Team F: Rescue Rangers

Juncheng Zhang

Teammates: Karthik Ramachandran
Sumit Saxena
Xiaoyang Liu

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1、Individual Progress

1.1、Overview

In the last week, my primary role was finalizing the requirement of our power distribution system. Based on the requirement, I carefully designed the structure of our system, including two subsystems with voltage regulation and protection circuits.

Also, I started to do some literature study about human detection last week. After reading several papers, Xiaoyang, who also takes charges of developing human detection algorithm, and I narrowed down our implementation to two possible approaches. One is the linear SVM(support vector machine) trained on HOG(Histogram of Oriented Gradients). The other one is the pure computer vision algorithm without using machine learning technique. We will go deeper in these two methods next week and try to implement the basic algorithm before the next Progress Review.

1.2、Conceptual Design for PDS

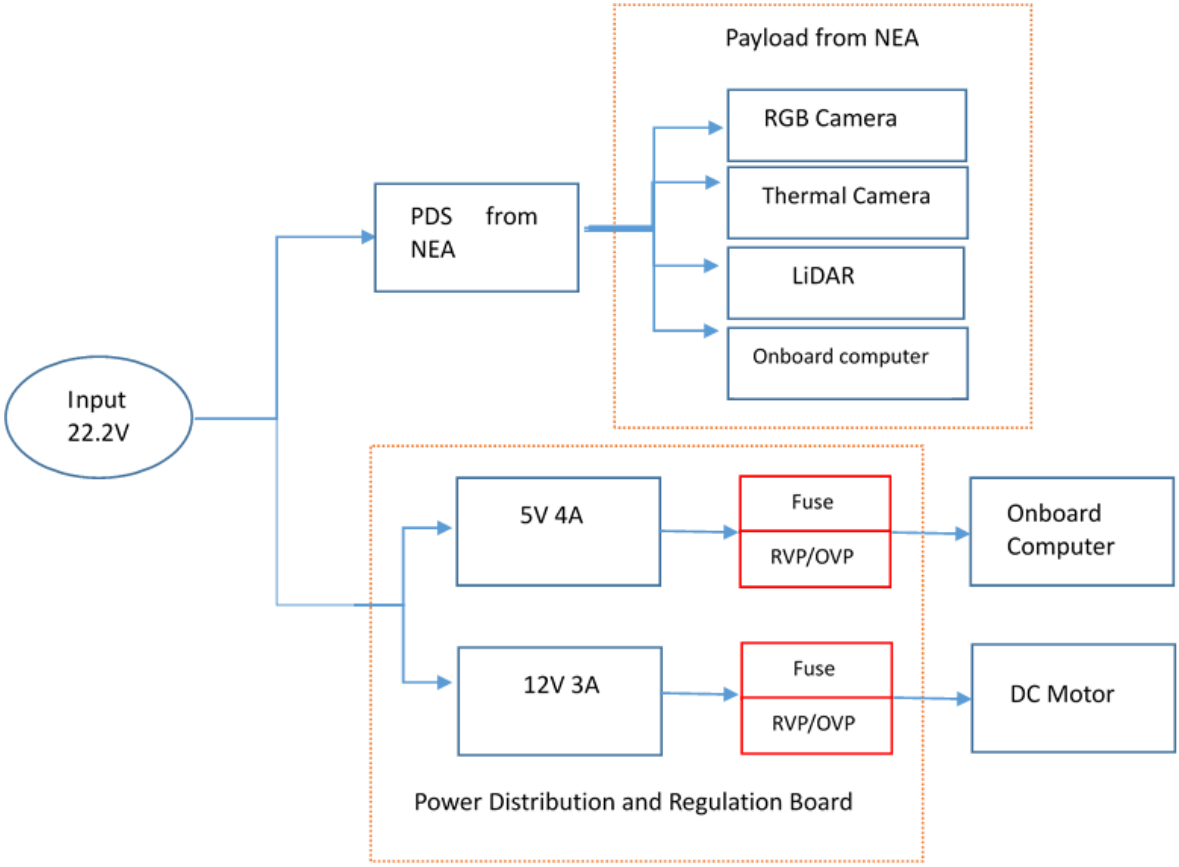

Figure1 Conceptual Design for PDS

Above is the conceptual design for our power distribution system. The input is from the battery of Matrice 600, whose voltage output is 22.2V. More specifically, the battery model is TB475, and its type is LiPo 65, with 4500mAh capacity. This battery actually provides electric

power to both the payload provided by our sponsor and our designed payload, which is used in human sound detection as well as controlling the actuator for dropping the rescue package.

