

Individual lab report #11

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Individual Progress

- Complete migrating code to Python
- Processed Pipeline
- Improved detection algorithm by eliminating false positives

Complete migrating code to Python

This week, Juncheng and I finished migrating most of the MATLAB code to Python for human detection signature subsystem.

Components of signature detection subsystem are:

- Thermal signature detection
- RGB signature detection
- Integration algorithm
- Thermal and HSV Thresholding
- Interfaces

Right now, we have already migrated 4 out of 5 parts except for the thresholding part. We will resume doing it for the next a few days.

The migration result is shown below. The black box in figure 1 shows the detected human in both RGB and thermal images.



Figure.1 Result of RGB and thermal after migration

However, after we test the migration result on our latest video, we found out that there are too many false positives. Plus, we should effectively eliminate it since it will decrease the reliability of our system. So, we did some tricks on dealing with this issue. We discovered that false positives are randomly appeared, but human will be detected in consecutive frames because real human can be detected as humans continuously. To make it clear, let's say the output before eliminating

false positives as “raw humans”, and the result after the improvement as “actual humans”. What we want to do is to first determine whether “raw humans” are in the consecutive frames, and then to check the overlap between the bounding boxes of “raw humans” in two consecutive frames. Finally, the “raw humans” appear in two consecutive frames and overlap within a certain range will be saved. We went through this process bit by bit, until the video ends.

The result in table 1 shows that this method helps to reduce false positives effectively. But we still have some false positives in the beginning and the end of the video.

Table 1. The false positives before and after the improvement

	False positives (video clip 1)	False positives (video clip 2)
Before eliminating false positives “raw humans”	62	70
After eliminating false positives “actual humans”	4	5

Further improvement

Figure.2 shows the reported timestamps along with human locations generated by the improved signature detection system. The red ones indicate that they are real humans, and black ones indicate that they are false positives. As you can see, the black ones often appear in the beginning and the end of the video. So, one way to further improve it is to cut the video and process it again.

Another way to do it is to add thermal thresholding things. In the process of thresholding thermal images, we can eliminate the grass and other distracted objects by setting up pixel intensity threshold. If the thermal image of an object cannot be as warm as human, we can easily eliminate it by using the thermal thresholding thing.

9	14:54:57.45296	1442	675	H
10	14:54:57.161440	1413	664	H
540	14:55:58.717770	1232	581	H
574	14:56:2.666667	1152	427	H
575	14:56:2.782811	1190	421	H
576	14:56:2.898955	1197	430	H
651	14:56:11.609756	979	767	H
652	14:56:11.725900	975	792	H
653	14:56:11.842044	975	816	H
695	14:56:16.720093	1234	430	H
731	14:56:20.901278	950	1051	H
823	14:56:31.586527	522	607	H
978	14:56:49.588850	1587	803	H
1049	14:56:57.835075	1201	416	H
1108	14:57:4.687573	1619	176	H
1109	14:57:4.803717	1625	248	H

Figure.2 Reported timestamps along with human locations

Processed the whole pipeline

In order to do our end to end test, we need the integrated signature detection system to generate an output file in a format that can be fed to the next GPS estimation system. After discussing the conversion of the two system, we decide to design the output to contain the name of output image, the timestamp which corresponds to each output image, the pixel location of detected signature, and the type of signature ('H' represents for human, and 'B' represents for bright objects).

Also, as you can see in Figure 2, the reported timestamps along with human locations will be the input of the next subsystem: GPS location estimation subsystem. Right now, we haven't integrated the bright object detection into the Python version code yet.

This time I also added the visualization part (see figure3). Every detected human will be saved as picture with bounding box. In this way, we can easily see whether we accurately find a human or not.



Figure.3 The final visualization result

Challenge

The biggest challenge in this week is to eliminate false positives. The first time we test our integrated code on the latest video, there were too many false positives that will severely affect the reliability of our system. After debugging, we found out that many human shaped things (like grass and poles) are detected as humans. On one hand, our training set needs to be updated, since we were using many online images as our training set which is not very feasible in our case. On the other hand, we need to try to find more common features of humans, for example high temperature, and try to threshold the detected objects by using these common features. Right now, we will eliminate the false positives which will appear in intermittent frames, and save the “actual humans” showing in consecutive frames.

Team Work

This week, Karthik mainly focus on integrating things to the software and finetune the sound detection subsystem. Sumit works on HSV thresholding things in Python, and fixed the GPS coordinate mismatch stuff mentioned in the previous PR. Juncheng finished mitigating code to Python in both RGB and thermal signature detection, and help me do the eliminating false positive things.

Future Work

Next thing is SVE. We should show our whole end to end system in NREC at that time. So, during this week we should finetune our algorithms, and test our algorithms on the latest videos. We will try to fix things before something unexpected happens in SVE. For me, I will retrain our dataset, and try to achieve a higher accuracy on detecting humans in latest self-collected videos.