

Team F: Rescue Rangers

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1、 Individual Progress

1.1、 Overview

Before the recent Progress Review, my primary role was designing an algorithm to detect potential human candidates in an image. I tried two different methods to solve this problem, which are blob detection and edge detection. Both results turn out to be satisfactory, while the edge detection has slightly better performance than the blob detection, in terms of several image samples I selected. But eventually, I plan to combine both methods to make our detection system more robust.

Additionally, my teammates and I tested the mobile SDK based waypoint navigation at the lawn in front of the Hunt library. During the test, the drone successfully navigated to several waypoints which we set in advance. And we will further work on that to find out a method to measure that the drone reaches the exact GPS locations.

1.2、 Blob detection method

Basically, the blob detection can find interest points in an image, which differ in intensity compared with surrounding pixels. The high level steps of this method are shown below:

1. Apply Gaussian filters with different values to create a Gaussian Pyramid.
2. Apply Difference of Gaussian for edge suppression.
3. Detect local extrema in both scale and space, which are interest points of an image.
4. Use Dilate and Erode operations to connect adjacent interest points.
5. Find connected components, which exceed a minimum number of pixels.
6. Rule out several possibilities based on the shape of connected pixels.

To better show the performance of this algorithm, I will take an image as an example.

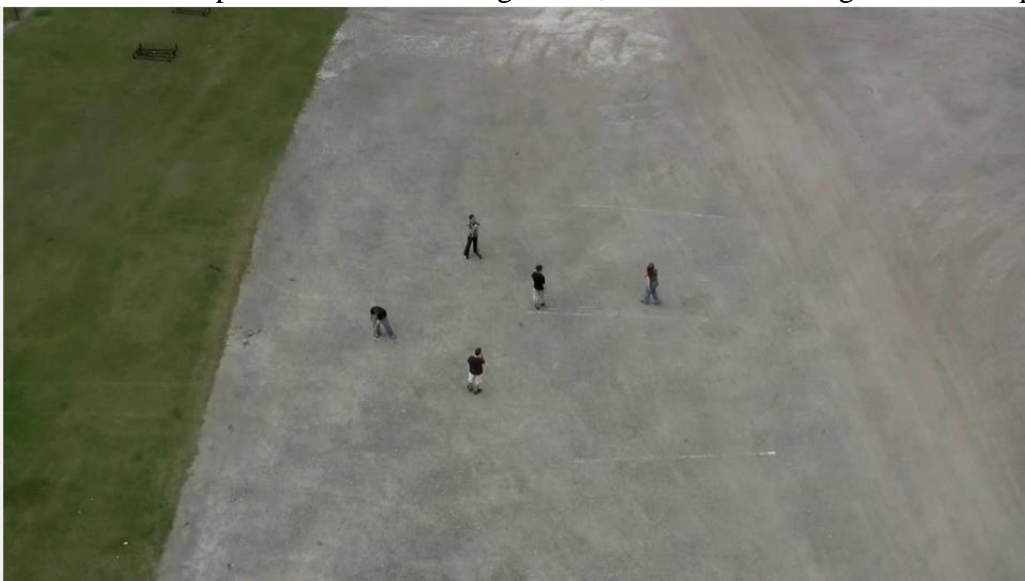


Figure1 Sample image

After the first three steps, the interests points found in the image are like:



Figure2 Sample image after blob detection

After dilation and erosion, the result becomes:

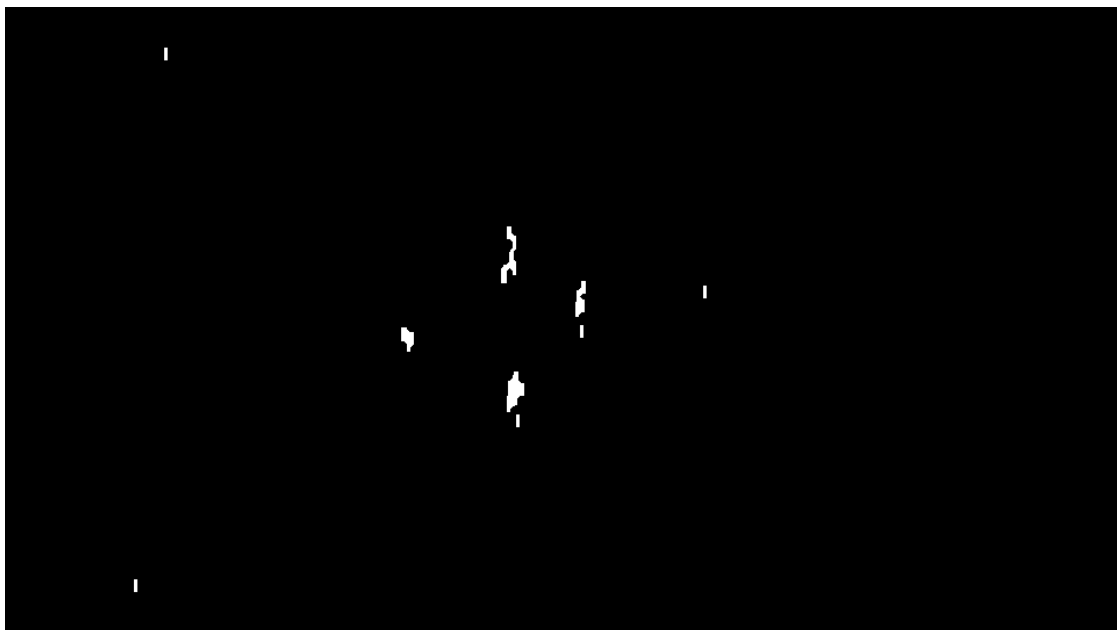


Figure3 Sample image after dilation and erosion

Then, after step 5 and 6, all connected components are detected, and some incorrect possibilities could be ruled out based on shape and size of the connected pixels. The final result is shown below:



Figure4 Result of blob detection method

From the figure above, we can see that it can detect most of the human beings in an image. However, if there are not enough interest points on the human in the image, that human may not be detected, just like the failure case in the sample image.

