GOES CHRONOLOGICALLY FROM BOTTOM (OLD) TO TOP (MOST RECENT)

[Manual link (start at section 4)]

- **judging guidelines: section 4.4.3**
- **SUMMARY OF REQUIREMENTS AND DETAILS**

[Jitsi Meeting Link]

[Decision Matrix]

[Planning Document]

[Presentation]

Original [Figma]
NEW [Figma]

Decision Matrix

	Criteria					
Ideas	Code complexity	Accuracy of BPM	Aesthetics	Simplicity	Cost	**Totals**
Pressure pads, lace side	4	5	3	3	4	19
Pressure pads, lace under	4	5	3	4	4	20
Smartwatch	2	3	5	3	2	15

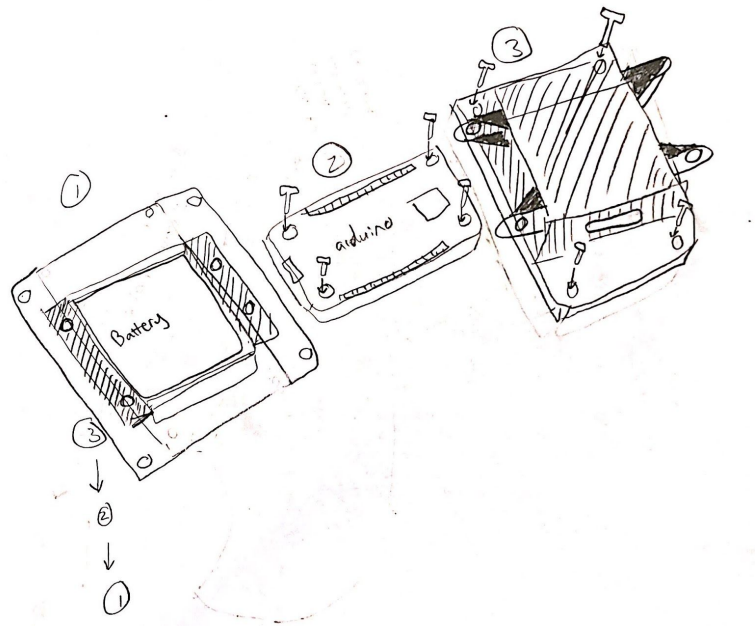
Scale: (bad) 1-5 (good)

Defining the criteria and justification:

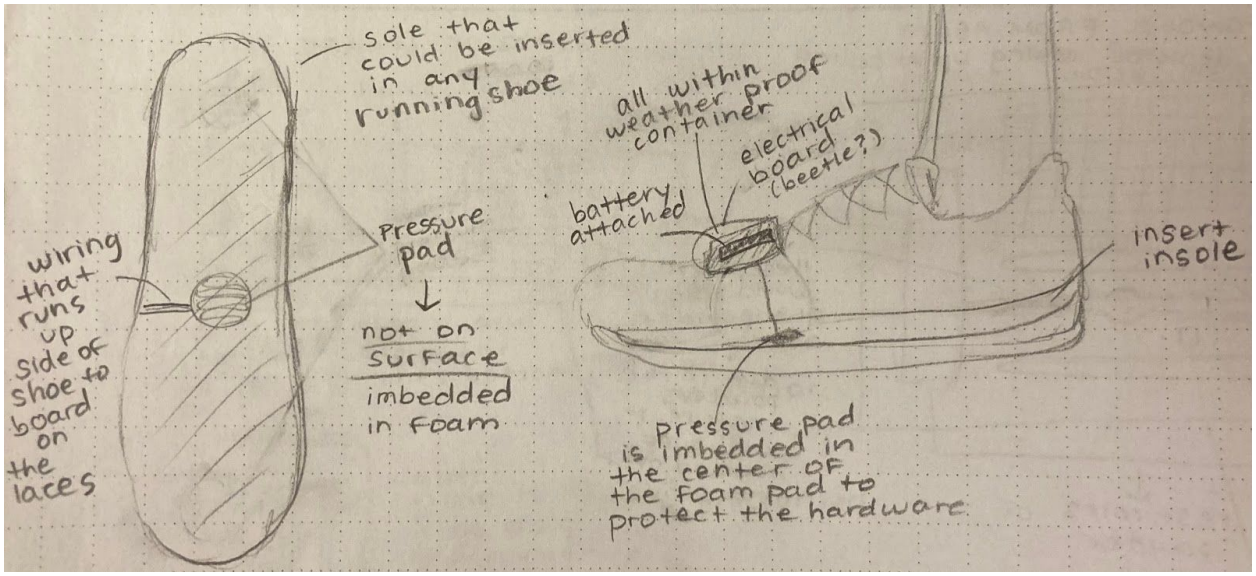
- Code complexity
  - Connecting to a smart watch is more difficult than connecting through code to our own pressure pads
- Accuracy of BPM
  - Pressure pads are directly under the foot and will more accurately

