Electric Longboard | 20mph | 10 miles

by **Matt Carl** on September 7, 2016

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Intro: Electric Longboard | 20mph | 10 miles

I'll start by saying this was an incredibly rewarding project that I'm able to use every day. If you haven't had the chance to ride an electric longboard, it is like no other mode of transportation, fast, fun, and portable. Commercial electric longboards start around $1,000 which is tough to swallow for a financially struggling college student, thus my expedition started to design and build my own! Plus it was a good way to keep my 3D modeling skills sharp!

This project ended up costing me around $400 since I was 3D print a lot of the components and built my own longboard deck, which you can learn how to do here.

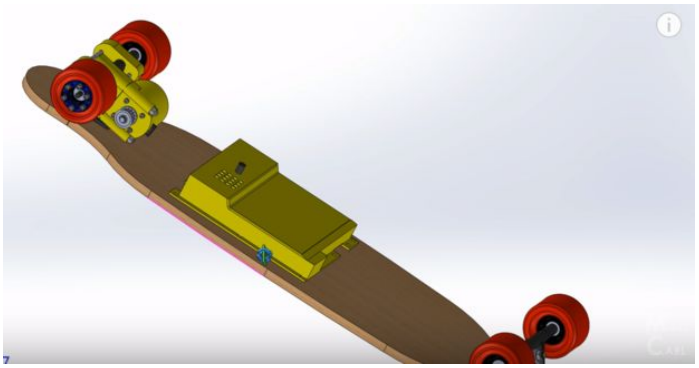
Lets get started!

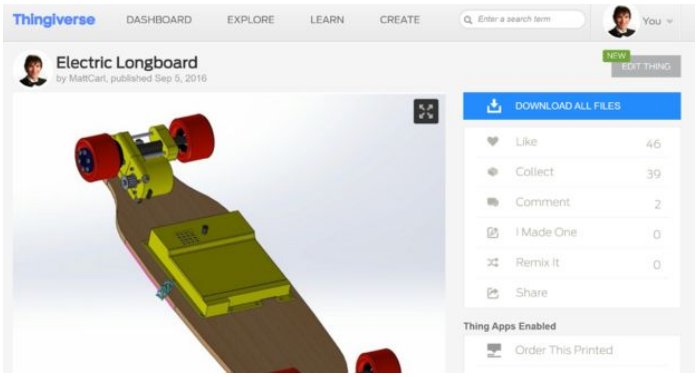
Step 1: Parts List and 3D Model Download Links

Hands down the most difficult part of this project was figuring out what specific parts I needed, making sure they all worked together, and making sure they were all in stock. I put together a comprehensive list of all the components I used throughout the build process, where I bought them from, and how much they were. Hopefully this sheds some light and helps guide you through choosing components.

Since I also have access to a 3D printer, I wanted to take full advantage of it and save some money. I 3D printed the motor mounts, the gear on the wheel, the electronics mounts, and the electronics case. I wanted to do this right, which meant I needed a 3D model of EVERYTHING on the board. This was incredibly time consuming, but I uploaded all the 3D models I made to thingiverse, so feel free to use them as you please!

Supplier	Part Name	Description	Model #	Unit Cos	Quanity	Cost (USD)	Website
Ebay	Trucks, Bearings	180mm Reverse Kingpin Longboard Trucks with Blank 70mm 79a Pro		36.99	1	36.99	http://www.ebay.cor
diyelectricskateb	Motor	Electric Skateboard Motor 6355 230KV 2650W		90	1	90	http://diyelectricskat
HobbyKing	Battery	Turnigy 5000mAh 3S 20C Lipo Pack (US Warehouse)	Z50003S-20	23.28	2	46.56	http://www.hobbykir
Amazon	Charger	Genuine SKYRC iMAX B6AC V2 Dual Power (6Amps, 50Watts): LiPo		52.8	1	52.8	https://www.amazor
Amazon	RC Transmitter and Reciev	FlySky FS-GT2B 2.4GHz 3-Channel Transmitter		26.79	1	26.79	https://www.amazor
Hobby King	Antispark	XT90-S Anti-Spark Connector (2pairs/bag)		5.47	1	5.47	http://www.hobbykir
Amazon	ESC	FVT 120A Brushless Sensored/Sensorless Car ESC, 2-6S		65.99	1	65.99	https://www.amazor
Ebay	Charger Adapter	Lithium Lipo Battery Balance Charger Twins Adapter Wire Charge Fo		2.79	1	2.79	http://www.ebay.cor
ebay	Wheels	Blank-Pro-83mm-Multiple-Color-Longboard-Flywheels-ABEC-7-Bearii		23.99	1	23.99	http://www.ebay.cor
ebay	Pulley	HTD5M-15 Aluminum Timing Belt Pulley 15 Teeth 8mm Bore 16mm V		3.59	1	3.59	http://www.ebay.cor
diyelectricskateb	Belt	265mm HTD5 9mm Belt		8	1	8	http://diyelectricskat
Amazon	ESC Programmer	LCD Program Card for FVT Car ESC's		27.99	1	27.99	https://www.amazor





