GMM Documentation

April 26, 2015

Contents

Chapter 1

Overview

Weight	16 lb 7.9 oz
Overall Height	10”
Overall Length	21”
Overall Width	20.5”

Table 1.1: GMM Specifications.

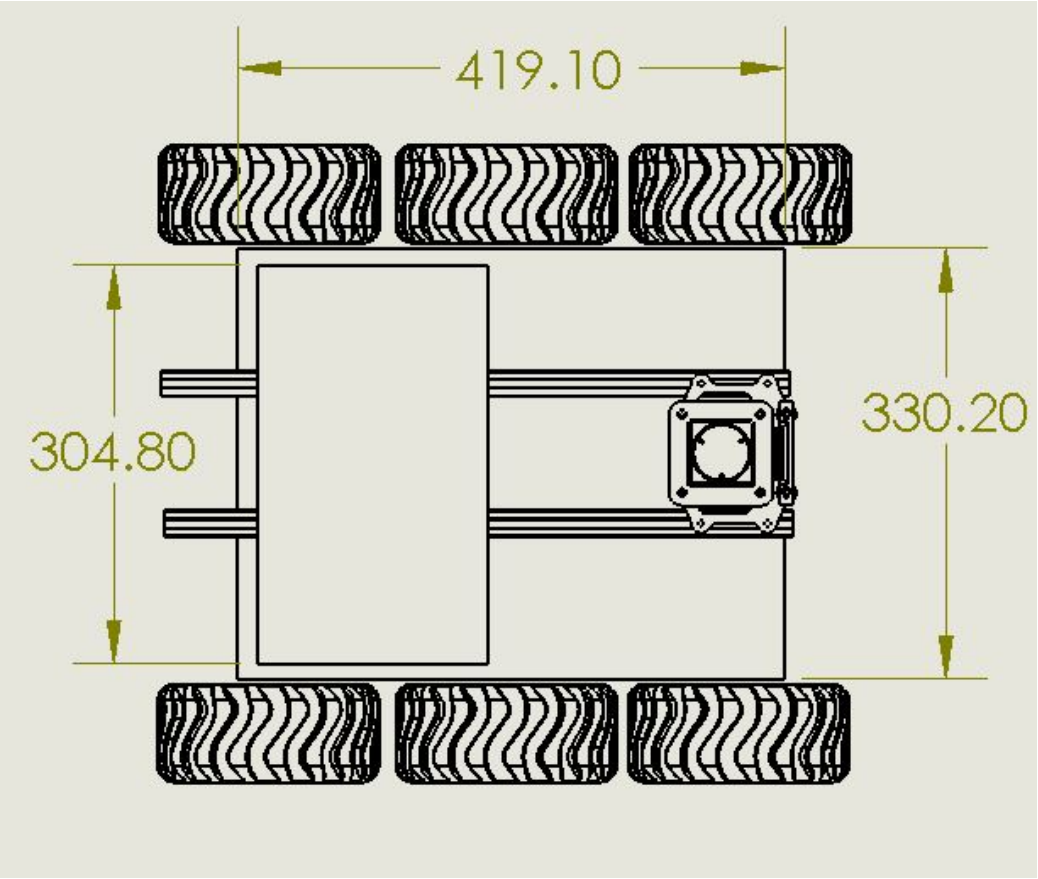

Figure 1.1: Diagram of GMM.

