# OPEN SOURCE HARDWARE AND SOFTWARE DESIGN FOR A QUADCOPTER

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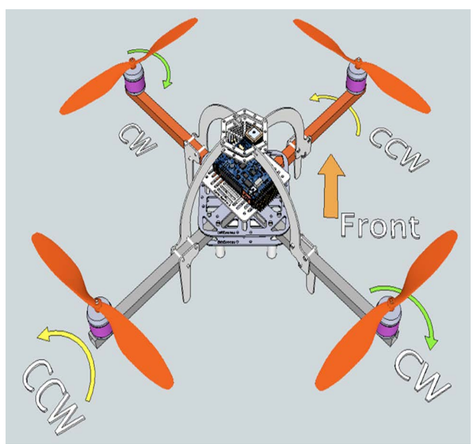
## Abstract

In the recent years quadcopter has attracted a great degree of attention both from researchers and users. Companies such as Amazon are planning to deliver goods using drones, even though applications of quadcopter might be very complex. Building and programming a drone is very easy and exciting engineering project. In this poster we describe and outline the steps for designing a quadcopter complete from scratch using components, with open source firmware. Hardware and Software is implemented in this poster.

## Introduction

As the future approaches us, so does the evolving engineering that goes into drones. Drones have become the new hobby to many. There are all types of drones available today. The technology that goes into creating drones is complex. This is why the market is flooded with very expensive drones. The open source firmware that the Flight Control Boards have, is the key to opening the door for future cheap drone creation. This poster contains sections referring to the hardware, and software side of drones.

## Hardware and Rotation Design



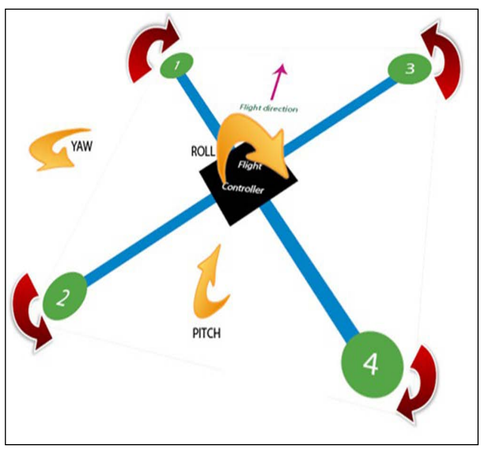




Figure 1 – 2: Conceptual View of Quadrotor Tour Guide

The drone is configured of a strong durable frame, which is going to carry the motors, engine speed controllers, distribution board, battery, rotors, and flight control board. The quadcopter is created from building the frame first. The frame has to be constructed of light weight material, such as aluminum, carbon fiber, fiber glass or wood. After the frame is put together properly, the engines are mounted to the ends of the frames arms. The next step is to solder the engine speed controllers to the distribution board, which the battery plugs into giving power to the controllers. The next step would be to solder and heat shrink wrap the engine speed controllers to the motors. This step is critical, due to the rotation of the blades, which will be applied in the last step. Final step before calibrating and programming the flight control board, is to connect the engine speed controllers, and receiver to the flight control board. The final step before going into the software part of the flight control board, is to pair the radio, which will be controlling your drone in flight. After of all required steps are meant the quadcopters structure will be complete, as shown in Figure 1-2.

