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SECTION A02 – FA24

DELIVERABLE H: PROTOTYPE III AND CUSTOMER FEEDBACK

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Summary

In the preceding deliverable, Deliverable G, we've built our second prototype of the final solution design. Now, as we progress to Deliverable H, our focus shifts to the third round of testing and prototyping results. This phase involves a thorough analysis of our systems and soliciting valuable feedback from our selected clients. The analysis is primarily concentrated on finalizing critical physical components, such as ensuring a better locking mechanism for the casing, as well as troubleshooting battery problems, RFID reader connector issues, and developing a tangible and usable user interface for our mobile app, while allowing it connectivity to the HC-05 Bluetooth module in order to receive data.

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Introduction

As upcoming design engineers, it is important that we keep a structured and organized work discipline, following specific and precise steps and instructions, as well as detailed in-sights of what and how the work will be done. As such, following the conceptualization steps of the Design Thinking process, we view it crucial to create a focused prototyping and testing schedule for the next 3 weeks of project work. Throughout this period, the team will be delivering one prototype overview and customer/user feedback report weekly (Deliverables F, G and H). The report will also include information about future work to be done on the prototypes, and improvements made to the design along the way.

In this deliverable, we present the third prototype which corresponds to an updated version of prototype 2. In order to optimize the reliability and efficiency of the final product we took into consideration the feedback from a selected potential user on prototype 2 then identified several flaws in this prototype and corrected them for prototype 3. This way we have a better understanding of the design as a whole so we can finish our product.

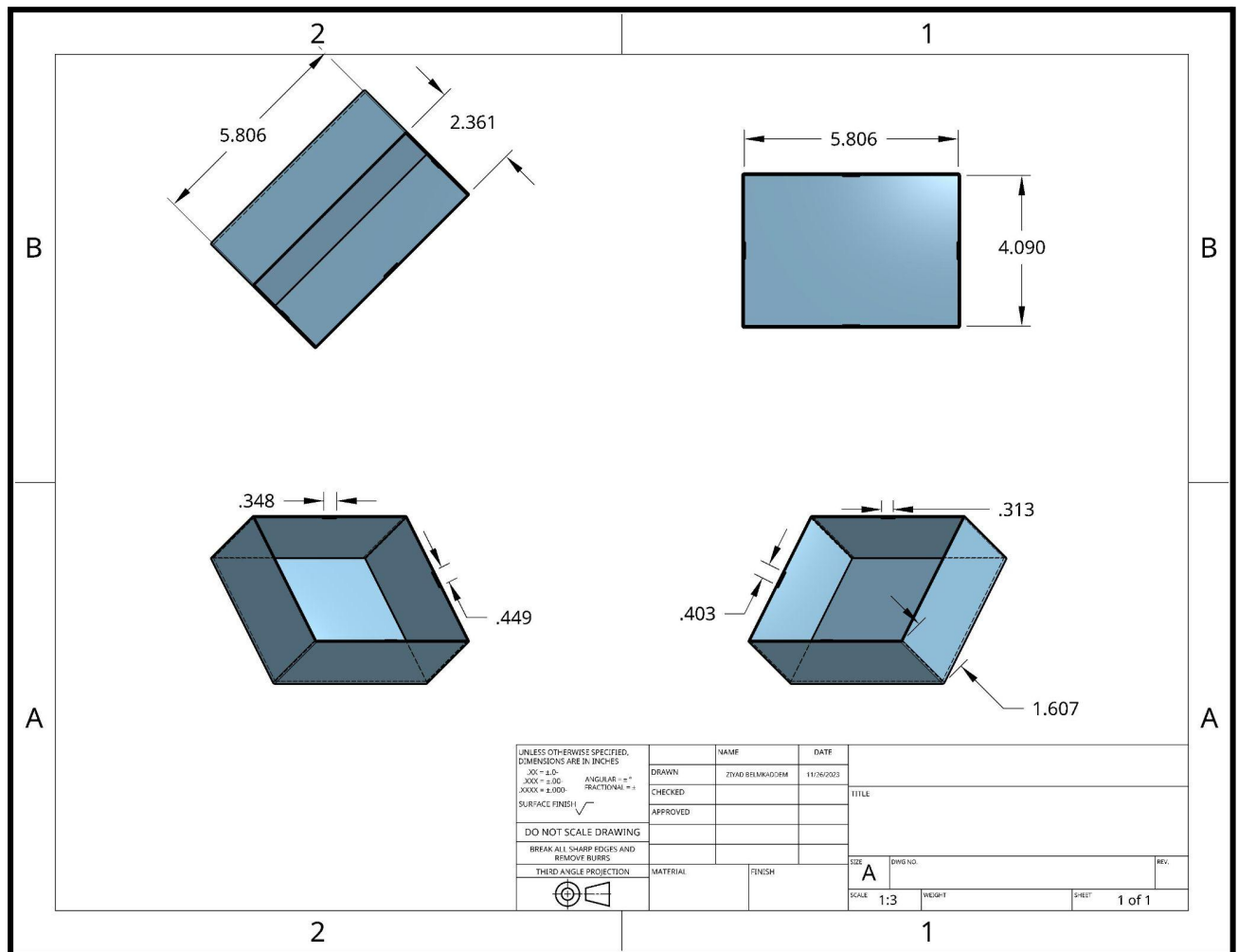
Prototype 3 Components

The third prototype was a complete and comprehensive, hardware AND software prototype. It differs from the previous prototypes with the existence of a usable mobile app to go along with the electrical circuit's functionalities.

