# SUGAWAVE

## wearable glucose monitor


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# Introduction

Hello!

SugaWave is a speculative wearable that reimagines how people living with diabetes interact with glucose monitoring.
Traditional medical devices are often clinical, cold, and disconnected from the wearer's emotional experience. SugaWave challenges that by transforming a medical necessity into an object of self-expression, fashion, and agency. This project imagines a future where healthcare wearables are not just tolerated—they're loved.

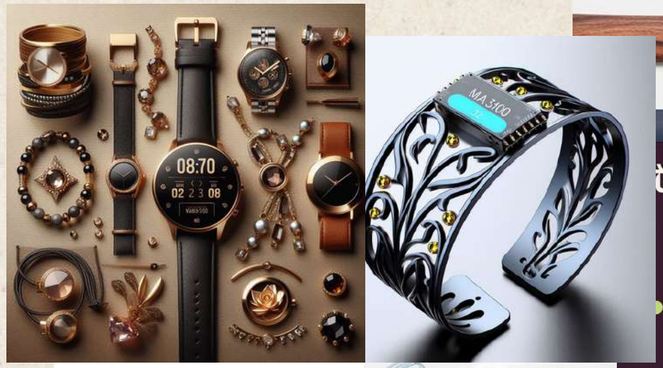
SugaWave is a glucose monitor designed for emotion, identity, and softness. It asks: What if wearables didn't just measure us — what if they mirrored us?

Blending medical inspiration with fashion-forward aesthetics, SugaWave imagines a future where chronic care isn't sterile — it's stylish, bold, and unapologetically visible.

# inspiration & research

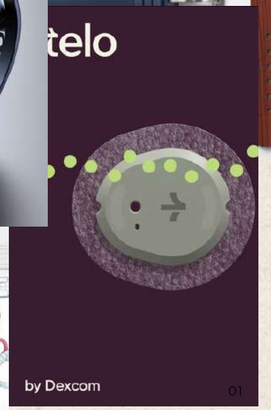
This project draws from multiple worlds: fashion tech, biohacking culture, and personal health. Inspirations include smartwatches, CGMs, and performance accessories seen in pop culture. Research also includes speculative design methods, wearable tech trends, and interviews with diabetic user who expressed frustration with existing medical aesthetics(that would be me, myself & I).

Visual moodboards helped define an identity that is strong, soft, and unapologetically visible.





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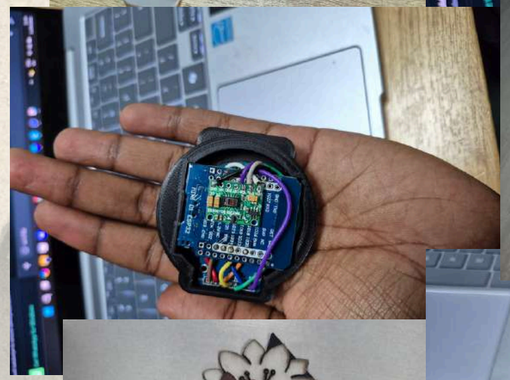
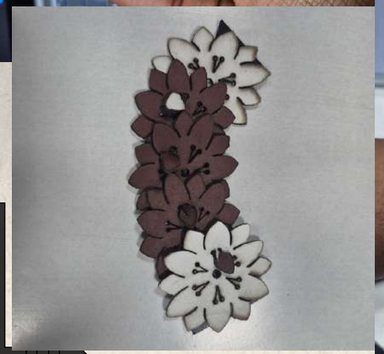




