Technical Journal

Week 09/05/21

The first week was primarily focused on group formation and planning. We as a team setup communication and bounced ideas amongst each other for a final project proposal. This included determining what was feasible for our collective skillsets. Individual introductions took place to share experiences and get a background for the project.

1. Meet and great
2. Communication setup (Microsoft teams/ for chat and file share)
3. Schedule weekly meeting
4. Project options and discussion

Week 09/12/21

The 2nd week after group formation marked the project decision and project proposal. We discussed our project idea amongst our professor for approval and looked at any contingencies. Amongst this discussion we ran into another group full of CS planning to do the software and app side of the project. The professor and project sponsor approved of a group of 9 working together to accomplish this goal.

1. Project decision
2. Project approval
3. Larger group formation
4. Resource (innovation campus Coach)

We decided to do the smart park system. This will indicate what stalls are occupied or vacant across college campus. It will also notify students and faculty what parking lots are completely full. This will save a lot of time and increase college campus traffic, efficiency, and convenience. We believe this is marketable across university campuses as parking is commonly a challenge. Increasing campus accessibility will also increase student enrollment and retention. We’ve decided to use 2 types of sensors to mitigate 1 point of failure. Further research is needed to decide what sensors to utilize. As of now we believe an inductive loop will be 1 of the 2 sensors.

Components

1. 2 types of sensors (infrared and inductive loop)
2. Power (hard wired/ battery/ solar)
3. Arduino or Raspberry pi

Week 09/19/21

In this week we fully integrated with our CS counterpart to discuss and plan the electrical hardware in conjunction with the interfaceable IOS app. We tasked each EE team member with a research project and report deadline. Each EE member was to research a sensor for vehicle detection and provide why it would or wouldn’t be a good fit for the project.

During our report meeting we concluded that a magnetometer would be the most applicable sensor. We still have concerns that a 2nd sensor type would be needed to effectively complete our project. During this meeting, we created a basis for how the system will operate collect data and communicate. A magnetometer IC (integrated Computer) will be attached to an Arduino LoRa (Long Range) transceiver. This Arduino will be able to take the data from the magnetometer and send signals to a raspberry pi gateway. Each of our nodes/sensors will be configured to simply send a 0 when measuring the Earths magnetic field. When a disturbance is detected due to vehicle occupancy of the parking stall the Arduino will send an update signal of 1 in near real time to the gateway. We plan for all our sensors to be completely wireless and battery powered. The raspberry pi gateway will utilize a Rak 2245 LoRa hat which will allow the Raspberry Pi to receive data from the Arduino. This gateway will send updates to the cloud where the phone app will update and interface with the user.

Week 09/26/21

Hardware purchases were made to begin integration and testing. CS team is updated accordingly with statuses of shipping dates and arrivals. One team member already owns a magnetometer IC and the Arduino LoRa transceivers arrived. Configuration of the prototype is crucial and a high priority item. We will begin learning about Arduino setup and test for data collection and calibration of magnetometer. We have completed our project planning paper and our next tasks to accomplish are getting sensors configured and working and creating a live power point to prepare for midterm presentations.

I will begin to time stamp my entries for research and hands on efforts going forward. (09/29/21)

09/28/21

Start 4:30 pm

Met with Coach Allen and Phong (CS team lead) to discuss requirements for Midterm Presentations. We learned that Coach Allen already has a gateway setup in the go create parking lot. We will no longer need Raspberry Pi or RAK 2245 hat for gateway. Orders have been canceled and we will primarily focus on sensor configurations.

Had an over the phone meeting with Alex (EE member) to discuss how to split up content for group presentations. We discussed what content should or shouldn’t be included. I created a list from all the information gathered. From this list each EE member will pick the content to cover for the presentation.

After sharing the list and communicating with the EE team I began to configure the Arduino MKR WAN 1310. This device will be our transmitter for vehicle detection. Since I conveniently live across the street from the Go Create facility, I will be trying to send a signal to the Gateway from my apartment. I would like to have a dummy signal sent to the gateway that can simulate a state (true/false, 0/1) and a unique identifier by Friday 10/01/21. Downloaded software and drives for Arduino and didn’t have proper micro-USB needed for device detection and connectivity.