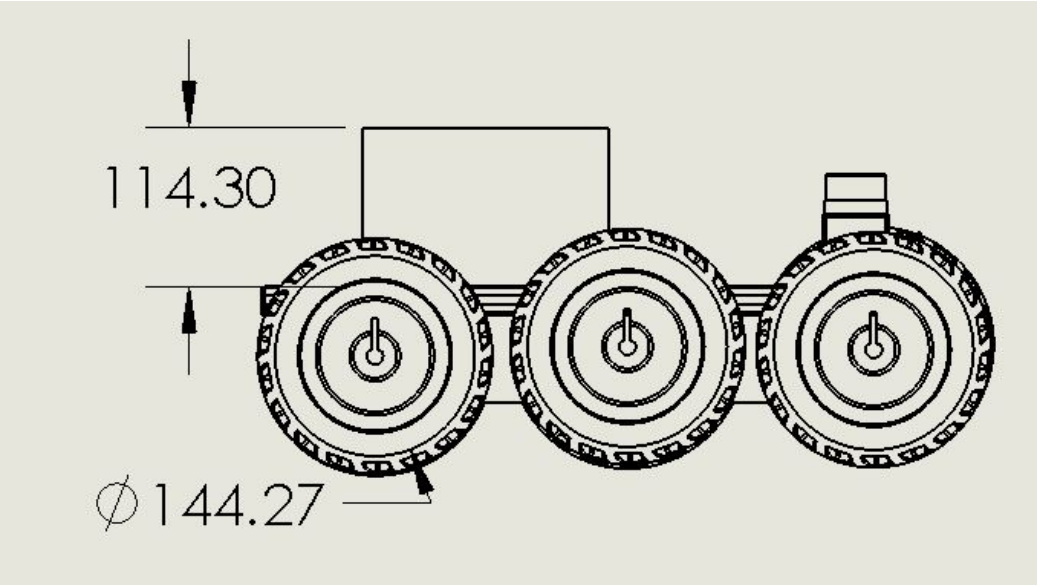

Figure 1.2: Diagram of GMM.

Label	Component	Description
A	Autopilot	RM48L952 and TM4C123GH6PZ processors
B	Camera	Support 5M video streaming, Focusing Range: 60cm to infinity
C	Encoders	2.6 kHz sampling rate
D	LIDAR	Accuracy ±30mm, Range 5600mm x 240, Scanning time 100ms/scan, Angular Resolution Step angle : approx. 0.36
E	Motors	No-Load Speed: 165 RPM, Max Torque: 680.5 oz-in.
F	Wifi	TP Link, Wireless Standard IEEE 802.11n, IEEE 802.11g, IEEE 802.11b
G	Odroid	Samsung Exynos5422 Cortex-A15 2.0Ghz quad core and Cortex-A7 quad core CPUs, LPDDR3 RAM at 933MHz

Table 1.2: List of GMM major components.

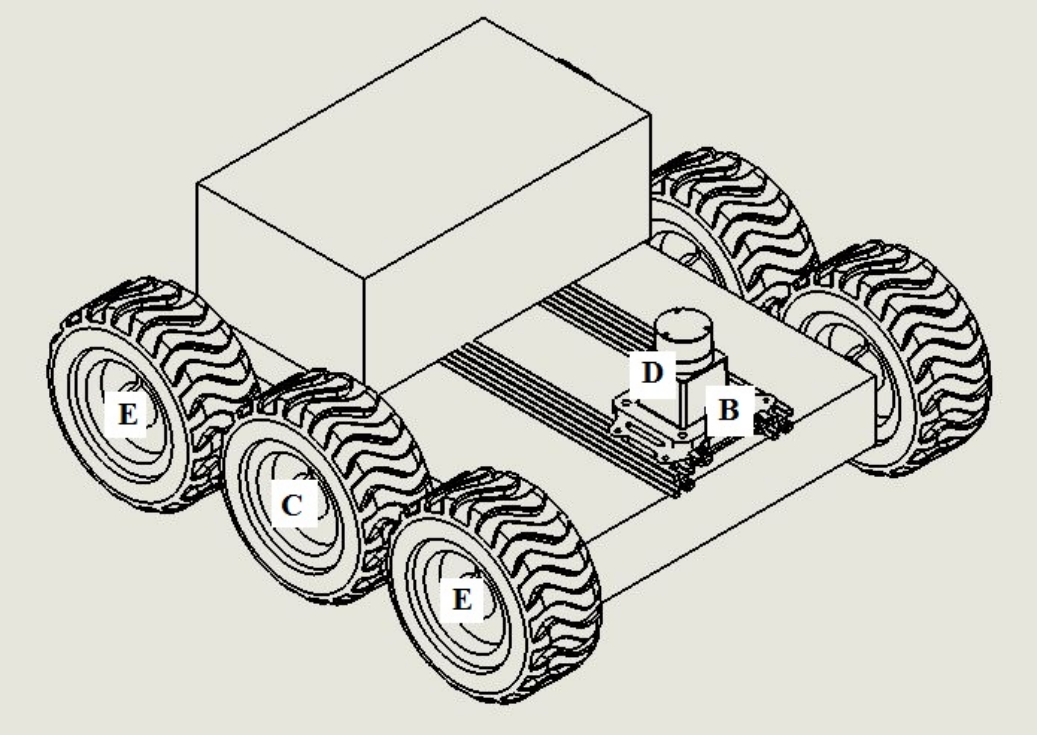

Figure 1.3: Diagram of GMM.

