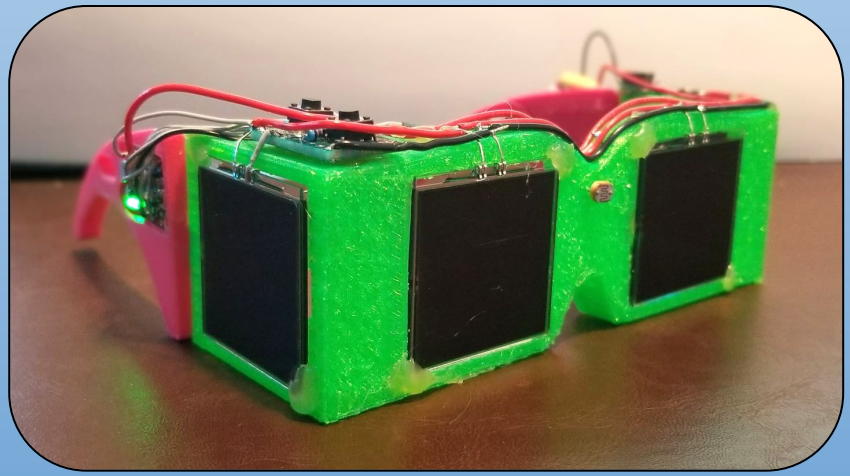
LightShield

Dynamically Polarizing Glasses



Group 2.4

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Zhema Wen

Project Summary

- Design a pair of glasses for people with extreme light sensitivity
- Design Process: Empathize, Define, Ideate, Prototype, Test
- Developed a business model and economics report

Problem Statement / Client Needs

- Pain & discomfort from bright light
- Carrying multiple pairs of sunglasses

Core Requirements:

- Adjustable tint
- Automatically adjust to ambient light
- Enclose the eyes
- Fast response time

This Is Inconvenient

Benchmarking

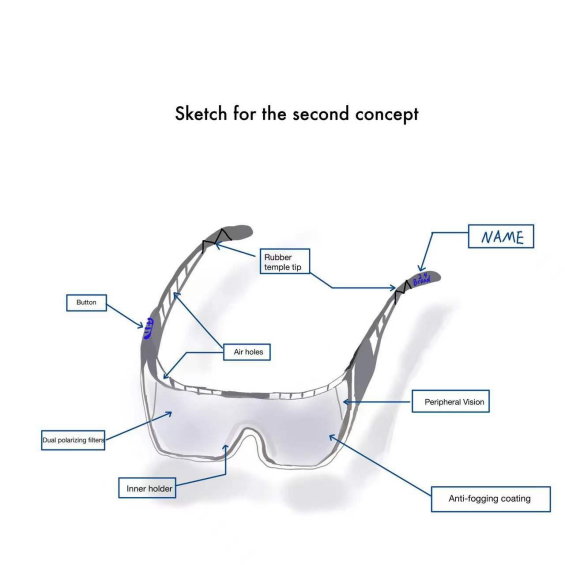
Specification	Cocoons 	SUGLSS 	AIDEN 	App-enabled electrochromic 
Description	peripheral vision polarized to eliminate blinding glare sports frame	photochromic lenses plastic frames 1 minute.	solar battery internal holder 1 second	app to change the tint level of lenses, a built-in location finder
Material (Frame/lenses)	Neoprene optical-grade lens material	plastic/TAC	TR90/liquid crystal	TR90/TAC
Weight	25-28g	21g	41g	26 g
Peripheral Vision	yes	no	no	yes
Visible light transmission	13%	15%.	10%	4% - 38%
Photochromic lenses	no	yes	yes	yes

Target specifications

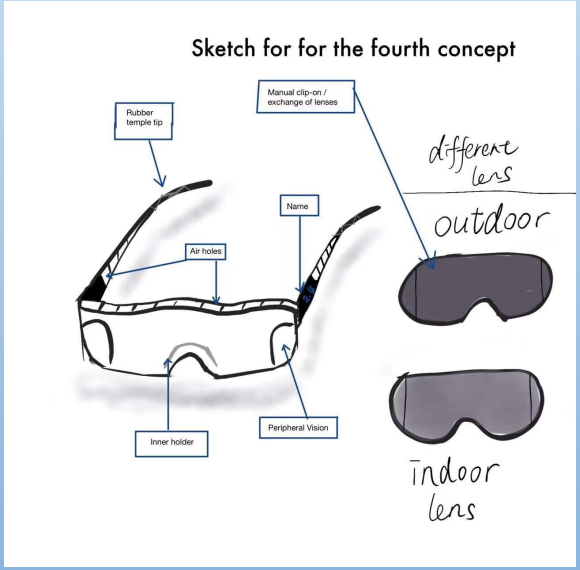
Metrics ID Number	Metrics Descriptor	Units	Target Values
1	Cost	CAD	< $ 100
2	Weight of the glasses	g	< 26 g
3	System response time	s	< 0.1 s
4	Visible Light Transmission (%)	*Unitless*	4% - 38%
5	Battery Life	days	~ 7 days
6	Cold Weather Durability	℃	>-10℃

