NOTRE DAME UNIVERISTY

LOUAIZE

ENG 270-SECTION A

Final Project Report

On

Sumo Robot

Team Name

Circuit Masters

Submitted To : Dr. Nisrine El Turky
Date Submitted : 21st of December 2023

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Abstract

Robot-sumo, or pepe-sumo, is a sport in which two robots attempt to push each other out of an arena (in a similar fashion to the sport of sumo). The robots used in this competition are called sumobots. The engineering challenges are for the robot to find its opponent and to push it out of the flat arena. A robot should avoid leaving the arena, usually by means of a sensor that detects the edge. A robot sumo wins when the opponent robot touches the outside area of the Dohyo (fight area) and must designed only to push the opponent out and not cause any other damage to the robot. Robot sumo is one the best sports to learn fundamentals of engineering in terms of mechanical design, electronics and coding.

Objective:

My teammates and I , will construct and validate our concept for the two-wheeled robot by involving sensors positioned at all sides, acting as triggers to influence the robot's movements. By using these sensors, our goal is to enable the robot to effectively push our opponent out of the playing arena, thus helping us win. All that, while keeping the cost as low as possible. Moreover, our main criterion for this project is Strategic play. Keeping that in mind, the following restrictions are placed on the design:

The requirements our system must meet:

- Properly programmed sensors.
- Precise and quick response by the motors
- Quick and strategic movement.

Introduction

A Sumobot, what exactly is it? Well, a sumobot is a robot who is designed and programmed to imitate the sport of sumo thus the name sumobot (Wikipedia, n.d.). A sumobot participates in a competition called a robot-sumo or pepe-sumo. Robot-Sumo has benefited the field of robotics by forcing those same enthusiasts to create more precise and advanced sensors, and to offer a practical and fun application of robotics.

Research Results

Rules agreed upon by the participants:

- There is no specific size limit.
- There is no height limit.
- You can upgrade your robot's motors, wheels, etc.…
- Only two motors may be used on the robot.
- The robot must be autonomous , it should not be remote controlled.
- No weapons to be equipped on the robot.

Match Procedure:

Two robots compete in a head-to-head match following the basic system of traditional human sumo matches. Robots are allowed no weapons, and are not allowed to flip each other. The sole purpose is a pushing match between the two robots to force the other from the arena. Multiple weight classes and control systems are allowed (autonomous compete against autonomous and R/C against R/C - they are separate classes and do not compete against each other.)

History

The Robot Sumo Tournament was started by Hiroshi Nozawa, the founder of FUJISOFT, with the idea of "giving dreams to young people who are responsible for manufacturing, and knowing the joy of manufacturing." This competition has been highly evaluated by universities and educational institutions in more than 30 countries around the world as the best teaching material for learning robotics, and a total of 80,000 people around the world are actively developing robot sumo. The robotics industry is expected to grow at an accelerated pace in order to resolve labor shortages and improve productivity, and along with the trend of DX (Digital Transformation), the importance of robotics education is increasing.

Types

There are 2 categories and 3 types of Robot-sumo that are stated as shown in the table below:

Category	Type	Weight	Width	Length	Height
Sumo	Autonomous	≤ 3,000 gr	≤ 200 mm	≤ 200 mm	Unlimited
	Radio-Control				
Mini-sumo	Autonomous	≤ 500 gr	≤ 100 mm	≤ 100 mm	Unlimited

Figure 1: Specifications of Sumo Robot Categories (FUJISOFT)

Advantages

- Education and skill development.
- Innovation and technology advancements.
- Sensor optimization.
- Real-world applications.
- Community and collaborations.

Disadvantages

- Waste of resources.
- Professional sumobots are very expensive and costly to maintain.
- Advocates human resources and technology to encourage chaos and destruction instead of innovation and improvement.

