

Team #19: Autonomous Lawnmower

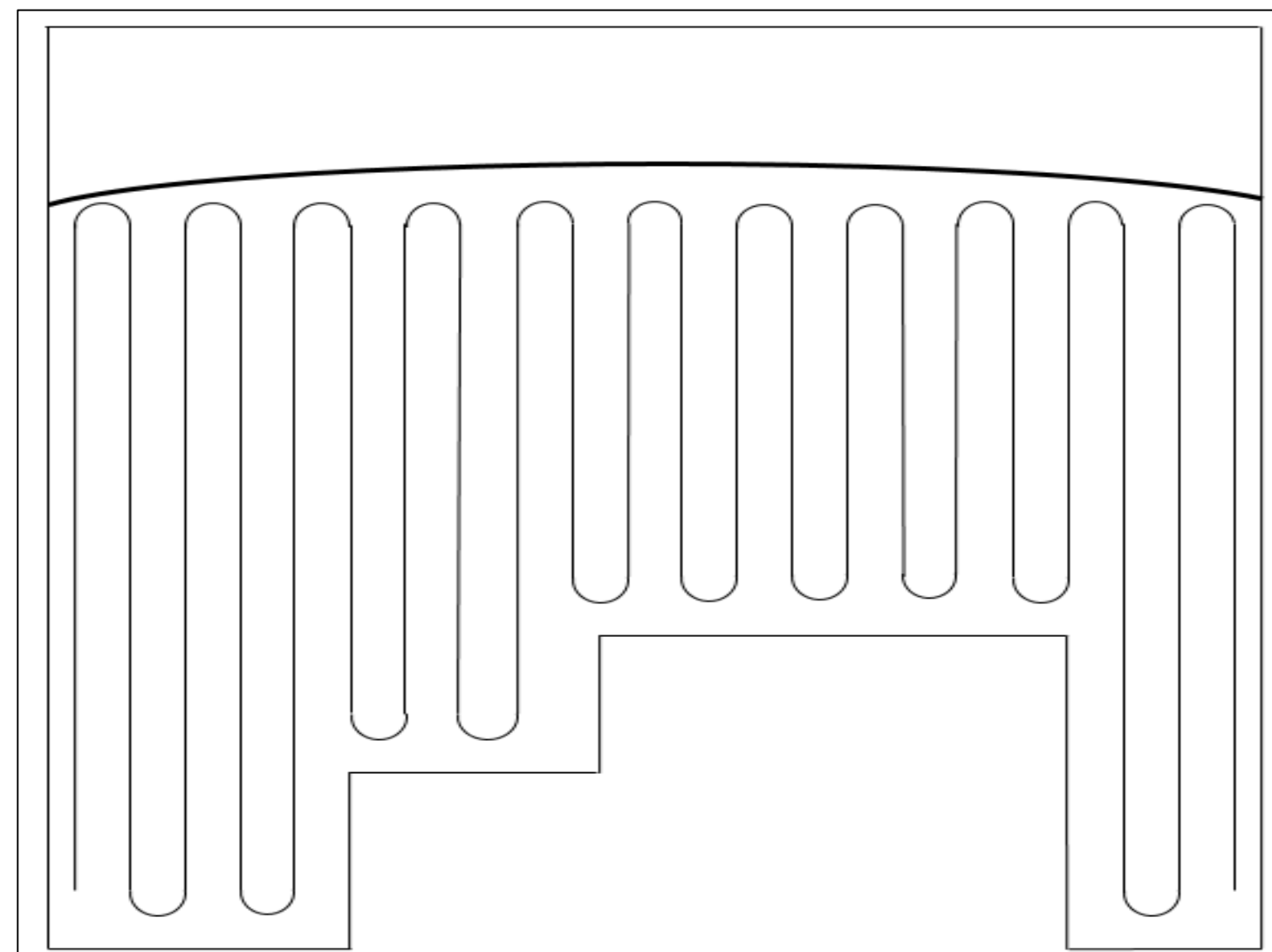
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Cutting Logic



