Crash Buddy

Collision Detection Device for Athletes

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The Problem

Problem Statement

With nearly one third of concussions going undiagnosed amongst athletes [1], there exists a clear need for automated safety measures

We wanted to...

- Identify crashes and notify emergency contacts if the user is unresponsive
- Alert user to seek medical attention if an impact is likely to have caused a concussion

[1]: Meehan WP 3rd, Mannix RC, O'Brien MJ, Collins MW. The prevalence of undiagnosed concussions in athletes. Clin J Sport Med. 2013 Sep;23(5):339-42. doi: 10.1097/JSM.0b013e318291d3b3. PMID: 23727697; PMCID: PMC3758800.

Problem Description

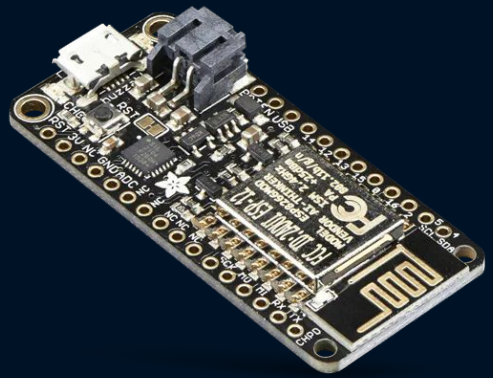
Our product will provide...

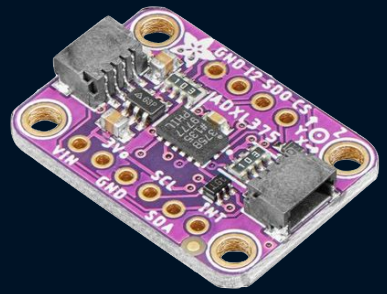
- Alert if a likely concussion causing impact has occurred
- Users and doctors with impact acceleration data after a crash has occurred for more informed diagnoses
- Users with the security of mind that their emergency contacts will be notified if they become unresponsive

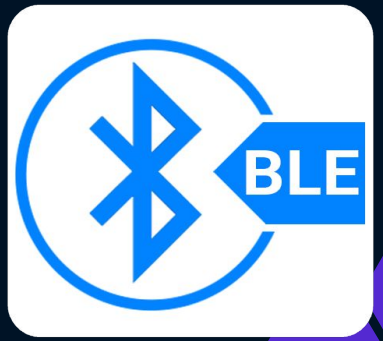
Conceptualization

Design Choices – Hardware

- Adafruit ESP32 Feather Board with integrated Bluetooth Low Energy connectivity
- ADXL375 sensor can measure up to 200 g's with a low power draw
- Portable battery to power the system





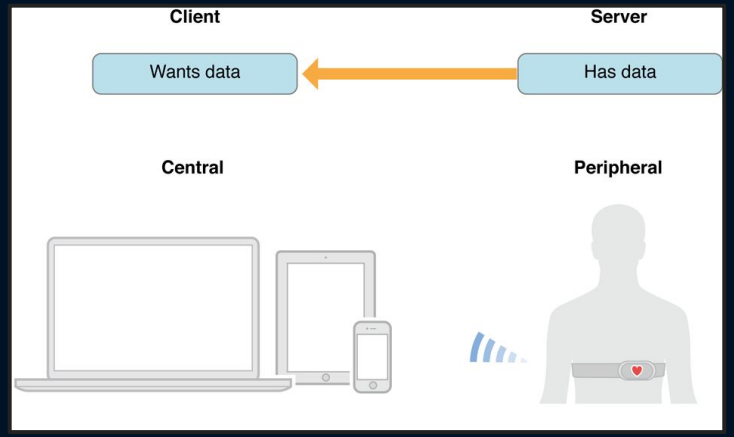


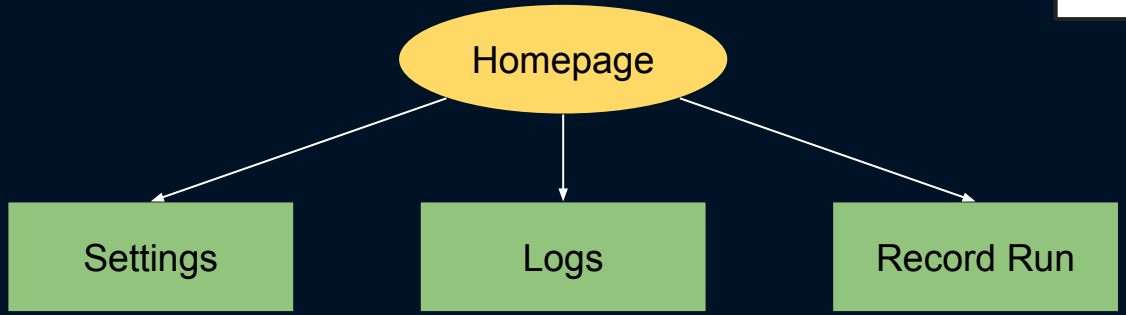
Design Choices – Embedded Software

- Interface via Bluetooth Low Energy (BLE)
- Detect collisions using accelerometer data
    - Configurable G threshold
- Transmit acceleration data on impact to App via BLE
    - 12 seconds of data before and after initial impact
- Configurable
    - Impact threshold

