GlowBox

Hearing aid enclosure

G1.3. Hear We Glow
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01

Introduction

Background and Client needs

Our client has a hearing disability. The hearing aid charger capsule has a blinking light which disrupts her sleep. As a solution, she covers the charger to hide it. This makes her forget to wear the hearing aids in the morning and delays her daily routine.

Based on our client meet 1, we have collected and prioritized a list of client needs to generate a design problem statement.

#	Needs	Importance*
1	Device is affordable	3
2	Device is portable and light weight	1
3	Device emits alarm sound that is loud enough	5
4	Device has a large size that must fit on a bedside table	5
5	Device is durable	5
6	The client wants bright contrasting colors.	3
7	Device blocks the light from the charger	5
8	The client wants wood texture.	2
9	Device is installed with fewer wires for the safety of cats.	2
10	Device is simple to use	4

Problem Statement

Design a device which **encloses hearing-aids** and enhances features of apparentness through increased size, contrasting aesthetic and loud alarm sound for patients who forget to wear their hearing-aids in the morning.

Prioritized by 2 important needs:

1) Effectiveness

2) Durable

Challenge:

1) Grasp the user's attention when alarm sounds but remain discrete when not activated

Result of benchmarking: Marginal and Ideal value

Metric	Unit	Marginal Value	Ideal Value
Weight of box and alarm combined	kg	<1.8	1.35
Dimensions of box	in	<7 long <5 high <5 depth	6.5 4.5 4.5
Maximal sound of alarm clock	db	<85	80
Thickness of box only	in	<1/2	1/4
Cost of our final product	CAD $	<100	85
Sustainability	1-5 scale	<3	4
Reliability of electronics	1-5 scale	<4	5

02
Concept Developpement

Subsystem 1
Subsystem 2
Subsystem 3
Subsystem 4
Decision matrix

Concept

4 subsystems combined all together will form a global concept

leading to the detailed design

- Subsystem 1: Safety and storage

- Subsystem 2: Aesthetic

- Subsystem 3: Notification system

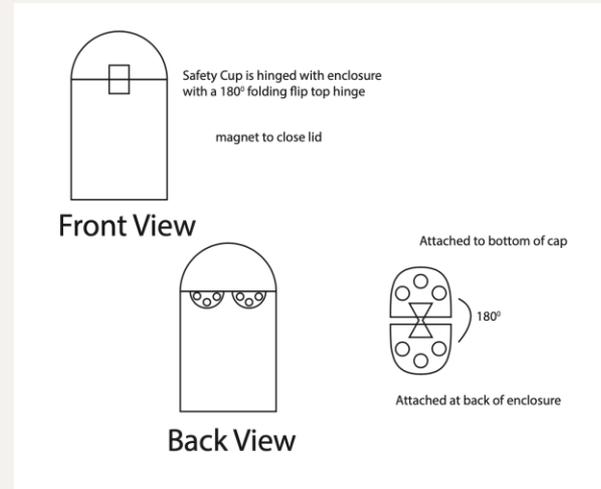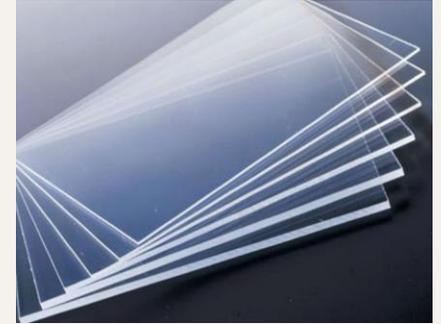- Subsystem 4: Power supply and electronics management

Subsystem 1 - Safety and Storage

- Material: Durable and lightweight
- Protection mechanism for safety

FINAL DESIGN

- **Material:** Plywood & Plastic
  - Sustainable, cheap, lightweight, easy to manufacture
- **Safety: Hinge mechanism**
  - 180 folding flip top hinge mechanism

