EE/CprE/SE 492 Biweekly Status Report 1

Dates: 8/27/18 – 9/10/18

Group #: 5

Project: Micro-Electro-Mechanical Systems (MEMS) Based Sensing System for Soil Conditions Monitoring

Client: Dr. Halil Ceylan

Advisor(s): Shuo Yang and Dr. Yang Zhang

Team Members:

Nathan Coonrod (Report Manager)

Kyle Kehoe (Communications Manager)

Jacob Verheyen (Meeting Facilitator)

David Severson (Web Master)

Sok Yan Poon (Timeline Manager)

Summary

Our team spent time getting some refresher on the status of the project by looking at previous semester's documentation (weekly status reports primarily) and discussing what we did last semester at our weekly meetings. We also held an advisor meeting with Shuo Yang on 9/6/18 to discuss project scope and clarify the direction we need to take on our project. Specifically, MEMS sensor recreation and feasibility was a primary topic discussed. We could fabricate aluminum MEMS sensors on a 3-inch wafer similar to what had been done a previous project but concerns about the robustness of the solution and differences in materials and process steps from what had been done previously on the project were brought up. It was agreed upon that our team should make a temperature and moisture sensor of our own design using more traditional methods on a PCB.

Accomplishments

- Kyle: Assisted with schematic design of moisture/temperature substitute sensor. Researched Arduino sleep modes and how to implement via RTC time-clock interrupt by means of a YouTube video and reading relevant sections of Atmega32u4 datasheet.

- Nathan: Designing moisture/temperature substitute sensor schematic as well as some initial design of the DAQ schematic including the microcontroller and battery management.
- Jacob: Researched sleep mode for microcontroller. Looked into possible solutions for waterproof connectors/wire harnesses between DAQ and sensors.
- David: Reviewed previous weekly status reports as a refresher. Researched sleep mode for the Atmega32u4 microcontroller. Refreshing old website with new information regarding the project.
- Sok Yan: Review previous semester's progress. Researched on moisture and temperature sensor.

Pending Issues

- Issues obtaining gold to recreate MEMs sensors due to lack of availability.
    - Everyone - A decision was made at an advisor meeting aforementioned to move in a different direction and recreate a more conventional sensor solution of our own on a PCB. This solution will be cheaper, more reliable, and we expect it to be more accurate than the original approach. The solution will also use different measurement techniques, and our group must come up with a different circuit design to accommodate the new solution.
- Arduino sleep mode and interrupt
    - Kyle/Jacob - Researched Arduino sleep modes and how to have the Atmega32u4 and enter and wakeup from desired sleep mode.
    - Throughout research, there have been many different ways to put the Atmega32u4 into "sleep mode," however, we need a solution which can cut down the power draw to the lowest possible levels, since we will need our data acquisition module to stay in the field for long periods of time.
- Waterproof connectors for DAQ
    - Waterproof connectors are quite expensive, so a creative solution will be required to achieve the durability and reliability required while also keeping costs and complexity low.

Individual Contributions

Name	Contribution	Hours This Week	Hours Cumulative
Kyle	New Sensor Schematic Design. RTC Interrupt and Atmega32u4 sleep mode research.	6.5	6.5
Nathan	New Sensor Planning and design, DAQ schematic work	6	6
Jacob	Sleep mode/waterproof connector research.	2π	2π
David	Sleep mode research, website management, circuit recreation investigation	6	6
Sok Yan	Research on moisture/temperature sensor circuit schematic.	6.5	6.5

General Comments and Discussion

In the first semester of Senior Design, our team was asked to create a data acquisition system for MEMS sensors. The MEMS sensors were developed by the ECpE Department at Iowa State and are being used by the Civil Engineering Department at Iowa State. Our group began interfacing with the sensors based on the specifications given by the research paper. As a team, we were concerned with the reliability of the sensors because they were on a silicon wafer and the traces were made with a very thin layer of gold.

The original wafers were not functional - the gold traces had been scratched off since they were stored in a petri dish which was transported multiple times. As a group, we planned on fabricating the sensors. We obtained all of the necessary items and professor assistance to recreate the sensors and we had developed a data acquisition system which would have the ability to gather data from the sensors.

Fast forward to the beginning of this semester, we found out that there were no materials available to make the gold traces on the sensors.

We have decided to recreate different sensors, using our own method. We spoke with our advisor and agreed to implement our own solution. We will ensure our sensor/DAQ solution is reliable, cost-effective, and effective at gathering the data that our client is looking for.

Plan for Coming Weeks (9/10/18 – 9/24/18)

- Kyle: Implement RTC time-clock interrupt with Arduino feather to wake up the Arduino from shut-down sleep mode by means of a push-button and falling edge interrupt on input pin. Once that is working can further refine to replace push-button with a RTC.
- Nathan: PCB design of alternative sensor design, further schematic development of DAQ, assist with simplifying software to decrease power draw. Goal to have PCBs ready to order in next two weeks.
- Jacob: Wrap up adding peripherals to DAQ PCBA (SD card, USB, solar panel circuitry, connector, analog buffers on inputs of ADC, external analog voltage reference (2.5V))
- David: Continue to manage website with updates. Fully develop a schematic with group members which can be fabricated as early as next week. Breadboard testing and brainstorming on circuit/sensor ideas
- Sok Yan: Update team project timeline. Research on Arduino sleep mode, help team members work on moisture/temperature circuit schematic design.