PINNACLE BIOMETRICS

presents

Floe

The Athletic Balance Monitoring System for Skiers


Using technology
to help athletes
meet their true
potential

Our Team

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Hardware Developer

Clara Tsang

Software Developer
(Front-End)

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Firmware Developer

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Software Developer
(Back-End)

Outline

I. Motivations / Project Background
II. *Floe* Overview
III. Project Overview
IV. Business Case
V. Conclusions
VI. Demo / Questions

I. MOTIVATION / PROJECT BACKGROUND

Clara

Motivations

We wanted:

- ➔ Something that would **give us each a different focus**
  - ➔ Something that's **new**
    - ➔ Something that's **cool**

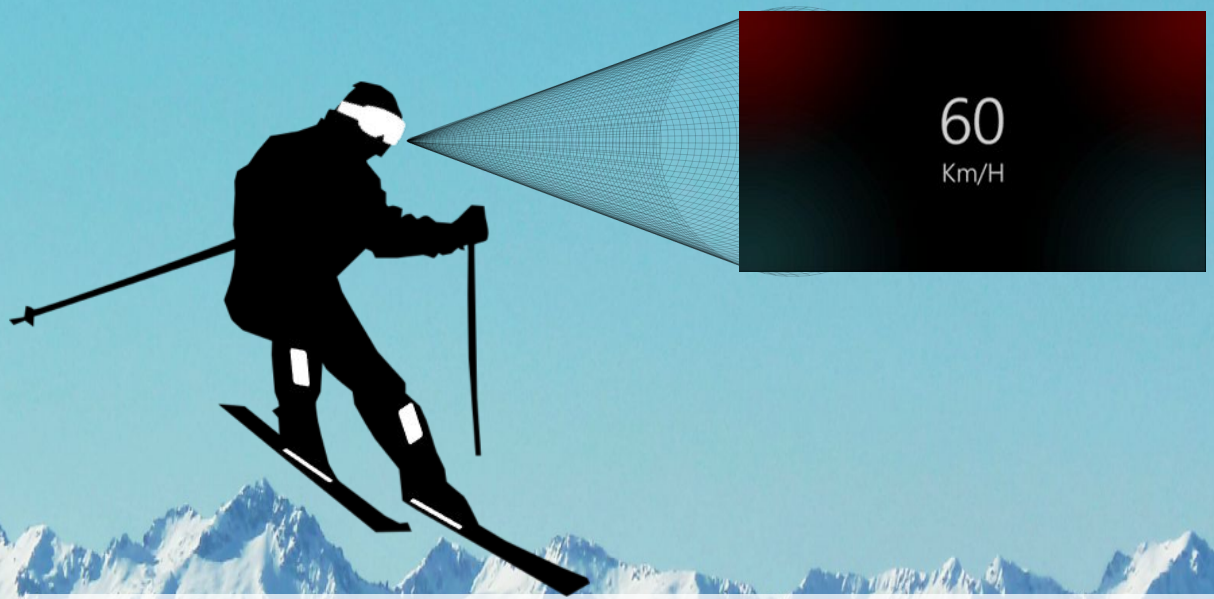
The Problem

What are we trying to solve?

- ➔ Limitations of exclusively qualitative feedback
- ➔ Lack of products in the market offering real-time performance feedback
- ➔ Lack of products in the market offering balance metrics in an athletic environment

Solution Design

The Concept Behind Floe



implementing existing technologies to provide athletes with quantitative augmented feedback to help them more effectively further their skills

II. *Floe* OVERVIEW

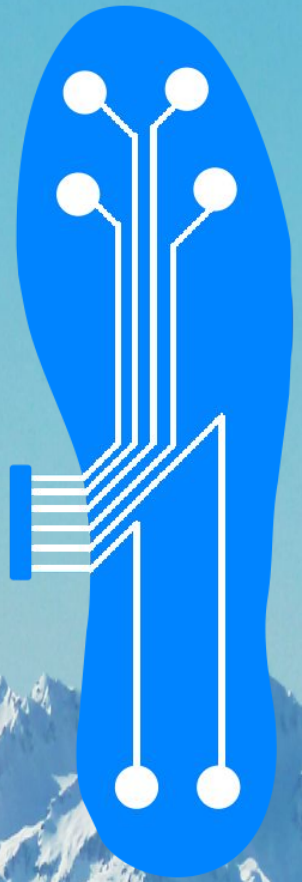
Eric

System Breakdown

I. Pressure-sensing Insoles
II. Boot Mounted Hardware (BMH)
III. User Interface (Mobile Device App) (HUD)

Insoles

- ➔ To be slipped into ski boots for simple retro-fitting
- ➔ Sense distribution of force applied by user's weight



