



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...

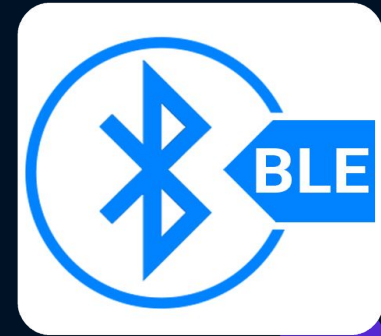
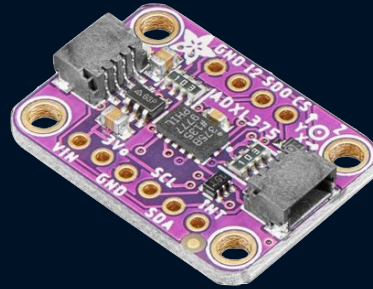
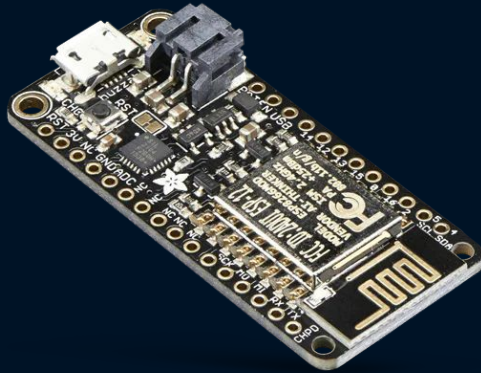
- Alert if a likely concussion causing impact has occurred
 - Users and doctors with impact acceleration data after a crash has occurred for more informed diagnoses
 - Users with the security of mind that their emergency contacts will be notified if they become unresponsive
- 



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



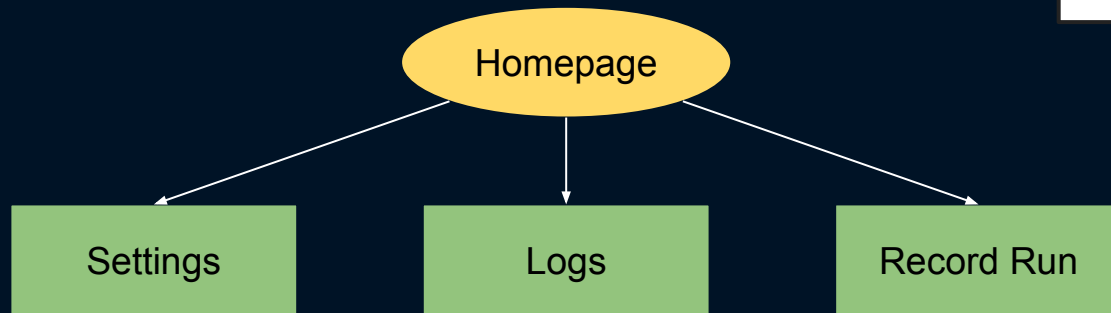
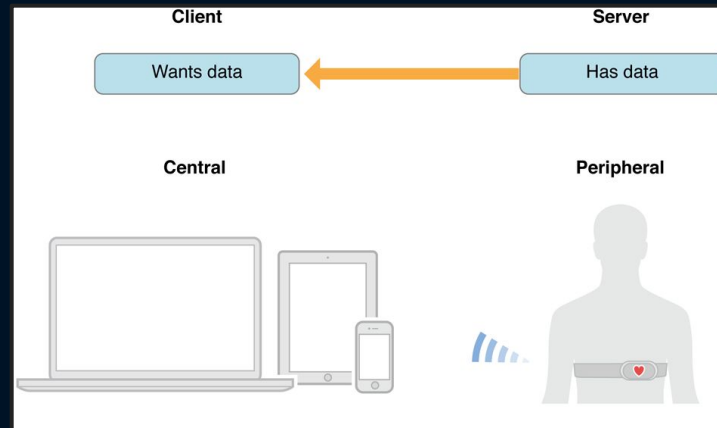
Design Choices – Embedded Software

- 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)





