

Introduction

What is the problem? One in three people worldwide will be diagnosed with skin cancer [1]

Why it's a problem: UV radiation is invisible and highly variable, making real-time awareness difficult [2]

Why current solutions fall short: Sunscreen and UV apps depend on user consistency and awareness [3]

Who it affects: Dermatologists, estheticians, and outdoor workers emphasize a need for automatic UV feedback

Problem Statement: How might we help individuals create sun protection habits that align with UV index safety recommendations?

Design Methods

Concept Selection



Figure 1. Concept Selection Decision Matrix

- After researching current UV technologies, our team narrowed down to four final concepts
- The concepts were compared using a decision matrix (Figure 1)
- Rated based on: Novelty, Feasibility, Cost, and Desirability
- The UV Sunglasses scored highest, showing a strong balance between function, comfort, and innovation

Design Results

Mechanical Subsystem:

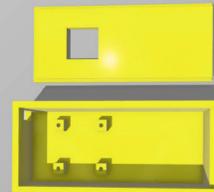


Figure 2. Sensor Housing



Figure 3. Sunglasses Frame

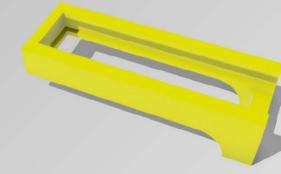


Figure 4. Mounting Bracket

- Frame:** Designed for balanced weight distribution and comfortable wear during extended use (Figure 3)
- Sensor Housing:** Protects the UV sensor while maintaining exposure accuracy and internal wire clearance (Figure 2)
- Mounting Bracket:** Provides stable attachment between the frame and sensor housing with minimal added weight (Figure 4)
- CAD validation confirmed proper fit, visibility, and overall ergonomic balance of the sunglasses assembly

Electrical Subsystems:

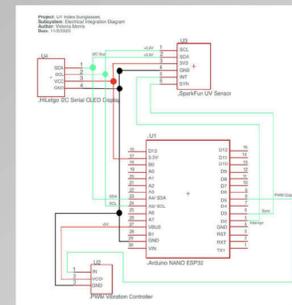


Figure 5. Electrical Subsystem Diagram

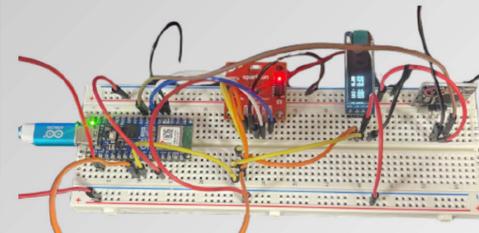


Figure 6. Breadboarded Circuit

View the code!



Figure 7. QR Code to Code

- The circuit schematic shows the integration of the full-spectrum UV sensor, OLED display, and PWM vibration controller with the Arduino Nano ESP32 (Figure 5)
- Validated I²C communication and consistent power delivery through 3.3V and 5V lines
- Diagnostic code verified correct sensor readings and vibration feedback (Figure 7)
- Testing confirmed full electrical functionality for the UV Index Sunglasses prototype (Figure 6)

Final Prototype Cost:

- Total prototype cost:** \$69.46
- Only paid components: Vibration Motor Module, OLED Display, Arduino Nano ESP32, and UV Sensor
- No-cost materials: Wiring (from repurposed Ethernet cable), PLA prints, and soldering supplies provided by Red Rocks Community College

Testing Methods

- Sensor validation:** Used a UV blacklight at 2-inch increments up to 12 inches to confirm accurate detection at varying distances.
- Wearability test:** Fitted on team members and mannequin heads representing male, female, and child sizes.
- CAD and fit testing:** Rebuilt three PLA housing prototypes to improve frame strength and ensure stable support for the sensor housing and OLED display.

Testing Results

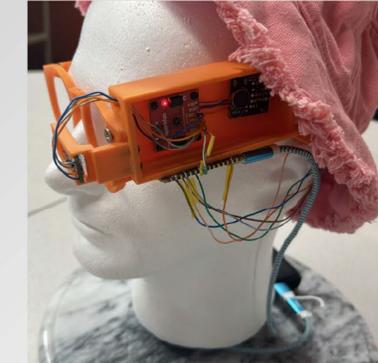


Figure 8. UV Index Glasses Side View



Figure 9. OLED Sensor Feedback

- UV flashlight testing from multiple angles and distances triggered a consistent sensor response (Figure 9)
- OLED screen provided instant, visible feedback as UV intensity changed
- The vibration motor activated automatically when UV levels exceeded the set threshold
- Glasses stayed secure during simulated motion, including head shaking and rotation
- All subsystems operated cohesively without failure, confirming full subsystem integration (Figure 8)

Conclusion

- This project resulted in a fully functional pair of UV Index Sunglasses that deliver automatic, real-time UV exposure feedback
- Testing indicated the device has potential to support passive UV awareness without phone apps or manual checks
- All mechanical, electrical, and software subsystems worked together as a cohesive system
- Future versions will focus on reducing component size, increasing battery efficiency, and weight balance
- The design demonstrates how engineering can address public health needs through accessible, purpose-driven wearable technology

References

- A. H. Roky, M. M. Islam, A. M. F. Ahasan, M. S. Mostaq, M. Z. Mahmud, M. N. Amin, and M. A. Mahmud, "Overview of skin cancer types and prevalence rates across continents," *Clin. Pharmacol. Ther.*, vol. 00, no. 00, pp. 1-10, Aug. 2024. doi: 10.1016/j.cpt.2024.08.002.
- Calbó, Josep, Daniel Pagès, and Joan Abella. 2005. "Empirical Studies of Cloud Effects on UV Radiation: A Review." *Reviews of Geophysics* 43(2). <https://doi.org/10.1029/2004RG000155>.
- D. B. Buller et al., "Compliance with Sunscreen Advice in a Survey of Adults," *J. Telemed. Telecare*, vol. 18, no. 7, pp. 395-400, 2012.