
EE/CprE/SE 491 WEEKLY REPORT #5

2/26 – 3/5

Group number: 12

Project title: Application Exploration of 5G-and-Beyond Wireless Systems and Rural Broadband

Client &/Advisor: Hongwei Zhang

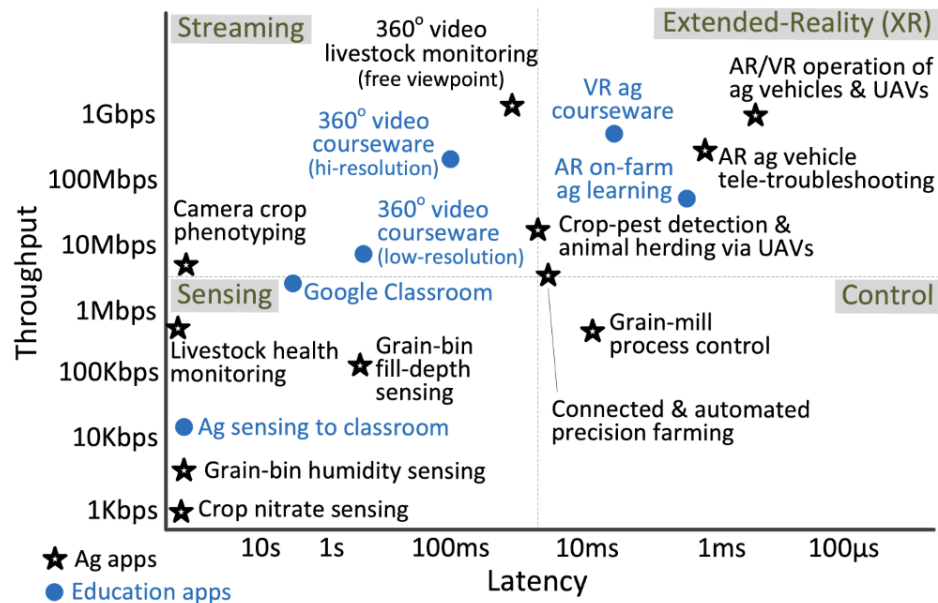
Team Members/Role:

Caleb Kitzelman - Undefined
Cristofer Espinoza - Undefined
Andrew French - Undefined
Jake Roskopf - Undefined
Samuel Rettig - Undefined
Vibhu Dhavala – Undefined

Weekly Summary

This past week our group had our bi-weekly meeting with Dr Hongwei and were joined by two of his colleagues that were involved in the ARA project or had relevant experience when it came to computer networking as it relates to agriculture. Within the meeting we were only able to discuss one of the issues we had been focusing on, soil health and monitoring. We presented the issue and a possible solution and received feedback and more direction in terms of what our project should include as we continue to try to define it. The solution we had involved sensors that measured mineral content. Although it had the potential to utilize the ARA network, we were told to think bigger picture and in the environment of production Iowa rather than research or local farms. Realistically with this application, the maintenance for adequate number of sensors in a production farm would be too tedious to sustain. We were told that a combination may be a viable idea with the concept of sensor fusion, but automation is the direction we should head. For example, a tractor with all the resources and sensors on it. Additionally, some of us have researched automated applications with drones. It is these high throughput and low latency applications our client is looking for to show the full capabilities of the ARA network. Dr Hongwei had also recommended reaching out to his graduate students to see the current uses of the ARA network for agriculture, but we have not yet heard from them.

The following are some of the resources discussed in our past meeting:



Microsoft Farmbeats

<https://www.microsoft.com/en-us/research/project/farmbeats-iot-agriculture/>

Microsoft FarmVibes

<https://www.microsoft.com/en-us/research/project/project-farmvibes/>

Past Week Accomplishments

Samuel Rettig: Investigated sensor fusing. It may end up becoming a large, if not central, part of our project. By researching more into it and learning more about its capabilities we can better understand how to best implement and use it. Similarly, investigated potential uses for heat sensors that would mesh with our current ideas.

