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Faculté de génie
Faculty of Engineering

Deliverable C

Detailed Design and BOM

Prepared by Group Z11

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Presented to

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GNG 2101Z - Introduction to product development & management for engineers & computer scientists

Faculty of Engineering
Department of Mechanical Engineering

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1. Introduction

In order to realize our project, we will in this report provide a detailed design as well as an estimate of the costs of materials and components of our concept. In addition, we will create a project plan containing the task to be completed following this project design with a list of risks and contingencies for any unforeseen events that may occur. This will also ensure that the required prototypes are created within the time frame.

2. Client feedback

After our second meeting with our client Chris, we received enthusiasm about our concept design. During this meeting we explained to him the metrics that will guide us through this project and also presented the different design concepts that we came up with; finally we showed him which choices we have decided to go with and why we made that decision. The main feedback we got from him was :

- Rapid fires are to be included - Rapid fires is a mode that when it is activated, it will act like a press trigger that is repeatedly being pressed until deactivated.
- More macro buttons are to be added, to do subsequent sequences of actions only by pressing it once. It is usually made when playing with a remote controller.
- A configuration mode to choose which buttons he will use to game with.

3. Final Detailed Design

In this part we will present our final design in their different aspects including the physical design, the circuit design, as well as the software to be used to control the remote.

3.1 Physical design

Here is the below the expected design of our controller through different views :

