12/10 Drivetrain Signoff Updated

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Motors

I have been weighing the pros and cons of salvaging the motors from the previous SECON team. I have come to the conclusion that it would be better to buy all new motors. My reasoning is that the previous SECON team bought their entire chassis, motors included. I was able to track down some info about the particular unit that they bought, and I ended up finding the motor model numbers. However, I was unable to find the motors for sale by themselves. In addition, I was unable to find any website that still sells the whole chassis unit. So, if anything were to happen to these motors, we would be left without a replacement.

The parameters considered when looking for motors were required voltage, robot weight, desired speed, acceleration, and wheel radius.

The weight of the robot is an important factor to consider when sizing the motors because it directly affects the size of the load. A chart of component weights can be found below in Figure 1.

Motors x4	**1.8 lbs**
Raspberry Pi + Arduino Mega	**0.2 lbs**
Shooting Mechanism	**Approx 2 lbs**
Wheels x4	**0.5 lbs**
Battery	**Approx 0.6 lbs**
Robotic Arm	**Approx 2 lbs**
Acrylic Chassis	**2.5 lbs**
Total	**9.6 lbs**

Figure 1. Component Weights

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The motors and wheels are known values. There will be four DC motors in order to separately drive each of the wheels. The chassis weight was based on Daniel's AutoCAD measurements and the weight of one square foot of acrylic sheet. The battery, robotic arm, and shooting mechanism weights were approximated based on what we think we may use.

Our original desired track completion time was 1 minute and 20 seconds. This was a very conservative estimate. Robot speed is something that will have to be heavily tested and tweaked when the time comes, but navigating the track should be much quicker than the initial estimate. The actual speed that we will be able to achieve will depend on the response time and accuracy of the navigation control system that we are able to produce. We don't want the robot going too fast at the risk of losing track of the line. In addition, on the return trip, the robot will have to move slower in order to locate the nets. All things taken into consideration, the desired speed is up to 1.5 ft/s.

Acceleration is another aspect that will directly affect the motor size. Torque and acceleration are directly related. A higher desired acceleration will require a higher torque rating. We would like our robot to be able to accelerate at 1 ft/s in order to quickly get off the mark.

The wheels have been selected and have a radius of 26 mm. With the wheel radius being on the smaller end, this means that the motors will have to have a fairly high rpm rating in order to achieve the desired traversing speed.

Finally, the motor voltage was taken into consideration. 12 V DC was chosen based on anticipated load. Based on my findings, 12 V DC seems to be the minimum rating to meet our needs of speed and torque.

Using the previously listed parameters, I used the motor sizing calculator that can be found at this link:
https://www.robotshop.com/community/blog/show/drive-motor-sizing-tool

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The motors that I would like to purchase can be found at this link:

https://www.amazon.com/Greartisan-Electric-Reduction-Centric-Diameter/dp/B071GTTSV3?th=1

These motors are rated for 12 V / 200 RPM and 2.2 kgcm. It is expected that the actual load of the robot will be slightly less than the rated load of the motors. I have selected these motors just to be sure that even if the robot weighs slightly more than our initial estimate, we will still be able to drive at the desired speed.

Wheels

The robot will use mecanum wheels because they will allow it to drive in any direction. Driving in any direction will be advantageous for two reasons. First, it will reduce the distance between the robot and the trees containing the beads, which will allow for a shorter robotic arm if needed. In addition, when aligning the robot to fire beads at the nets, we will be able to reduce the distance to the target, which will reduce the distance that our projectile will have to travel. I was able to find the mecanum wheels from the robot that we currently have online and available for purchase. These wheels have a weight capacity of 1-30 lbs and will easily be able to support our robot. The motor coupling shaft is 3 mm by default, but the machine shop can be used to drill the wheel hubs to 6 mm in order to match the shaft of the motors we will be using. Buying these wheels will allow us to already have a backup set should anything happen to them.

https://www.robotshop.com/en/mecanum-wheel-4-pack-w-metal-hubs.html

H-Bridges

Our robot will need H-Bridges to supply voltage and direction control to the motors, as well as to provide shielding for the Arduino. It is important that the motor driver circuit we select meets the voltage and current rating requirements for the motors. The L298N motor driver board has a voltage range of 5-35 V, and the maximum current per channel is 2 A. This meets the needs of the

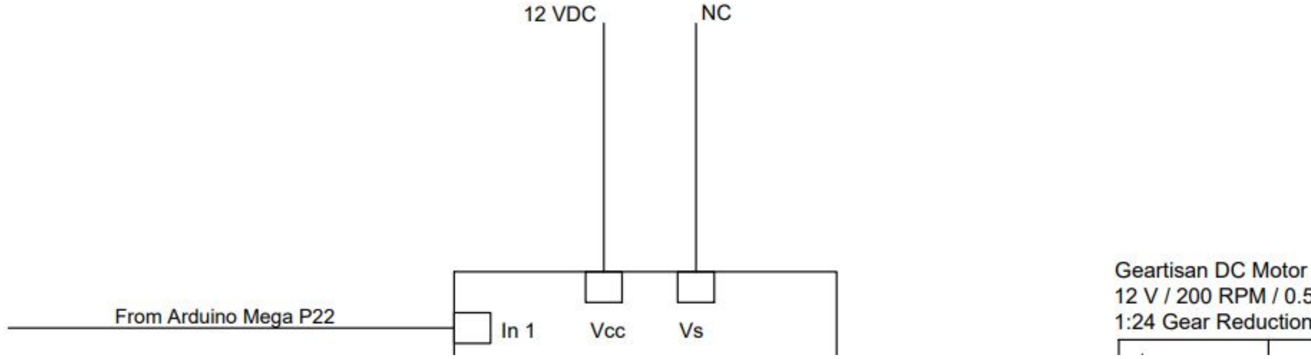
motors that we are driving, which are rated for 12 V and 0.5 A. The L298N board also has controls for polarity, which we will need to change the directions of the motors. Additionally, the L298N is commonly used in Arduino projects, so the logic voltage level and current are not an issue.
https://www.amazon.com/Controller-H-Bridge-Stepper-Control-Mega2560/dp/B07WS89781/ref=pd_di_sccai_2/139-5769337-4410160?pd_rd_w=ymVfw&pf_rd_p=c9443270-b914-4430-a90b-72e3e7e784e0&pf_rd_r=TFX0FT262DMV4GWPZ5EY&pd_rd_r=b7197111-35e5-4333-aff0-fd834374030c&pd_rd_wg=26Ice&pd_rd_i=B07WS89781&psc=1

Drivetrain Schematic

Below is the detailed schematic of the drivetrain layout. The figure shows how two motors will be controlled. In reality, there will be another identical version of this schematic, the difference being the pins coming from the Arduino.

Pins 1-4 of the L298N board control the polarity for each motor. Pins ENA and ENB are the PWM channels that we will use to control the voltage levels that each motor sees. All inputs are from the Arduino Mega 2560 that we will be using as the main controller.

VCC is the main power from the battery, and VS is an optional 5 V output that could be used to power an Arduino. However; it will not be used in our application.



5 A / 2.2 kgcm
n Ratio
1

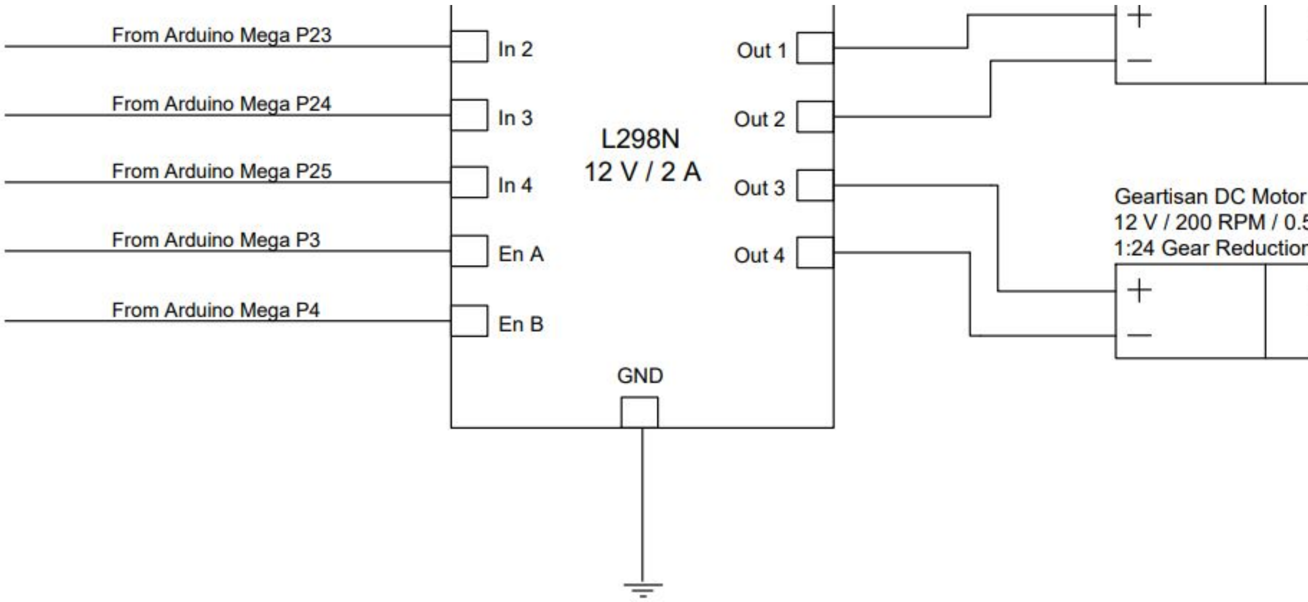


Figure 2. Detailed Schematic

5 A / 2.2 kgcm
n Ratio