GNG 2101 Project Report

Project Deliverable C: Conceptual Design and Project Plan

Submitted by

GNG 2101 - Lab C 02, Group 2.4

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Abstract

This deliverable is intended to generate design concepts and create a project plan for constructing multiple prototypes in time based on client's need. Correspondingly, detailed research and the idea we developed must be evaluated as well in order to establish which design is the most competitive. In addition, an updated project plan from the website *Wrike* is illustrated to monitor advances in our solution and our team's performance over time. Ultimately, a simple but effective client meeting preparation, including problems in the design process and opinions to be presented to customers, will also be included in this paper.

1. Introduction

This document continues our group's goal of solving the "Dynamically Polarizing Glasses" issue presented to us by our client. In this deliverable, we are tasked with defining and prioritizing our design criteria. Exact target specifications are also required. We must also do some research into similar products to ensure the most thoughtful solution. The objective as stated on BrightSpace is as follows: "Develop a conceptual design for your product and create a plan for completing multiple prototypes in time for Design Day."

2. Conceptual Design

2.1 Functional Decomposition

The dynamically polarizing glasses can be decomposed into the following subsystems: power system, control system, lenses, frame. The power system contains all of the components required to supply power to the design (E.g: Lithium ion polymer battery). The control system consists of the components that sense the ambient light in the environment and then send a signal to change the tint of the lens. The lenses are the main component of the design. They must have a mechanism to vary the amount of light that can be transmitted through it. Finally, the frames are responsible for positioning the lenses on the user's face, as well as house any electrical components that may be used.