The main power need of our aerial system is the payload provided by Near Earth Autonomy, including a RGB Camera, a thermal camera, a LiDAR and an onboard computer. The power distribution system is also inside the payload, which means the team doesn't need to be concerned with that. Besides that, our system still need to power an onboard computer for storing data of the sound sensor and communicating with the DJI flight controller, as well as a DC motor to drop the rescue package.

In terms of the onboard computer, our initial idea is to use the ODROID-XU4, whose required voltage is 5V and its rated current is 4A [1]. Because of that, our subsystem is designed to satisfy this requirement. With regard to the DC motor, we haven't finalized the model yet. However, I can still design this subsystem by searching the requirement of possible model types. As 12V and 3A output is able to drive most 12V DC motors, the subsystem for DC motor is designed in this way.

The protection circuit which can protect against short circuits, overvoltage, and reversed input is required to both subsystems. Also, our system includes 2 status leds to show whether the protected supply for each subsystem is operating.

1.2、Literature Study About Human Detection Algorithm

For most object detection problem, machine learning is always a feasible approach. The difficult part is what kind of feature you plan to extract from the image for your specific purpose, and what kind of classifier is to be used for fast and accurate detection. For our aerial system to detect human signature using RGB camera, linear SVM based on HOG seems to be a feasible approach [2]. The reasons for that will be illustrated as below.

In terms of our case, the image is taken at a high altitude. As a result, human face is almost impossible to be recognized in an image, which makes face detection using haar cascade unachievable. On the contrary, the Histogram of Oriented Gradients(HOG) detectors not only can extract features of human faces, but also can detect features like limbs, shoulders and etc. Because of that, if enough aerial images about human are given for training sets, it is feasible to use a simple linear SVM classifier to detect human beings. Details about implementation and result of this approach are in this paper [3].

Furthermore, I also think about another approach without using machine learning algorithm. Since sometimes we can only see human's head in an image, a blob detection can have a good performance in this scenario. In other cases, if a human wears a red shirt, then simply a color segmentation would work. The feasibility of these approaches still need to be reconsidered after more research.

2、Challenges

The main challenge I faced last week was to narrow down all possible solutions of human detection. There are many detection methods that can be used for detecting human presences, like face detection, blob detection, motion detection and so on. Each of these methods all have huge amount of algorithms, and it is impossible for me to look at all of them. However, in our case, these implementations all have their limitations. For example, a person may not be facing the camera, hence detectors that use features for face detection may fail in such cases. Also, a person may be sitting without significant movement, so motion based detectors may not work.

After discussing with Prof. Narasimhan, who is the professor of my computer vision class, I seem to have possibly right approaches to our problem. He confirmed that if appropriate and enough training images were given, Histograms of Oriented Gradients for Human Detection would work in our application. Apart from that, he suggested me to look for non-machine learning approaches since some information of our target human might be given. If we could figure out the way to detect these information, this method would be more accurate and robust than the machine learning method.

3、TeamWork

After Progress Review 1, our team discussed the plan for the next week, and broke the work down as follows:

Table3 Work distribution form

Member	Work
Karthik Ramachandran	Intermediate GPS waypoint generation based on locations of interest.
Sumit Saxena	Basic UI for specifying locations of interest.
Juncheng Zhang	Conceptual design for PDS; literature study on human detection
Xiaoyang Liu	Schematic design for PDS; literature study on human detection

The team worked with great coordination during execution of the entire task. Since we were not able to get real hands-on experience on the drone, our initial plan about working on waypoints navigation through DJI simulator had to be delayed. After team discussion, we quickly figured out what we could do instead, and each of us did a good job.

4、Future Plans

Before the next Progress Review, we are able to get our purchased drone. As soon as we get that, we will assembly it and test it using the simulator. Also, we plan to work on waypoints navigation using DJI SDK based on GPS locations. If everything goes well, we are able to test the drone on the external site.

Except for that, Karthik will finalize the type of the microphone and write programs to test its ability. Sumit will continue to work on basic UI for specifying locations of interest.

Xiaoyang and I will finish the literature study on human detection algorithm and decide two different approaches to solve our problem. We will collect some aerial images about human beings if we test our drone outdoors. When enough samples are collected, we could implement the basic Histograms of Oriented Gradients for human detection. Additionally, I am also in charge of modifying the schematic of PDS and designing the layout for that.

5、Reference

[1]. http://www.hardkernel.com/main/products/prdt_info.php?g_code=G143452239825
[2].http://www.pyimagesearch.com/2014/11/10/histogram-oriented-gradients-object-detection/
[3] N. Dalal and B. Triggs. Histograms of oriented gradientsfor human detection. Computer Vision and Pattern Recognition (CVPR), 2005. 1