BMH

- ➔ To be attached onto ski boots for simple retro-fitting
- ➔ Receive sensor data through wired connection and send wirelessly to mobile device

Mobile App

- To be easily accessed through user's existing mobile device
- Display centre of pressure information in intuitive, useful manner
- Give predictive feedback to user in RT

Proof-of-Concept Scope

- Insoles
  - 4 Sensors
  - Signal conditioning circuitry
- BMH
  - BLE wireless transmission
  - RT data transmission (10 samples/sec)
  - Start/Stop data transmission
- Mobile Application
  - Record events
  - Display recorded events
  - Display RT visual feedback

III. PROJECT OVERVIEW

Kurtis

Projected Schedule		Actual Schedule	
Jan 18	Research commences	Jan 18	Research commences
Feb 1	Parts arrive, development starts	Feb 1	Parts arrive, development starts
Feb 28	Single BMH and mobile app	Feb 19	BLE transmission of 1 sensor
Mar 13	Second BMH and HUD	Mar 20	App database; signal conditioning
Mar 28	Full prototype, testing starts	Apr 6	Physical housing
Apr	Project Deadline	Apr 8	Both insoles; app UI
		Apr 10	BLE transmission of all sensors
		Apr 12	Insoles connected to BMH; app BLE
		Apr 13	BMH and app integration
		Apr 15	App works with 2 boots, testing
		Apr 19	Project Presentation

Reasoning for delay

- ➔ Lack of funding
- ➔ System redesign
- ➔ Time constraint

Project Scope Changes

- Heads-up-Display removal
- Force range of the FSRs
  - Signal conditioning circuitry
- Custom BLE Service
- Predictive feedback
- Physical housing

Materials / Costs

Funding	Projected Costs		Final Expenditure	
	Item	Cost	Item	Cost
ESSEF: $513.00	2 x BLE SoC nRF52 Dev-kit	$230.00	2 x BLE SoC nRF52 Dev-kit	$171.31
	16 x Flexiforce A201 FSR	$340.00	8 x Flexiforce A201 FSR	$165.27
	Recon Instruments Snow2	$580.00	9 x Interlink 402 FSR	$65.00
	Power & Signal Electronics	$80.00	Power & Signal Electronics	$42.17
	Physical Housing	$10.00	Physical Housing	$0.00
	20% Contingency	$248.00	Tax and Shipping	$80.71
	Total:	$1488.00	Total:	$524.46

Materials / Costs

Funding	Projected Costs	Final Expenditure
$513.00	$1488.00	$524.46

- → No Recon Snow2
- → Reduced amount of sensors
- → 2 types of FSRs
- → Extra circuit components
- → Recycled physical housing

IV. BUSINESS CASE

Louis

Market

- 6.5 million skiers visits
  - Less than 5% of people ski
- Force-sensing products
  - More sensors, less portable
- Rise of the (performance) Trackers

Competition

Flaik

- GPS

Trace

- GPS
- 9-axis
- Tricks

Piq

- GPS
- 9-axis
- Tricks & Turn

Financing/Pricing

- Revenue Streams
  - Private investment
  - Crowd-funding
  - Device sales
- Pricing
  - $220 price range
  - PCB, bulk orders

Carv : A Midway Awakening

"Carv analyses your skiing technique in real-time providing feedback on the slopes and detailed analysis between runs"

- ➔ Kickstarter launched 10 February 2016 - Raised $275,000
- ➔ 2 years of development

V. CONCLUSIONS

Clara

Project Summary

Proof-of-Concept Model

- ➔ Scope revisions
- ➔ Completed implementation final revised model and operating as expected
- ➔ Physical design could be improved

Personal Learning

Kurtis Bohlen

- HW system design
- PCB fabrication
- Signal conditioning
- Eagle/PCB layout
- FSRs

