Executive Summary

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A portable microscopic fluorescence detection platform, though an unwieldy title, is comprehensively descriptive. The scientific method of fluorescence spectroscopy utilizes a light source to excite a sample and detect the presence and concentration of a compound. This project will port this technology to a mobile platform, one which will be capable of analyzing these samples in the field and communicating its findings wirelessly to a mobile application on an Android device. This kind of technology has applications most saliently in healthcare. Use of this technology can aid in diagnosis of patients, as well as identification of certain drugs in the body. Bringing this to a mobile platform would extend its availability greatly. Thus, the pillars of this project include mobility, usability, and affordability.

We were not the first engineers to attempt a solution for Cheng Research Group; we iterated on the work of previous capstone students at OSU. We began by inheriting a partially-developed platform, completing a thorough system analysis on the platform, and then redesigning the system. We determined where improvements would be necessary. The first improvement was moving the project to a smaller, more affordable, but equally as capable microprocessor. Next, we determined that the wireless communication medium that the previous engineers used was not up to the standards of our project partner. The previous version of the solution made use of WiFi enabled emailing and communication between a mobile application and the system. Our project partner wanted the communication to occur over bluetooth so that WiFi was not necessary on site when the system was being used. These major improvements necessitated a new design of the power system, a new design of the enclosure, major modification to the embedded code, and a new mobile application.

After the project was completed, we evaluated the possible areas of improvement on our solution. Our current design produces spectra for the red, green, and blue components detected in the image. We recommend that this data be used to calculate and produce a light wavelength spectrum instead, which would make the output easier to interpret. Next, we recommend that a more accurate sensor be used for detecting the fluorescence, while ensuring that it does not increase the system cost excessively. Our third and final recommendation would be to include advanced optic filtering to more accurately detect wavelengths present in the fluorescence of the sample.

Throughout the process of building this solution, we learned a few important lessons about project workflow and teamwork in engineering. We learned the absolute importance of detailed and collected documentation. Our inherited project lacked any significant documentation, and that greatly extended the development time that needed to be dedicated to effectively reverse engineering the previous project. We also learned the importance of constant and honest communication between team members on progress, delays, deliverables, and requests for help. If we had created a more robust protocol for team and individual workflow and group communication, we would have cut down significantly on development time and likely produced an even more impressive solution.

Project timeline

	Week 1	Week 2	Week 3	Week 4	Week 5
Presentation Video				Presentation Video ("E")	Presentation Video (Thur)
Project Partner Updates				Project Partner Update ("E")	
Project Documentation				Draft Project Document Section 1 ("E")	Draft Project Document Section 2 (Fri)
Research					
Prototyping / Testing					Test previous "inherited" project, determine downsides/what should be improved ("E")
Prototyping / Testing, cont.					
Evaluation					Review Proj Doc + inherited project: Redesign or not? (E)
Other		Meet up and decide meeting times		Exec Summary ("B")	Requirements ("J")
Other Cont.				Gap Analysis ("J")	Design Impact Statement ("B")
Other Cont.				Team Com. Protocols/Standards ("M")	Risks ("M")
Other Cont.				Timeline ("G")	References and File Links ("E)
Other Cont.					Revision Table ("E")

Figure 1: Fall 2021 Weeks 1 - 5

	Week 6	Week 7	Week 8	Week 9	Week 10
Presentation Video	Presentation Video ("E")	Presentation Video ("E")	Presentation Video ("E")		Presentation Video ("E")
Project Partner Updates		Project Partner Update ("E")			Project Partner Update ("E")
Project Documentation	Peer Review Draft Project Document: Section 1 and 2 ("E")	Project Document: Section 1 and 2 ("E")	Draft Project Documentation Sections 3 ("E")	Peer Review Draft Project Document: Sections 1-3 ("E")	Project Document: Sections 1-3 ("E")
Research	Lenses to add to camera to provide a "better" image ("G")	Bluetooth Image/Data transmission Research ("B")	Bluetooth Image/Data transmission Research ("G")		
Prototyping / Testing	Get working prototype to take images, and turn on/off provided LEDs ("J")	Prototype takes pictures on press of button ("J")	Prototype sends some data through bluetooth (to computer or phone, whichever is easier) ("J")	Prototype sends tweaked image/4 images from week 8 to some device (PC or mobile, whichever easier) ("E")	
Prototyping / Testing, cont.		Prototype takes 4 pictures on press of button: 1 w/ no LED's, 1 w/ LED A, 1 LED w/ B, 1 LED w/ C ("J"/"B")			
Evaluation					
Other			Block Diagram ("J")		
Other Cont.			Block Descriptions ("B")		
Other Cont.			Interface Definitions ("E")		
Other Cont.			References and File Links ("E")		
Other Cont.			Revision Table ("E")		

Figure 2: Fall 2021 Weeks 6 - 10

	Week 1	Week 2	Week 3	Week 4	Week 5
Presentation Video		Presentation Video ("E")	Presentation Video ("E")		Presentation Video ("E")
Project Partner Updates			Project Partner Update ("E")		
Project Documentation					
Research		Power efficiency (B)			Raspberry Pi Zero Bluetooth Communication (J)
Prototyping / Testing			Block 1 Validation. Power Supply(B), RasPiHat(M), AndroidCommunication (G), AndroidAppBackend (J)	Block 1 Verification	
Prototyping / Testing, cont.					
Evaluation					
Other		Draft Block Validation: Block 1 (E)	Peer Review Block Validation: Block 1		Draft Block Validation: Block 2 (E)
Other Cont.					
Other Cont.					
Other Cont.					
Other Cont.					

Figure 3: Winter 2022 Weeks 1 - 5

	Week 6	Week 7	Week 8	Week 9	Week 10
Presentation Video	Presentation Video ("E")		Presentation Video ("E")	Presentation Video ("E")	
Project Partner Updates	Project Partner Update ("E")				Project Partner Update ("E")
Project Documentation					System Verification 1 (E)
Research					
Prototyping / Testing		Block 2 Validation. Fluorescence Detector (B), Portable enclosure (M), AndroidAppUI (G), Fluorescence embedded (J)			
Prototyping / Testing, cont.					
Evaluation					
Other	Draft Block Validation: Block 2 (E)			System assembly (E)	
Other Cont.					
Other Cont.					
Other Cont.					
Other Cont.					

Figure 4: Winter 2022 Weeks 6 - 10

	Week 1	Week 2	Week 3	Week 4	Week 5
Presentation Video		Presentation Video ("E")			Presentation Video ("E")
Project Partner Updates			Project Partner Update ("E")		
Project Documentation			Project Poster Draft (E)	System Verification (E)	Project Poster Final Draft (E)
Research					
Prototyping / Testing					
Prototyping / Testing, cont.					
Evaluation				Project Poster Peer Review (E)	
Other					
Other Cont.					
Other Cont.					
Other Cont.					
Other Cont.					

Figure 5: Spring 2022 Weeks 1 - 5

	Week 6	Week 7	Week 8	Week 9	Week 10
Presentation Video					
Project Partner Updates	Project Partner Update ("E")				
Project Documentation	Final Project Document (E)		Project Showcase (E)		
Research					
Prototyping / Testing					
Prototyping / Testing, cont.					
Evaluation					
Other					
Other Cont.					
Other Cont.					
Other Cont.					
Other Cont.					

Figure 6: Spring 2022 Weeks 6 - 10

Project Timeline Spreadsheet Link:
https://docs.google.com/spreadsheets/d/1ouE_E5FX80h85E5u2vF_gLWPRAbcxqr9WxoZP73m2go/edit#gid=0