🚀 Excited to share my project for the IC102P (Foundation of Design Practicum) course: a PID Controlled Line Following Robot! 🤖✨s

🔍 Objective: Develop an autonomous robot that can smoothly follow a black line path using a sophisticated PID (Proportional-Integral-Derivative) control algorithm.

- ❖ Key Highlights:
  - ➢ Microcontroller: The brain behind the robot, processing sensor inputs and executing control algorithms.
  - ➢ Sensors: Infrared sensors detect the line's position, feeding real-time data to the microcontroller.
  - ➢ Motors and Actuators: Ensure precise movement and control, enabling the robot to follow the path accurately.
  - ➢ PID Control Algorithm: Fine-tunes the robot’s movement, adjusting speed and direction to minimise error and stay on track.

- ❖ Skills and Process:
  - ➢ SolidWorks Design: We began by designing a SolidWorks model to ensure the proper placement of components and to create a designer hood cutout.
  - ➢ PCB Design with EasyEDA: Using EasyEDA software, we designed the PCB and fed the Gerber file to the PCB printing machine for fabrication.
  - ➢ Algorithm Development: We programmed the algorithm into the Arduino. The concept is based on two middle IR sensors following the black lines, while the outer two follow the white.
  - ➢ PID Control: The PID control algorithm adjusts the robot’s movements by calculating the proportional, integral, and derivative of the error. This ensures precise and smooth line tracking.
  - ➢ Breadboard Testing: All connections were initially made using a breadboard for testing.
  - ➢ Final Assembly: After successful testing, we soldered the components onto the PCB.
  - ➢ PID Tuning: Finally, we tuned the PID values to achieve the desired result.

📹 Attached is a video of the robot in action on the test track.

- ❖ Implementation of PID controller:

We implemented a line following robot using IR sensors and a PID (Proportional - Integral - Derivative) controller to optimise the error, which we defined as the distance from the centre of the line.

We employed four IR sensors, positioning the middle two to detect whether the robot was directly on the line. This configuration enhanced the stability of the system, ensuring more accurate line following despite the limitations of the discrete sensor setup.

In a line follower robot using IR sensors, the error calculation is critical for determining how far the robot is from the desired line path. With four IR sensors, let's denote them as S1, S2, S3, and S4 from left to right. The middle two sensors, S2 and S3, are used to detect if the robot is on the line.

1. **Sensor Readings**: Each sensor outputs a value indicating whether it detects the line (1) or not (0). For simplicity, assume the line is a single value like a black line on a white surface.
2. **Error Calculation**: The error can be calculated based on the readings of S2 and S3. If both sensors detect the line, the error is zero (robot is centred). If only S2 or S3 detects the line, the error is positive or negative, respectively. If neither detects the line, the robot may be significantly off the path, and additional logic was needed to determine the direction.

For PID description : Click Here

- What I Learned:
  - Integrating sensors and actuators for real-time data processing and response.
  - Implementing and tuning PID control algorithms for optimal performance.
  - Hands-on experience in robotics and control systems, bridging theoretical knowledge with practical application.

- Acknowledgments:

I extend my deepest gratitude to my exceptional team whose hard work and dedication brought this project to life. Asif Hoda, Ayush Raj, Mankirat Singh Saini, and Rajsi Sangra, your behind-the-scenes efforts have been nothing short of remarkable. The unwavering commitment and teamwork have been instrumental in driving this project forward.

A special acknowledgement goes to our esteemed mentor, Prateek Patel. Your invaluable guidance, wisdom, and support have been the cornerstone of our success. Your mentorship has not only guided us through challenges but has also inspired us to strive for excellence.

💡 This course and project has not only deepened my understanding of about robots but also sparked a passion for robotics and automation.

Looking forward to more such exciting projects and challenges! 🚀🔧

Follow the link to the repository for resources.

#Robotics #Automation #PIDControl #Design#Practicum#Engineering #IC102P