Project Schedule

		WEEKS					
		WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6
		2-Nov	9-Nov	16-Nov	23-Nov	29-Nov	3-Dec
TASKS	PERSONNEL						
CONCEPT SELECTION	Andy, Charbel And Pedro	2-Nov					
GET ALL THE COMPONENTS	Andy, Charbel And Pedro		7-Nov				
COME UP WITH THE RULES	Andy, Charbel And Pedro	3-Nov					
CREATE THE SIMULATION ON TINKERCAD	Charbel, Pedro and Andy	3-Nov					
RESEARCH RESULTS	Andy	3-Nov					
SETUP AND TEST THE MOTORS	Pedro and Charbel		9-Nov				
PROGRAM ALL THE SENSORS	Charbel, Pedro and Andy		11-Nov				
BUILD THE FIRST PROTOTYPE	Charbel, Pedro and Andy			13-Nov			
CODE THE MOTORS	Charbel		11-Nov				
1ST EXPERIMENT	Charbel and Pedro			14-Nov			
CODE IMPROVEMENT	Charbel, Pedro and Andy	ALWAYS IMPROVING					
ROBOT STRUCTURE	Pedro				22-Nov		
BUILDING THE ROBOT'S RAMP	Charbel, Pedro and Andy				23-Nov		
TESTING OUR ROBOT ON OBJECTS	Charbel, Pedro and Andy				24-Nov		
POTENTIAL IMPROVEMENTS	Charbel, Pedro and Andy						
FINAL CHECKS	Charbel, Pedro and Andy						2-Dec

Concept Selection

Concept 1:

Concept 1 has 4 TCRT5000 infrared sensors whose job is to detect the outer lines to make the robot avoid going out of the arena and eventually losing the game. The ultrasonic distance sensor scans the arena to detect the opponent and once detected, rams at it at full speed to push it out of the arena.

Do note that due to the lack of sensors on tinkercad, we have improvised and used the default IR Sensor on tinkercad.

The H-bridge we have used on tinkercad is also different from the one we must use in class.

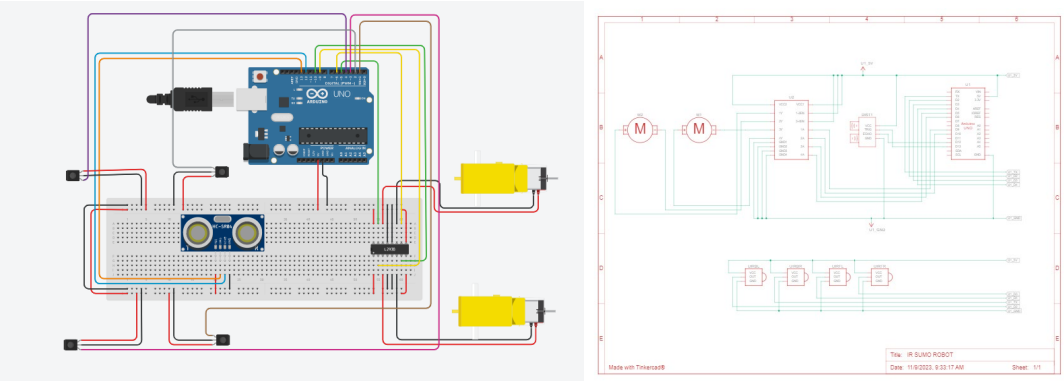
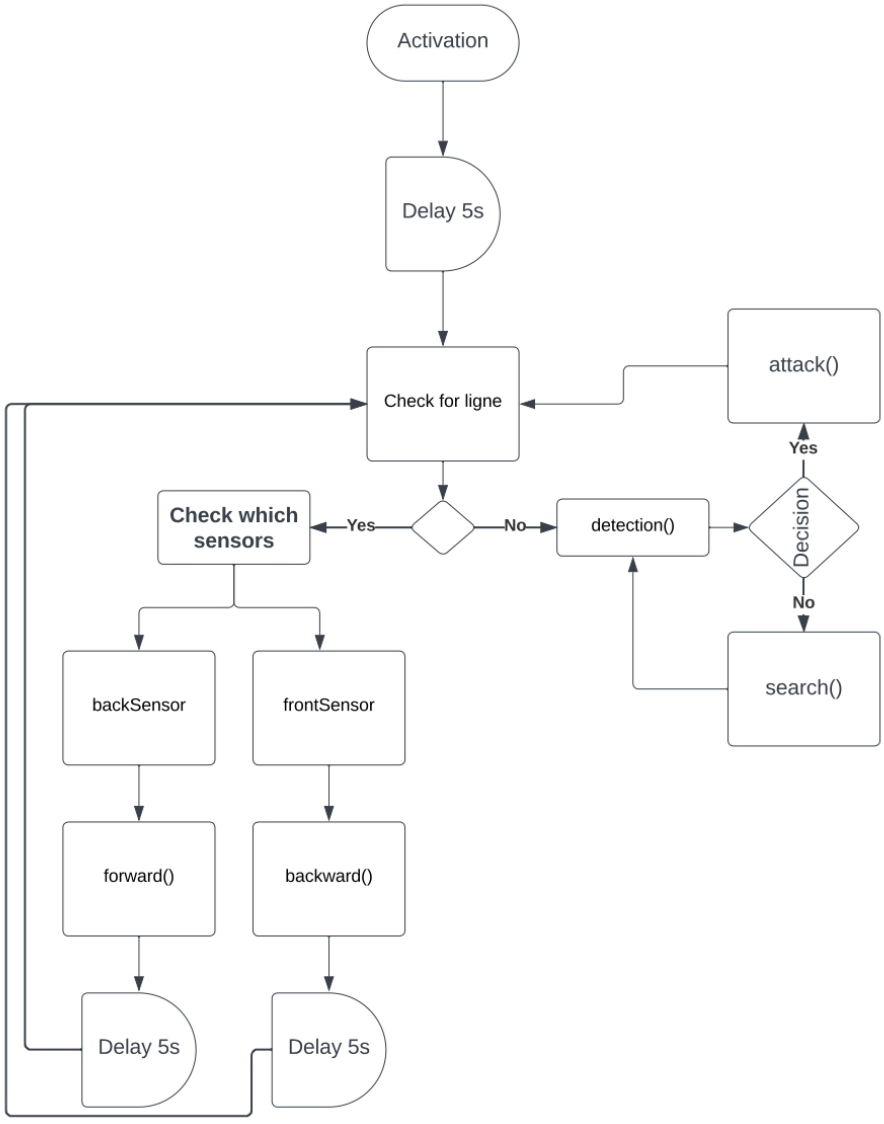


