

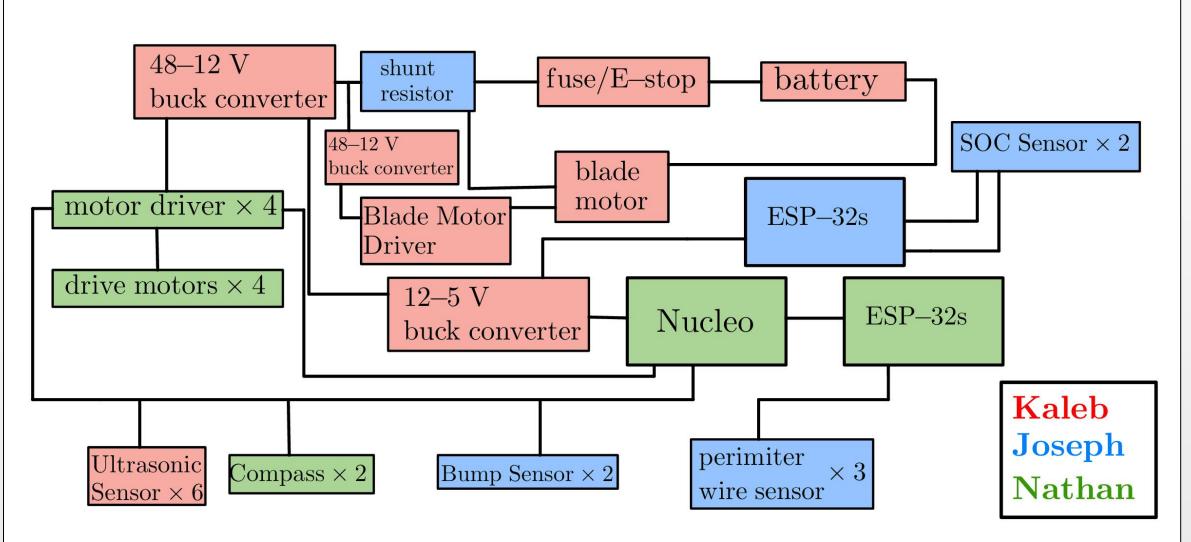
Robot Mower

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Introduction

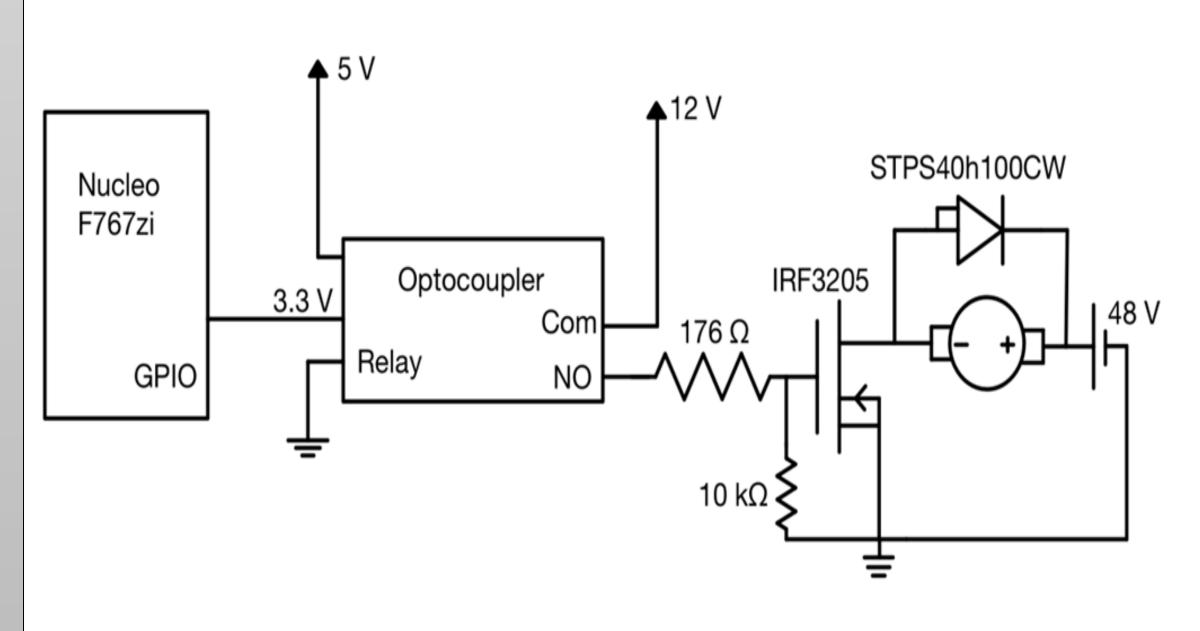
The goal of this project is to design and build an autonomous lawn mower that will mow small to medium sized flat yards. The mowing area is defined by the user using a perimeter wire. The mower will avoid obstacles within this area.