Safety Cup is hinged with enclosure
with a 180⁰ folding flip top hinge

magnet to close lid

Front View

Attached to bottom of cap

180⁰

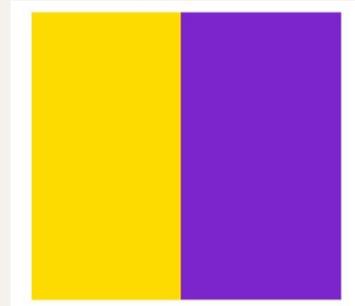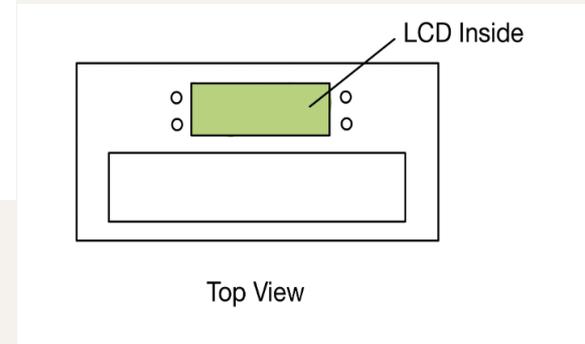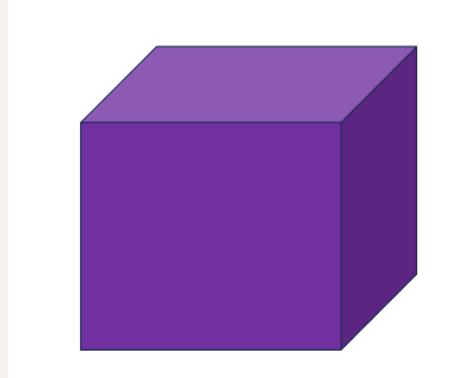Attached at back of enclosure

Back View

Subsystem 2 - Aesthetics

- Shape

- Color combination

- Placement of UI (User Interface)

FINAL DESIGN

- **Shape:** Cubic

- **Color combination:** Yellow-Purple

- **Placement of UI:** Inside of enclosure

Subsystem 3 - Notification System

- Time display
- Audio notification
- Visual notification
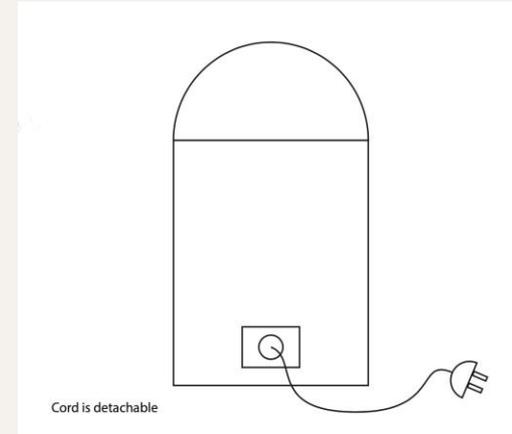- UI design for setting

FINAL DESIGN

- Digital system with LCD display, timer and alarm
- **Audio:** Piezo buzzer
- **Visual**: LED lights on the exterior of enclosure
  - Both are activated with the alarm
- Can setting the real time and alarm with buttons
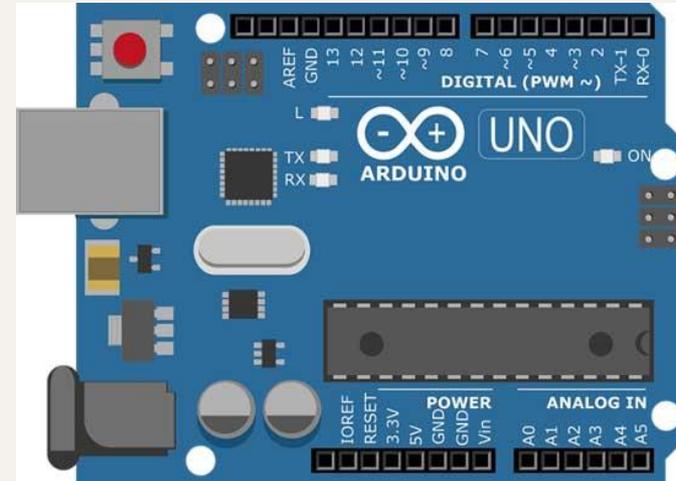
LCD Inside

