



GNG 1503  
**User and product manual for design project**

**ITM**

**ITM**

**Id, Track and Manage with itm**



Submitted by:

24BEES & FA24

BELMKADDEM ZIYAD, 300341780

BOULAYAD ZAKARIAE, 300342278

BROU DEVA, 300343931

SALIBA ELIE, 300383637

EL BARROUG MAHDI, 300354668

10/12/2023

University of Ottawa



uOttawa

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## Liste d'acronymes et glossaire

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**Table 1. Acronymes**

<b>Acronyme</b>	<b>Définition</b>
ITM	Identify, Track and Manage

# **1 Introduction**

This user manual and product (UMP) provides the necessary information for warehouse workers to effectively use the ITM and for prototype documentation.

The inventory management corresponds to a set of complex processes requiring in-depth knowledge of stocks. It involves analyzing the inputs and outputs of products, as well as maintaining optimal stock levels. In other words, inventory management is a process of monitoring your company's stocks. It allows you to know exactly which product is available, where, and at what time. Inventory management remains fundamental for any business to optimize the supply chain while being able to meet customer demands and identify potential problems before they become critical. We thus asked ourselves, how could we minimize human error to the maximum and provide a comfortable user experience to our users? The answer to this is to make room for automation, provide a soothing user interface, and produce a portable system for inventory scanning and tracking: This is the ITM.

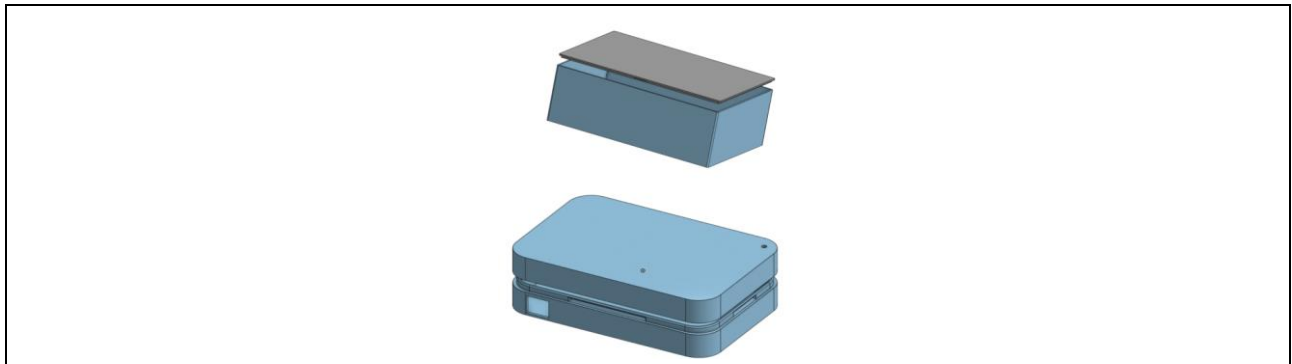
This user manual aims to reproduce or refine our design. You will find all the necessary elements and considerations to take into account for designing and operating our product.

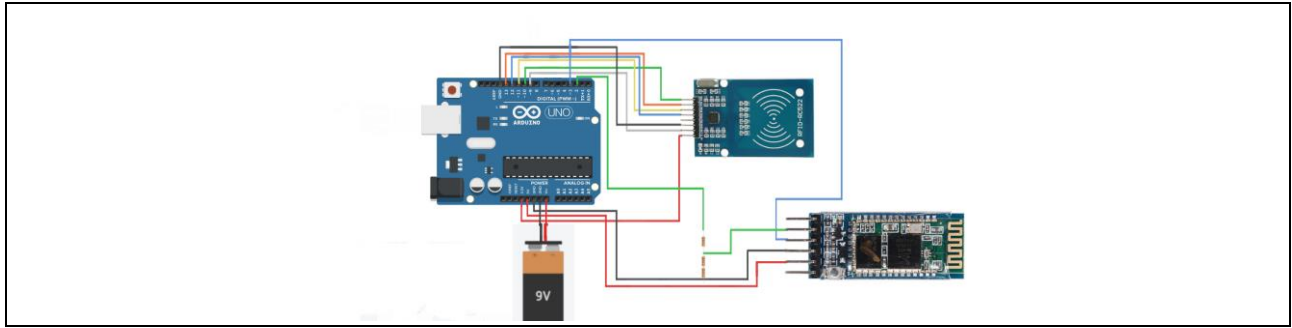


## 2 Preview

The proposed product aims to offer a fast, intelligent and automated inventory management system. The reason behind this is the operational issues and the complexity of this management as well as the inconvenience it causes.

Our product solves this problem by offering a detection and monitoring system mainly composed of an mobile application, a circuit and a 3D printed plastic case. It offers easy accessibility to its user and a notable aesthetic





## 2.1 Conventions

When there will be a particular instruction the user needs to follow, the different step will start with “-”

## 2.2 Cautions and Warnings

Even though the use of this prototypes doesn't requires any authorization, the potential user of this product should be warned about the following :

It is recommended that before using the product, the user reads this entire document.

Responsible and appropriate use of this system is the user responsibility and any consequences resulting from improper use will apply to them.

Compliance with hardware and software compatibility set out in this document is the responsibility of the user; in other words if the user chooses not to use the same software and materials as those indicated, we do not take responsibility for the failure of the system to function.

We are not held responsible for poor training of a potential user. Please do not assign this product to unqualified persons.



## **3 To start**

### **3.1 Considerations for the configuration**

#### Electronics Case:

Our case is what allowed us to provide a portable and ergonomic function to our product.

The entire design of the Electronics Case was done using the online software OnShape©.

Therefore, you will need to create an account through the following link:

<https://www.onshape.com/fr/>. Subsequently, create a document that should have the following characteristics:

**Workspace units**
✔ ✘

▼ **Length**

Length default unit		Display decimals		
Inch	▼	0.123	▼	

---

Linear acceleration default unit		Display decimals		
Inch per second squared	▼	0.123	▼	

▼ **Angle**

Angle default unit		Display decimals		
Degree	▼	0.123	▼	

---

Angular velocity default unit		Display decimals		
Degree per second	▼	0.123	▼	

▼ **Mechanical**

Mass default unit		Display decimals		
Pound	▼	0.123	▼	

---


Force default unit		Display decimals		
Pound-force	▼	0.123	▼	

---

Moment default unit		Display decimals		
Inch-pound	▼	0.123	▼	

---

Pressure default unit		Display decimals		
Pound per square inch	▼	0.123	▼	

To access all the features, click on  next to the title of your document, then on

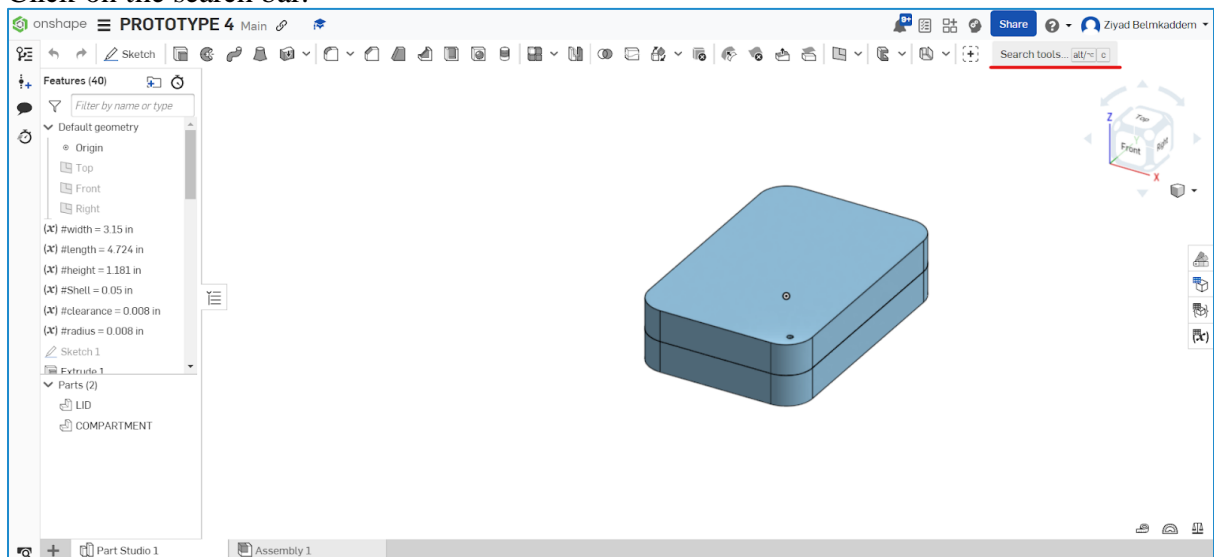
**Workspace units...**

. From there, you can adjust the settings presented, to match those used in the design of our Electronics Case for our product. Next, create a set of **(x) Variable** taking the following values:

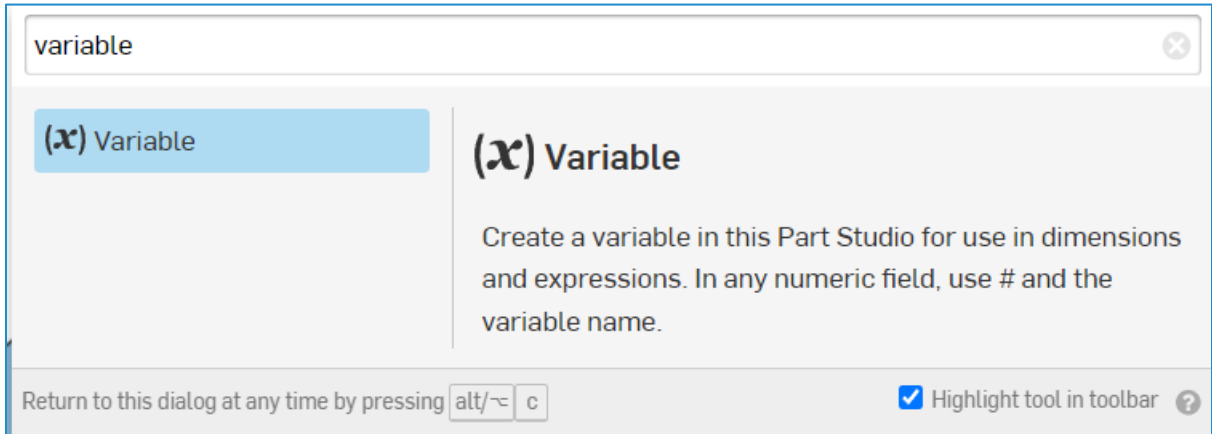
(x) #width = 3.15 in  
(x) #length = 4.724 in  
(x) #height = 1.181 in  
(x) #Shell = 0.05 in  
(x) #clearance = 0.008 in  
(x) #radius = 0.008 in

To do this, follow the steps below:

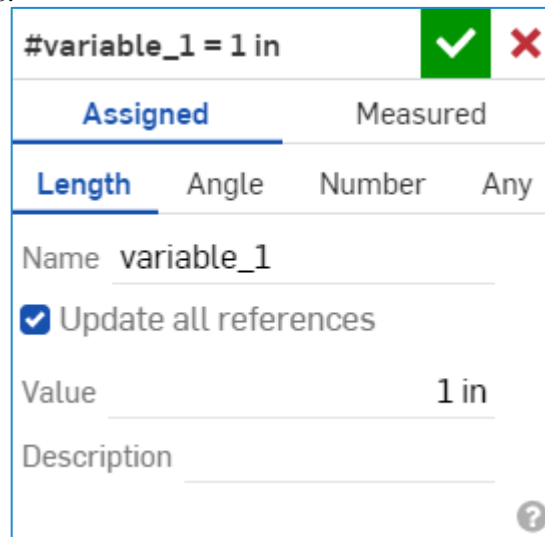
- Click on the search bar.



