EE/CprE/SE 492 STATUS REPORT 4
2/28/25 – 3/13/25

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

The designed pcbs, along with the necessary components, arrived this week so the team has begun the initial testing phase to determine functionality of the pcb modules. However, issues in the ordering process led to us not having the required stencils for soldering the components to the board. This makes the soldering process much more difficult and has delayed the group's ability to test the pcbs. The designated MCU pcb board was designed as a double sided pcb but we do not have the capability to properly solder the components onto a double sided pcb. This required the team to redesign the mcu pcb into two separate pcb boards and those have been ordered. The optical pcb board was soldered, but initial testing revealed issues regarding delivering power to the board. Basic tests suggest that the photodetector properly responds with an increased voltage for increased light intensity. Further testing will be conducted to determine source of error preventing proper delivery of power to the board.

Work has been continued on trying to use google Colab to store data in a google sheet from the mcu. We have achieved transfer of data from the google Colab application to a google sheet but have not tackled Bluetooth or serial transmission of data from the mcu to the google Colab application. The team investigated the issue of transferring data from the mcu to a server and then to a google sheet but found it required the use of a paying subscription and faced technical issues beyond our capabilities. This limits our ability to transfer data without a user initiating a connection with the device from close proximity. We will continue to explore solutions to this functional challenge in upcoming weeks.

A initial prototype housing design has been submitted to ETG for CNC manufacturing. We expect to obtain the manufactured housing after spring break and then will proceed to testing. The design was updated to include the required filter, lensing, as well as the pcbs. After obtaining the design, we will test fit of the components, their functionality within the housing and make the required improvements.

Past week accomplishments

Cade Kuennen:

- Met with ETG to discuss board design and soldering logistics:
    - Was told the current design will not work for soldering capabilities at ISU.
        - Will create new TEST MCU board that splits double sided PCB into 2- one sided PCBs for testing.
        - Will need to get smaller build assembled and soldered directly from JLCPCB.
            - This will require finding components JLCPCB can source directly in China.
            - Components must be in JLCPCBs hands before sending the PCB files which causes board turnaround time to be longer if we go this route.
- Designed new TEST MCU board that takes both sides of MCU PCB and splits them into their own larger PCBs for ease of testing and soldering.
    - Once this design is verified, we can talk about having JLCPCB assemble and solder for us.
- Started assembling and soldering 20mm OPT PCB, which was difficult with small component sizing.
    - Initial tests concluded there is an issue with getting power delivered to the board.

Alex Upah:

- Developed diagram of optical filter and lens setup within housing module to help Rakesh with design.
- Helped Cade with initial testing of optical pcb board. Found issues with getting power to the board but require further testing to find source of the issue.
    - Photodetector had an increased voltage drop from 45 mV to .2 V when hit with iPhone camera flashlight which illustrates functionality of photodetector component.

Wes Ryley:

- Achieved data transfer between USB connected device and Google Colab program.
    - Program allows for user to decide functions for data collection. Need to create program for MCU to decipher the implemented operational controls.
- In addition, integrated Google Sheets storage option for data once it has been collected into Google Colab.
    - Future goals involve implementing methods for manipulating sheets data to create trend graphs and concentration approximations.

Rakesh Penmetsa:

- Completed the redesigning the Cell housing and submitted the design to ETG to get the design make using CNC machine.
- Worked with Alex on the Diagram for optical filter and lens setup in housing cell

Pending issues

Cade Kuennen:

- TEST MCU PCBs have come in, but the components are not in yet. Will need to start this build after break.
- Need to find out why 3.3V power is not being delivered to OPT PCB.

Alex Upah:

- Need to determine current issues with optical pcb board and why power is not getting delivered to the board.
- Time available to contribute to project was limited by travel for graduate school visits. This is last week of graduate visits which will allow me more time to work on testing and characterizing optical pcb board.
- Can't get RGB LED off the mcu dev kit without damaging the mcu so will need to order compatible components that fit footprint on pcb board. Will have to use alternative led to test for now.

Wes Ryley:

- Develop a way to connect BLE data transfer to the Google Colab program space. Possibly use ESP32-Google-Sheets-API library, however this most likely has to be implemented through Wi-Fi.

Rakesh Penmetsa:

- Waiting for Physical model of cell housing form ETG to start the testing the cell

Individual contributions

NAME	**Individual Contributions** *(Quick list of contributions. This should be short.)*	**Hours this week**	**HOURS cumulative**
Cade Kuennen	Met with ETG, completed TEST MCU design, compiled and ordered TEST MCU materials, started soldering components onto OPT PCB, completed initial testing and started troubleshooting errors	14	40
Alex Upah	Developed diagram of optical components in housing to help Rakesh with housing design. Helped on initial testing of optical pcb board.	8	24
Wes Ryley	Developed Google Colab program with functioning operations. Began data collection for through testing USB connection with first prototype until first iteration of the design is completed.	8	30
Rakesh Penmetsa	redesigned the cell housing and made the design modification and submitted the design to ETG.	7	29

Plans for the upcoming week

Cade Kuennen:

- Plan to continue testing OPT PCB with Alex

    - Need to continue troubleshooting why 3.3V isn't getting delivered to board properly.
- Plan to start assembly and soldering of TEST MCU with ETG granted components arrive over break.

Alex Upah:

- Plan to continue testing optical pcb board with Cade
- Once issue regarding getting power to the optical board is resolved, plan to test response of photodetection to LED.
- Will test impact of filtering with green LED and impact of the lens
- Once basic tests have been completed with filtering and lens, will test with gfp cells from Dr. Lu. Characterize response as a function of cell density to see impact of increased GFP expression on voltage value.
- Plan to test optical components fit within manufactured housing module.
- Plan to determine max amount of storage of data capable in MCU for mass dumping of data when connected to bluetooth device.

Wes Ryley:

- Develop BLE connection to Google Colab program.
- Discover methods for implementing a Google Cloud for users to generate sheets through personal accounts rather than an individual account.
- Being working towards Google GPS mapping for connected devices.

Rakesh Penmetsa:

- To start the testing the design whether it has airtight sealing or not. And based on the test outputs update the design.

<u>Summary of weeklyadvisor meeting</u>

Wednesday – 3/5/25: Did not meet with advisor due to Dr. Lu availability.

Wednesday – 3/12/25: Used meeting time to update Dr. Lu on status of different parts of the project and get his feedback

- Housing: CNC to be completed by ETG by end of week or beginning of next week (spring break week)
- PCBs: Will need to start testing of Optics board after break. Let Dr. Lu know when the MCU Test boards are ready to be soldered by ETG, he wants to see what their process and capabilities are.
- GUI & Data Transfer Code: Dr. Lu mentioned not having the data be sent to an external google sheet for simplicity
    - Instead, we should have the data be graphed in real time like we did for prototype demo
- Testing: Dr. Lu let us know that the fluorescence beads we can use for testing are available when ready. Dr. Lu mentioned setting up a time to walk through his lab and show us this after break.