Top View
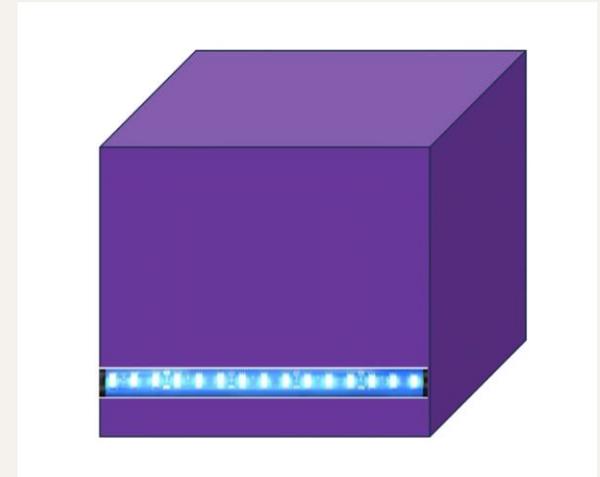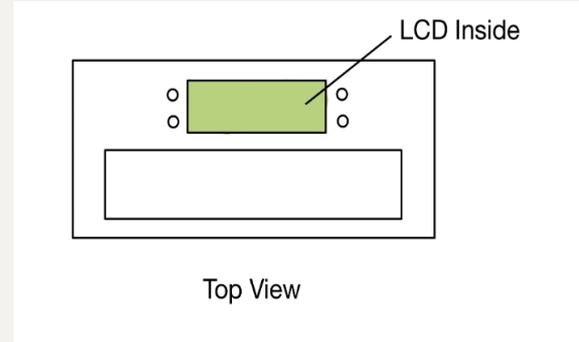
Subsystem 4
Power Supply and Electronics Management

- Cord design

- Power supply

- Controller

FINAL DESIGN

- Detachable cord & Minimal cables

- USB-A cable

- Controller via Arduino

Cord is detachable

Decision Making Process

Subsystem 1: Hearing aid enclosure materials and safety

Selection Criteria	Concept A: Lift Cap	Concept B: Hinge cap	Concept C: Automatic
Weight of box and alarm combined	4	4	2
Dimensions of box (not including alarm attached)	4	3	3
Maximal sound of alarm clock	N/A	N/A	N/A
Thickness of box only	4	4	3
Cost of our final product	5	3	1
Sustainability	2	2	2
Reliability of electronics	2	2	5
Aesthetic/contrast	1	4	4
OVERALL	22	22	20

Subsystem 2: Design, User Interface type

	Shape		User Interface	
Selection Criteria	Concept A: circular	Concept B: cubic	Concept A: LED display outside	Concept B: LED display inside
Weight of box and alarm combined	3	3	3	3
Dimensions of box (not including alarm attached)	2	4	2	4
Maximal sound of alarm clock	N/A	N/A	N/A	N/A
Thickness of box only	N/A	N/A	2	4
Cost of our final product	1	5	3	3
Sustainability	3	4	3	3
Reliability of electronics	N/A	N/A	3	3
Aesthetic/contrast	3	5	3	4
OVERALL	12	21	19	24

Subsystem 3: Alarm system

Selection Criteria	Concept A: Digital alarm	Concept B: analogue
Weight of box and alarm combined	4	1
Dimensions of box (not including alarm attached)	2	5
Maximal sound of alarm clock	5	2
Thickness of box only	N/A	N/A
Cost of our final product	2	5
Sustainability	1	5
Reliability of electronics	5	1
Aesthetic/contrast	5	2
OVERALL	24	21

Subsystem 4: Charging: Power, Charging system, Battery

Selection Criteria	Concept A: cord attached	Concept B: cord detachable
Weight of box and alarm combined	3	4
Dimensions of box (not including alarm attached)	3	3
Maximal sound of alarm clock	N/a	N/a
Thickness of box only	3	4
Cost of our final product	4	4
Sustainability	3	4
Reliability of electronics	5	4
Aesthetic/contrast	3	3
OVERALL	24	26