- Search for 'Variable' :



- Click on and set the name and value of your variable in the Assigned → Length sections on the window that appears:



### 3D printing settings:

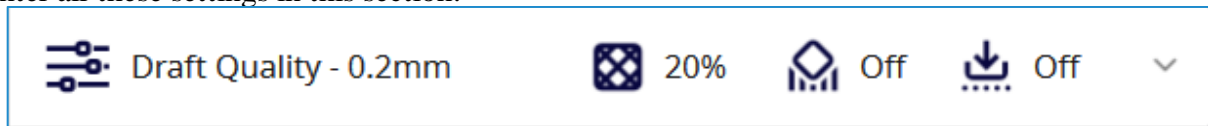
The 3D printer you will use to print the Electronics Case will be an Ultimaker 2+©. You will also need to install the Ultimaker Cura© software through the following link:  
<https://ultimaker.com/software/ultimaker-cura/>.

Once installed, start the software, select the printer to use (in this case, Ultimaker 2+©), and enter the following settings:

Printer used: Ultimaker 2+  
 Materials: Generic PLA  
 Build Plate Adhesion Type: Skirt  
 Layer height: 0.2 mm  
 Wall thickness: 1.6 mm

Wall line count: 2  
Horizontal expansion: -0.02 mm  
Top/Bottom thickness: 1.2 mm  
Top/Bottom layers: 6  
Nozzle size: 0.8 mm  
Draft quality: 0.2 mm  
Infill density: 20%  
Infill pattern: Cubic  
Print speed: 70 mm/s

Enter all these settings in this section:



## The Electrical Circuit:

The electrical circuit is the foundation of our automated system; without it, we cannot establish our smart inventory management system.

Concerning the electrical circuit, you will need to have all the elements (n) and (n) listed in the materials specification (refer to the table of contents).

## Code for the App:

Our app is the reason why we aimed to provide a reliable, autonomous, and practical system to use.

To build Optiflow, we used Visual Studio.

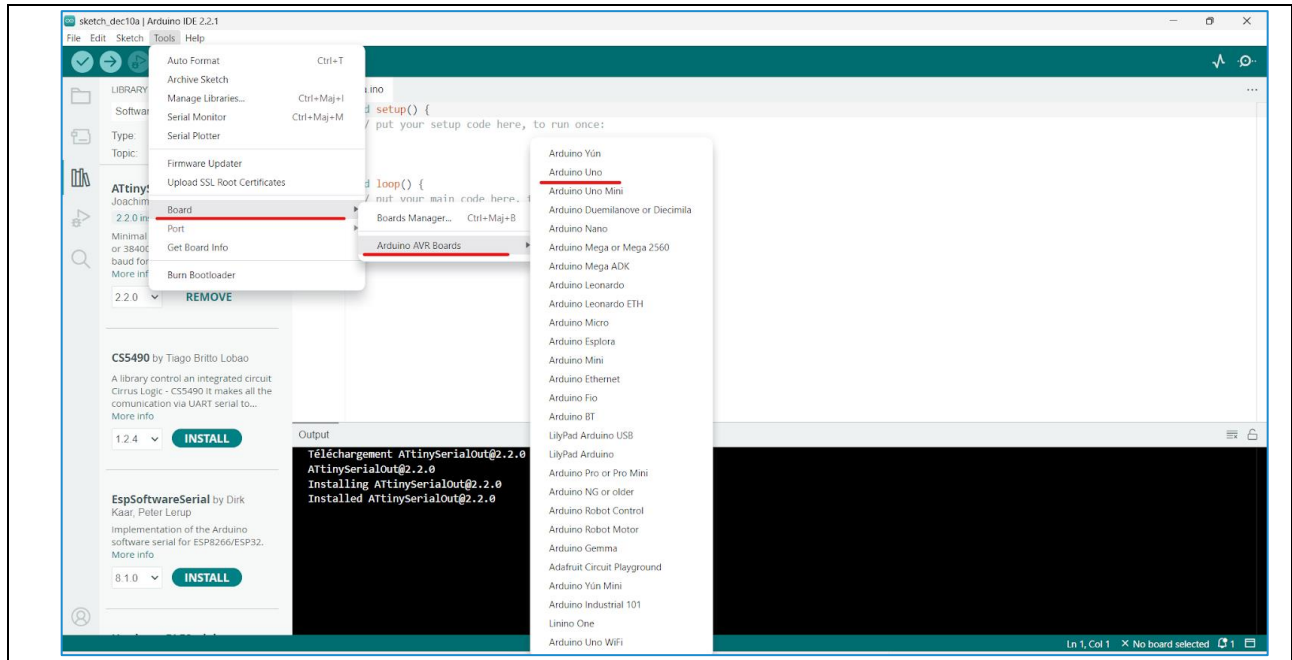
## Code for the Arduino:

The Arduino code allows us to configure our RFID reader so that it can read information related to a tag and also allows us to configure our Bluetooth module to enable the transmission of data read by the RFID sensor to the mobile application.

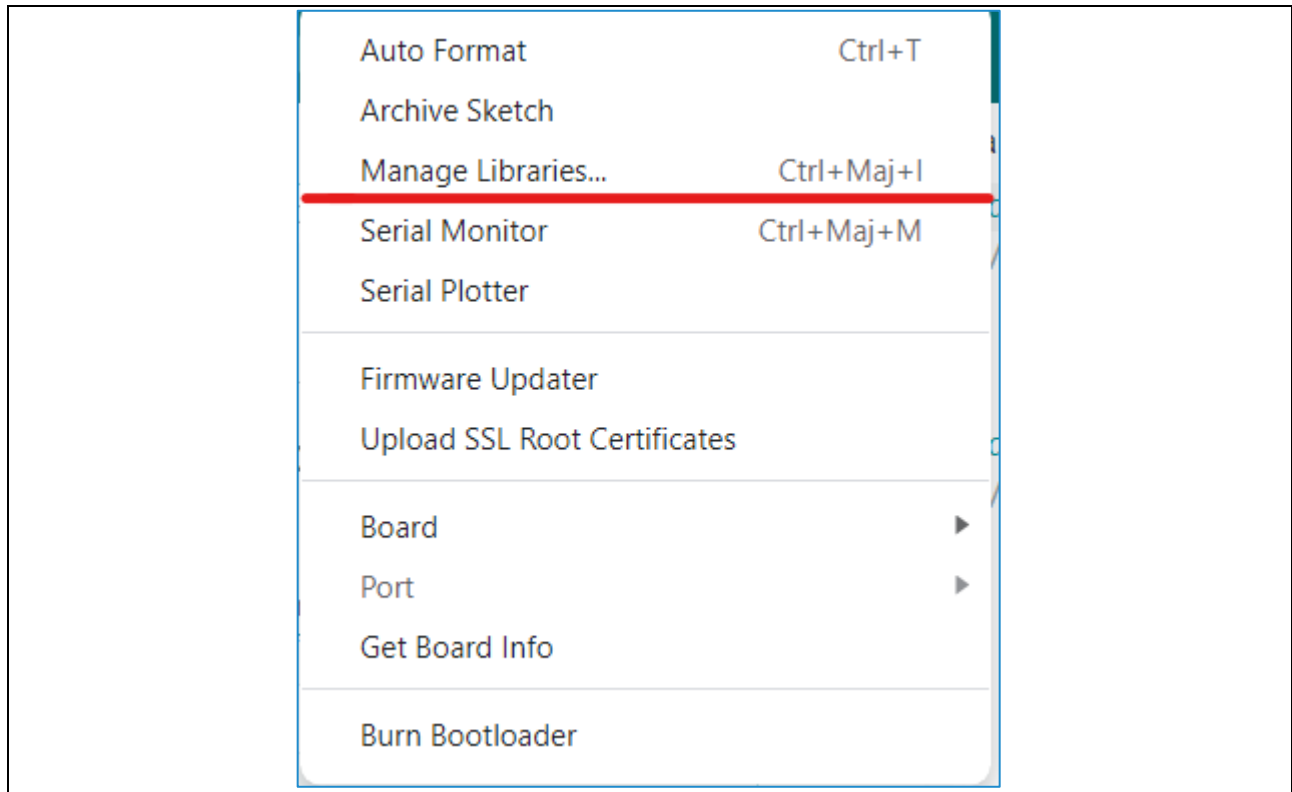
To access the code, you need to install the Arduino IDE © software. Set it up as follows:

- In the section **Tools**, select “Board” → “Arduino AVR Boards” → “Arduino Uno” :





- In the section **Tools**, select “Manage Libraries” :



- In the search bar displayed below, look for the "MFRC522 library" by Miguel Balboa and click on "Install":

## LIBRARY MANAGER

Filter your search...

Type:

Topic:

### **AIPlc\_Opta** by Arduino

Arduino IDE PLC runtime library for Arduino Opta This is the runtime library and plugins for supporting...

[More info](#)

1.0.4

**INSTALL**

### **AIPlc\_PMC** by Arduino

Arduino IDE PLC runtime library for Arduino Portenta Machine Control This is the runtime library and...

[More info](#)

1.0.4

**INSTALL**

### **Arduino Cloud Provider**

#### **Examples** by Arduino

Examples of how to connect various Arduino boards to cloud providers

[More info](#)

1.2.1

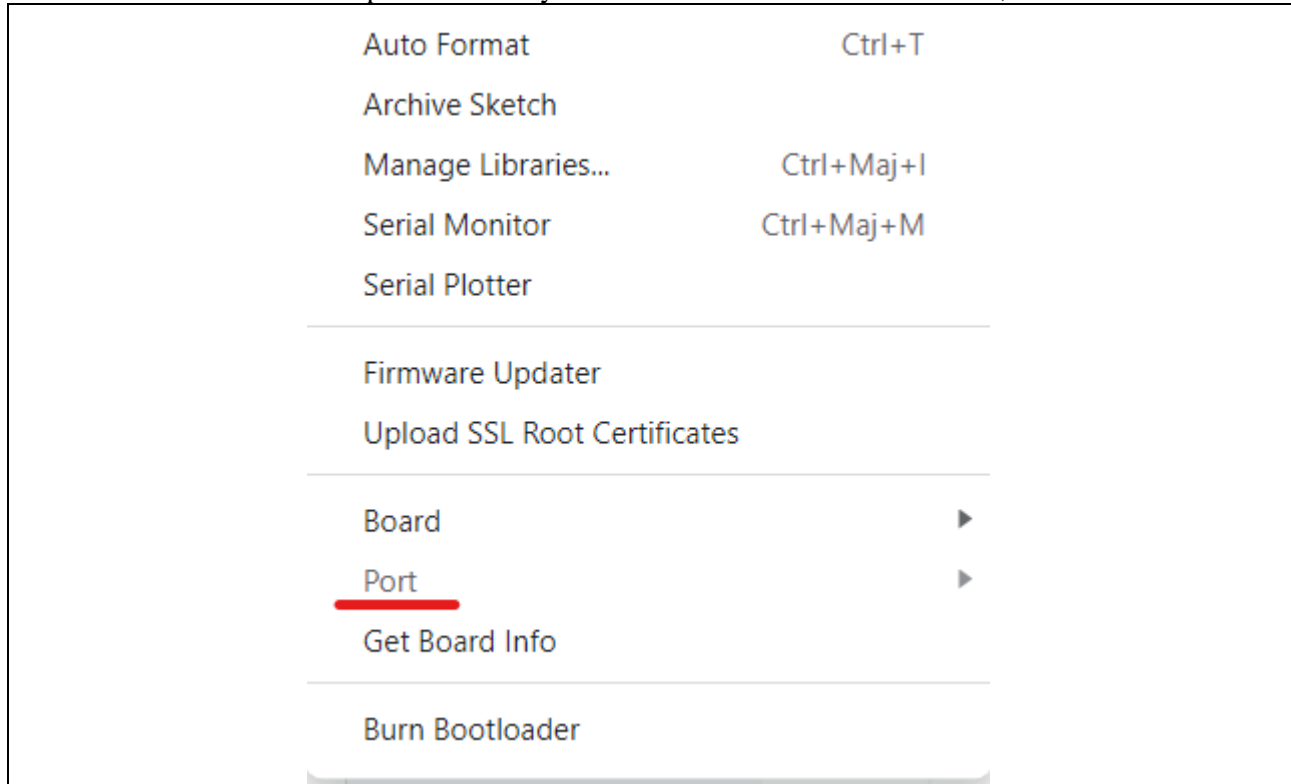
**INSTALL**

### **Arduino Low Power** by Arduino

From now on, you can submit the code used for the Arduino Uno microcontroller available at the following link:

To connect your electrical circuit to the Arduino Uno, follow the steps below:

- You must select the port to which you have connected it. In the section, choose "Port":



- Click on the buttons  to check and upload the code.