Design Choices – Software

- SwiftUI Framework
- MVVM
- Services
  - CoreBluetooth
  - CoreLocation
  - AlamoFire (HTTP Networking)



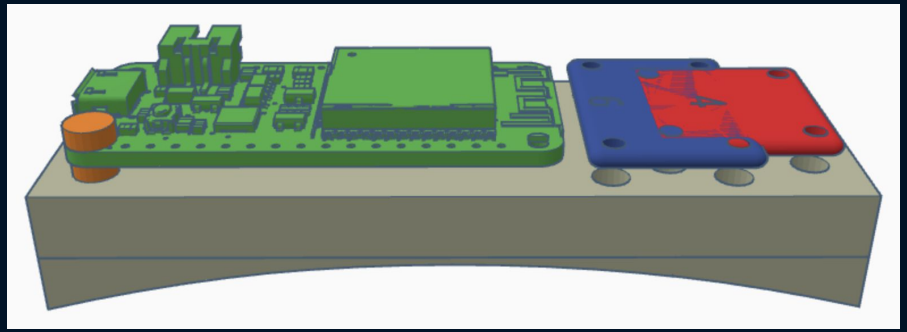


Implementation

Peripheral

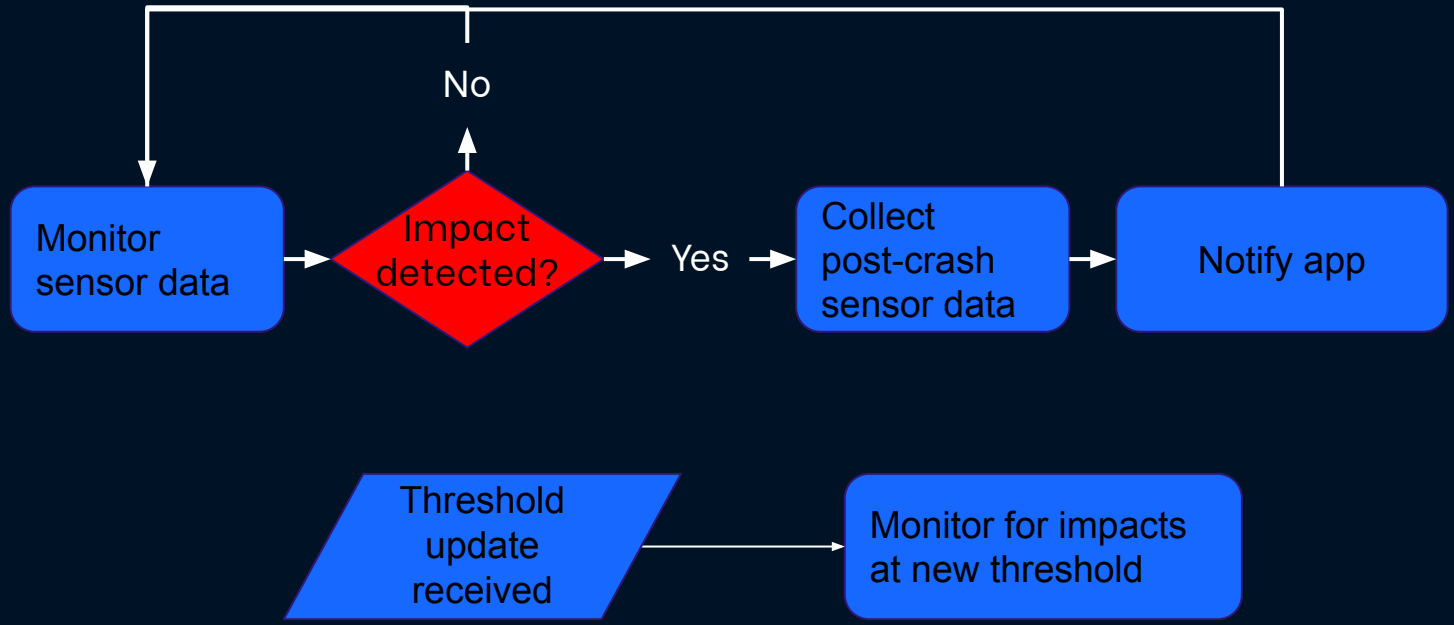
Mounting Design

- 3D Printed Base (Fits most helmet curvatures)
- Heat Set Inserts
- Nylon Screws and Washers
- VHB Tape