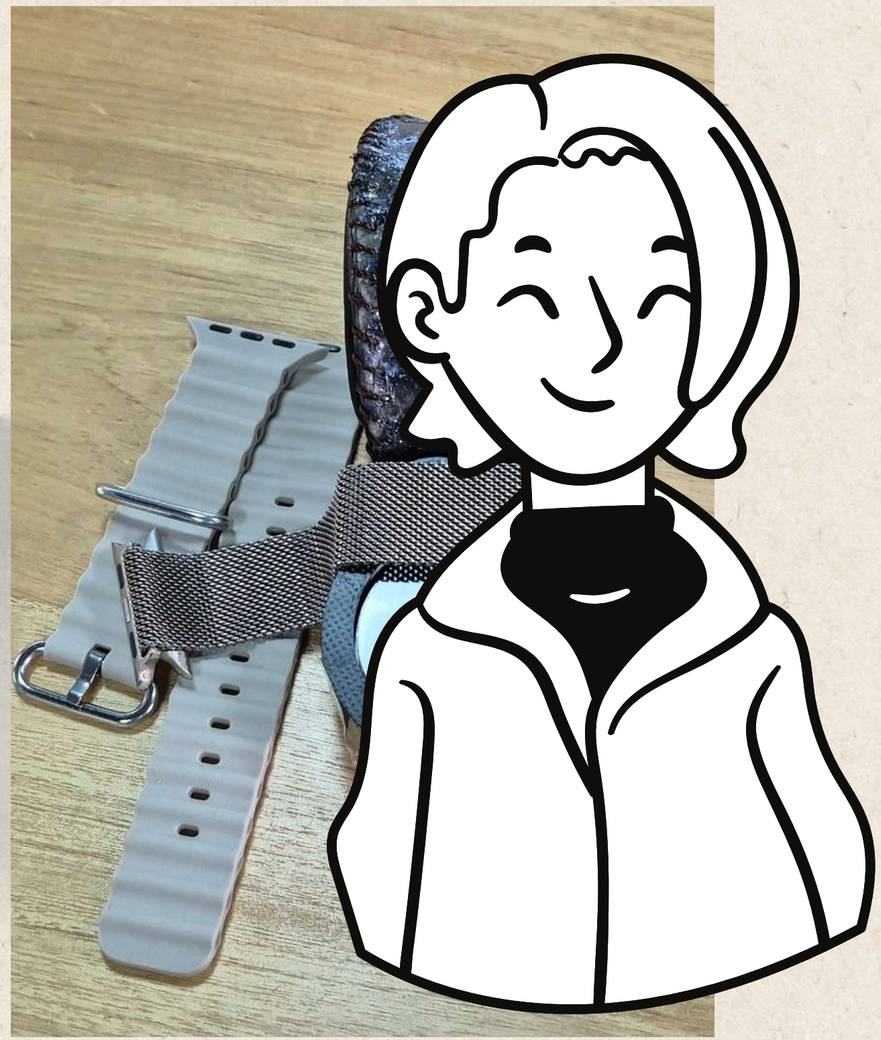
# concept development

Early IDEAS explored forms that felt more like jewelry than tech. The round shape echoed both smartwatches and traditional amulets. Straps were designed to be interchangeable to suit different moods or outfits. The concept evolved into a modular, customizable wearable that centers dignity and visibility in diabetes management.

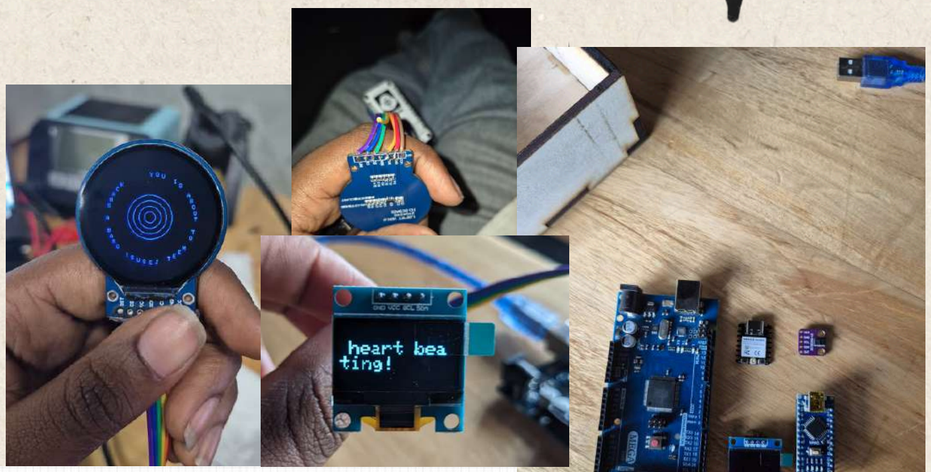
SugaWave began as a sketch of a "round patch with a purpose." Early ideation included:

- Wearables that resemble jewelry more than medical tech
- Modularity: could the device detach, change straps, or evolve?
- Form inspired by bangles, brooches, and statement watches
- Aesthetics that challenge invisibility and embrace visibility