Evaluation method of concepts

- Decision matrix against client needs, target specifications and pros-cons list
- Evaluated on a scale of 1 to 5 based on 8 criteria
- The concept with the highest total score is selected.
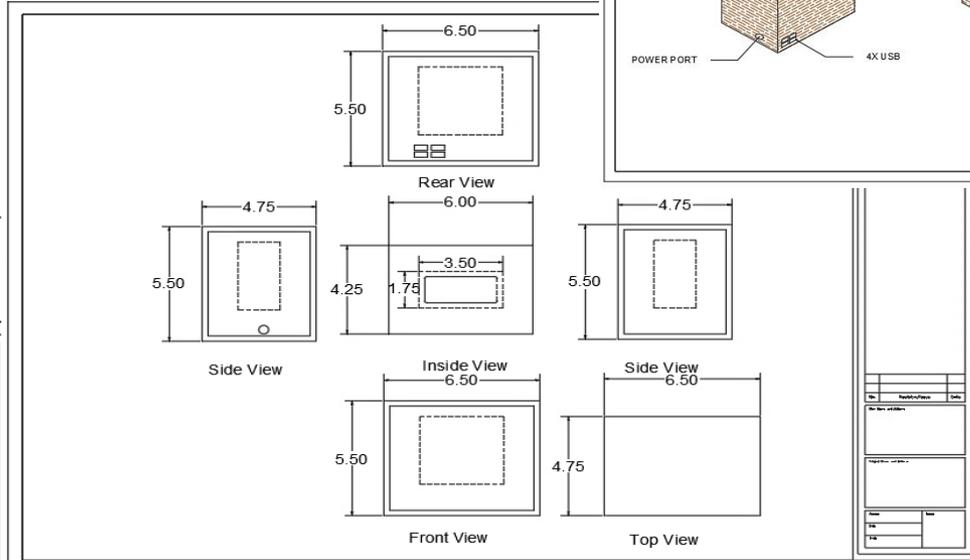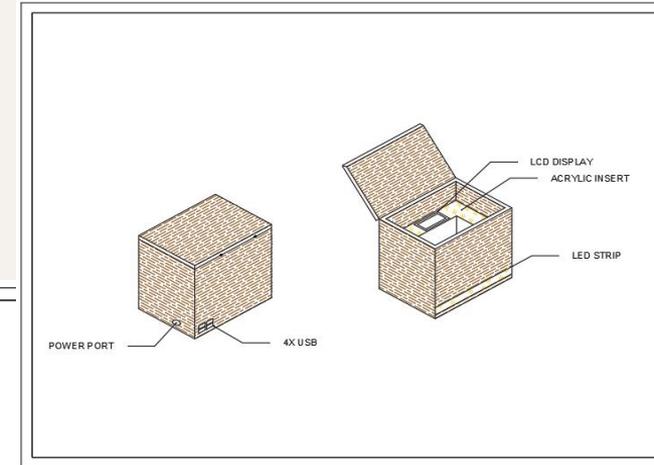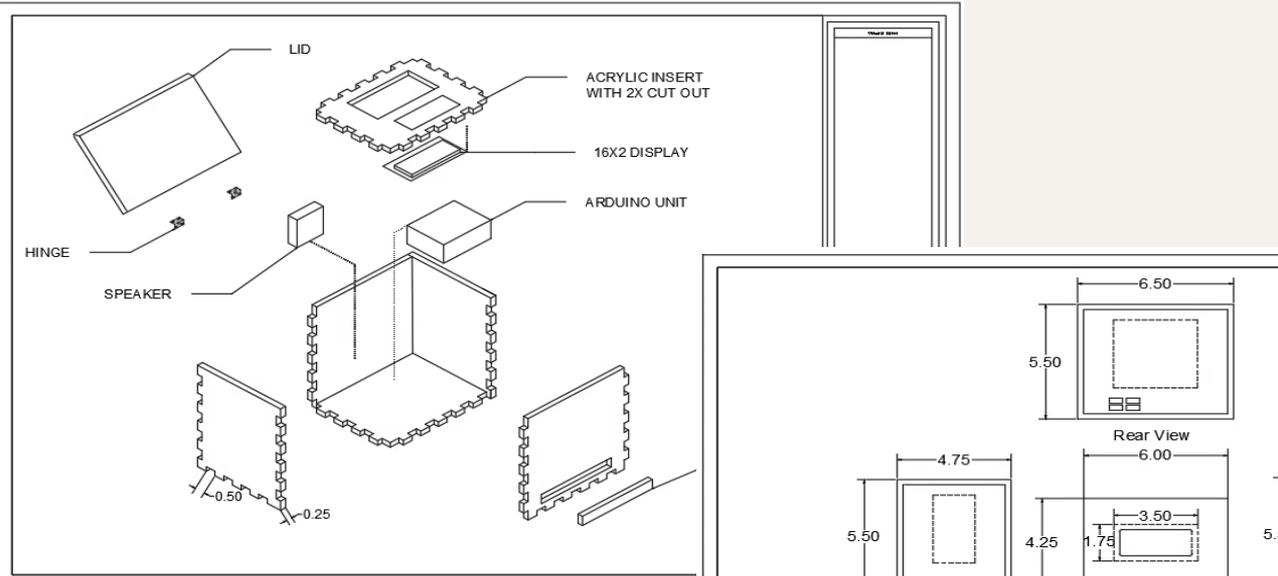- Bring all subsystems together and develop a prototype