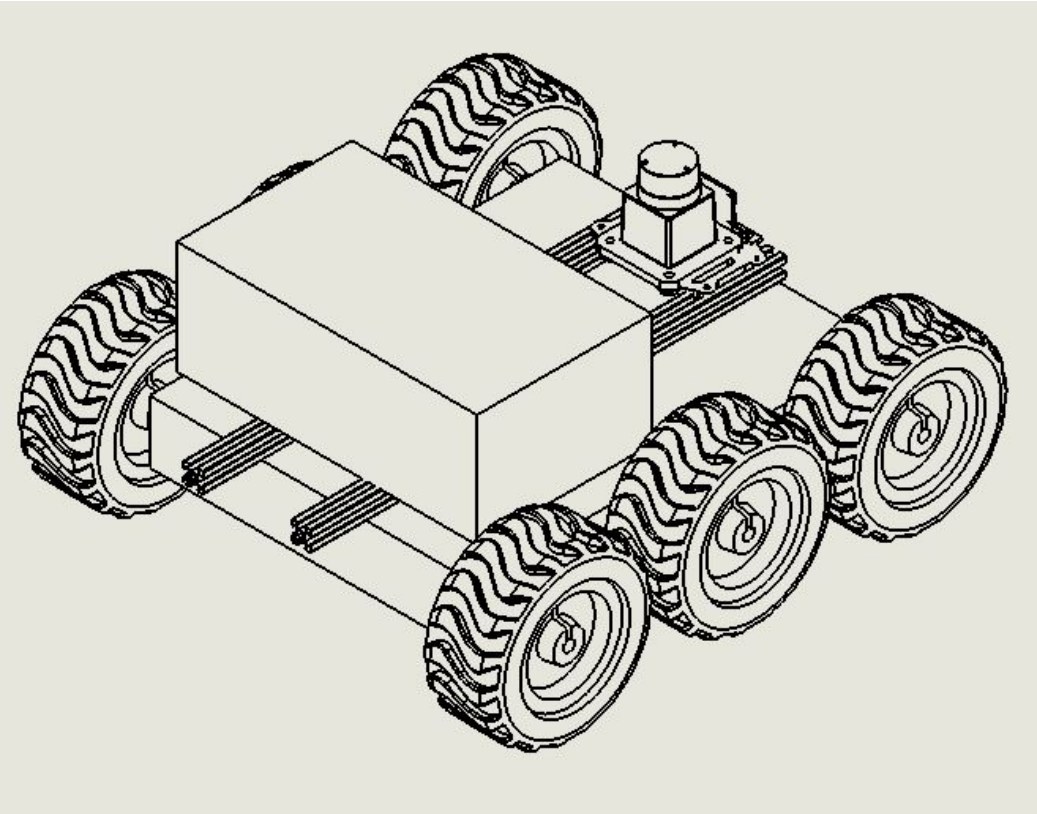

Figure 1.4: Diagram of GMM.

