

**EE/CprE/SE 491 WEEKLY REPORT 1**  
**8/26/2024 - 9/19/2024**

**Group number: sdmay25-17**

**Project title: MicroBial Pill Sensor**

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

**Team Members/Role:**

**Not yet decided will be assigning roles once there is more information and initial design for the project.**

**Wes Ryley:** Data Transmission Design Lead

**Rakesh Penmetsa:** Bacteria Housing Design Lead

**Alex Upah:** PCB Design Lead

**Cade Kuennen:** Communication, Organization, and Assistance Lead

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○ **Weekly Summary**

During this first week, the team's goal was to meet with the project's client, Dr. Meng Lu of the Electrical Engineering Department, and get a base understanding of what the project goals are. During this meeting, the team was able to ask questions related to the biology aspect of maintaining bacteria, whether the project should use a wi-fi or Bluetooth connection to transmit data, and how everyone should spend time contributing to the project. In addition to this, Dr. Lu provided a research paper to cover before the next meeting on 9/16/2024.

After the second meeting with Dr. Lu, the team broke up the project's goals and started talking about assigning roles. As of now, we are still planning on working on research as a team until we have a clearer idea of the overall project goal and the other parts of the project design. As of now, we are still planning different components, past projects along with their data and outcomes, and begin working with the software Fusion 360.

● **Past week accomplishments**

● **Team**

- Scheduled times for weekly meetings both as team and with faculty advisor Dr. Lu
- Met with Dr. Lu to establish introduction to project goals, timeline and roles

● **Alex**

- My first task was to compile each individual team member's schedule into one group schedule, allowing us to determine appropriate meeting times that work for everyone in the group. Following our first introductory meeting with Dr. Lu, we were

given two research papers providing information on potential prototypes facing similar research problems which we could base our project design. I read both papers before our second meeting with Dr. Lu, in which we discussed what features and capabilities of the designs presented in the papers would need to be included in our design. Both discussions and the papers established need for an optical detection circuit, a housing chamber to maintain the growth of our cells, a low-power microcontroller, and the capability to send the signal to an external receiver. The details about the optical detection circuit were not available in the provided paper and will need significant in-house design work by our team.

- Cade

- This week I worked on studying the two research papers given to us by Dr. Lu. The Human GI Tract Inflammation Sensing paper will be a good reference for understanding how we could design a circuit for transmitting data from the pill to a PC for reading. It outlined a low-power MCU that we could potentially research. The Pig GI Tract Inflammation Sensing paper will be a good reference for understanding how we should design the sensing circuit for our project. Both papers outline a good design for the housing, which we could potentially use for our design. I also spent some time downloading, creating a collaborative team space for, and learning about how to use Fusion 360. This allowed me to become familiar with the software, jump-starting my ability to help with PCB design for this project.

- Rakesh

- After our first meeting with Dr. Lu, I focused on analyzing the two research papers we were given, which provided valuable insights for our project design. The paper on GI Tract Inflammation Sensing helped me understand how to structure a data transmission system using low-power microcontrollers, while the second paper on GI Tract Sensing in pigs offered guidance on sensor requirements and housing designs. Since the optical detection circuit was not detailed in the papers, I began exploring options for designing the PCB layout.

- Wes Ryley

- Following our first meeting with Dr. Lu, the team was given two research papers to review which would assist us in beginning the project. I have reviewed this material and taken key points from each project that can be implemented into the team's design to achieve our goals and improve on the previous designs. I also began looking into transmitting data through a Bluetooth connection. There was a small bit of material in one of the research papers that discussed their data transmission, however a broad background would be good to have before designing our own system. Lastly, I downloaded the software Fusion 360 that the team will use to design our PCB's.

- **Pending issues**

- Create a Fusion 360 team for joint-collaboration.

- **Individual contributions**

<b><u>NAME</u></b>	<b><u>Individual Contributions</u></b> <i>(Quick list of contributions. This should be short.)</i>	<b><u>Hours this week</u></b>	<b><u>HOURS cumulative</u></b>
Cade Kuennen	Research into different designs of other pill sensors related to our project goal provided by Dr. Lu. Research into how Fusion 360 works and downloaded it to my PC. Created a Fusion team space to allow us to collaborate on design files.	4.5	4.5
Wes Ryley	Review the paper Dr. Lu sent. Download Fusion 360 and watch the tutorial video. Begin looking into the functionality of Bluetooth and how it can be integrated.	4	4
Alex Upah	Compiled a group schedule to serve as tool for ease in future scheduling. Read prototype papers provided by Dr. Lu.	4.5	4.5
Rakesh Penmetsa	Study on paper related to project. And groundwork on technologies used	5	5

- **Comments and extended discussion**

- N/A

- **Plans for the upcoming week**

- As of this point in the project, plans for the upcoming week will still be by a team basis, rather than individually focused. Each team member should read papers presented by faculty members, as well as establish some familiarity with working biosensing principles. Further establishment of component specific roles should occur next week. Our faculty advisor Dr. Lu said that he would put together a presentation providing background information and actionable goals and learning topics that the team will fulfill on receiving presentation and information.

- **Summary of weekly advisor meeting**

9/9/2024 Meeting: Met with Dr. Lu and discussed the following topics:

- Personal Introductions
  - Each individual gave an introduction to who they are, what they are studying, and where they think they will exceed in the project.
  - Dr. Lu and Zheyuan Zhang gave introductions into their field of expertise.
- Dr. Lu walks through the previous models of this project and supplies the team with background information for the team to cover.
  - Covers a previous lab-assessable only model.

- Breaks down the project into comprehensible sections:
  - Data Transmission
  - Maintain Cell Growth
  - Optoelectronic Sensor Use
  - Processing System

9/16/2024 Meeting: Met with Dr. Lu and discussed the following topics:

- Need to look into possible low-power MCUs for the design
  - nRF52832 (MCU used in GI Tract Inflammation Profile paper sent by Dr. Lu)
  - ESP32 (Arduino-based MCU proposed by Dr. Lu)
- Types of sensors needed for this design
  - Temperature sensors for observing and controlling the temperature of cell housing.
  - Optoelectronic sensor for sensing level of bioluminescent emission from cell.
- Data transmission for design
  - Bluetooth transmission from pill straight to PC
    - No portable comms station for out-of-lab testing is needed for this design
- Housing design
  - need well-sealed housing design to ensure the solution the pill is submersed in does not leak into the electronics
- Fusion 360
  - The team has created a senior design team workspace in Fusion 360 which we can all access PCB and Housing design docs in. If anyone who hasn't yet created Fusion accounts, they can all get in the same team space during the next meeting with Dr. Lu.
- Dr. Lu meeting summary presentation
  - Dr. Lu will be putting together and sending out a post-meeting summary presentation in discord with actionable tasks that we should complete before the next meeting with him.