- Aesthetics
- Simplicity to build
- Cost of hardware and consequently product. Bad if it's more expensive because then it's less accessible

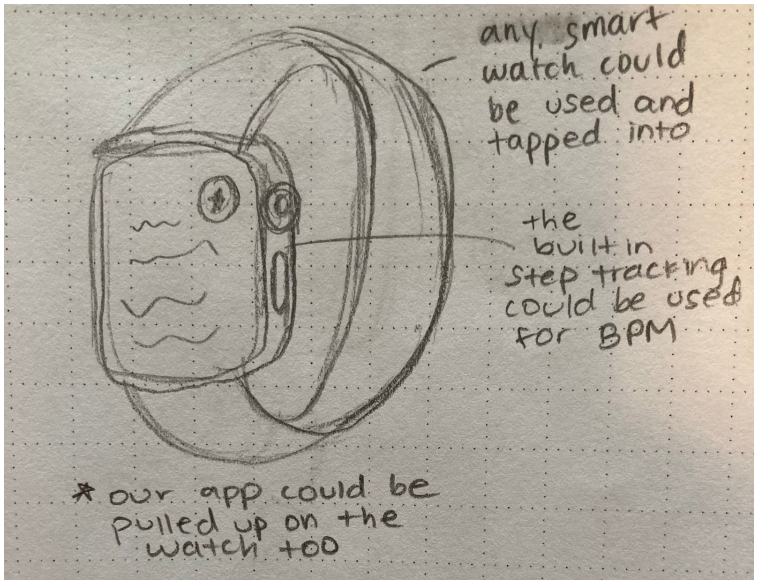
Brainstorming Sketches:

1. 

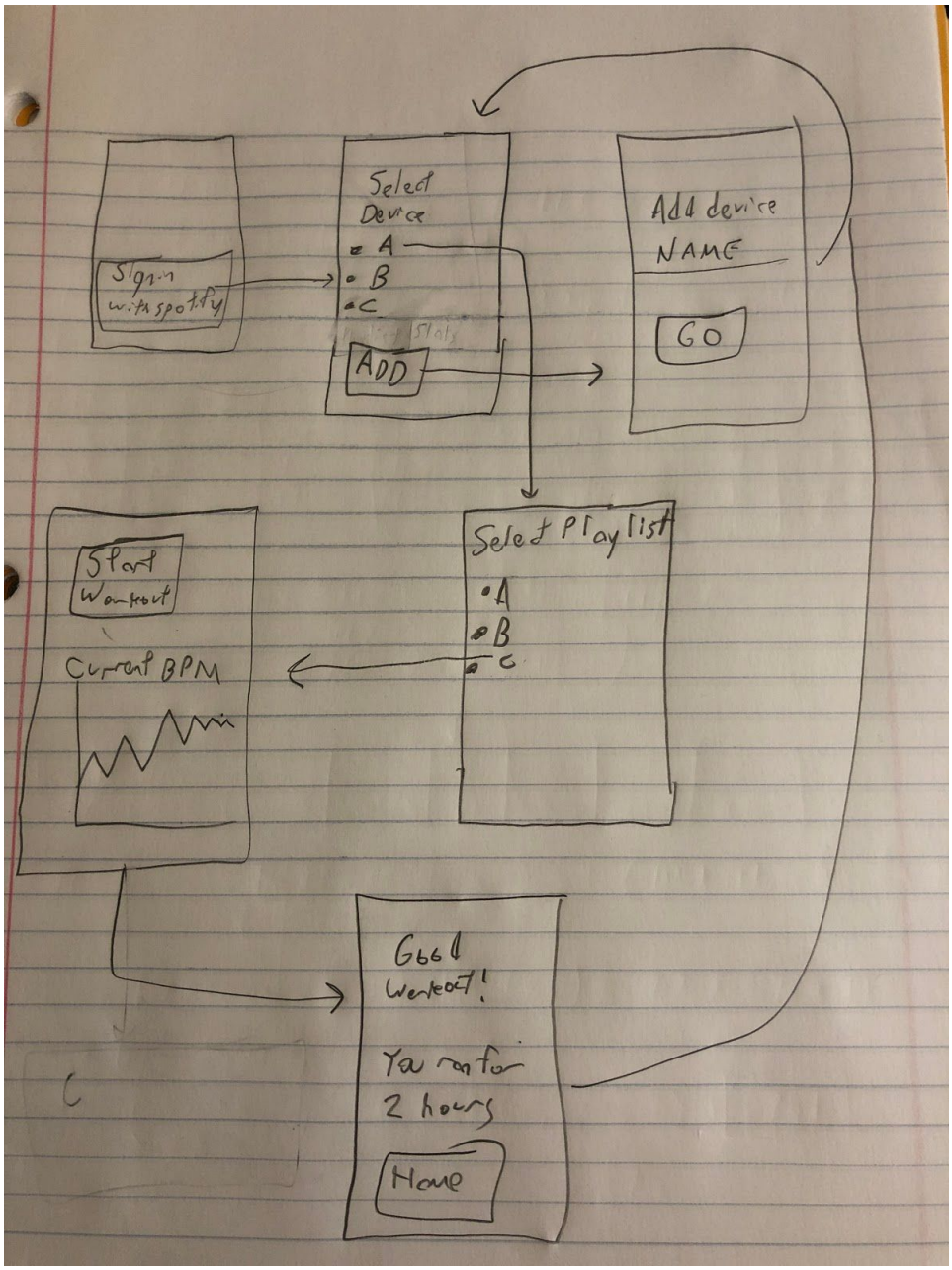
2. Pressure pads attached to a bluetooth microcontroller on the laces. Laces go through slots on the bottom of the battery and microcontroller housing.