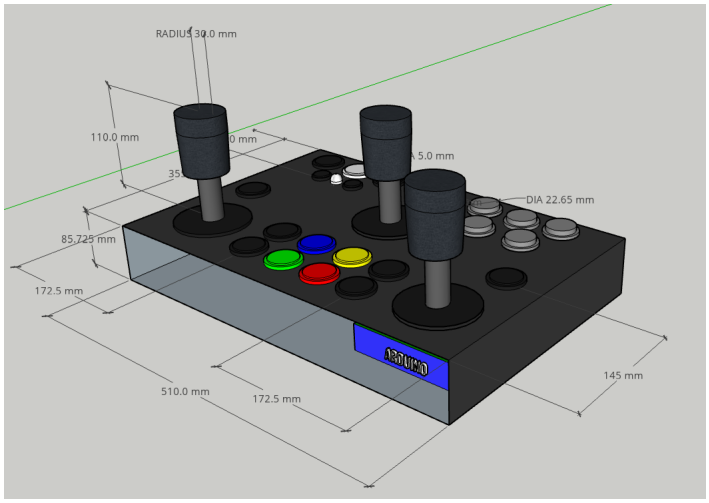


Fig 1 - Overall view of the controller

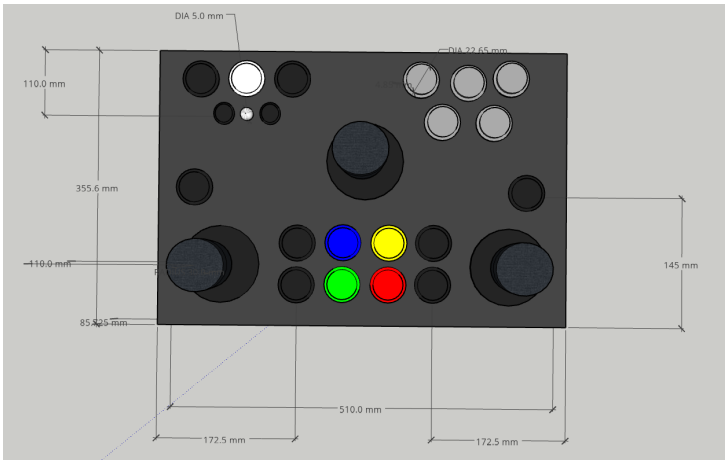


Fig 2 - Controller viewed from the top

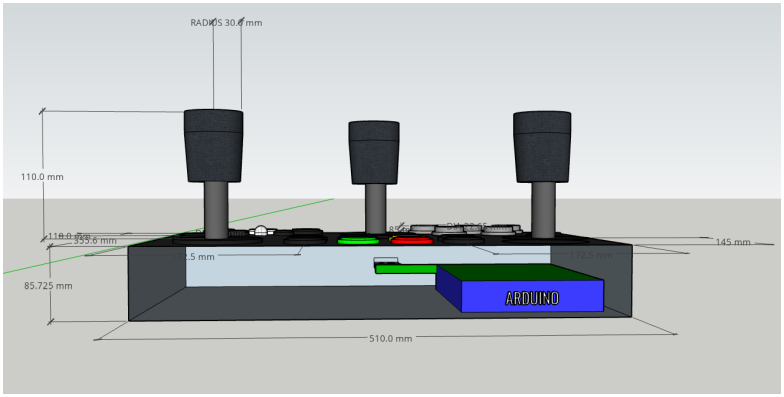


Fig 3 - View of the front

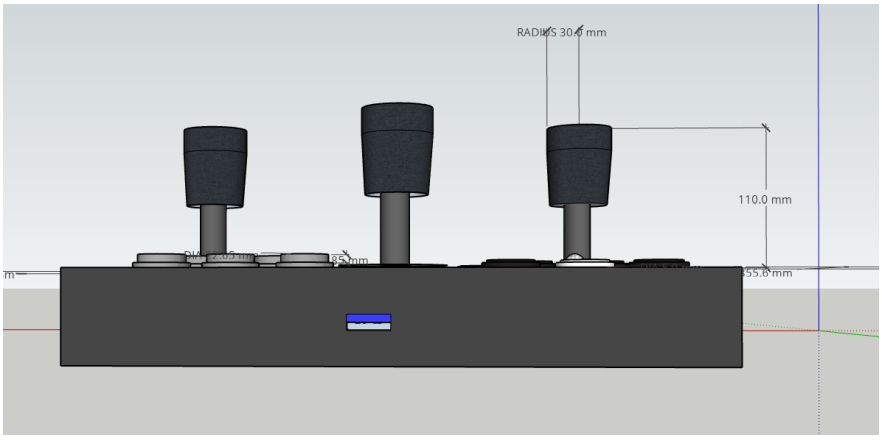


Fig 4 - View of the back

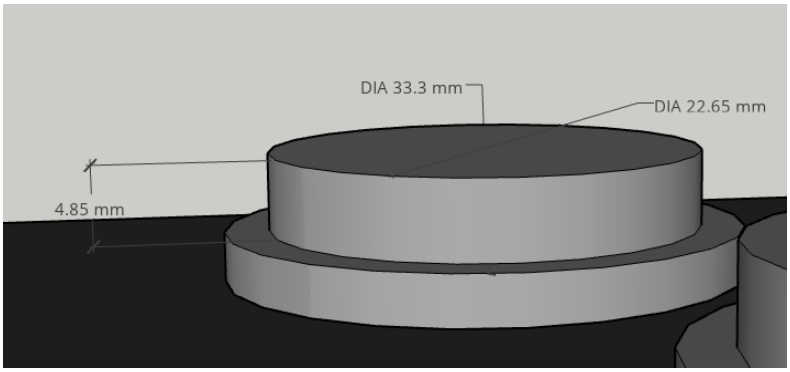


Fig 5 - Close-up view of a button

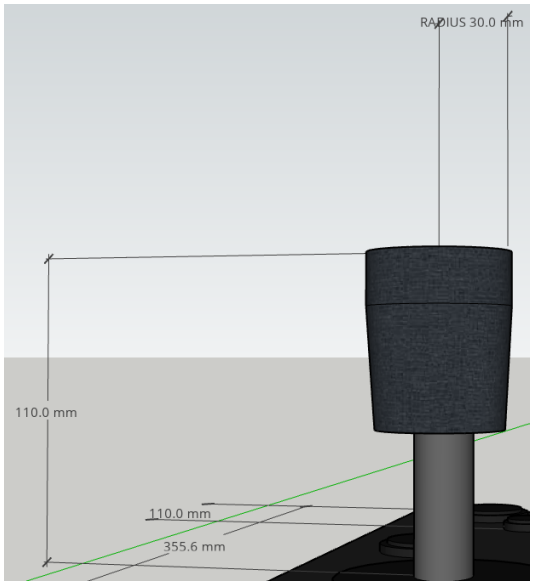


Fig 6 - Close up view of Joystick

Our controller will be composed of the listed items :

