Team F: Rescue Rangers

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1、Individual Progress

1.1、Overview

During the last two weeks, my primary role was finalizing the layout of our power distribution system. When trying to finish the layout, I also modified the schematic accordingly based on the electronics which we plan to use. Finally, I created the required manufacturing files and got the report from www.freedfm.com, showing that our power distribution board has no major errors

Also, as long as our Matrice 100 arrived last week, we started to set up our drone. After assembling it, we upgraded both the firmware of the remote controller and the drone itself. Then, we calibrated the rotation of motors, the compass and the remote controller so that we could actually fly the drone and do further development.

Furthermore, after reading several papers, Xiaoyang and I started to implement the rudimentary RGB-based signature detection algorithm, using HOG (Histogram of Oriented Gradients) and SVM(Support Vector Machine). The result accords with the literature [1], based on the dataset from INRIA. We will improve our basic algorithm and enhance its performance in terms of aerial images

1.2、Power Distribution Board

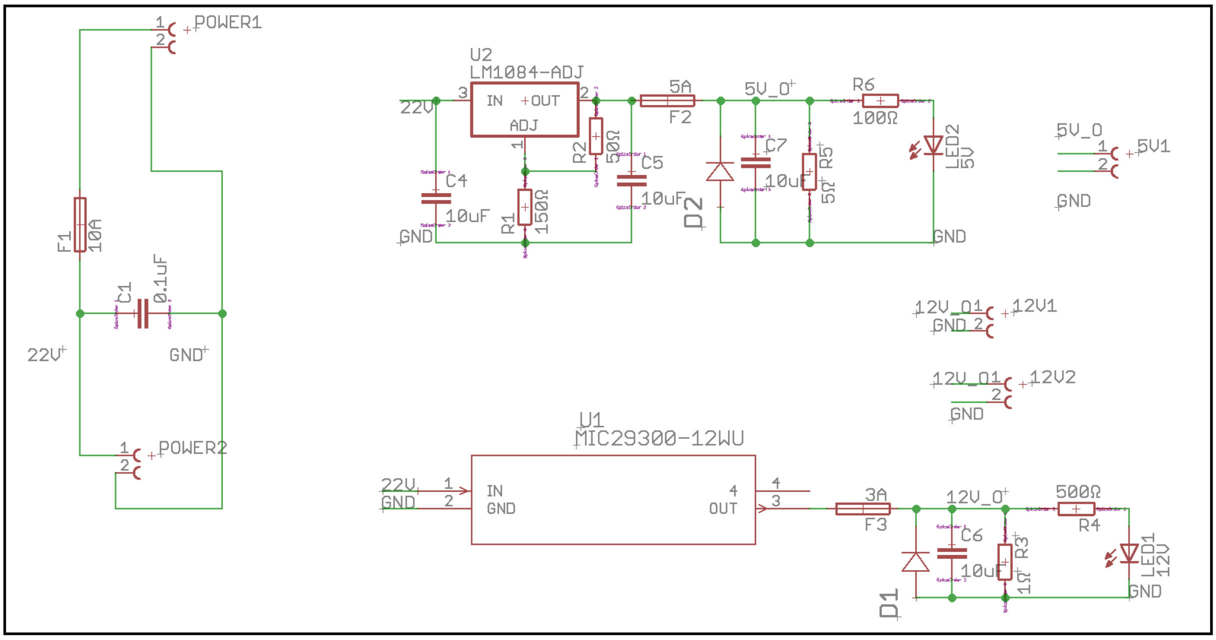

Figure1 Final schematic of PDS

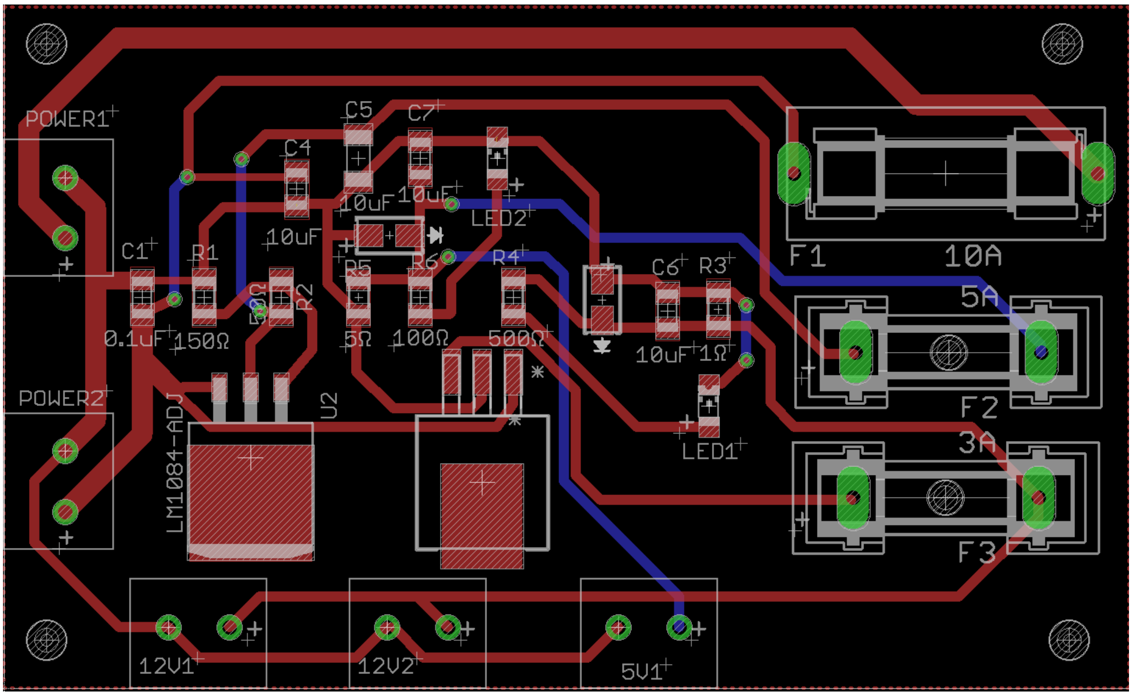

Figure2 Final layout of PDS

Above is the final schematic and the final layout of our power distribution system. For eventually printing the board, I still need to create manufacturing files from .brd file. The required files for printing are as below:

.drd – drill file

.cmp – top copper layer

.plc – top silkscreen layer

.pls – bottom silkscreen layer

.sol – bottom copper layer

.stc – top soldermask layer

.sts – bottom soldermask layer

After submitting all these files to www.freedfm.com, they could be checked for incoming orders. The multilayer output result is like:

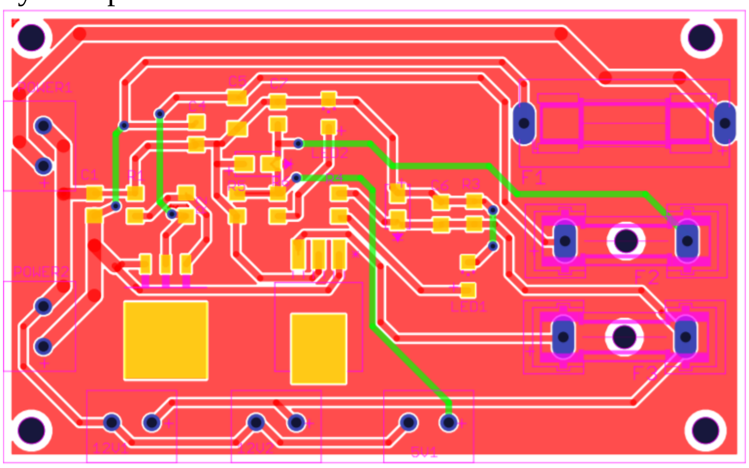

Figure3 Multilayer output result

1.3、Matrice 100 Setup

For setting up Matrice 100, we firstly checked all parts from the part list and assembled them step by step according to the tutorial on DJI's website. Several parts are shown in Figure4.

Figure4 Parts of Matrice 100

Then, we used DJI Assistant2 to upgrade the firmware of Matrice 100 and tested the rotation of motors. After that, we downloaded a mobile application called DJI Go to help us fly the drone. We also used this app to upgrade and calibrate the remote controller, as well as to check the IMU and calibrate the compass. The screenshot of this application is shown below:

Figure5 DJI GO

After all these preparation work, we could finally flied our drone in the net set in the basement. The picture of flying Matrice 100 is as follows:

Figure6 Flying Matrice 100

1.4、Rudimentary RGB-based signature detection

For rudimentary implementation, we used HOG to extract signatures and classified these signatures using SVM. The whole process of this algorithm can be illustrated by the flow chart below [1].