Step 2: Schematics

Let's start with the electronic speed controller and work our way out:

Electronics Speed Controller (ESC)

This is the brain of the board, it controls how much power the motor is recieving based on the input from the user via remote controller. With a programming card (see parts list), you can change how quickly the board accelerates, how much it brakes, if it drag brakes (automatically slows down), and many more options, this is really useful and allows you to tweak the board to your own riding style. The ESC comes with its own switch, which will turn the ESC (and effectively the whole board), on and off.

Motor

There are many, many different types of motors out there, but for an electric longboard application, you will almost always see brushless outrunner motors. You'll want to look for one with a low Kilovolt rating (<300Kv) as it provides enough torque to propel you forward. The motor is connected to the ESC via 3 phase wires, which you will have to fiddle with the order of their connections to get your motor to spin in the correct direction for your board set up. Some brushless motors also offer a sensored setup, not really necessary, it simply ensure it will never hiccup when starting from complete rest.

Battery

Most electric longboards (and mine as well) use lithium polymer batteries (or LiPo) due to their incredibly high weight to power ratio. You'll want at least a 6S or 6 cell battery pack, for a better form factor, I wired two 3S or 3 cell batteries in series to provide the 6 cells that will keep you riding for miles. The battery is then wired to the ESC, but I also added an antispark switch on the positive (red) line. this XT90 antispark connector allows you to connect the battery pack without a large amount of sparking, which isn't really necessary but also nice to have. The LiPo batteries also come with balance cables, which are used for charging the batteries and make sure all the cells in the packs are charged evenly.

Battery Adapter Board

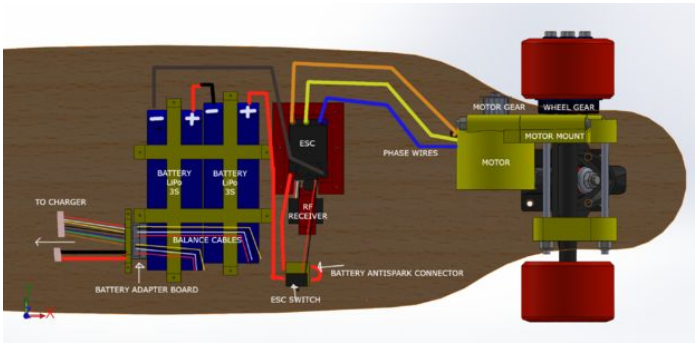
This adapter board converts the two separate balance cables into one cable that allows by balance charger to think that it really is a single 6S pack and chargers it as one. This means you can charge both batteries at once instead of having to charge them separately.

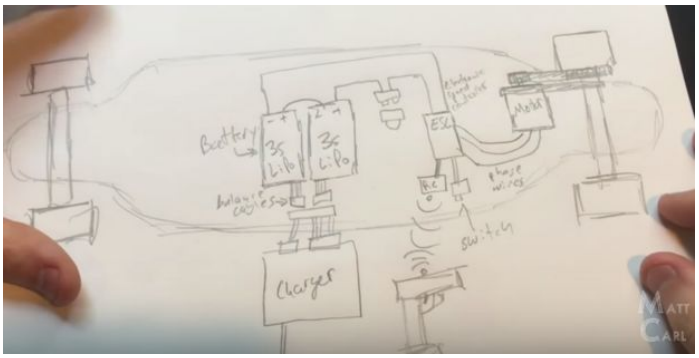
Remot Control (RC) Receiver

This little device will come with you RC remote controller and allows your handheld controller to talk to the ESC to tell the motor to speed up, cruise, or brake. There is a cable coming from the ESC that connects to the RC receiver and turns on/off with the board.

Motor Gear

Gear mounted to the motor, usually 15 tooth. Do NOT try to 3D print this piece, it will fail!