Chapter 2

Block Diagrams

2.1 Communication and Control Diagram

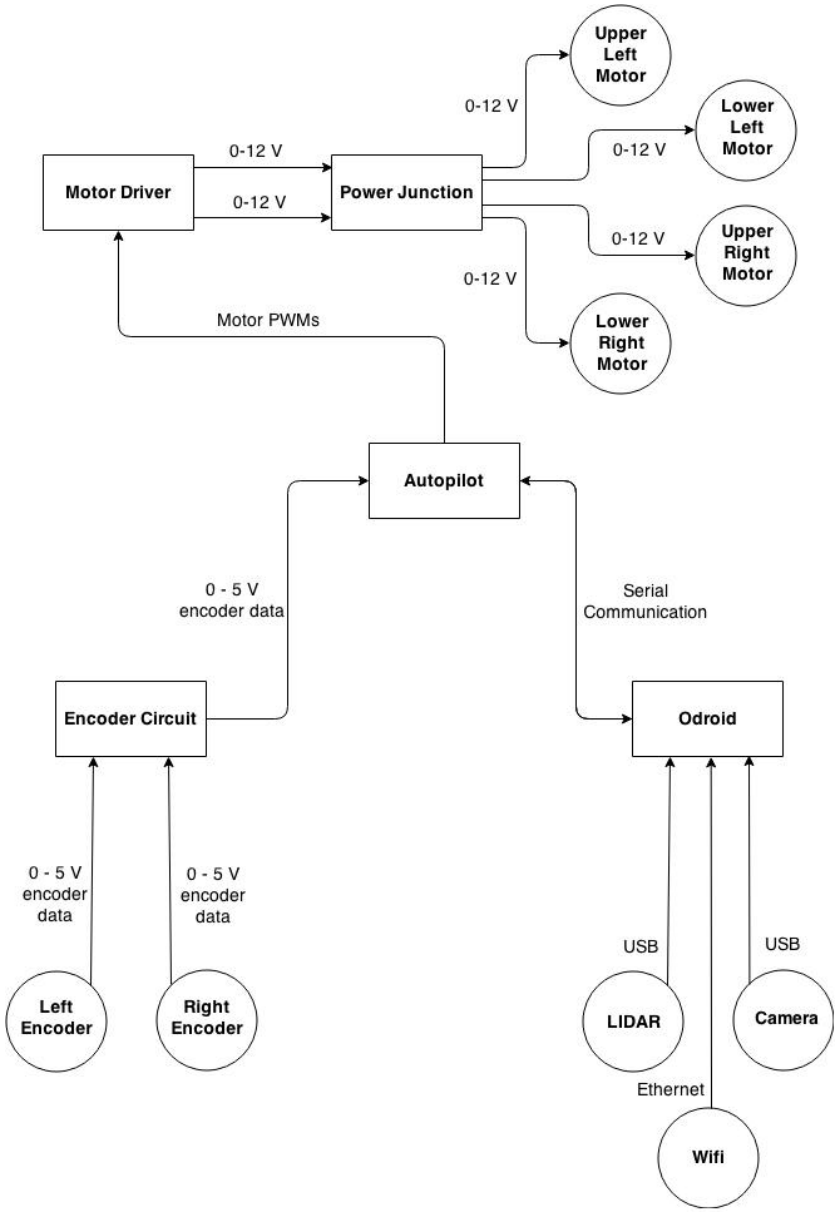

Figure 2.1: Diagram of communication connections.