1.3、 Edge detection method

The idea of the edge detection is straight forward, and the steps are shown below:

1. Use Sobel method for edge detection[1].
2. Use Dilate and Erode operations to fill the inner areas of edges.
3. Find connected components which exceed a minimum number of pixels.
4. Rule out several possibilities based on the shape of connected pixels.

Using the same sample image, the result of sobel edge detection is like:



Figure5 Sample image, after sobel edge detection

After dilation and erosion, the connected components are like:



Figure6 Sample image, connected components

With the same method to rule out several incorrect possibilities, the final result of edge detection is shown below:

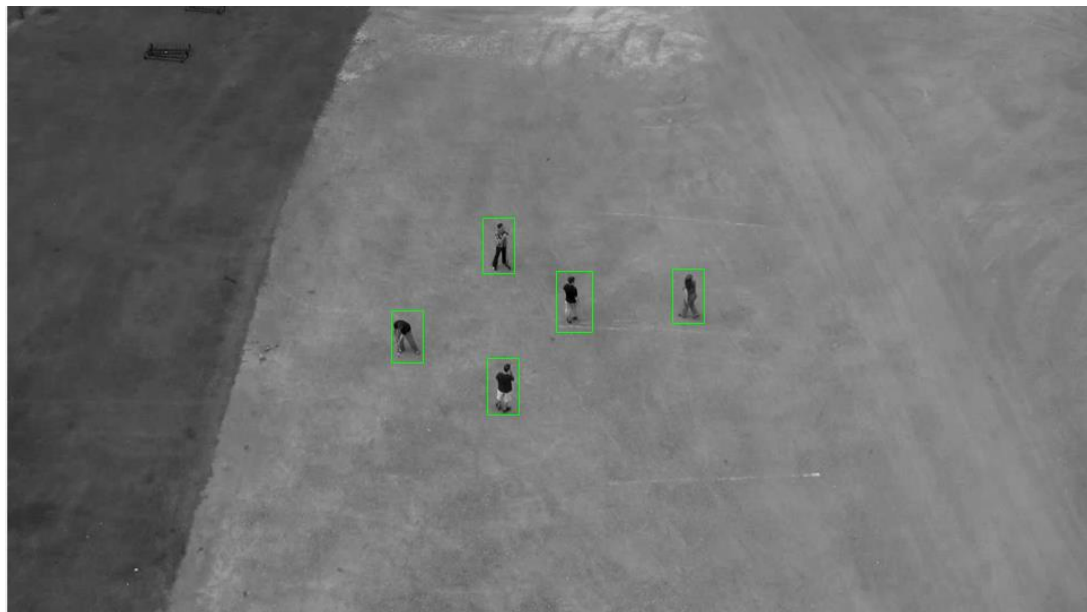


Figure7 Result of edge detection method

Compared with the blob detection method, the edge detection method has even better performance and is more stable when the human looks salient in the image. But when the edge of human is sometimes difficult to be detected, the blob detection can contribute at that time. In the end, I plan to combine both methods to make the detection system more reliable.

2、 Challenges

The main challenge I faced last week was to adjust the parameters of dilation and erosion in order to improve the performance of my blob detection algorithm. In the beginning, since I had no previous experience in using these two operations, I simply did several experiments to know how they can actually work. After that, I read some examples about using dilation and erosion. Among them, the example of detecting a cell using image segmentation [1] is really helpful. Also, it inspires me to use edge detection to find potential human beings in an image. Finally, in terms of the blob detection method, I used a bar shaped structuring element for dilation to connect interest points on a human, and a diamond shaped element for erosion to smooth the connected components.

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	Improve mobile SDK based waypoint navigation
Sumit Saxena	Design mechanisms for mounting a camera on the drone and for package drop
Juncheng Zhang	Develop an algorithm to find potential human candidates, using blob and edge detection
Xiaoyang Liu	Develop an algorithm to find potential human candidates, using background subtraction

The team worked with great coordination during execution of the entire task. After Karthik achieved mobile SDK based waypoint navigation on the simulator, all the team members went to the lawn in front of the Hunt Library and did the outdoor testing. We coordinated with each other and the outdoor test turned out to be very successful.

4、 Future Plans

Before the FVE, my work is to integrate the RGB based human detection algorithm. Currently, we have designed algorithms to find potential human candidates and an algorithm to classify whether the human candidate is actually a human or not, using HOG+SVM. The remaining work is to combine these two steps and design a good demo to show the performance of our algorithm. Also, I will work with Xiaoyang to solder and test our power distribution board as long as all required electronic components arrive.

5、 Reference

[1].<https://www.mathworks.com/help/images/examples/detecting-a-cell-using-image-segmentation.html>