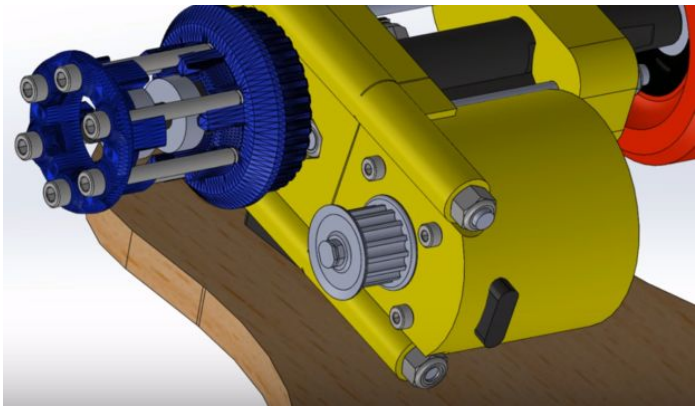


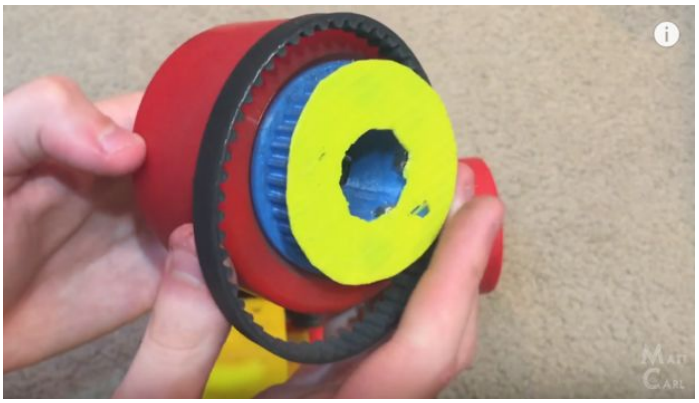


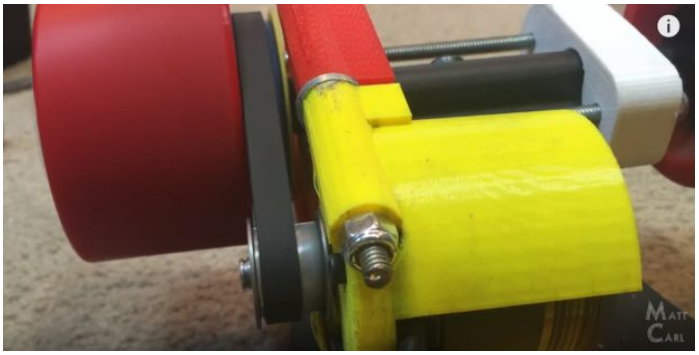
Step 3: Mechanical Design | Wheel Gear

So there is a gear on the motor and a bigger gear on the wheel, a belt is connected between the two and that's how the board is driven forward. There are multiple different ways to attach the gear to the wheel: from drilling into the wheel, to buying adapters that fit into the wheel. I decided to buy a set of wheels that have "spokes" or spaces around the center the wheel, and 3D printed a gear designed to fit those cutout. This was by far the easiest way of tackling this design problem. There are two pieces to this gear: the actual gear itself which is on the backside of the wheel, and the outer shell that faces towards the road. 6 M8 x 2.75" bolts hold everything together.

Both the design files for the gears to be 3D printed and the link to the aluminum gear that mounts to the motor can be found on my parts list.







Step 4: Mechanical Design | Motor Mount

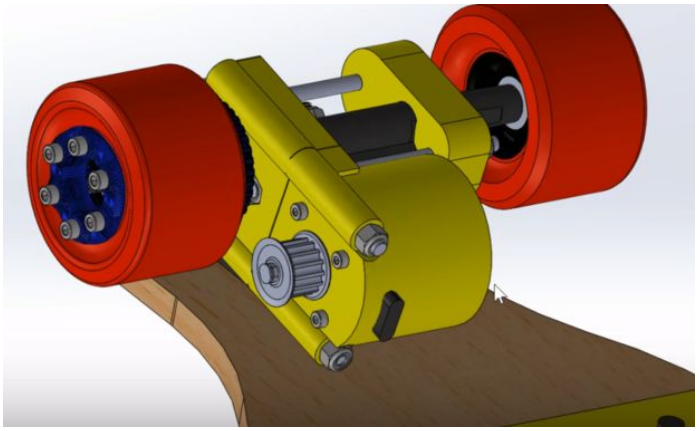
The motor mount, is always the most difficult part about actually building an electric longboard. Some people cut out and weld metal plates to their trucks, or buy expensive motor mounts that clamp onto the board. I was inspired by user Nick_Tesla's design (http://www.instructables.com/id/3D-Printed-Electri... of a fully 3D printed motor mount and decided to design my own jumping off of his idea.