Figure 2: Diagram illustrating concept 1

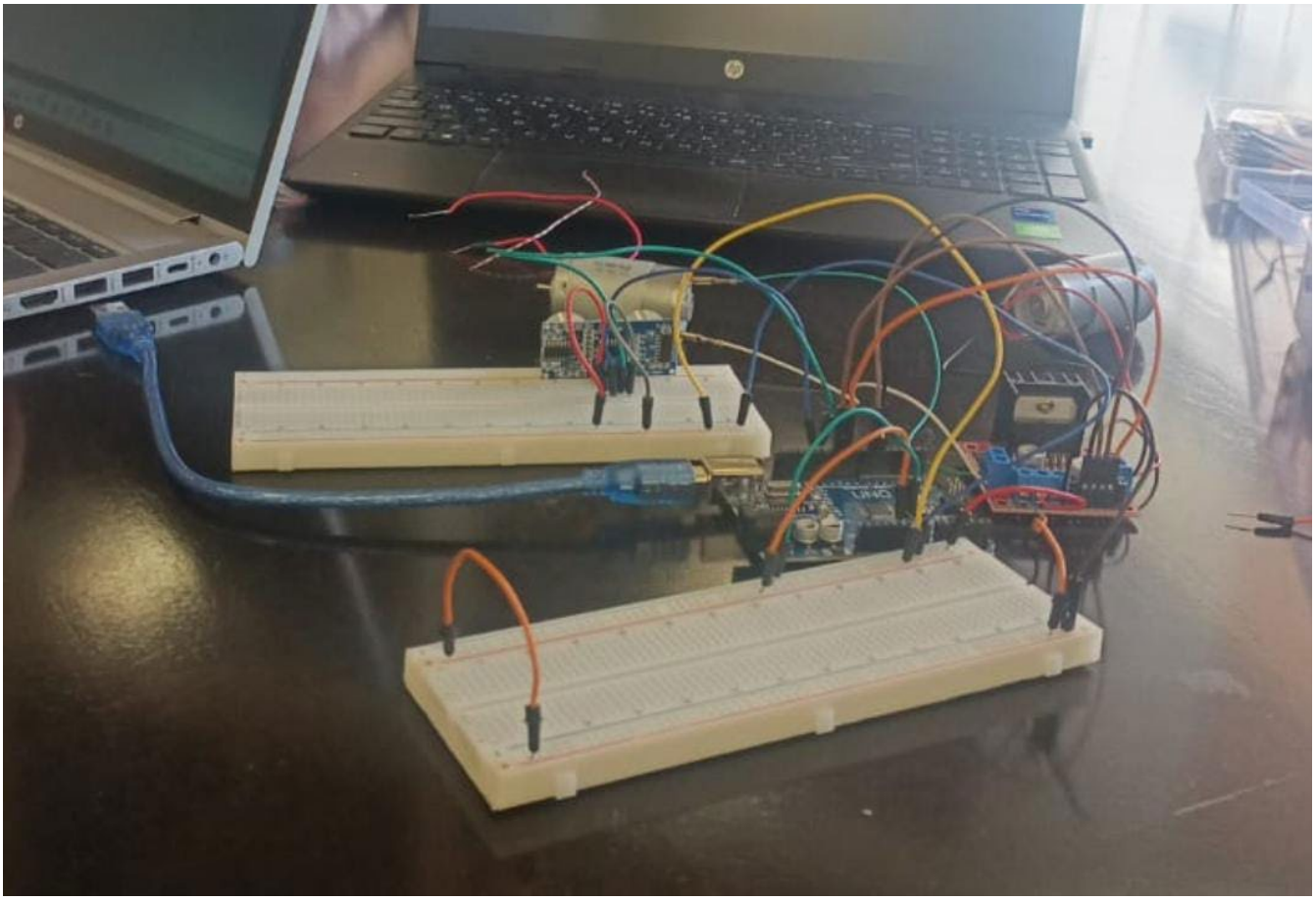
Code Concept:

The code we'll be writing will be functioning in a way to fully automate the movement of the robot by forcing the vehicle to move a certain way by controlling the motors depending on where the robot is ,using the IR sensors input. The ultrasonic distance sensor will scan for the opponent and once found, will send a signal to both the motors to go full power towards it in the intention of ramming it and pushing it out of the arena .

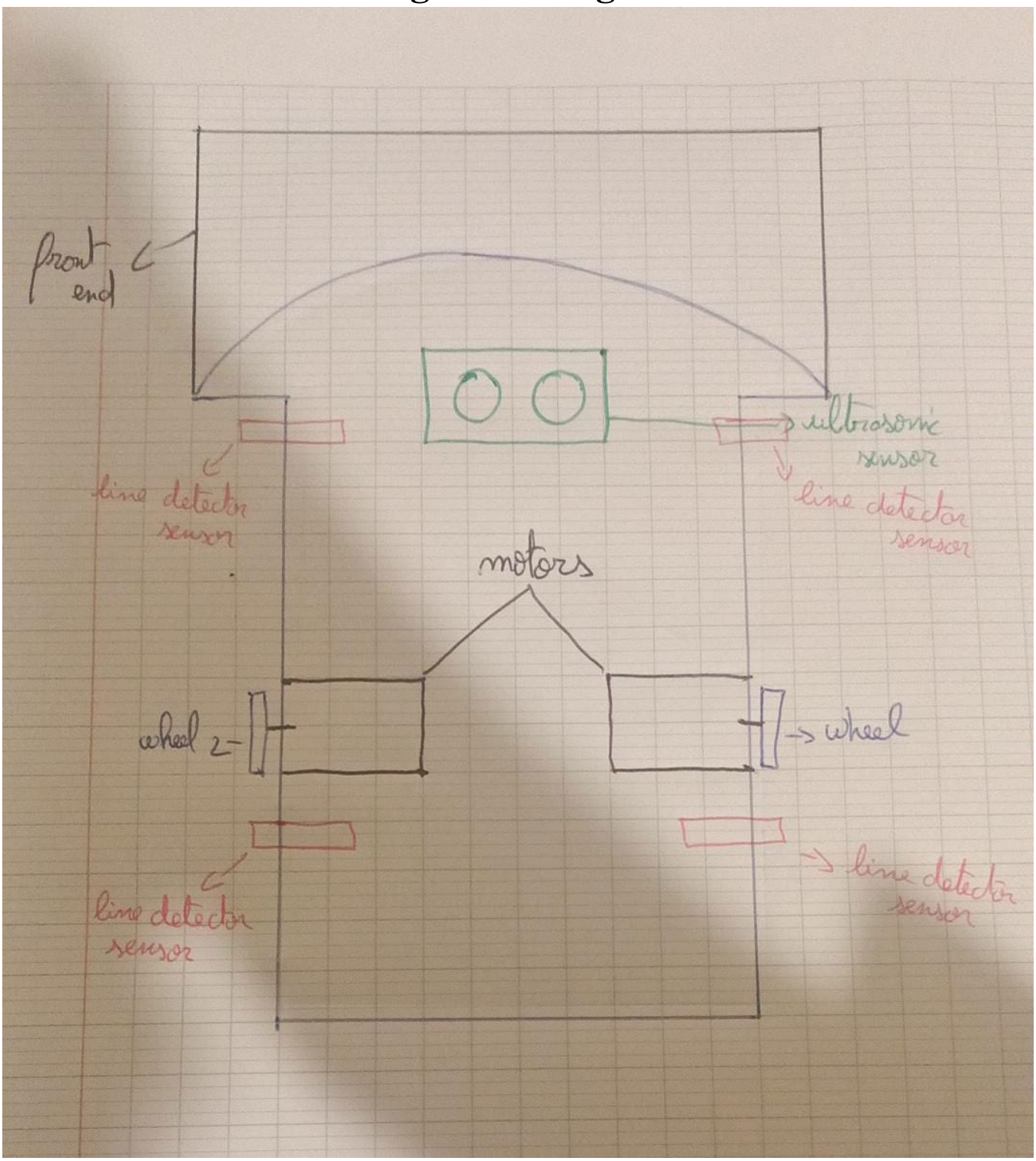
Code Diagram:



Experimental Results:



Design Drawing:



Challenges Faced:

- Regrettably, as a result of miscommunications during our Zoom session, an Arduino board was inadvertently damaged. Unfortunately, one of our team members accidentally short-circuited the Arduino board while attempting to augment power to the motors using VIM.
- While playing our first round, we overly hyped the distance to attack and set it to 30 cm which was an over-estimation that caused us to lose our first round.
- While working on our project, our ultrasonic distance sensor started to bug out and give out values such as 0,800,0,800 and the source of the problem is a small malfunction from the factory and we had to replace it.
- Our project experienced a breakdown 30 minutes prior to the challenge due to transportation issues. However, we successfully restored it to its original state just in time.
- And finally, our opponent did use lithium batteries which gave him a huge advantage.

Discussion of results:

Base Robot specifications:

Weigh: 266.486 grams

Dimensions: 22cm x 5cm x 14cm

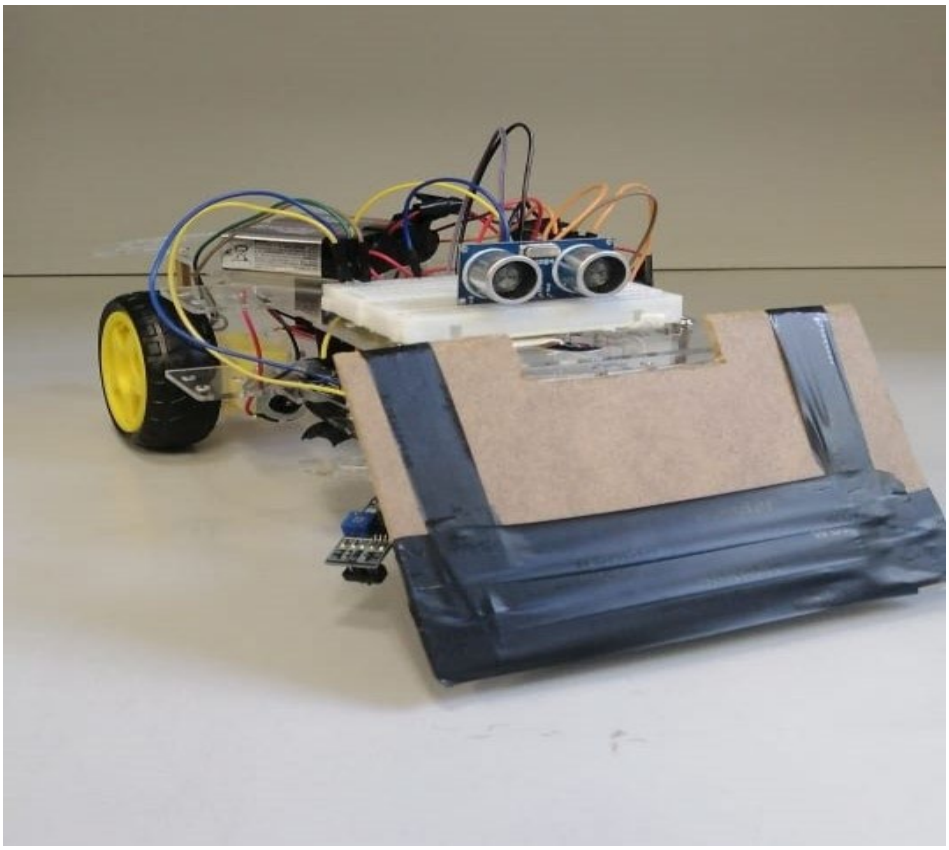
Wheel Size : 6.5cm (Diameter) x 2.7cm (Height)

