4CBLA10 Design of a Launching Mechanism

Self-Study Assignment
Group ...

SSA No.	Description
3	Designing Tank-Like Cimber
SSA Owner	
Pranav Joshi	

Introduction

As decided in the meeting, this SSA is aimed on creating a design that can fit the geometric constraints of the clear box (30*30*15 cm)

Goal

To create a design that can fit the geometric constraints of the clear box (30*30*15 cm)

Problems

Unfortunately, due to my new laptop I could not use NX to design the entire system in the given time, however hopefully by the next meeting this can be resolved

Conclusion

A preliminary design for a tank-like robot has been designed succesfully with basic technical drawings. The dimensions of the robot are not set in stone and can be subjected to further optimization. However, the basic concept is now made clear.

Continuation SSA's/Recommendations

1. It is recommended that the design is subjected to weight saving and volume saving measures (like minimizing empty spaces and removing unnecessary volume in the arduino/servo housing). This will allow for faster, cheaper and material efficient manufacturing.
2. It is also recommended that if this design is chosen, a prototype is made to see if the robot can climb the stairs on the racecourse. After which, the prototype can be used to measure and hence optimize the speed.

1 Elaboration

1.1 Constraints and Requirements

To start the design process, first all the geometric constraints were listed as below:

- The robot has to fit within a box of 30 * 30 * 15 cm
- The robot has to house an Arduino of around 25g with dimensions 6.86 * 5.34 * 1.25 cm [2] , [1]
- There needs to be sufficient space for the servos (with dimensions 2.032 * 4.064 * 5.58 cm [4] and weight of 44 g [4]) to operate freely

1.2 Designing

Technical Drawing

To start off, a simple technical drawing 2 was sketched to get a rough feel for dimensions and orientations of the core components.

Since the front arm requires a significant amount of space along the length (30 cm) of the clear box, these placement constraints have been applied to the components to minimize the length of the robot housing, and maximize the use of the breadth (30 cm) of the clear box. This way the front arm can have an optimal length (ie; longer than the first stair) and hence reduce the angle of attack with which it needs to climb

Keeping the above in mind, it is ideal for the Arduino to be oriented so that its longest side is parallel to the width of the robot. The servos have to be oriented such that their longest side lies flush with the longest side of the robot and there is a minimum distance of 10 cm between the front and back servos, this minimum distance ensures the wheels to be atleast 0.5 cm away from eachother at all times, preventing them from clashing into eachother.

To visualize the component placement better, the image 1 below shows an open box view of the robot when viewed from top.

These placements are intended so that the back servos provide the power to rotate the belt, whereas the front servos only rotate and adjust the angle of the front arm. In the next section, the transmission is elaborated further.

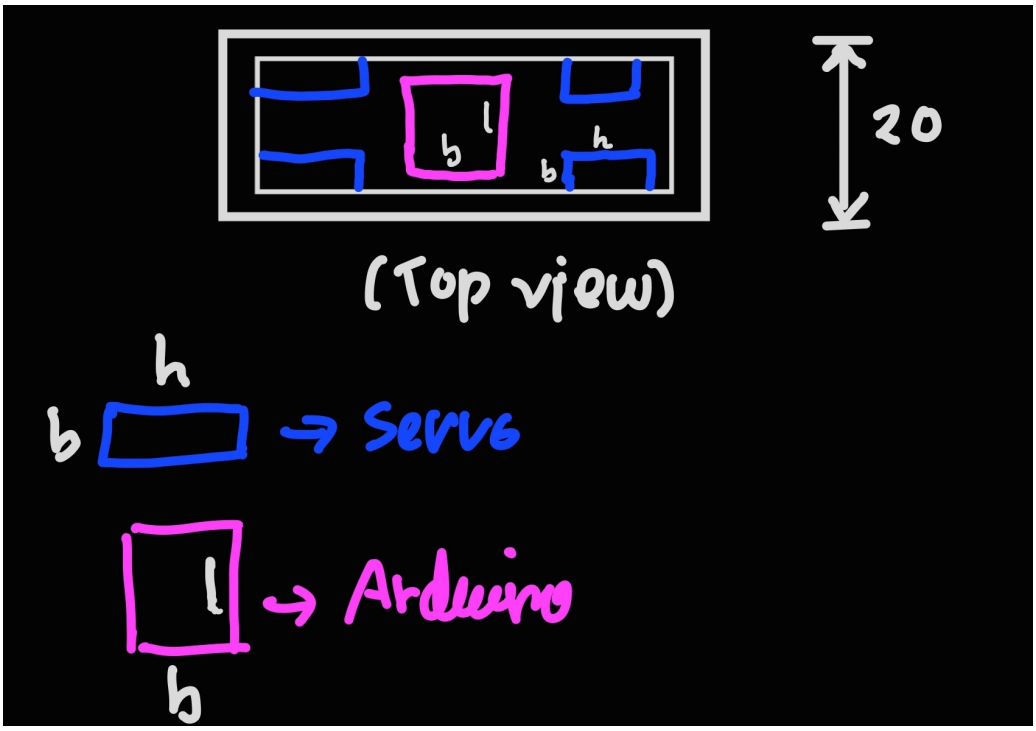

Figure 1: Rough sketch of component placement

Where length (l) and breadth (b) of Arduino are 6.86 and 5.34 cm respectively, height (h) and breadth (b) of servo are 5.58 and 4.064 cm respectively. While making the technical drawing shown below in fig. 2, the height of the arduino (1.25 cm), length of the servo (2.032 cm) and extra space needed for wires was taken into account.