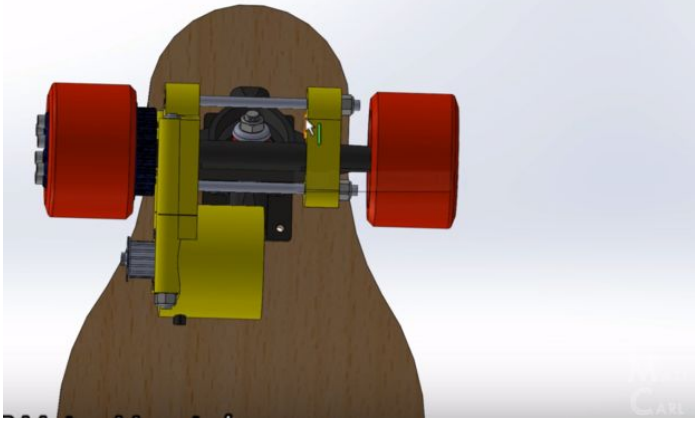
There are 3 parts to this motor mount, two of them are inserted onto the truck and are secured together using two 1/4"-20 threaded rods. Another piece is held onto the main motor mount by another set of threaded rods. This means that you can wedge washer in between the gap and tension the belt.

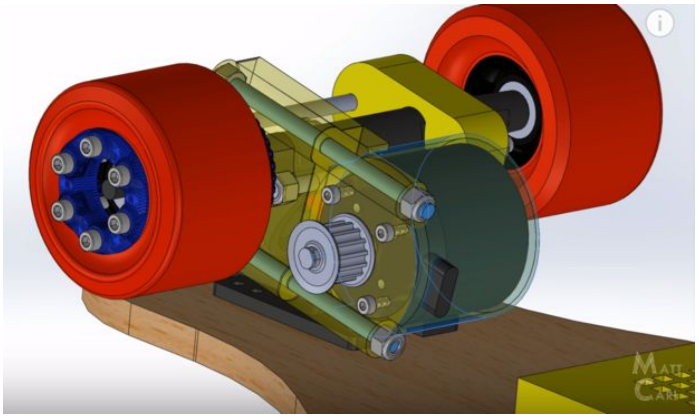
I printed these pieces with 75% fill density in PLA and they work wonderfully. I've ridden then over 20 miles without any signs of wear.

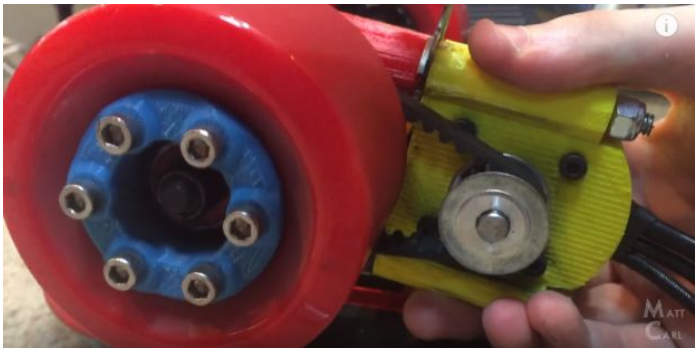
These motor mounts are designed specifically for the trucks that I bought, they perfectly fit around the truck's geometry. I have links to the trucks I used off of ebay in the parts list section, they were fairly inexpensive.

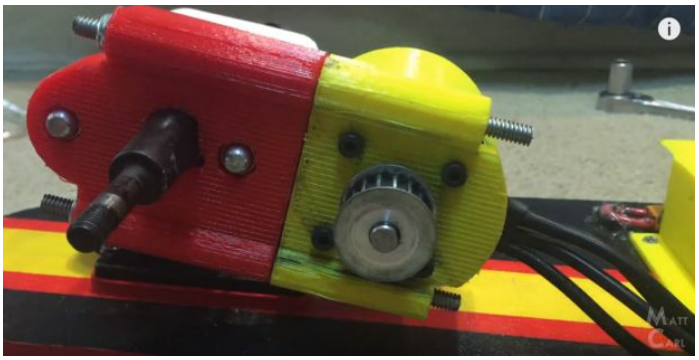
Be sure to use a threadlocker for the final assembly, lots of vibrations while riding and bolts/set screws WILL come undone if no threadlocker is used!