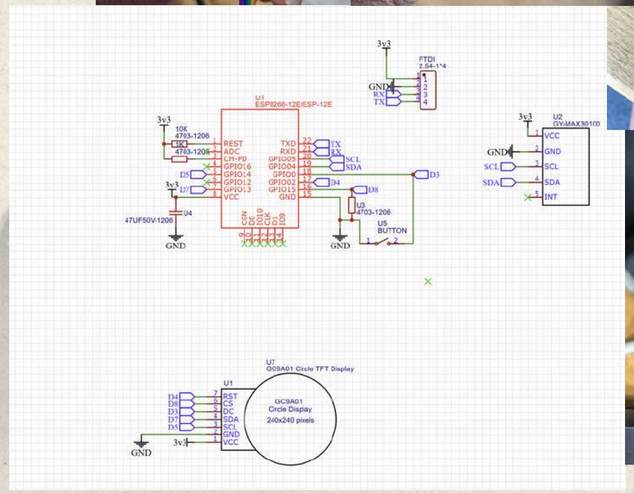
# personas



1. The Active Romantic – A young woman managing Type 1 diabetes who refuses to wear clunky devices. She wants something sleek that reflects her personal style.
2. The Quiet Rebel – A gender-nonconforming user who wants a wearable that blends tech with edge, challenging the invisibility of chronic illness.






# ✦ Electronics Exploration

I began with the GY-MAX30100 sensor and tested it on Arduino Uno alongside a small 0.96" OLED display — basic, but a useful proof of concept.

To achieve visual elegance, I introduced the GC9A01 round display. Its compatibility issues led me to test various microcontrollers:

- Xiao ESP32-C3 → Display failed
- ESP8266 → Display worked, but not with sensor
- Xiao ESP32-S3 Sense → Sensor worked, but not the display
- MINI ESP32 → Finally, both worked perfectly

Switching to MAX30102 improved signal quality and slightly more reliable data for heart rate and oxygen saturation, which I used to simulate glucose levels via code logic.

# ✦ Code & Function

```
#include <Wire.h>
#include <SPI.h>
#include <Adafruit_GFX.h>
#include <Adafruit_GC9A01A.h>
#include "MAX30100_PulseOximeter.h"

#define TFT_CS    5
#define TFT_DC    2
#define TFT_RST   4

Adafruit_GC9A01A tft(TFT_CS, TFT_DC, TFT_RST);

#define REPORTING_INTERVAL_MS 2000
PulseOximeter pox;
unsigned long lastReportTime = 0;

void onBeatDetected() {}

void drawScreen(float glucose) {
  tft.fillScreen(GC9A01A_BLACK);

  uint16_t bgColor;
  if (glucose < 100) {
    bgColor = tft.color565(75, 0, 130);  // Indigo
  } else if (glucose >= 100 && glucose < 140) {
    bgColor = tft.color565(144, 238, 144);  // Soft Sage
  } else {
    bgColor = tft.color565(255, 127, 80);  // Coral
  }

  // Background gradient simulation (use solid color as approximation)
  tft.fillCircle(120, 120, 120, bgColor);
```

I coded the system to read heart rate and SpO2 values from the MAX30102 and used those to approximate blood glucose levels through estimation formulas. While not medically accurate, this allowed me to explore speculative health data interaction.

The round display showcases glucose status visually — suggesting how users might someday receive subtle, beautiful alerts instead of cold, clinical numbers.

# ✦ Material Development – Fish Leather

My first experimental strap involved biofabricating fish leather from tilapia skin:

- First attempt: soaked too long in dish soap + citric acid + glycerin → result: overcooked, unusable.
- Second attempt: cleaned with water, soaked in egg yolk, liquid soap & glycerin for 10 mins → dried 2 days + 2 weeks → soft, flexible, and ready to use.

I used this as a soft, sustainable alternative strap.

# Material Development – Modular Leather

✦ Material Development – Modular Leather

For a more decorative approach, I designed a modular floral motif, laser-cut from brown and white scrap leather. The units were hand-connected into an interchangeable strap that's both functional and expressive.

This aesthetic echoes ornamentation found in traditional jewelry while staying rooted in wearable tech design.

