

# Weekly Blog

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# 1 Fall Term

## 1.1 Week 3

### 1.1.1 Progress

We have made a lot of progress this week on both project requirements and class work. We have completed our rough draft of the requirements document (and it's much more than a rough draft, we are anticipating little adjustments between our rough and final drafts). We are in the process of merging our problem statements (waiting for grades to come back before submitting). Lastly, we have gathered all information currently needed for the project from our client and have set up a meeting with him for next week.

The project is going smoothly right now, and we have planned steps for designing the actual project, and that should begin early next week.

Our meeting with the TA in charge of our project went smoothly, nothing to report there.

### 1.1.2 Problems

Our client (Bechir Hamdaoui) is super busy as a professor here at OSU. As a result, the frequency of meetings is going to be low. However, this really shouldn't be an issue for us at all as we were given all requirements early, and at this time our group doesn't really have any questions for him.

Overall we have not encountered any problems that may prove to be a barrier to our work.

### 1.1.3 Plan

We are going to merge our problem statements the moment we receive grades on them. If our grades are expected, we will merge based on the best parts of each problem statement. We have finished our rough draft of the requirements document, so over the weekend and throughout next week we will continue to revise. We are also looking forward to the peer review to see what other groups have done, and will take that into consideration for our revised document.

Outside of the class work, this week we will begin to design the three major components of our project: hardware, server, and the android application. We are going to be assigning one of these components to each team member (for the most part), and will start our individual work on designing the software and the hardware. There is a lot of designing work to be done, and it is important that we design as best as we can first to minimize problems in the actual building phase. This is especially important as we only have the school year to complete our project, and do not have the opportunity to follow a truly agile development process.

## **1.2 Week 4**

### **1.2.1 Progress**

This week consisted of research into the circuit boards and transmitters necessary to begin design of our project. For our project we are required to use the LoRa protocol to communicate between the cow collars and the gateway/server. These transmitters are proprietary, and must be purchased from Semtech. Luckily they are fairly inexpensive, however research still needs to be conducted into the very wide variety of different options. We are comparing and contrasting the different receivers, and are very close to purchasing and testing some of these boards. We are still in communication with our manager/mentor Prof. Bechir Hamdaoui, who is looking into getting us the funds to purchase the (cheap) receivers for testing and development purposes. We have tidied up our requirements document and are happy where it is currently at, and will submit on time tonight. We anticipate there will be very little difference between this submission and our final submission later on.

### **1.2.2 Problems**

No problems have been encountered this week. The project has been smooth sailing so far, and we have not hit any blockers that demand resolution.

### **1.2.3 Plan**

Our next big step is to get the hardware ordered and begin testing. Once we have hardware in hand we can get the software written and tested to ensure that there are no issues communicating over the LoRa protocol. Once we understand how communication works between the end nodes and the gateway, and have successfully established that link over long distances, we can begin building the very first prototype. Ideally this upcoming week we will have purchased some transmitters for testing purposes so that the following week can be spent testing and developing. I'll update in the next progress plan our status in regards to this plan.

## **1.3 Week 5**

### **1.3.1 Progress**

The most progress I've made this week was completing the tech review. I am planning on adjusting it just a little before turning it in Sunday. Outside of classwork I met with our project adviser/client Professor Bechir Hamdaoui on Tuesday to discuss funding and purchasing hardware. He proposed a meeting with the entire group to go over our ideas before purchasing. He also informed me that our team should receive funding from this course, as there should have been some money set aside for our project. After this meeting I got together with my team and since then we have been working on a presentation for Professor Hamdaoui sometime next week. We also passed along our desire for funding to our TA during the weekly team meeting.

