Aerial sensor platform

Gonzalo Hermida Ruiz

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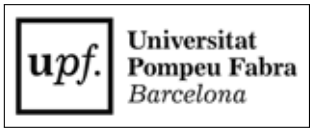
DIRECTOR/S OF THE TFG:
Jaume Barcel, Carles Ayesa, Luis Sanabria
DEPARTMENT:
Departament de Tecnologies de la Informaci i les Comunicacions (DTIC)



To my family.

Acknowledgments

I would like to thank to

Also, to

At last,

Abstract

This work addresses the gathering of data in areas of difficult access or which are potentially dangerous. Examples include high tension power lines, collapsed buildings and fire areas. We build a flying platform with the ability of carrying light sensors (e.g., small cameras or infrared cameras) and transmit the sensed data wirelessly to a control point. The platform is a highly manoeuvrable multicopter that uses the Arduino microcontroller and the multiwii software.

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Chapter 1

INTRODUCTION

This thesis consist on the construction of an ardupilot in order to the gathering of data in areas of difficult access due to the ability of carrying light sensors and transmit the sensed data wirelessly to a control point. An ardupilot is a remotely controlled UAV (Unmanned Aerial Vehicle) based on Arduino, a free hardware platform based on a board with a microcontroller and a development environment, and MultiWii, a free software used to control multirotor RC models.

An Arduino board consists on a microcontroller with complementary components to facilitate programming and incorporation into other circuits. An important aspect of the Arduino is the standard way that connectors are exposed, allowing the CPU board to be connected to a variety of interchangeable add-on modules known as shields, which are printed circuit expansion boards that plug into the normally supplied Arduino pin-headers providing i.e. motor controls or GPS.

The Arduino integrated development environment (IDE) is a cross-platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiring projects. The Arduino IDE uses the GNU toolchain and AVR Libc to compile programs, and uses avrdude to upload programs to the board. Arduino programs are written in C or C++ and called ”sketch”.

The MultiWii is an open source software project aiming to provide the brain of a RC controlled multi rotor flying platform. It is compatible with several hardware boards and sensors and have a lot of supported features.

Chapter 2

ELECTRONIC COMPONENTS

2.1 Transmitter

A radio transmitter is an electronic device which produces an electromagnetic signal called radio wave and transmits it.

Typically it includes generation of a carrier signal, a modulator, a power amplifier, and a filter and matching network to connect to an antenna and send the signal through free space.

2.2 Receiver

A radio receiver is an electronic device that receives radio waves and converts the information carried by them to a usable form. Its antenna intercepts radio waves and converts them to tiny alternating currents which are applied to the receiver, which extracts the desired information.

Typically it includes electronic filters to separate the desired radio frequency signal from all the other signals picked up by the antenna, an electronic amplifier to increase the power of the signal for further processing, and finally recovers the desired information through demodulation.

2.3 Flight Controller

The flight controller is the electronic device that interprets the signals that arrive at the receiver. It is responsible for transmitting the interpretation to the ESCs so

they can in turn control the motors according to orders received.

Furthermore, the controller is equipped with several sensors such as gyroscope, accelerometer, barometer, altimeter and magnetometer, allowing potentially increase device functionality and improving decision making.

2.4 Electronic Speed Control

An electronic speed control or ESC is an electronic circuit that controls the amount of power/speed of the electric motor. The ESC interprets the signals transmitted from the flight controller and regulates the variation of motor speed and direction, and may also serve as a braking mechanism.

Brushless ESC systems basically drive tri-phase brushless motors by sending a sequence of signals for rotation. Computer-programmable speed controls generally have user-specified options which allow setting low voltage cut-off limits, timing, acceleration, braking and direction of rotation.

2.5 Brushless motors

Brushless motors are synchronous motors that are powered by a DC electric source via an integrated inverter/switching power supply, which produces an AC electric signal to drive the motor. In this context, AC, alternating current, does not imply a sinusoidal waveform, but rather a bi-directional current with no restriction on waveform.

Chapter 3

MOUNTING THE DEVICE

This section details step by step how to assembly the device, with the addition of several reviews, tips and images to provide an explanation as accurate and understandable as possible.

3.1 Mounting the arms structure

The motors must be screwed onto the ends of the arms. The screws that brought the motors were too short, so had to buy some longer.

Figure 3.1

We should note that the holes motors and arms are not equally spaced, so it is possible that when we screw a couple of screws fit and the rest not. To make sure they fit correctly, you must make the motor cables face the other end of the arm as you see in the figure below.