2.2 Power Diagram

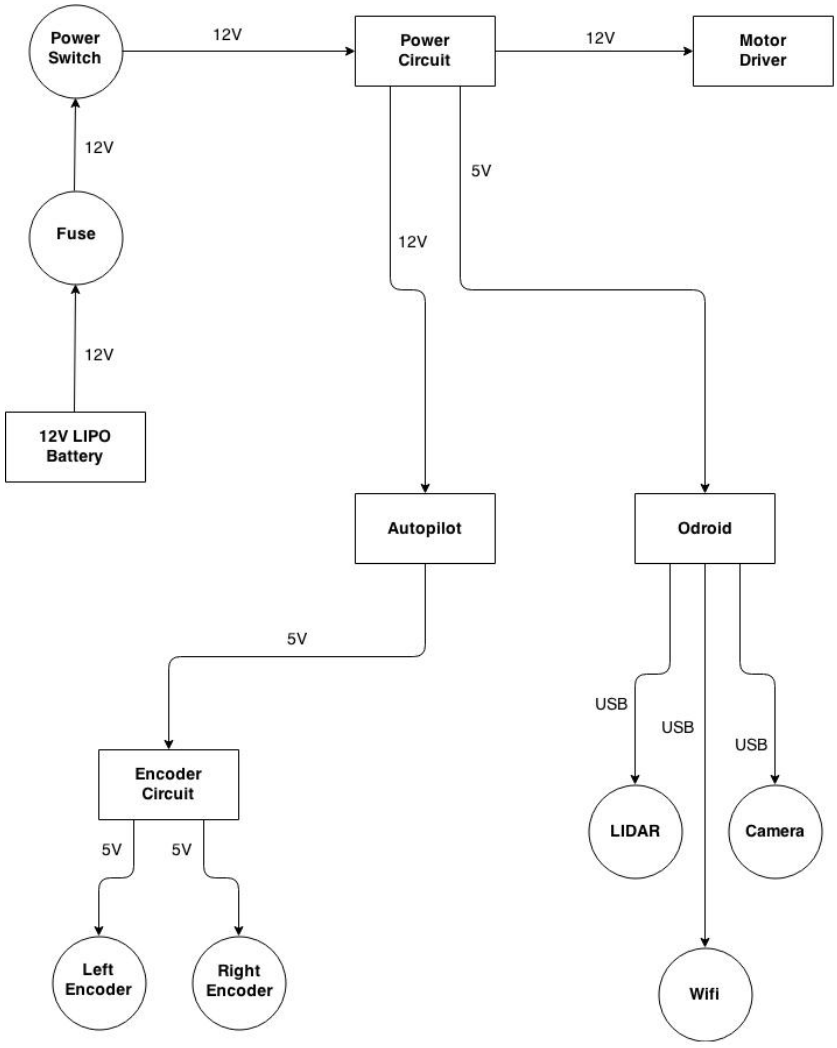

Figure 2.2: Diagram of power connections.

Chapter 3

Connections

3.1 Autopilot

Almost all connections to and from the autopilot, including power are done through the main 50 pin connector on the top of the autopilot. The serial connection to the Odroid is the only connection not make through the 50 pin connector but made through the JTAG on the back of the autopiot. The autopilot is connected to the encoders to provide 5V to power them as well as read the data from them through the ADC. Two PWMs are connected the motor driver to control the motors on the left and right side of the robot. A JTAG connector on the back of the Autopilot connects the SCI2 serial interface to the Odroid.

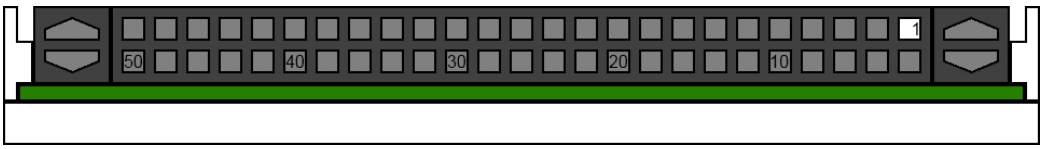

Figure 3.1: 50 pin Connector on the Autopilot

Pin Number	Function	GMM Connector
1	Input Power, Vin	12V
7	ADC	Encoders
8	ADC	Encoders
15	SCI RX	Debug
16	SCI TX	Debug
17	Regulated 5V	Encoders
35	Motor PWM	PWM
36	Motor PWM	PWM
2,?,?,?	GND	12V, Encoders, Debug, PWM
All Others	See Autopilot manual	Not Used

Table 3.1: Autopilot connections.

3.2 Encoder and Power Junction Circuit

This circuit provides connections between the motor driver and the motors and the autopilot and the encoders. The power from the motor drivers is sent to both motors. The power from the autopilot is sent to both encoders and their data line is connected to the autopilot.

Voltage Port	Voltage	Connected To
V1	A	To upper left motor
V2	B	To upper left motor
V3	A	To lower left motor
V4	B	To lower left motor
V5	A	From motor driver
V6	B	From motor driver
V7	A	To upper right motor
V8	B	To upper right motor
V9	A	To lower right motor
V10	B	To lower right motor
V11	A	From motor driver
V12	B	From motor driver

Table 3.2: Encoder and power junction circuit connections.

