EE/CprE/SE 491 WEEKLY REPORT 03

9/18/17 – 9/22/17

Group number: 11

Project title: RFRD Phase II

Client &/Advisor: Dr. Daji Qiao and Dr. Nathan Niehart

Team Members/Role:

Bailey Akers - Facilitator/RFRD Tag Design/Fabrication Engineer
Colin Sunderman - RFRD Tag Design/Fabrication Engineer
Lyle Bishop - Principal Antenna Engineer
Pengyu Que – Antenna/Power Harvesting Engineer
Nathan Mulbrook - RFRD Wireless Communications Engineer

o Past week accomplishments

Team Member 1: Bailey Akers
Develop and present the 3 minute elevator speech. Researched methods and current technologies related to measuring capacitance.

Team Member 2: Colin Sunderman
Develop and present the 1 minute elevator speech. Researched methods and current technologies related to measuring capacitance

Team Member 3: Pengyu Qu
Researched methods and current technologies related to measuring capacitance

Team Member 4: Lyle Bishop
Develop and present the 30 second elevator speech. Researched methods and current technologies related to measuring capacitance

Team Member 5: Nathan Mulbrook
Researched methods and current technologies related to measuring capacitance

o Weekly Summary

9/18 – Colin Sunderman and Bailey Akers met with Scott Melvin to discuss capacitance sensing design.

We evaluated the three methods to measure capacitance: Integrator, Wein-Bridge Oscillator, and Relaxation Oscillator. We decided the most feasible ways to measure capacitance in our application would be the Integrator or Relaxation Oscillator design.

We ruled out the Wein-Bridge Oscillator design due to the capacitance/resistance balancing circuitry. The capacitance/resistance balancing circuitry would require capacitance/resistance banks (which take up a lot of area on a PCB).

9/20 - Colin Sunderman and Bailey Akers met to decide on which design we would use to measure capacitance. We researched designs and decided to pursue the Relaxation Oscillator approach to measuring capacitance. This is due to the amount of academic resources and feasibility of this design.

Feasibility factors included: size of components (need to be small enough to fit on 3x3 inch PCB), low power (we are assuming we can only supply 1 Watt of power to our circuit wirelessly), appropriate gain-bandwidth (in Megahertz range), and with somewhat of a gain to supply to our Rx/Tx module.

9/20 - Pengyu Qu and Lyle Bishop met to calculate max power that can be transmitted and received by an antenna using Friis Equation.

9/22 - Bailey Akers and Lyle Bishop met to discuss results from Friis Equation calculations. Found an online Friis equation calculator.

9/22 - Nathan Mulbrook researched specific communication protocols for RFRD applications. He evaluated all the different methods and decided there wasn't a standard protocol for RFRD. He found issues with the non-uniformity and lack of resources for RFRD communication protocols.

9/22 - Met with advisors Dr. Daji Qiao and Dr. Nathan Neihart.

- Nathan Mulbrook expressed doubts for RFRD communication protocol resources. He also expressed a lack of non-uniformity and standards in industry regarding RFRD communication protocols.
    - Dr. Neihart suggested he conducts further research into the topic and present a powerpoint for next weeks meeting.
- Lyle Bishop expressed incorrect calculations using Friis Equation for the amount of power transmitted/received wirelessly from an antenna. In more discussion, we realized that Friis Equation is limited for small distances at frequency levels around 350 MHz. We concluded that Friis Equation will not be adequate to use in our application.
    - Dr. Neihart suggested for Lyle and Pengyu to research alternate methods to calculate max power transmitted/received wirelessly from an antenna.
- Colin Sunderman and Bailey Akers presented on the pros/cons for each of the capacitance measuring methods (integrator, wein-bridge oscillator, and relaxation oscillator). They discussed the resources that they used to determine their conclusion, an IEEE article called "Limitations of a Relaxation Oscillator in Capacitance Measurements".
    - After discussion, the group concluded on the relaxation oscillator design.
    - Dr. Neihart and Dr. Qiao suggested for Colin and Bailey to determine what criteria for the relaxation oscillator would be needed for the op-amps.
    - They also suggested that if we conclude on the criteria, we research into what specific op amps would be available for us to purchase within our design criteria.

- They suggested looking for a similar op-amp to the obselete AD848 that was suggested in the IEEE article.

This Week:

NAME	Individual Contributions Summary	Hours This Week	Hours Cumulative
Bailey Akers	Capacitance measuring design and presentation. Friis Equation support.	7	18
Colin Sunderman	Capacitance measuring design and presentation.	6	16
Pengyu Qu	Friis Equation research.	6	12
Lyle Bishop	Friis equation research. Troubleshooted Friis Equation. Presented Friis Equation results.	6	13
Nathan Mulbrook	RFRD communication protocol research and presentation.	4	13

***Details of weekly contributions are noted in above Weekly Summary section.**

o Comments and extended discussion

o Plan for coming week

Goals for next week's advisor meeting (9/29): Details also listed in Weekly Summary section.

Capacitive Sensing Circuit Design: Colin Sunderman and Bailey Akers

- Dr. Neihart and Dr. Qiao suggested for Colin and Bailey to determine what criteria for the relaxation oscillator would be needed for the op-amps.
- They also suggested that if we conclude on the criteria, we research into what specific op amps would be available for us to purchase within our design criteria.
    - They suggested looking for a similar op-amp to the obsolete AD848 that was suggested in the IEEE article.

Antenna Design: Pengyu Qu and Lyle Bishop

- Dr. Neihart suggested for Lyle and Pengyu to research alternate methods to calculate max power transmitted/received wirelessly from an antenna RFRD Reader

Communications, Tx/Rx Module: Nathan Mulbrook

- Dr. Neihart suggested he conducts further research into the topic and present a PowerPoint for next week's meeting.

o Summary of weekly advisor meeting

Description of weekly advisor meeting is above within the weekly summary section.

o Team Difficulties

The main difficulties were with the RFRD communication protocols and Friis Equation. Details listed within weekly summary section.

Grading criteria

Each weekly report is worth 10 points. Scores will be awarded as follows:

• 8 – 10: Progress for your project seems to be suitable. Documentation and hours reported by team members are adequate.

• 6 – 8: There is scope of improvement both in your report and your project progress. Can consult with instructor/TA after class for further inputs.

• < 6: Please talk to instructors/TA after class hours about any difficulties that you/your team is facing.