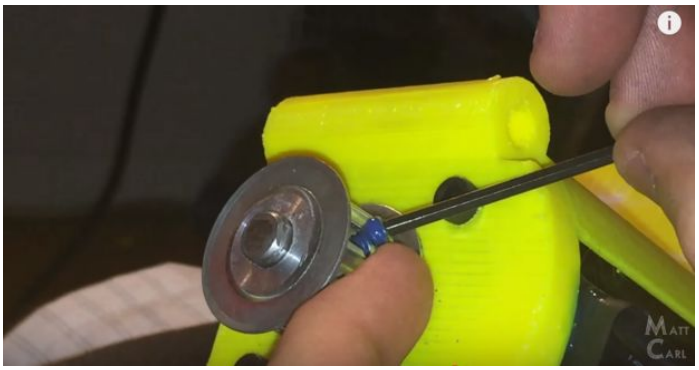


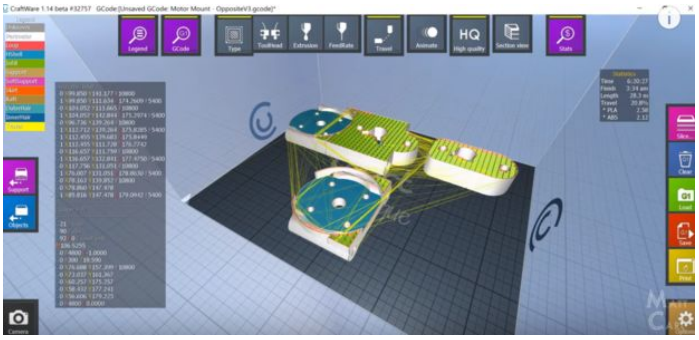


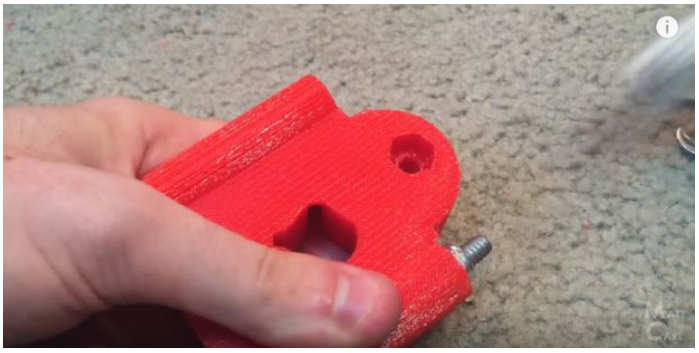












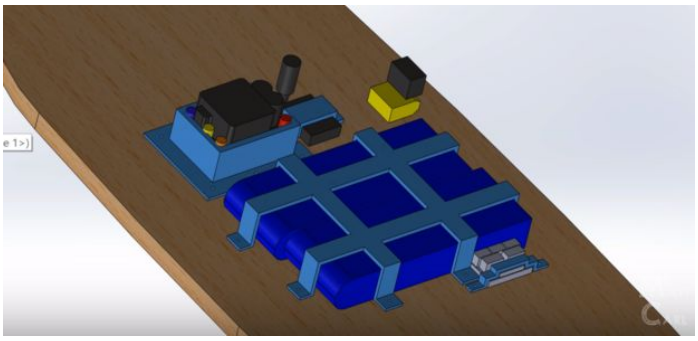
Step 5: Mechanical Design | Electronics Mounts

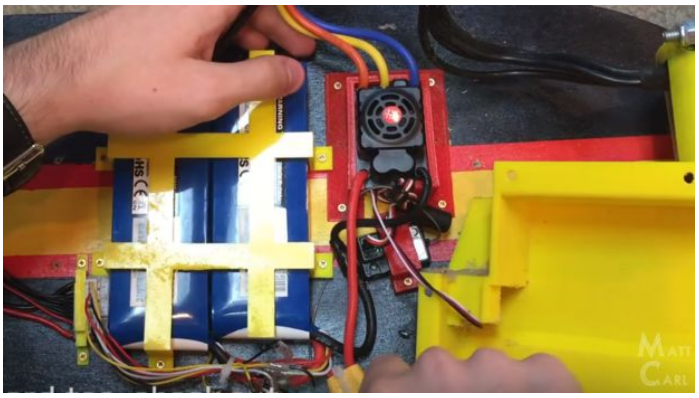
There are lot's of different ways people have held their electronics to their board. Some people have used tupperware containers, others zipties, or velcro. I decided to design and 3D print brackets for each electronics component. These brackets would be held in place with really small wood screws (about 1/4" in length), but if I were to do it over again, I'd go with longer screws since they were a pain to install.

