Department of Biomedical Engineering
University of Wisconsin - Madison

Wearable Light Logger for the Treatment of Mood Disorders

October 4, 2024
Client: Dr. Jean Riquelme
Advisor: Dr. Brandon Coventry

Team Members: Kate Briesemeister, Ella Eklund, Neel Srinivasan, and Molly Wilhelmson

Overview

- Problem statement
- Background
- Summary of product design specifications
- Designs considered
- Design matrix
- Final design
- Fabrication and future work
- References and acknowledgements

Client Description and Problem Statement

Client

- Dr. Jean Riquelme, MD
- Clinical Professor at the UW-Madison Department of Family Medicine and Community Health

Figure 1 [1]: Dr.Jean Riquelme

Problem Statement

- Currently, there are no clinical wearable light-logging devices on the market.
- Full-spectrum light therapy has been proven to be successful in treating mood disorders, especially seasonal affective disorder, but patient response studies are lacking [2].

Background Information

- Seasonal Affective Disorder impacts up to 16% of the general population worldwide [2].
- Only 50-60% of adults respond to first line antidepressants, and 35-40% experience remission symptoms [2]
- Significant reduction in depression symptom severity was associated with bright light treatment and dawn simulation in seasonal affective disorder and with bright light treatment in nonseasonal depression [3].
- A wearable sensor allows for accurate representation of light intensities which reach the retina, the presumed site of action.

Existing Designs

- Clouclip [4]
  - Glasses clip that attaches to a standard pair of glasses.
  - Device performs and collects long term real-time data for illuminance in lux.
  - Not for mood disorder treatment - used for myopia.
- No clinical research light loggers on the market

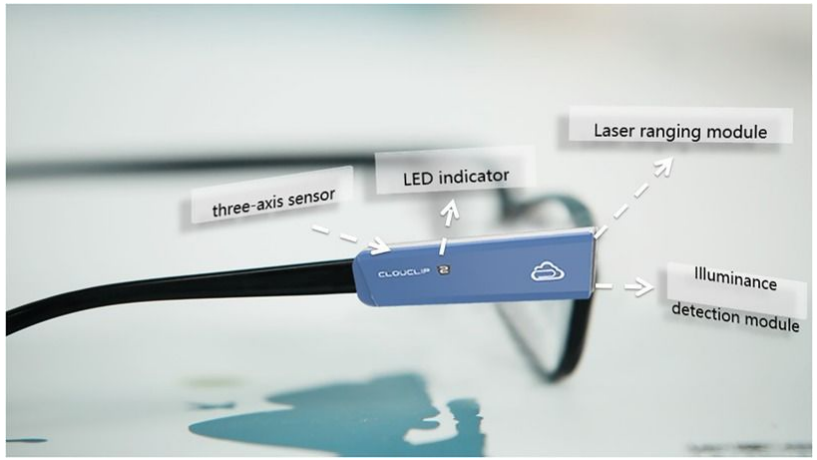

Figure 2 [4]: Clouclip

Product Design Specifications

Design Requirements

- Wearable device that can record the amount of illuminance in lux near the retina
- The device must be able to be used up to once a day for a maximum period of 2 hours
- Must be comfortable and wearable for the user
- Must accurately interpret the lux the device is intaking
- Budget must be within $500

Designs Considered

Glasses with built in sensor | Glasses with clip on sensor | Headlamp

Figure 3: Glasses with built in sensor

- Internal electronics
- Light sensor built into bridge of glasses

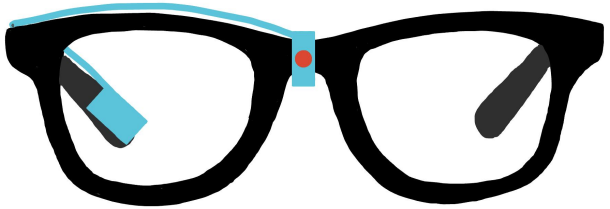

Figure 4: Glasses with clip on sensor

- Light sensor clips onto bridge of glasses
- Wiring connects to circuit box on frame

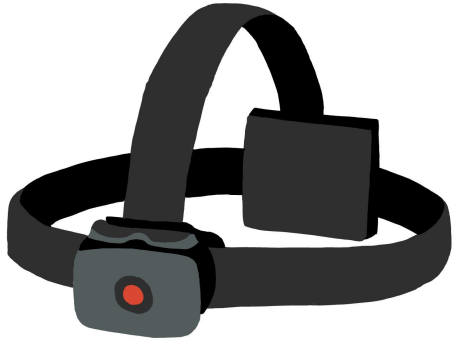

Figure 5: Headlamp

- Electronics located anteriorly
- Accommodating headstrap

Design Matrix Criteria

Usability	Inclusive design, allows easy data recording, comfortable, does not fall off during data collection	20
Accuracy	How close to the area between the eyes the sensor will be, how accurate the recorded data will be compared to the light actually entering the eyes	20
Durability	Device will be reusable and last for multiple trials without replacement	20
Ease of Fabrication	Device can be fabricated and tested within one semester	15
Safety	Designed with the user's safety in mind, will not expose to any danger	10
Cost	Within $500 budget	10

Design Matrix

Table 1: Design Matrix

Criteria:	**Design 1:** Glasses with built in Sensor 		**Design 2:** Glasses with clip on Sensor 		**Design 3:** Headlamp Design 	
Usability (20)	*3/5*	12	*2/5*	8	5/5	20
Accuracy (20)	*5/5*	20	*4/5*	16	3/5	12
Durability (20)	*2/5*	8	*1/5*	4	4/5	16
Ease of Fabrication (15)	*1/5*	3	*3/5*	9	3/5	9
Safety (10)	*5/5*	10	*2/5*	4	3/5	6
Cost (10)	*1/5*	2	*3/5*	6	3/5	6
Total: 100	**55**		**47**		**69**	

Chosen Design

Headlamp Design

Figure 6: Headlamp

- Most user friendly and inclusive
- Simple fabrication

Fabrication and Future Work

This Semester:

- Wearable device
- Circuitry and code to interpret signals
- Sensor testing with Happy Light

Fabrication Plans:

- 3D print enclosure for circuitry
- Construct circuit board
- Attach components to headlamp

Acknowledgements

Our team would like to thank:

- Dr. Brandon Coventry
- Dr. Jean Riquelme
- Dr. Puccinelli
- BME Department

Figure 7: Light Loggers

References

[1] https://www.linkedin.com/in/jean-riquelme-29423b270

[2] Julia Maruani, Pierre Alexis Geoffroy, 2019. "Bright Light as a Personalized Precision Treatment of Mood Disorders," Front Psychiatry. 2019; 10: 85. doi: 10.3389/fpsyt.2019.00085

[3] R. N. Golden et al., "The Efficacy of Light Therapy in the Treatment of Mood Disorders: A Review and Meta-Analysis of the Evidence," American Journal of Psychiatry, vol. 162, no. 4, pp. 656–662, Apr. 2005, doi: https://doi.org/10.1176/appi.ajp.162.4.656.

[4] "Clouclip," Clouclip.com, 2024. https://www.clouclip.com/webCarbon/pc.html (accessed Sep. 20, 2024).

Questions?