- 3 joysticks → left joystick, right joystick and another joystick for the Dpad
- Twenty buttons available for playing
    - Eight buttons in the center
    - Five buttons in the left upper corner
    - Five buttons in the right upper corner for macros
    - 1 button at each side of the remote
    - An LED to switch modes on the controller
- Arduino Leonardo
- USB port

3.2 Circuit design

Link To Circuit → https://www.flux.ai/rambolps/gng2101-z11-circuit?editor=schematic

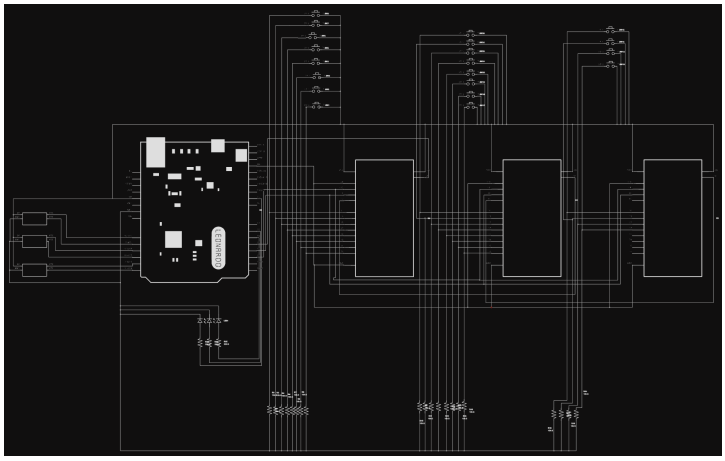


Fig 7 - Complete Overview of Circuit

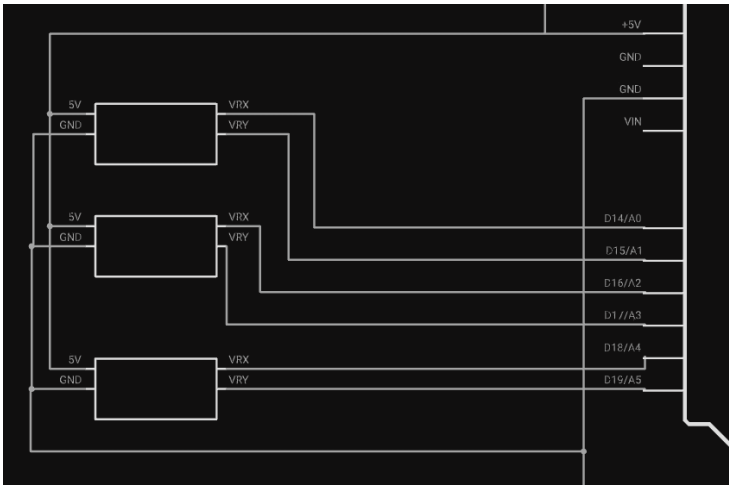


Fig 8 - Joystick Subsection of Circuit

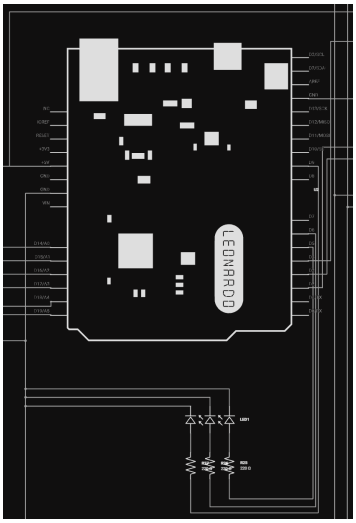


Fig 9 - Arduino Subsection of Circuit

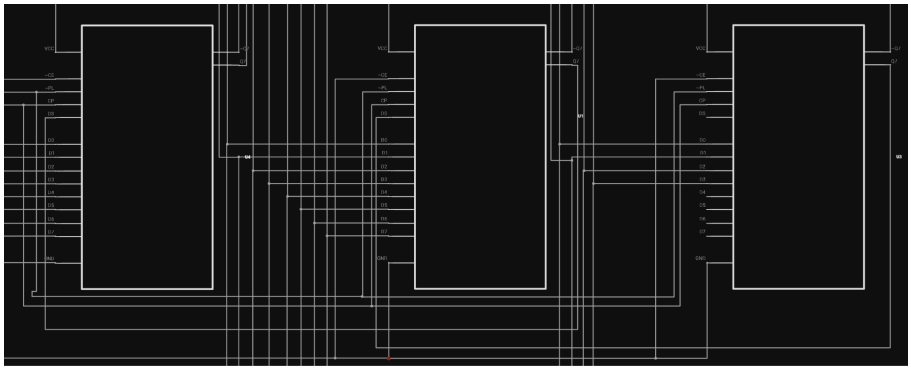


Fig 10 - 74HC166 PISO Shift-Register Subsection of Circuit

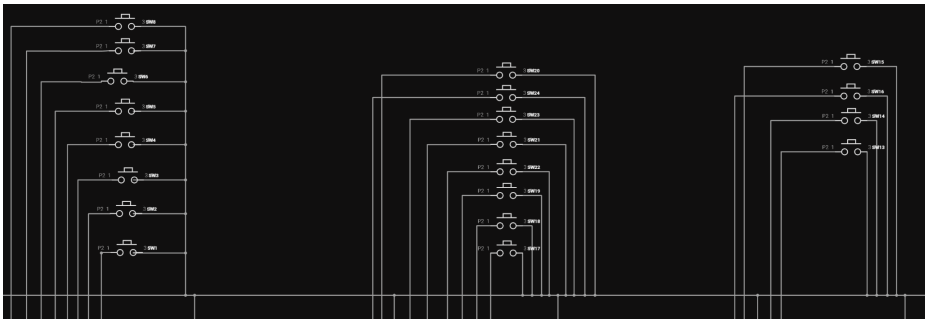


Fig 11- Push Button Subsection of Circuit

3.3 Software

A flowchart will be presented to explain how our software will work.

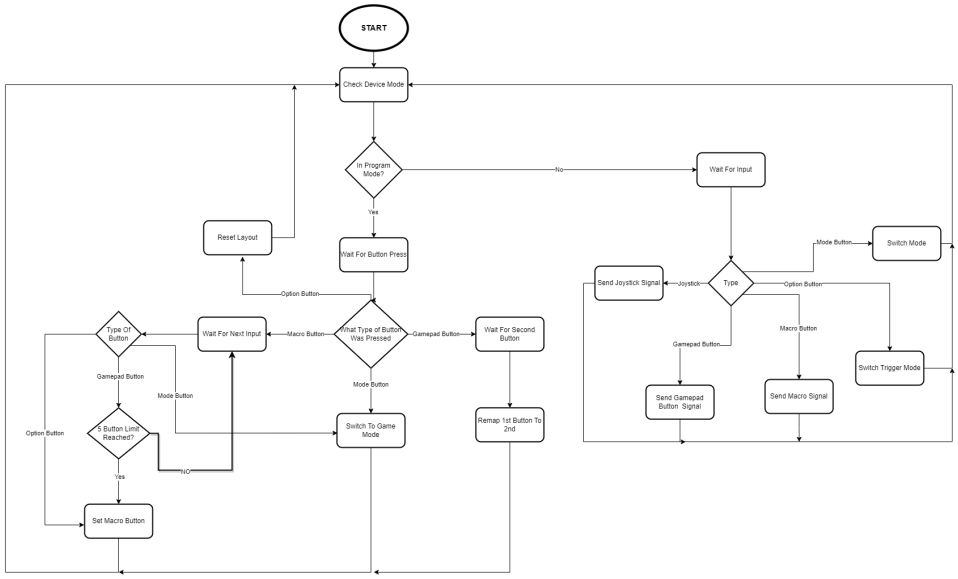


Fig 12 - Flow Chart of software functionalities

Link To Flowchart →
https://cdn.discordapp.com/attachments/1104055441236959242/1112543854281904178/software.png

4. Skills and Resources

There are 3 distinct parts to our product that need to be developed. The first one is the physical hardware aspect of the system. This includes the buttons and joysticks, basically anything the user touches. We have the skills on our team in terms of building boxes and other items out of wood. We also have experience using these types of buttons and potentiometers. We lack some skills that pertain to 3D printing, which is a resource we will be using to create our joysticks. We will make up for this by learning from friends and online how to 3D model a part to 3D print. The second part of our product is the electrical circuit. This includes the shift register chips, the Arduino, and the wiring for everything. We have loads of experience with Arduino and making circuits with IC (integrated circuit) chips on our team. The last part of the product is the software. Luckily, we also have tons of experience writing software, which includes writing Arduino software. The majority of our team has experience with it.

