IOWA STATE UNIVERSITY
Department of Electrical and Computer Engineering

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

Client: *Dr Hongwei Zhang*
Team Name: *SDDEC23-12*
Website: *https://sddec23-12.sd.ece.iastate.edu/*

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Meet the Team

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Multimedia Framework Researcher

Vibhu Dhavala
Software Engineer
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Electrical Engineer
Applications Researcher

Caleb Kitzelman
Electrical Engineer
Applications and XR Researcher

Jake Roskopf
Electrical Engineer
Applications and XR Researcher

Andrew French
Electrical Engineer
XR Researcher

Project Statement

- Develop a 5G application benefiting agricultural and/or rural communities

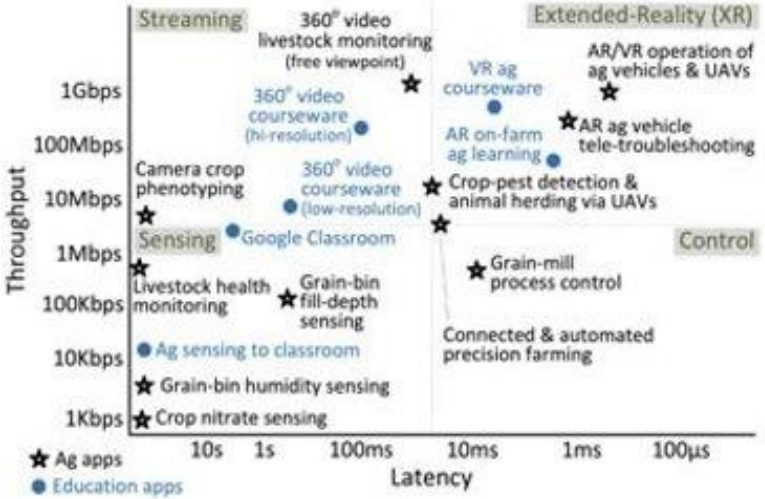
- **CURRENT GOAL:** Create an XR application that demonstrates the capabilities of the ARA network.

Conceptual Sketch

Functional Requirements

Requirements were based around showcasing and testing capabilities of 5G

- Must run on the ARA network
- Agriculture/Rural Focus
- Demonstrates high data throughput
- Requires low latency communication



Non-Functional Requirements

- UI Elements with intuitive design
- Responsiveness of application must feel correct
- Must be useful enough to warrant commercialization

Technical Considerations & Constraints

- ARA wireless network availability and infrastructure
- Current XR technology and Software Design Kits (SDKs)
- Durability and longevity

Market Survey

- 5G offers new opportunities that didn't previously exist, with its low latency and ability to transmit large volumes of real time data.
- ARA network allows research into these new opportunities.
- Current research into
  - Using drones for imaging
  - Using IoT sensors
  - Automating tractors

Potential Risks & Mitigations

- High Priority Risk 1 - Setting up initial connection for hardware and demonstration may be harder than we expected.
- Mitigation – We will begin work on this early next fall so that we won't be blindsided by any complications. We'll seek counsel from those familiar with the network.
- High Priority Risk 2 - Back-end algorithm development will prove to be difficult, leading to slower than expected delivery of testable software.
- Mitigation – Setup software environment during the summer to allow more flexibility during the fall semester.

Resource/Cost Estimate

Most of the things we need to complete our project are either provided through the current ARA project or are open source.

We are in the process of obtaining an XR headset, which will be used in our ARA application and future research.

Project Milestone & Schedule

End of Spring23 – Obtain needed infrastructure.

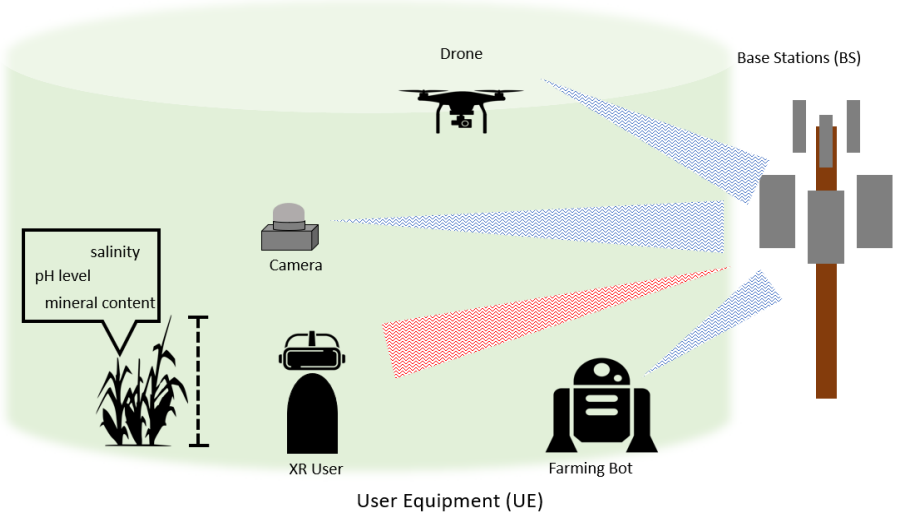
Start of Fall23 – Research and characterize appropriate open-source software development kits (SDK) for application

November Fall 23 – Create solutions for XR that utilize data analytics and algorithms

End of Fall23 – Refine front-end design and test and verify XR functionality

Design

- No current functional modules
- Prospective ideas using XR in the upcoming semester
  - Analyzing images/videos for quantified information or sensor fusion
- Creating a framework



HW – Magic Leap 2 AR/XR Headset

Magic Leap 2

- High resolution and refresh rate
- 70 degrees horizontal field of view
- Ability to dim real world to 0.3%
- Better specs and reviews for AR experience

Development Software

- Unity
- C-API
- OpenXR now natively supported

SW/Technology Platforms

- Native Android application utilizing the headset SDK
- OpenXR – API for interfacing between application and XR runtime
- Gstreamer – framework for linking transforming data stream types and linking to a pipeline
- Monado – XR runtime which provides support for OpenXR and Gstreamer

- Agricultural SDKs
  - Azure FarmBeats (Data hub for farms)
    - Info like Farm Health, Sensor data collection, Soil moisture map, and Insight building AI/ML models

Test Plan

Unit Testing:

- Jitter
- Latency
- Throughput

Interface Testing:

- Usability
- Displays
- Delay

System Testing:

- Networking(ARA)
- XR Application (Our Team)

Project Status

Task	Jan.	Feb.	Mar.	Apr.	May
Develop understanding of mobile networks, architecture and 5G technology					
Research issues within rural and ag communities and potential 5G applications					
Define an application/device that we want to focus on that will help rural and ag communities					
Create a XR headset proposal with research for HoloLens, MagicLeap and Meta for approval					
Research into SDKs for XR headsets					

Moving Forward

Task	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Order XR headset								
Research applicable SDKs available								
Perform XR headset setup and configuration								
Create solutions for data analytics or automation algorithms								
Front-end development and testing								

Q&A