Individual lab report #4

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Xiaoyang Liu

Team F Rescue Rangers

Juncheng Zhang (Henry)

Karthik Ramachandran

Sumit Saxena

Individual Progress

- Did further exploration of human detection algorithm based on HOG and SVM
- Assisted Henry in finishing final PCB layout and BOM of power distribution system
- Tried a few methods to create suitable training set for the classification.

Further exploration of the human detection algorithm based on HOG and SVM

1) Overview of the algorithm

HOG [1]: A short term for the histogram of oriented gradients. It's a feature descriptor used in computer vision and image processing for object detection. The technique counts occurrences of gradient orientation in localized portions of an image. It's widely used in computer vision area because of its high accuracy of detecting pedestrians.

SVM [1]: The support vector machine (SVM) classifier is a binary classifier which looks for an optimal hyperplane as a decision function. Once trained on images containing some particular objects, the SVM classifier can make decisions regarding the presence of an object, such as a human, in additional test images

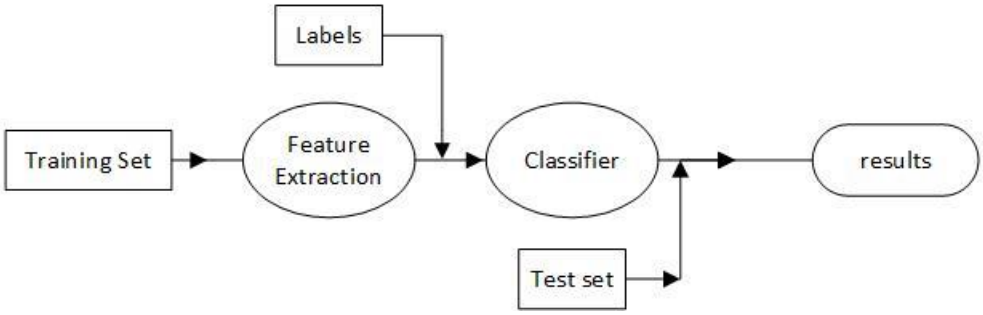

Figure.1 Overview of the human detection algorithm based on HOG and SVM

Above is the general idea of the human detection algorithm based on HOG and SVM. First we will give each image in the training set a positive or negative label and extract their features by using HOG algorithm. Then we use the labels and the calculated HOG feature descriptors to train a classifier based on the SVM algorithm. After that we utilize the trained classifier to classify our own test images, and eventually get the classification results showing the ratio of the accurate classified test images and the total amount of test images.

2) Examine the accuracy of output result

Table.1 Classification result

Train| Test	Positive	Negative
Positive	404	49
Negative	180	946

Above is the classification result of 1579 pedestrian images provided by INRIA Person Dataset [2], the same as it was used in CVPR 2005 paper: Histograms of Oriented Gradients for Human Detection[3]. As it shows in Table.1, the total number of images that are correctly classified is 404(positive) + 946(negative) = 1350. Therefore, the total accuracy is 1350/1579 = 0.85

