Sumo Robot Algorithms and DAF Structure Performance Study

Posted on September 24, 2019

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Abstract

The paper introduces Robot Sumo, which has taken the world stage by surprise as a friendly type of fight similar to the famous sport of sumo. The article then explains the nature and kind of rules that exist and are recognizable during a robot sumo fight. Also, the competitive advantages that give a competitive edge to any two robots are discussed intensely in the paper. The methodology applied and the participants who helped create robot A and robot B for this fight are credited and acknowledged for their contribution. The article then further states the procedure for the construction of both the robots in length as well as the statement of the material used for their development, respectively. In the fight, robot B emerged victorious due to the advantages it had over the robot in terms of torque, speed, design, and programming, greatly increasing its strength and agility in the battle ring.

Introduction

People have used robots in spectator sports such as BattleBots. However, Robot Sumo has emerged as a form of competition that differs from the original fighting bots. Robot sumo has the same objective as the parent sport, sumo, in which a robot is not allowed to destroy its opponent or turn it into a pile of junk, but instead pushes the opponent out of the ring. It is the execution of this process by the robots that makes the sport fun and entertaining to watch.

According to Wyffels et al. (2011), another exciting thing about the robot's fight in the Robot sumo is that the robots are completely autonomous and not controlled by humans. The robots duke it out autonomously rather than because they are directly controlled by humans. The robots are fitted with many sensors whose objective is to detect the opponent, while mechanical arms, lifts, and sheer brute force help them accomplish their goals. The robots are, however, built differently to withstand different pressures; some are created fast to zip around, aiming for the killing blow, while some are slow and able to resist continually being pushed by the faster robots. Although robot sumo seems like an informal sport, there have been extensive rules that have been set up objectively to govern the fight, ranging from the ring size and the type of jamming to flammable materials.

The rule of this game is that the winner is determined when one robot flips the other robot out of the ring, and the remaining robot wins. The sumo ring is typically four feet across, including a two-inch border situated on the ring's edge. The surface of the ring, nonetheless, is smooth plywood that is painted level dark and sits about one and a half inches off the ground level. The two robots fighting are usually set around ten Lego studs apart, which is an equal distance from the inside of the ring. A robot is thought to be vanquished when both of its units are handicapped or expelled from the ring or part of the robot tumbles off the edge and thus touches the floor. In a competition, there are two points given for a win, one for a draw and zero for a loss. No programming changes should be made during the match, and flying competitors are not used in the fights.

According to Do et al. (2016), one of the significant factors that determines which robot wins is the tyres when the two robots are otherwise evenly matched. Better tyres have a better grip on the surface of the ring and push more effectively unless they are severely underpowered, whereas narrow, worn tyres spell disaster because they can be pushed around easily (Benavidez et al., 2012). Another significant element is the scoop or arm, which is usually designed to shift the opponent off their weight, reducing the grip of the opponent's robot and increasing the scooper's grip. Choosing the color of the robots is a crucial factor because, for example, dark robots cannot be easily seen by infrared; however, these sensors increase the chance of efficiently detecting mobile robots and hence attacking effectively. Finally, the slick, encased robots are usually slippery, which makes it difficult for the opponent to obtain a grip.

Method

Participants

1. Dr. Max (team coach) (his mission was to supervise us, encourage us, and solve any technical issues)
2. Mr. Adel (art and design teacher) (solved some design issues of the robot regarding the stabilization of the body and the wheels)
3. Mr. Ansar (workshop owner) (I gave a 3d design of the robot to him, and Ansar made the metallic model)

Materials

We made two robots, A and B.