### 3.2 Considerations for users accessibility

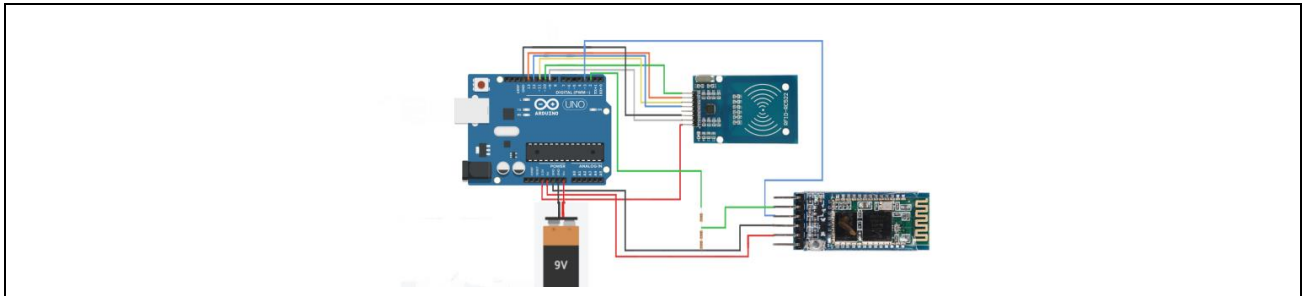
If you are a user of the product, please adhere to the following restrictions:

- Your electronic device must be in developer mode to access the application at all times.
- Our box is made of PLA, which means it is fragile to any destructive impact (such as dropping or throwing the box).
- Our box closure system is sufficiently strong to prevent the electrical components from coming out. Avoid shaking the box to prevent any damage to the closure mechanism or the circuit components. Only open the box for circuit or closure mechanism repairs to avoid damaging the closure mechanism.
- Please wait patiently when clicking on a button in the OptiFlow application's user interface.

### 3.3 Access/installation of the system

#### Electrical Circuit:

All electrical components must be connected as follows:

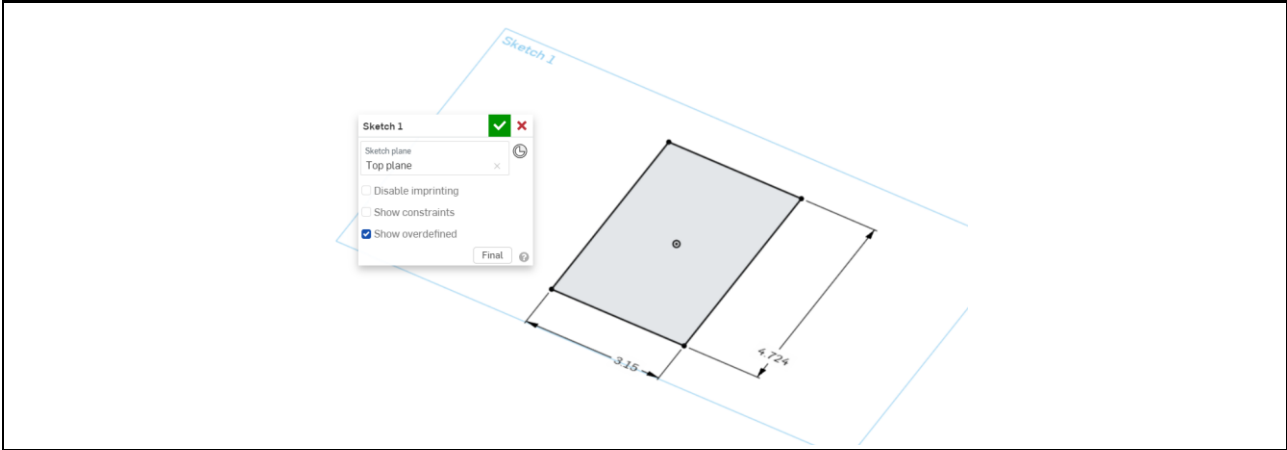


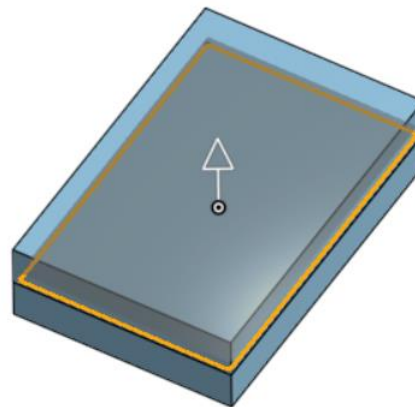
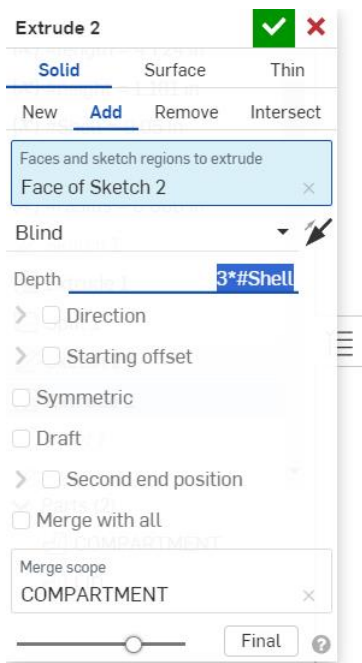
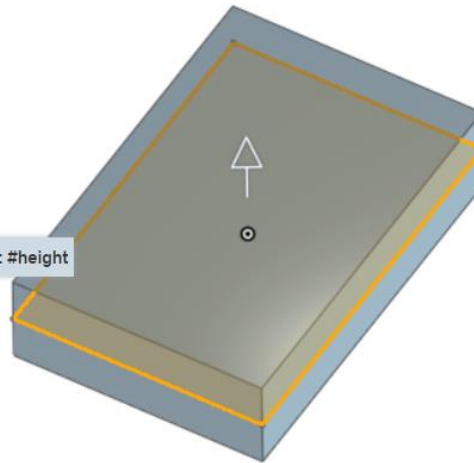
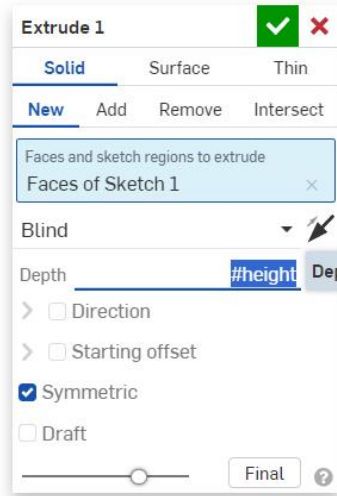
#### Box:

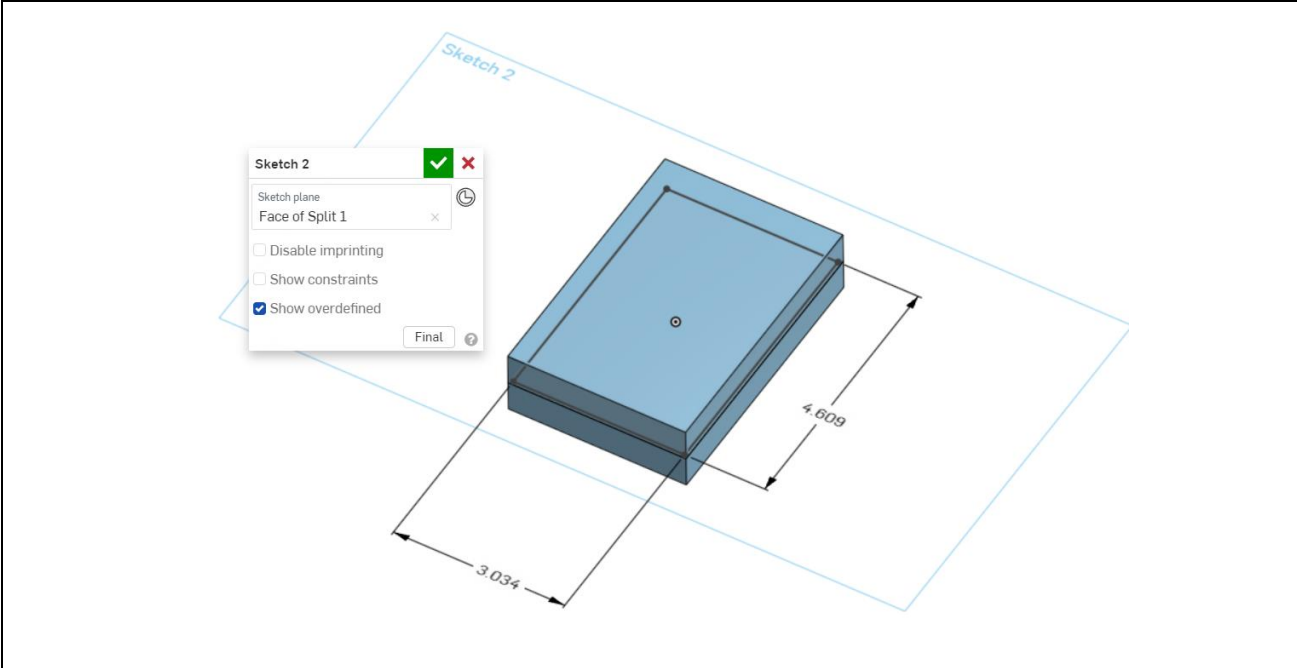
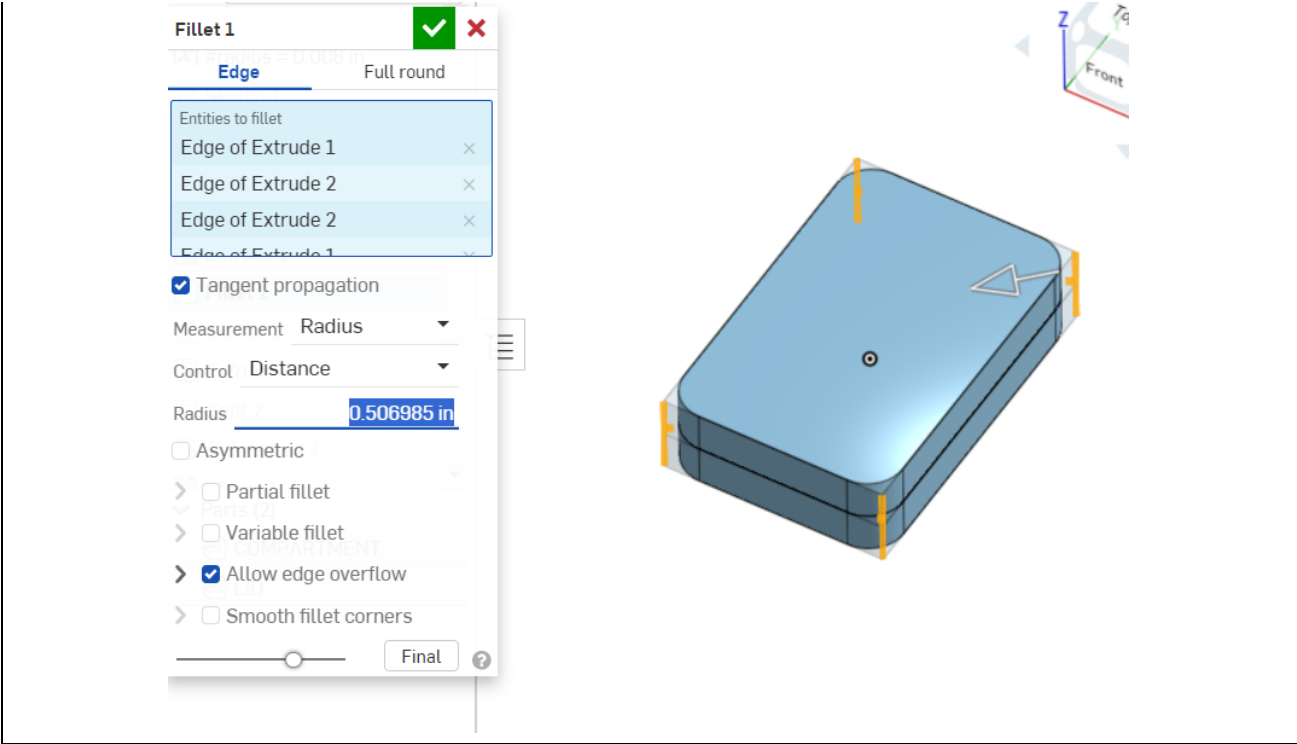
Before printing:

To design the box, we recommend following the tutorial video provided, especially if you are not familiar with OnShape: [https://www.youtube.com/watch?v=rjJWCJAKQ\\_U](https://www.youtube.com/watch?v=rjJWCJAKQ_U)

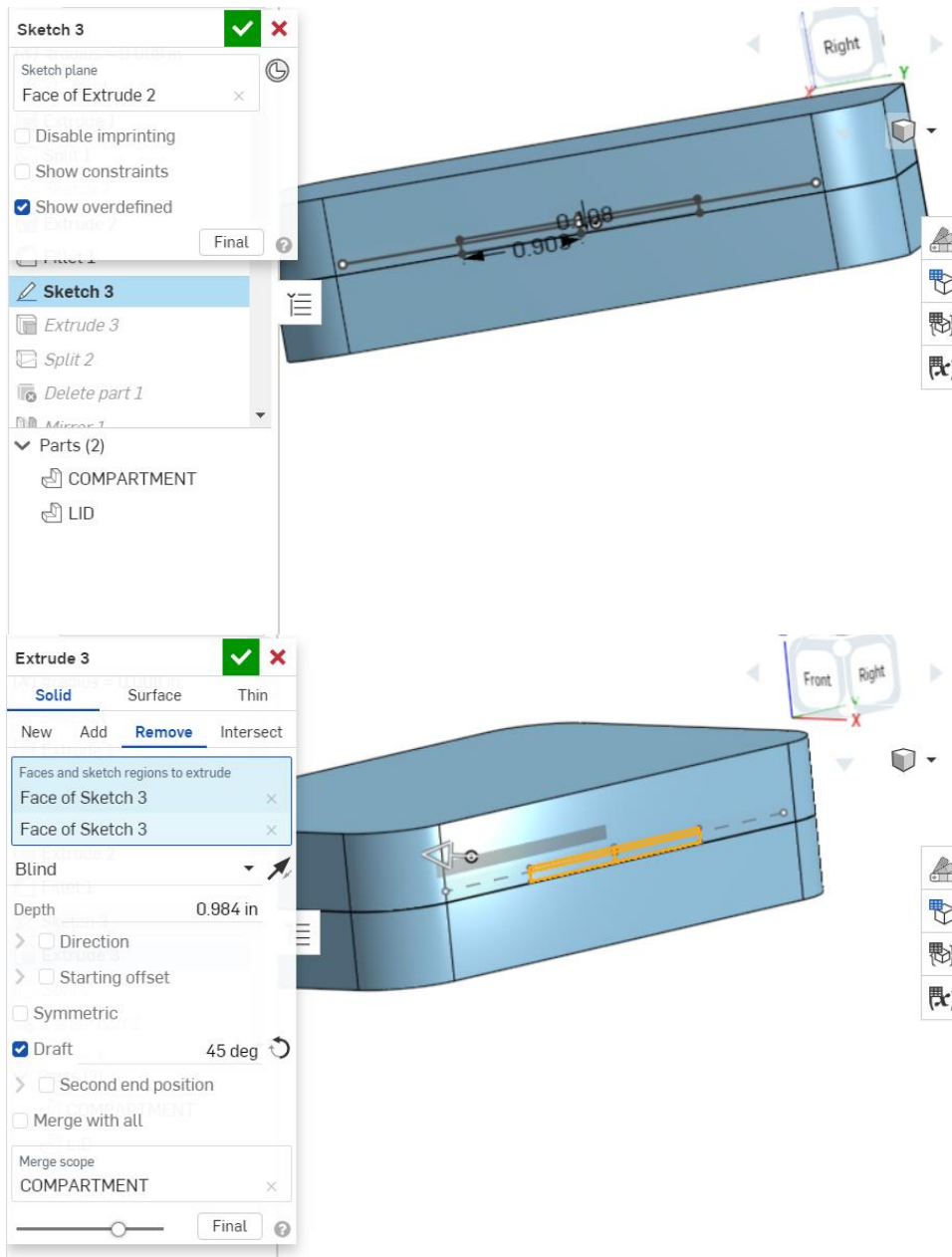
However, to achieve a result similar to ours, please make sure to use the following settings in each of these sections:

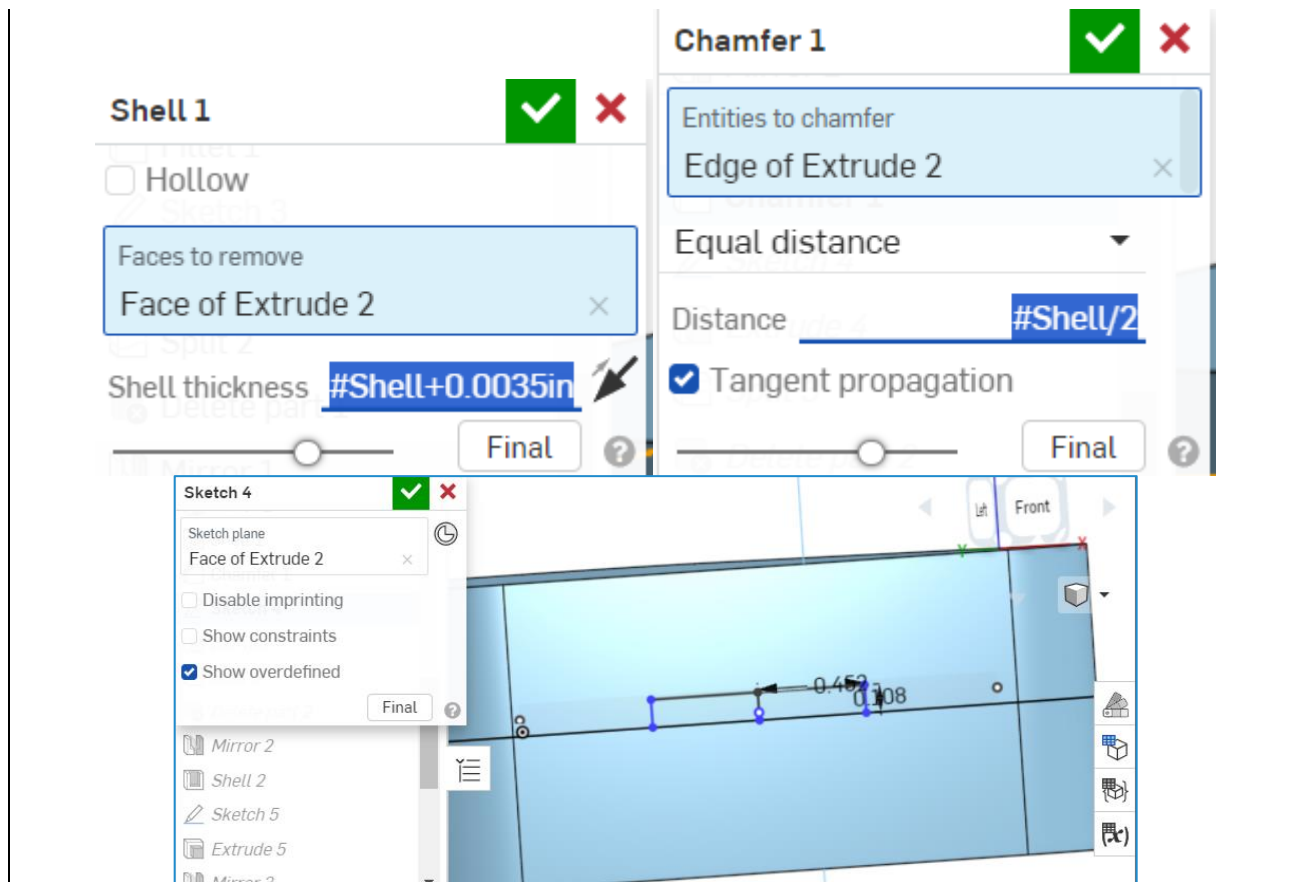


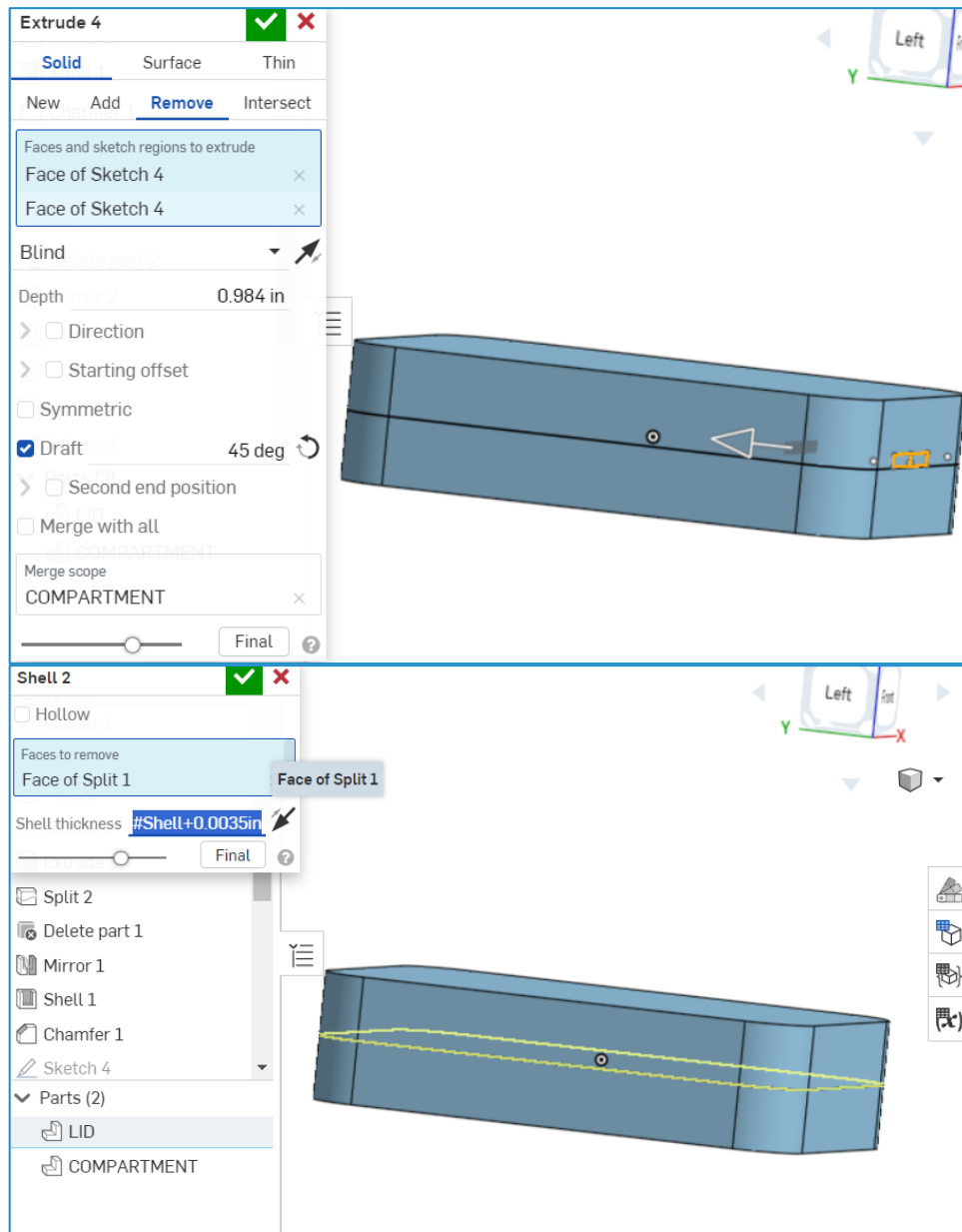


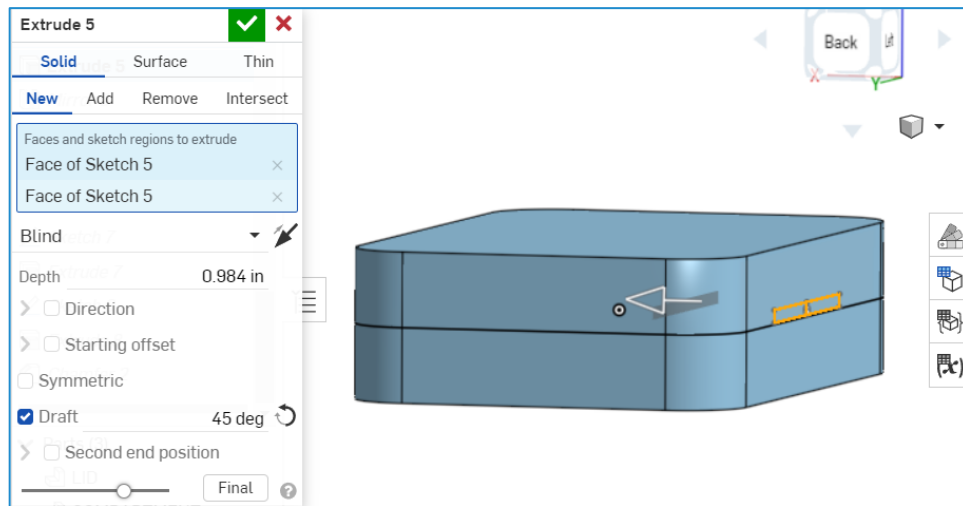


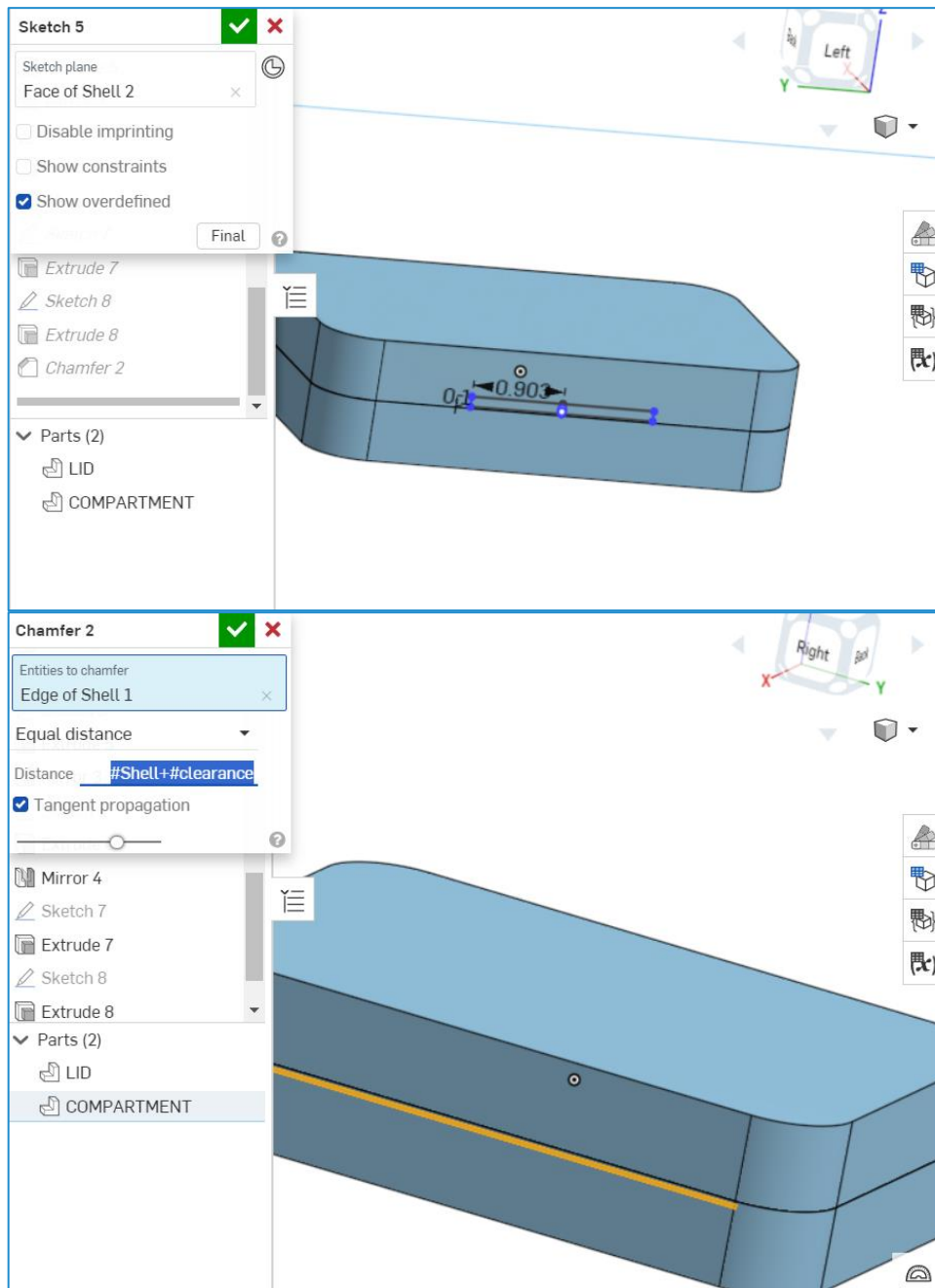


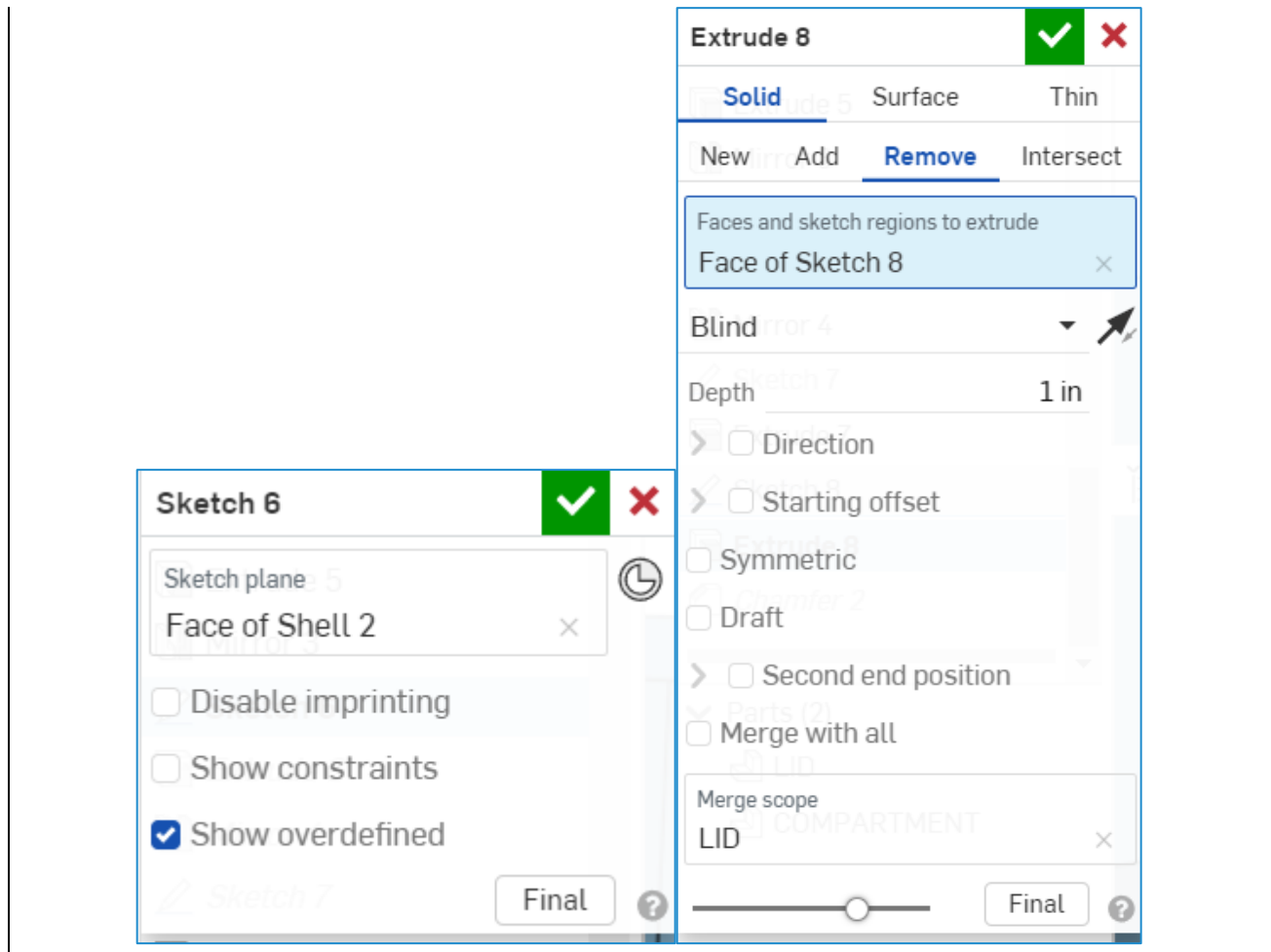












### 3.4 Organization of the system and navigation

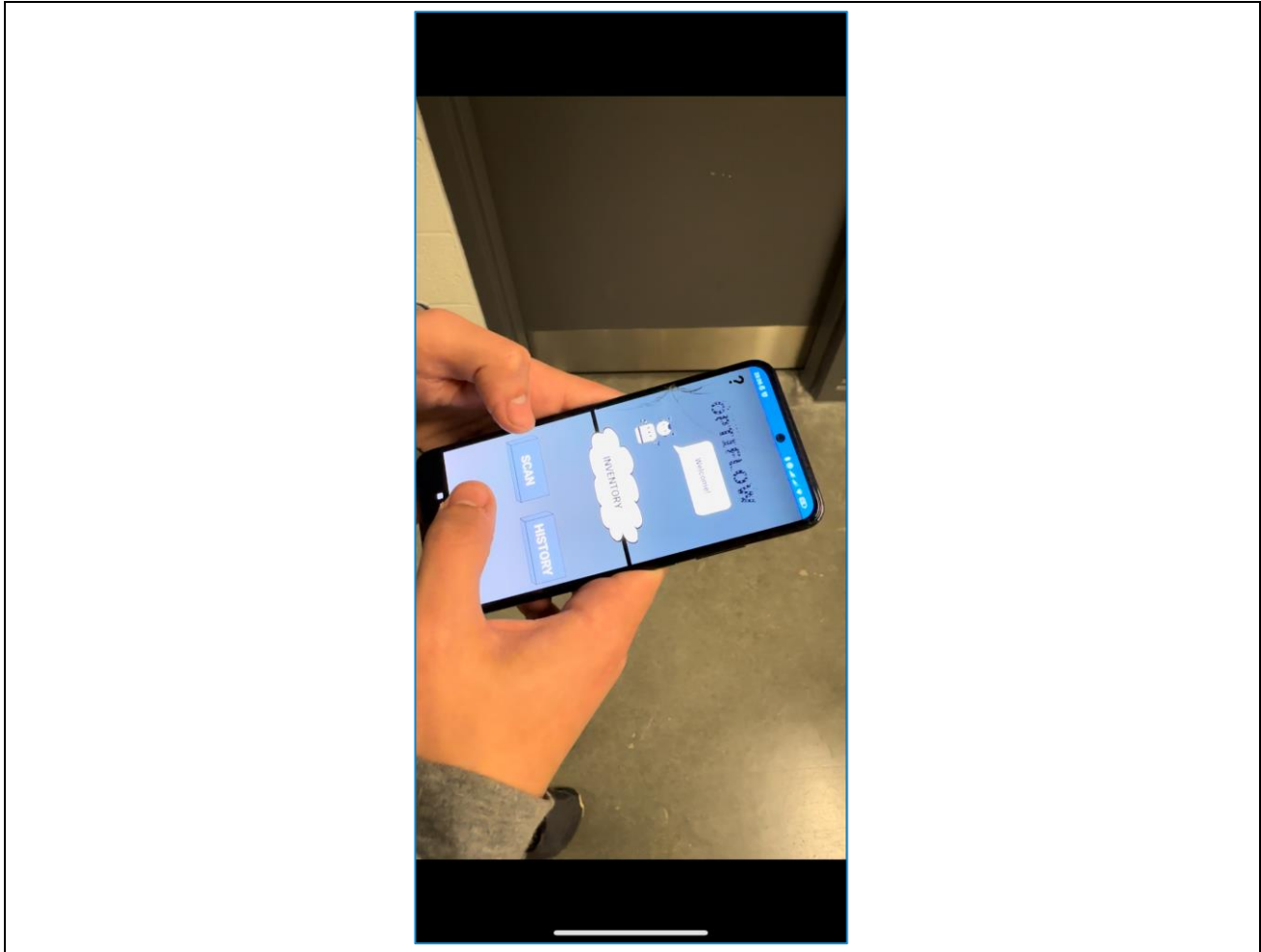
#### Electrical Circuit :

After you've installed the Electrical Layout, you simply turn it on by connecting the battery to the system. Then you connect it by bluetooth connection to your smartphone by accessing to the bluetooth settings of it.

