Auto-Leveling Drone

PROJECT 3

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Introduction

As we previously explained in our interim report my colleagues and I were aiming to build an autonomous drone (A.K.A quadcopter) with an accompanying app and website. The app and website were intended to be used for monitoring and possibly controlling the drone. The drone on the other hand was intended to have the following features:

- Auto level
- Altitude hold
- GPS hold
- Course lock
- Telemetry

And in the time duration we had we were able to build the drone and implement most of the auto-leveling features as well as designing and coding the website and app interface. But due to time constraints and the processing power of the Arduino Uno we did not get a chance to fully implement live monitoring and remote flight control. In this report I will go in depth on the building process of the drone and gloss over website and app development (as my focus was working on the drone), discussing the process top to bottom from preparing the schematic and gathering/ordering parts to finally testing and flying the drone.

Quadcopter Building Process

In this part of the report, I will go through the process of constructing the drone, which I have divided into four sections, and they are as follows (click on heading to jump to section):

1. Preparation
2. Assembly
3. Testing
4. Final Product

In the Preparation section I will go over what was done in the planning phase which includes choosing parts, building the schematics, and getting all the tools required for constructing the drone.

In the Assembly section I will focus on the technical aspects of building, issues that emerged and how I managed to tackle/solve them. That includes, but is not limited to, setting up the frame, allocating spaces for components and soldering connections.

In the Testing section, I will demonstrate the steps taken to test functionality of the quadcopter over the different development phases.

And finally in the Final Product section, I will show what the outcome/result of the quadcopter looks like and reflect on what was achieved.