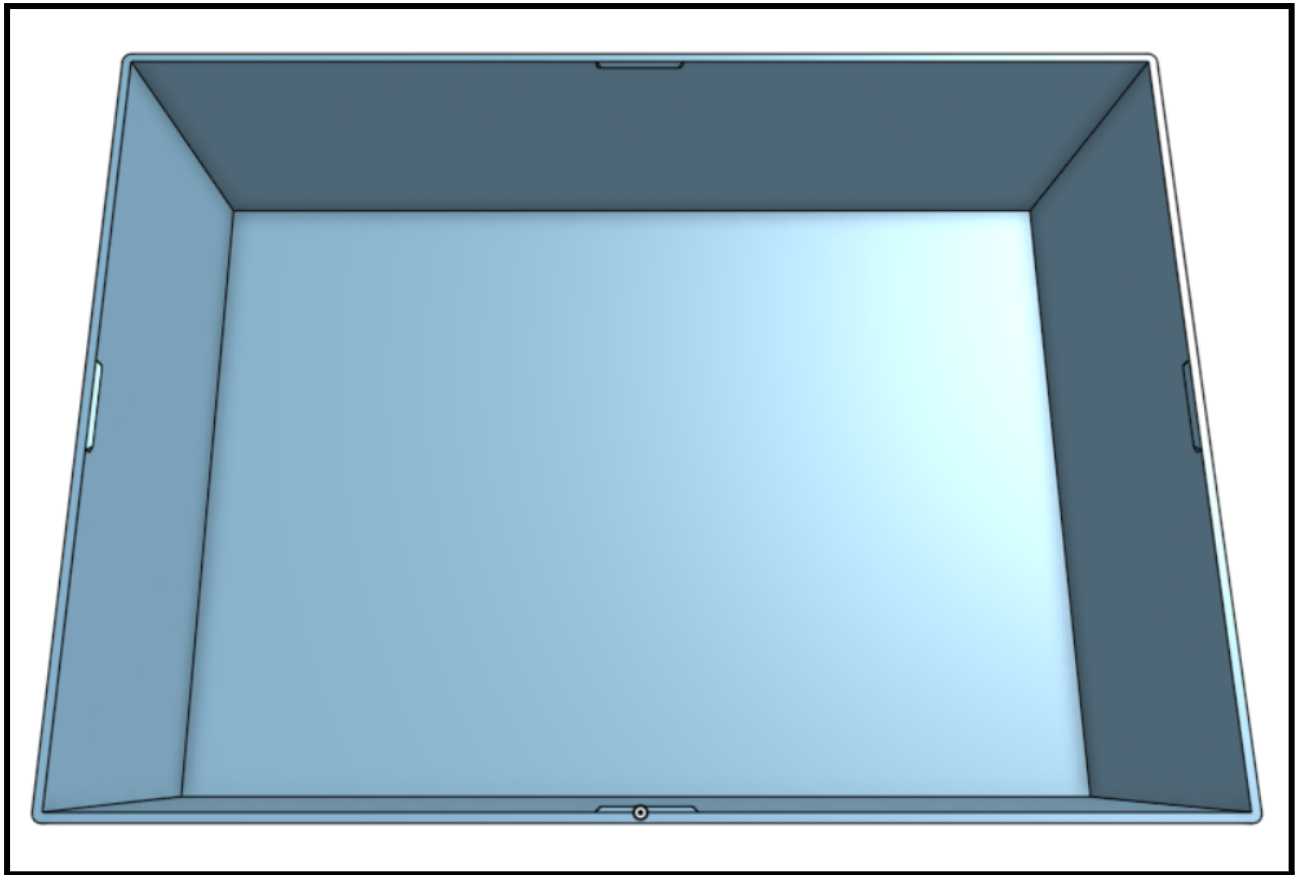
ELECTRONICS CASING

For our Electronic Casing, since we've encountered that our 2nd prototype box was dealing with some issues with the locking mechanism, we decided to improve it by adding 2 more attachment points with one in each mid-segment of the cover's surface. We've also modified the dimensions of the case so that at the same time it could implement all the electrical circuits and offer a strong and reliable locking mechanism.