### **1.3.2 Problems**

No significant problems as of yet. While we were expecting to be blocked by funding this week our client asked for a presentation regarding our plans and what we wanted to purchase. As a result we have spent our time on ensuring that our presentation is good and the parts we have picked fit the project. We had a small problem trying to find a time that works with all of the team members and Professor Hamdaoui for our presentation. We are currently exploring options and our client may instead recommend that only two of us present (easier to find free time), or pass along a full report instead. While we are waiting to hear back from our client in regards to this problem we have been working on the presentation and our individual tech reviews.

### **1.3.3 Plan**

We plan to present to Professor Hamdaoui sometime next week and begin purchasing parts immediately thereafter. Our work on our presentation will be alongside work for this class.

## **1.4 Week 6**

### **1.4.1 Progress**

In terms of class work I have revised and completed my tech review, while keeping in mind the most common mistakes and the peer reviews. Our team had a chance to talk to our TA this week which went well and indicated no issues on any side. Outside of the class work our team met with our client Professor Hamdaoui and had a chance to talk specifically about the technology and the ideas we had on how to implement our project. That was a substantial meeting, and was extremely important as it was the first time we as an entire team had a chance to meet with the client. During our meeting we set up a time once every two weeks to meet with the entire team and the client in order to discuss specifics and stay on top of our project.

### **1.4.2 Problems**

We have no problems at this time to report. Last week our problem was getting a time set up for the entire team to meet with our client, and we resolved that this week and put a biweekly meeting with all of us on the calendar.

### **1.4.3 Plan**

Our meeting with Professor Hamdaoui this week provided us with plenty of action items to accomplish, mainly conducting more research into the specifics regarding the LoRa protocol. As it will take a bit to receive funding for our project, we have been spending our time researching and debating among ourselves in regards to exactly what technology we are going to use. We will continue to do so until we are one hundred percent sure exactly what we need, so that when we build our first prototype we minimize the amount of work needed to become familiar with the hardware.

## **1.5 Week 7**

### **1.5.1 Progress**

Much of our time this week was spent getting the design document built and written. As this is a large group project we ended up starting early, yet we are not entirely satisfied with our first draft and have continued to revise in anticipation of our second draft due soon. We also spent time determining exactly what we want to purchase and will propose the components to our client on Tuesday, at which time we hope we will be able to start buying parts in order to stay on schedule.

### **1.5.2 Problems**

Other than just a quick question in regards to the design document formatting (which was answered by our TA), we have encountered no problems this week. Everything is going well, and communication with our client is perfect.

### **1.5.3 Plan**

Our future plans include completing the design document (hopefully soon) and purchasing hardware to begin LoRa testing.

## **1.6 Week 8**

### **1.6.1 Progress**

Our team has just recently completely finished our design document, and have emailed it to our client. We wanted to get it to our client early so that he has a chance to read over it prior to our meeting on Tuesday. We confirmed the structure of our design document with the two professors in class on Thursday and had a chance to get it peer reviewed by other students. We found that earlier in our assignments we weren't using the exact correct format so we wanted to ensure that our format was correct for this assignment.

### **1.6.2 Problems**

The only problem remotely related to this class is for registration I had to submit a time conflict for next term, which really isn't a problem at all. With that said, there are no significant problems to report for this week.

### **1.6.3 Plan**

We plan to meet with our client on Tuesday directly after class (or when class would have been) to discuss the design document and ensure that we are all on the same page for the end of term report/survey our client needs to complete. We hope to be able to get funding directly at the beginning of next term so we can get our hands on some hardware ASAP



## **1.7 Week 9**

### **1.7.1 Progress**

The design document has been finished, peer reviewed, and turned in this past weekend. Upon completing the design document we compiled our other project files and have sent them to our client (Professor Bechir Hamdaoui) for review.

### **1.7.2 Problems**

We have no problems to report for this week.

### **1.7.3 Plan**

We are currently waiting to hear back from our client in regards to the documents we sent, and will make any necessary changes once he responds. After Thanksgiving we will complete the final end of term report. We also plan to meet with our client on Tuesday in week 10, and hope that he will have had a chance to read our documents by then.