Robot A

- 2 LEGO EV3 brains
- 8 LEGO NXT motors

- 12 LEGO Gear with 40 teeth
- 12 LEGO Gear with 24 Teeth
- 2 LEGO EV3 ultrasonic sensors
- 2 LEGO EV3 color sensors
- One metallic blade
- 12 cables
- Two Lego EV3 batteries

Robot B:

- ArduPRO Robot Controller (With Arduino Nano)
- 2 QTR1A Contrast (Edge) Sensor
- 5 Mz80 Infrared Sensor
- Cytron SmartDriveDuo Smart Dual Channel 10A Motor Driver
- 4 DC 12V 300RPM Geared Motor High Torque 37GB-550 Gear Reducer Motor
- PROFuse 3S 11.11V high-quality Li-PO battery 1750mAh 25C
- Four silicon wheels
- Wires
- Blade
- The metallic body
- 9V battery ENERGIZER
- Screws

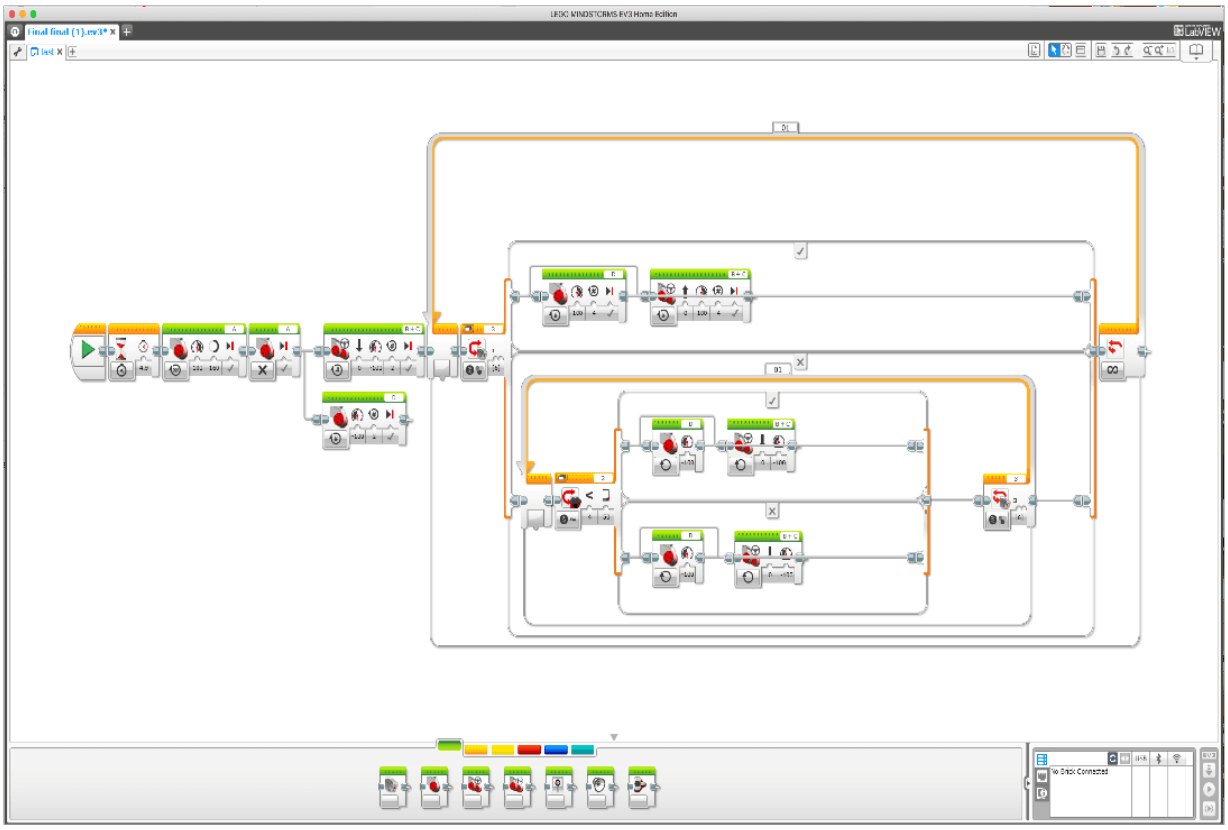
Procedures

According to the competition rules, a robot must have specified dimensions: a minimum width of 20 cm and a maximum length of 20 cm, while the height is not defined. It is also vital to consider the shape and weight of the robot, which should not exceed the specified kilograms. For the construction of robot A, the first step was to draw a 3-D image of the design. Then, the attachment of both the sides, bottoms, and servos, as well as the battery and lower ramp, is done using Velcro. Then the wheels are screwed in place, and spacers are added to electronic mounts. The next step is to assemble the ultrasonic and colour sensors, then add the upper ramp before attaching electronics and attaching Velcro for scanners. Finally, the top components are put in place.