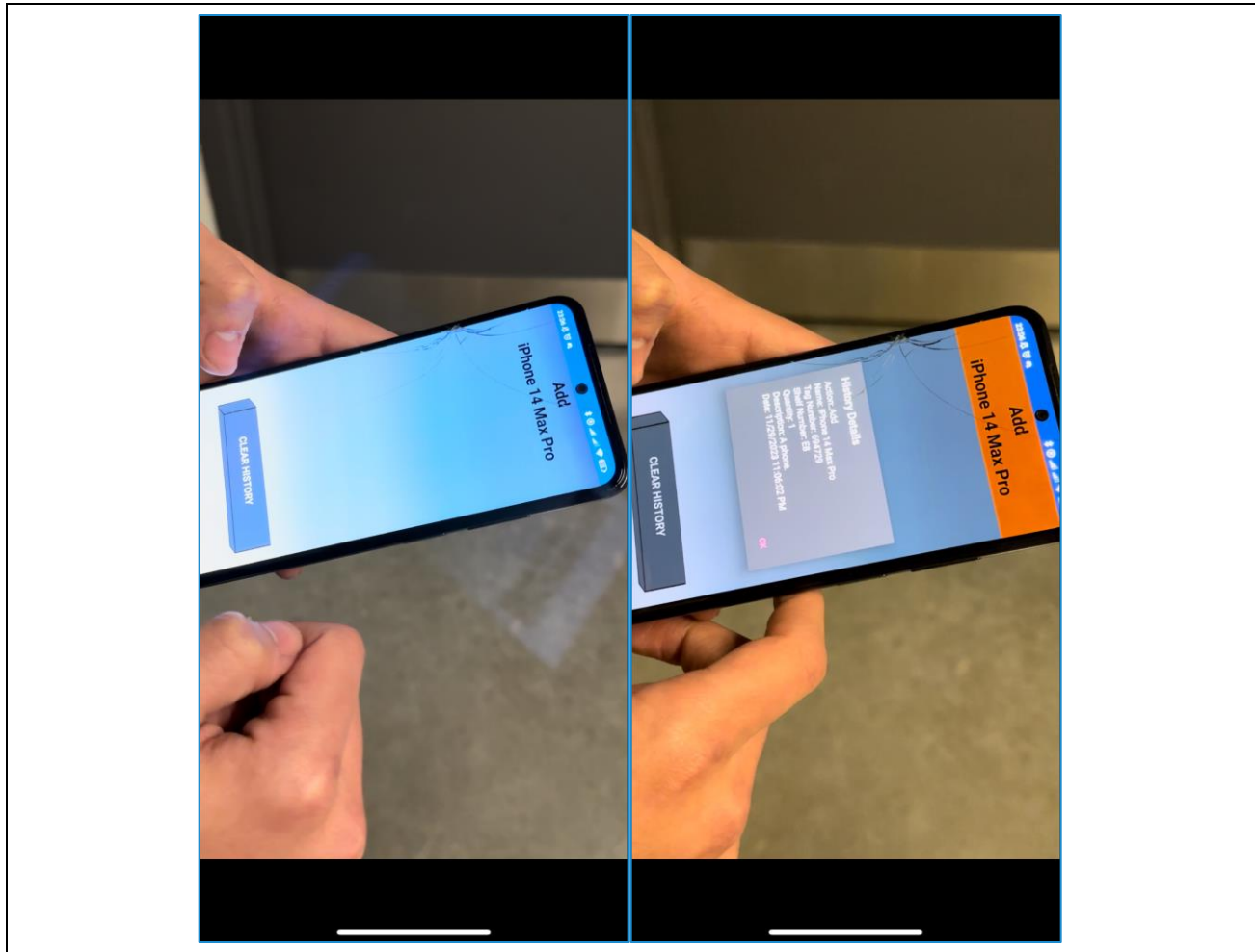
## App :

After you've connected the electrical circuit by bluetooth connection to your smartphone by accessing to the bluetooth settings of it, launch the app and start scanning and tracking !

When you open it you will have to sign into the app by using your email adress then your password. Now you are on the main page you can have access to two pages :

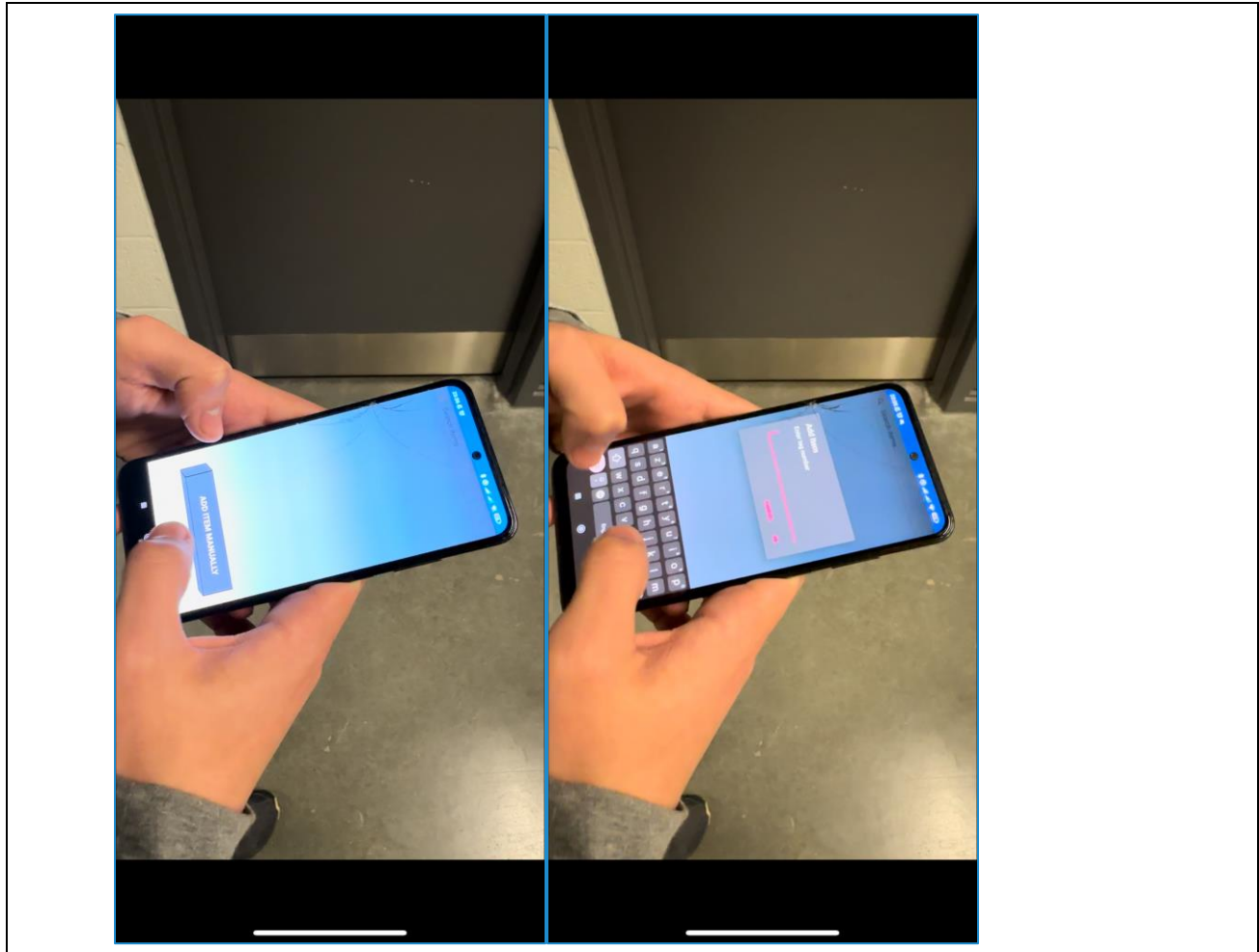


- History : You will have access to all the items entered in your inventory and by pressing the item you get access to all his informations :



- Inventory : Here you can add an item manually. A page will ask you to add several information about the item





### 3.5 Quitting the system

Box :

To close the box, press the compartment against the lid until you here a closing sound.

To open it, try to separate the lid from the compartment.

Electrical Circuit :

To organize the circuit , do exactly the same in the following picture :

To start



## App:

To leave the app in the correct way go back to the main page of the app by clicking on the Return Button then go to the home screen of your smartphone.

## 4 Using the system

Physical system : Box & Circuit

The physical system (box + circuit) has a primary function of scanning items into the inventory for better management. The user must coincide the bottom of the box next to the tag of the item.

- The user must maintain a distance of  $< 5\text{cm}$  when scanning a tag using the box and must hold the position for  $\sim 3$  seconds for a successful scan.
- The box is small, portable, fits in the pocket and can be maneuvered effortlessly.
- The box can be opened easily to adjust the circuit or to change components if necessary.
- The Arduino can be connected to the computer with a USB cable, if necessary, but can function independently.
- The information scanned by the RFID reader is sent automatically by the Bluetooth module to the nearest phone. This information is stored in the mobile app automatically.

Software design: Mobile app

The mobile app provides the user with access to information regarding their inventory content, inventory history, items' locations, and a notification system.

First, the user must sign into his account via email and password to access his inventory app.

Then he has access to several featured options:

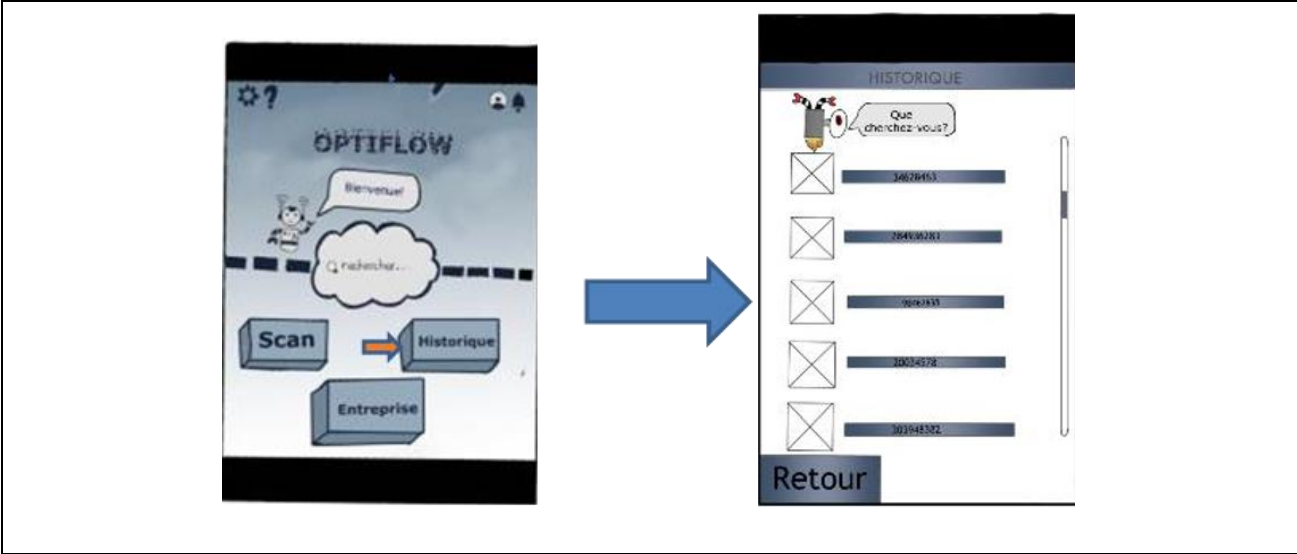
- When user clicks on "Inventory" they are sent to a page that shows a list number of the items they currently hold.
- When user clicks on "History" they are sent to a page that shows all the entry and exists of previous items and activity.