End 2:00 am

09/29/21

Start 9:30 am

Got some breakfast and ran to best buy to find a compatible micro-USB. All they had in the entire store was a PS4 game controller cord for roughly $10.00. I went home to test, and it was compatible. My laptop detected the Arduino. I will now work on setting up testing and begin to push for the dummy signal transmission.

10/03/21

Phong and I worked together to research and sync a LoRa module to the Go create gateway. This gateway is a Tektellic Kona Macro which is superior for providing LoRa infrastructure in outdoor environments. We successfully sent a signal to the gateway and was able to monitor/join our device to the IoT (internet of things) Network called Chirpstack. We did this by creating our own SmartPark application. We then manipulated code libraries and eui and app keys for connectivity.

10/08/21

We did research on LoRa compliance, and Lora requirements that we specifically would like to utilize for our data infrastructure going forward. We also educated our selves on the Lora regional parameters which include rules and frequency range of operation.

10/17/21

We planned for the next phase of the prototype which is to configure the module to sensors. This includes wiring, wire management, specific pin outs and utilizing code to collect or decrypt sensor data. We will also be implementing our power sources lithium Ion batteries and other options as well as a solar panel.

10/24/21

Our focus during this week was to wire our sensors to our LoRa Module. We successfully ran power from the Arduino MKR WAN 1310 to our time of flight and magnetometer sensor. During this process we learned that one of our sensors is three sensors in one with a magnetometer, accelerometer, and gyroscope. We will continue to do more testing, but we may be able to also utilize the accelerometer for the vibration detection capabilities. During our configuration we were able to run code for each senor one at a time and visualize the data. We took various metal objects and moved them around the magnetometer to get different results. We did the same for the time of flight sensor moving any object within line of sight to see different data.

10/31/21

Building off the previous week we pushed to be able to see data from both sensors on the same terminal putting it all in one program. We also talked through the Boolean logic and how the code will work to determine true and false. We will now push to package our sensor into a housing for the coming weeks. We would like to prepare for our showcase in advance to mitigate any foreseeable problems.

11/07/21

Start 5:00 pm

All hardware for the first prototype has been received and I began to configure our first working node. I took our poly case enclosure which is a 3.5 x 4 x 3.5-inch housing and drilled a hole for the flush mount micro-USB. This allows for us to connect to the Arduino without having to open the enclosure. The intent is to test the sensor detection within the enclosure to see if the housing will interfere with the data. The magnetometer was not affected by the enclosure however the Time of Flight was. We specifically bought an enclosure with a transparent top to mitigate line of sight obstructions. However, the Time-of-Flight sensor was not able to effectively detect through the window of the housing. We believe that the offset requirement of half a millimeter was not achieved. We also think it could be the UV resistant rating of the top that is blocking infrared signals from the sensor. We plan to test both hypotheses to solve the issue.

The magnetometer did not necessarily provide the data we expected to see. Although it did detect a vehicles presence. I did not consistently hold a value but instead, displayed spikes. Part of the problem is car manufactures using lighter materials such as aluminum which is a not a ferrous metal. Another problem is the brand of the magnetometer we chose to use. We found very little technical data on the range and sensitivity of this integrated circuit. The reason we originally chose this specific magnetometer is because one of the teammates already owned one. We made the mistake of assuming all magnetometers are made the same. Another problem was our expectation, we did some research and found that spikes are what we should expect to see in the magnetometer’s detection.

Stop 10:00 pm

11/14/21

Start 5:00 pm

Due to the issues observed from the previous meeting, this week was all about solving those issues. First, Alex purchased an equivalent Time-of-Flight sensor that does not have connection ports. These ports were believed to have created too much space between the actual physical sensor and the window of the enclosure. We will now mount the TOF to the window to see if the smaller offset will allow for the infrared to pass through. If this does not work, we will look for an enclosure that does not include the UV rating. For the magnetometer, another EE teammate Martin has purchased a different unit to provide our magnetic detection. This was a unit that we researched during the previous week. We questioned whether our current device was sensitive enough to detect a vehicles presence consistently and hold a value. We will test all our improvements tomorrow and hope to have worthy solutions to last week’s problems.