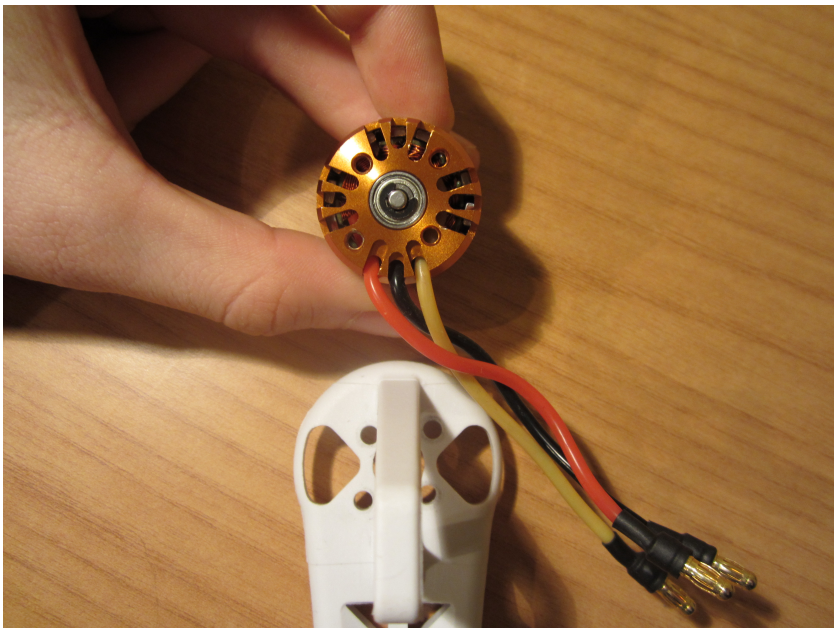


Figure 3.2

As a tip, first screw the screws located diagonally in order to strengthen the position. This allows you to screw in a more convenient and simple way the rest.

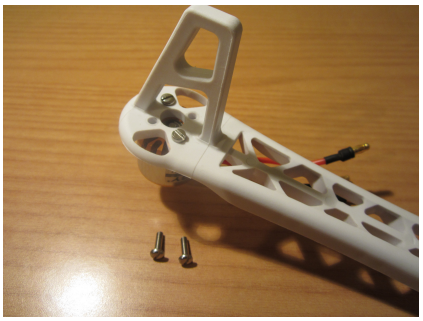


Figure 3.3

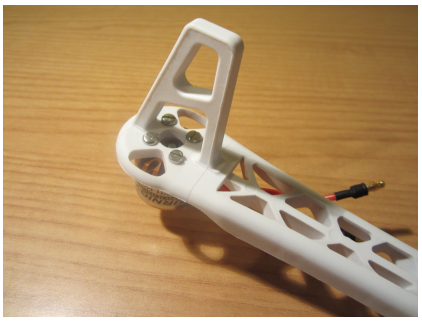


Figure 3.4

If now we set the propeller on the motor we can see how they stand out a bit. This fact is not very important, however, it is recommended to trim the iron bar of about 0.5cm, so they are closer together.

Figure 3.5

Figure 3.6

To perform this task we protect the engine from scrap when we cut, so it is recommended to drill a paper with iron or tape to cover the motor and prevent damage.

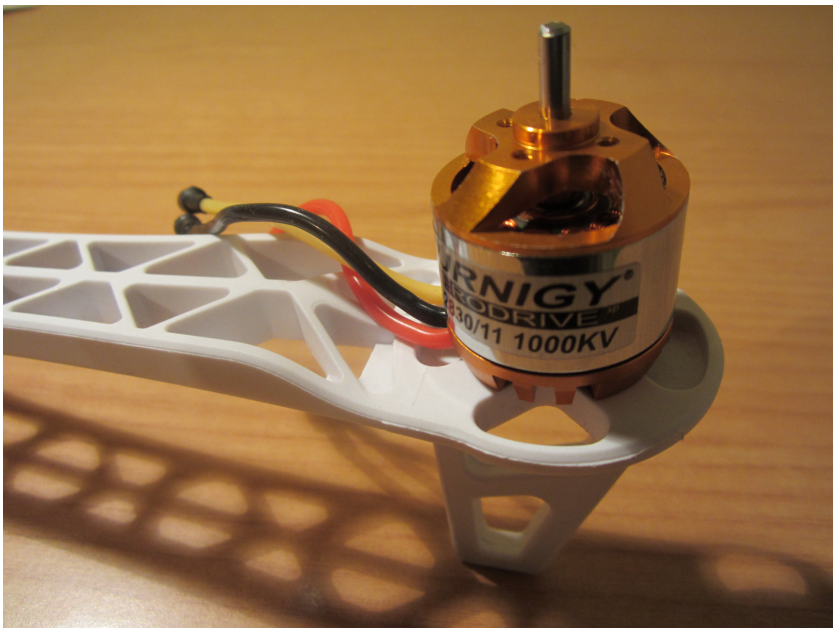


Figure 3.7

3.2 Base solders

The wiring that connects the ESC to the base is too long, so it is recommended to cut the remaining wiring. This cut is approximately 1.5cm excluding the connector. After that, do not forget about to peel 0.5cm of cable in order to solder it correctly.