Again these were printed in PLA around 40% fill density.

They ended up working extremely well, they all fit very snug against the board and allowed me to have a slimmer case in the end.

Again, filed for all the components I used can be found in the parts list/3D model link section. Make sure to account for the correct tolerances while designing, I added around 1/16 of an inch on all sides to make sure the could be assembled without bending the plastic pieces too far.





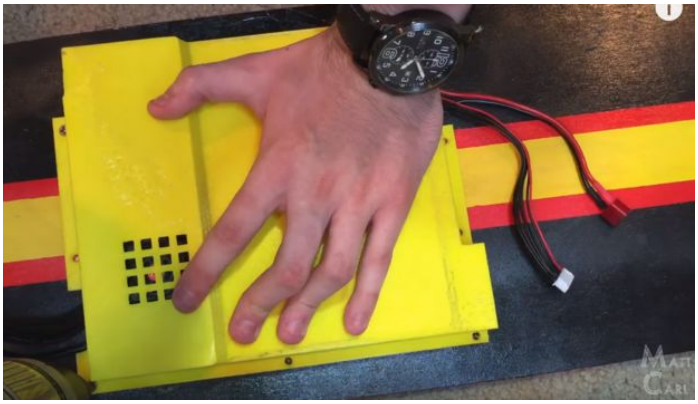
Step 6: Mechanical Design | Electronics Container

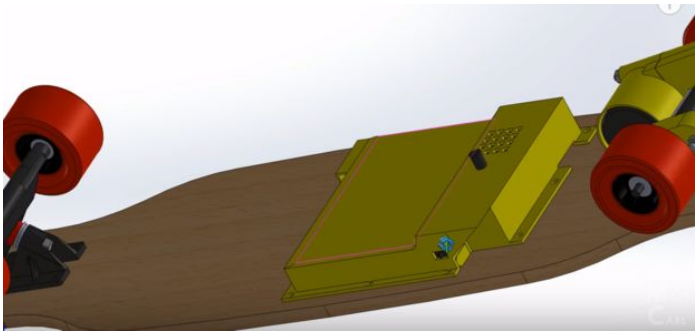
I wanted a really sleek electronics container, one that people would question if the board was bought or made at home. The biggest challenge was figuring out a configuration for the electronics that would allow for the overall dimensions to fit inside my 3D printer's build platform.

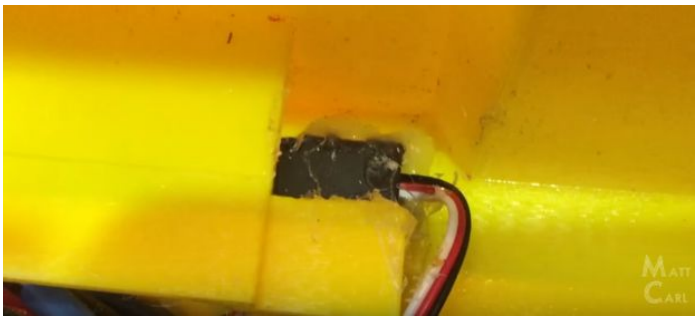
I integrated the ESC switch into the electronics case so it was easily accessible from the outside of the board. I also added ventilation holes for the ESC.

I added a slot by the ESC switch with was suppose to be for the antispark switch. I initially wanted to be able to remove a part of this switch to disconnect the batteries while not in use. This didn't work at all. the vibration from riding always jiggled the connection of the antispark switch loose and caused my board to randomly shut off while riding, not fun. Instead I just ziptied it all together and fit it within the case.

You'll also notice the two charging wires coming out of the back of the electronics case, I designed a little cavity for the ends of the wires to sit in while not being charged. This will allow for the wires to be held securely instead of flopping around while riding, you can see this little cave for the wires in the first image in the bottom right, it's the little square section. It works surprisingly well!



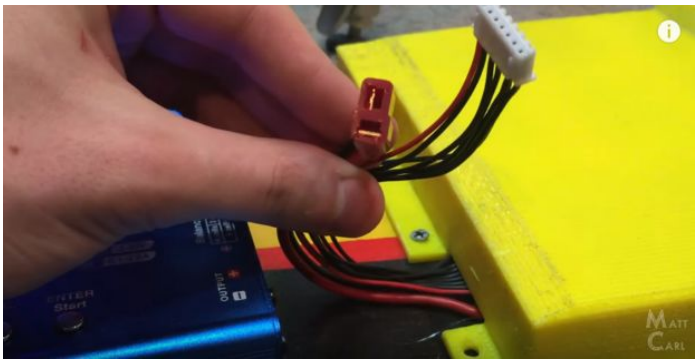


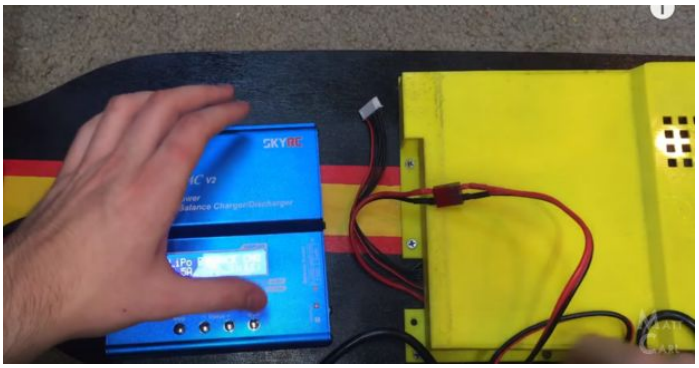


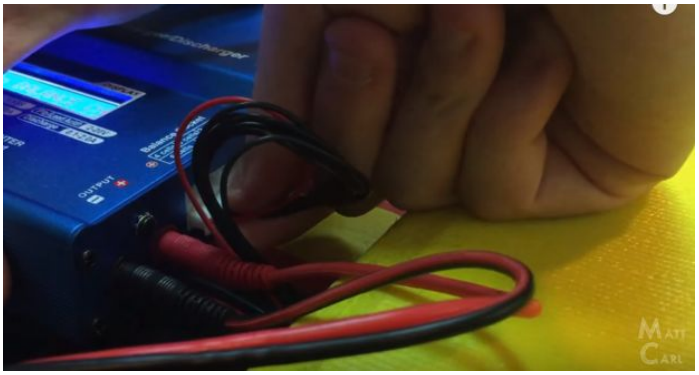
Step 7: Charging

To charge the board, I simply connect up the 7 pin balance cable to the charger. and the deans to banana plug connector which comes with the charger. I then entered my battery's info like type, number of cells, and capacity, and then let it do its thing!

It takes about 2 hours to fully charge. I'm really happy with the charger and highly recommend it (link in the parts list section).







Step 8: Riding Statistics

I used a GPS tracking app called Cyclemeter to measure my distance, speed, and elevation while riding.

I brought the board to a local park fully charged and rode around 7.8 miles, when I got back I connected the board back to my charger and it indicated I still had around 25% battery left. With a little math you'll get a full range of around 10 miles.

Next I brought it to a flat straight away and wanted to test the top speed of the board. I ran it a couple of times and pretty consistently stayed between 18-21mph as the top speed, not too shabby!


Legal
RIDE TIME
1:11:30
0:00
DISTANCE
7.79
miles
SPEED
0.93
mph
CALORIES
511
Speed
mph
20
12
4
1 2 3 4 5 6 7
Reset
GPS
Done Aug 22, 2016, 6:38 PM
Stopwatch
Map
Calendar
History
More


Verizon
11:35 PM
83%
New Route
Cycle
SPEED
0.93
mph
AVERAGE SPEED
6.54
mph
FASTEST SPEED
25.23
mph
FROM BEST
--:--
AVERAGE SPEED
8.81
Previous Split
AVERAGE SPEED
6.62
Current Split
Speed
mph
20
12
4
1 2 3 4 5 6 7
Reset
GPS
Done Aug 22, 2016, 6:38 PM
Stopwatch
Map
Calendar
History
More


Legal
RIDE TIME
2:23
0:00
DISTANCE
0.52
miles
SPEED
12.74
mph
CALORIES
27
Speed
mph
18
14
10
0.1
0.3
0.5
0.7
0.9
Reset
GPS
Done Aug 23, 2016, 12:50 PM


Verizon
11:36 PM
82%
New Route
Cycle
SPEED
12.74
mph
AVERAGE SPEED
13.11
mph
FASTEST SPEED
20.27
mph
FROM BEST
--:--
AVERAGE SPEED
0.00
Previous Split
AVERAGE SPEED
13.11
Current Split
Speed
mph
18
14
10
0.1
0.3
0.5
0.7
0.9
Reset
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Stopwatch
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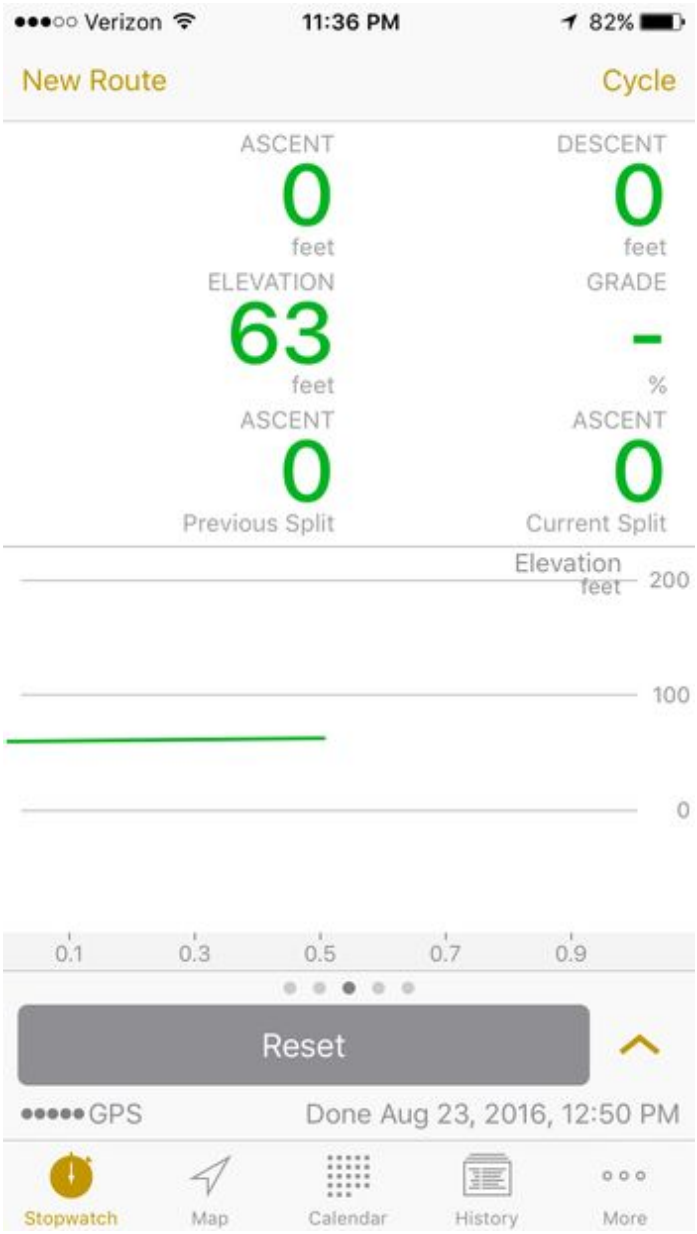

Step 9: Future Changes/ Suggestions

After showing this off to a couple engineers at work, I found the main flaw is the lack of removable batteries. LiPo batteries can be very dangerous and should be inspected regularly. With my current design it is very inconvenient to take the electronics cover off and inspect the batteries, simply because I wasn't thinking about battery safety.

In the future I plan on redesigning the electronics cover to allow the batteries to be pulled out and disconnected from the board. Everything else has been working wonderfully!

Please let me know if you have any questions, hopefully this will give you enough confidence to start designing and building your own!

-MattCarl

Related Instructables

3D Printed Electric Longboard by Nick_Tesla

3D Printed electric Longboard V2 by Saral Tayal

The Budget DIY Electric Longboard by CoolRextreme

V3, No Weld, 3D Printed, Electric Longboard by Saral Tayal

DIY INSANE Electric Longboard (note: testing in progress) by treyisgolfing

DIY 3D Printed Electric Skateboard with 1500W of power! by Saral Tayal

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