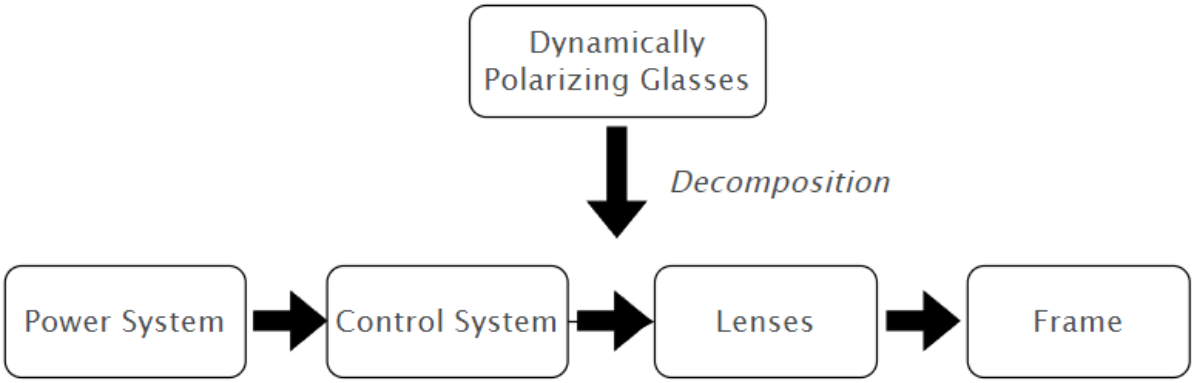

Figure 1. Functional decomposition of the dynamically polarizing glasses

2.2 Conceptual Design

Table 1. The generation of individual concepts

Creator	Subsystem	Concept	Description	Evaluation & Assessment
Ken	Lens	Liquid Crystal Light Valve Lenses	These lenses can change its transparency according to an applied voltage (0-5V)	- Glass panel - Blocks upto ~95% of light - Requires low voltage (0-5V) - Controllable via microcontroller
Ken	Control System	Photoresistor feedback	Use a photoresistor to measure the intensity of ambient light and use this data to adjust	- Inexpensive sensor (~$1)
Ken	Control System	Button-controlled user input	Use two buttons mounted to the frame to increase/decrease the transparency	- Intuitive interface for user interaction - Adds weight to the design
Zhema	Frame	Inner holder	Inner holder can be fitted with user's own myopia or presbyopia glasses	- Improves the vision for the user - Increases bulkiness in the design
Zhema	Frame material	TR-90	TR-90 is a thermoplastic material that is incredibly durable, flexible, and lightweight, and they are flexible to wrap the user's face. The price of tr-90 is also within our budget.	- Durable, flexible, and lightweight - Inexpensive - Difficult to custom manufacturer
Ken	Frame Material	Polylactic acid (PLA)	Common plastic used by 3D printers	- Free (via Makerspace) - Compatible with 3D printers
Zhema	Frame	Air holes and anti-fogging coating	Based on the client's needs, our client often wears a hat, so the air vent is for better cooling.	- Prevents the vapor exhaled by wearing a mask
Avery	Lens	Category 3 lens	These lenses are all brown and grey. They block 82% - 92% of light.	- Susceptible to lost lenses - User needs to carry the unused lenses
Avery	Lens	Category 4 lens	These lenses are very brown and grey. They block 92% - 97% of light.	- Susceptible to lost lenses - User needs to carry the unused lenses

Avery	Control System	Manual adjustment	The Category 3 and 4 lenses can be exchanged via clip-on method.	- Susceptible to lost lenses - User needs to carry the unused lenses
DongYu	Control system	Phone app	The glasses transparency is controlled by the phone through a microcontroller	- App development is time consuming
DongYu	Power System	Rechargeable battery through type C port	Battery through type C port (if we use electronic means)	- Very common charging port