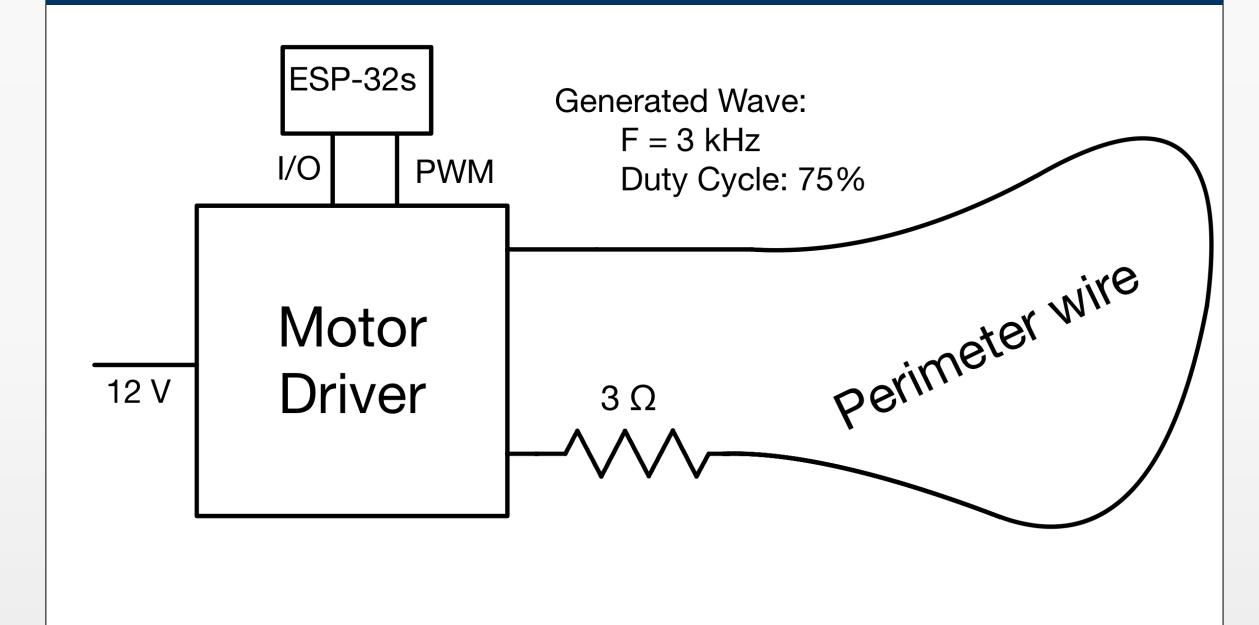
Above is a diagram of the mower and which parts were worked on by each team member.