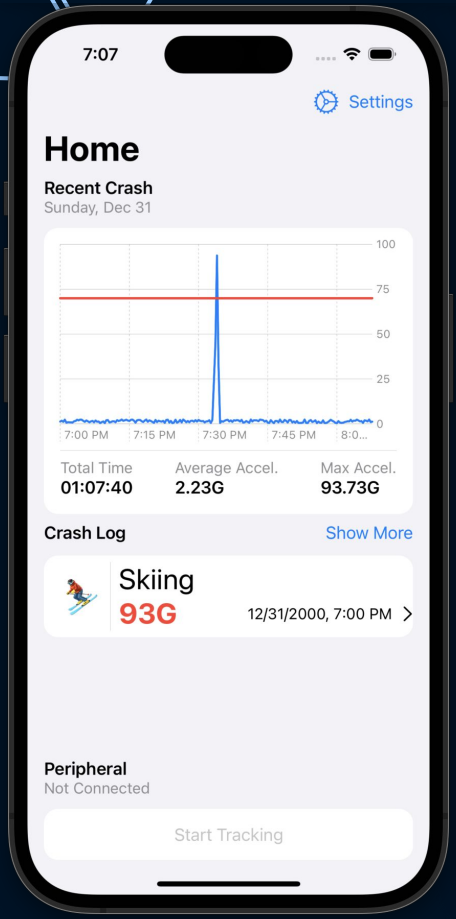




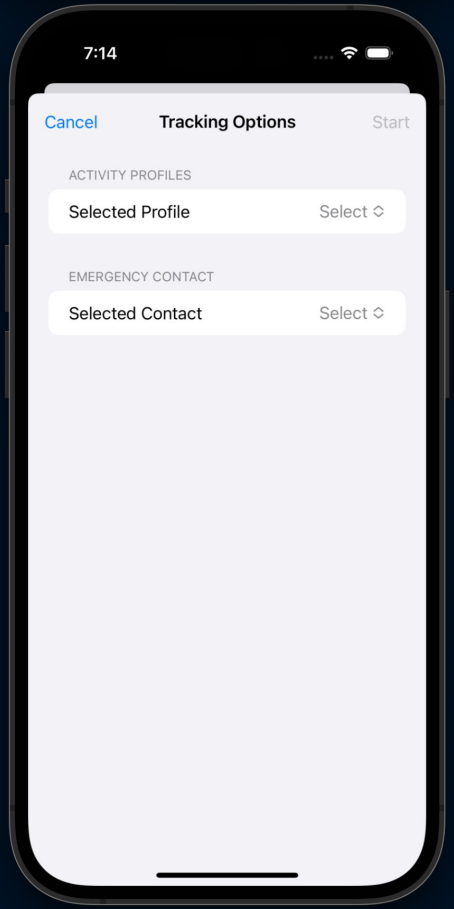
Embedded Workflow

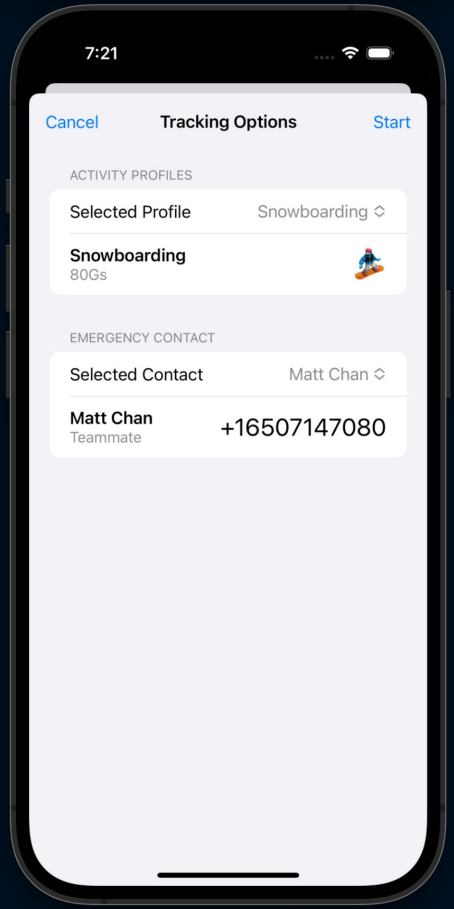


App Walkthrough

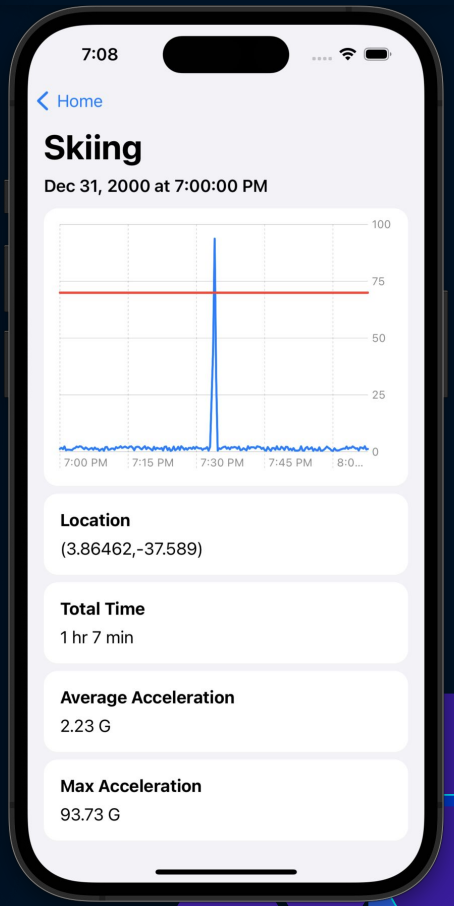


Home Page



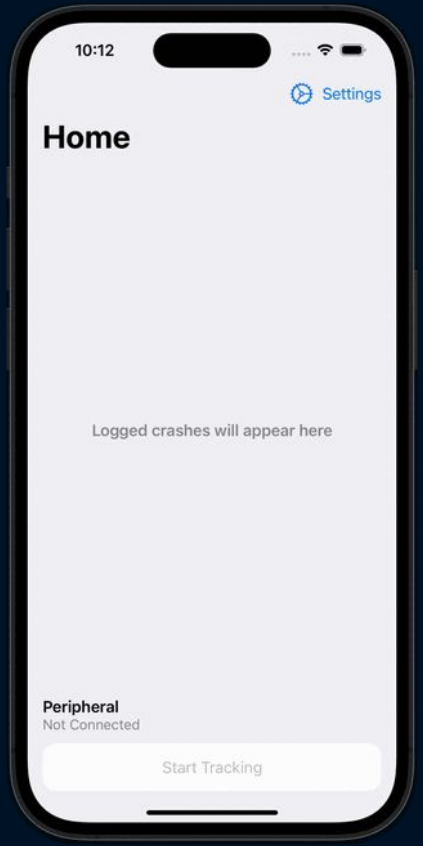


“Start Tracking” Popup



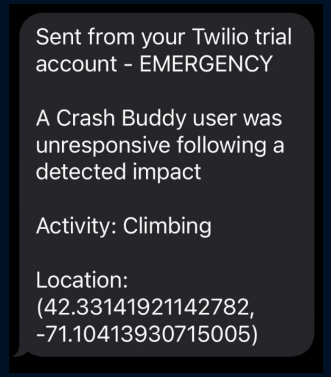
Individual Crash Log

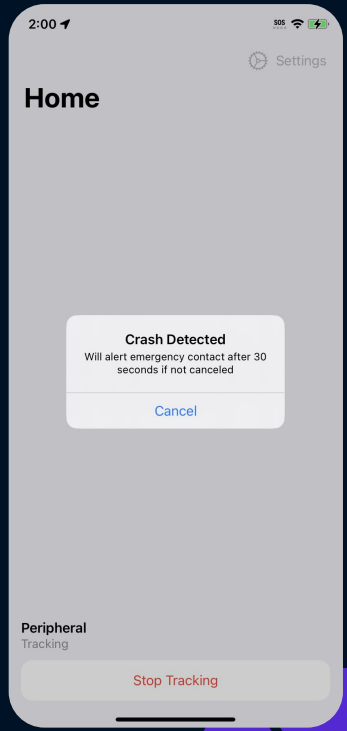
Settings


10:12
Settings
Home
Logged crashes will appear here
Peripheral
Not Connected
Start Tracking

Automated Text Message Workflow

- Locally hosted python server with Flask
  - Relays to Twilio
- Ngrok reverse proxy to the localhost
- CoreLocation records current location
- Alamofire sends HTTP request
  - Selected contact number
  - Latitude & Longitude





Future Additions

- Moving from local storage and python backend to the cloud
- User accounts (Crash Buddy User Network)
- Peripheral Button (power, bluetooth pairing, run start/stop)
- Additional Peripheral Memory and Integrated Battery
- Encased electronics / PCB
- Edge Case Testing / User Input Analytics

Final Cost

Item	Quantity	Total Price
Portable Battery	1	$10
Adafruit ESP32 Feather	1	$25
ADXL375 Accelerometer	1	$13.66
3D Printed Base	1	$25.43
Heat Set Inserts	6 (Pack of 10)	$6.75
Nylon Spacer	7	$7.84
Nylon Screw	6 (Pack of 100)	$7.97
		~ $96.65

Thank You!

Questions?