DongYu	Lens	Magnetic dismountable lenses	Lenses are magnetic and portable, and users have to change lenses in different lightness. (less favorable)	- Susceptible to lost lenses - User needs to carry the unused lenses
Ken	Lens	Rotating polarizing filters	Use two sheets of polarized filters. When you rotate one sheet with respect to the other, the transparency through the two filters decreases/increases.	- Blocks ~100% of light transmission (when orthogonal)
Ken	Lens	Composite lens	Use a primary transparency-adjustable lens, as well as VLT 15% lens to cover peripheral vision	- Adds manufacturing complexity - Adds weight - Provides additional peripheral vision for the user
Ken	Control System	Microcontroller	Use a microcontroller, like an Arduino, to receive ambient light data and send a signal to change the transparency of the lens.	- Small enough to fit in frame - Requires a power source (150mA current draw)
Zhema	Power system	Solar power	The solar battery has unlimited endurance, which the client does not need to charge the glass	- Renewable energy source - Too large to mount to glasses (55mm diameter cell)
Ken	Power System	Lithium Ion Polymer Battery (LiPo)	Common battery type for maker projects	- Inexpensive - Energy dense
Zhema	Frame	Rubber temple tip	The rubber is more soft than TR-90, so the user will feel more comfortable.	- Improved comfort for long-duration use
Zhema	Frame	Peripheral Vision	Side view of the glasses.	-Client need

2.3 Evaluation of Each Concepts

Table 2. Ranked concepts for decision-making

	Subsystems			
Design	**Power System**	**Control System**	**Lens**	**Frame**
A	- Lithium Ion Polymer Battery	- Photoresistor - Microcontroller - Buttons (+/-) - Phone app	- Liquid Crystal Light Valve - Anti-fogging coating	- Inner holder - TR-90 - Air holes - Rubber temple tip - Peripheral Vision
B	- N/A	- Manually-adjusted	- Dual polarizing filters - Anti-fogging coating	- Inner holder - TR-90 - Air holes - Rubber temple tip - Peripheral Vision
C	- Lithium Ion Polymer Battery	- Servo - Photoresistor - Microcontroller - Buttons (+/-) - Phone app	- Dual polarizing filters - Anti-fogging coating	- Inner holder - TR-90 - Air holes - Rubber temple tip - Peripheral Vision
D	- N/A	- Manual clip-on / exchange of lenses	Adjustable Category 3 & 4 lenses	- Inner holder - TR-90 - Air holes - Rubber temple tip - Peripheral Vision

