TANK SUMO ROBOT

L. Al Sarayreh, A. Odetallah, A. Abu Nijim
Supervisor: Dr. Belal Sababha
Embedded Systems Final Design Project, 2022
King Abdullah II School of Engineering
Princess Sumaya University for Technology

Introduction

The goal of this project is to build and program a robot that will compete with other robots in a black circular playground. The robot should try to knock out its opponent out of the playground while trying to avoid leaving it. Our project focuses on the mechanical, electrical and software part.

The way our robot functions is that it tries to avoid the other opponent and tries to stay inside the black playground. While we had the option to build the robot using Lidar, we decided to use an infrared sensor and an ultrasonic sensor. The embedded software part of this robot uses Timers and the PWM modulation technique and was implemented using C language. As for the mechanical part, we ran our embedded software code on two different sumo robot bodies. Moreover, we ordered the parts from a website and assembled them together.

The most challenging part of this project was that we were not allowed to use any ready-to-use functions from libraries.

Design

As in any complex engineering project, the first step was to research the kind of hardware components and software tools to be used, how they can be acquired and their costs.

Our robot is autonomous and its dimensions don't exceed 20*20 cm. Furthermore, for the mechanical part we looked at different kinds of sumo robot bodies. We used two different bodies, the first one had two wheels / 2 DC motors while the other one had four wheels / 4 DC motors. We ended up using the 4WD robot body and glued the breadboard, as well as the h-bridge and power bank, on top of it. Also, we placed one of the infrared sensors at the front along with the ultrasonic sensor and the other infrared sensor was placed at the back.

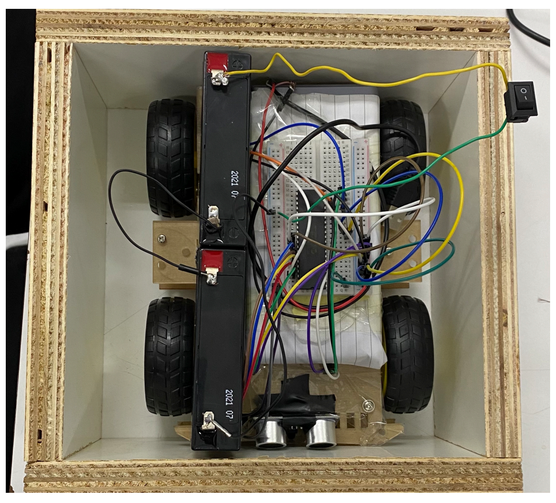
Next, for the electrical part we had to connect the two batteries in series to give the appropriate amount of voltage in order for the DC Motors to move at the desired speed. The 16F877A PIC's data sheet was also used to place the wires in the correct pins.

Both the electrical and mechanical parts are connected with the PIC microcontroller.

Additionally, in the embedded software code we used PWM, Timer0, Timer1, Timer2, Interrupts, and Delay. Three ports were used, Port B, Port C, and Port D. Port B was used for the motors and IR sensors, Port C for PWM and Port D for the ultrasonic sensor. In addition, delay was used to make the robot wait 5 seconds after pressing the push button. The defensive strategy we implemented in this robot's code is that it will move inside the black playground while avoiding and running away from the opponent's robot.

Table1. Components Used

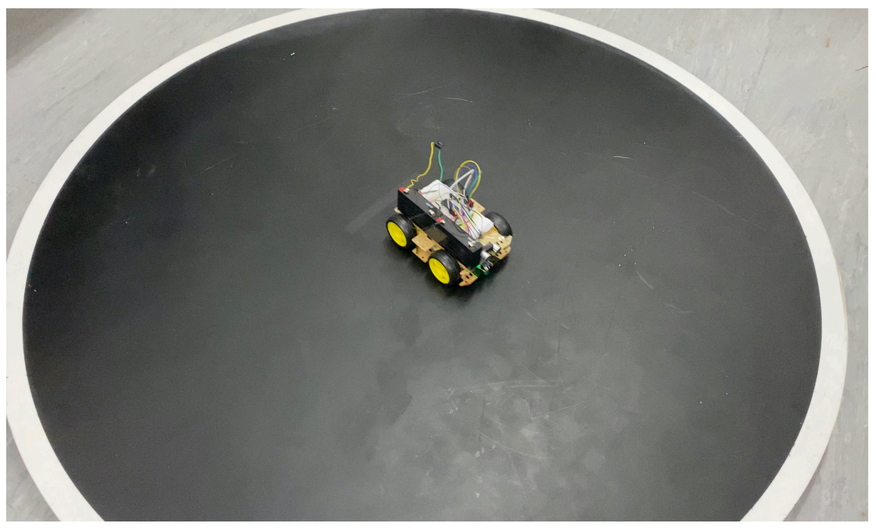
2 Infrared (IR) Sensors
1 Ultrasonic Sensor
4 DC Motors
Wires
One Power-Bank
Two 6 volt Batteries
One Push Button
One 16F877A PIC