PCB layout and BOM of power distribution system

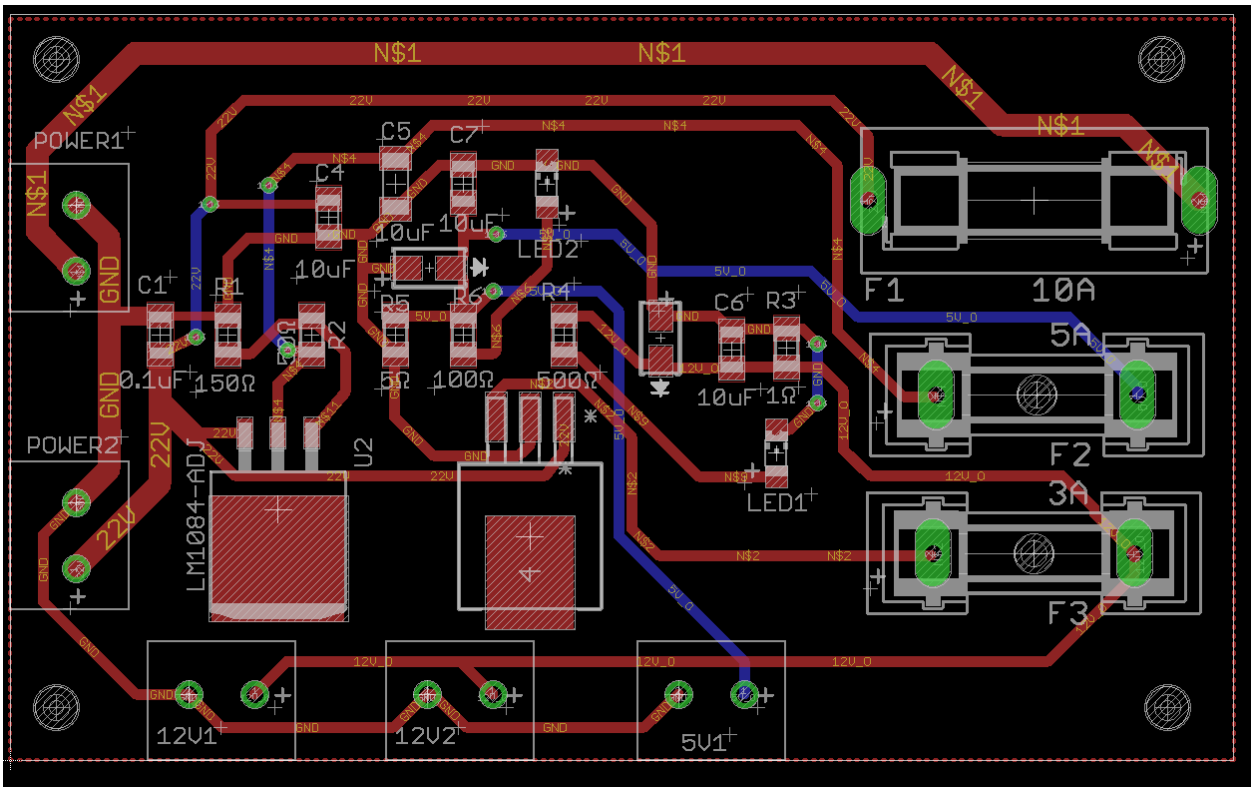

Figure 2. Final PCB layout for power distribution system

Above is the final PCB layout for power distribution system of TeamF. Henry was responsible for drawing the layout this time, and since I made the schematic last time I had to modify the packages of some components. In order to be more unified, I chose to use 1206 SMD packages for almost all the capacitors and resistors and used a terminal block connector instead of the

original connector. Hopefully, those changes can make it easier for soldering and making connections with peripheral devices. Also, I helped Henry checking the wire width in accordance with current magnitude. Finally, I verified that each component in the board is approachable, and finalized all the vendors and manufacture numbers in the BOM file.

Create suitable training set for the classification

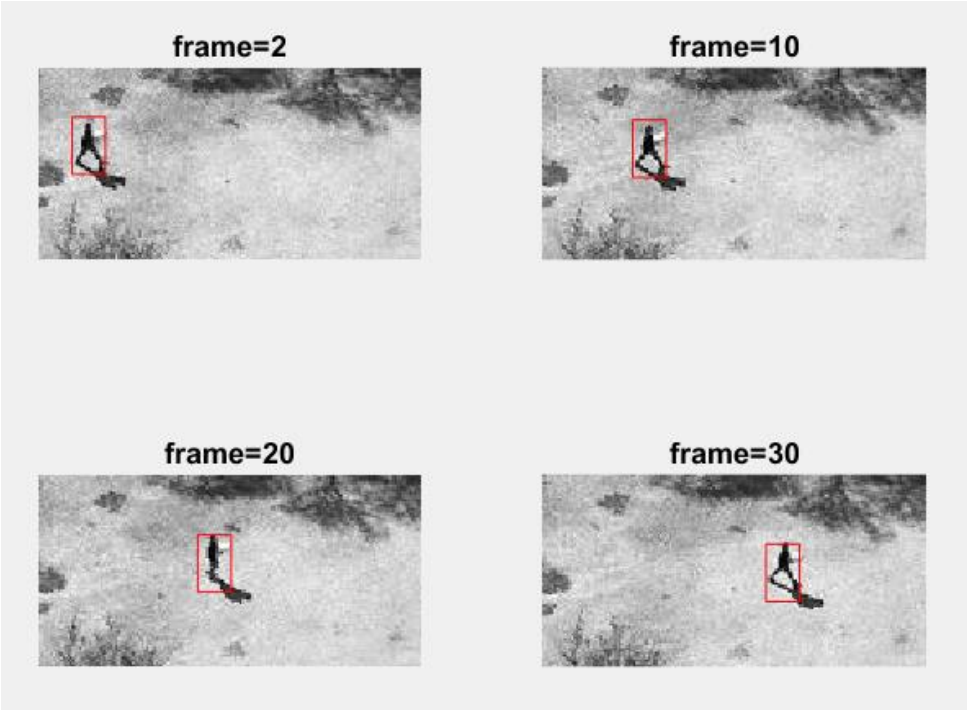

Figure 3. Using Lucas-Kanade to track humans in aerial images

Figure 4. Cropped image in a tracking rectangle

As I mentioned in the previous ILR report, it's not an easy task finding existing aerial dataset on the Internet. So, I tried to create an aerial dataset for training purpose. First I converted some aerial video clips into frames of images, and then cropped human beings in those images. I used improved Lucas-Kanade algorithm to first track human beings in the images and then generate a

tracking rectangle (see Figure 3). Second, I collected sets of cropped images in the rectangle, which is shown in Figure 4.

Right now, I've got approximately 1000 aerial images and created nearly 200 cropped human images by using this method.

Challenge

- Although it went smoothly when examining the performance of HOG algorithm on INRIA person dataset [1], it didn't work fine with the aerial images collected directly from aerial video clip. I thought that maybe it's because that the images contain too many other features besides humans, which makes the classifier not exclusively be applied into detecting humans. Therefore, after collecting frames of images from the video clips, I tried to crop person in each image and create another set of training images with only humans in it.
- Also, when we finished the final PCB layout for our power distribution system, we tested it on FreeDFM.com and got a feedback on a redundant soldermask issue. We couldn't figure it out at first, but after checking the "Stop Layer" we found out that the footprint of one of our voltage converter seemed to have an extra soldermask, and we need to eliminate it to get the final PCB layout.

Team Work

Juncheng(Henry) devoted most of his time drawing the final PCB. As we decided to do manual routing this time, it took a long time for him to accomplish it professionally. Plus, he also did some research on other human detection algorithms besides HOG. Karthik worked on implementing waypoint generation V2 with localized pattern as well as doing the mobile SDK based navigation simulation. Sumit mainly focused on the onboard SDK, and did hardware and software setup for Odroid XU4.

Future Work

- I will continue to focus on human detection algorithm implementation based on HOG and SVM. I will examine different training as well as test set in order to get a better accuracy in aerial cases, since our goal for FVE is to get an expected output of detecting humans in at least 60% of the images.
- Because videos taken from flights usually cover the range which is too large for us to see the shape of humans, and thus we need to explore ways to process aerial images so that we can obtain better test images. The basic idea here is to use background subtraction techniques to detect moving objects and capture human and crop the whole image into a set of human-like images. Therefore, we can only analyze test sets which might have human filled with the entire image.

Reference

[1] https://en.wikipedia.org/wiki/Histogram_of_oriented_gradients

[2] http://pascal.inrialpes.fr/data/human/

[3] Navneet Dalal and Bill Triggs, Histograms of Oriented Gradients for Human Detection, Computer Vision and Pattern Recognition, 2005. CVPR 2005. IEEE Computer Society Conference on, vol. 1, pages 886 – 893 IEEE, 2005