for high-powered brushed DC motors, utilizing MOSFETs for precise speed control and relays for reliable braking functionality. The board offers efficient power management and robust performance, ensuring smooth motor operation under heavy loads. Its design is optimized for high current applications, featuring advanced heat dissipation mechanisms and safety protections such as overcurrent, overvoltage, and thermal safeguards. This controller is ideal for applications requiring precise speed regulation and effective braking in demanding environments.

Automatic Wire Cutting Machine



I designed an automatic wire cutting machine that streamlines wire processing by automating the cutting process. The user can feed a large roll of wire, input the desired wire length and quantity through a user-friendly interface, and the machine automatically cuts the wire to precise specifications. The system is powered by a custom-designed control board based on the Atmega microcontroller, ensuring reliable performance. A bright LED display provides real-time information to the user, enhancing ease of operation. The machine integrates stepper motors for precise wire feeding, solenoids for cutting operations, and other components to deliver efficient and accurate results, making it an ideal solution for industrial and commercial wire processing needs.

Milk Dairy Display System

I developed a display system for milk dairies that consolidates data from multiple machines using RS232 communication. The system retrieves values such as fat content, SNF (Solids-Not-Fat) percentage, and the volume of milk in liters from dedicated measurement machines. Using this data, it calculates the cost of the milk based on the pre-set daily rate and displays all relevant information on a seven-segment display. The system streamlines data handling and ensures accuracy in calculations, providing dairy operators with a reliable and efficient tool for milk quality assessment and pricing.

Self-Balancing Robot

I designed and built a self-balancing robot powered by stepper motors for precise motion control and stability. The robot utilizes advanced sensors, including an IMU (Inertial Measurement Unit), to continuously monitor its orientation and make real-time adjustments to maintain balance. A custom-designed control system processes sensor data and controls the stepper motors to ensure smooth and accurate self-balancing behavior. This project highlights expertise in dynamic stabilization, motion control, and integration of hardware and software for robotics applications

FPV Drone for IIT Bombay Drone Competition

I designed and built an FPV drone for the prestigious IIT Bombay Drone Competition. The task involved flying the drone through challenging obstacles while carrying a payload, identifying designated drop locations via QR codes, and accurately delivering the payload. The drone featured a bottom-mounted FPV camera that transmitted a live feed to an FPV monitor. A teammate scanned the QR code from the monitor using a cellphone to determine the drop location, enabling precise payload delivery. Out of 76 participants, my team secured 5th position, demonstrating skill in drone design, control, and teamwork under competitive conditions.

Automated Hand Sanitizer Machine

During the COVID-19 pandemic, I designed an automated hand sanitizer machine to promote safe and contactless hygiene practices. The machine was installed in government offices, hospitals, and schools, providing a reliable solution for public spaces. Leveraging a small business I established for this purpose, I successfully sold over 100 units, contributing to community health and safety during a critical time. The project exemplifies innovation, adaptability, and entrepreneurial success in addressing real-world challenges.

Self-Propelled IC Engine-Powered Onion Harvester

I was part of a team that developed a self-propelled IC engine-powered onion harvester. As a member of the electronics team, I designed a closed-loop control system to regulate the depth of the harvesting mechanism. The system featured a conveyor with digging teeth for soil excavation and onion transportation, operated by a hydraulic cylinder controlled via a solenoid valve. A linear potentiometer measured the depth, while a user interface allowed for setting the desired depth. The controller dynamically adjusted the hydraulic system to ensure precise excavation. Additionally, a load cell was integrated into the holding area to measure the quantity of the harvest, enhancing operational efficiency and precision in agricultural practices.