03
Prototype

Prototype 1
Prototype 2
Final Prototype

Prototype 1 – Mechanical design: CAD Model

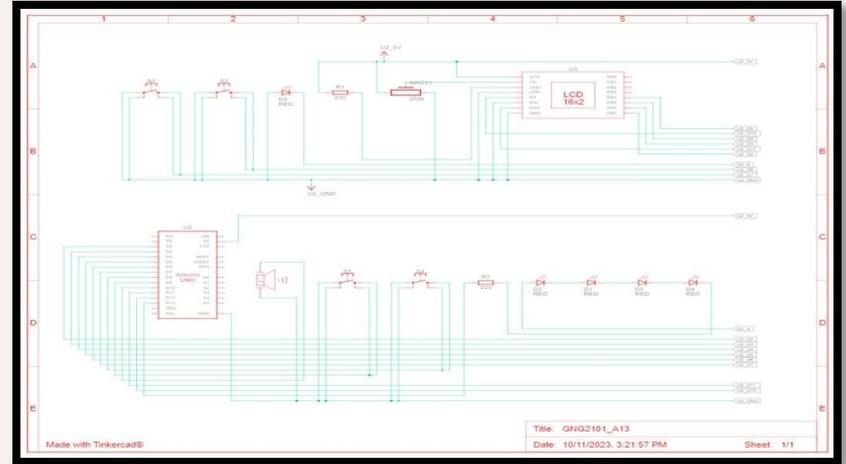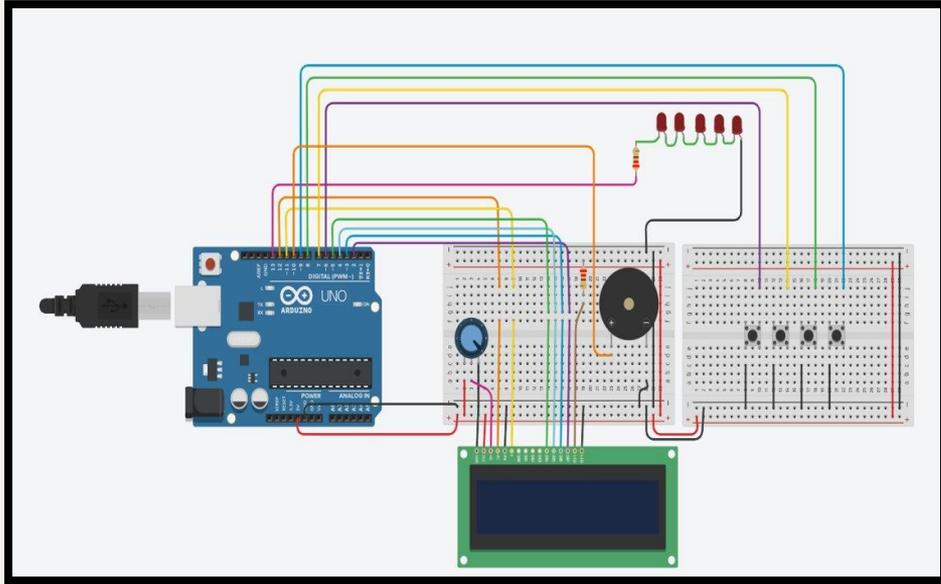# Prototype 1 – Cardboard model Enclosure
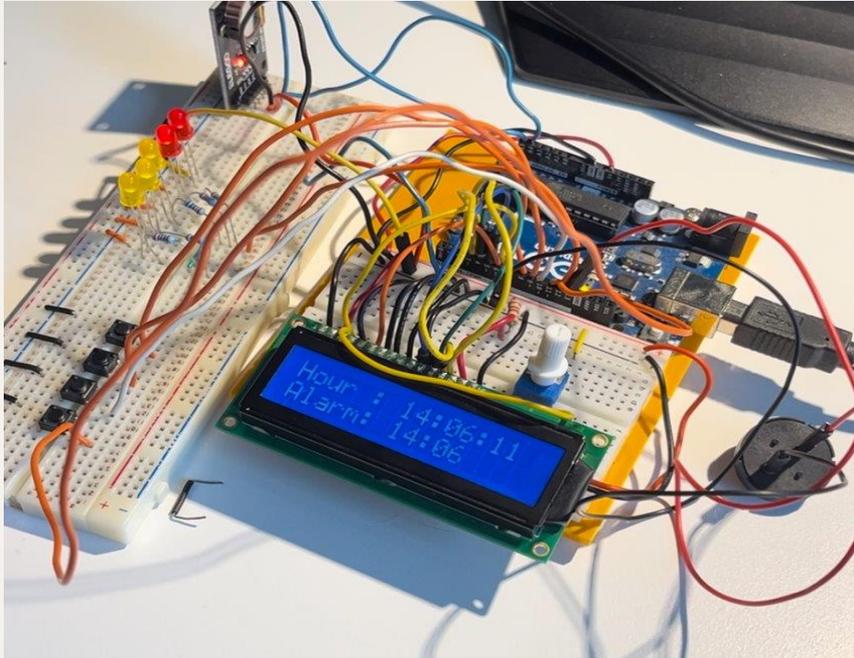
Prototype 2 – Enclosure Design

Prototype 2 – Electrical design: Tinkercad simulation

Prototype 2 – Electronics + Code


```
alarm_v2.ino

17    //***********libraries**************/
18    #include <Wire.h>
19    #include <RTClib.h>
20    #include <LiquidCrystal.h>
21
22    //**************************************//
23    LiquidCrystal lcd(7, 6, 5, 4, 3, 2); // (r
24    RTC_DS3231 RTC;
25
26    //************Button****************//
27    int P1=8; // Button SET MENU'
28    int P2=9; // Button +
29    int P3=10; // Button -
30    int P4=11; // SWITCH Alarm
31
32    //************Alarm**************//
33    #define LED 12
```