# ✦ Strap Collection

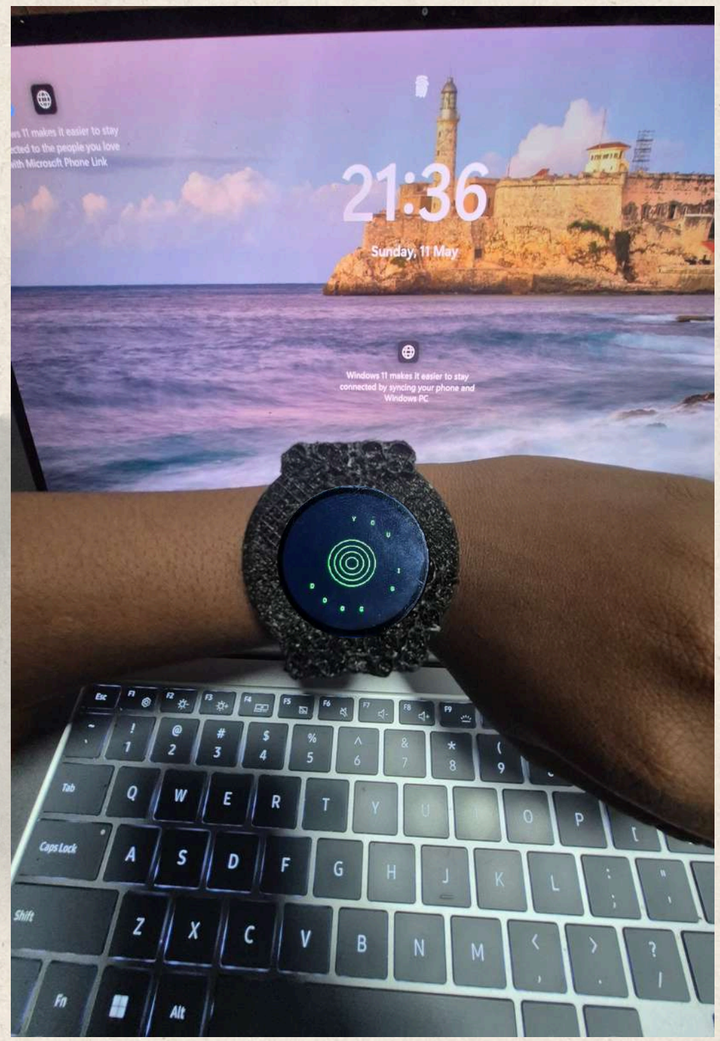
To complete the modularity of the prototype, I included:

- Reused metal watch strap (chainmail aesthetic)
- Classic rubber watch strap (for sporty use)

Each strap represents a different identity: rugged, soft, decorative, minimal — allowing users to reflect their mood or occasion.

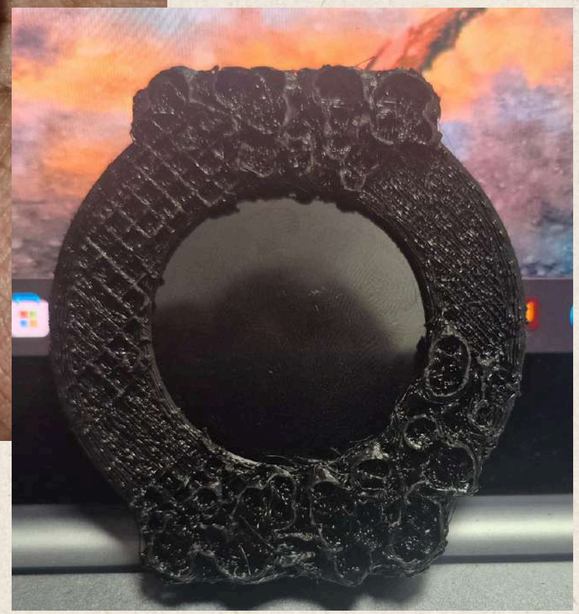

# ✦ Casing & Assembly

I designed the final SugaWave casing in SolidWorks, made to hold the MIN ESP32, MAX30102, and round display. It was 3D printed in white PLA, then assembled to allow access to ports and components. The casing was designed to be modular and compact.




# Final Outcome

SugaWave consists of a round central module with sensor to keep track of your glucose and detachable straps. Worn like a bracelet or cuff, the wearable becomes a daily ritual and a personal artifact. The final prototype includes multiple strap options to show its adaptability across styles, from minimal to glam.

# ✦ Challenges & Learnings

This journey was full of trial and error:

- Microcontroller conflicts tested my patience
- Sensors failed or gave unreliable data
- Fish skin failed... then triumphed
- Electronics that refused to cooperate finally clicked into place

But in navigating these challenges, I built something that felt personal, plausible, and poetic.

# Reflection

This project pushed the boundaries of what a health wearable could be. I learned how design can reframe illness as strength, and how aesthetics matter in care. While the prototype is speculative, it raises real questions: What if CGMs were designed by fashion designers? What if medical devices were emotionally intelligent?

The project taught me to design for both function and feeling.

While SugaWave isn't a certified medical device (yet), it's a bold step in merging wearable tech, fashion, and DIY biomonitoring.

# What's next

With more time. I'd explore:

- Integrating real-time cloud data storage
- Improving sensor calibration for accuracy
- Miniaturizing the board or embedding in soft circuits
- Developing a fully functional mobile app for interpretation

SugaWave is a beginning — not an end.

# Thank You!