ELECTRONIC COMPARTMENT

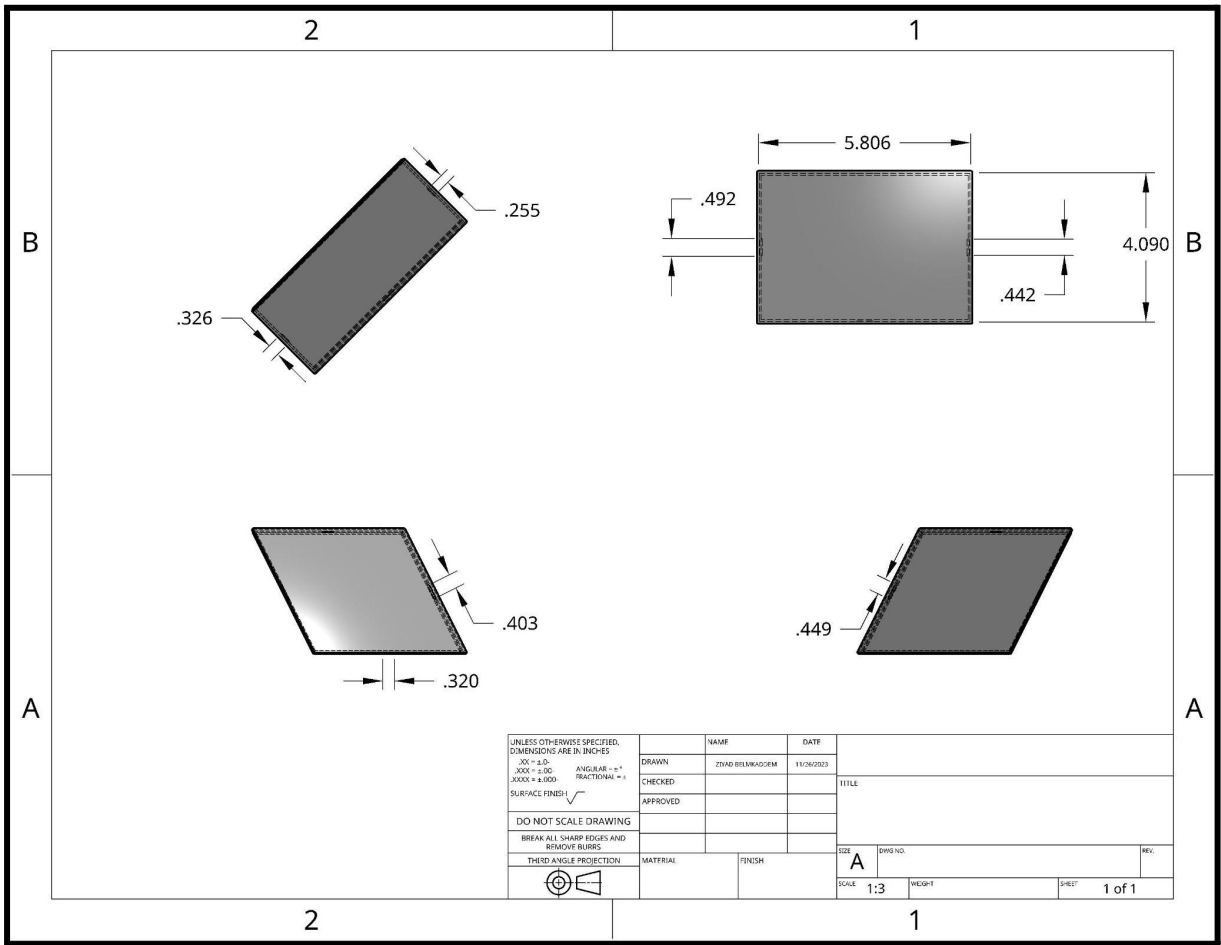


Compartment measurements and schematics