Final Prototype
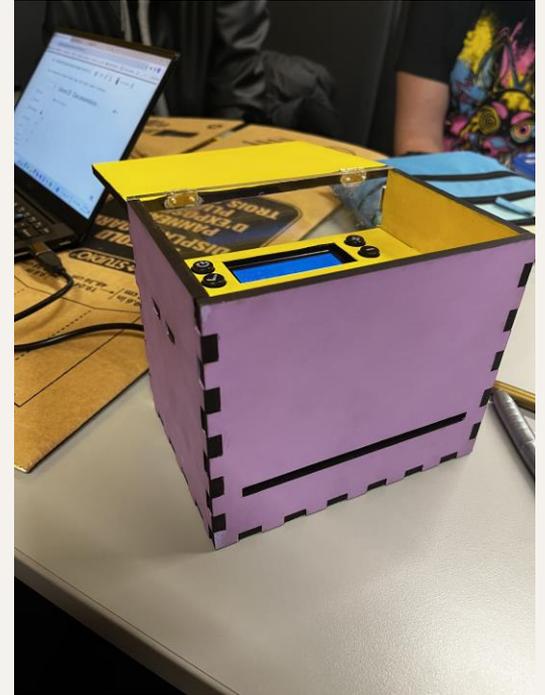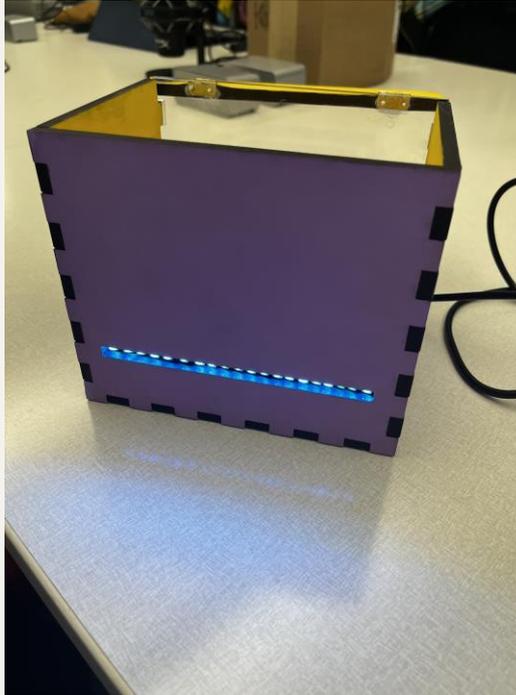
Video demo

04
Business Considerations

BOM
BMC
Income statement

Bill of Materials

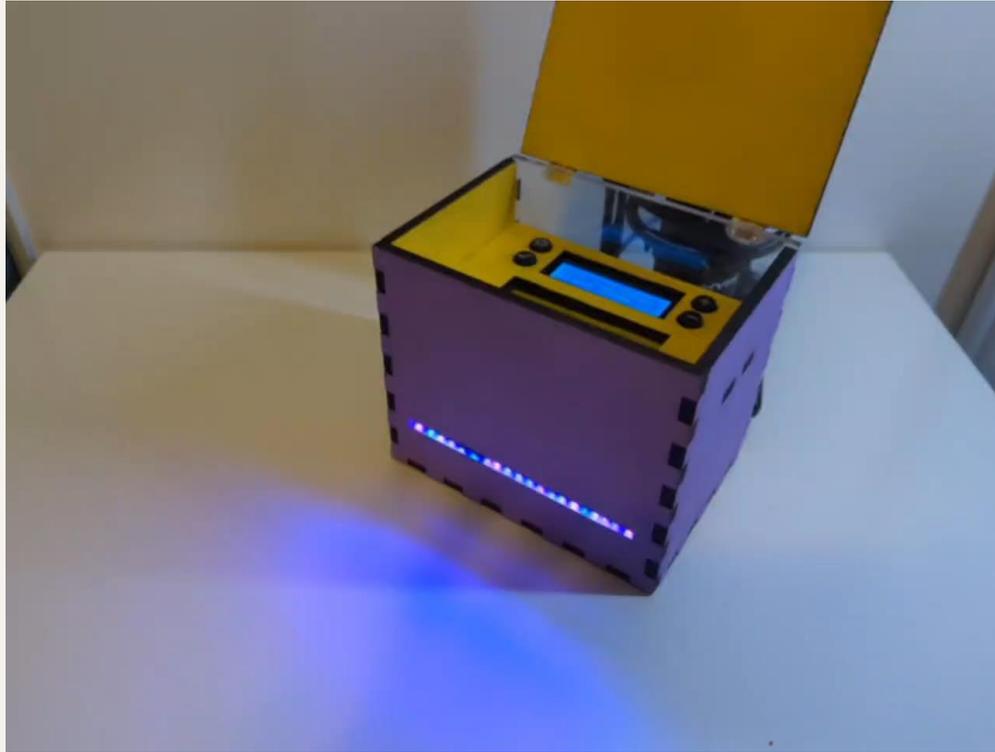| Item#	Name	Description	Dimensions	Quantity	Cost (CAD$)
1	Plywood	Birch Materials of the exterior of the enclosure	12" x 24"	2	3.95
2	Clear polycarbonate plastic sheet	Enclosure interior material for color contrast	1/4" x 6" x 12"	1	4.96
3	Arduino uno	Arduino + cable Power supply	2.7" x 2.1"	1	17
4	LCD Display	User Interface	12.45 x 4.32 x 1.02 cm; 40g	1	12.98
5	LED Strip	Visual alarm	Blue	1	8
6	Speaker (Buzzer)	Auditory alarm	0.496" Dia 1.5V	1	1
7	Wires	For connection between Arduino and LCD, LED, and Buzzer		5ft	1.60
8	Resistor	220ohm		5	0.01
9	DS3231 RTC module	Real time clock	22W x 38H mm	1	10.99
10	Push button	To operate system	6 x 6 x 5 mm	4	0.61
11	Hinges	Connector for opening and closing the enclosure lid on the enclosure	0.79" x 0.79" x 0.79"	2	0.96
TOTAL					66.02