## **2 Winter Term**

### **2.1 Week 1**

#### **2.1.1 Progress**

Our team started this term running in regards to our work on our project. Our primary goal was to complete a list of hardware requirements as that is our current major blocker to getting a prototype complete. The list has been finished and emailed to Professor Fairbanks for approval. The next thing we completed this term was determining a way to assign team members things to accomplish on our own internal website. We have successfully laid out the next several weeks with things to accomplish for each team member, which clarifies exactly what is expected from each of us. Personally, I have started work on researching AVR and the LoRa network specifics and will upload documents detailing my research soon. Lastly, I have completed the team critiques of my team members and submitted it, receiving a 45/50 for not missing a specific requirement that was detailed in class. I must have just missed the professors discussing it.

#### **2.1.2 Problems**

No problems to report for this week, everything is going smoothly!

#### **2.1.3 Plans**

My current plans are to continue research as detailed on our external website. Once I have that research completed and we have hardware in hand Matthew and I can start writing the software and integrating the hardware components.

## **2.2 Week 2**

### **2.2.1 Progress**

One of the biggest milestones we reached this week was the purchase of our hardware. Professor Fairbanks and the accounting department got through our purchase request very quickly, and we expect to have all of our hardware in hand within the month. The long wait for shipping is because of purchasing on ebay, as it is the cheapest way to acquire this hardware that we would otherwise be purchasing from the actual companies (and would likely need to be in bulk). This week I also completed several research requirements prior to getting our hands on the hardware, and as a result will be ready to work on the hardware the moment we get it. Lastly, we finally determined a time to meet with our TA Fariba (Wednesdays at 5pm), which was way more of a hassle than I had expected due to my teams conflicting schedules.

### **2.2.2 Problems**

There are no problems to report for this week!

### **2.2.3 Plans**

This upcoming weekend myself and Matt are going to get together for an entire day and play with some hardware that we already own to prepare and learn for when our real hardware arrives. Luckily, Matt has a LoRa radio transceiver so we can get hands on experience this weekend with the LoRa protocol before needing to implement it on the actual collars. This entire next week we anticipate will be research and playing with the current hardware we have in anticipation of the ordered hardware arrival. Also, we are likely to begin writing the server code as we can test that code on my Raspberry Pi.

## **2.3 Week 3**

### **2.3.1 Progress**

Matt and I met up this week a couple of times to finish getting LoRa to work with our current (temporary) hardware. While we are still waiting on some hardware to arrive, we have enough to begin testing the LoRa protocol, and I am happy to report this week we successfully got two nodes to communicate with each other utilizing the LoRa protocol. One of our major issues afterwards was fixing the range issue. We had initially found that the range we could achieve was only up to about 20 feet, but after looking into it we found out that we had set the voltage incorrectly, and the default constructor for the LoRa library we were using was defaulted to the EU radio range, and therefore didn't integrate well with our antenna. We fixed those issues, and are currently in the process of writing some more code to test the actual raspberry pi.

### **2.3.2 Problems**

I am happy to report we had no problems this week (that we didn't immediately fix, that is).

### **2.3.3 Plans**

Integrate LoRa with our temporary Raspberry Pi and finish a LoRa research paper detailing the specifics of the protocol.

## **2.4 Week 5**

### **2.4.1 Progress**

Matt and I have fully set up the Raspberry Pi with the LoRa protocol, and have successfully got communication to work between the Arduinos and the Pi. I completed research on the LoRaWAN protocol, and have gathered my findings into a brief document for the rest of my team. Lastly, Daniel has finished the prototype Android application that will be our user interface.

### **2.4.2 Problems**

We have come to realize this week while working with the hardware that we will require some additional hardware for the LoRaWAN gateway/server as a result of the specs of LoRaWAN. We are getting the additional hardware ordered, but for now I'm writing a simple protocol to connect two LoRa devices in preparation for our alpha functionality demonstration. We will still meet alpha, just with a slightly different approach.