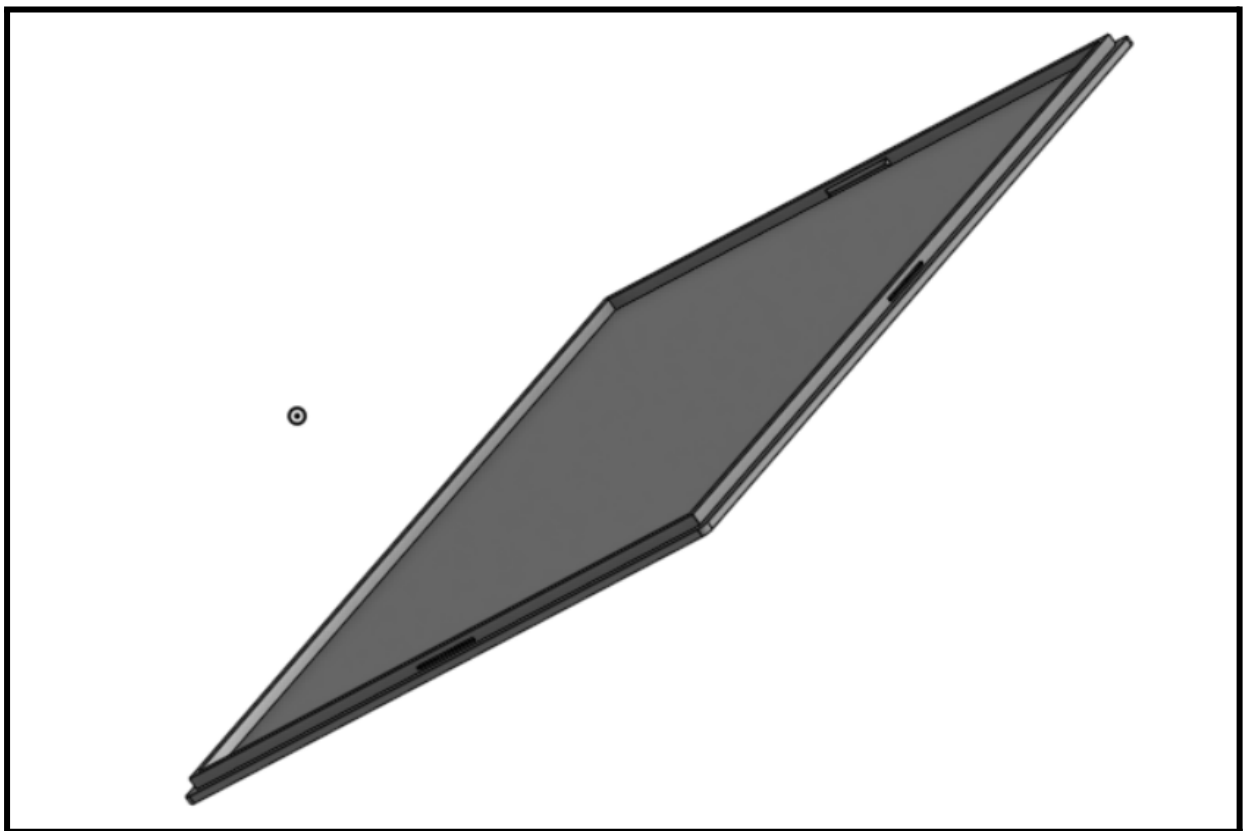
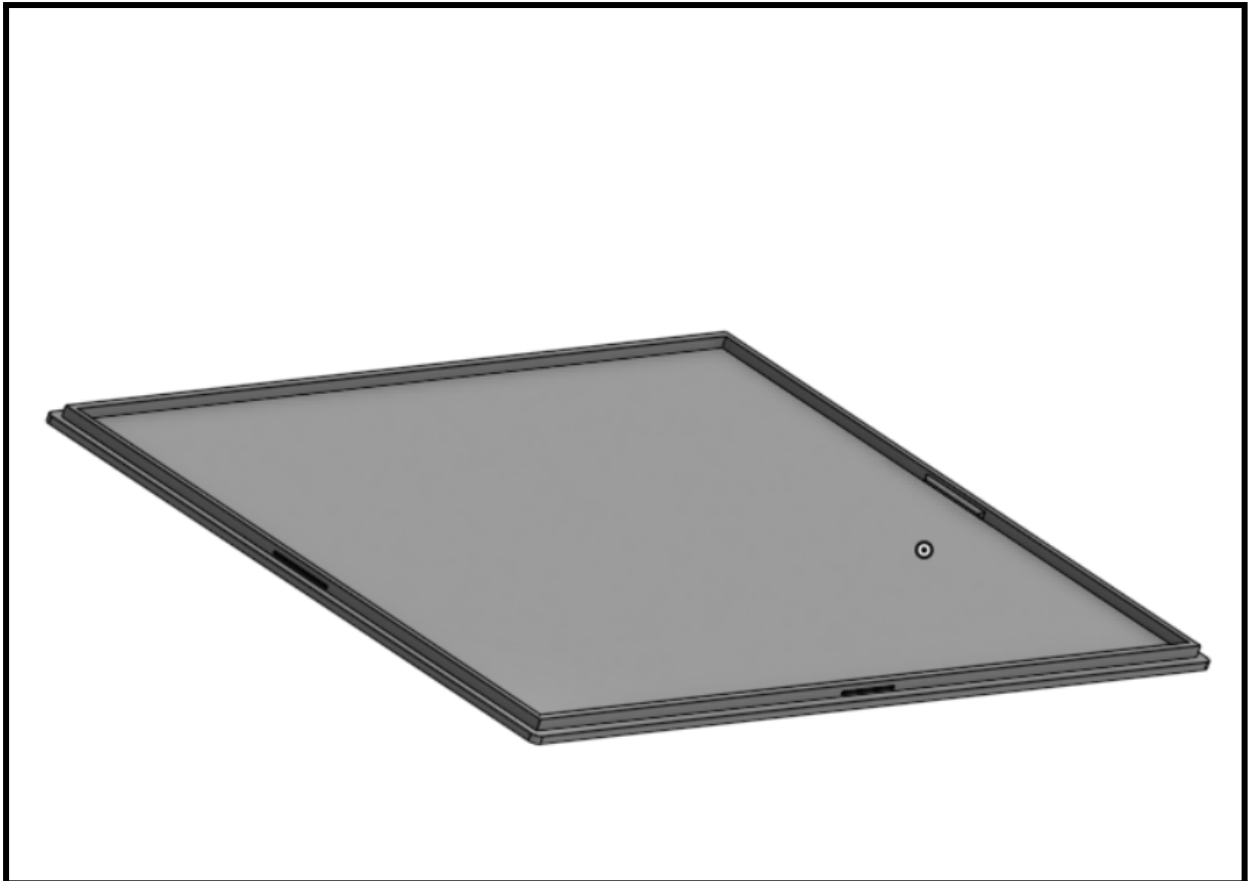


