

# Intelligent Autonomous Robot

## Project Description:

This engaging undergraduate project challenges students to create an intelligent autonomous 2-wheel robot car using the **Raspberry Pi Pico microcontroller**, equipped with various sensors and a PID (Proportional-Integral-Derivative) controller. The primary goal is to develop a robot car that navigates a predefined track, efficiently avoiding obstacles and recognizing barcodes using infrared sensors. The integration of a PID controller enhances the car's control system, ensuring smooth and accurate motion during navigation and barcode scanning.

## Project Objectives:

1. **Robot Car Construction:** Assemble and construct the 2-wheel robot car, ensuring mechanical stability and precision wheel control.
2. **Sensor Integration:** Integrate ultrasonic sensors for obstacle detection, infrared sensors for line following and barcode recognition, and a magnetometer for orientation.
3. **Navigation and Mapping:** Implement navigation algorithms that guide the robot car along the track, while avoiding obstacles and optimizing for efficiency.
4. **Barcode Recognition:** Develop algorithms to enable the car to detect and interpret barcodes on the ground using infrared sensors.
5. **PID Controller:** Design and implement a PID controller to regulate the robot car's speed and steering, ensuring smooth and precise movement.
6. **Efficiency and Speed Optimization:** Optimize the navigation and PID control algorithms to achieve the shortest track completion time while accurately recognizing barcodes.
7. **User Interface:** Create a user interface that allows users to initiate the robot, adjust parameters, visualize the car's performance, and monitor PID controller behavior.
8. **Documentation, and Testing:** Thoroughly document the project's design, construction, programming, challenges faced and insights gained. Additionally, conduct comprehensive testing to validate the functionality and performance of the developed solution, ensuring its robustness and reliability.

### Project Deliverables:

- A functional 2-wheel robot car featuring ultrasonic, infrared, and magnetometer sensors.
- Source code with implementation of navigation algorithms, sensor fusion, barcode recognition, and the PID control system.
- A comprehensive project report detailing the design, construction, algorithms, results, challenges, and insights.
- A presentation showcasing the robot car's capabilities, navigation efficiency, barcode recognition accuracy, and the impact of the PID controller.

### Project Improvements (Bonus):

- **AI-enhanced PID Controller:** Develop and deploy an AI-enhanced PID controller that combines the strengths of traditional Proportional-Integral-Derivative (PID) control with artificial intelligence techniques. **[up to 15%]**
- **Sensor Fusion:** Develop advanced algorithms to fuse data from multiple sensors, improving decision-making accuracy during navigation and barcode recognition. **[up to 15%]**
- **Incorporating  $\mu$ T-Kernel RTOS [up to 50%]**  
([https://github.com/tron-forum/mtk3\\_bsp/releases/tag/v1.00.00.B5-pico\\_rp2040](https://github.com/tron-forum/mtk3_bsp/releases/tag/v1.00.00.B5-pico_rp2040))
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### Project Deviations:

A team may propose your own project. However, please update the Module Lead (Fauzi) before the end of Week 2 with a one-page brief of what the team would like to develop. Try to follow the format of this brief.

Approval is subject to component availability, project viability, and most importantly, is it fun to work on. 😊