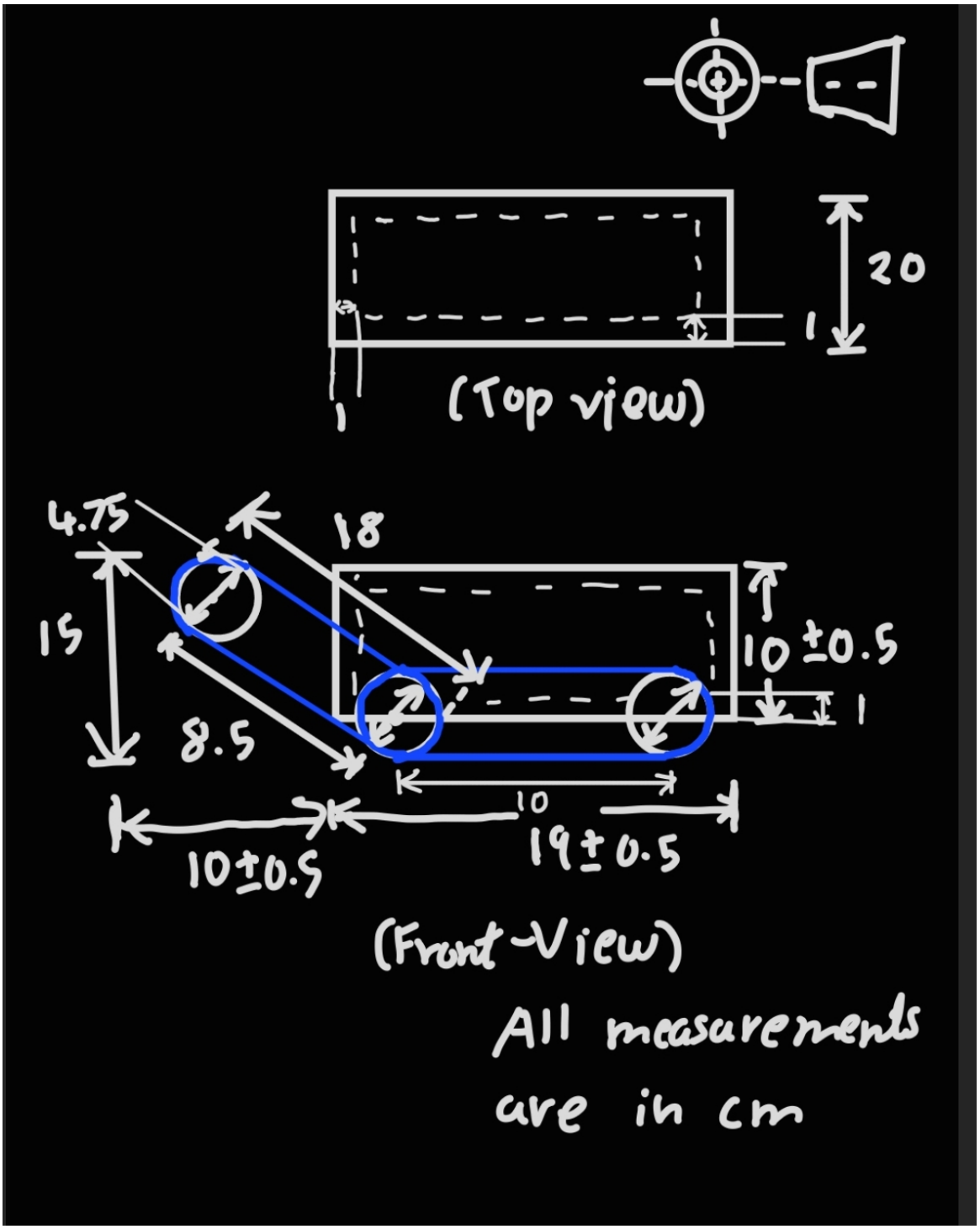

Figure 2: Technical Drawing

It is important to note that the technical drawing is not scaled, and indeed the wheels are quite big when scaled.

Transmission Concept

The rear wheels will directly receive the torque provided by a servo on each side. The front wheels will receive this torque through the belt transmission. The front belt will also be powered by the back wheels, the

front wheels will be free to rotate both belts. The front wheels will rotate around a shaft that connects the arms at each end. This stationary shaft will be connected to the front servos, allowing the angle of attack of the front legs to be controlled. In an attempt to depict this motion and explain it, drawings 3 and 4 were made.