Compartment 3D model view

COMPARTMENT COVER



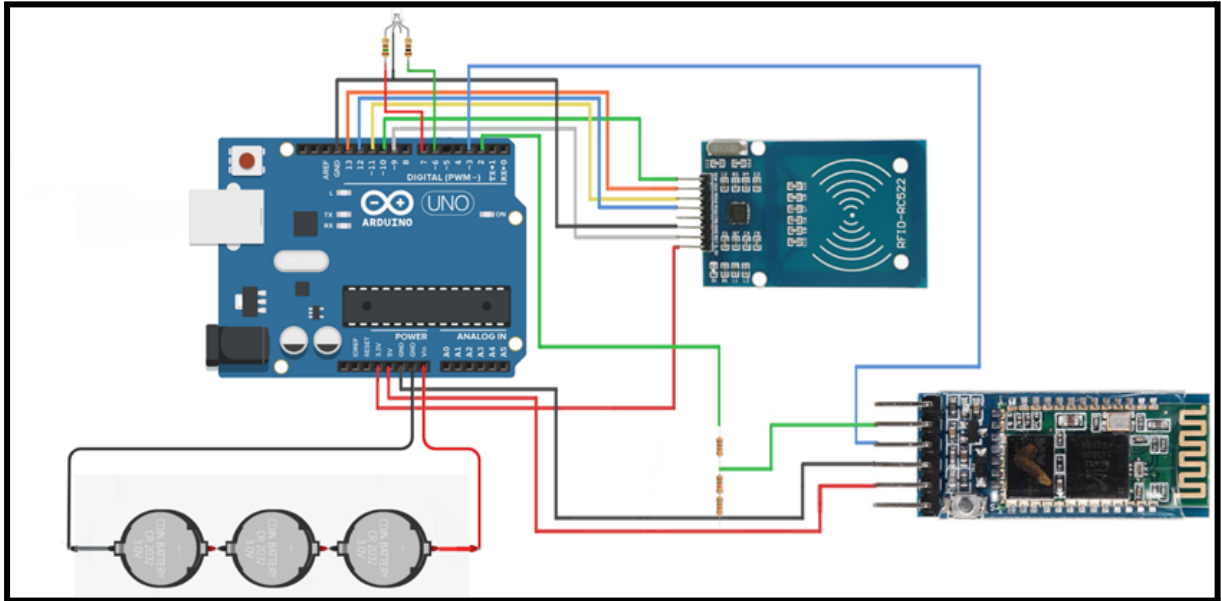
Cover measurements and schematics



Cover 3D model views

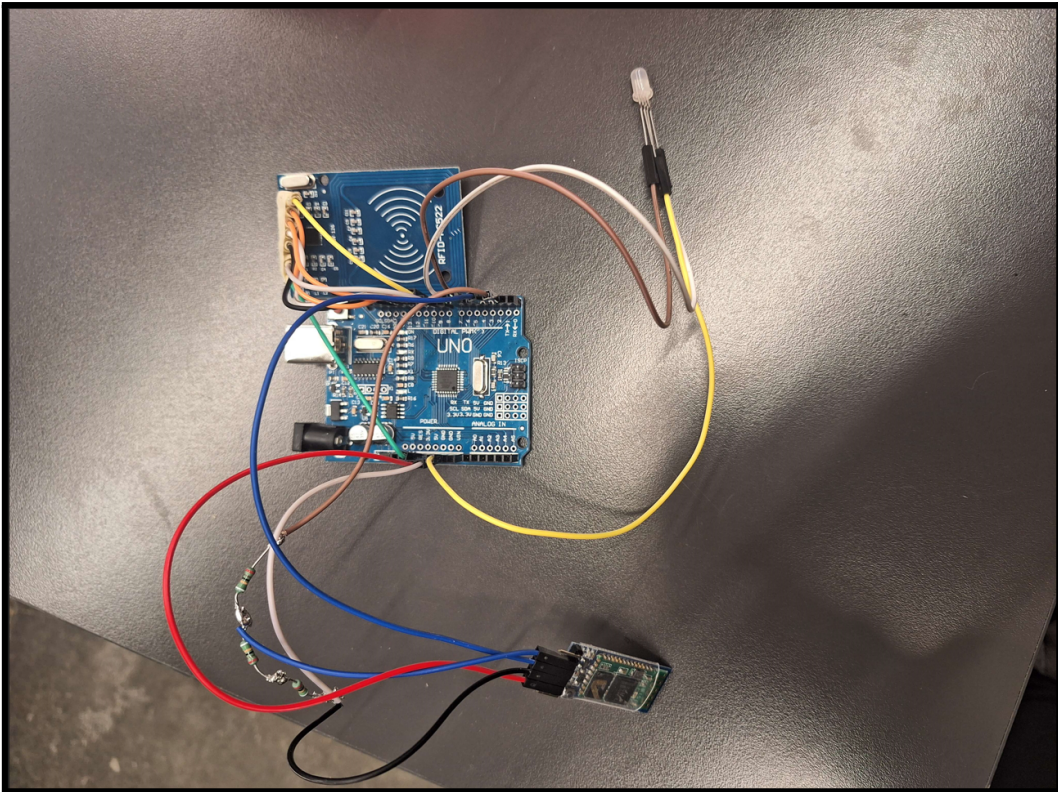
ELECTRICAL LAYOUT

For the third prototype, the team chose to abide to the following circuit:

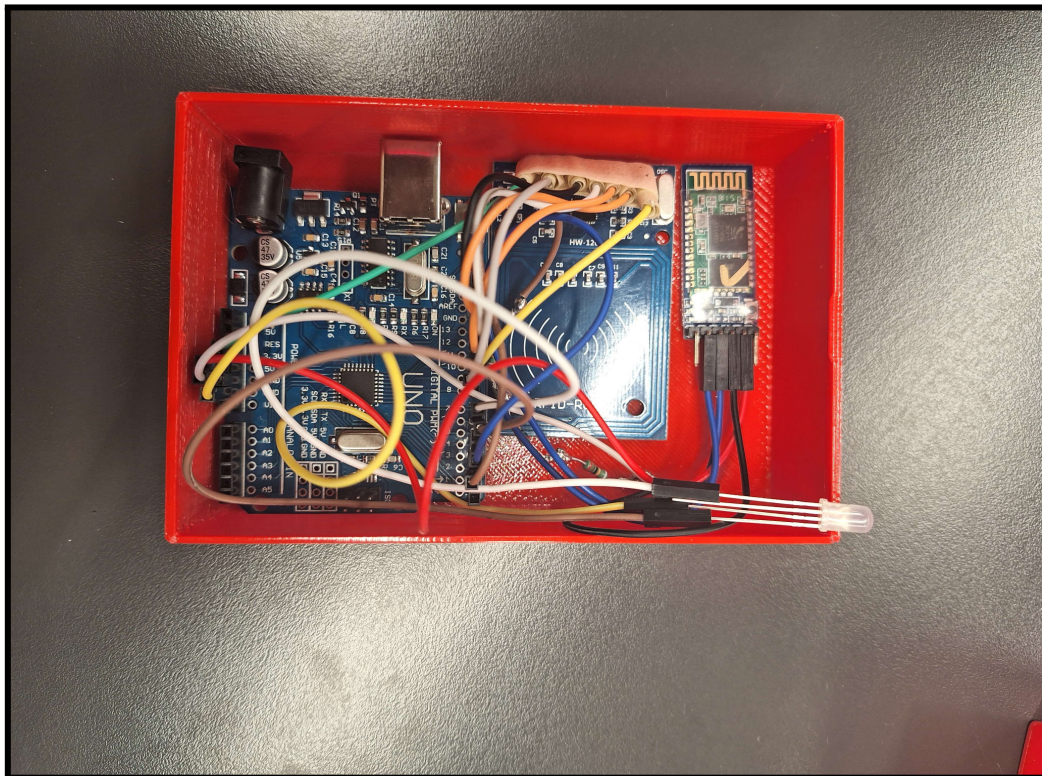


For prototype 3, we modified the previous circuits from prototypes 1 and 2 for a better and more organized solution:

- We added the RGB LED lights to the circuit as a failure detection system. For a failed scan the RGB LED light will flash red and for a successful scan the LED flashes green.
- As the batteries were very unreliable and unstable we troubleshooted the problem and it turns out that no matter how much the batteries provided 6-10V the bluetooth module only functions if the power source provided to the arduino is from the USB port so for this prototype we will stick to a USB power source until the problem is solved
- We cut down the cables and made them shorter to make the circuit fit easily in the box and to organize them.
- We used double sided tape to fix the arduino, the Rfid and the bluetooth module on the bottom of the box and we ended up with a stable and organized layout of the first and second sub-systems together.