Port P1 is connected to the autopilot. It sends power to the encoders

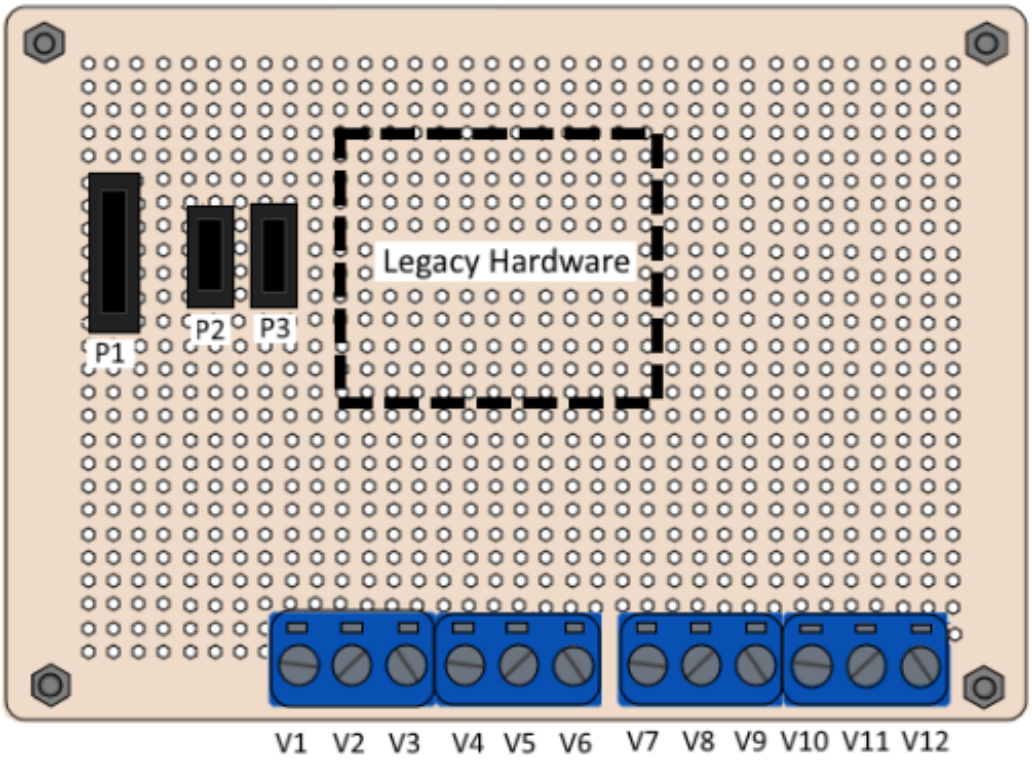

Figure 3.2: Diagram of encoder and power junction circuit with connectors and voltage ports labeled.

and receives their voltage signals, from both the left and right side encoders. Ports P3 and P2 are connected to the encoders, the signals are then send to the autopilot port and their power is connected to the power from the autopilot connector. Both the left and right encoder are connected in the same way, meaning the ports P2 and P3 have the same connections. Port P2 is connected to the right encoder and port P3 is connected to the left encoder.

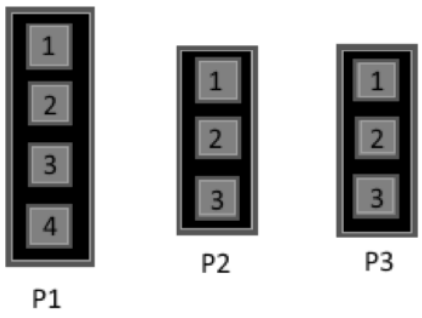

Figure 3.3: Diagram of encoder and power junction circuit with connectors and voltage ports labeled.

Pin	Function	Value)
1	Right encoder voltage	0 - 3.3V
2	Left encoder voltage	0 - 3.3V
3	Encoder Vin	3.3V
4	GND	0V

Table 3.3: Port P1, connected to autopilot.

Pin	Function	Value)
1	Encoder voltage	0 - 3.3V
2	Encoder Vin	3.3V
3	GND	0V

Table 3.4: Port P2 and P3, connected to encoders.

3.3 Motor Driver

The motor driver receives PWM signals for the right and left side of the robot. It then outputs the corresponding voltage to send to the motors. These voltages are sent to the power junction circuit to give the same voltage to both right side motors and both left side motors.