5. Time Assessment

For the outer physical aspect of the controller, building the box and 3D printing should take two days in total, since the materials need to be cut out for the box and fastened together, and 3D printing the joysticks may take 3 to 4 hours each. Building the circuit should take 8 hours and programming the software should take about 6 hours.

6. Critical Product Assumptions

We are making critical product assumptions that could affect our ability to implement our design. The first one is that we are not currently worrying about the input lag of the buttons. There may be some input lag on the buttons or joysticks. Additionally, the clock rate of the shift registers is not yet determined and will be determined through testing. The length of wire we are using for the outer USB cable is 3 m, so we are assuming that the user will not be more than 3 m from the game device. Another assumption is that the user will have at least one available USB input on their game device to connect the controller, since the controller is not wireless. We are also assuming that the Arduino Leonardo will have enough current delivery to power the circuit. We think it should be fine, but we have not done the math on it. We are also assuming that the current delivery is in the range that the Shift-registers will be able to operate at those current levels. We are also assuming that our 3D prints will be able to be made in the time constraints of the MakerLab hours, and that our parts will still be available that we need to purchase from the MakerLab.

7. Bill of materials (BOM)

ID #	Name	Description	Unit	Quantity	Unit Cost	Extended Cost	Link
1	Arduino Leonardo	Main logic board	Unit	1	$15.00	$15.00	https://edu-makerlab.odoo.com/shop/product/arduino-5#attr=7
2	LED	RGB light to display mode info	Unit	1	$2.00	$2.00	https://edu-makerlab.odoo.com/shop/product/rgb-led-33?category=10#attr=
3	Arcade Button Type 1	Arcade gamepad button	Unit	10	$3.83	$38.30	https://www.digikey.ca/en/products/detail/adafruit-industries-llc/3489/7349495
4	Arcade Button Type 2	Arcade settings button	Unit	10	$0.00	$0.00	
5	Joystick	analog joystick potentiometer	Unit	3	$0.00	$0.00	
6	Single Coil Wires	electrical wire to connect components	Meters	10	$0.00	$0.00	
7	Joystick Cover	3d printed cover for accessibility	g	30	$0.15	$4.50	
8	SN74HC166N	parallel-in/serial-out shift register to extend inputs	Unit	0	$0.00	$0.00	
9	USB Male Micro B To Female A	inner usb wire. Arduino to box wall	Unit	1	$0.00	$0.00	
10	USB Male A To A	outer usb wire. controller to game device	Unit	1	$0.00	$0.00	
11	PCB	PCB to connect electronics to	Unit	1	$5.00	$5.00	
12	Solder	lead free solder	Unit	1	$0.00	$0.00	
13	Header pins		Unit	3	$0.30	$0.90	https://edu-makerlab.odoo.com/shop/product/header-pins-22?page=2#attr=32
14	MDF Wood	wood panels to be laser cut for box	m^2	0.56	$17.85	$10.00	
15	Wood Glue	glue to hold box together	Unit	1	$0.00	$0.00	

16	Arduino XInput Library/Firmware	To let arduino be used as controller	Unit	1	$0.00	$0.00	
17	Resistors 10K	resistors for buttons	Unit	20	$0.01	$0.20	https://edu-makerlab.odoo.com/shop/product/resistor-6?category=13#attr=23
18	Resistors 220	resistors for rgb led	Unit	3	$0.01	$0.03	https://edu-makerlab.odoo.com/shop/product/resistor-6?category=13#attr=11
19	USB Convertor	to allow the controller to work on xbox	Unit	1	$0.00	$0.00	
Total product cost (without taxes or shipping)						$75.93	
Total product cost (including taxes and shipping)						$93.80	Includes $8 Shipping

