



Smart Car

In collaboration with:



Senior Design Project

Abdul Majid & Isaac Rodriguez-J

Sonoma State University Department of Engineering Science

Advisor: Dr. Farid Farahmand

Client: Mr. Peter Oliver

[https://majidabdul4578.wixsite.co
m/mysite](https://majidabdul4578.wixsite.com/mysite)

majid@sonoma.edu

or

rodriisa@sonoma.edu



Overview

- Who are Switch vehicles?
- Problems
- Project Proposal
- Engineering & Marketing Requirements
- Functional Overview & Hardware
- Software Design
- Current Test Results
- Lists of Components & Estimated Budget
- Challenges
- Schedule
- Supported Courses
- References
- Questions & Comments

Switch Vehicles

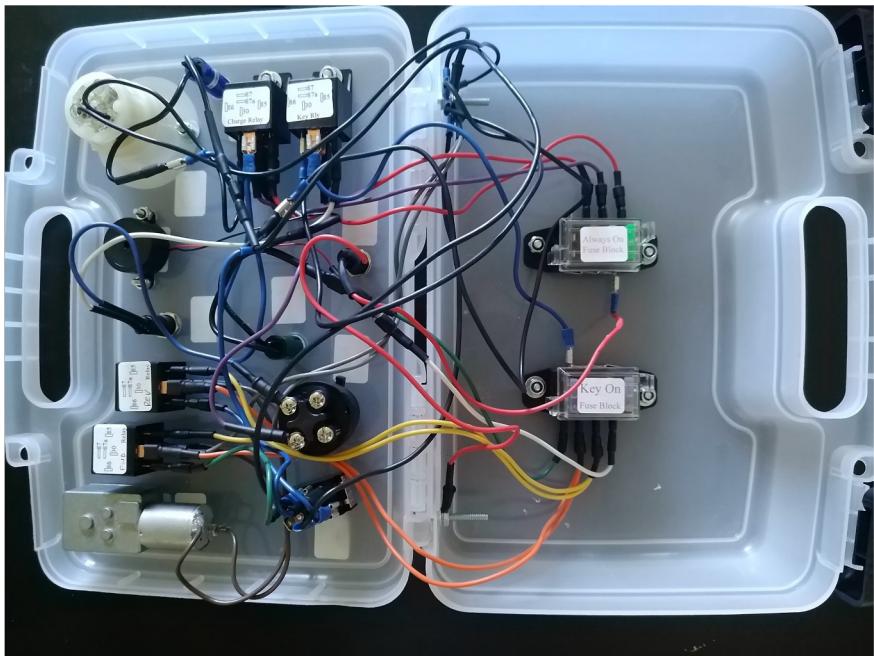


- Builds EVs
- Provides workshops for educational purposes





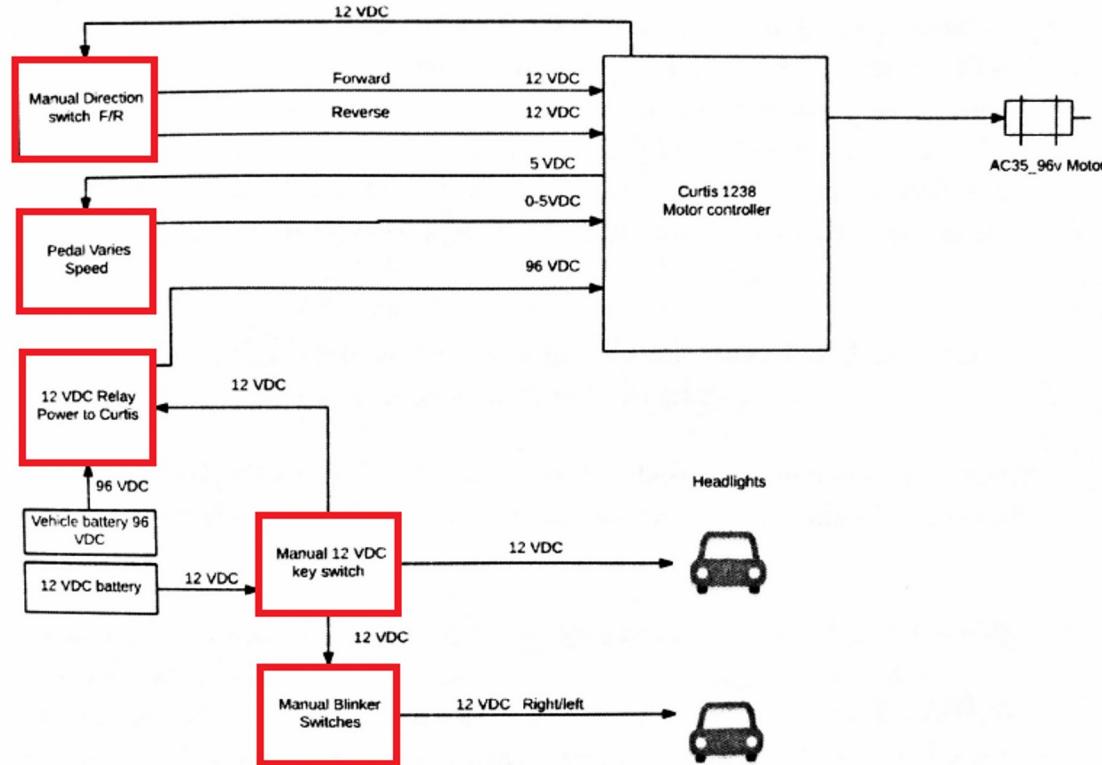
Educational Kit



- Enhance existing educational kit.
- It consume approximately 2W.
- It cannot be integrated into vehicle.

Design a system that can control basic functionalities of a Switch vehicles with an App

- Turn vehicle On/Off
- Lights On/Off
- Direction forward/reverse
- Speed control 0-5VDC



Project Proposal continue

- Use wireless technology to send commands from an Android phone.
- Add-on feature (Use Lidar to detect objects and alert driver).
- Enhance the educational kit of the Switch vehicles.





Marketing Requirements

- To establish wireless communication at least 15ft.
- The system is able to turn the vehicle on and off, toggles between forward and reverse and is able to turn the headlights on and off.
- The system will consume 1 watt or less in idle mode excluding Lidar.
- The system will control the speed of the motor.
- The system has a minimalistic construction design that allows it to be universal and portable.