Concepts

DESIGN A



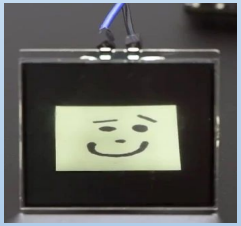
DESIGN B



DESIGN C

Decision matrix

Criteria	Importance	Design A	Design B
Cost	3	2	4
User Friendly	5	4	3
Weight of the Glasses	4	3	4
System Response Time	4	5	1
Visible Light Transparency (%)	5	5	5
Battery Life	3	3	5
Total	N/A	92	88

Design A	
Lens 	- Liquid Crystal Light Valve

Design B	
Lens	- Polarizing Filters - 

Type	Vendor	Description/Dimensions	Price (CAD)	QTY.	TOTAL
Controllable Shutter Glass	Elmwood Electronics	A Liquid Crystal Light Valve (a.k.a a LCD Controllable Black-out Panel; LCD size: 31 x 33 x 2 mm; Dimensions: 36 x 36 mm ; Driving voltage: 3-5V)	$4.99	4	$19.96
Microcontroller, Adafruit Trinket M0	Elmwood Electronics	The Adafruit Trinket M0 is a tiny microcontroller board: 27mm x 15.3mm x 2.75mm / 1.07" x 0.6" x 0.1"; Height with MicroUSB: 3.5mm / 0.14"; Weight: 1.4g	$12.99	1	$12.99
PLA Glasses Frame	UOttawa 3D printer	3D printable plastic	$0.00	1	$0.00
Tactile Switch Buttons	Elmwood Electronics	Medium-sized clicky momentary switches are standard input "buttons" on electronic projects; The pins are normally open (disconnected) and when the button is pressed they are momentarily closed.	$3.99	1	$3.99
USB LIION/LIPOLY CHARGER	Elmwood Electronics	The charge current is 100mA by default. If you want you can easily change it over to 500mA mode by soldering closed the jumper on the front, for when you'll only be charging batteries with 500mAh size or larger.	$9.99	1	$9.99
Lithium Ion Polymer Battery	Elmwood Electronics	3.7V 110MAH	$9.99	1	$9.99
Total product cost (without taxes and shipping)					$56.92
Total product cost (including taxes and shipping)					$64.32

Business Model Canvas

<table>
<tr>
<td rowspan="2">Key Partners

- Electronics Suppliers
- Microprocessors
- Power supplies
- Electrochromic displays
- Miscellaneous

- Plastic suppliers
- PLA plastic
- TR90 plastic</td>
<td>Key Activities

- Research & development

- Manufacturing</td>
<td rowspan="2">Value Proposition

- All-in-one solution

- Hands-free

- Fast response time</td>
<td>Customer Relationships

- Customer service
- Sales representatives
- Ratings and customer feedback</td>
<td rowspan="2">Customer Segments

- Individuals with light sensitivity

- Vehicle drivers</td>
</tr>
<tr>
<td>Key Resources

- Engineers

-Products</td>
<td>Channels

- Brick and mortar
- E-commerce platforms
- Amazon
- Shopify site
- Social media marketing</td>
</tr>
<tr>
<td colspan="3">Cost Structures

- Manufacturing
- R&D Costs
- Employees
- Website hosting
- Cost of Materials
-Overhead</td>
<td colspan="2">Revenue Streams

- Sales</td>
</tr>
</table>

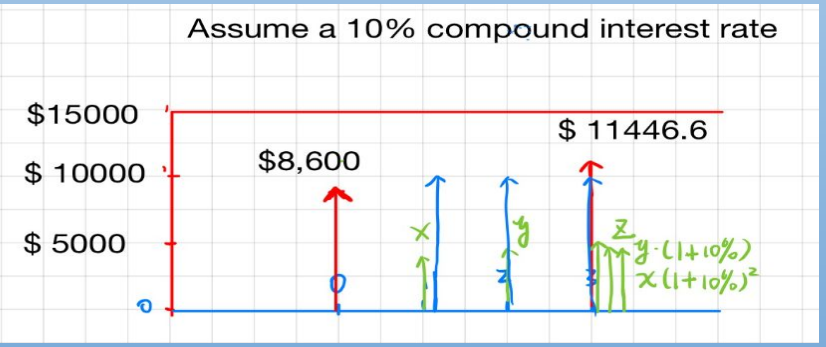
Three year income statement

Assume we sell pairs of glasses, without any debt or interest							
Column1	Accounting	Unit Price	Units sold in three years	Tax Rate	Average salary per employee per year	years	employees
Revenue	$611,964.00	$169.99	3600				
TYPES OF COSTS							
Material cost	$181,224	$50.34	3600				
Marketing campaigns	$20,000						
Electricity	$10,000						
Total salary	$300,000				$25,000	3	4
Overhead	$25,000						
Rent	$21,000						
Depreciation	$10,000						
Operating income	$44,740						
Interest	$0						
Earning before tax	$44,740						
Net Income	$33,555			25%			

