EE 491 Senior Design Group Meeting

Safe Communication Between Lead and Following Vehicle

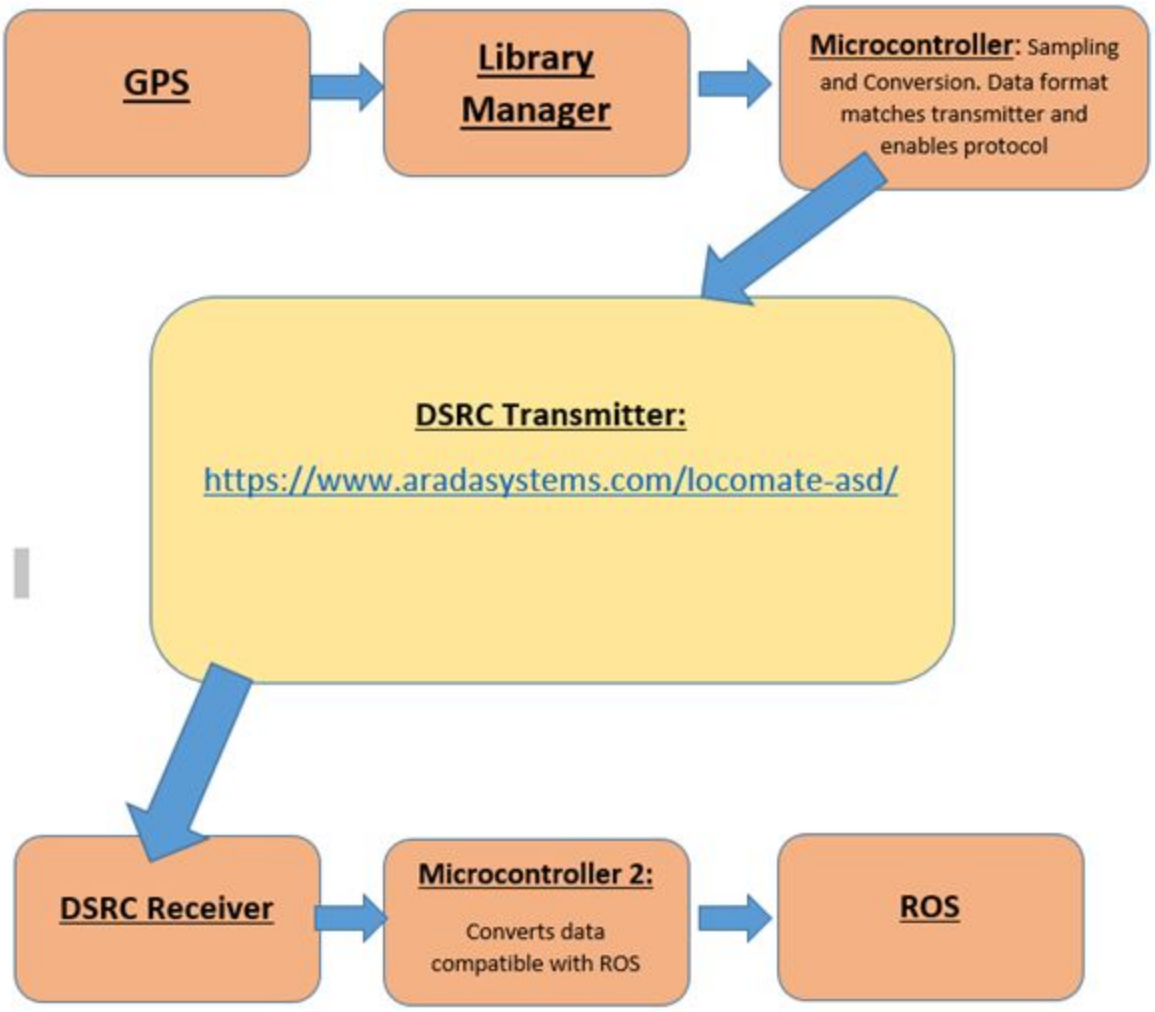
Week 7 Report

Team Members:

Bradley Stiff- Software Lead, Project Lead
Justin Wheeler- Software Lead
Sanguk Park- Scribe Lead, Communication Lead
Zhize Ma- Scribe Lead, Hardware Lead
Junho Chun- Hardware Lead
Yifan Lu- Hardware Lead
Jose Candelario- Project Lead, Communication Lead

This Week Accomplishments:

For this week, we had a group meeting with Vishal, our project lead and discussed our project's progress with the other groups. Our group has originally decided to use a DSRC transmitter, but due to heavy budget prices and being a government regulated device, we chose to choose a frequency smaller than the DSRC's 5.9 Ghz and create a transmitter device that can emit a 5.0 Ghz wave. Even though the frequency is smaller and only can achieve shorter distances regarding direct communication, we can implement a device that we can program to have the correct data format for the data transmission into the ROS. Our original diagram for our transmission plan is shown below:



Even though we cannot obtain a specific DSRC transmitter that emits a 5.9 Ghz frequency, we decided to implement a microcontroller that is dedicated to transmitting data over elongated distances. Although the frequency is limited to 5.0Ghz, we realized after meeting with Vishal, that our testing procedures for the following car will only need a maximum direct data transmission range of 200 feet. The other important thing with the meeting was that our data transmission format should be in NEMA format which is the standard format for GPS transceivers. For this implementation, we decided to initially use Raspberry Pie, but instead we turned to a microcontroller called Xbees.