For the second robot, B, one of its main components is the ArduPRO Robot Controller, which acts as the motherboard, linking and controlling all the parts of the robot. According to Bagnall (2014), the first step in making this robot is to solder all the electronic systems that are used to control the motors together so that they will communicate with each other effectively. The next process is attaching the wheels to the shaft towards the motors and ensuring that they are tightly fixed. Then, the base of the robot is attached, ensuring that everything fits together wholly and cleanly. The following step is to attach the back and battery support as well as the front ramp support, taking into

consideration that they are secured. The next step is to connect the electronics, such as the batteries and the wires, before making the robot wedge. Finally, the battery and the top of the ramp are fixed, and controller adjustments are made to ensure that the robot moves around quickly.

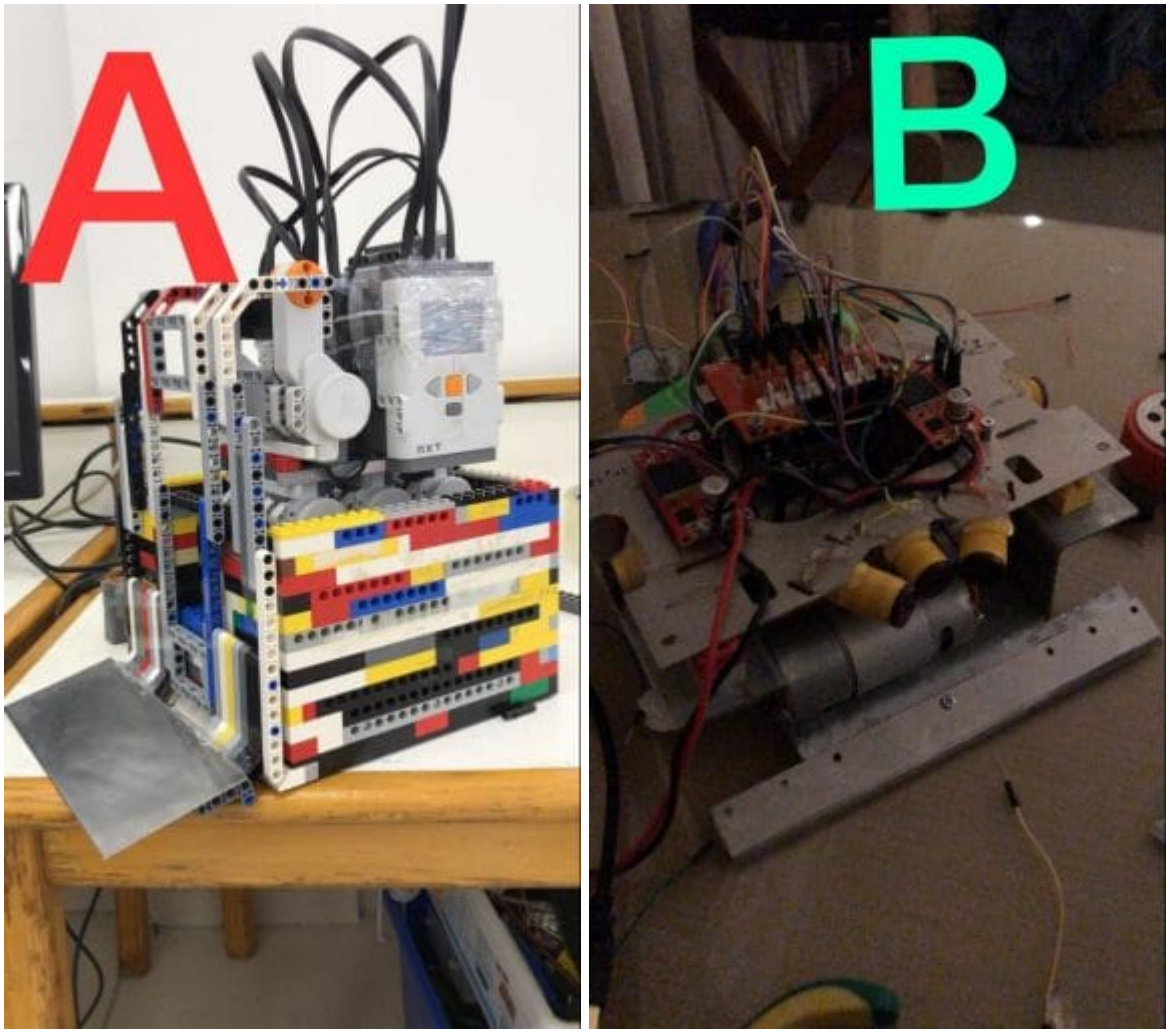
The two robots are then programmed as below:



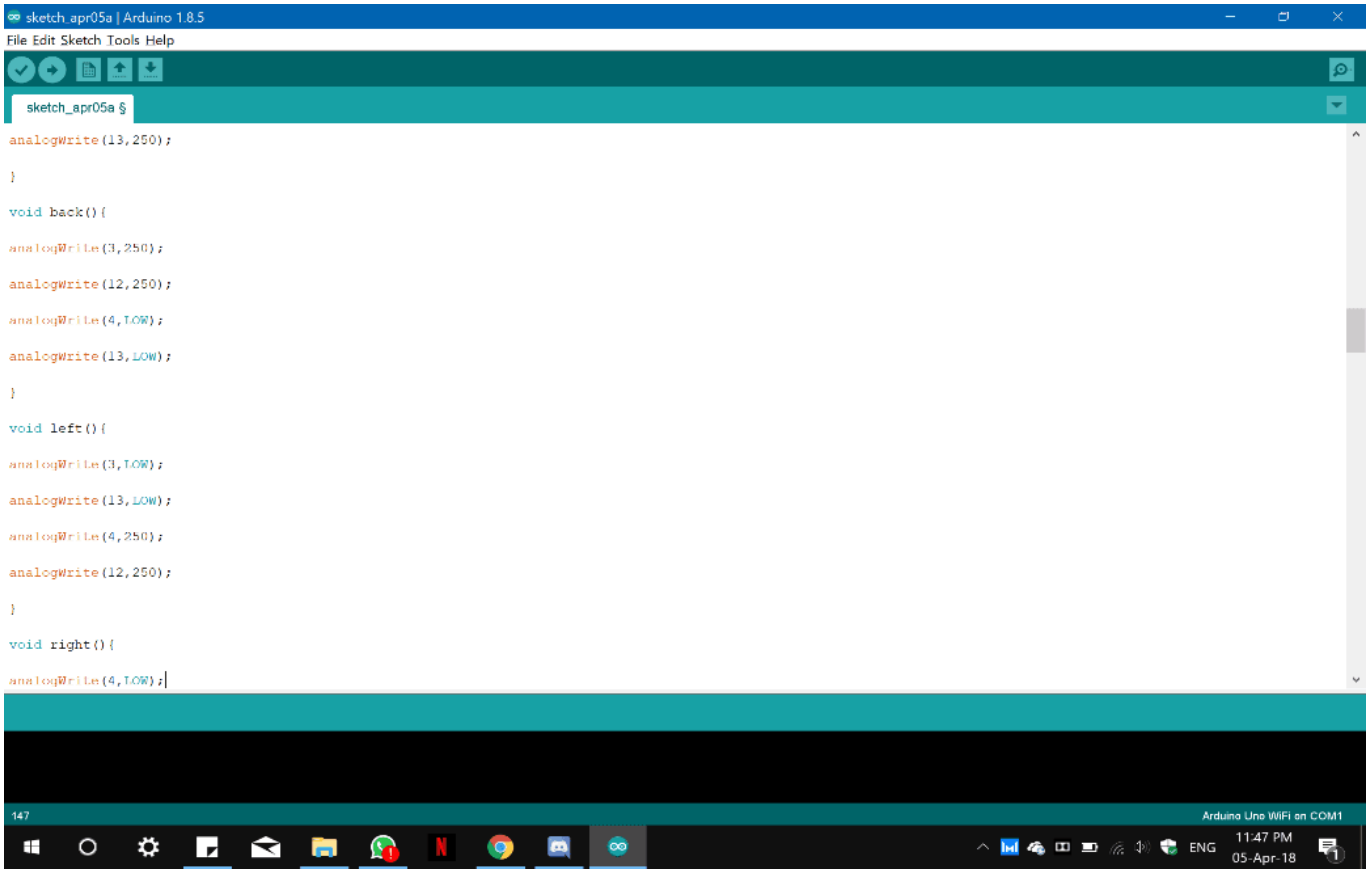
When the program begins, the robot will wait 5 seconds. Later, the two arms will drop with the blade; after that, it will move straight 20cm, and then the robot will start rotating until the Ultrasonic sensors detect the opponent; after that, the robot will attack the opponent and strike it with the blade from dawn. If the robot reaches the white line, the light sensors will command the robot to turn back to avoid the corner.