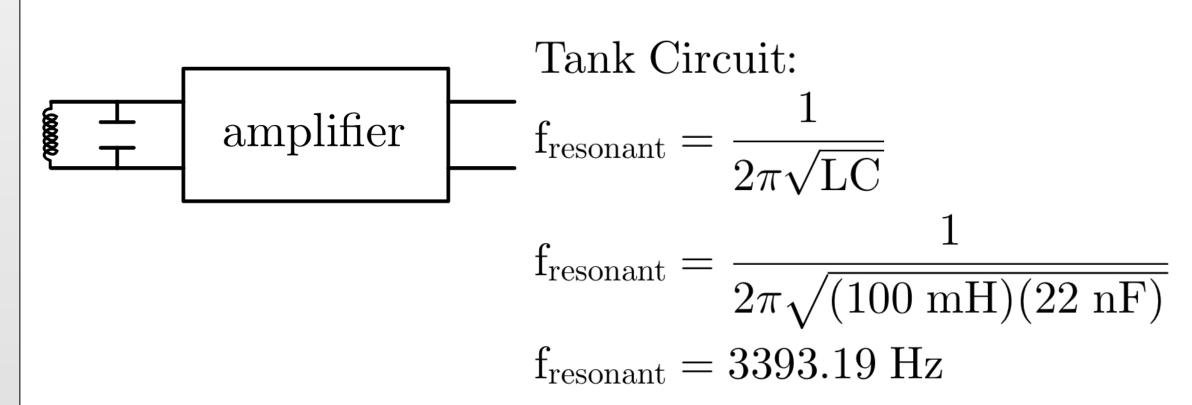
Blade Motor Driver Circuit

The blade motor for this project was a large motor that ran at 48 V and could draw currents up to 68 amps which made it difficult to find a motor driver that would be able to control the motor without blowing up. Instead, we designed a MOSFET switching circuit which would turn the blade on and off when we said so. When a signal was sent from the microcontroller to our relay the relay would close the higher power side which allowed a voltage to be applied to the gate of our MOSFET. The MOSFET's drain would then connect to the source allowing current to flow through which would then turn on the motor. We used a diode in parallel with the motor to insure that when the motor was turning off and on the MOSFET or any other part of the circuit would not be damaged. A 10k ohm resistor was used as a pull down resistor to ensure the gate would go to 0 and would not float leading th the motor never turning off.