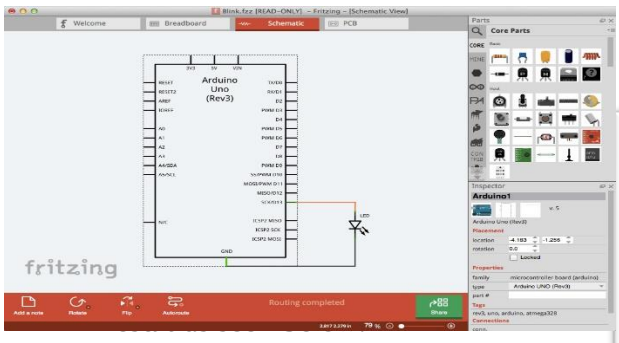
PREPARATION

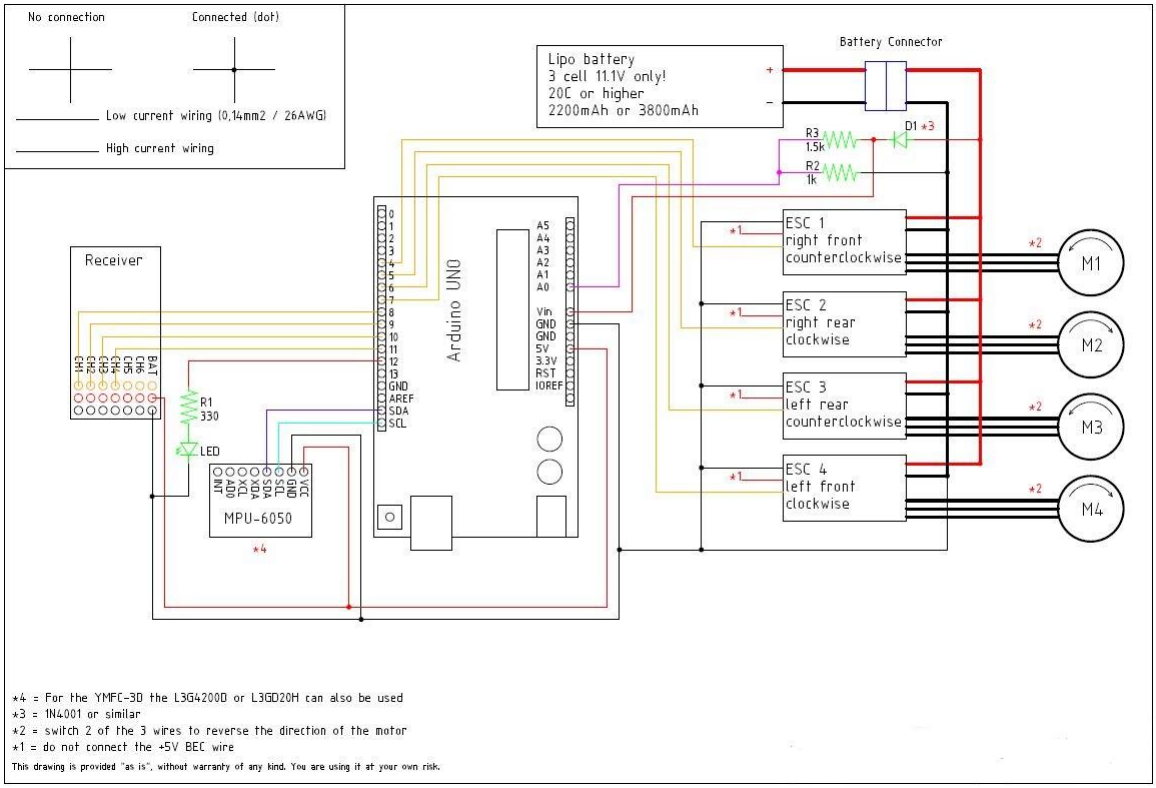
My first step when it came to preparation was to order the parts needed for the project. I had to take a few factors in mind, since we were hesitant on what project to do at first. These factors were as follows:

- Budget: we had a tight budget of around 200€ so the price of each component had to be kept in line while simultaneously not diminishing performance.
- Shipping times: due to the pandemic, as is known, shipping times have lengthened so I had to look through multiple websites and check which ones had the least delay so work on the project can start hastily. On some components I even spent the extra buck getting them for the EU as shipping times were overlong when ordering from the far east.
- Specifications: due to the complexity of the project each component must be compatible with the rest. Therefore, I had to consider closely the following attributes for each component: voltage requirements, weight/size of each part, number of I/O ports (Analog or digital) needed, etc.

Subsequently when I assessed those factors, I eventually choose the parts after a few days of research that it required as discussed in the Interim Report. I was able to stay within the budget which was ideal and achieve the required specifications. While on the other hand, shipping times were estimated around February which was not ideal, but it was the best we could do at that point.

After the factors were taken care of and the parts were ordered, which arrived at the first week of February to our relief, I had to create the schematic before the parts arrived to save time and be ready in time for when they arrived. For that I used an application called Fritzing to design the schematic.





Another element that I had to address was tools, for I needed I couple of things such as a soldering iron, solder, zip ties, screwdrivers, etc. Some of those things I had about, some I bought, and some I was able to get access to at college/lab such as the soldering iron which was terrific.

ASSEMEBLY

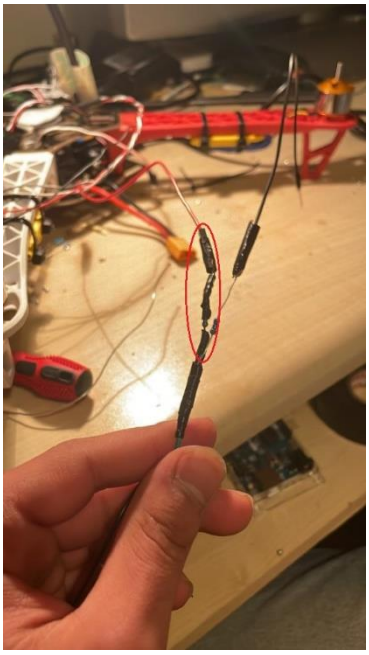
After I had received most of the parts and soon as I got the frame parts, which is the main structural component of the quadcopter. I started the first step which was assembling the frame together.