The structures of the robots, including their components and body shapes, greatly determine how well they perform in a fight. When installed with motors of different types, two different robots will have different revolutions per minute, influencing their speed and increasing their prey instincts. Also, these motors have different torque levels that give different strengths to robots with different motors. Torque determines the strength of the robot and how effectively a robot will attack another robot in the first instance by overcoming friction (Liu and Zhang, 2004). Also, the type of intelligence system will determine the number of strategies that robots can be programmed to use during a fight. For example, the Arduino used in robot B can be programmed to run three different strategies at a time,

unlike robot A, which can run only a single program at a time, giving robot B a competitive advantage.




B



Robot (B) has three different strategies that must be chosen before the match. The first strategy goes straight to the opponent; the second goes right. To attack the opponent, the third goes to attack the opponent. Due to the five IR sensors, there is no need to rotate to find the opponent. The robot will find it and attack it directly. In all strategies, the robot moves back when it sees the white ring of the match table.

Results

The results of a sumo fight between the two robots, A and B, produced the expected win for robot B. The success is attributable to various factors such as the strength, speed, and torque of robot B compared with robot A. Robot B is fitted with the Cytron SmartDriveDuo Smart Dual Channel 10A motor driver and 4 DC 12V 300RPM geared motor high torque 37GB-550 gear reducer motor, while robot A is equipped with 8 LEGO NXT motors. The motors in robot B are much stronger regarding torque and revolutions per minute, making robot B stronger and faster than robot A.

For robot A, the measured torque is 220.4 N/cm at 88.5 rpm, which determines its speed. Also, the programming strategy of this robot allows only one approach at a time. The advantage robot B has over robot A is indicated by its rpm and torque, which are 300 and 220 N/m, making robot B faster, stronger, and more agile than robot A in sumo robotics. Also, another advantage is that, unlike robot A, robot B can be programmed with three different strategies of fighting, giving it a competitive edge

in the fight.

It is the advantage that robot B possesses over robot A in torque, rpm, and agility that gave robot B the win. Robot B is much stronger as a result of the direct impact of these advantages, which gives it a competitive edge in the battle ring.

Discussion

Robot B emerged victorious because of the three different strategies, along with the speed and high torque. Also, robot (B) won because of the top features of the body and the policies that were used in programming. The robot won all competitions quickly and without spending any effort.

However, Robot A similarly had great features and successful programming, but it could not win the match against Robot B because Robot B was much stronger than Robot A. But in the end, Robot A won third place in the national competitionrd place.

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