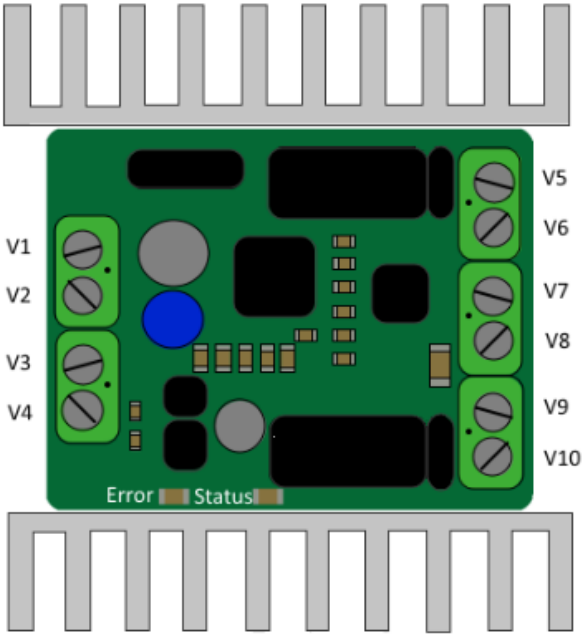

Figure 3.4: Diagram motor driver with voltage ports labeled.

Voltage Port	Voltage	Connected To
V1	GND	Autopilot
V2	-	Unconnected
V3	PWM	Autopilot
V4	PWM	Autopilot
V5	B for right side encoders	To power junction circuit
V6	A for right side encoders	To power junction circuit
V7	GND	From power circuit
V8	GND	From power circuit
V9	A for left side encoders	To power junction circuit
V10	B for left side encoders	To lower right motor

Table 3.5: Motor driver connections.

3.4 Odroid

All Odroid connections, except for its power source are made by USB on the front side of the odroid. The power connects with a round plug into the backside. The Odroid gets data from the camera, lidar, and autopilot. The Odroid also sends data to the autopilot through serial connection, to send movement commands to the autopilot which in turn controls the motors.

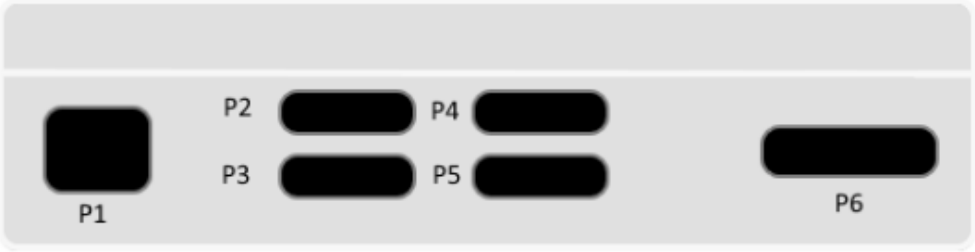

Figure 3.5: Diagram of labeled Odroid connection ports, front of odroid.

Port	Type	Current Use
P1	10/100 Ethernet	Wifi, TP-LINK
P2	USB 2.0 Host	Wifi, TP-LINK power
P3	USB 2.0 Host	Autopilot SCI
P4	USB 2.0 Host	Camera
P5	USB 2.0 Host	Not used
P6	Display Port	Not used

Table 3.6: Odroid front connections.

Figure 3.6: Diagram of labeled Odroid connection ports, back of odroid.

Port	Type	Current Use
P1	DC Jack 5V, 4A	5V power from Autopilot
P2	USB 3.0 Host	Camera
P3	USB 3.0 OTG	Not used
P4	Micro SD Slot	Not used
P5	Micro HDMI	Not used
P6	Headphone Jack	Not used

Table 3.7: Odroid back connections.

3.5 Power Circuit

This board takes 12V input from the battery and splits it to other parts of the robot. The autopilot and motor drivers both receive 12V from this board and the Odroid recieves a regulated 5V.