Clara Tsang

- Android API
- Java
- UI development
- Multi-threaded programming

Eric Raposo

- BLE protocol
- SoC firmware development
- Nordic nRF SDK
- ADC timer PPI peripherals
- Android API

Louis Roux

- Android API
- Java
- Multi-threaded programming
- Asynchronous callbacks

Future Plans

Possible Revisions (Prototype)

- Performance optimization
- Aesthetic improvement
- Physical improvement
- Additional sensor information

Possible Revisions (Final Version)

- Gyroscope/ accelerometer integration
  - Stance sensing
  - Movement analysis
- HUD
- Predictive feedback

Consensus:

SCRAP

- Carv

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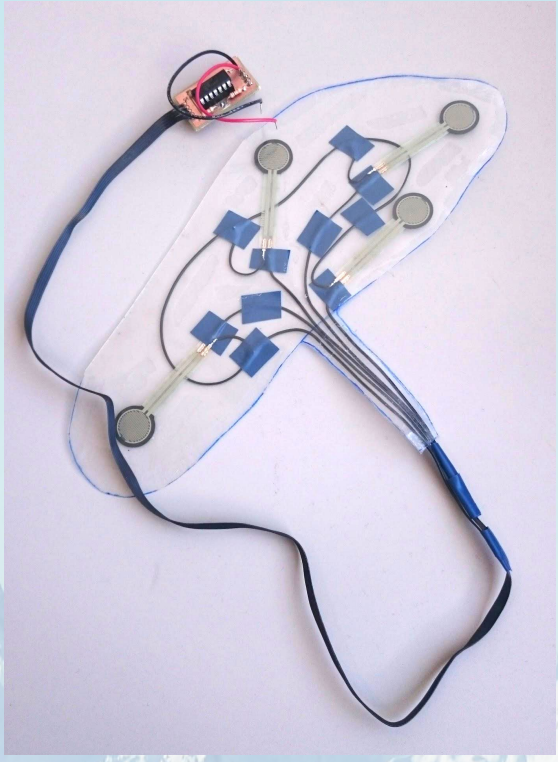
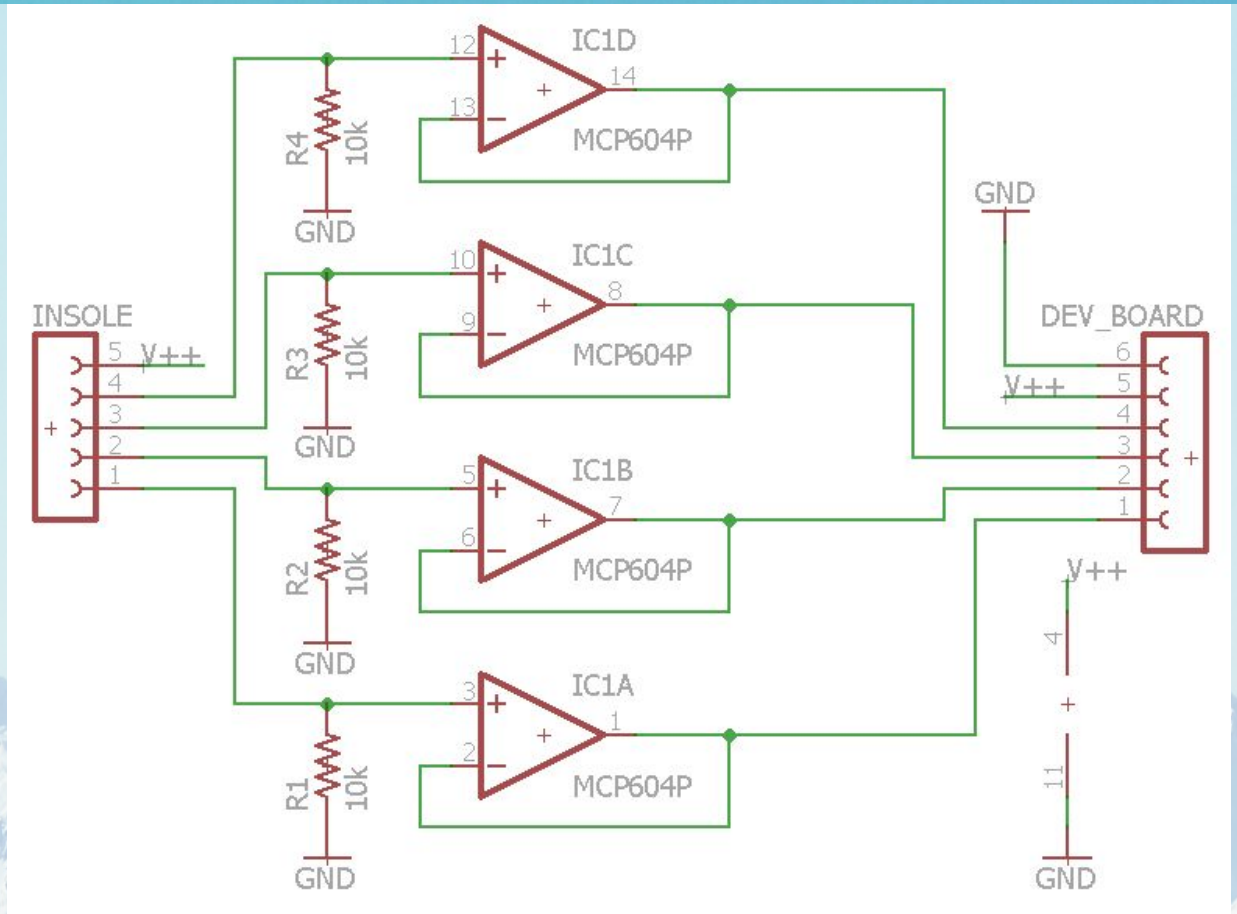
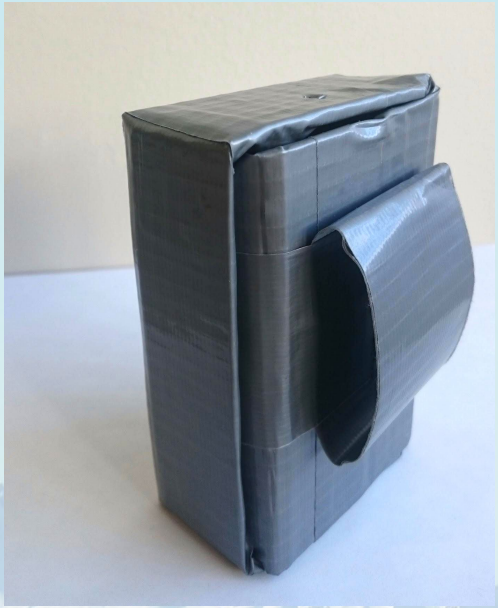
VI. DEMO / QUESTIONS