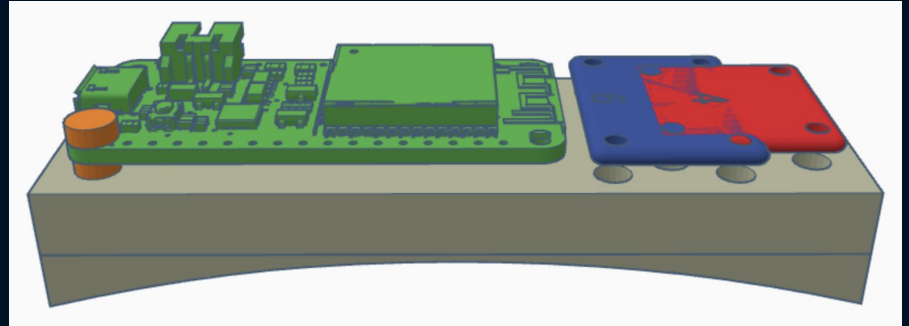
Implementation



Peripheral

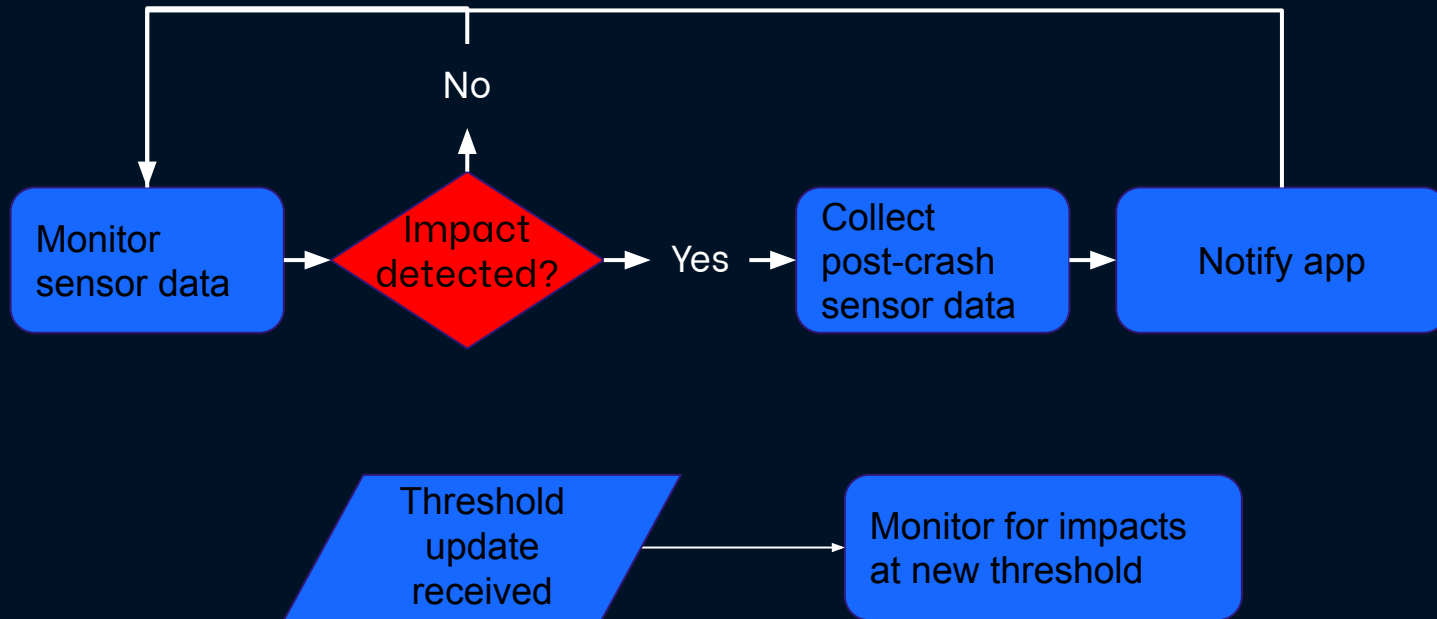
Mounting Design

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



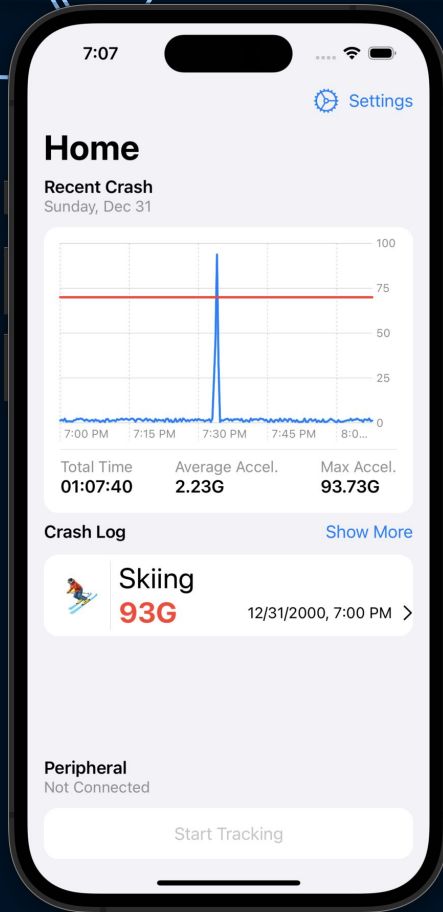


Embedded Workflow



The background is a dark navy blue. It is decorated with various hexagonal shapes. In the corners, there are clusters of 3D hexagons in shades of purple and blue. Scattered throughout are several 2D hexagons, some in solid blue and others as white outlines. A large, thin purple outline of a hexagon is positioned in the center-left of the image.

