Individual Lab Report 6

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1. Introduction

This report gives a brief description of our team progress along with my individual contribution so far towards the MRSD project. After our last progress review on November 19, 2013 before the winter break, I did trade studies on Wi-Fi cameras and IMU sensors that will be used, and also simplified our PDM board and tried to develop image comparison program in Python. This semester I will be focused on the electrical side and the visualization system of the robot, which is detecting the April Tags for localization and also doing inspection using image comparison. I will also help the team for building new attaching mechanism.

2. Individual Progress & Challenges

2.1. Power Distribution Board Simplification

One of our goal this Spring semester is to minimize and eliminate the weight of the robot. While the other team members working on designing the new mechanical parts, I am responsible to minimize our PDM board into a half. I eliminated these parts:

Current PDM	Simplified PDM
2 Power Channels Input	1 Power Channel input
2 Servo channels Output	1 Servo channel output
3 Peripheral channels output	1 Camera channel output

By eliminating unused channels, the new board design can be seen in figure 1. However, I am still working on looking for the smaller fuses with smaller current rate since we realized that we can use smaller fuse to optimize our PDM design. Adding capacitor for battery monitoring channel is also necessary to reduce noise.

2.2. Trade Studies on Wi-Fi Cameras

One of our goals for this spring validation is to make the robot able to read the tags on the wall to identify its location. Hence we need to implement visualization system on the robot, which using camera. We chose using wireless camera to make it less complicated with the communication system. Based on the needs, the cameras must have requirements:

- Able to connect using Wi-Fi,
- Do a live-stream video,
- At least have 640 x 480 video resolution,
- Light weight,
- Can be accessed using Linux Ubuntu PC platform
- Can be powered with no more than 7.4V supply.

There are 7 cameras that are likely to be our best options:

1. 27X Optical Zoom 1/4 inch Sony Color CCD
2. EasyN FS-613A-M136 Wireless Wi-Fi Pan/Tilt IP Camera
3. Wireless/Wi-Fi Network IP Camera 3x Optical Zoom PTZ Security
4. Cloud Camera 1050, Day Network Cloud Camera
5. Belkin NetCam Wi-Fi Camera with Night Vision Network camera
6. Belkin NetCam HD Wi-Fi Camera with Night Vision Network camera
7. EasyN 2-Audio Wireless Wi-Fi IP Camera IR Night Vision

Currently our best option is number 6 which has the best resolution and with reasonable price (only $80).

2.3. Trade Studies on IMU Sensors

For getting feedback on direction and transition speed, the robot shall have IMU sensor. Hence, I did some trade studies on IMU Sensors. There are 12 sensors as our options:

1 IMU Digital Combo Board - 6 Degrees of Freedom ITG3200/ADXL345
2 MinIMU-9 v2 Gyro, Accelerometer, and Compass
3 10 DOF Mems IMU Sensor
Kootek® Arduino GY-521 MPU-6050 Module 3 axial gyroscope
4 accelerometer stance tilt module
5 9 Degrees of Freedom - Razor IMU
6 DIYDrones ArduIMU+ V3
7 IMU Fusion Board - ADXL345 & IMU3000
8 Digital IMU Breakout - IMU3000
9 9 Degrees of Freedom - Sensor Stick
10 Triple Axis Accelerometer and Gyro Breakout - MPU-6050
11 ArduPilot Mega - Arduino Mega compatible UAV Controller
12 UDB5 - PIC UAV Development Board

We have not decided which IMU sensor that is the best option for us, but the IMU shall have this requirements:

1. Have 3 axis of Gyro's measurement: x, y and z axis with at least $10°/\text{sec}$,
2. Can be powered with less than 7.4V supply,
3. Have accelerometer that can measure at least 2g .

2.4. Image Comparison Program using Python

As the first step of robot's visualization, I've been working on the image comparison algorithm using python. The idea is calculating two images' histogram, and then compare them to find if those images are identic or not. Hence, while building the code, when inserting the images as the input, there was an error "Object's array is too deep". I have resized the image until its size went as small as 10x10 pixel but I still got that error. For the future work I will debug the code.

