

Yihao Qian

Team A: Aware

Teammates: Amit Agarwal Harry Golash

Menghan Zhang Zihao (Theo) Zhang

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## Individual Progress

During the last week, I was in charge of integrating stereo vision and object detection system.

### Stereo Vision & Object detection sub-system integration:

The requirements for stereo vision system & object detection system:

1. Object detection system should provide the bounding box and position of the interest objects (Pedestrians and vehicles)
2. Stereo vision system should achieve more than 80% accuracy on depth measuring
3. The integrated system should draw the bounding box of the object on the depth map.
4. The integrated system should output the depth information of the object and show it on the map.

At this stage the system can achieve requirement 1,2,3,4. I finished 2,3 with Zihao during the last week.

We switched from ELAS to SGBM to increase the speed of our system. Before switching to SGBM, ELAS worked on single thread, it would take us a long time to compute the disparity map of one image. After switching to SGBM, the speed increases.

However, each coin has two sides. There are several disadvantages.

1. Decrease of density of disparity map: ELAS is a dense algorithm that could provide dense disparity map, which means that there are less holes in disparity map compared to SGBM. Also, ELAS provides much smoother result compared to SGBM. You may find the original image and SGBM's disparity map in Figure 1 & 2.
2. Decrease of accuracy of depth map. Given a bounding box, at this stage, we extract all the depth value in the depth map and compute a predicted depth value of the object. If there are a lot of noise in the bounding box, we may predict wrong value.

We are still trying to solve this problem. We are planning to add some filtering on the disparity map. If there was not a huge improvement in disparity map, we will try to find out a more reasonable depth predicting function.

Integrating our system needs huge effort. Zihao and I spent whole week trying to integrate the system together. We first tried to use SGBM ROS package, but we soon find out the depth information that the stereo vision provides is not correct. We found out the disparity map seems correct but the depth value was not correct. The

depth value stayed the same no matter where the pedestrian was. Comparing with the SGBM code I wrote at the beginning of this semester, we found out this error was due to the format changes in disparity map. After changing to correct format, the stereo vision system seemed to provide correct depth value.

However, the depth value contains a lot of noise, we could barely get the depth value of the pedestrian. Even we could get the depth information of pedestrian, the depth value usually varies a lot. At this stage, we eliminate extremely small value and infinite depth information in the map.

## Challenges:

### System integration:

As I mentioned before, we need to satisfy very strict requirements. Even each of the sub-system works well individually, it does not mean that the system could run perfectly as a whole. I think the main limitation is ROS, ROS does not guarantee real time operation. That is the reason why our integrated system has almost 1s latency.

I am think whether we could descope the project, right now the system works at 1 FPS and the system has almost 1s latency. I am afraid that velocity of the object we computed is not correct.

## Teamwork:

During the past weeks, Zihao and I set up the system and integrated the stereo vision system with object detection system. Menghan built visualization tools for depth measure. Harry and Amit worked on filtering the data from radar.

Name	Teamwork
Yihao Qian	System set up, changed from ELAS-CPU
Zihao Zhang	Stereo vision node set up
Menghan	Visualization node set up
Amit	Set up radar and filter radar data
Harry	Set up radar and filter radar data

In the next week. We will integrate object detection system with radar system. We will first filter the data from Radar, and integrated the vision and radar system together. I am planning to work on the second part. Zihao is going to set up GPS node. Menghan is going to combine object detection system & stereo vision system with object tracking system.

**Figures:**



Figure 1. Left camera image



Figure 2. Disparity map