BMC

Key Partner	Key Activities	Value proposition	Customer Relationships	Customer Segments
- Manufacturing in distribution and sales	1- Product development based on customer feedback 2- Management of customer relations (help/support desk)	An enclosure for hearing aids that will allow to hide the blinking lights and make itself visible to the client.	- Long-term: Interaction with clients on a recuring basis to evaluate quality of product - Self-service: Users follow the website to address for technical issues with the device.	For customers with hearing disabilities that require the use of hearing aids or for customers that use wireless earphones
	Key Resources 1- Customer base 2- Distribution 3- Raw materials 4-Maintenance/ troubleshoot equipment 5- GNG2101 Labs		**Channels** - Through e-commerce platforms - Later evolve to personal website and store	

Cost Structure	Revenue Streams
- Mostly fixed cost, only requires one time cost for the design and fabrication of hearing aid design - Variable costs: Maintenance/repair, marketing, salaries for workers	- Each hearing aid will be sold at a set price

Income Statement – 3-year projection

Income Statement
For The Year Ended December 31, 2024 to 2026

	2024	2025	2026
REVENUE:			
Net Sales	$40,000	$160,000	$320,000
Cost Of Goods Sold	$20,000	$80,000	$160,000
Gross Profit	$20,000	$80,000	$160,000
OPERATING EXPENSE:			
Marketing	$1,200	$2,400	$4,800
R&D	$2,000	$4,000	$8,000
General expenses	$6,000	$12,000	$24,000
Labour cost	$150,000	$150,000	$150,000
Operating Expenses	$159,200	$168,400	$186,800
Net Income	-$139,200	-$88,400	-$26,800

Assumptions

1- Sale price: 80$/unit

2- Cost per unit: 40$

3- Total units sold

Year 1: 500

Year 2: 2000

Year 3: 4000

4- Marketing cost fixed at 3%

5- R&D expenses fixed at 5%

6- General expenses fixed at 15%

7- Labour cost: 3 workers

with a salary of 50,000$ each

05

Conclusion

Strengths and lessons learned
Future improvements

Strengths and Lessons learned

Strengths

- Excellent time management
- Equal contribution from all members
- Productive weekly team meetings
- Consistent communication throughout the semester

Lessons learned

- Set deadlines earlier than actual due date to have room for extra time
- Consult experts/TA/profs for suggestions
- Overthinking

Future Improvements

- Clean finish

- Mechanism to hold the lid when opening the box

- Sensor to indicate when hearing aids removed

- A switch to disable the buzzer but keep lights

- A potentiometer to modify the volume of sound

- Option to select type of alarm sound

- Option to set multiple alarm times

- Addition of usb ports to serve as a charging dock

- Control any box setting using an app

- Automation

Join us in revolutionizing how individuals with hearing impairments approach their daily lives.

Hear We Glow – lighting up lives one box at a time