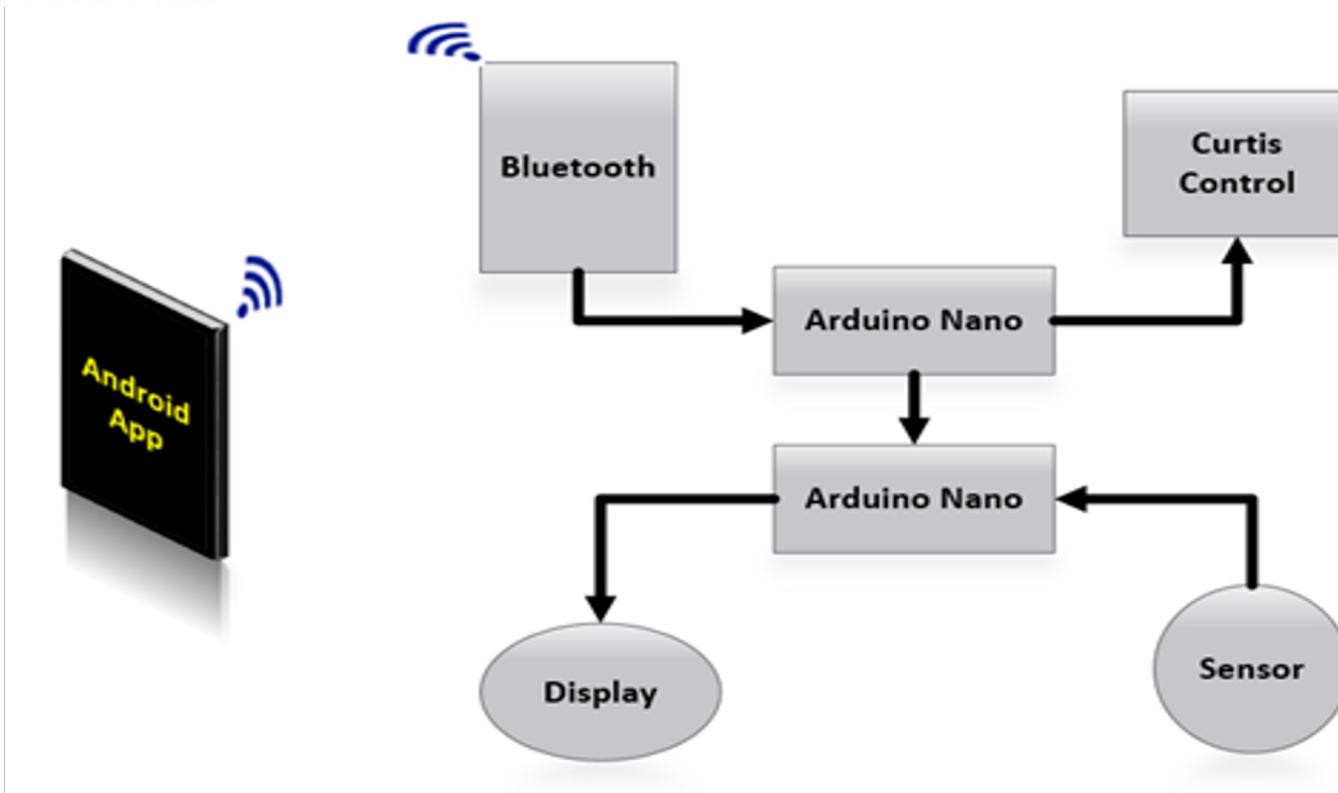


Engineering Requirements

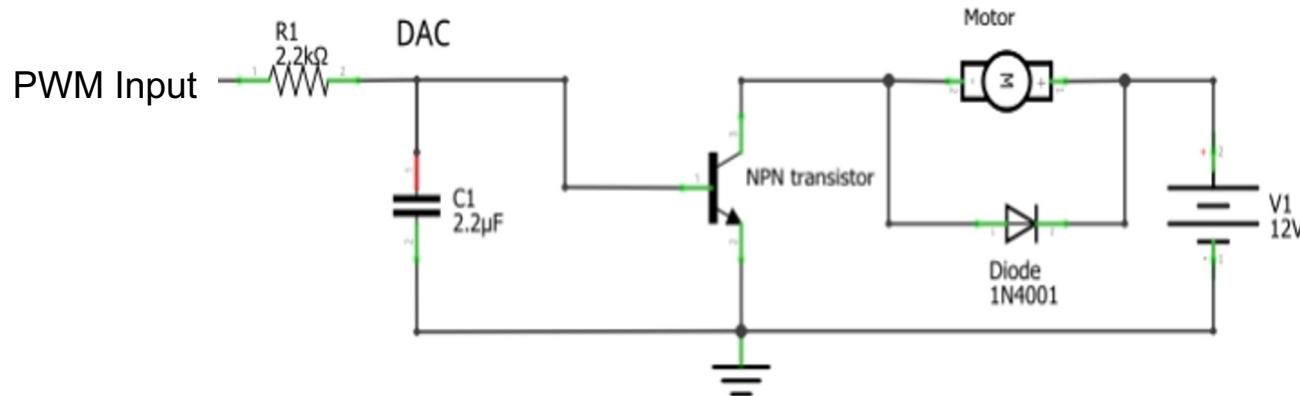
- Arduino Nano is used to control the HC-06 Bluetooth module in order to receive commands from an Android phone.
- Isolation is needed in order to control higher voltages with 5 volts
- In order to reduce overall system power usage, we have