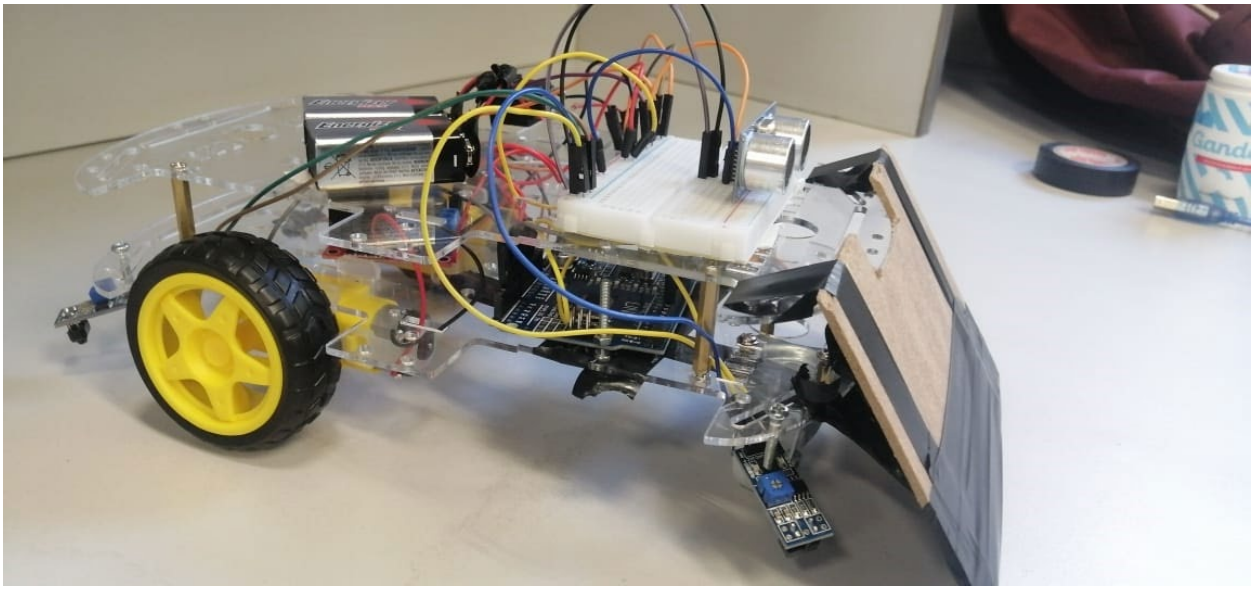
Motor specifications:

Motor dimensions : 6.4cm x 2.8cm

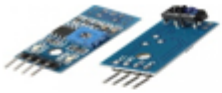
Motor specifications: 6V 4500RPM , 91g

Photos of our robot car:





Cost:

Component:	Quantity	Picture	Total Cost
TCRT5000 Infrared reflective sensor	4		5$
HC-SR04 Ultrasonic Distance Sensor	1		4.5$
Motor Toy 390	2		7$
Motor driver l298n	1		3$
Robot Car 2 wheels (Big Board)	1		4.25$
Battery 9V	1		1.5$
TOTAL COST:			25.25$

Conclusion and recommendations :

- We should encourage the youth and everyone to participate in sumo robots competitions no matter their skill set as it'd help them learn robotics in a simple yet very effective way.

- Participating in such competitions can bring out the creativeness and innovation of everyone in a fun environment.

- Being apart of a big robotics community which would help in networking opportunities and would teach them valuable skills and proper and logical thinking.

- No matter the challenges we faced, this was a great experience to us all and made us all become close friends.

- Despite the frustration it caused, this project served as a valuable learning experience for our team. It highlighted the importance of thorough hardware checks before usage.

- In addition, this project underscored the challenges of remote teamwork on hardware projects, emphasizing that it may not always be the most optimal solution.

References

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