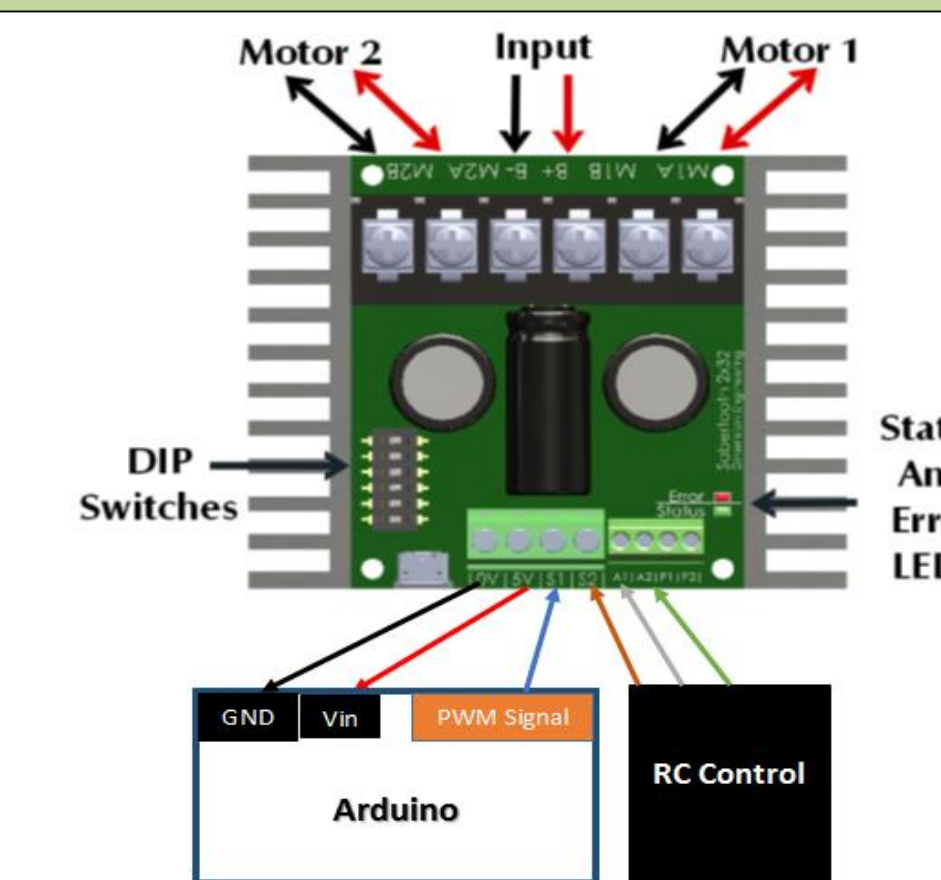
Right: Pictured to the right is the path that the Arduino would be programmed to take in a yard of that layout. As you can see, the distances shorten as the yard decreases in length. This drawing is an accurate representation of the description below.
Above: The picture above is a clip from the mower following the path shown to the right and described above.



The Autonomous Lawnmower will know the necessary path to travel based on its starting position in the yard. The on-board Arduino will be programmed to travel the distance of the yard followed by a U-turn. This process will be repeated until the entire yard is cut. The benefit of this cutting style is that the majority of the yard can be cut without the necessity of an expensive navigation system. If the property has more than one yard to cut, due to permanent obstacles such as trees or fences, more Arduinos can be programmed to cut the other sections of the yard. For example, the cutting pattern in the backyard can be programmed on one Arduino and the front yard can be programmed on another Arduino. Once the backyard is finished being cut, its Arduino will be powered off and the Arduino with the code for the front yard will be turned on. Once programmed, this cutting method is a simple to operate but effectively gets the job done.



Sabertooth Motor Driver



- Dual motor input with the ability to supply a continuous 32 Amps to both motors.
- Offers a variety of operating modes including tank style mixing and automatic calibration.
- Custom, programmable user modes via USB port.
- Arduino and RC compatibility with immediate RC takeover in the event of an emergency.
- Ability to monitor motor driver in real time using DEscribe Software and micro-USB port.

Safety



Emergency Stop Button: The Autonomous Lawnmower will come equipped with an on-board emergency stop button that, upon being pushed, will shut down power to the drive motors causing the lawnmower to stop.

Remote Kill Switch: The remote control module that will be used to drive the mower through its initial track to record the waypoints will also be used as a remote-activated kill switch. The Arduino will be programmed such that, when the remote control module is turned on, the Arduino will immediately stop following the SD card distance commands and begin following the potentiometer signals from the remote control.