Unfortunately, we were not able to add the item location due to time restrictions.

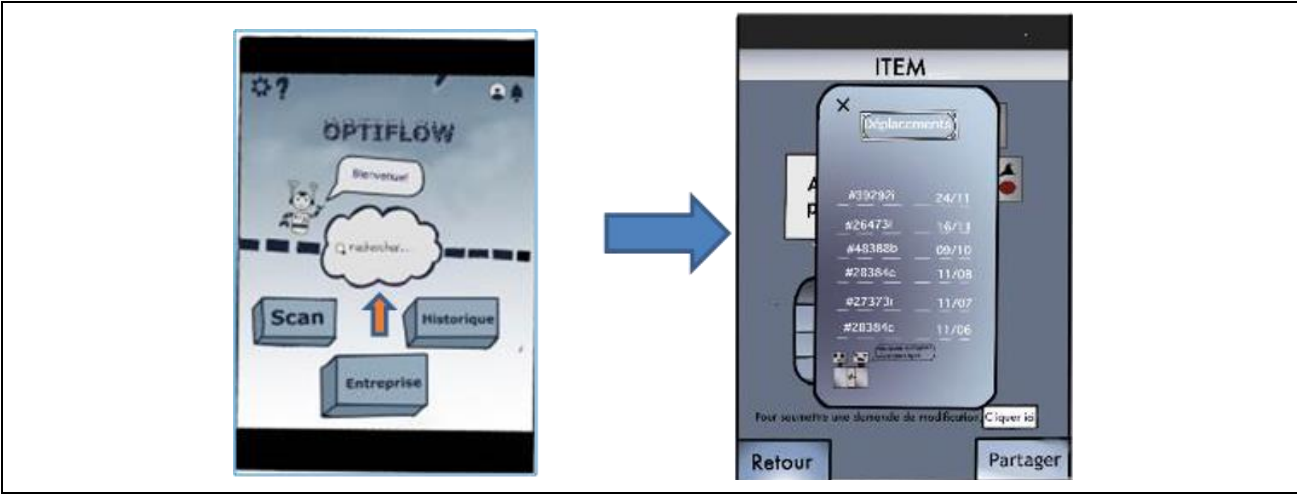
### 4.1 "Function/Feature provided"

Mobile app functionalities:

Press "Historique" => History page



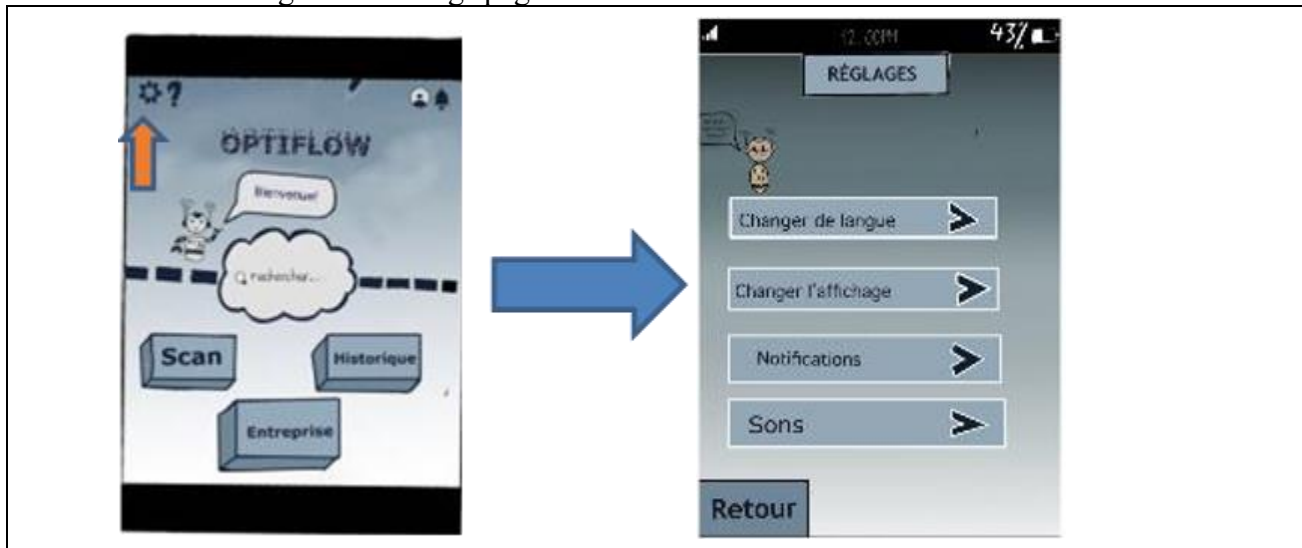
4.1.1 Press “Rechercher” => Item List



4.1.2 <Sous-fonction/Sous-caractéristique donnée>

Unfortunately we couldn't finish making these sub-functions available because of time-restrictions:

Press "settings" => Settings page



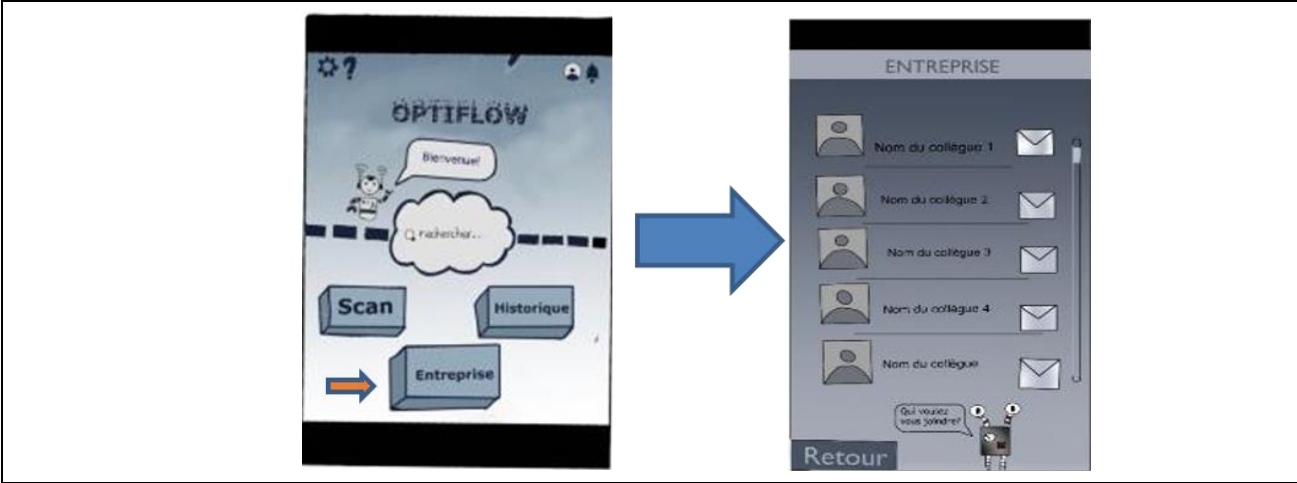
Press "Scan" => Barcode scanner



Press "?" => Help page



Press "Entreprise" => List of suppliers



## 5 Troubleshooting & Support

While the team spent a considerable amount of time to account for possible and potential mishappenings and design flaws, it is always probable that the client may encounter unexpected errors and obstacles prohibiting optimal functionality of either components of the product. Whether it were hardware (casing issues, electrical problems) or software (mobile app unresponsiveness, database inaccuracies, Bluetooth incompatibility), failure of these elements could mean incomplete functionality or sub-optimal performance of the product as a whole. In addition to this, it is important to put into consideration that errors in either components could affect the other's functionality, due to the high dependancy between the OPTIFLOW mobile app and the ITM tag scanner.

This section will include all of the flaws and errors that could be encountered, whether or not they are repairable, how to troubleshoot the issues in case it is possible, and ways the user could seek support and assistance in case all of their attempts fail, or the instructions are not clear enough or insufficiently detailed.

### 5.1 Messages ou comportements d'erreur

#### 5.1.1 Casing

The PLA 3D-printed electronics casing serves as an enclosure for the electronic components of the ITM scanner, mainly the Arduino UNO, the HC-05 Bluetooth module, the RC522 RFID tag reader, and the 9V Alkaline battery power supply, as well as all of the corresponding wiring and cable management. Some of the errors that could be encountered when it comes to the casing are:

- Non-functional closing mechanism: Upon printing the casing, it is very unlikely that the closing mechanism wouldn't work. However, in the case of an improper print, either due to the user providing inaccurate input for the 3D printing software (Cura), or because of a faulty 3D printer (using an inappropriate nozzle size).
- Insufficient width for the USB port hole in the casing: This is due to an oversight in the design of the casing. This means that the USB port hole is too small for the cable to pass through and connect to the Arduino. This can be fixed by using a strip of sanding paper, or any other appropriate tool, to scratch away a few layer off the top of the hole, providing more space for the cable to pass through.

#### 5.1.2 Electronics

The electronics system in our product is of high quality and reliability, this is proven by the extensive testing process which managed to demonstrate the high efficiency of this system. For our final prototype, it was determiend that were no unexpected electronics issues that may be encountered. However, theoretically, it is possible that the batteries may run out of charge prematurely:

- Battery life running out: It was determined through testing of the final prototype, that the battery can last sufficiently long for an optimal functioning of an entire work session (~12 hours). Regardless, in the case of the batteries running out of life duration, it is possible to change them by manually opening the casing, unwrapping the cables from around the battery poles, and pulling it away with sufficient force to remove it from the double-sided tape keeping it attached to the casing. The user may then insert the new battery in its place and wrap the connections around the poles again

### 5.1.3 Software

Software errors are the ones related to the code-behind of the mobile app, and the C++ code implemented into the Arduino micro-controller.

- RC522 tag reader unresponsiveness: In the event that a user scans a card quickly and repeatedly, this may confuse and overload the RC522 tag reader, which causes the display of an error containing the message “Reading Failed.”. Following this error, the tag reader will refuse to read any cards afterwards. Fixing this requires re-uploading the C++ code to the Arduino entirely, which involves connecting it to a computer with the Arduino IDE software, and uploading the code from the project code repository.
- Mobile app button unresponsiveness: The interactive buttons in the main page of the mobile app have a clickable space smaller than the visible space of the button, meaning that clicking the buttons in certain points will not trigger the targeted event. As such, the user may need to attempt clicking a button more than once in different locations to use its functionality.

## 5.2 Special considerations

Using the login feature requires a specialized “Username” and “Password” combination that can only be implemented in the source code of the mobile app, instead of through one of its indirect functionalities. It is advised that if a user were to decide to add a new user to their customized version of the app, then the user must contact the design team to assist in this operation, as it requires directly modifying a few lines of the source code of the app.



## 5.3 Maintenance

In order to avoid failures, and maintain proper reliability of the product:

- Test the scanner monthly using a Bluetooth Serial Terminal app, in order to guarantee that the Arduino code is functioning optimally. The user should be able to receive the raw data being transferred to the phone from the RFID tag on the Bluetooth Serial Terminal.
- Always keep track of the contents of the history page of the mobile app to verify any modifications and changes to the inventory list.
- Regularly test the battery by opening the casing, and verifying that all of the components' LED's are adequately lit. A faint luminosity, especially for the Bluetooth HC-05 Module

## 5.4 Assistance

For assistance and technical support, please contact either one of the design team members through one of the emails provided below:

- Boulayad Zakariae ([zboul083@uottawa.ca](mailto:zboul083@uottawa.ca))
- Belmkaddem Ziyad ([zbelm085@uottawa.ca](mailto:zbelm085@uottawa.ca))
- Brou Deva ([dbrou036@uottawa.ca](mailto:dbrou036@uottawa.ca))
- Saliba Elie ([esali042@uottawa.ca](mailto:esali042@uottawa.ca))
- Barroug Elmahdi ([ebarr073@uottawa.ca](mailto:ebarr073@uottawa.ca))

Please include a brief description of the issue as the subject of the email, while also providing any important details such as screenshots of error messages, or images and videos of the faulty components at play. You will be contacted as soon as possible by one of the team members to troubleshoot the issue and guide you through the process.

