Wearable LLLT Device for Burn Wound Therapy

Dustin Luong, Renzo Calilung, Fretherich Pinardo, Temi Jekayinfa

Introduction

Annually, 1.1 million individuals in the United States sustain burn injuries, with half requiring medical attention. Our innovative low-level light therapy (LLLT) wearable device aims to boost cellular regeneration and expedite recovery times for burn patients. Accelerated recovery time may reduce the likelihood of infections, minimize discomfort, and reduce hospital stays and costs for severe burns. Although current LLLT devices claim to promote wound healing, they are often bulky, expensive, and primarily marketed for beauty or health purposes. These devices are poorly constructed and do not emit sufficient light to achieve the desired effect. Our team's disposable and wearable design targets the at-home user and burn care centers. The device must feature an intuitive design, as our aim is to appeal to at-home users. Furthermore, we strive to create a wearable, effective, and affordable product, unlike existing LLLT devices.

Design Criteria

Criteria	Our specified guidelines
Wavelength	Red or near infrared range
Duration	Several hours
Heat	40°C or 104°F
Portability	Lightwieght and flexible
Fluence	2-5 j/cm^2
Irradiance	40°C or 104°F

Project Goal

- Fabrication of multi layer soft circuit device that is able to deliver optimal LLLT treatment for therapeutic effects on grade 1 or 2 radiation dermatitis [1]
- Design validations and verification testing of manufac tured prototype