A picture of the complete and final electrical circuit



A picture of the complete and final electrical circuit placed in our box

THE MOBILE APP INTERFACE

Wireframe

Here is the wireframe for the application, which is still the same as the wireframe of the second prototype, because it didn't need to be changed. This one is high fidelity and includes these following :

- The interface: which is the main menu, where you have access to every option that the app provides .
- Reglages (Settings) : in which we can change the language, the display, the notification you receive and the sound.
- Aide (Help) this page gives you access to the FAQ (for more general questions about how the application works) and to a phone number and an Email to contact when you have a more specific problem.
- ITEM: This page shows the information about the item that you are searching for : the serial number, the location, the date of entry(=When did the item enter the inventory), the history of this item(= every move in the inventory). With the option « partager »(share) you can share the information you found with other members of your team.
- Historique (History): provides the user with their items' search history .
- Enterprise: From there, the user can chat with all their colleagues who use the application.
- Scan: allows the owner of the app to use their cellphone as a scanner for the item.
- Informations : provides the information about the person that logs in; their name, their email, their phone number and the name of their company. Furthermore, they can edit their personal information at any instant.
- Notifications : we can track any item's registration activity within the inventory.
- Login page: From here the user can log in to their account using either their email address or their phone number and entering their password.
- FAQ page: From here the user has access to several questions through which the answer to his problem can be found.
- Two discussion pages: From the first discussion page, the user has access to all their conversations with their co-workers and on the second one, the user can chat with one specific co-worker.
- Notifications setting page: Here the user can choose which notifications he wants to receive.

- Sound setting page: From here, the user can activate the sound of the application or deactivate it.
- Languages pages: from here the user can configure the language of the application. He has the choice between English and French.
- Display setting page: from here, the user can change the font display.
- The validation page: This page is only available on the version of the application that the office's boss owns. From there, He can choose to accept or to decline the modification that an employee wants to do on an item.