In case of a security breach, please contact Boulayad Zakariae the moment the breach is identified in order to take the most effective and immediate course of action in transferring all of the data to a different customized version of the app. If possible, provide as many logs and technical information displayed by the app in order to facilitate the troubleshooting process.

## 6 Product Documentation

Our prototype can be categorized into three parts

Electrical part (circuit):

The Arduino circuit serves as a processing and execution unit for the base code. The board is responsible for directing orders and decision-making algorithms, as well as detection loops to the RFID reader, as well as the Bluetooth module.

The RFID reader repeatedly seeks out RFID tags in the proximity, once it detects one that is within range (by receiving a response in the form of a reflected radio wave), it sends out an electrical signal to the Arduino, indicating that an RFID tag has been detected, and sending a serial print containing the RFID identifier for that particular tag, which in-turn contains critical identifying information such as: Name of the item, date/time of last addition, date/time of last deletion

The Bluetooth module receives this information through the medium of the Arduino, where it relays it to a mobile phone in the proximity, to which it is connected by bluetooth. The information relayed is then uploaded to the shared storage cloud (which serves as a database) through the mobile app. Any request to access information through the mobile app will be directed to the cloud

The overall circuit is supplied by a 9V power supply, originating from the 3x CR2032 Lithium coin batteries. However, it should be noted that the main electronic components (RC522 RFID reader and HC-05 Bluetooth module) have different voltages for nominal operation. We decided to rely on the integrated Arduino UNO voltage regulator, in order to split the circuit into a 3.3V flow (for the RC522 RFID reader) and a 5V flow (for the HC-05 Bluetooth module). This way, we can save on the materials required for building a regulating circuit (using resistors). However, this is not an option for the HC-05 Bluetooth module RXD pin, which has a level of 3.3V, unlike the rest of the pins which operate on a 5V voltage. To avoid frying the Bluetooth module, we were forced to implement a “level-shifter” circuit between the RXD pin on the Bluetooth module, and the GND and Digital (2) pins on the Arduino UNO.

We also calculated the longevity of the electrical circuit by determining the life span of 3x CR2032 Lithium coin batteries in a series composition:

Assuming the HC-05 module and the RC522 reader are always at 100% peak consumption (30 mA and 20mA respectively), and the Arduino UNO is at its nominal consumption too (50 mA), we can add up the consumptions to find:

Total consumption in the circuit = 30 mA + 20 mA + 50mA = 100mA

And with every battery having an average capacity, presumed to be at 225 mAh, then we can calculate the total capacity to be at:

$1/\text{Total capacity} = 3 \cdot 1/225 \text{ mAh} = 1/75 \text{ mAh} \implies \text{Total capacity} = 75 \text{ mAh}$

Using a standard battery life calculator, conveniently available openly on the Internet [3], we can find the battery life to be at: 36 minutes.

**ISoftware part(application)**

For the creation of this subsystem, our first step was to plan the design and t different functionalities that should appear on the application using a wireframe structure.

And 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.

### **Mechanic part(casing)**

The electronics casing's role is to enclose the entire electrical layout and its respective components. This, combined with the complete electrical setup, forms a comprehensive representation of the physical aspect of the product.

To guarantee that the electronics compartment will fit all the crucial electronic elements, we calculated the total usable space in the compartment based on the Onshape measurements for the surface of each face:

Compartment walls:  $8\text{ cm} * 2.5\text{ cm} = 20\text{ cm}^2$  and  $10\text{ cm} * 2.5\text{ cm} = 25\text{ cm}^2$

Compartment base:  $8\text{ cm} * 10\text{ cm} = 80\text{ cm}^2$

Usable volume:  $80\text{ cm}^2 * 2.5\text{ cm} = 200\text{ cm}^3$

Calculating the total space taken by all electronic components is a challenging task, given that some of them have irregular shapes and geometries. As such, for the sake of simplicity, we suppose that all the electrical components have 2D geometries only, with a presumed thickness of 0 cm. The thickness is neglected since all of the elements have a very miniscule thickness (<1 cm), which makes it impossible for them to go past the height of the compartment walls, even when stacked one on top of the other. The calculations give the following:

Surface of the Arduino UNO:  $6.86\text{ cm} * 5.34\text{ cm} = 36.63\text{ cm}^2$

Surface of the RC522 RFID reader:  $6\text{ cm} * 4\text{ cm} = 24\text{ cm}^2$

Surface of the HC-05 Bluetooth module:  $4\text{ cm} * 1.5\text{ cm} = 6\text{ cm}^2$

Surface of 3x CR2032 Lithium coin batteries:  $\pi*(1)^2\text{ cm} * 3 = 9.42\text{ cm}^2$

The sum of all component surfaces gives the following result:  $76.05\text{ cm}^2$

Afterward, we used a 3D printer to print the case with the adequate dimension.

## 6.1 Sub system 1 of the prototype

### 6.1.1 BOM (Bill Of Materials)

	ITEM NAME	Description	Unit of measurment	Quantity	Unitary	link
1	RFID Reader (RC 522)	Scanner + tag		1	5\$	<a href="https://www.amazon.ca/CANADUINO-RFID-Starter-13-56MHz-Keyfob/dp/B07B2CV31T/ref=sr_1_2?crd=YZTDLLULKJU5&amp;keywords=RFID+reader+Arduino+UNO&amp;qid=1698606710&amp;srefix">https://www.amazon.ca/CANADUINO-RFID-Starter-13-56MHz-Keyfob/dp/B07B2CV31T/ref=sr_1_2?crd=YZTDLLULKJU5&amp;keywords=RFID+reader+Arduino+UNO&amp;qid=1698606710&amp;srefix</a>

						<a href="#">=rfid+reader+arduino+uno%20Caps%2C89&amp;sr=8-2</a>
2	Arduino UNO	Arduino UNO microcontroller (processing unit)	Unit	1	17\$	<a href="https://makerstore.ca/shop/ols/products/arduino-uno-r3/v/A001-WTH-USB">https://makerstore.ca/shop/ols/products/arduino-uno-r3/v/A001-WTH-USB</a>
3	Bluetooth Module (HC 05)	Bluetooth transceiver	Unit	1	9\$	<a href="https://makerstore.ca/shop/ols/products/hc-05-wireless-bluetooth-module-with-at-button">https://makerstore.ca/shop/ols/products/hc-05-wireless-bluetooth-module-with-at-button</a>
4		1x 10-pack Male- to-Male	Unit	3	1\$	<a href="https://makerstore.ca/shop/ols">https://makerstore.ca/shop/ols</a>

	Jumper cables	(20 cm) 2x 10-pack Male-to-Female (20 cm)				<a href="#">/products/jumper-cables-per-10/v/JMP-CBL-20C-ML</a>
5	Battery	9V Alkaline Battery	Unit	1	1.5\$	Locally bought, PANASONIC
6	Resistors	-1K $\Omega$  -100 $\Omega$  -150 $\Omega$	Unit	-3  -1  -1	1\$	Makerstore
7	LED	-Diffused RGB  5mm LED	Unit	1	0.60\$	<a href="https://makerstore.ca/shop/ols/products/diffused-rgb-5mm-led">https://makerstore.ca/shop/ols/products/diffused-rgb-5mm-led</a>
8	Data base	SQLite	N/A	N/A	0\$	N/A

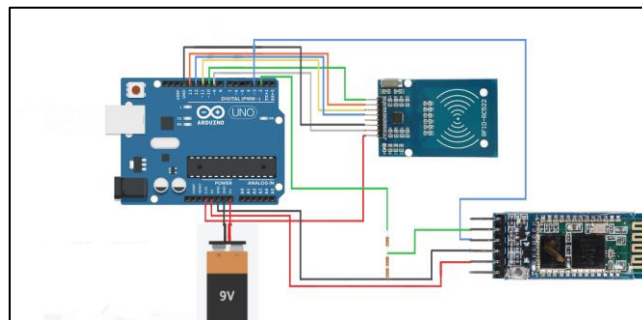
10	Code libraries	-MFRC522 -Software Serial	Unit	2	0\$	<a href="https://github.com/miguelbalboa/rfid">https://github.com/miguelbalboa/rfid</a>
	Total without Tax or delivery fee				≈39.60\$	N/A
	Total with Tax and delivery fee				≈45.40\$+0\$	N/A

### 6.1.2 Equipment list

Besides those which have been stated in the previous part, there is no other additional equipment which has been used for the design of the arduino circuit.

### 6.1.3 Instructions

to build the arduino circuit the only notable step is to follow the model of the following circuit



All the resistors, leds, and cables must be at the exactt same place for it to work

## 6.2 Tests and Approvals

N° of the test	Objective of the test	Description of the prototype used and test methodology/procedure.	Description for results to gather and how they will be used	Estimated duration and time of beginning of the test
1	Verify app interface user-friendliness	Analytical and partially comprehensive, we will allow a test-user (a friend, or random person) to use the app for a few minutes and discover its features (Simulating an early-access phase of the app)	User feedback and suggestions. These suggestions will be taken into account during the development of the third prototype, where we will consider the test-user's rating for each functionality and its usability. Any functions with a notably low rating will be reworked and improved upon.	30 minutes, 18th of November, 2023
2	Verify integrity and functionality for the cover locking mechanism	Physical and partially comprehensive, we will attempt to close the cover and attach it to the compartment firmly, we will check its integrity by repeatedly shaking the casing while upside-down.	Observe whether the cover falls off easily, or whether it's too hard to re-open. Redesign of the locking mechanism in either cases.	10 minutes, 18th of November, 2023
	Verify integrity and functionality for the cover locking mechanism	Physical and partially comprehensive, we will attempt to close the cover and attach it to the compartment firmly, we will check its integrity by repeatedly shaking the casing while upside-down.	Observe whether the cover falls off easily, or whether it's too hard to re-open. Redesign of the locking mechanism in either cases.	



## **Test Results**

### Results related to 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.

### Results related to power supply test

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.

## **7 Conclusions and recommendations for future works**

In conclusion, the development of this user guide for the GNG 1503 inventory management system marks a pivotal step in ensuring seamless and efficient utilization of the system's functionalities. With a comprehensive exploration of various features, procedures, and troubleshooting steps, this guide aims to empower users with the knowledge and confidence to navigate the system effectively.

By meticulously detailing the system's operations, from inventory tracking to order management, we aimed to bridge the gap between complexity and user-friendliness. This user guide not only serves as a manual but as a companion, providing clarity and guidance every step of the way.

Our commitment to user-centric design and clarity remains at the forefront, intending to streamline processes, reduce errors, and ultimately enhance productivity for all users. As technology evolves, so will this guide, adapting to new updates and enhancements, ensuring its relevance and usefulness in the dynamic landscape of inventory management.

## **8 Bibliography**

No external bibliographical sources have been used for this manual.

# APPENDIX

## 9 APPENDIX I: Design File

Table 2. Referenced Document

Name of the Document	URL
Prototype 4	<a href="https://cad.onshape.com/documents/7af2182cdd664869230fd8db/w/3b1f94baf731c2eb645c">https://cad.onshape.com/documents/7af2182cdd664869230fd8db/w/3b1f94baf731c2eb645c</a>
Prototype 1, 2, 3	<a href="https://cad.onshape.com/documents/8f4b0cc50aac21c20323d64b/w/f1718eea2c8e68708ef5c">https://cad.onshape.com/documents/8f4b0cc50aac21c20323d64b/w/f1718eea2c8e68708ef5c</a>

## **10 APPENDIX II: Other Appendices**

The following is a link to all the code used in the Software components of the product:

ARDUINO AND VISUAL STUDIO CODE FOR MOBILE DEVELOPMENT:

<https://drive.google.com/drive/folders/15xutf4oJLIEPcfyXDBvGOcJT2ROXKYa?usp=sharing>