Design

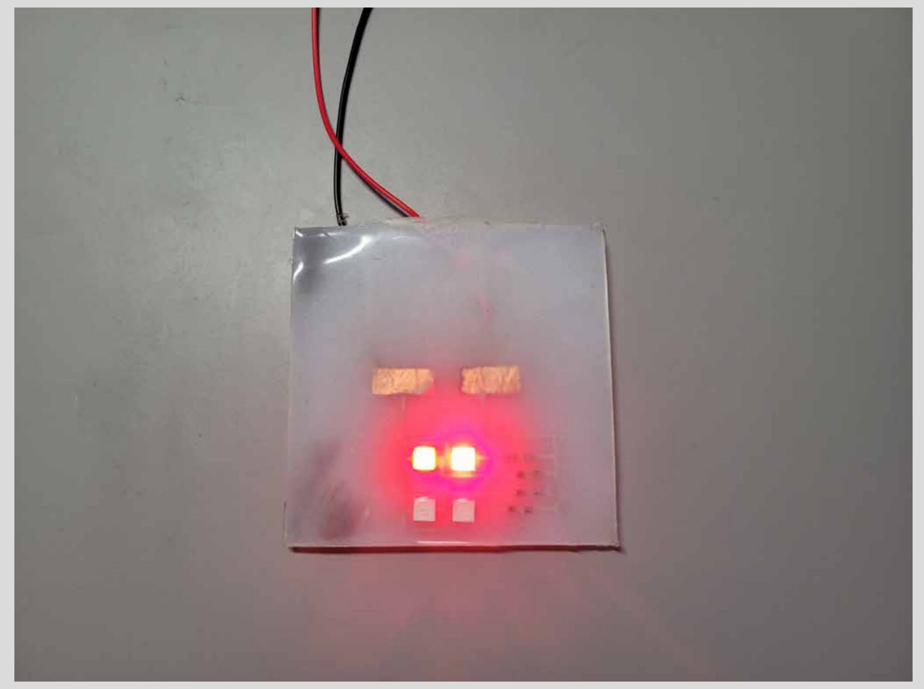


Figure 1: Current prototype

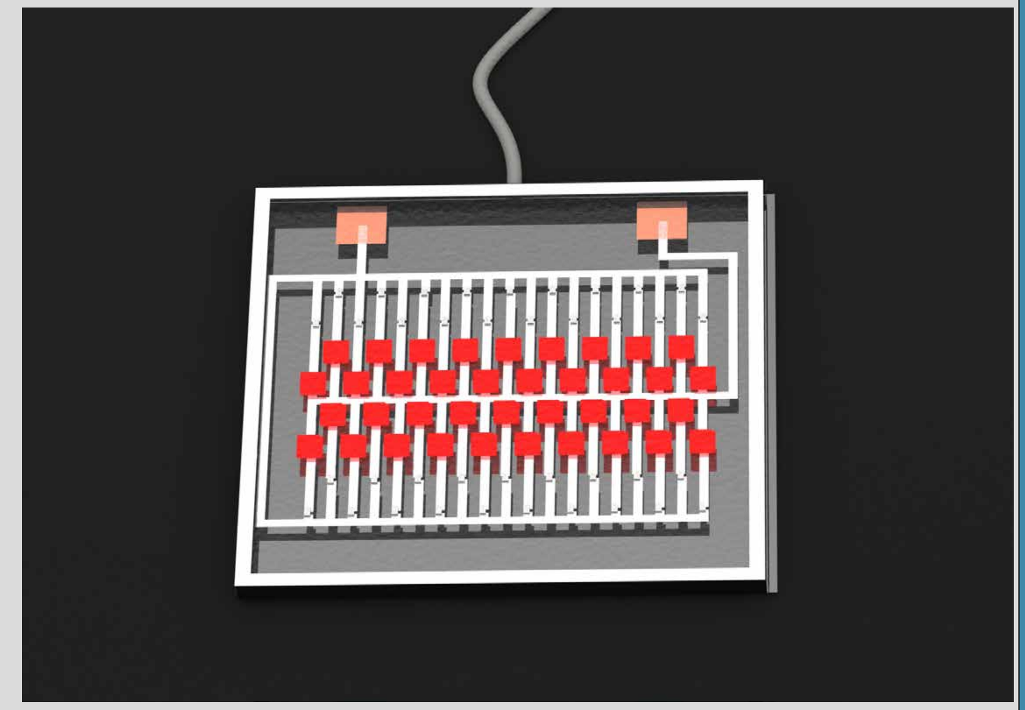


Figure 2: Concept of final design

- Delivery of 635 nm wavelength at optimal distance and low fluence for best therapeutic effects for specific cell type
- Activation and increase of proliferation and migration of keratinocytes
- Increase ATP production leading to faster recovery
- Physical barrier to protect wound from outside
- Flexible and comfortable enough for longtime use