Perimeter Wire Detection

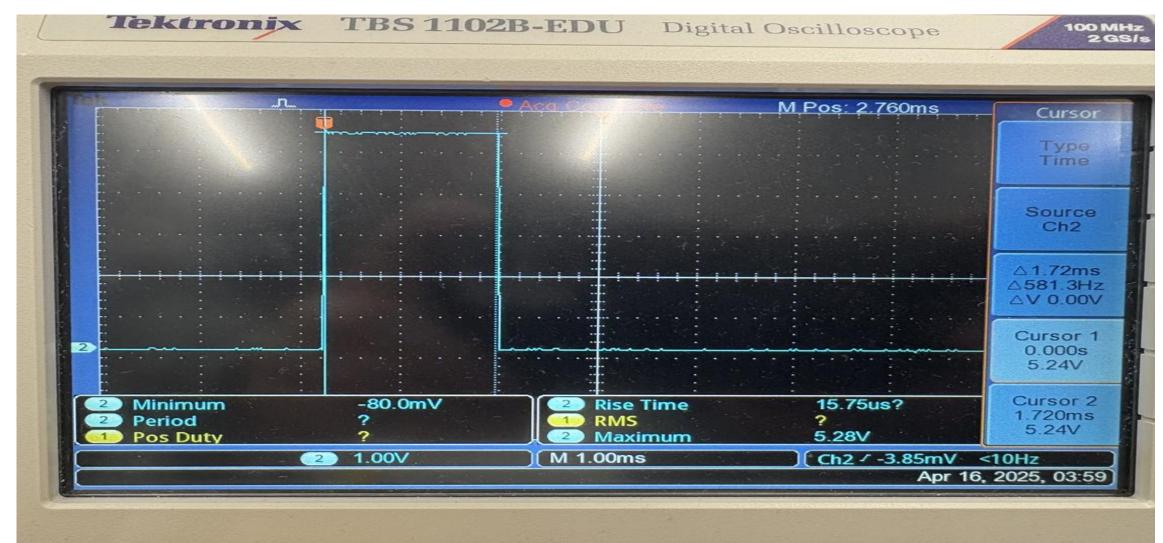




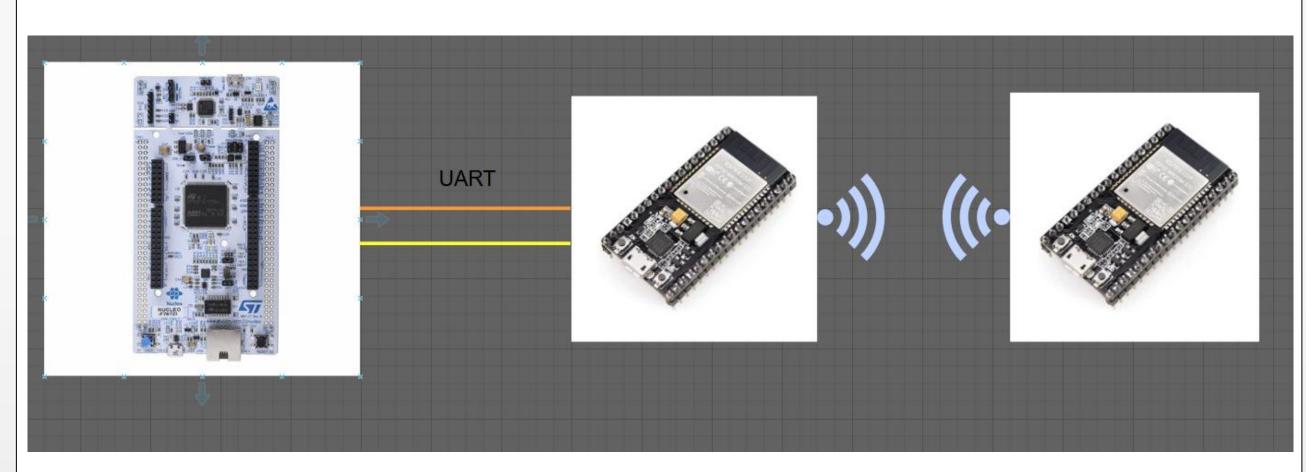
The mower must remain in a designated area, this area is defined by the boundary wire. A signal is generated through a boundary wire around the perimeter of the yard. Sensors on the mower that are tuned to the resonance frequency of the generated signal are used to detect the presence of the boundary wire. Preventing the mower from escaping the yard.

Ultrasonic sensors

Below is the signal that our microcontroller would receive telling it how far away an object is from our mower. The ultrasonic sensors used would use the equation: Pulse width*.0343/2 which would tell us the distance in centimeters.



Mower Communication



The mower uses both wireless and wired forms of communication. The wireless communication allows for the mower to send and receive data from the base station. The base station allows the user to send start and stop commands to the mower and the ESP32 on the mower relays those commands to the Nucleo over UART. ESPNOW allows for a heartbeat command to be sent back and forth to ensure the base station is powered on to prevent the mower from leaving the area.

Power Calculation

The goal for this project was to run for a total time of at least 30 minutes. Everything in the project pulled approximately 895W so we bought a 48 V 14 Ah battery, and when calculating we were able to run for 45 minutes.

Item	Quantity	Voltage (V)	Current (A)	Power (W)	Total Power (W)
Logic Level Relay	1	5	0.07	0.35	0.35
Bump Sensor	2	5	0.01	0.05	0.1
Wheel Motors	4	12	3.5	42	168
Motor drivers	4	5	0.03	0.15	0.6
Boundary Sensor	1	5	0.02	0.1	0.1
ESP32	2	5	0.4	2	4
Blade motor	1	48	15	720	720
Ultrasonic sensor	6	5	0.015	0.075	0.45
Compass	2	5	0.045	0.225	0.45
PZEM	2	5	0.02	0.1	0.2
TTL converter	3	5	0.01	0.05	0.15
MOSFET	1				0.0007
Nucleo f767zi	1	5	0.3	1.5	1.5
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