Green row=cash in

Red row=cash out

Yellow= 0



*Blue line is the salary. Red lines are other costs. Green line is the (unit price of products-unit price of raw materials) * units sold.*

Therefore, the overall salary in the third year is

$ 25000*4 + $ 25000*4*(1+10%) + $25000*4*(1+10%)^2=$331000

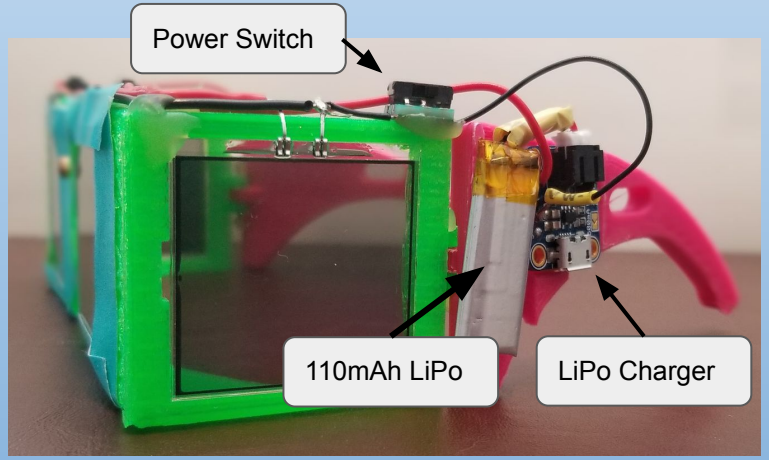
Except material costs and salary

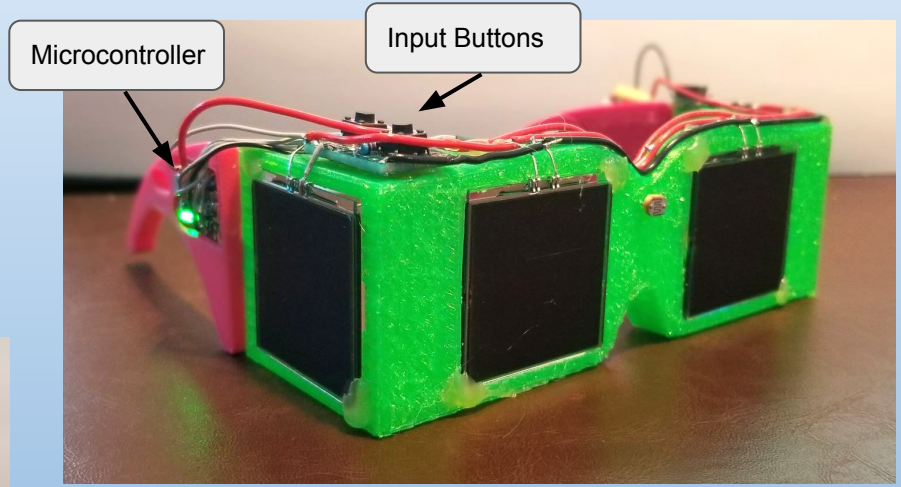
$ 8600*(1+10%)^3=11446.6

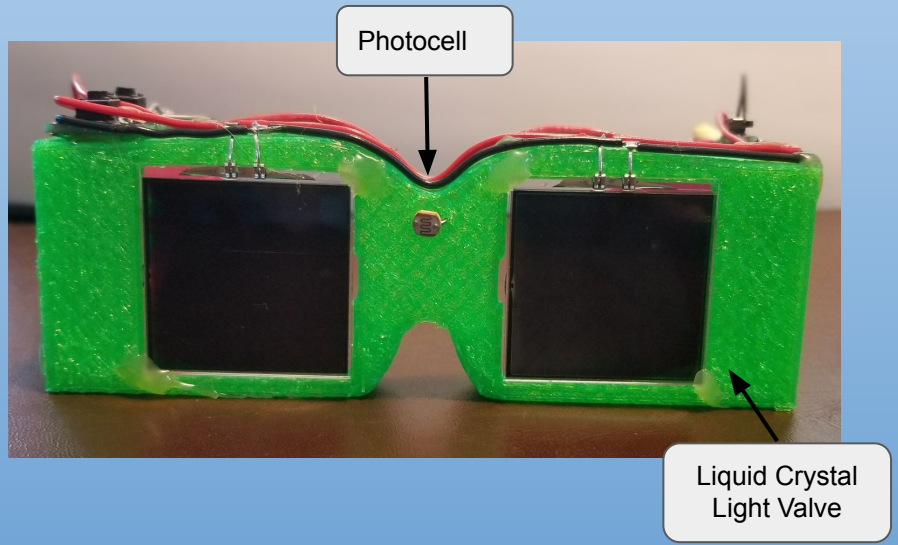
Units sold per year = 864.6735254 = 865

Units sold in three years = 2594.020576 = 2595

Prototype III







Demo

Auto-adjust Mode

Manual-Adjust Mode