## Quadcopter Components

Figure 3 – 5: Engine Speed Control, Propeller, and Battery Connection

Figure 6: Quadcopter Built with Different Components

## Software Calibration

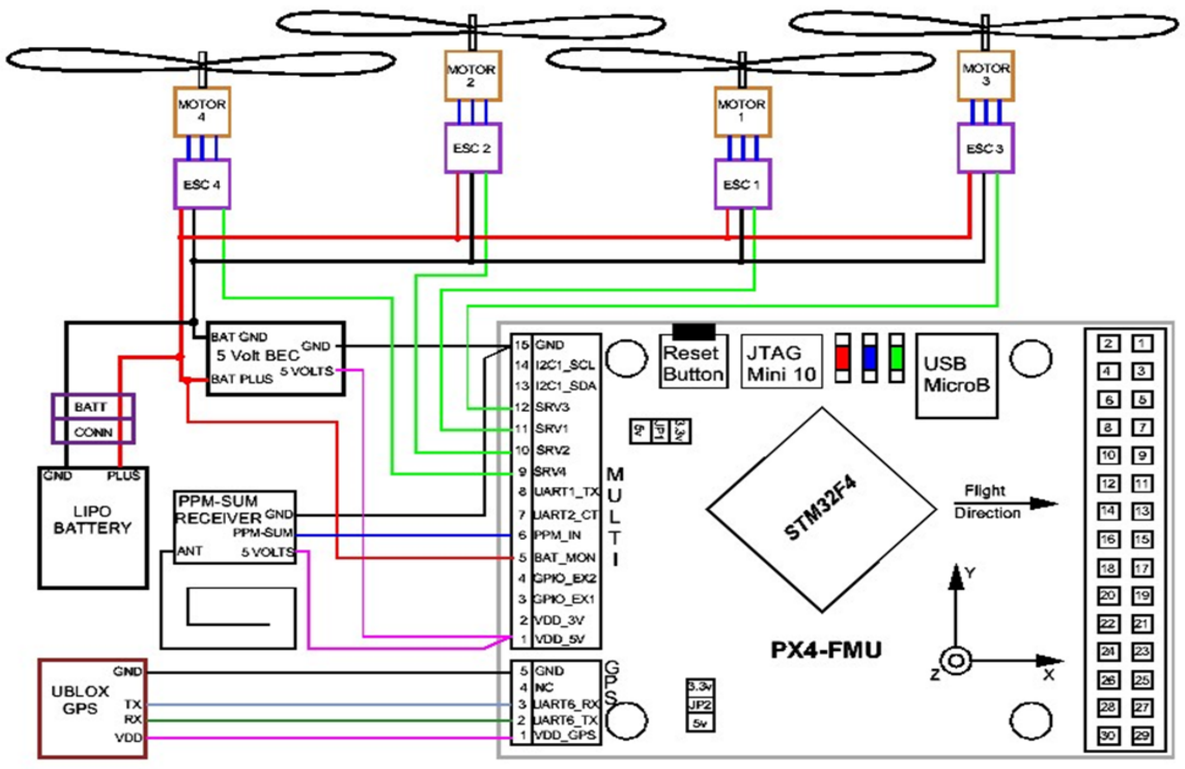



Figure 7: PX4-FMU Flight Control Board Layout

The most important part of the drone is the flight control board shown in Figure 7. The flight control board is the brains of the drone. Just like our brains, the flight control board has the functionality of keeping it balanced and stable. Many flight control boards come with self-leveling onboard gyros, which will keep the drone level with the ground, when calibrated on a level surface. The importance of being level is so you have a smooth flight, and gives you a balanced platform to calibrate the yaw, pitch and roll shown in Figure 2. The open source firmware of these boards are programmable. Meaning you could either configure the board yourself with different technics found on the internet, or get programs off of someone who created the program for your specific drone. The sky is the limit with the read and write software. Many hours went into creating the software, so with a little trouble shooting, you will be in flight in just a few minutes after calibration and configuration of the flight control board. Figure 7 will give you a complete schematic of how the layout should look when put together correctly. Figures 8 – 11 shows you how the actual wiring of the Flight Control Board looks like in comparison with the schematic in Figure 7.

## Experiment Results

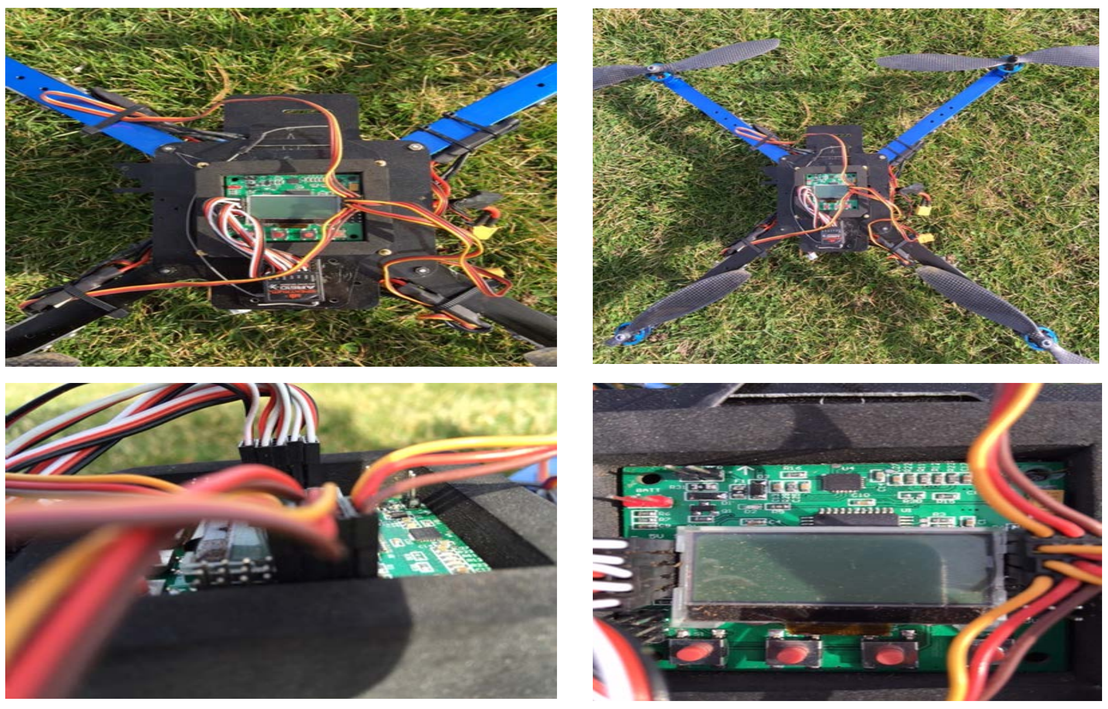


Figure 8 – 11: Hardware and Flight Control Board Pre-Flight

After all the building, connections, and programming was complete, our drones where ready for flight shown in Figure 8-11. During this experiment we came into calibration issues during flight due to outside elements, but with a self-leveled drone the calibrations where minimal. When reaching higher altitude the drone became a little unstable due to the turbulence and downforces surrounding the drone. After the completion of the first flight, the results where positive. Just by following the instructions stated above you will be flying in no time, and could build so many different drone platforms from octocopters, hexacopters, quadcopters, and tricopters. The quadcopter in Figure 6 was built from parts found on Amazon under $150.00.

## Conclusion

Our goal in this poster was to build a drone/quadcopter from cheap hobby parts found on the internet, and fly it. Upon completion of flying the drone, I wanted to create an easy step by step guide on how to build it yourself. Finally, This guide could show anyone from the novice to advanced how to build a drone from scratch.