Course Project: Robotics

Line Following Mobile Robot Design

Group Info.

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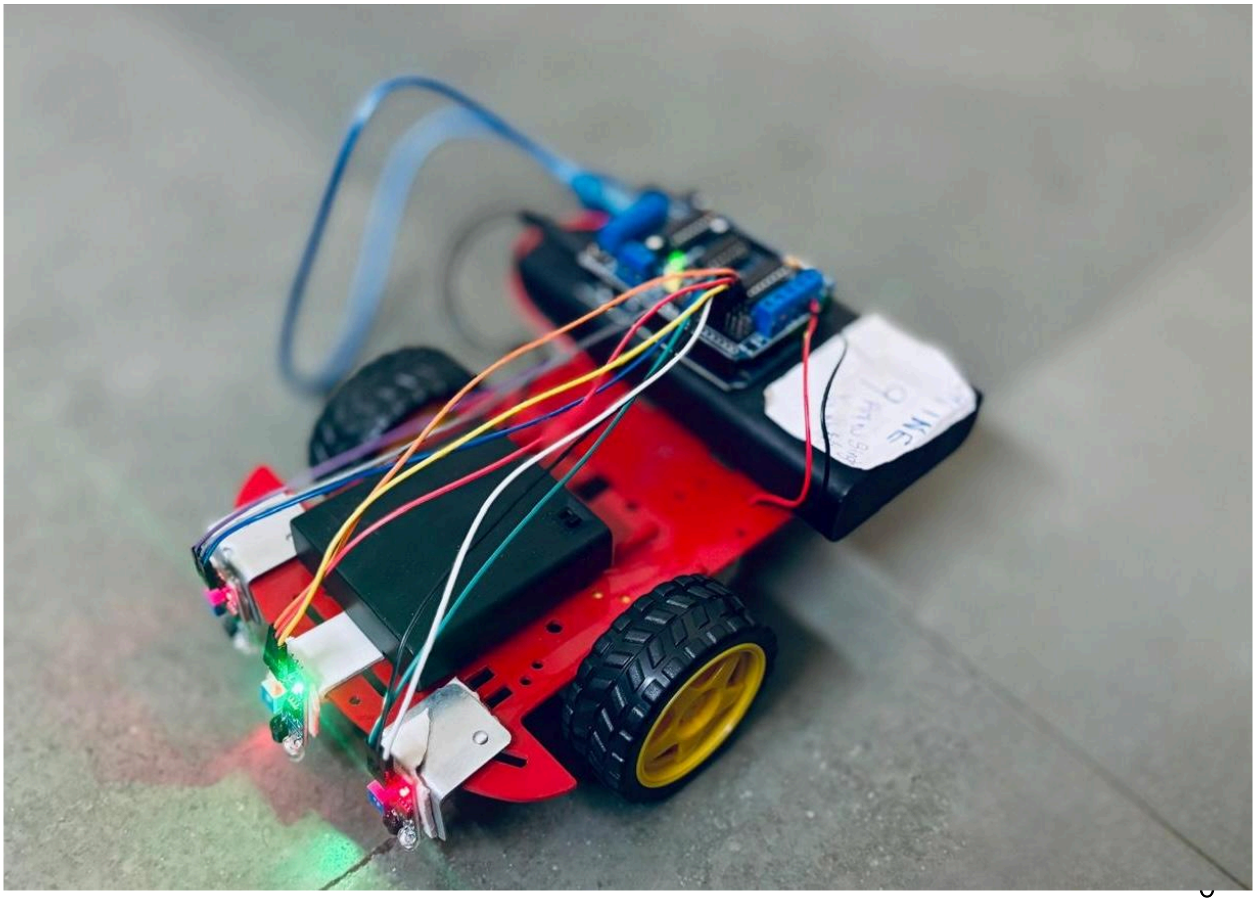


Project Description

This project focused on developing a mobile robot capable of navigating predefined test tracks, using IR sensors, microcontrollers, and L293D motor shields to detect and follow black tape curves on A0-sized tracks while demonstrating flexible traversal behavior.

Objectives:-

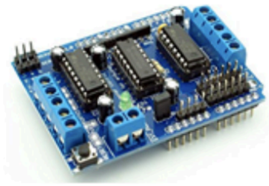
- **Assembling the Robot**
  Purchase a DIY Robotics kit, tape and screw the motors on the chassis, attach power sources, screw the unicycle and castor wheels, attach the motor to the L293D shield and the UNO R3, and connect the UNO R3 with IR Sensors using F-F wires.

- **Coding the Feedback Controller**
  Develop an algorithm capable of detecting and correctly following the test tracks regardless of the initial orientation.

- **Tuning the Sensors**

  Tune the IR Sensors using a screwdriver to correctly discern between black and white surfaces

Robot Components

			
UNO R3-Compatible	USB Cable	IR Sensors	L293D Motor Shield
			
2WD Car Chassis	Battery Holder	F-F Wires 10pcs	
			
	Black Tape	L-Clamp X2	

In addition to the listed components, I used double-sided tape to stick the L-Clamps to the chassis, and 8 Phillips head screws with nuts to hold the wheels and the motors.

How does it work?

The robot has 3 IR Sensors to detect potential paths, in the right, left, and center positions, which feed binary data to the UNO R3 through the L293D motor shield, with a “1” representing a dark surface, and “0” otherwise. The UNO R3 then processes this data using the loop algorithm fed to it and passes instructions to the 4 DC motors, which then rotate the wheels through EMI, thereby moving the entire body.

The robot is powered by a Xiaomi 20,000 mAh power bank (through the USB connection), and 4 Duracell AA Cells in a Battery Holder (through the power jack). We chose to include the power bank since, (a) it incremented the input, and (b) it pushed the center of mass to the back, which (based on our observations of other models) helped to ensure smooth-er motion (in addition to the castor wheel), despite us using a bang-bang controller.

Finally, we implemented an unused function in the setup code, which delegates the bot to move forward till it finds a black path to traverse, which had been suggested as a possible initialization by the course TA, during a team trial in October.

Results

The robot performed rather well on all the tracks, but especially on the third track, where it was able to somehow improve its performance iteratively after being given an unorthodox start. We'd like to believe that our team's performance was the best among all the participating groups, but given the overall performance, that accolade isn't much to celebrate.

Overall, our robot's performance improved throughout the semester, becoming more and more adaptive to the different tracks it was supposed to follow, and aided our understanding of robot dynamics, and modeling, from a practical standpoint.

We wished to have a chance to implement the PID algorithm, but given the shift to virtual classrooms in the latter half of November, we weren't left with many opportunities to tune the control gains to adequately track the given paths. Nonetheless, our performance with the bang-bang controller is still laudable, and we hope the instructors see it that way as well.