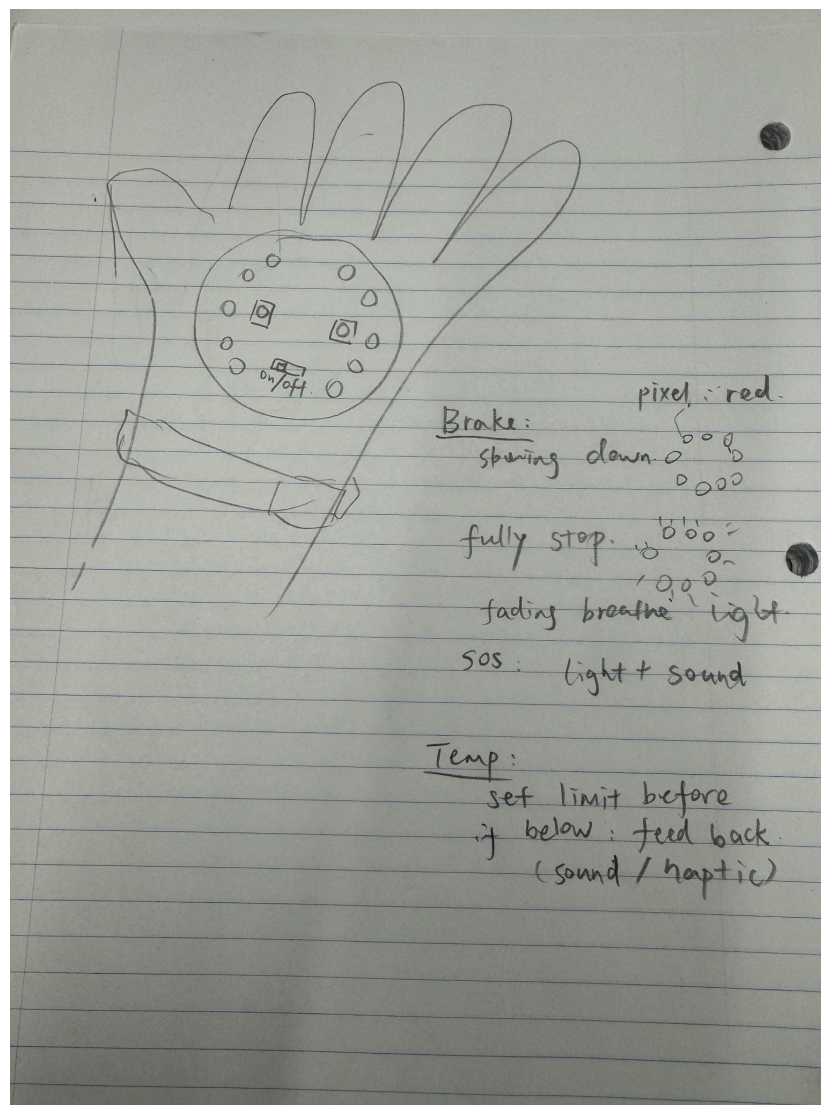


# Homework 1: Ski wearable system

## Conceptual Framework

When designing this wearable device for skiers and snowboarders, I drew upon personal experiences and common challenges faced in outdoor sports. One significant consideration was the practicality of using technology while fully geared up. For skiers, interacting with mobile phones on the slopes, especially with gloves on, is not just inconvenient but often impractical. This insight led to the development of a wearable device that easily attaches to a glove, offering straightforward, glove-friendly controls that greatly enhance the user experience.



### 1. Brake Light for Safety

In skiing, sudden stops are a common cause of accidents, with skiers unexpectedly braking and those behind them unable to react in time. Integrating a brake light feature into the wearable device addresses this risk head-on. By providing a clear, visual and sound signal whenever the skier suddenly slows down, it alerts followers on the slope, significantly reducing the chances of collisions.

## 2. Heart Rate Detection

By using light sensors in a novel way to measure pulse from a finger, the device provides immediate feedback on the wearer's heart rate, displayed through visual LEDs. The integration of a heart rate detection feature into the wearable device offers users a real-time insight into their physical state, enabling them to manage their exertion levels more effectively.

## 3. Environmental Awareness and Emergency Alerts

Skiers often encounter extreme environmental conditions that can pose serious risks to their health and safety. Recognizing these challenges, the device is equipped with a temperature sensor to monitor ambient conditions constantly. This feature is critical for alerting skiers when the environment becomes too harsh, potentially preventing cases of frostbite or hypothermia by advising when it's time to seek warmth.

Moreover, the unpredictable nature of outdoor environments underscores the necessity of an emergency beacon. Whether due to injury, getting lost, or facing adverse weather conditions, the ability to signal for help is invaluable. The wearable device incorporates both sound and light alerts for emergencies, making it easier for rescuers or fellow skiers to locate someone in distress.

# User Interaction

- **Functionality Switch:** A physical switch enables users to toggle between the brake light and heart rate monitor, adapting the device's functionality to the immediate context of use.
- **Braking Threshold Adjustment:** Two buttons are dedicated to fine-tuning the sensitivity of the brake light activation, allowing users to customize the device according to their preferences and conditions.
- **Heart Rate Measurement Activation:** The decision to initiate heart rate measurement through a button press, specifically located near the light sensor, was made to facilitate ease of use and ensure accuracy during the measurement period.
- **Emergency Mode Activation:** A long press on both buttons engages the emergency mode, a critical feature designed to enhance user safety through a simple yet effective interaction.

- **Bluetooth Connection:** Pairing up with user's phone by BluefruitConnect, it can send EMA magnitude change, heart rate and temperature to record more data for analyzing.

## [Demo Video](#)

## Challenges and Limitations

- Ensuring reliable heart rate readings required meticulous calibration and testing, highlighting the limitations of using non-specialized sensors for health monitoring.
- The braking indicator, relying solely on the accelerometer to calculate changes in the exponential moving average (EMA) magnitude, is insufficient for definitive activity determination. Skiing actions are intricate, with hand movements that may not directly correlate to braking or other intended signals. To achieve more accurate and contextually relevant detections, real-world testing is indispensable, along with the potential application of machine learning techniques.
- Another significant challenge was balancing the device's functionality with power consumption, especially under a cold ski environment. As features, especially background sensing and computing were added, the demand on the device's power resources increased. It requires a delicate trade-off between the number of active sensors and the frequency of data processing and transmission.
- Scaling up the project with Circuit Playground presented its own set of challenges. The original design envisioned a device brimming with functionalities, including haptic feedback and inter-device communication to allow skiers to send messages to each other. However, incorporating additional hardware components to realize these features proved difficult. The complexity of integrating these components while maintaining a user-friendly interface necessitated significant debugging and refinement. We have to balance innovation with wearability and ease of use. Moreover, we have to consider the balance between what could be achieved by simply taking the smartphone out of pocket, and what is the unique benefits offered by the wearable.