The transmission process that is shown above will be roughly the same, but instead of the DSRC transceiver, plan on using the Xbees transceiver microcontroller for the data

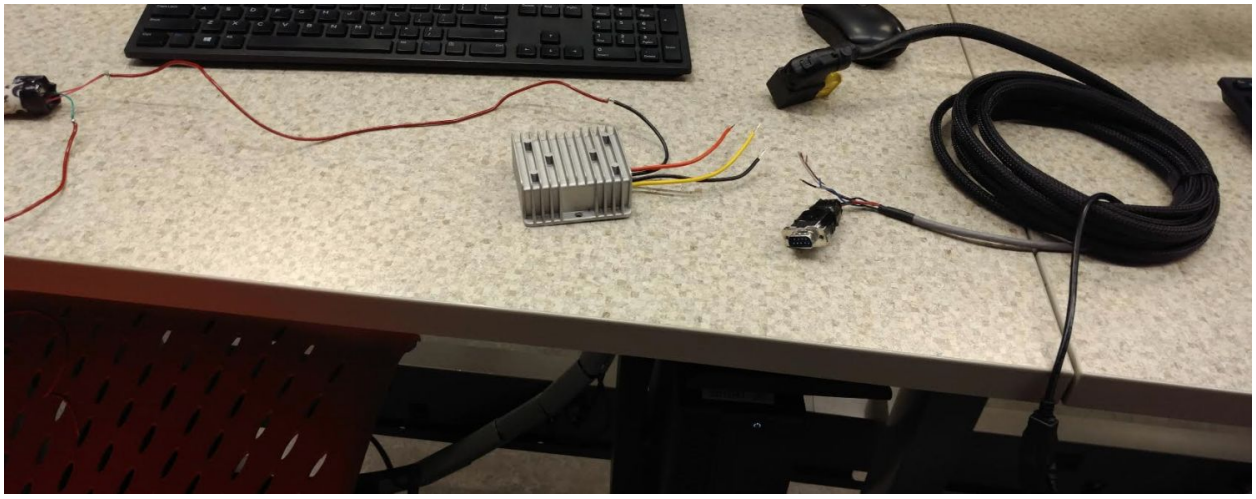
transmission. We ordered two models of the Xbees, where one will be attached to the lead car and the other will be attached to the following autonomous car. Our group did not have a clear idea of how or what specifications the GPS had until this week, but after knowing what certain model we were considering for our GPS, we found out that there will be 2 GPS systems where 1 will be attached to each car. The GPS system will have a default data output called NEMA, which is as mentioned before, the standard format for all GPS transceivers. Knowing this, our group had a much general idea of how the GPS will operate on the car. Since our group was solely responsible of data transmission of the car locations (in XY coordinates or longitude and latitude) it was critical for us to know how the GPS will function. Our group plans on following these steps in order to operate our transceiver:

- We ordered two models of the Xbees to implement into each of the leading and following car so that both the lead and following car can transmit and receive data
- Using the Xbees, we will connect each transceiver to the GPS attached to the cars.
- The data from the GPS is sent to the Xbees in the NEMA output format.
- The NEMA data format that is sent to the XBEES is then converted to ECEF format which is a coordinate transformation format
- The ECEF format is sent to both the controls group which tracks the trajectory of the lead car.
- The following car receives the data from the Xbees device in ECEF format which is translated back to NEMA format and then sent to the GPS of the following car

Through this method, we can get both transmit and receive data that is output by the GPS and cause little room for error. This method is important for making sure that the data that is both sent and received is consistent with the GPS.

The Radar

The hardware group was responsible for setting up a central power system for the radar and making sure that the radar data transmission wire could both power the radar itself along with the DB9 male connecter to output the data received from the radar system (ESR). We decided to have a central power system of 12V with a DC-DC buck converter of 12V->24V to power the radar. Since we were installing all of the hardware onto a car, we decided to use the car's 12V power system to power all of the hardware, and use any DC power converters to match each of the sensor's power supply. The radar among the sensors used the most power which was 24V in which we implemented in the picture below. It shows the central power source of 12V connected to a buck converter for the radar. This can be extended to power the rest of the sensors.



Individual Contributions (10/7~10/14)

Team Member	Contribution	Weekly Hours	Total Hours
Brad Stiff	Uninstalled ROS Lunar and Installed ROS Kinetic. Researched long distance connections between 2 Raspberry Pis and Raspberry Pi and the NVidia PX2. Researched LoRa before Xbees was found.	4	27
Jose Candelario	Researched more on the DSRC as well as Xbee. Ordered two Xbee pros as well as the USB dongles for them.	5	37
Junho Chun	Looked for possible way to transmit data to GPS and went to INTRANS to test GPS to transmit.	3	22
Justin Wheeler	Dual booted with Ubuntu 16.04 to simulate NVidia PX2 and re-installed ROS Kinetic. Researched GPS UART data and rented a RPI 3 to test out installing ROS on it. Also researched Xbees for new possible solution.	6	22
Sang Uk Park	Connected the Radar to a proper power connector to be able to receive data. This will allow us to look at the input coming in and use it as appropriately.	4	28
Yifan Lu	Looked into details about how Xbee pro series work and their corresponding specs. Also looked into	3	24

	microcontrollers such as Arduino to modify the source data.		
Zhize Ma	Research and understand possible way to transmit GPS data. Understand DSRC	3	23

Goals for Next Week

We will have to look around and contact sellers regarding DSRC devices and make sure we have a reasonable budget when purchasing one. We should also keep on searching for alternative methods for transmission devices even though it may not be a 5.9 Ghz frequency as the DSRC. As long as it can satisfy the range and data limit aspect, we believe that those alternatives are more than valid.