The second step was allocating/designating where each component will sit on the frame, this was vital to decide beforehand because some components would have to sit in a permanent position.

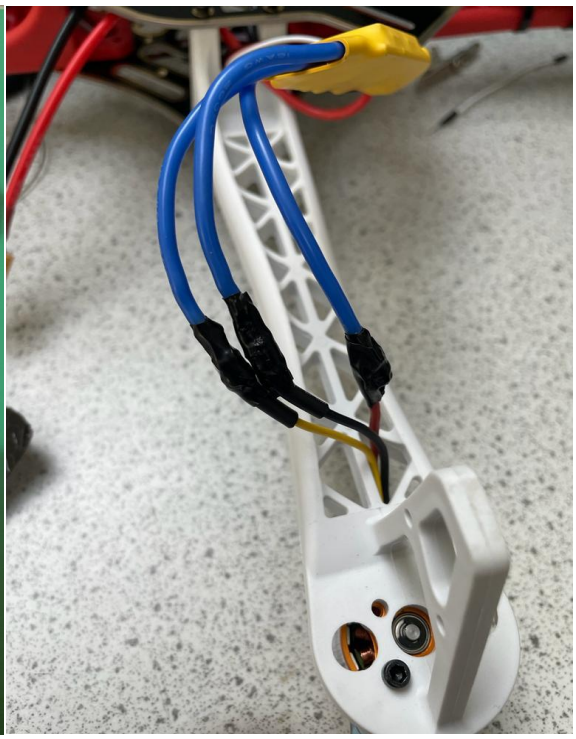
After allocation was complete, the third step was to start connecting and soldering components to the Arduino. I did run into a few hiccups some of which I was able to notice right away which I will show/discuss in this section. While other issues weren't noticeable until the Testing phase and so I will discuss them in that section in due time.

Some of the issues I ran into were as follows:

- I was supposed to use 2 resistors for a voltage divider to track battery voltage as it gets lower as seen on the schematic, but I was only able to find the 1KΩ resistor and not the 1.5KΩ resistor. Due to that I had to connect 3 resistors in series adding up to the required value as seen from this picture:



- On my first attempt at connecting the ESC's I accidentally soldered the connections making them very flimsy. Instead, I should have just connected them and then using a heat shrink kept them in place. So due to that fact I had to make sure they had a good connection and then wrapped them with electric tape to make sure they were protected. You can see the difference in these side-to-side photos:

TESTING

Testing the drone is a tremendous task that takes time and patience since it is a continuous process. Whenever you test and see loss in performance/issues or even room for improvement then we go back the 2 previous steps (Assembly and Coding) and adjust were needed.

But once I finished assembly and uploading the code to Arduino, I began the testing process. I was checking over all the connections using a voltmeter to make sure there is no short-circuits in my soldering. After that I started checking that there is a connection between the remote and the receiver, once that was established, I started testing the motors directly without using the remote control to ensure that any issues that may occur later are purely due to the remote control. This was a good idea because at this stage I realized that I needed to switch 2 of the ESC's cables to change the polarity of 2 of the motors, otherwise, all the motors were spinning in the same directions not allowing the drone to fly.

FINAL PRODUCT

All in all, the main objectives were met but I feel that if we had slightly more time, we could have added more sensors for additional features such as humidity, CO_2 and temperature levels as well as a camera for aerial view. It was a fun learning experience where I learned about aerodynamics and the physics of flying a drone. I would

personally love to add most the remaining features which I am planning to do in my free time as a personal project.

Website Development and App Development

I was an active member in the development of either, but I helped Chenlong and Pablo when it came to the design and keeping track of the features required. If I was asked to lend a hand, I was able to help as I had done HTML before and we did Android Studio this year.

Summary

As I had expressed I think this was wonderful project, I learned a lot about electronics and I hope to work on this again in the future.