reduced computing power and supplied an external voltage regulator that reaches a peak efficiency of 74%.
- PWM will be used to supply 0 - 5 volts.
- The system will be in a (10" x 6" x 4") enclosure and upto 5 lbs.



High Level Diagram



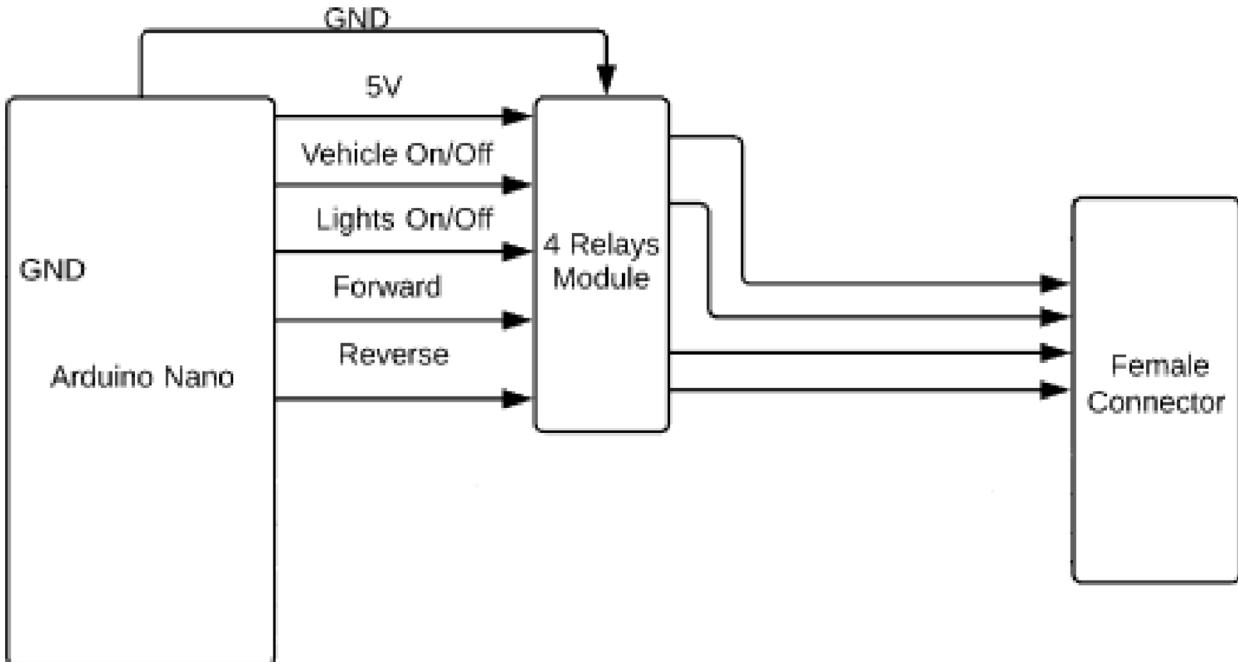
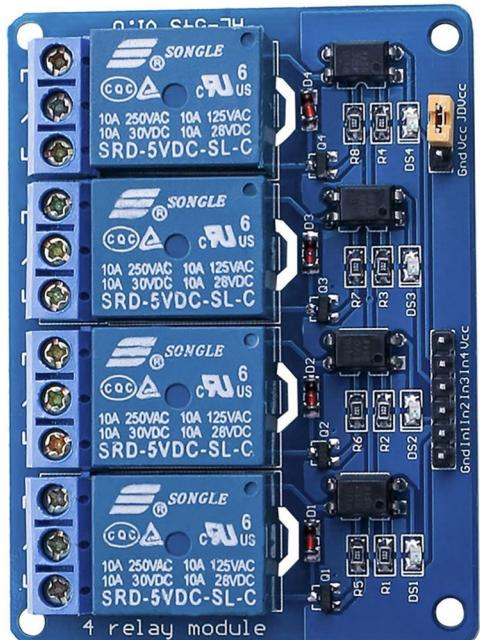
Curtis Control – Motor Speed