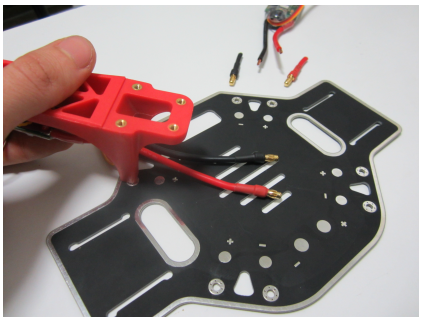


Figure 3.8
Soldering process

Figure 3.9

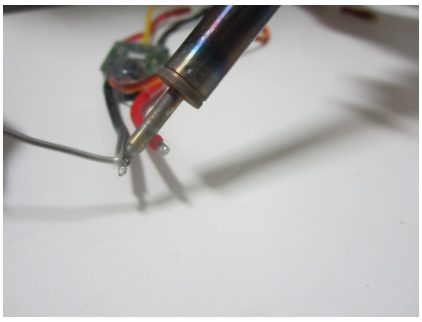


Figure 3.10

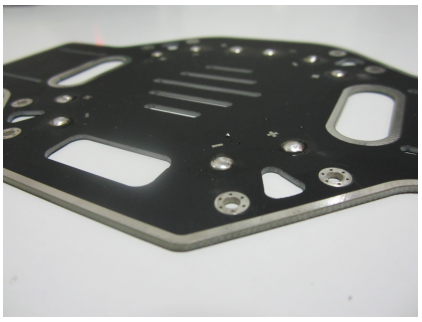


Figure 3.11

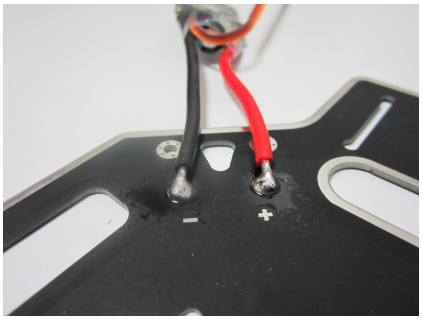


Figure 3.12

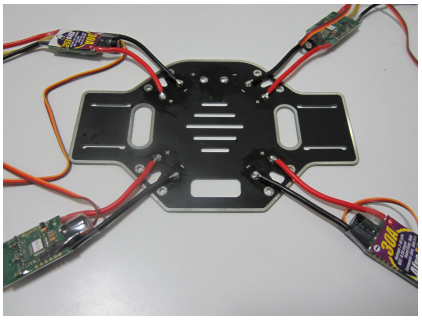


Figure 3.13

Once the ESCs have been soldered at the base, it is time to solder the cables that connect to the battery. These cables were purchased aside with a series of connectors compatible with the battery in order to build the necessary wiring.

To find out the length of the cable that connects to the battery is recommended to simulate the assembly of the infrastructure with the arms and putting the battery in the top base to see how this connects with the cables.