Challenges and Things I have learned

The main challenge during the trade study of the Wi-Fi cameras is there are so many options and lack of information about their usage for robotics application or in Linux Ubuntu. Most of the Wi-Fi cameras in the market already have specific application on Mac, Windows, and mobile platform. This can be an issue if the camera is unable to access to Linux due to the unavailability of the drivers. Learning to connect the camera wirelessly and extracting the video and images using python will be a huge challenge in the future.

3. Team Work

I worked with Nate to simplify the PDM board. We eliminated unused power channels and shrank the size of the board. Nate also worked on the design and fabrication of the new gearing system using MakerBot.

Brian mostly focused on the software design, reorganized it so that it can be expanded in the future. He also designed user-friendly GUI by putting buttons with simple commands such as "Turn Left" or "Turn Right". Songjie gave some input about new attaching mechanism and also worked with Brian to do fabrication using MakerBot.

4. Plans / goals for following week

For the PDM board, I will work with Nate to make the size of the board smaller and choose the most-effective fuse for the channels. We will also buy a camera and the IMU sensor in the following week and will test them. My primary focus will be continuing my work on the image comparison programming and once the camera arrives, I will test to collect image from the camera in Linux. I will also work simultaneously with the other team members to design and build the new attaching mechanism using MakerBot.

5. Figure(s)

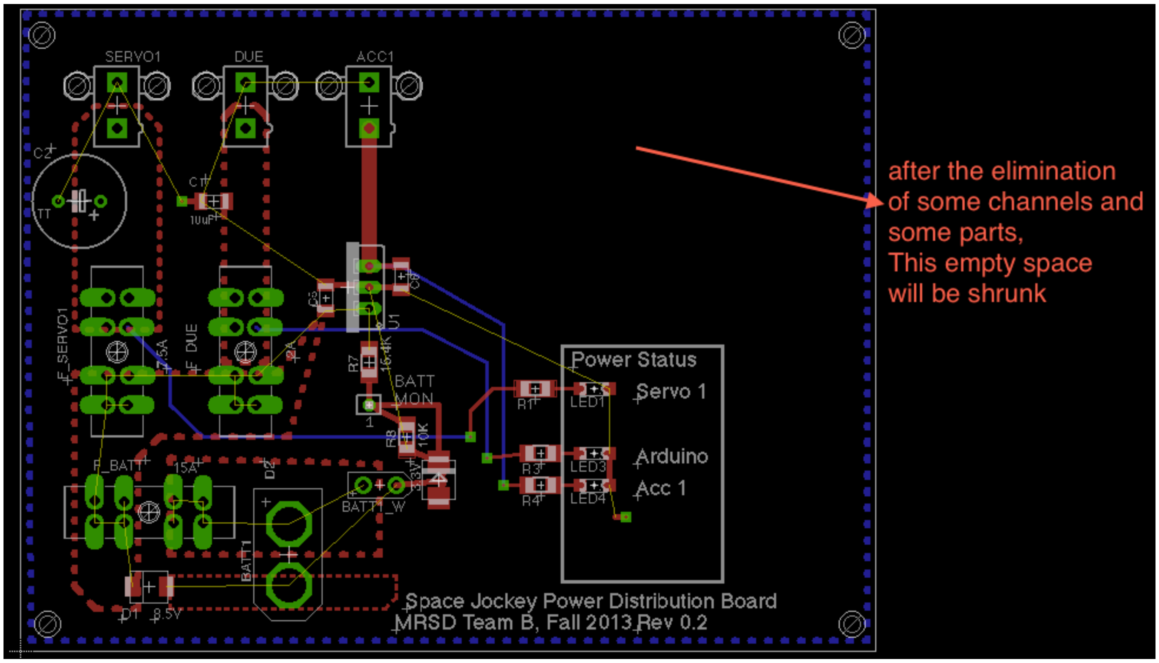

Figure 1. Simplified PDM Board