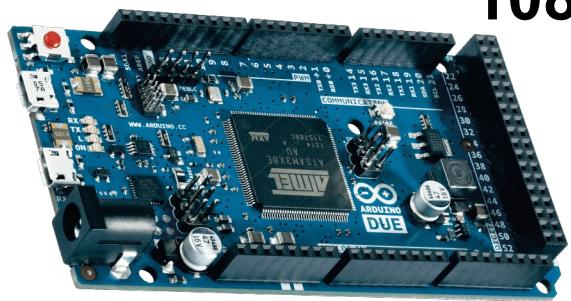
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Curtis Control - Relay





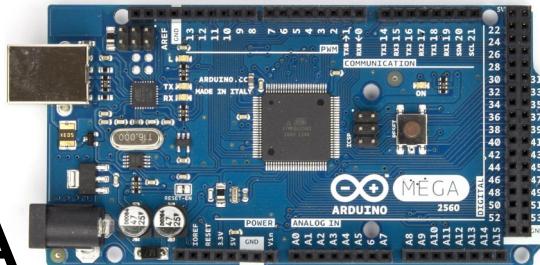
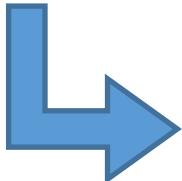
Reducing Power Consumption



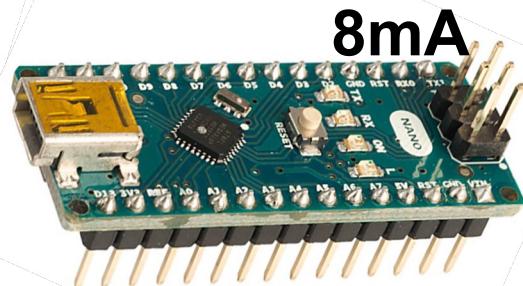
108mA



34mA

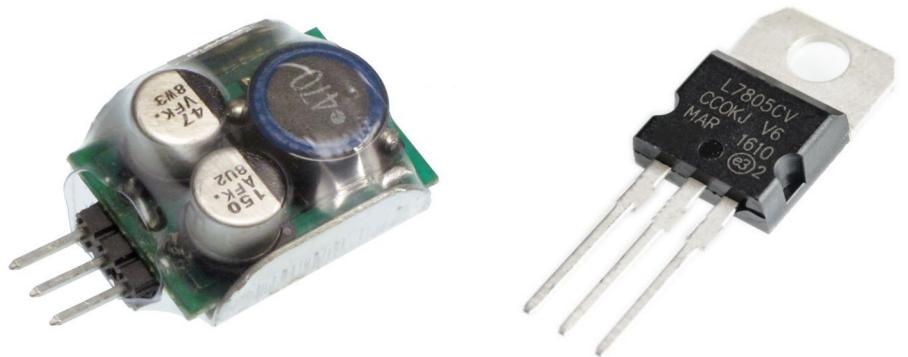
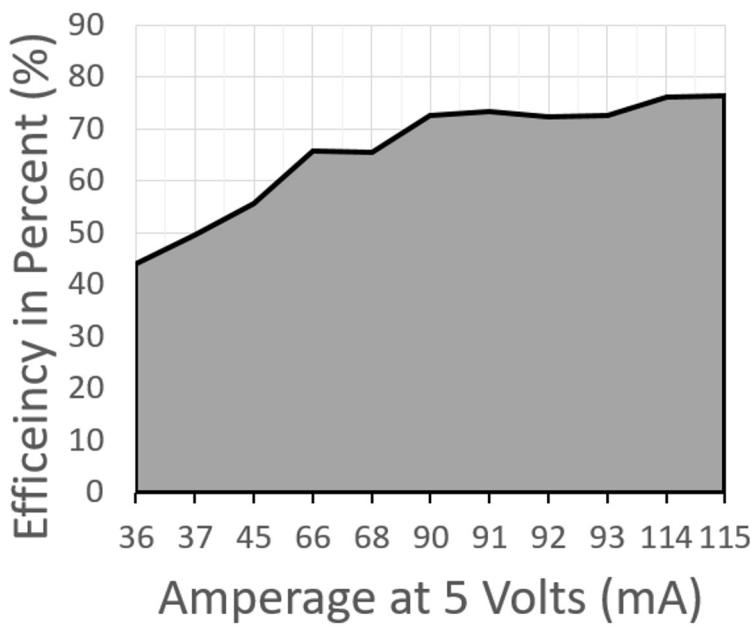