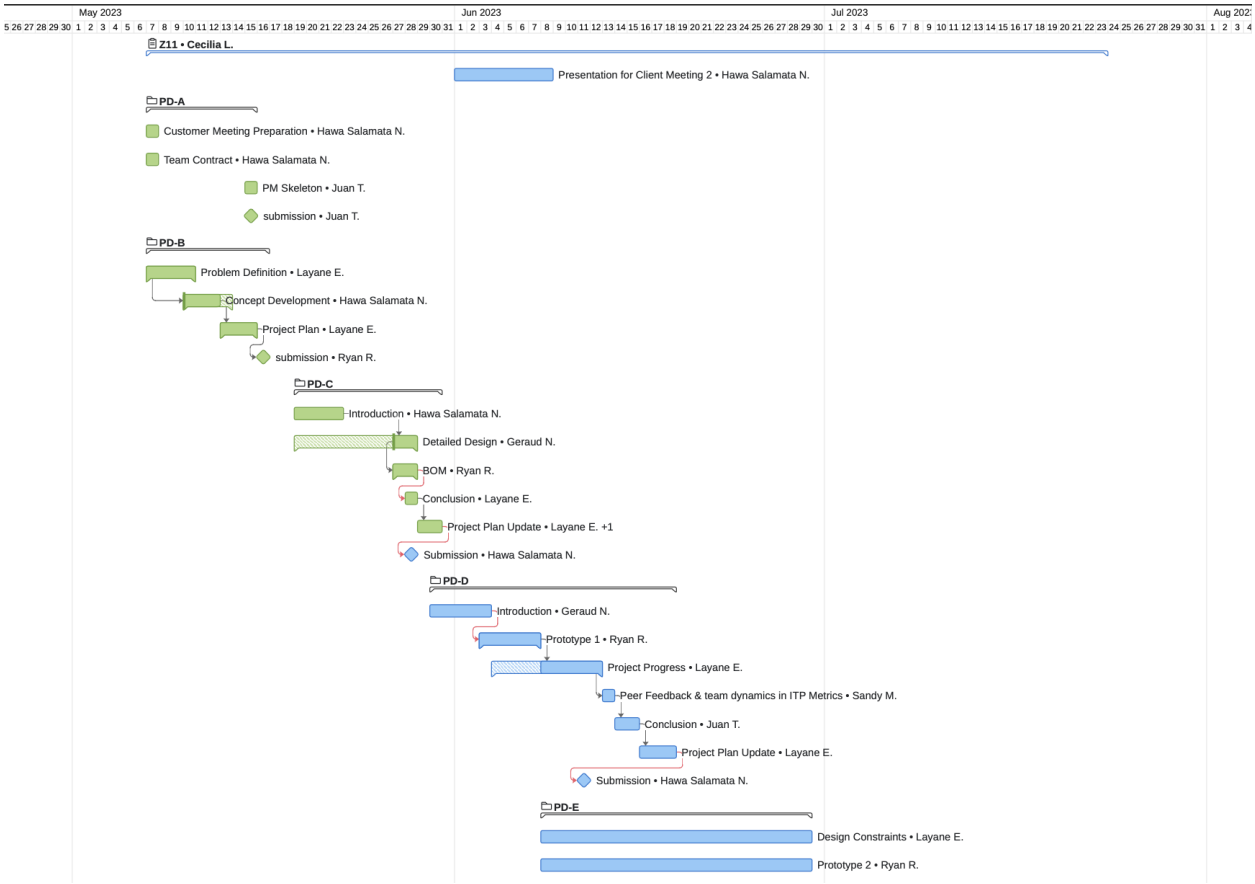
8. Conclusion

The project schedule and cost developed above for our final concept allows us to better define the basis of our project. They will serve as support for the prototyping test and the project progress presentation that will be carried out in the next steps.

B.1 References

[1] Joystick dimensions (*visited on 25/05/2023*)
[2] https://canasstech.com/products/ultra-joystick (*visited on 26/05/2023*)
[3] https://assets.nexperia.com/documents/data-sheet/74HC_HCT166.pdf (*visited on 27/05/2023*)

B.2 Project Plan Update



Snapshot : https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=F3W1JeO0rX9BvnEASm2pVY7Bqmd9Agwj%7CIE2DSNZVHA2DELSTGIYA