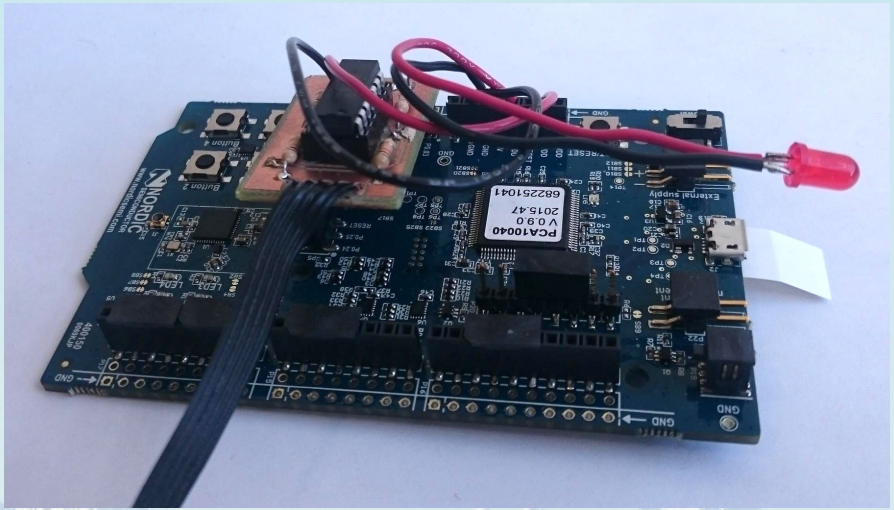
Insoles



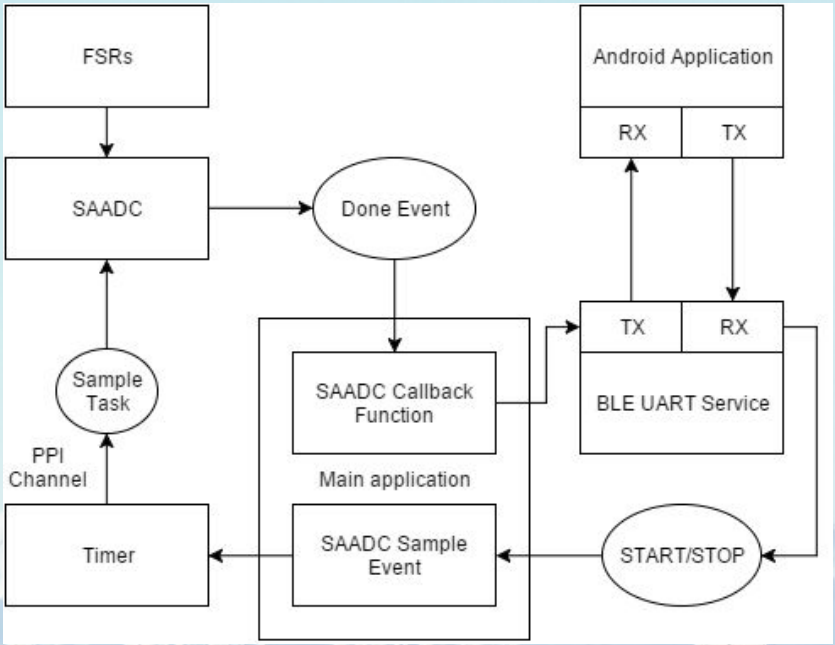

IC1D
MCP604P
IC1C
MCP604P
IC1B
MCP604P
IC1A
MCP604P
R4
10k
R3
10k
R2
10k
R1
10k
GND
INSOLE
V++
DEV_BOARD
GND
V++
V++
GND

BMH




PCA10040
V0.9.0
2015.47
682251041
nRF51822
GND
Button 1
Button 2
Button 3
Button 4
External supply

BMH Firmware



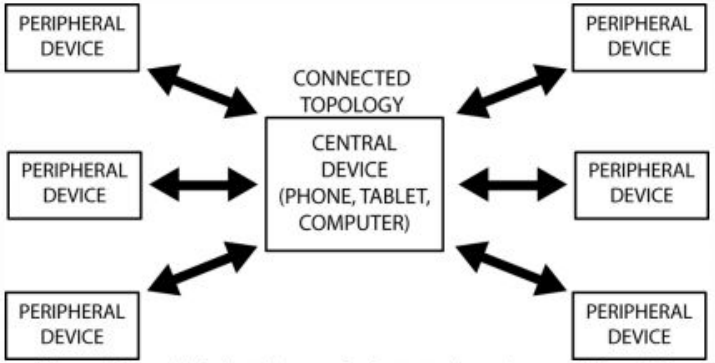


Figure 5.1 - Wireless transmission master-slave relationship

Table 5.2 - Transmission data packet breakdown

Byte #	0	1 - 8	9
Content	Header	FSR Data	Unused
Left BMH	0x 4C	0x AA AA BB BB CC CC DD DD	0x 00
Right BMH	0x 52	0x AA AA BB BB CC CC DD DD	0x 00