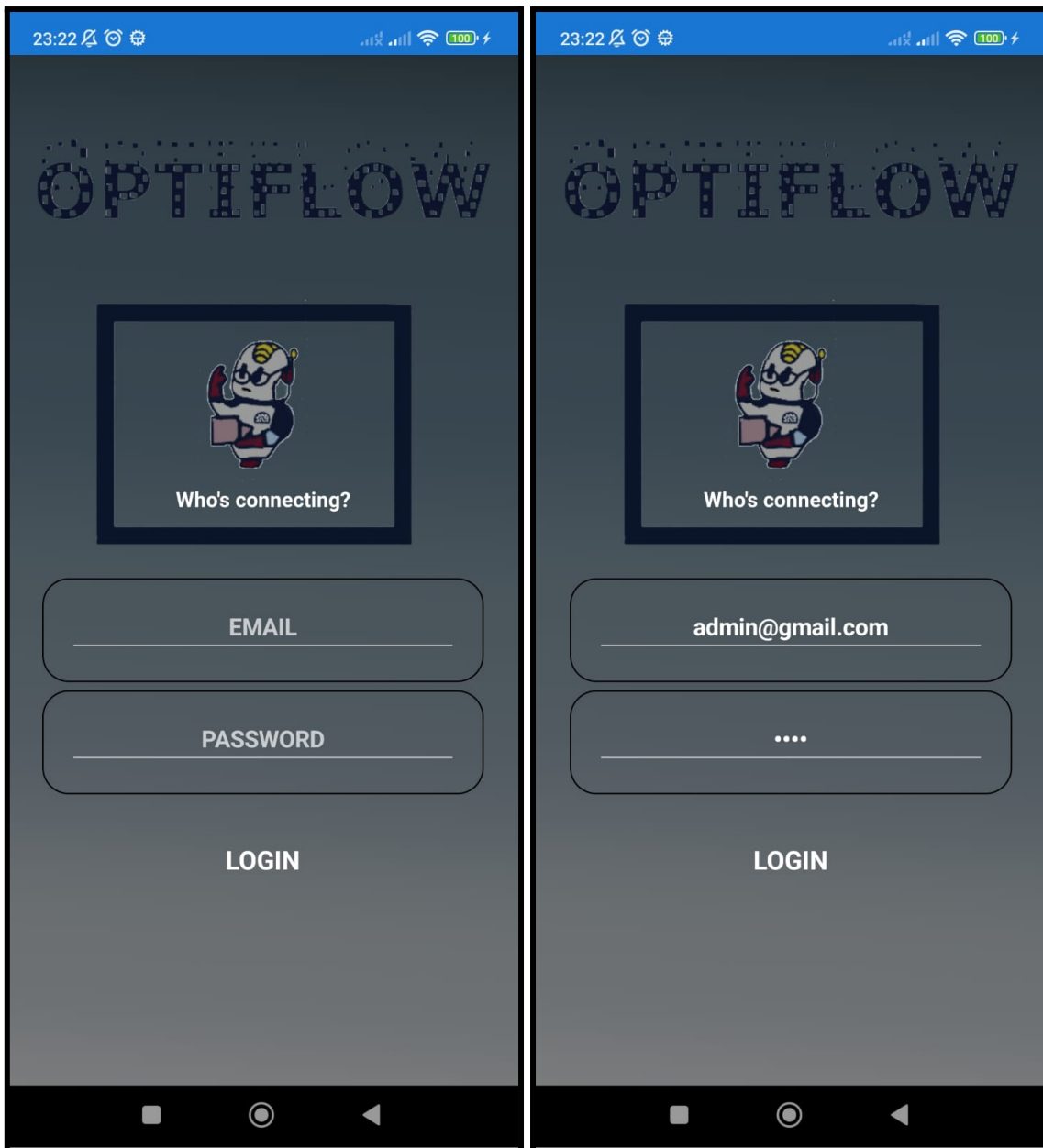
Wireframe pages

Mobile App

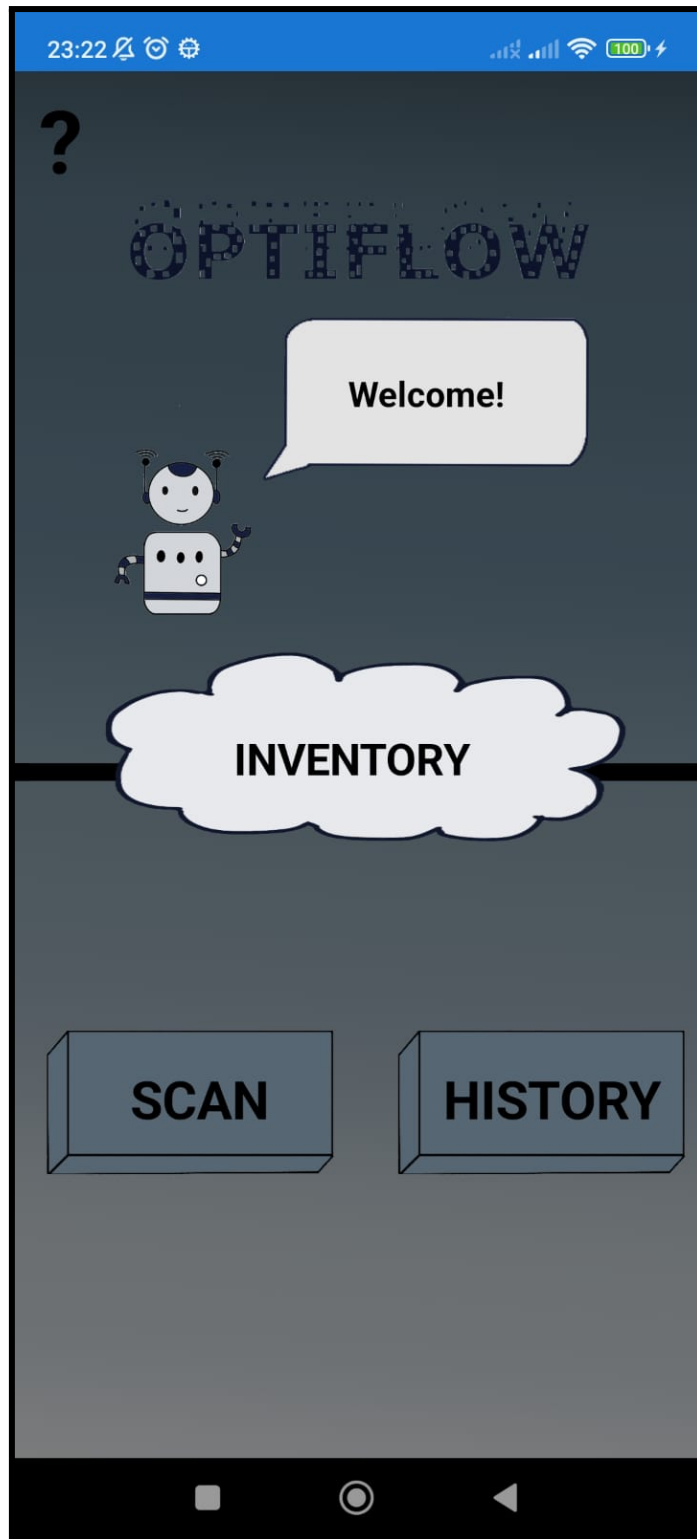
After several weeks, we've finished our fully functional mobile app :

The team managed to achieve four of the main functionalities that were aimed for beforehand. These features are:

- A secure “login” system, with account identifies and passwords being stored locally for enhanced security.
- An inventory page, with an “add” feature, which allows the configuration and display of all the items stored in the inventory, as well as their properties. Their properties are: Name, tag number, description, quantity, and date/time of addition.
- A scanning feature, using the phone's own camera.
- A history page, allowing the user to view previous additions/deletions.



Screenshots of the app's login process



The main page

While it was found that many of the features that were planned are missing, the team plans to implement as many of them as possible in the coming few days (27th to 29th of November) in preparation for Design Day, and in their journey towards “perfecting” their product, to their perceived standards.

Prototyping Test Results

TEST #1: MOBILE APP INTERFACE

In order to ensure that our mobile app offers a good user experience, we've decided to get feedback from several users to see if we need to improve it before the design day.

Part of the testing process was to allow a test user to review the app, and give feedback regarding three main criteria: **Time, Usability and Aesthetics.**

The test user in question is a uOttawa student, Mohammed Boustta. His reviews, in respect to the previous criteria, give the following results:

- **Time:** Performing a task using the app is very time-efficient, as all of the functions and features are displayed in an organized and easy-to-find manner. This allows for the fastest time in moving from one page to another. The average time it took for the test subject to access an inventory item in the inventory list, starting from the login page, finishing with the inventory page, was: **<52 seconds.**
- **Usability:** All of the features are clear and self-explanatory, the test subject had no issues understanding their usefulness and their roles for the purposes of this app.
- **Aesthetics:** The test subject marked that the app was not very aesthetically appealing; While the drawings and graphical illustrations were interesting, it was noted that the text fonts used were not pleasing to the eyes, it was also noted that the color scheme chosen was confusing, and often mixed with the text color, making it very hard to read. The test subject finally rated the app on a scale of 10, around aesthetics: **5.5/10.**

TEST #2: POWER SUPPLY

The usage of batteries was later noted very inefficient, regarding their self-discharge and the fact that it is very difficult to obtain batteries that would supply the system for very long, but that are also sufficiently small to be stored in the miniature casing. As such, it was decided by the team that a failure prevention system would be implemented: A hole will be provided next to the powerjack of the Arduino UNO microcontroller to allow for the application of an external power supply, in the case of failure of the batteries. The team will also simplify the interchangeability of the batteries, viewing how often they will need to be changed. Conclusively, it was ultimately decided that providing alternatives in case of failure is more plausible, rational and reasonable than addressing the cause of the failure, especially at this point of the development of the product.