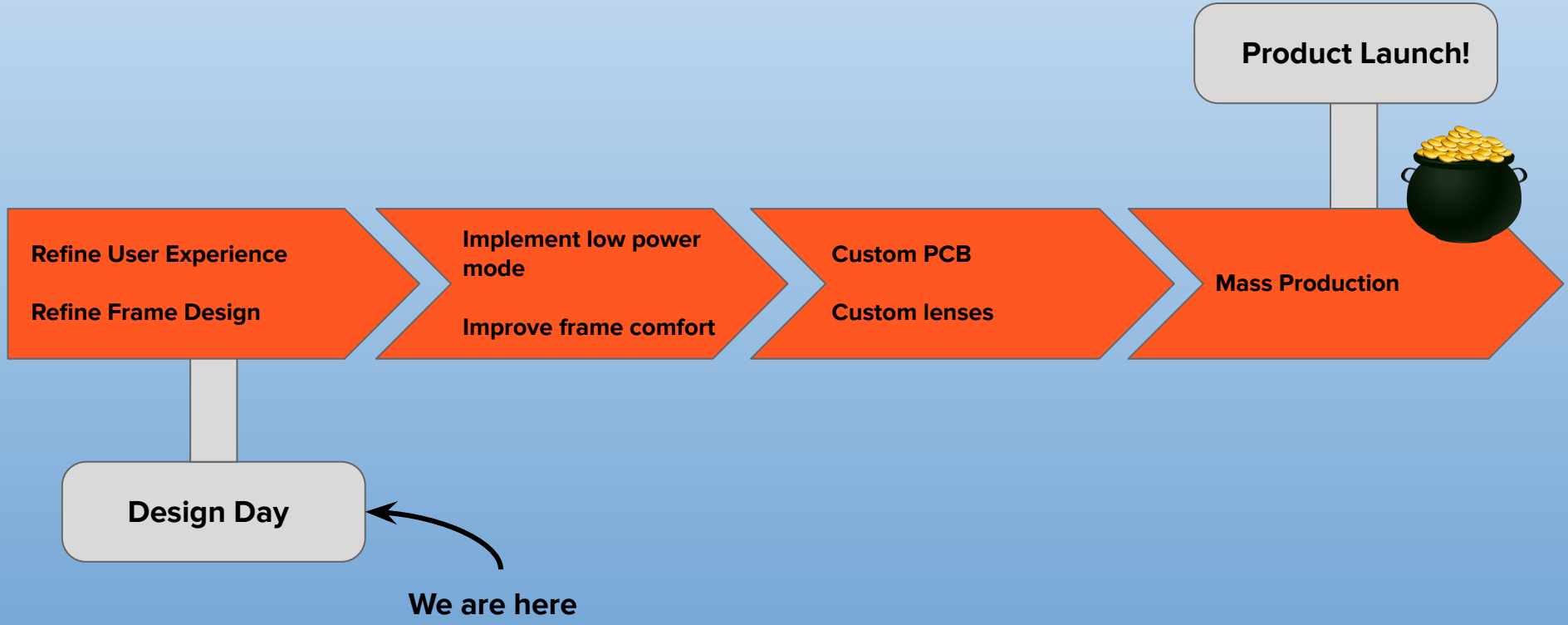
Trials and Tribulations

Metrics ID Number	Metrics Descriptor	Units	Target Values	Prototype III Values
1	Cost	CAD	< $ 100	$ 57
2	Weight	g	< 26 g	59 g
3	Response Time	s	< 0.1 s	0.1 s
4	Visible Light Transmission	*Unitless*	4% - 38%	9.4% - 36.6%
5	Battery Life	Hours	168 (~7 days)	9.03
6	Cold Weather Durability	℃	-10℃	-8℃

Other Challenges:

- Lens shape and size
- Frame fit

Future Work


Product Launch!
Refine User Experience
Refine Frame Design
Implement low power mode
Improve frame comfort
Custom PCB
Custom lenses
Mass Production
Design Day
We are here

Thanks!
Questions?