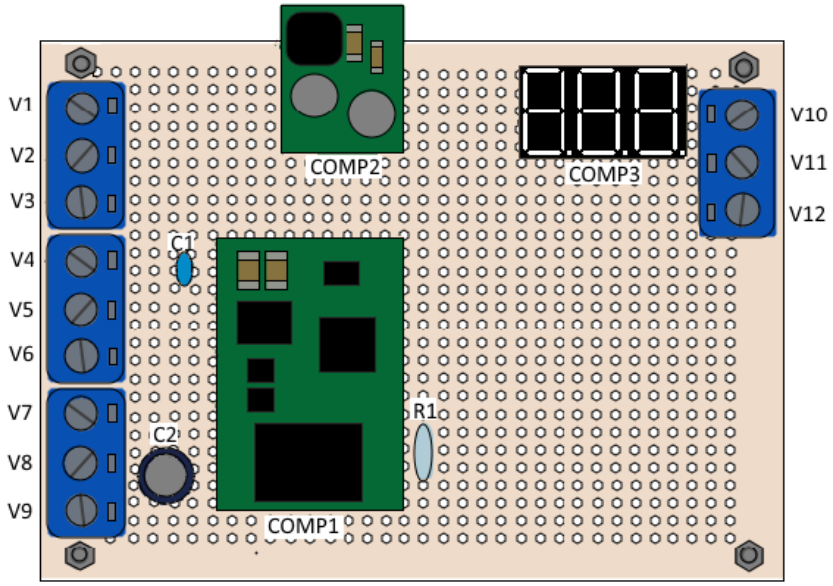

Figure 3.7: Diagram of power circuit with voltage ports and parts labeled.

Component	Function
COMP1	6V Regulator
COMP2	5V Regulator
COMP3	Voltage Monitor

Table 3.8: List of components on power circuit.

Voltage Port	Voltage	Connected To
V1	12V	To motor driver
V2	GND	To motor driver
V3	12V	To autopilot
V4	GND	To autopilot
V5	5V V	To odroid
V6	GND	To odroid
V7	6V	Unused
V8	6V V	Unused
V9	GND	Unused
V10	12V	From switch
V11	GND V	From switch
V12	Unconnected	Unused

Table 3.9: Odroid front connections.

Chapter 4

ADC and DAC Filters

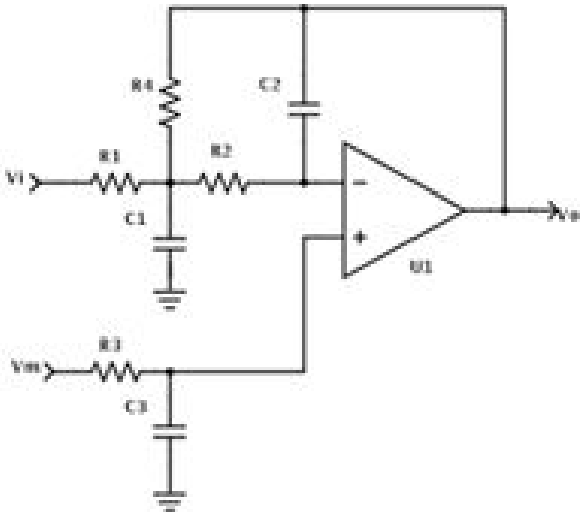

Figure 4.1: Diagram of filter circuit.

Gain = 0.5
Cutoff frequency = 132 Hz
Dampening Coefficient = 0.1527
Cutoff frequency of voltage offset = 10 Hz

Component	Autopilot Component Name	Value
R1	Zix4	1.1k ohm
R2	Zix3	1.1k ohm
R3	Zix1	2.2k ohm
R4	Zmx1	15.9k ohm
C1	Zix2 V	1 microF
C2	Zix5	115nF
C3	Zmx2	1.31micrpF

Table 4.1: Filter component values.

Chapter 5

Part List

A Autopilot
- Version 2.3.1
- See Autopilot Documentation for more information

B Battery
- 12V LIPO Battery 3S
- Lab made 3 series packs

C Camera
- Leopard Imaging LI-OV5640-USB-72
- https://www.leopardimaging.com/LI-OV5640-USB-72.html

D Encoders
- US Digital MA3 Miniature Absolute Magnetic Shaft Encoder
- http://www.usdigital.com/products/encoders/absolute/rotary/shaft/MA3

E Encoder and Power Junction Circuit
- new part coming soon!

F LIDAR
- Hokuyo URG-04LX-UG01 Scanning Laser Rangefinder

G Motors
- 165 RPM HD Precision Planetary Gear Motor

H Motor Drivers
- Sabertooth 2x12
- https://www.dimensionengineering.com/datasheets/Sabertooth2x12.pdf

I Odroid
- Odroid XU3

J Power Circuit
- 5V Regulator

5V, 5A step-down voltage regulator D24V50F5
https://www.pololu.com/product/2851

6V Regulator
Texas Instruments PTN78020WAH
http://www.digikey.com/product-detail/en/PTN78020WAH/296-20515-ND/717485

Fuse
10A

Fuse Holder
30A max