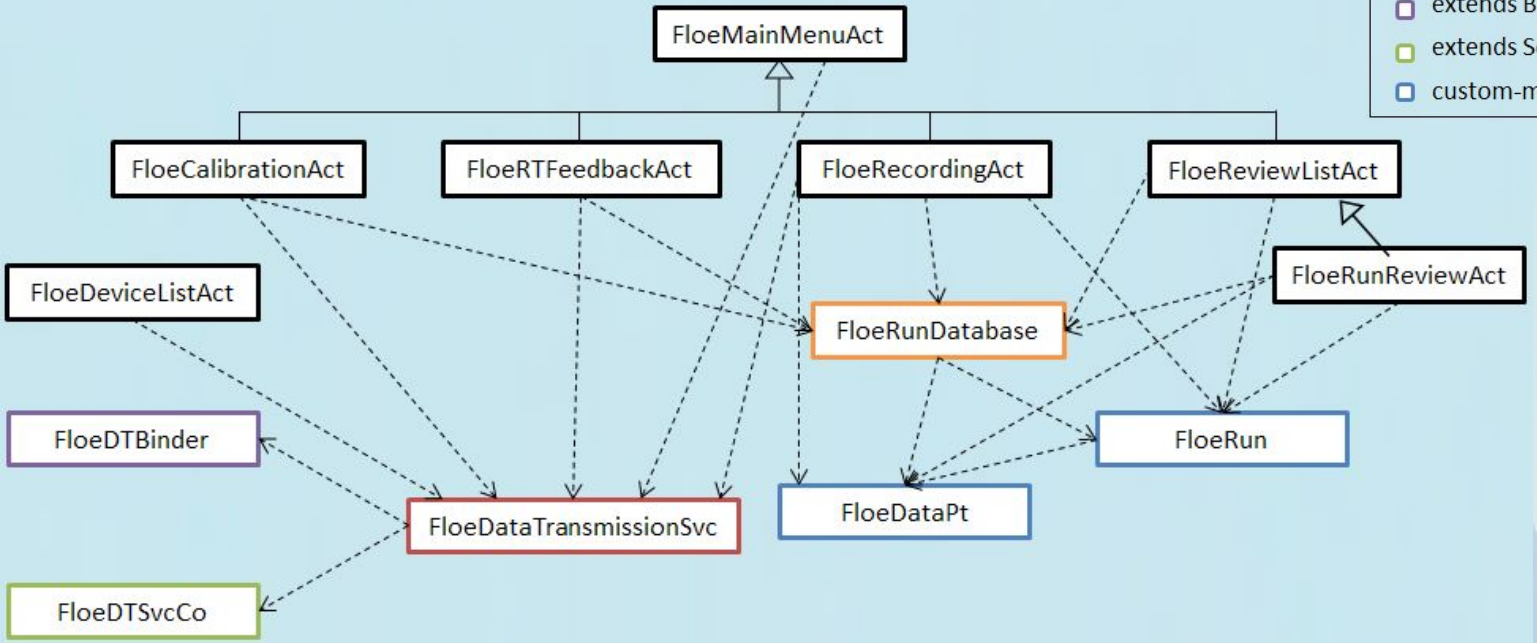
* A = Sensor 1 Data, B = Sensor 2 Data, C = Sensor 3 Data, D = Sensor 4 Data

Table 5.3 - Receive data packet breakdown

Byte #	0	3	4 - 9
Content	Header	Command	Unused
Left BMH	0x 4C	ENABLE | 0x45 DISABLE | 0x44	0x 00 00 00 00 00 00
Right BMH	0x 52		