Cristofer Espinoza: After meeting with Dr. Hongwei and some of his colleagues that were involved within the ARA project or worked in relevant fields, we had received more direction in what we should be focusing our research towards. The main issue in agriculture that I wanted to focus on was soil contamination which eventually turned into soil health and monitoring. I had proposed an idea that utilized sensors in the ground that measured mineral content, specifically Nitrogen, Phosphorus and Potassium. These sensors could then utilize an Arduino or microcontroller for computing and a modem to send data to the base stations. This will utilize the low latency aspect of 5G providing real-time updates. I had also reached out to the graduate students that are more involved in the agricultural applications of the ARA network to see the current uses, but I have not yet heard back from them.

Jake Roskopf: This week I continued reading Computer Networks: A Systems Approach and learned a lot about how data is broken down and transferred. I also spent most of my time familiarizing myself to the "Farmvibes" project and trying to think of ways we could explore some of their ideas into our project. I also began brainstorming how we could use the sensors and tech that ARA is already installing to carry out our project.

Vibhu Dhavala: This week I read about Microsoft's project FarmVibes, specifically the FarmVibes Edge and FarmVibes AI projects. For the FarmVibes AI project I read the GitHub documentation on the ML model and looked at the example projects demonstrating use cases for FarmVibes.AI. I also researched the use of sensors on commercial farms to better get an understanding of what types of data is used and how we could improve with the implementation of 5G .

Caleb Kitelman: This week I investigated data collection via IR sensors and heat maps to find out various things about soil and plant health. I also looked at ways of predicting yield outcomes and weather effects on crops. I also looked more into the connectivity of rural areas and farms to gain more insight about 5G. Read about the Microsoft Farmvibes research.

Andrew: In the meeting it was suggested we look into the research done through Microsoft in the Farmbeats and Farmvibes projects, so I watch some presentations they gave and read their papers on "Towards Low Cost Soil Sensing Using Wifi" and "Low-Cost Aerial Imaging for Small Holder Farmers".

Individual Contributions

<u>NAME</u>	<u>Individual Contributions</u>	<u>Hours this week</u>	<u>HOURS cumulative</u>
Jake	Continued research and narrowing down ideas	2	15
Samuel	Looked into further narrowing down ideas	2	16
Cristofe r	Continued research on computer & mobile networks, and sensor fusion.	2	16
Caleb	Research into IR sensor usage in farms and prediction methods using sensor data	3	17
Andrew	Looked into the research down by Microsoft through farmbeats and farmvibes.	6	27
Vibhu	Looked at Farmvibes and the documentation for Farmvibes AI	3	

Plans For the Upcoming Week

Samuel Rettig: Over the spring break, I wish to make sure that our project is further defined by investing more time (aka exams take a lot of time) to try to make sure our project is as best as it can be.

Cristofer Espinoza: The colleagues of Dr Hongwei had recommended sensor fusion, the utilization of both soil sensors and drones sensing. Therefore, in this next week I plan to continue research on how I can combine the idea of in ground sensors with XR, drones, or automation (tractor w/ sensors).

Jake Roskopf: I plan to continue research and start to set goals for spring break and the rest of the semester since our project idea is beginning to come together. I am hoping that we can begin defining roles and project guidelines.

Vibhu Dhavala: I plan to continue researching how AI can be used along with sensors in farming. I hope to be able to properly define our project in the upcoming week. I also plan to continue reading into the the research Microsoft has done with FarmVibes.

Caleb Kitzelman: I plan to continue to investigate the uses of IR sensors in agriculture. I also want to look more into sensor fusing and what we can find from different sensors currently used on farms. I also hope to get some insight into some projects being worked on now in the lab by current grad students.

Andrew: Continue looking into existing research that has been down through Microsoft or others on soil testing and aerial imagery.