Table 3. Evaluation of each concepts

Criteria	Importance	**A**	**B**	**C**	**D**
Cost	3	2	5	4	3
User Friendly	5	4	3	3	2
Weight of the glasses	2	3	4	2	3
System response time	3	3	5	3	5
Visible Light Transmission (%)	5	5	5	5	5

Battery Life	3	66	78	65	65

2.4 Design Concept Descriptions

2.4.1 Design Concept A

Design A uses a liquid crystal light valve (LCLV) to vary the visual light transmission of the lens. The level of tint displayed by the LCLV will be controlled by a microcontroller. A photoresistor mounted to the frame of the glasses will sense the ambient light and send that signal to the microcontroller. The microcontroller will vary the lens' tint in accordance with the ambient light. Moreover the design will include buttons that the user can press to manually increment or decrement the tint. All of the electrical components will be powered using a small lithium ion polymer battery. All of the components will be housed in a TR-90 plastic frame.

Benefits:

- Automatic tint adjustment
- No moving parts
- Optional manual adjustment

Trade Offs:

- Requires battery power
- Electrical components add weight to the design

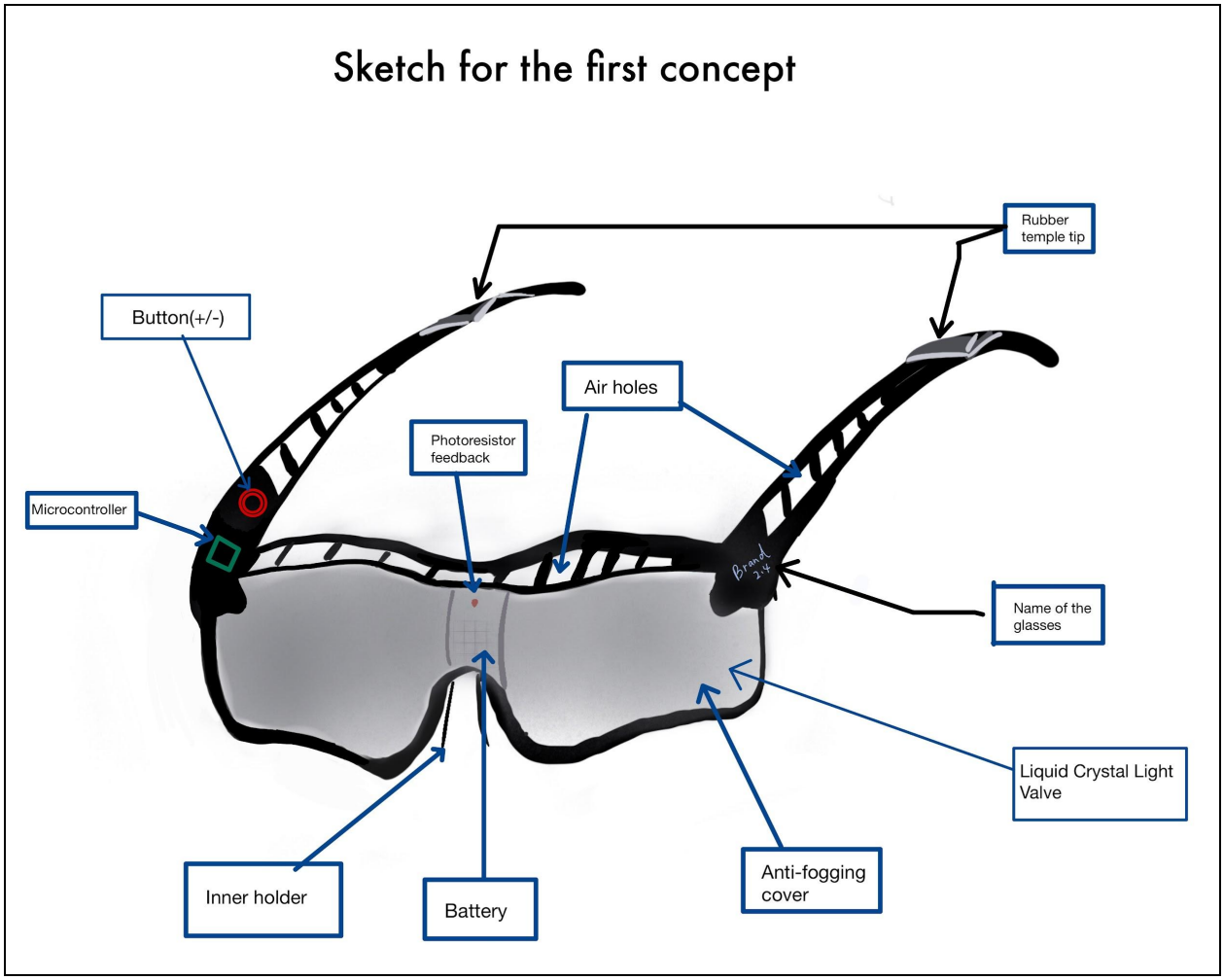

Figure 2. Sketch of design concept A

2.4.2 Design Concept B

Design B uses dual polarizing filters to vary the visual light transmission of the lens. When the filters are rotated with respect to each other, the amount of light that is transmitted decreases until the two filters are rotated by 90 degrees. At this point, no light is transmitted. The user will manually control the amount of light transmitted by rotating the filter to achieve the desired tint.

Benefits:

- No battery
- Inexpensive technology

Trade Offs:

- Must be manually adjusted
- Moving parts

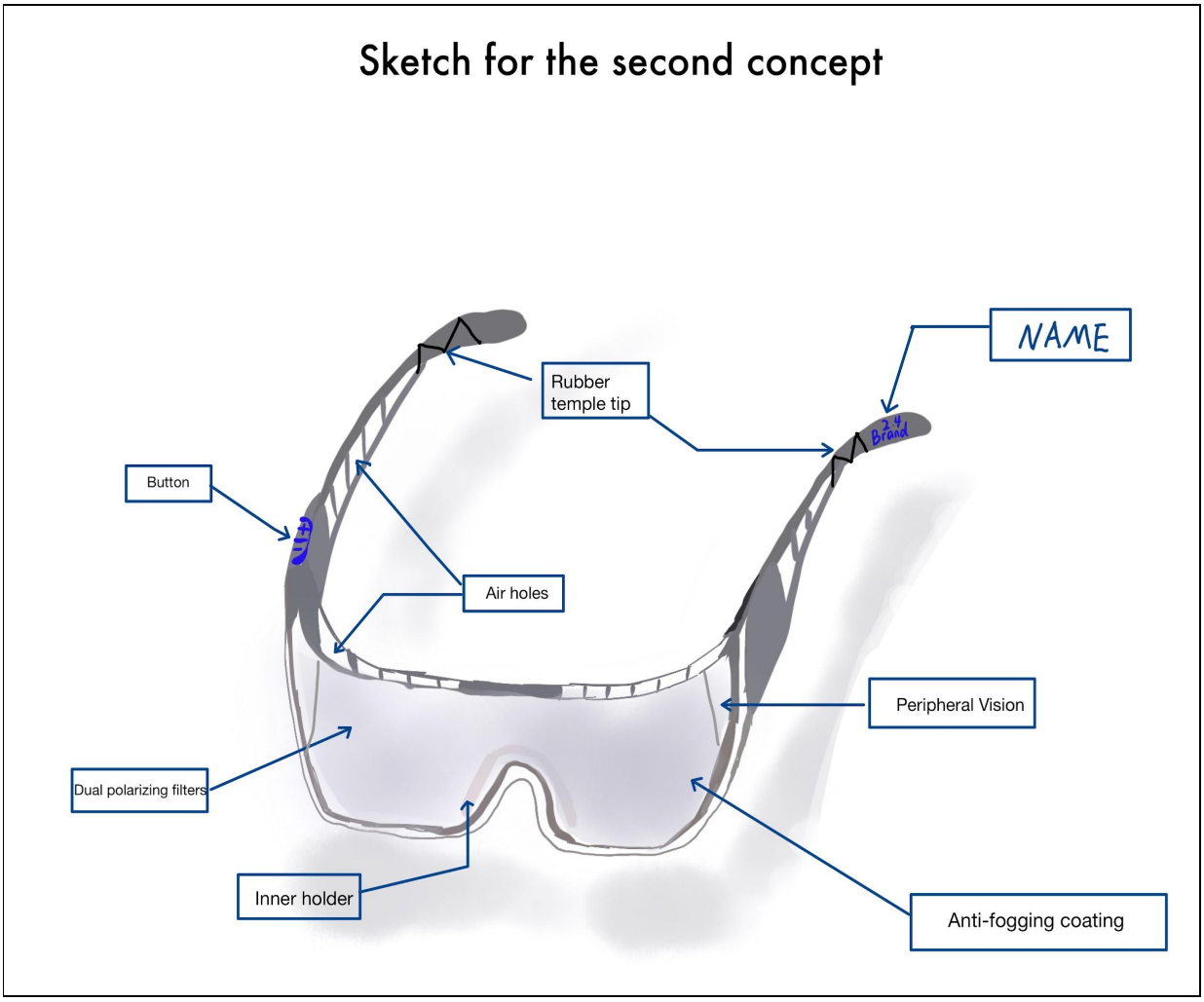

Figure 2. Sketch of design concept B

2.4.3 Design Concept C

Similar to Design B, Design C also uses dual polarizing filters to vary the visual light transmission of the lens. The main difference is that Design C adds servo motors that will automatically adjust the filters. In addition to a motor, this design would add a microcontroller, photoresistor, buttons, and a battery.

Benefits:

- Automatic tint adjustment
- Optional manual adjustment

Trade Offs:

- Requires battery power
- Electrical components add weight to the design
- Moving parts