Design Validation

Design verification Methods

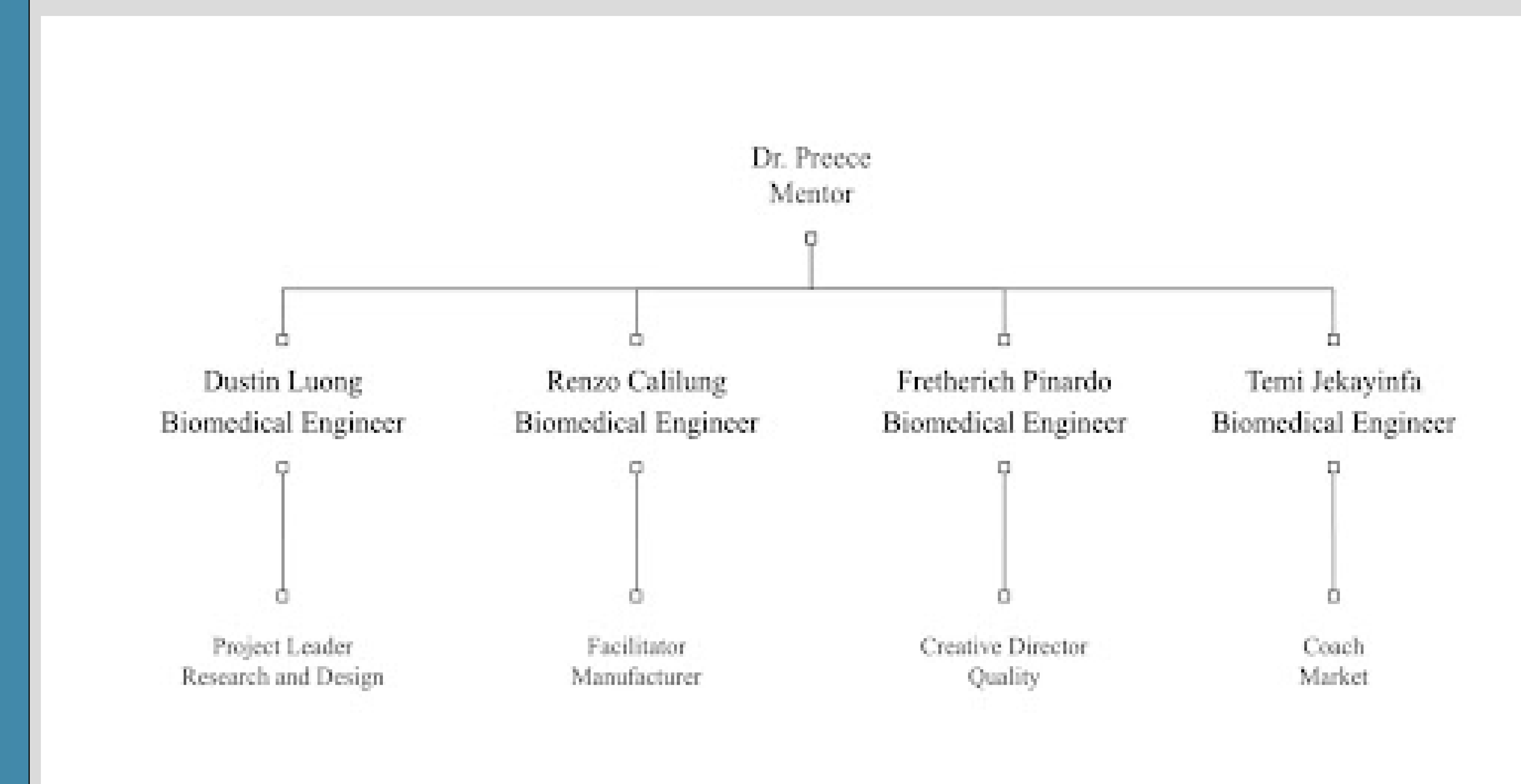
Wavelength	Use spectrometer to analyze light flux
Duration	Perform burn-in tests over period of 10 hours
Heat	Thermometer utilized to ensure device does not overheat
Fluence	Lux meter and image processing program (image j)
Irradiance	Lux meter and image processing program (image j)

ISO Standards

ISO 10993	Biological evaluation of medical devices
ISO 14971	Medical devices - Application of risk management to medical device
IEC 60601-11	Basic Electrical Safety for Home Health Devices
IEC 60601-2-57	Basic Safety And Essential Performance Of Non-Laser Light Source Equipment
IEC 60601-2-83	Basic Safety And Essential Performance Of Home Light Therapy Equipment
IEC 62471	Photobiological Safety Of Lamps And Lamp Systems

Timeline

Spring Quarter										
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
Final Prototype Design										
Final Prototype Creation										
Design Testing										
Final Device Adjustments										
Market Interviews										
NVC Board Room Pitch										
Final Presentation/Prep										
Device Showcase										



References

[1] S. Nagels, R. Ramakers, K. Luyten and W. Deferme, "Silicone devices: A scalable DIY approach for fabricating self-contained multi-layered soft circuits using microfluidics," in Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, 2018.

[2] F. N. Bray, B. J. Simmons, A. H. Wolfson and K. Nouri, "Acute and chronic cutaneous reactions to ionizing radiation therapy," Dermatology and therapy, vol. 6, p. 185–206, 2016.

Acknowledgements

- Special thank you to Bioendine and the Beckman Laser Institute
- Dr. Preece - Department of Biomedical Engineering