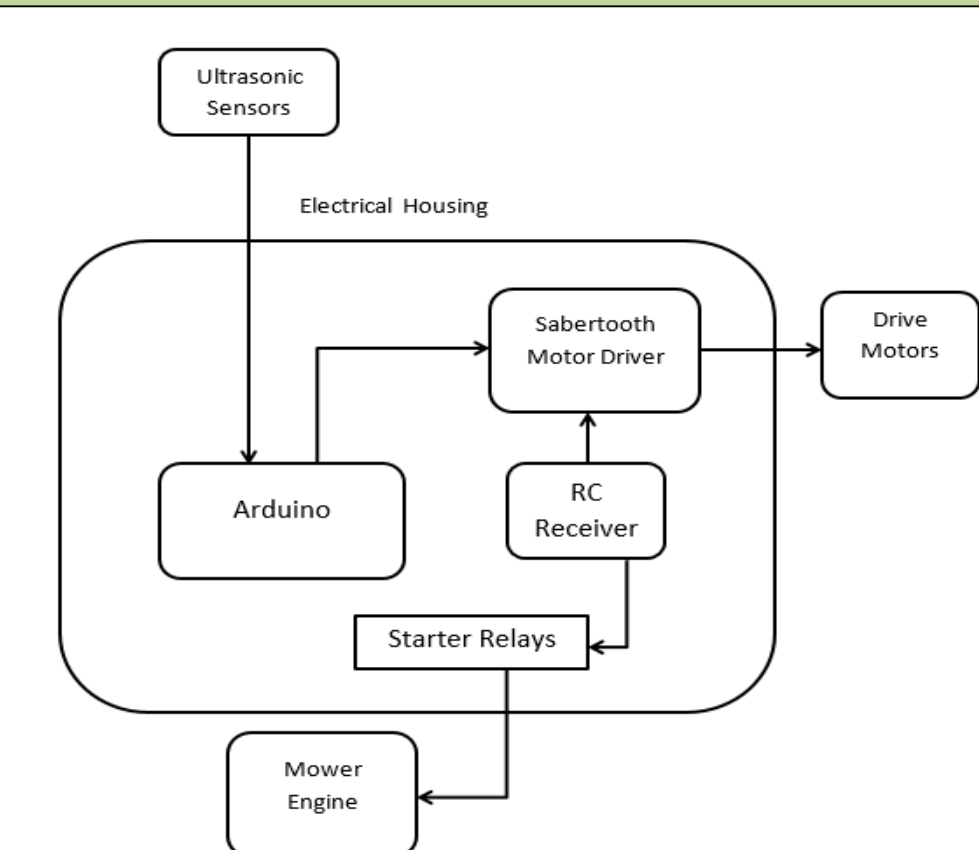
http://www.mini-lathe.com/reviews/Lathes/Sieg_C8/estop01.jpg

Ultrasonic Distance Sensors: There will be four ultrasonic distance sensors on the mower to prevent the mower from running into any seen or unforeseen obstacles. Two sensors will be mounted on the front for when the mower is travelling in the forward direction, and one sensor will be mounted on each side of the mower to protect it while it is turning in either direction. The sensors will provide a 1' range of protection.



<http://www.tinyosshop.com/image/cache/data/sensors/Ultrasonic/MB7067-1-600x600.jpg>

Electrical Component Layout



The basic configuration of the electronics depicted in the schematic to the left shows the flow of information for the system. The Arduino analyzes the signal from the sensors to determine if an obstacle is ahead. If the path is clear, the Arduino continues with the process described in the "Cutting Logic" box located above. The Arduino will work directly with the Sabertooth Motor Controller, which can also be used to convert the remote control signal to guide the mower.

Steps for Initial Setup

1. Obtain the dimension of the yard to be cut.
2. Program the various distances into the Arduino as time delays.
3. Use remote control to position mower at starting point.
4. Power on Arduino to run cutting program.

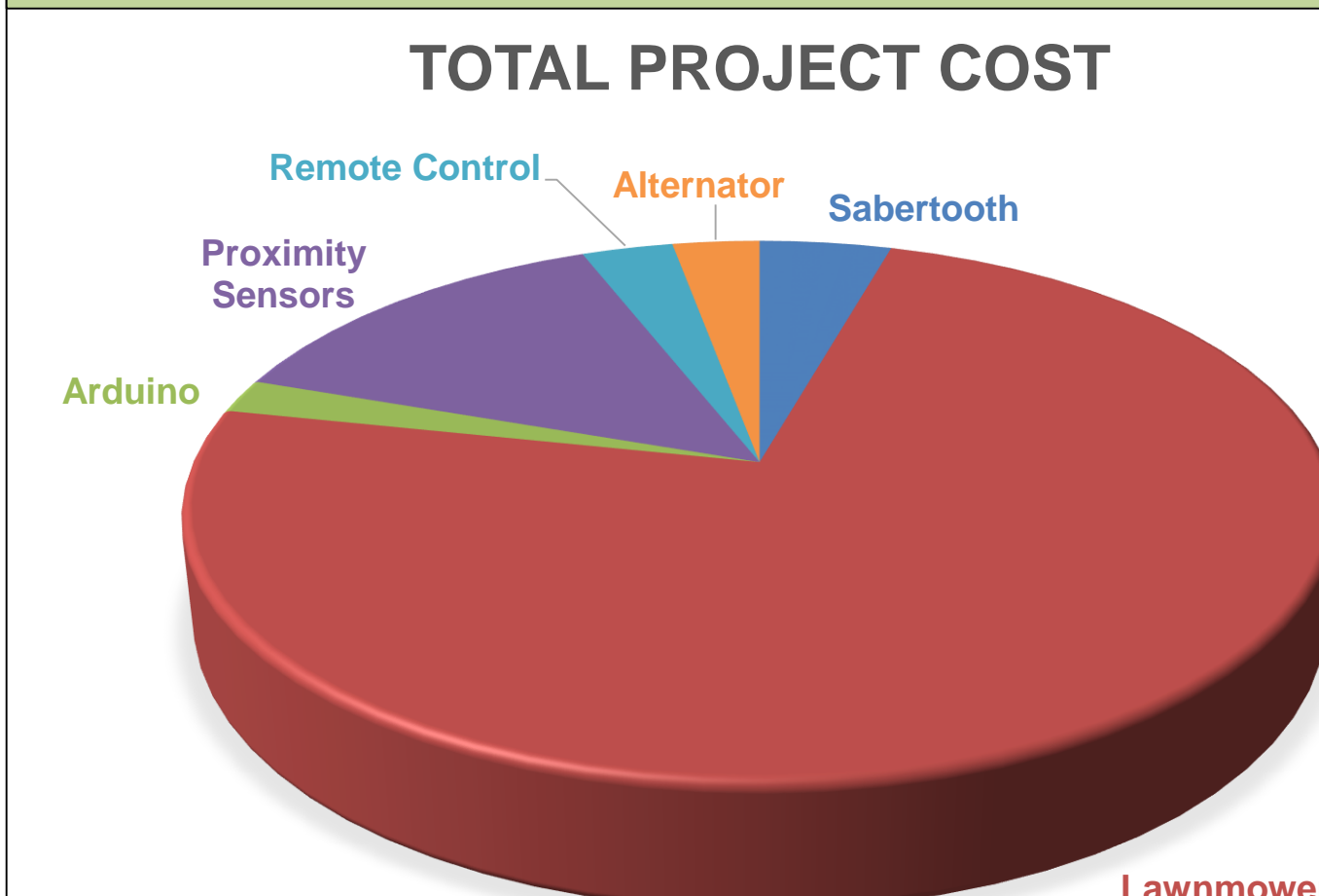
Objective

The goal of our project is to design an autonomous lawnmower that can be programmed to follow a designated path with minimal human interaction.

Engineering Specifications

1. Mower must travel at a cruising speed of about 2 mph.
2. Maximum production cost must not exceed \$10,000.
3. Mower must sense obstacle and stop at least 1 foot away to avoid collision.
4. Mower must follow a predetermined path programmed into the Arduino.
5. Blade height must be adjustable between 1 and 6 inches.
6. Optional remote control takeover.

Budget



The overall budget for this project is shown above. The lawnmower and proximity sensors were purchased last year. While the Sabertooth motor controller and new Arduinos, an alternator, and a new remote control were purchased this year.

Testing Plans

1. **System Control Testing:** Testing to make sure Arduino board works adequately with Sabertooth Motor Controller
2. **Accurate Turn Testing:** Calculating the delay time for perfect right turns, left turns, and U-turns. Perform turns in the grass to make sure calculations are correct.
3. **Distance Calculation and Speed Control Testing:** Testing to make sure code for distance and speed control is accurate enough for mower application.
4. **Sensor Testing:** Making sure the sensors can detect objects within optimal range
5. **Obstacle Avoidance Testing:** Making sure the lawnmower can avoid set obstacles and boundaries, including using sensors and waypoint recording of path