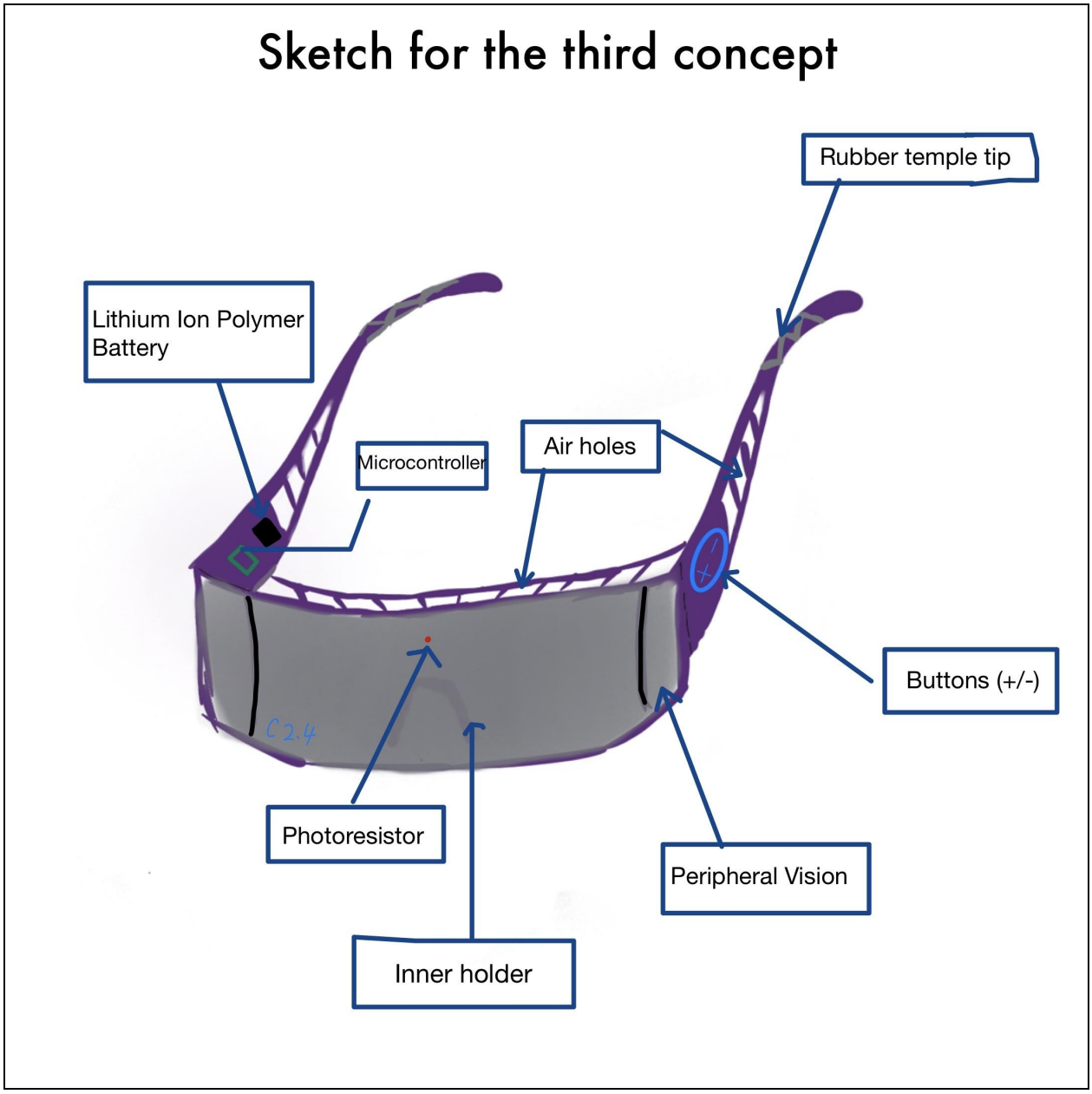

Figure 2. Sketch of design concept C

2.4.4 Design Concept D

Design D uses detachable lenses in order to vary the amount of transmitted light. The user will carry multiple lenses of different tint that can be easily attached and detached from the frame

Benefits:

- Inexpensive technology

Trade Offs:

- Can lose the lenses

- Moving parts

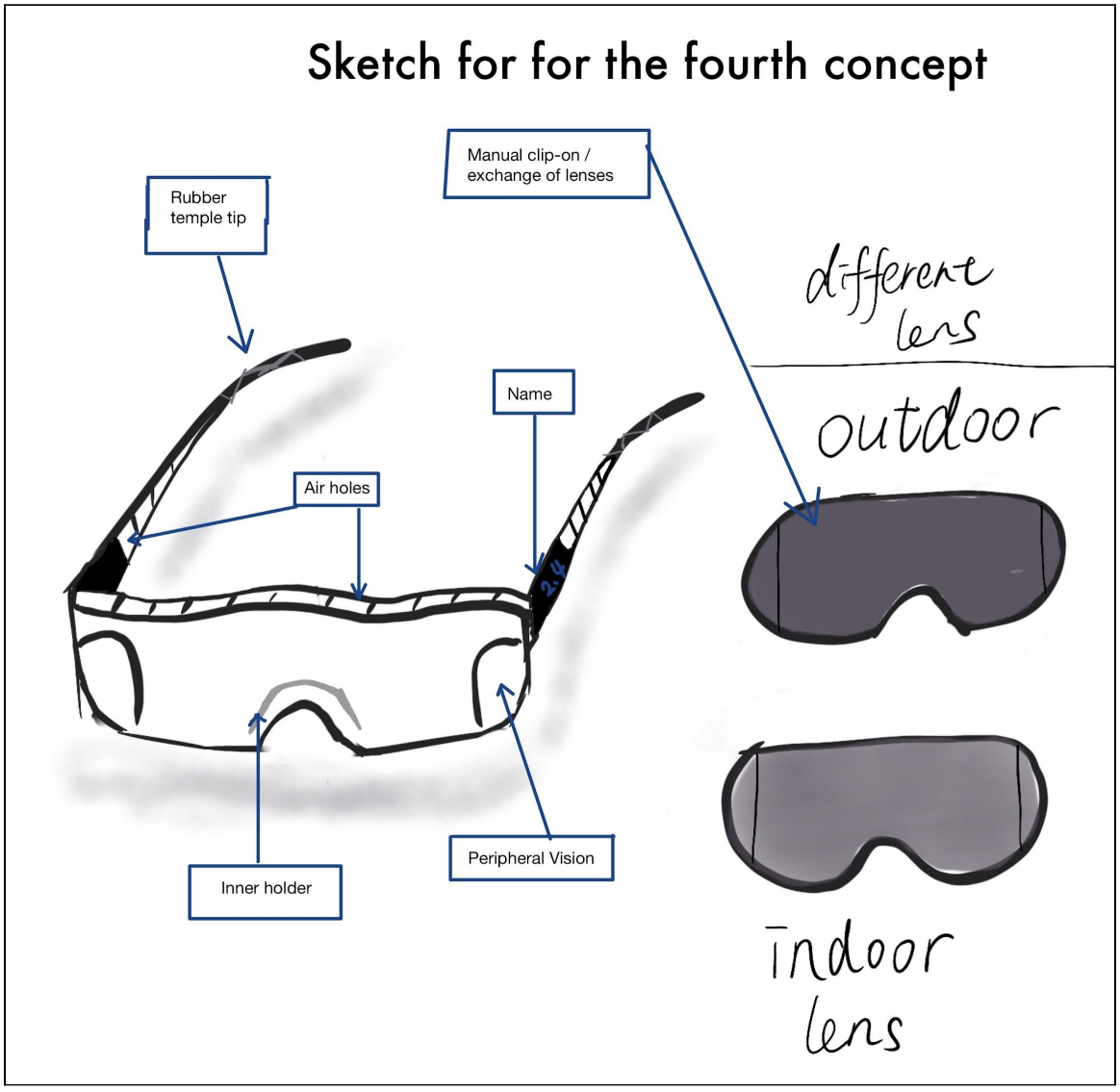

Figure 2. Sketch of design concept D

3. Client Meeting Preparation

Demonstrate:

- LCD lens
- Dual polarizing filter

List of questions:

~ Does the client drive?
~ Does the product (glasses) need to be universal? Does she want to benefit other patients with her condition too?
~ Do they prefer something manual or automatic?
~ What are the precise dimensions of her own glasses?

4. Project Plan

Title	Assignee	Status	Start date	Due date	Duration
GNG 2101 C#02 Group 2.4	Dongyu Wang	New			
Closing					
PD I: User manual		New	04/04/2022	04/10/2022	7d
PD J: Final presentation		New		04/05/2022	
Execution					
PD A.2: Client meeting preparation	Avery Lai, Dongyu Wang, Ken Lorbet...	Completed	01/10/2022	01/16/2022	7d
PD A submission	Avery Lai	Completed		01/16/2022	
Client meet 1	Avery Lai, Dongyu Wang, zhema wen...	Completed		01/17/2022	
PD B: Needs	Ken Lorbetskie, Dongyu Wang, zhem...	Completed	01/17/2022	01/23/2022	7d
PD C: Concepts	zhema wen, Avery Lai, Dongyu Wang...	Completed	01/24/2022	01/30/2022	7d
Client meet 2	Dongyu Wang, zhema wen, Ken Lorb...	New		01/31/2022	
PD D: Detailed design	Dongyu Wang	In Progress	02/01/2022	02/07/2022	7d
PD E: Project progress presentation		New	02/08/2022	02/19/2022	12d
Client meet 3	Avery Lai, Ken Lorbetskie, zhema wen...	New		02/28/2022	
PD F: Prototype 2		New	02/28/2022	03/06/2022	7d
PD H: Design day		New		03/30/2022	
Initiation					
PD A.1: Team contract	Ken Lorbetskie, Avery Lai, zhema wen	Completed	01/10/2022	01/16/2022	7d