* ENABLE = enable SAADC sampling, DISABLE = disable SAADC sampling

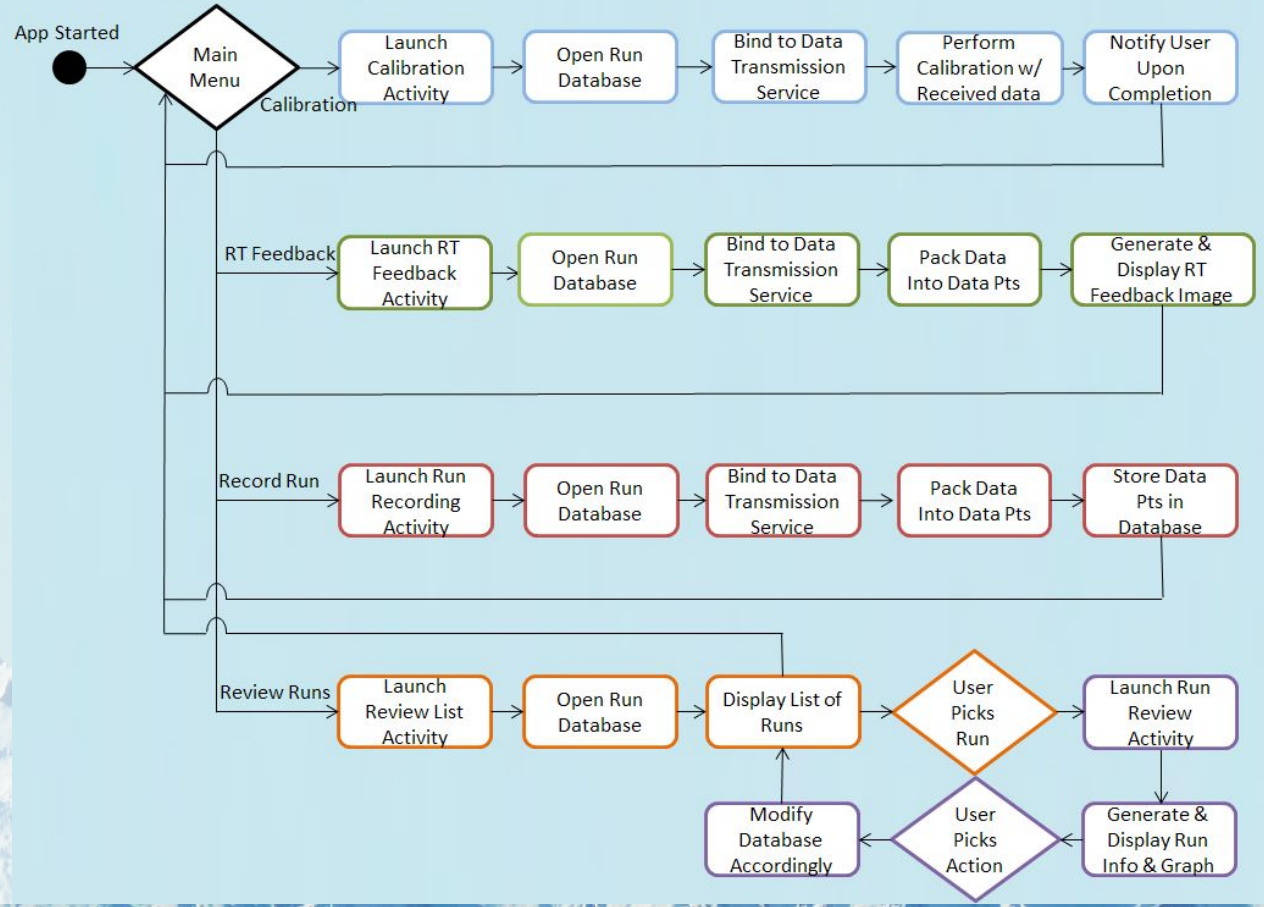
Mobile App - Data Structures



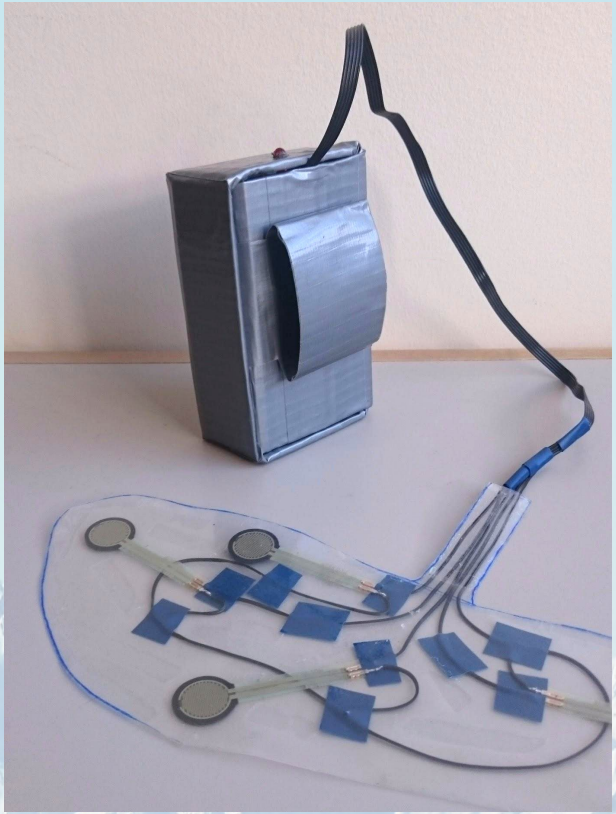
Additional Inheritance Notes:

- extends Activity
- extends Service
- extends SQLiteHelper
- extends Binder
- extends ServiceConnection
- custom-made class

Mobile App Activity Diagram



Demo



THANK YOU

QUESTIONS?