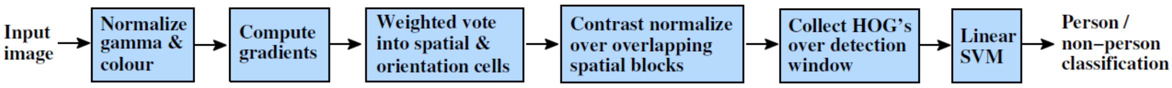

Figure7 Overview of the method

Even though our algorithm will finally be applied to aerial images to see whether there are human beings or not, we simply use the pedestrian images for training and testing in order to get a general idea of this method and evaluate its performance.

We used the dataset provided by INRIA for training, including 2416 positive images and 1217 negative images. For the test set, 453 negative images and 1126 positive images are included. The result of confusion matrix is listed below:

```
confMat =

   404    49
   180   946
```

Figure8 Confusion Matrix

Through this matrix, we can tell that among all 453 negative data, 404 of them are classified as the negative and 49 of them are misclassified as the positive. While for 1126 positive images, 946 of them are correctly classified. The overall accuracy of this algorithm is 85%, which accords with the result from the paper.

Our future work will focus on implementing this algorithm on aerial images and improving its performance accordingly. We will collect the dataset of aerial images both through the Internet and by ourselves. Also, in order to constrain the search area in an image, we did some literature study, and two possible ways are:

1、Background subtraction using ViBe method[2]

2、Blob detection with geometric constraint[3]

We will do further study before next PR, and hopefully we can successfully implement our algorithm on aerial images, and finalize the way to constrain the search area.

2、Challenges

The main challenge I faced last week was to fix an error reported by FreeDFM when I submitted the first version of our PDS. In the report, there is a potential show stopper called missing solder mask clearance. More specifically, it is said all surface mount pads should have solder mask relief, or they will be covered by solder mask, and unsolderable.

In the beginning, I had no idea about what the problem referred to. After searching the meaning of solder mask layer and consulting with my teammate, I understood that the solder mask is used to protect against oxidation and to prevent solder bridges from forming between closely spaced solder pads. However, each component in the layout should have a solder mask relief for electrical connection and other purposes. The reason of the error is that one of the component did not have a solder mask relief in its layout, which is required in terms of thermal relief and structural support. Finally, I manually drew its solder mask relief on the corresponding layer, and this problem was solved.

3、TeamWork

After the last Progress Review, our team discussed the plan for the next week, and broke the work down as follows:

Table1 Work distribution form

Member	Work
Karthik Ramachandran	Mobile SDK; Waypoint generation v2.0 implementation
Sumit Saxena	Onboard SDK; Initial exploration of thermal signature detection
Juncheng Zhang	Layout design for PDS; Rudimentary RGB-based signature detection
Xiaoyang Liu	Dataset collection for aerial images; Rudimentary RGB-based signature detection

The team worked with great coordination during execution of the entire task. As long as the drone arrived, the whole team started to set up the Matrice 100 together and we finished this task quickly. Also, we split the work according to each person's ability and willingness, and everyone did a great job.

4、Future Plans

Before the next Progress Review, we plan to further work on the mobile SDK and onboard SDK to implement basic waypoint navigation. We will first test this capability through simulator, and if everything works well, we plan to do some outdoor tests to see whether the drone can navigate to the exact GPS location of each waypoint from the input. Also, we will continuously work on the RGB-based human detection algorithm to improve its performance with regard to aerial images.

Specifically, my work is to work with Xiaoyang to implement our rudimentary algorithm on datasets of aerial images. After that, I will do more literature study about using the blob detection to constrain the search area of each image, so that we don't have to swipe the search window for the whole image for human candidates. Hopefully, I can find the best way to implement the blob detection with other constraints to find all human candidates in an image accurately, which can effectively reduce the time complexity of our algorithm.

5、Reference

[1]. N. Dalal and B. Triggs. Histograms of oriented gradientsfor human detection. Computer Vision and Pattern Recognition (CVPR), 2005. 1

[2]. http://www.telecom.ulg.ac.be/research/vibe/doc2/index.html

[3]. http://vision.eecs.ucf.edu/news/Reilly_ECCV_2010_Geometric.pdf