Potential User Feedback

User 1 : Mohammed Boustta: “While the product is interesting and largely sufficient when it comes to its purpose, it fails to expand its horizons on other important aspects, especially the ones related to a comfortable user experience. While it is not a completely negative remark, it is an important one, nonetheless. It seems to me as if the team focused more on the functional aspect of the product, completely overlooking non-functional user-oriented aspects.”

User 2 : Hamza Boulayad: “From a Civil Engineering viewpoint, I believe the team’s approach was adequate. A product like this should not value the user experience more than functionality, after all, it was made for an industrial and commercial setting, more than a general usage setting. Commercial settings require more in-depth features and capabilities, which rarely leaves time for side-tracking unimportant aesthetic and non-functional features.”

P.S: The quotes were largely modified to fit the professional standards of the deliverable, however, the explicit information remains the same.

Summary of our progression from Prototype I to Prototype III

First prototype :

The first prototype included 3 components, which were the electrical layout, the electrical compartment and the wireframe for our application.

For the test related to the electrical compartment, we have decided to use 3D printing. Through this test, we wanted to determine the permeability of 3D materials for the radio waves coming from the RFID reader and tags, as well as their structural integrity and strength. For this prototype we only did the casing of the compartment without the Cover.

As a result, the RFID tag was successfully detected at an acceptable distance as evidenced by the display of the contents of the RFID tag in the serial monitor of the Arduino IDE upon conducting the test.

The test related to the electrical layout consisted of initiating the Bluetooth circuit through the arduino code using a Serial Bluetooth Terminal app on our mobile phone in order to communicate with the Bluetooth module and verify connectivity. We determined, as a result, a maximal distance of approximately 30 meters which we considered as sufficient.

For the wireframe of prototype one we had a total of nine pages : the interface, the setting page, the help page, the ITEM page, the history, the scan page, the information page, the notifications, the FAQ and the discussions page.

Second prototype:

This prototype included the same components as the first one but we updated them

For the electrical compartment , we came to the conclusion that the case we made for the first prototype was too small. Therefore, we decided to make it bigger. Unlike the first one, this electrical compartment had a cover where we tested the closing mechanism .

We did two tests related to the electrical layout, one for the arduino code and one for the battery. thought to include

those several updates for the 2nd prototype to produce our 3rd prototype :

- a failure detection system using an LED

- buy new o-the-shelf 9V batteries because the 7V the batteries were delivering weren't sufficient.

For this prototype, we updated the wireframe and made it high fidelity by adding 5 new pages: notifications setting page , sound settings page, languages page, display settings page and the validation page.

Prototype 3

As said in this deliverable, in this prototype we did some updates on our different components such as adding attachments to our electrical compartment, adding new leds, cutting the cables, and fixing the arduino with double sided tapes for our electrical layout, but for the wireframe we didn't do any modifications since the version we did for deliverable 2 was already completed.

And in this we also made progress on our mobile app.

MATERIAL NAMING

	Item Name	Description	Unit of measurement	Quantity	Unitary Cost	Expected cost	Link
1	RFID reader (RC 522)	Scanner + tag	Unit	1	5\$	5\$	https://www.amazon.ca/CANADUINO-RFID-Starter-13-56MHz-Keyfob/dp/B07B2CV31T/ref=sr_1_2?crd=YZTDLLULKJU5&keywords=RFID+reader+Arduino+UNO&qid=1698606710&sprefix=rfid+reader+arduino+uno%2Caps%2C89&sr=8-2
2	Arduino UNO	Arduino UNO microcontroller (processing unit)	Unit	1	17\$	17\$	https://makerstore.ca/shop/ols/products/arduino-uno-r3/v/A001-WTH-USB
3	Bluetooth module (HC 05)	Bluetooth transceiver replacing the serial cable	Unit	1	9\$	9\$	https://makerstore.ca/shop/ols/products/hc-05-wireless-bluetooth-module-with-at-button
4	Jumper cables	1x 10-pack Male-to-Male (20 cm)	Unit	3	1\$	3\$	https://makerstore.ca/shop/ols/products/j

		2x 10-pack Male-to-Female (20 cm)					umper-cables-per-10/v/JMP-CBL-20C-M L
5	Battery	TO BE DETERMINED	Unit	N/A	N/A	N/A	N/A
6	Resistors	-1K Ω -100 Ω -150 Ω	Unit	-3 -1 -1	1\$	5\$	N/A
7	LED	-Diffused RGB 5mm LED	Unit	1	0.60\$	0.60\$	https://makerstore.ca/shop/ols/products/diffused-rgb-5mm-led
8	Data base	SQLite	N/A	N/A	0\$	0\$	N/A
9	RFID case	A plastic case that contains the Arduino, the RFID and the batteries (3D-printed)	Unit	1	0\$	0\$	https://cad.onshape.com/documents/8f4b0cc50aac21c20323d64b/w/f1718eea2c8e68708ef56824/e/fe41029a669a977626162548?renderMode=0&uiState=653ea72120e66a34a1bbd021
10	Code libraries	-MFRC522 -Software Serial	Unit	2	0\$	0\$	https://github.com/miguelbalboa/rfid
	Total without Tax or delivery fee					≈39.60\$	N/A
	Total with Tax and delivery fee					≈45.40\$+0\$	N/A

[4]

Conclusion

After completing our first and second prototype and receiving the customers' feedback, we were able to refine our work and make a better version of the product for our third prototype. This prototype includes a fully functional electrical circuit, a bigger and more convenient RFID casing, and a completed wireframe design. We plan on refining our final solution before the design in a way that encourages our client to buy the product.

References

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- [3] <https://www.electronicwings.com/sensors-modules/bluetooth-module-hc-05->
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