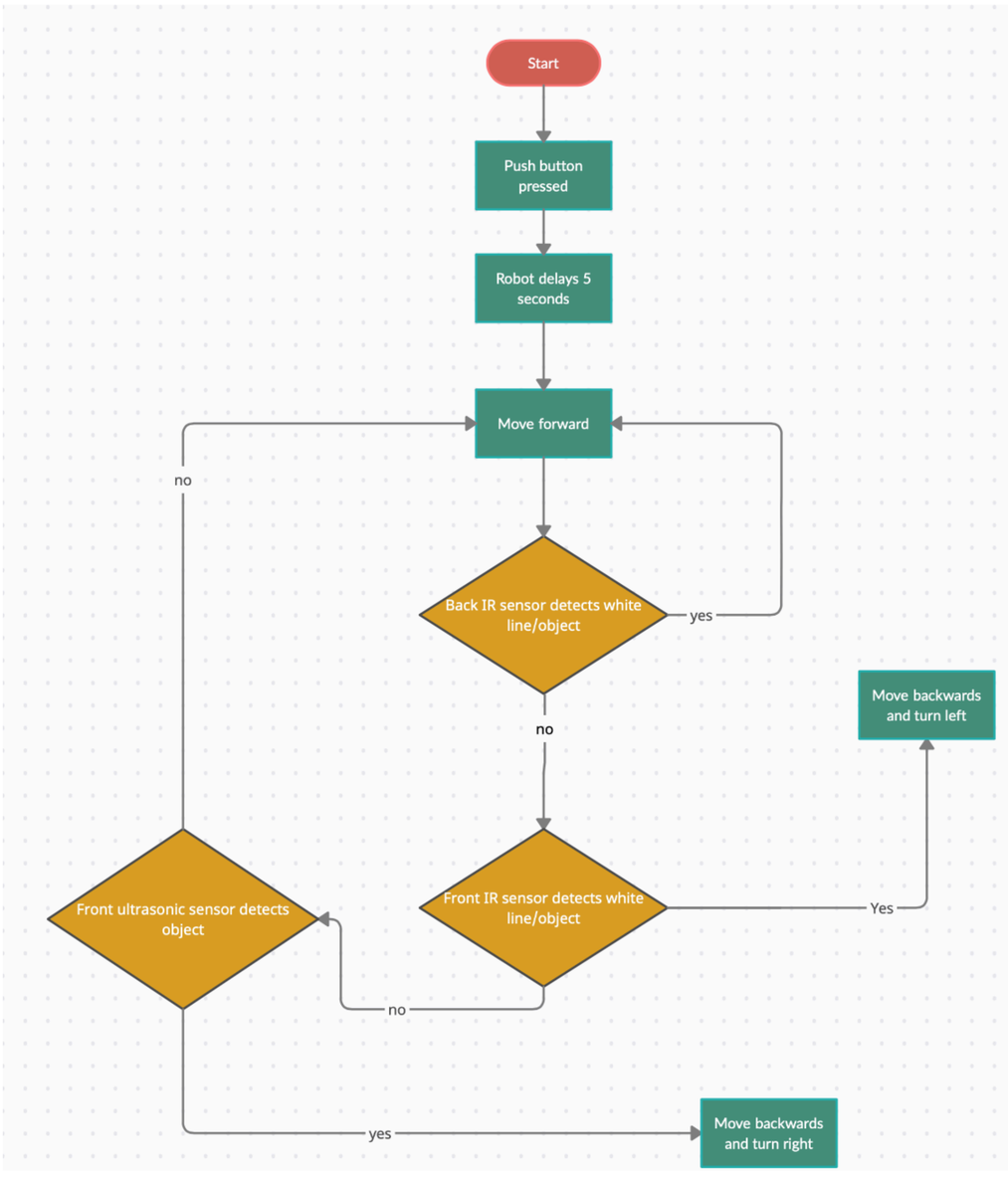


Results

Our sumo robot worked as we intended it to work. It was able to detect the white lines around the black circular playground and move in the opposite direction to avoid leaving the playground.

If the IR sensor at the back detects a white line or object it moves forward, and if the IR sensor at the front detects a white line or object it moves backwards and turns left. Also, if the front ultrasonic sensor detects an object, the robot moves backwards and turns right.





Conclusion

Designing and building a sumo robot to compete with other sumo robots inside a playground was a challenging thing to do, but we were able to build it at the end. Overall the project was successful; however, there are still many improvements that can be made , such as using better sensors. We tried to make use of all of the available resources and the final result was satisfying given the time limit and our knowledge of the MCU at the time. In the end, designing and putting together the parts for the robot was so fun that we all enjoyed working together on the robot.