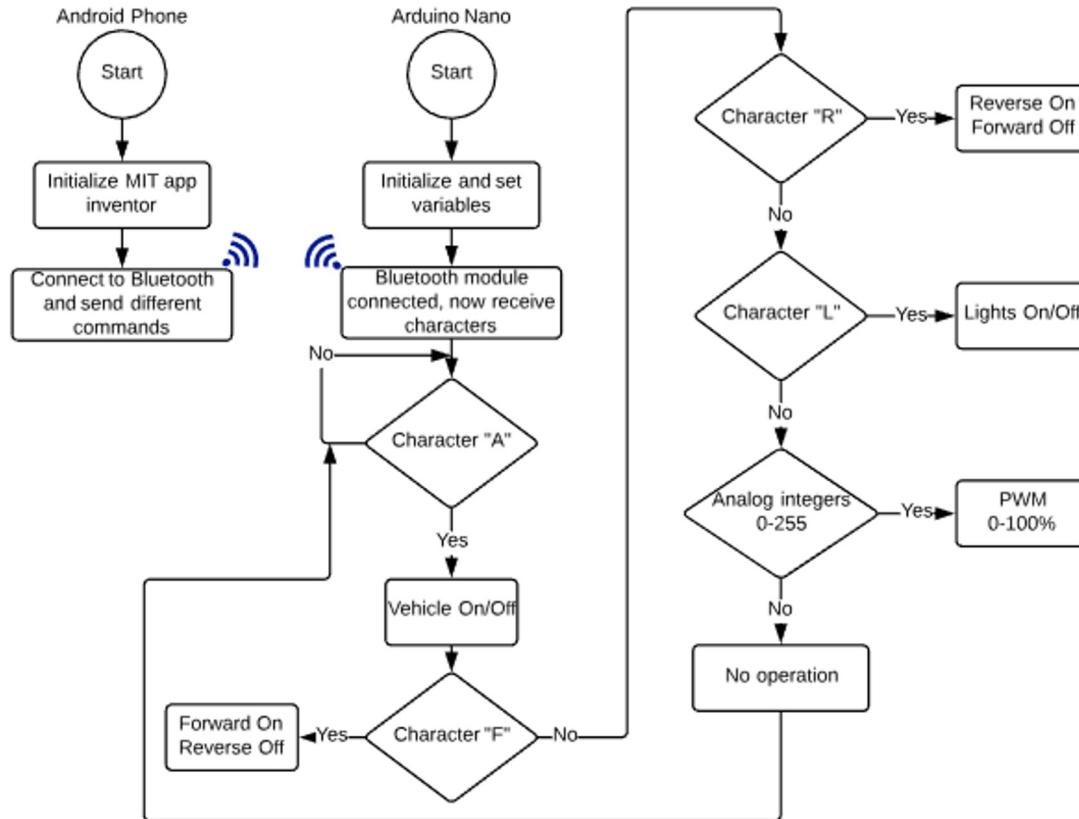
40mA



8mA

External Voltage Regulator Efficiency

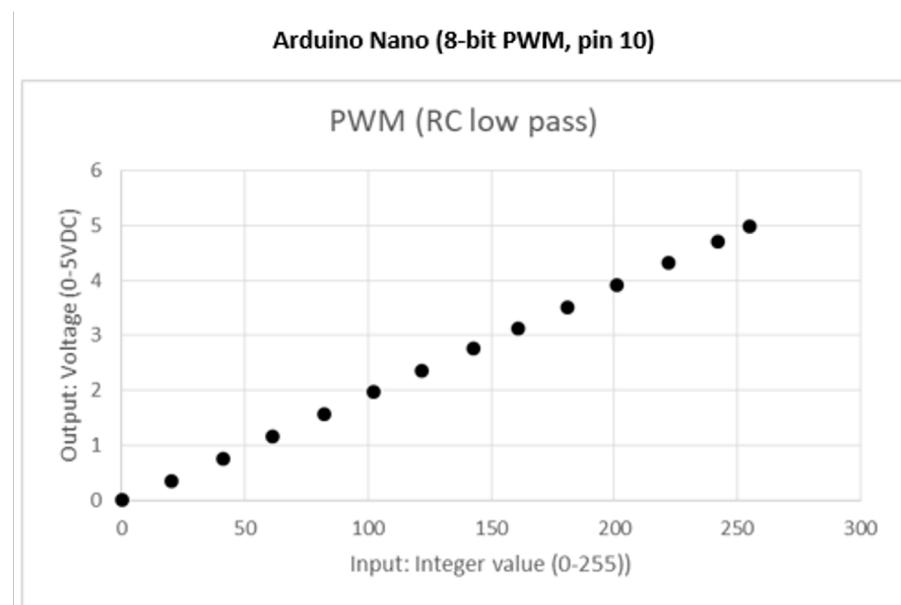




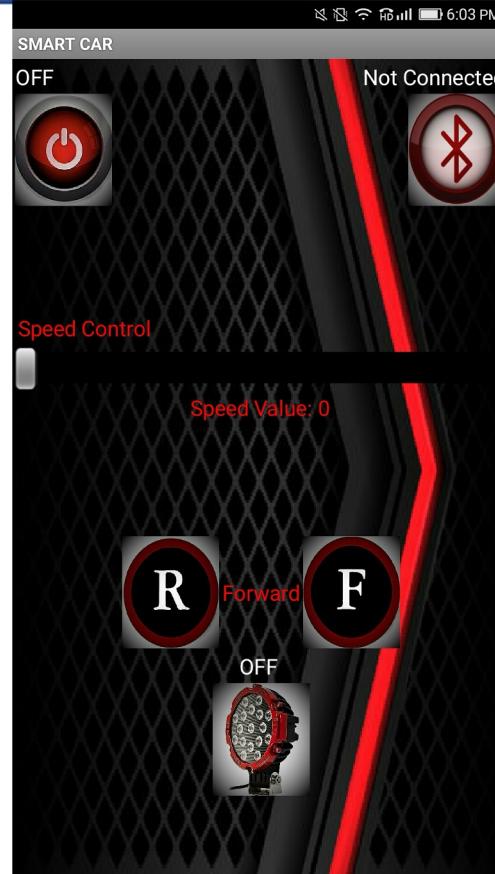


Test Result: PWM (RC low pass)

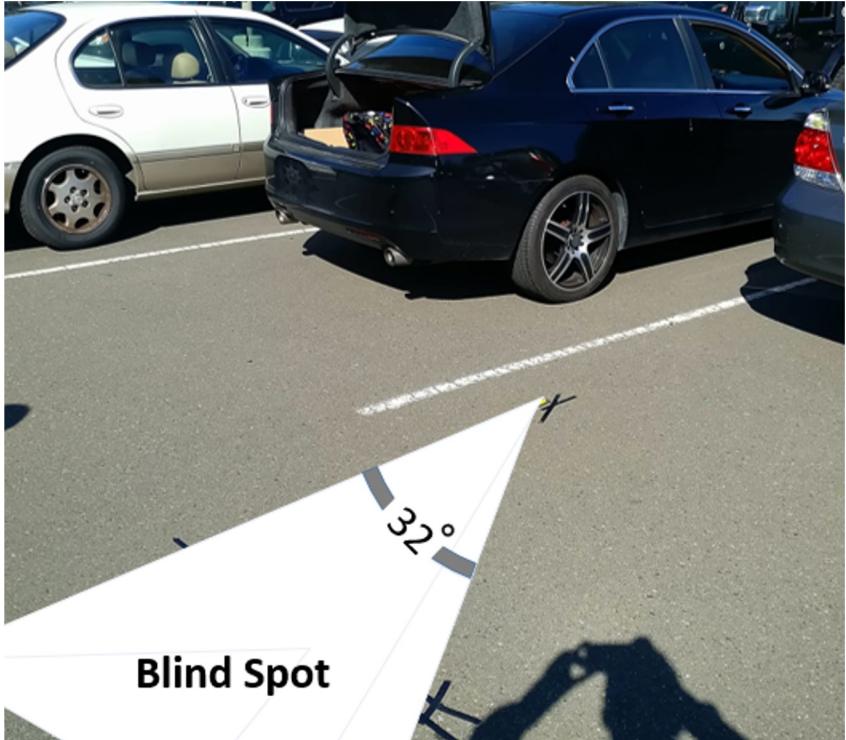
Duty Cycle (%)	Input(0-255)	Output(0-5VDC)
0.00	0	0
7.93	20	0.34
16.26	41	0.76
24.20	61	1.15
32.53	82	1.56
40.47	102	1.96
48.41	122	2.35
56.74	143	2.76
63.88	161	3.12
71.82	181	3.51
79.76	201	3.91
88.09	222	4.32
96.03	242	4.72
100.00	255	5