Ball Bearings (preferably large, to maximize the diameter and strength of the axle) can be used to realize this effect. The shaft **should be friction fitted** through the ball bearings, hence preventing any unwanted slipping.

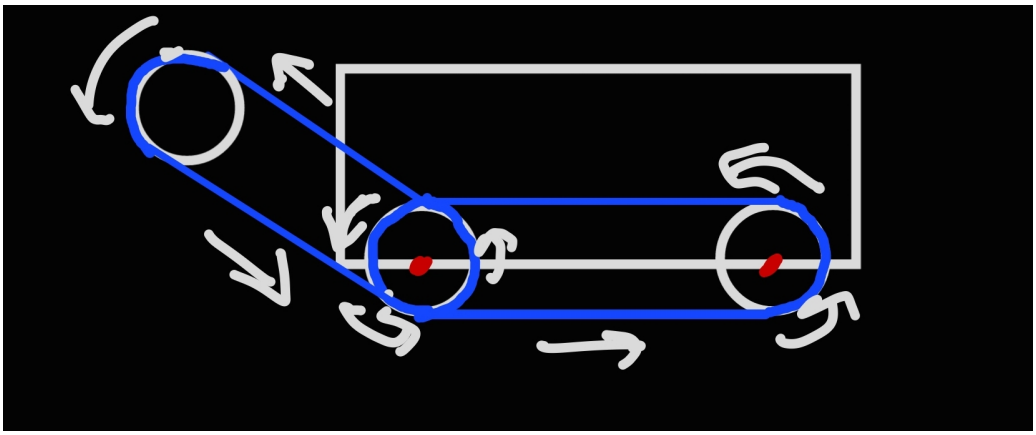

Figure 3: Working of Belt system

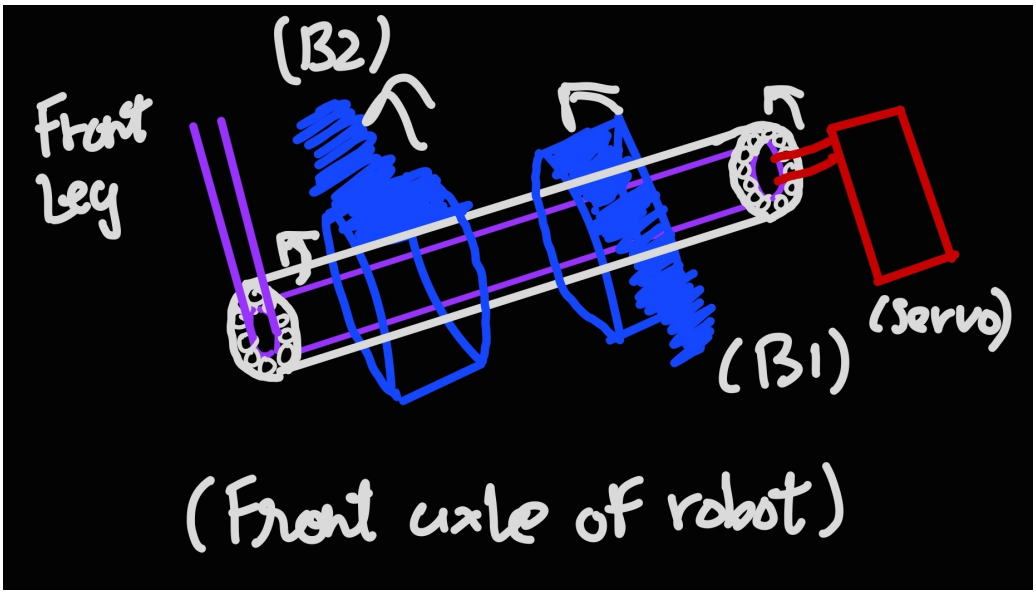

Figure 4: Front Axle of Robot

In the above figure 4, Belt B1 refers to the belt connecting the belt connecting the front axle to the back wheel. Belt B2 refers to the belt connecting the front axle to the end of the front leg. The section highlighted in purple does not rotate when belt B1 rotates. The rotations of the purple section purely depend on the torque provided by the servo that is attached on one end (as seen in red in fig. 4). It is important to note that the dimensions of the components, including the axle and bearings are not to scale, they are only used to gain a better intuitive understanding.

If it is still unclear on how the tank really works, this video [3] can be seen to visualize better.

Overleaf Link to this SSA

https://www.overleaf.com/read/pbzcmdcvhpwq#d5b0bd

References

[1] *Arduino UNO R3 SMD - Anu Electronics*. URL: https://anuelectronics.com/products/arduino-uno-r3-smd. (accessed: 17.02.2024).

[2] *Arduino Uno Rev3 - Arduino Online Shop*. URL: https://store-usa.arduino.cc/products/arduino-uno-rev3. (accessed: 17.02.2024).

[3] *Edubotix Stair Climber Robot*. URL: https://www.youtube.com/watch?v=o1JjZUogVlU. (accessed: 15.02.2024).

[4] *Parallax Standard Servo*. URL: https://docs.rs-online.com/0e85/0900766b8123f8d7.pdf. (accessed: 17.02.2024).