### **2.4.3 Plans**

I'm going to spend this week developing the MAC networking protocol for communication between two end-nodes for alpha, and integrate GPS onto the boards.

## **2.5 Week 6**

### **2.5.1 Progress**

We have essentially finished the rough draft of our poster, and are adding some finishing touches before submitting this evening. While the alpha is looking all good for showing off next Tuesday (our slot is on the 18th), we are going to take the weekend to add some finishing touches to ensure that our presentation goes smoothly. All of our hardware has arrived and has been integrated, and the software is working as intended for alpha.

### **2.5.2 Problems**

Depending on signal strength inside of the room we are presenting, showing the minute differences in location through GPS may be difficult. We may instead record testing in a field (as the product is intended to be used) and show that recording during our presentation as our proof of concept. Otherwise, we are looking good for presenting on the 18th.

### **2.5.3 Plans**

This weekend we will spend finalizing and adding some more things onto our alpha. We will be getting together multiple times through the weekend to work and ensure we are ready to present on the 18th.

## **2.6 Week 7**

### **2.6.1 Progress**

Our alpha is fully complete, and our design review presentation went well. Essentially, we have a fully working software stack from the collar all of the way to the Android application. We got protobuf working on the collar and the server, and integrated the GPS chip onto the board. The collar now gets GPS data, encodes it using protobuf, and sends it every certain amount of time to the gateway using LoRa. The gateway then decodes the message and saves the information to a SQL database. Lastly, when the user opens the cell phone application it queries the python http server which then queries the database to display information. As a result, we are able to see where all of the collars are and see them move in real time.

### **2.6.2 Problems**

Only significant problem is we fried some boards during dev by flashing software compiled with the wrong frequency on them. We have since resolved this by utilizing a new board and improved internals.

### **2.6.3 Plans**

The next step is to allow the user to adjust field dimensions on the Android application and have those changes propagate to the end-nodes. Then, the end-nodes need to check their GPS coordinates against those restrictions every so often. Lastly, we want to implement LoRaWAN to improve battery life and scalability (currently using our own software we wrote).

## **2.7 Week 8**

### **2.7.1 Progress**

This week was not as productive as I might have hoped for my own work due to two unexpected surgeries. However, the group was able to order some new hardware for our finished product, and fixed our poster rough draft. I was able to schedule a meeting with our client for the upcoming Tuesday to show him all of the hardware and its interaction. That is, we will show him the alpha functionality (and then some).

### **2.7.2 Problems**

No problems to report.

### **2.7.3 Plans**

Our plans are to present to our client our Alpha functionality on Tuesday and continue to work on our Beta functionality. Once our hardware arrives, we will integrate LoRaWAN with the new concentrator and finalize the entire software stack.



## **2.8 Week 9**

### **2.8.1 Progress**

This week we had an opportunity to meet with our client and go through a detailed demo with him, and actually demonstrate the capabilities of our alpha. He was very receptive, and gave some great advice for where to focus to make our final product as good as possible. This week we also received some of our required hardware (LoRa concentrator), enabling us to begin implementation of a LoRaWAN library.

### **2.8.2 Problems**

No problems to report, our client enjoyed our work and everything is going smoothly.

### **2.8.3 Plans**

Now that we have the LoRa concentrator, we need to wire it onto our board and implement a LoRaWAN library to provide full functionality on the link layer.

## **2.9 Week 10**

### **2.9.1 Progress**

This week we completed our poster, and started work on our video and write-up that's due next week. I've completed the video recording of the actual demo, and all that's left is a recording of the Android application and a voice-over in some parts of the video. Once that's complete, we can edit the video and submit. Lastly, we have also received the concentrator and have started work on getting that integrated and LoRaWAN implemented.

### **2.9.2 Problems**

COVID19 restricted my team from meeting, so the quality of our video is a little worse as we weren't all together to create it.

### **2.9.3 Plans**

Complete the video and the write-up by Tuesday!