- Open source, cloud-based tool.
- Provides QR code to install app on your smartphone.

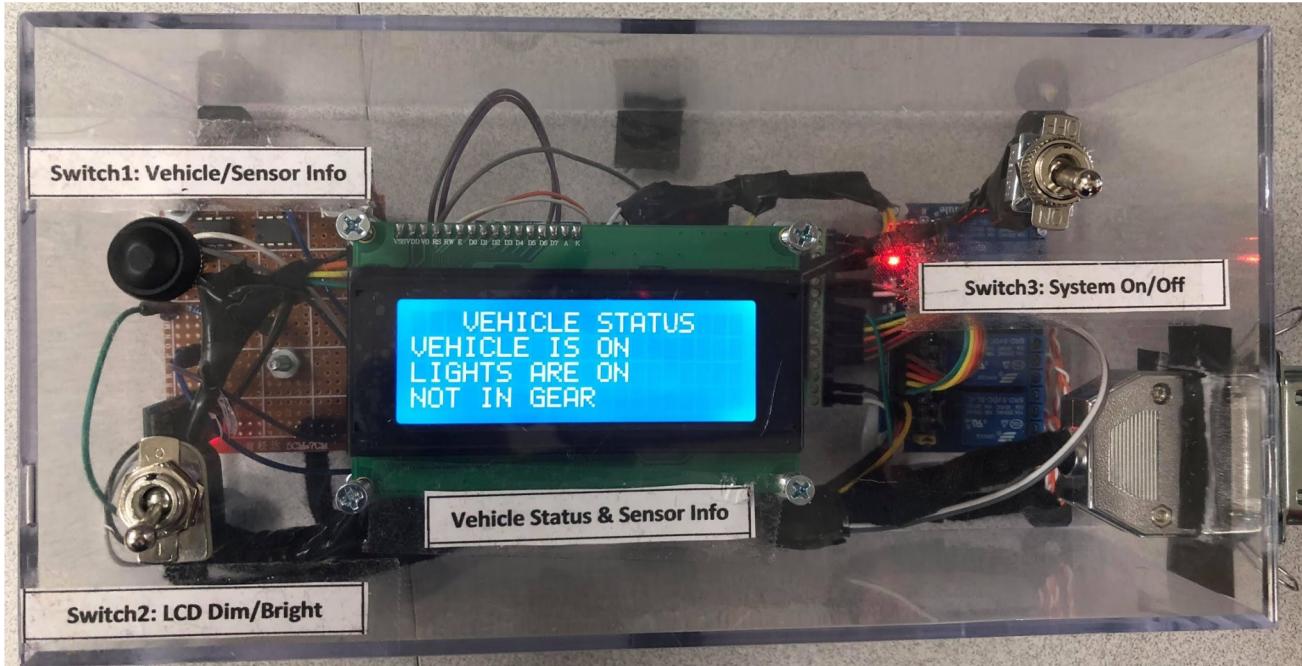


Lidar / Blind Spot Testing



Main System

- Portable
- Enhanced
- Consume 0.4W (in idle mode)



Connector

List of Components & Cost

Parts	Quantity	Description	Price
Arduino Nano	2	Embedded System	\$45
Arduino Shield	2	Screws down wires	\$13
Wire Spool	1	To connect various components	\$10
5 volt regulator	1	Convert from 12 to 5v	\$15
Fuses	6	100mA fuses to protect hardware	\$5
Fuse Holder	6	Holds the fuses	\$5
LIDAR	1	Distance sensor	\$120
LCD	1	Display	\$13
Buttons and Switches	4	Control various aspects of the system	\$15
Relay Module	1	Control lights, gear engagement and vehicle on or off	\$10
Digital Potentiometer	2	Alternate input for motor speed control	\$15
Bluetooth Module	1	Connects phone to system	\$10
Miscellaneous	X	Estimated Cost from Parts used from Lab	\$25
Total Cost			\$300

- Working with SwitchLab was the biggest challenge.
- Making system somewhat vibration resistant.
- Power consumption.
- Design Process.
- Plan B design (after switch vehicles stopped supporting).