App Walkthrough

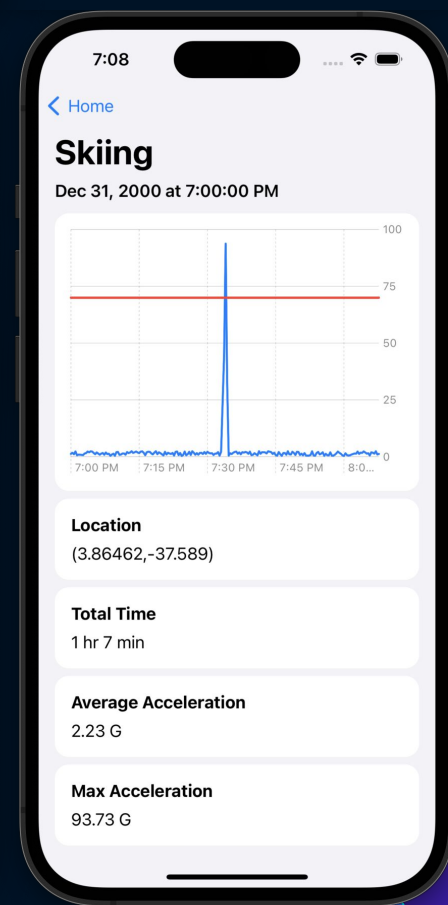


Home Page

The 'Tracking Options' popup screen allows users to configure tracking settings. It includes sections for 'ACTIVITY PROFILES' and 'EMERGENCY CONTACT'. Under 'ACTIVITY PROFILES', there is a 'Selected Profile' dropdown menu. Under 'EMERGENCY CONTACT', there is a 'Selected Contact' dropdown menu. The screen has 'Cancel' and 'Start' buttons at the top.

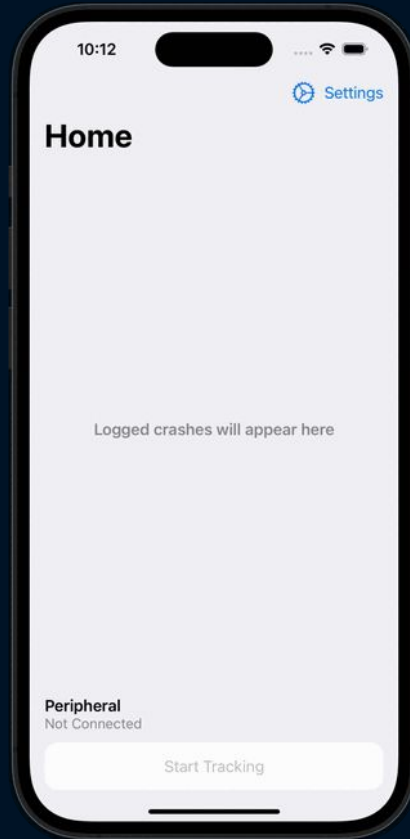
“Start Tracking” Popup

This screen shows the 'Tracking Options' popup with specific selections. Under 'ACTIVITY PROFILES', 'Snowboarding' is selected with a sub-label '80Gs' and a snowboarder icon. Under 'EMERGENCY CONTACT', 'Matt Chan' is selected with a sub-label 'Teammate' and a phone number '+16507147080'. The screen has 'Cancel' and 'Start' buttons at the top.



Individual Crash Log

Settings



Automated Text Message Workflow

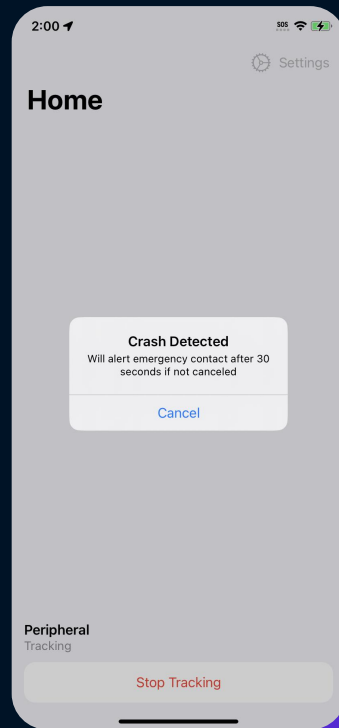
- Locally hosted python server with Flask
 - Relays to Twilio
- Ngrok reverse proxy to the localhost
- CoreLocation records current location
- Alamofire sends HTTP request
 - Selected contact number
 - Latitude & Longitude

Sent from your Twilio trial account - EMERGENCY

A Crash Buddy user was unresponsive following a detected impact

Activity: Climbing

Location:
(42.33141921142782,
-71.10413930715005)



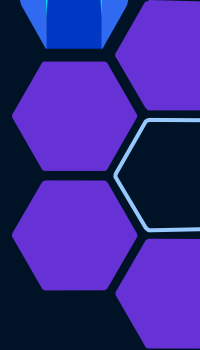
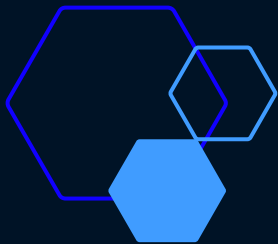
Future Additions

- 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?

