EE/CprE/SE 491 WEEKLY REPORT 6
10/17/2024 – 10/24/2024

number: ***sdmay25-17***

Project title: ***Microbial Pill Sensor***

Client &/Advisor: ***Dr. Meng Lu***

Team Members/Role:
Roles still subject to change as we transition from research to design phase.

- ***Wes Ryley:*** Data Transmission Design Lead
- ***Rakesh Penmetsa:*** Bacteria Housing Design Lead
- ***Alex Upah:*** Biosensor Design Lead
- ***Cade Kuennen:*** PCB Design Lead

Weekly Summary

This week, we were able to transmit data from our ESP32 board to an external PC via low-power Bluetooth. By doing so, the generation of a functional macroscale prototype of the LED, photodetector, and microcontroller components is complete. Our macroscale mockup prototype functionally activates an LED, measures the emitted lux via a photodetector component, and transmits the recorded lux values via low-power Bluetooth to an external PC where those values are then displayed.

This functional macroscale prototype is not a true prototype of our microbial pill sensor final design but does provide clear proof of concept via the recording of a lux value and the transmission of that value via low-power Bluetooth. Following the completion of this macroscale mockup prototype, we discussed its completion and next steps with Dr. Lu during our weekly advisor meeting.

Past week accomplishments

Team:

- Successfully transmitted lux sensor readings via low power Bluetooth to an external PC where readings were then displayed.
- Completed desired macroscale mockup prototype with full functionality of activating LED, reading lux sensor measurements, and transmitting them to external device for display.

Cade Kuennen:

- Learned how to import a PCB 3D-model into Fusion 360 for housing design
    - Practiced using the tools in Fusion 360 for housing design

- Started searching for a schematic of the Arduino dev kit used in our breadboard prototype to see what parts we could rid of for our project more compact final design
- Researched videos going through how to do PCB design utilizing the ESP32-C3

Alex Upah:

- Assisted Wes with the successful completion of low-power Bluetooth
- Reviewed principles and code behind low-power Bluetooth
- Reviewed use of genetically engineered E. Coli to express GFP responsible for detection mechanism underlying microbial pill sensor functionality

Wes Ryley:

- Completed the task of establishing a BLE connection and transmitting recorded Lux values
- Reviewed the functions of UUID and sourced appropriate IDs for both receiving and transmitting via UART functions on Low Energy Bluetooth
- Resourced materials that will be used as a skeleton for the PCB design with the assistance of Cade.

Rakesh Penmetsa:

- Worked on Arduino code and learn about the Fusion 360 and how to design a cell inside the circuit fusion 360 and built the system around the board.

Pending issues

Team:

- Upon completion of our macroscale mockup prototype, we are now shifting focus to the miniaturization of our components to generate a prototype possessing more resemblance to our actual microbial pill sensor components. To do so, we need to reduce the unnecessary components from our Lilypad ESP32 board as we will want only the necessary components along with the ESP32 microcontroller in our final design.

Alex Upah:

- Continue to review and research components and principles related to uniform dispersion of light in the chamber and the lensing used to focus and filter the light returning from chamber for detection mechanism.

Wes Ryley:

-

Individual contributions

NAME	**Individual Contributions** *(Quick list of contributions. This should be short.)*	**Hours this week**	**HOURS cumulative**
Cade Kuennen	Contributed to the extensive amounts of class-related assignments. Learned how to import KiCad files into Fusion 360. Looked for schematic of Arduino dev kit used in our breadboard prototype.	6.5	37
Alex Upah	Assistance and troubleshooting with Wes on low-power Bluetooth operation. Extensive	6	33.5

	contribution to class-related assignments such as the design document.		
Wes Ryley	Completed the Arduino code to connect and send data that's collected on the Photodetector through BLE. Resourced materials that will be used in KiCAD to construct a first edition PCB.	8	36
Rakesh Penmetsa	Worked on converting kicad files to fusion 360	5	30

Plans for the upcoming week

Team:

- Now that the macroscale prototype has been completed, our next major team goal is to break down the ESP 32 board and dev kit we have been working with into a complete schematic where we can reduce the unnecessary components currently included.
- We are also entering the stage of breaking the work up and starting to individually focus on a component, which will begin next week.

Cade Kuennen:

- Start component decomposition of Xiao ESP32-C3 to get a minimized component version of the Arduino dev kit used in our breadboard prototype.
    - This will allow us to get a better understanding of the minimum sizing we are allowed to have for our final design.
    - This will also allow us to start the PCB design portion of our project.

Alex Upah:

- Continue assistance with major goal of breaking down ESP 32 board to necessary components
- Further investigate use of lensing and filtering in optical components of design to ensure uniform dispersion of light in bio-detection chamber.

Wes Ryley:

- Research into the functionality of a self-made GUI and how to get started with its assembly.
    - Python program that will process the transferred data and display it for the end user.
    - Display's a correct Lux conversion which correlates to a concentration of analytes which will be found during testing.
- Ensure that the GUI will be compatible with the project's goal of creating a universal experience and pairs well with the UART data transferred through BLE.

Rakesh Penmetsa:

- Start working on Fusion 360 design and help in breaking down the components donwn ESP 32 board

Summary of weekly advisor meeting

This week during the meeting with Dr. Lu, the group demoed our fully functioning breadboard prototype. This prototype was able to make the LED blink at a specific frequency, collect data from a photodetector, and send that data to a Bluetooth-enabled device.

We also were given a short lecture on how the E. Coli we will be using as our biosensors were engineered to allow it to produce GFP when introduced to a specific analyte. We also discussed the future of biosensor technology and what commercial biosensor engineering services are available for consumers to use today.