Schedule

Smart Car

Pre-Presentation Testing

Testing Ultrasonic Sensors
Test Bluetooth with MCU and Phone w...

Presentation

Prepare for Presentation

After Dec. 1 Presentations

Continue Documentation
Testing Ultrasonic Sensor
Test Curtis Box Inputs
PWM and Digital Potentiometer

After Jan. 26 Meeting

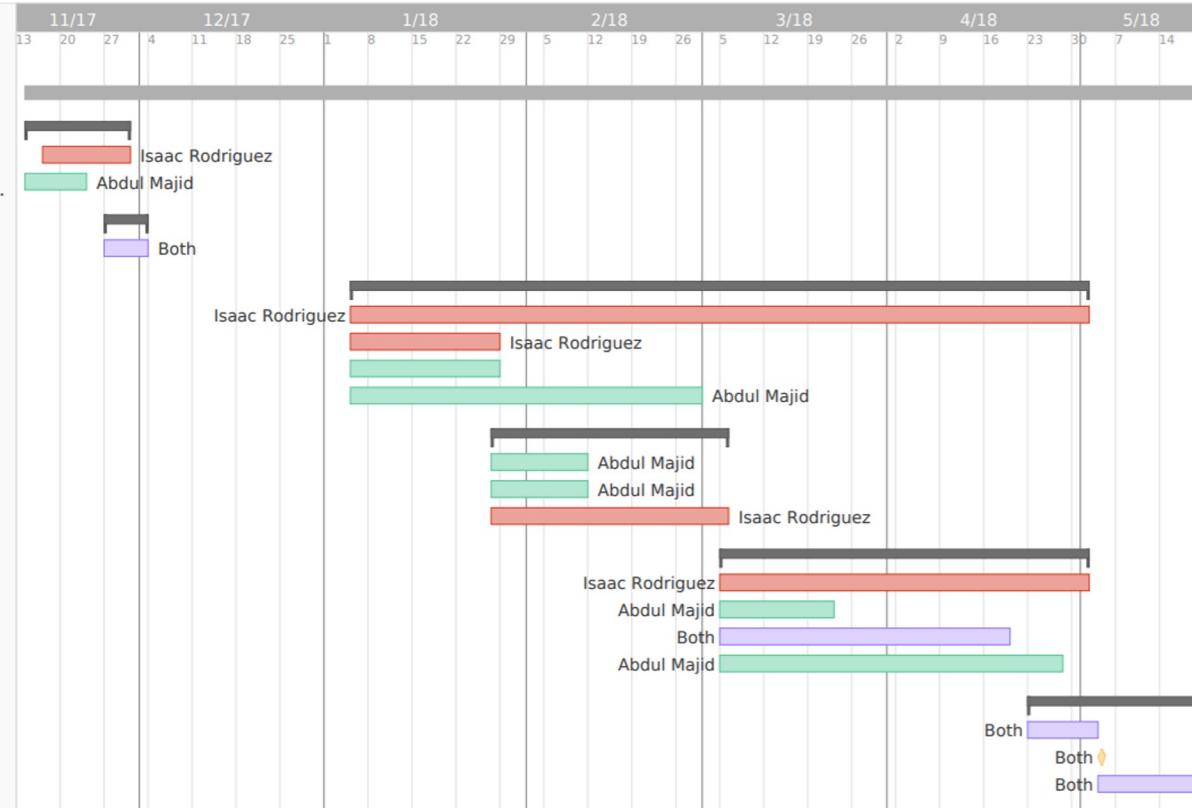
Test Relay Module
Finalize code for Android App
Design Our System

After Mar. 2 Meeting

Started Using LIDAR Sensor
Finalize Control of Curtis w/App
Finish Housing for Electronics
Create Test Board

Final Stretch

Prepare for Presentation
Presentation May 4
Finalize Documentation



- Project requires more work to implement error free blind spot system.
- Low power single embedded system can be utilized.
- Technical issues can be improved.
- More functions can be added to the system.

Supporting Courses

- Fundamentals of Digital Logic Design Laboratory (EE112).
- Microcontroller (EE310).
- Electronics (330).



References

The SwitchLab

<http://www.theswitchlab.com/>

Curtis Box

http://www.evwest.com/catalog/product_info.php?products_id=103

Japanese Panasonic wheelchair

<https://www.engadget.com/2017/08/08/japan-autonomous-wheelchair-accessibility-panasonic-airport/>

Boston Autonomous Vehicle

<https://www.technologyreview.com/s/609450/autonomous-vehicles-are-you-ready-for-the-new-ride/>

MIT App Inventor

<http://appinventor.mit.edu/explore/tutorial-version/app-inventor-2.html>

Parasitic draw current

<https://www.optimabatteries.com/en-us/experience/2010/12/what-normal-parasitic-draw>

Questions & Comments