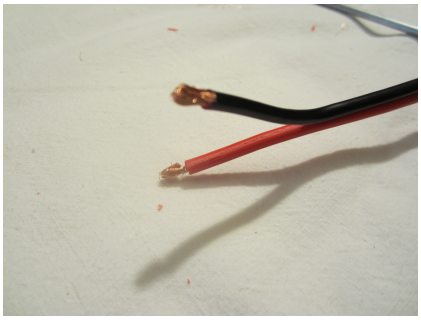


Figure 3.14

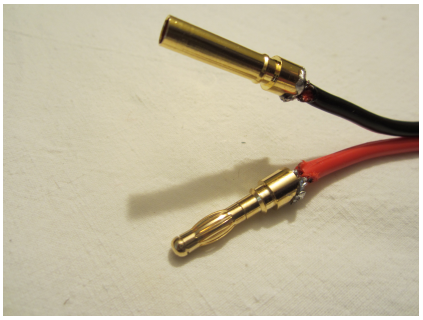


Figure 3.15

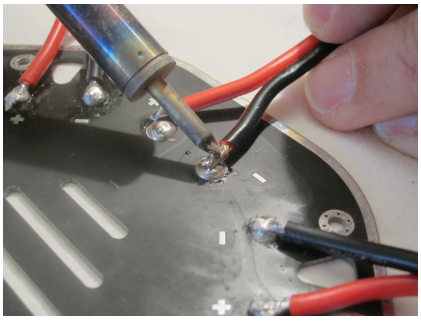


Figure 3.16

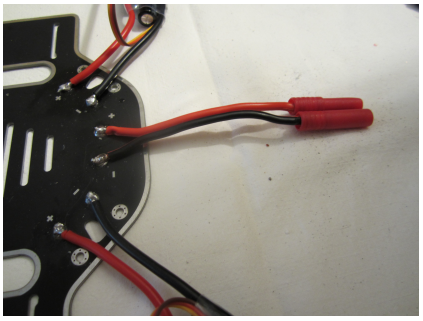


Figure 3.17

Once you have all the welding done, it is advisable to apply a bit of silicone with a cold gun to protect these points and avoid possible short circuits later.

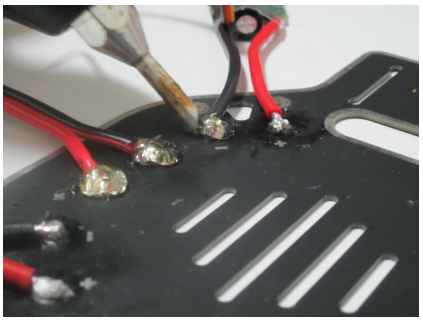


Figure 3.18

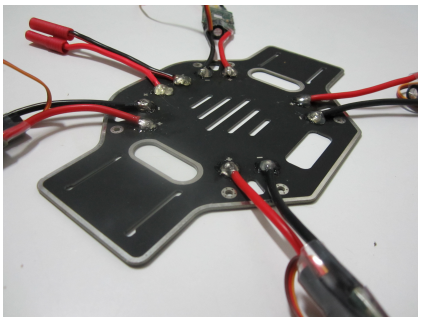


Figure 3.19

3.3 Completion of mounting and connections

It is important to bear in mind from now the QUAD-X figure.

Chapter 4

PLANNING REPORT

The following sections explain the tasks that I will do in the course of this project.

4.1 Pieces adquisition

This item includes the estimate time to plan which pieces are needed, how many of each, the purchase of them and the average waiting time until them arribe.

4.2 Assembling infraestructure device

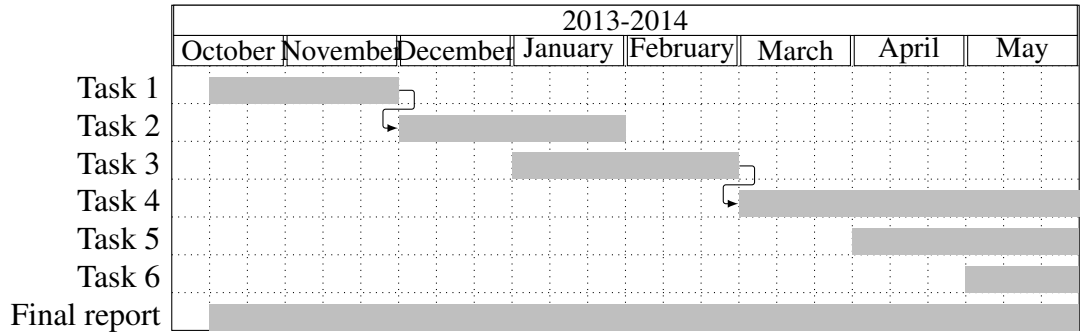
This item includes the required time to assembling the device once the pieces have arribed and we have all the needed tools.

4.3 Software Implementation

This item includes the required time to install the different software on the arduinos: the transmissor, the receptor and the controller; plus all the required software to be able to configure the arduinos through the PC.

4.4 Flight Tests

This item includes the required time to do the flight tests itself and the time to calibrate the device based on the results obtained on the tests and their interpretation.



4.5 Camera incorporation

This item includes the time needed to incorporate a camera to the device in order to take video images and transmitt it on live.

4.6 Device improvements

This item includes the required time to incorporate a bluetooth module to facilitate the connection between the arduino and the PC on a wireless mode, plus the incorporation of a GPS module, in order to extend the device possibilities.

4.7 Final report

The wording of the report is performed in parallel with the tasks that are being performed.

4.8 Gantt chart