Monitoring and Control					
PD A quality check	Avery Lai	Completed	01/10/2022	01/16/2022	7d
PD B quality check	Ken Lorbetskie	Completed	01/17/2022	01/23/2022	7d
PD C quality check	zhema wen	Completed	01/24/2022	01/30/2022	7d
PD D quality check	Dongyu Wang	In Progress	01/31/2022	02/06/2022	7d
PD D projet plan update	Dongyu Wang	New	01/31/2022	02/06/2022	7d
PD E quality check		New	02/06/2022	02/17/2022	12d
PD E project plan update	Dongyu Wang	New	02/07/2022	02/17/2022	11d
PD F quality check		New	03/07/2022	03/23/2022	17d
PD F project plan update	Dongyu Wang	New	02/18/2022	03/06/2022	17d
PD G quality check		New	03/21/2022	03/27/2022	7d
PD G project plan update	Dongyu Wang	New	03/14/2022	03/20/2022	7d
PD H quality check		New	03/21/2022	03/30/2022	10d
PD I quality check		New	04/04/2022	04/10/2022	7d
PD J quality check		New	03/28/2022	04/05/2022	9d
PD J project plan update	Dongyu Wang	New	03/30/2022	04/05/2022	7d
Planning					
PD A.3: Project skeleton	Dongyu Wang	Completed	01/10/2022	01/16/2022	7d
PD C.2: Project plan	Dongyu Wang	Completed	01/24/2022	01/30/2022	7d
PD D.1.8: BOM	Dongyu Wang, zhema wen, Ken Lorb...	In Progress	01/24/2022	01/30/2022	7d
PD G: Business model and economics report		New	03/14/2022	03/20/2022	7d

5. Conclusion

Based on our research, the problem is now better understood and dissected. Also, our group has a better idea on how to create an effective solution. The design criteria and specifications were identified. Moreover, the individual concepts were ranked from the most to least ideal. Our group drew four concepts in total. Additionally, ideal values and ranges were provided for the target specifications. Furthermore, the team concluded that Design A and B (shown in Table 2) were the most favourable solution for the "Dynamically Polarizing Glasses" problem. Overall, this deliverable enhanced our knowledge of the task at hand.

6. Reference

Clifden Matte Black Sunglasses | Oakley® CA. (n.d.). Retrieved January 30, 2022, from https://www.oakley.com/en-ca/product/W0OO9440

James, S. (2020, September 19). *These sunglasses are designed to *really* block light - & light-sensitive eyes rejoice!* Bustle. Retrieved January 30, 2022, from https://www.bustle.com/style/the-best-sunglasses-for-light-sensitive-eyes

What do sunglass categories mean? Sunglasses For Sport. (2021, September 16). Retrieved January 30, 2022, from https://www.sunglassesforsport.com/2014/09/25/what-do-sunglass-categories-mean/

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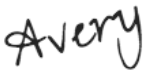
7. Personal Ethics Statement

a) I participated in formulating the standards, roles, and procedures as stated in this contract.
b) I understand that I am obligated to abide by these terms and conditions.
c) *I understand that if I do not abide by these terms and conditions, I will suffer the consequences as stated in this contract.*

Signatures - - - - - - - - - - - Date: January 30 / 2022

Avery Lai: 	Kenneth Lorbetskie: 
Dongyu Wang: 	Zhema Wen: