DIY Electric Skateboard: Remote Controls & Electronics

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Abstract

Electric skateboards have become a popular mode of travel among today's youth, especially in urban cities and college campuses. While anyone can purchase an electric skateboard from a variety of manufacturers; the price of a reliable board can be very high, and the consumer passes up a valuable opportunity to learn from the construction of his or her own board. This project provides the opportunity for aspiring engineers or any tinkerer to design and build their own electric skateboard, and in the process learn about: design, CAD, manufacturing, and various electronic components including motors, remote controls, and electronic speed controllers. The instructional documentation provided with this kit will provide all of the information necessary to design, manufacture, and assemble all of the parts required to create a functional, affordable, and safe electric skateboard. This project was created in collaboration with Adrian Cardona, with my focus being on the design and construction of the control system. This includes design and manufacturing of the remote control, as well as the wiring and programming of the ESC to control the motor using the remote.

Remote Control

In order to comfortably control the skateboard while riding, a remote control must be designed to fit in one hand and allow the ability to accelerate or decelerate the motor with ease. While electric skateboard remotes may be purchased online, doing so forfeits the opportunity of designing a custom remote to one's liking, as well as the valuable opportunity of developing CAD and 3D printing skills.

For this build, the HK-GT2B remote control by Hobby King is used because it is reliable and readily available. In order to transform it into an electric skateboard remote, a new housing must be designed which can comfortably fit in one hand while still holding all the required components. This is where one has the option to get creative and design the housing however they like. The housing is required to fit the main PCB, the battery, the antenna, and the trigger mechanism while providing access to the trigger, the power switch, and the charging port. In order to make the smallest possible design, the main PCB and the PCB of the trigger mechanism may be carefully shaved down so long as the wires printed in the board are not reached. A benefit of using the HK-GT2B is that the remote's battery can be charged directly through the PCB using a micro-USB cable. This means that the battery can be rewired to be connected directly to the main PCB, allowing it to be easily compacted into a smaller remote control housing.

Figure 1: HK-GT2B remote control prior to disassembly

Figure 2: RC components assembled into newly constructed housing

Figure 3: Completed remote control for electric skateboard

ESC Programming

In order to control and regulate the speed of the motor, an ESC must be used. The ESC receives the signal from the remote control and regulates the current provided to the motor by the batteries.

While programming an ESC for an electric skateboard may sound like a daunting task, there are tools that make the process simple and intuitive. The ESC used for this build is the FSESC 4.12 50A ESC by Flipsky. The reason for selecting this ESC is for its compatibility with the VESC Tool, a computer program that allows for easy configuration of the motor and input for the ESC. The VESC Tool is used to map the ppm input from the RC remote receiver as well as set the current and voltage limits of the motor and batteries.

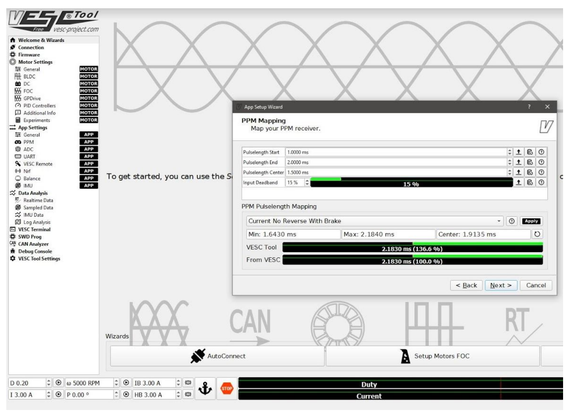

Figure 4: PPM mapping of receiver for ESC using VESC Tool

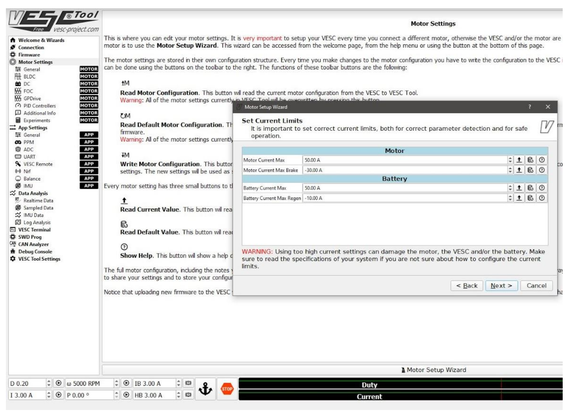

Figure 5: Configuration of current and voltage limits

Wiring and Assembly

The wiring and assembly of the control system provides an opportunity to practice soldering as well as safety measures for using high current electronic components. For this build, two lipo battery packs consisting of four cells each are used. Each battery pack has an overall voltage of 14.8V and a capacitance of 5000 mAh, together providing plenty of current to run the motor at the torque required for this project. A series connector is created to connect the batteries using an XT 90 connector, HXT 4MM bullet connectors, and 10 AWG wire.

Figure 6: Turnigy 4S 5000 mAh LiPo hard case battery packs

Figure 7: Series connector for batteries with XT90 connector output

While this setup may now be used to power your ESC and run your motor, the user would be greeted with a great spark every time the ESC is powered. To avoid this, an Anti-Spark loop key may be built. The loop key provides the user with the ability to easily power their board while avoiding a spark by simply plugging in a key. The key is built by creating a new series connector to go between the ESC and the series connector for the batteries. The new series connector consists of XT-90 connectors on two ends, with the free end featuring a male XT-90S Anti Spark connector. A female XT-90S connector is then shorted by soldering 10 AWG wire across the terminals, which now acts as the key completing the circuit. With this newly constructed series connector, power can safely be delivered to the ESC by simply plugging the "key" into the socket, which will be accessed through an opening in the casing of the electric skateboard. The implementation of the Anti-Spark loop key also provides more security for the electric skateboard, because it can not be turned on without the key. Keep in mind though that the key is not unique and may be easily replaced.

With the power delivery system set up, the remote control constructed, and the ESC programmed, the control system is complete and ready to be put into the housing of the electric skateboard, which is designed and manufactured by my partner Adrian Cardona.

Figure 8: Anti-Spark Loop Key

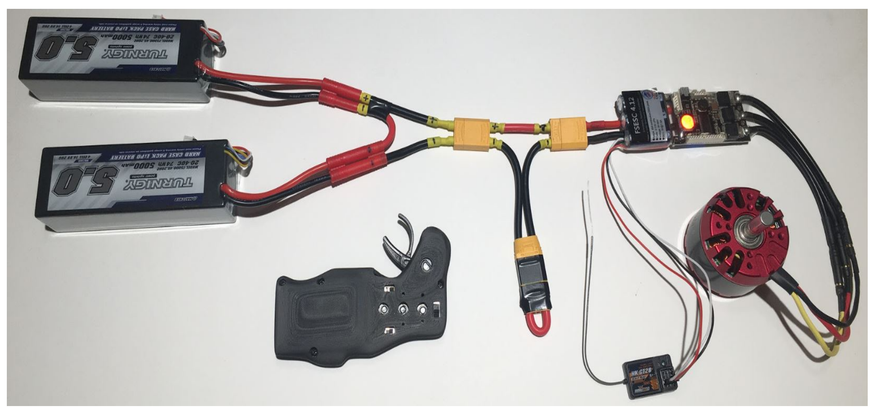

Figure 9: Complete assembly of electric skateboard control system and remote control

Future Work

The control system will be housed in a 3D printed casing which will be fastened to the bottom of a longboard deck. The motor will be mounted to the front truck and will drive a wheel using a belt. The housing, motor mount, and belt/pulley system are designed and manufactured by my partner Adrian Cardona. Once the COVID-19 pandemic passes, and 3D printers become accessible, the board may be assembled and then tested to tweak the ESC using the VESC tool in order to provide the smoothest, safest riding experience.