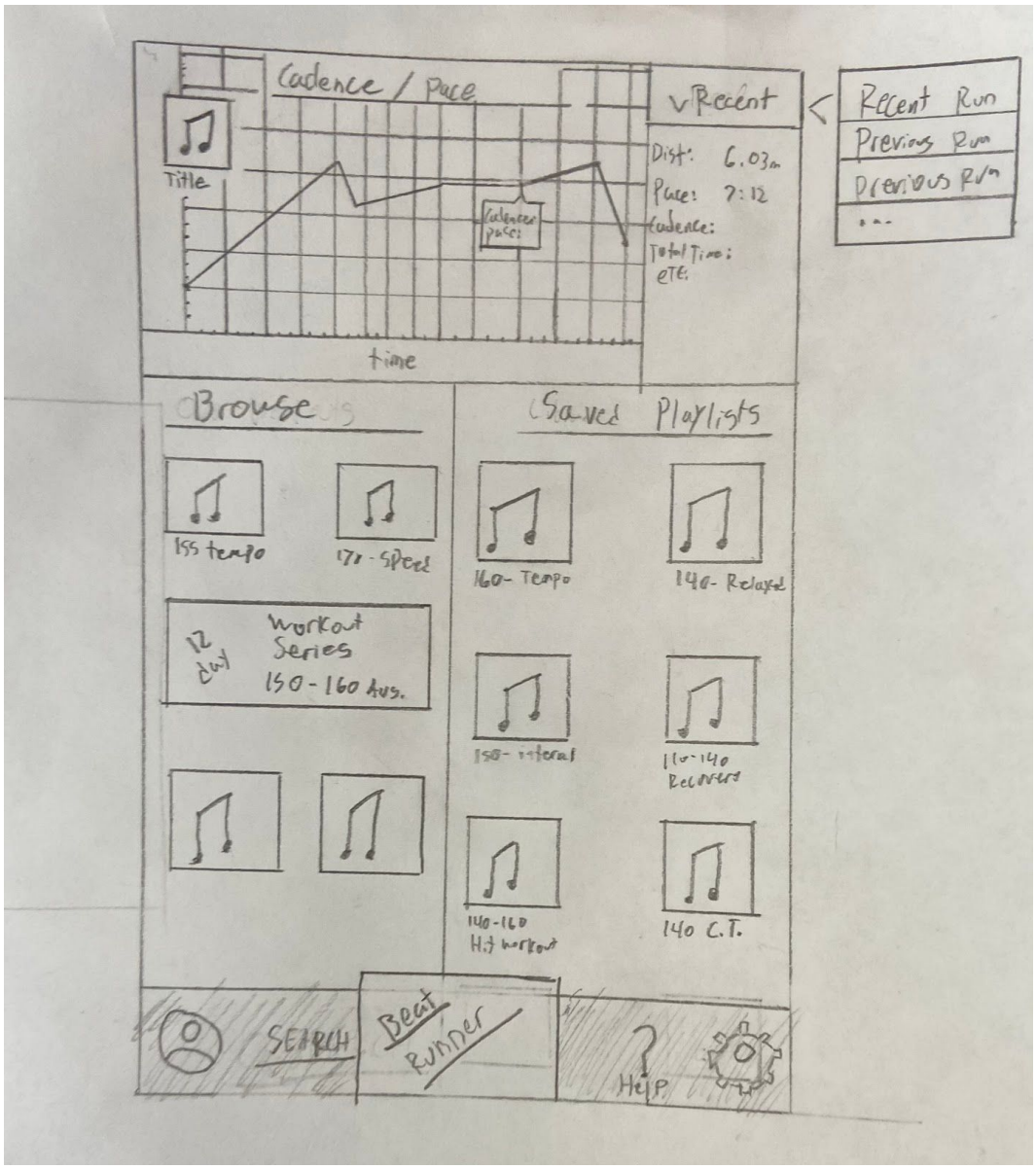


3. Smartwatch that is bought individually and connected through bluetooth

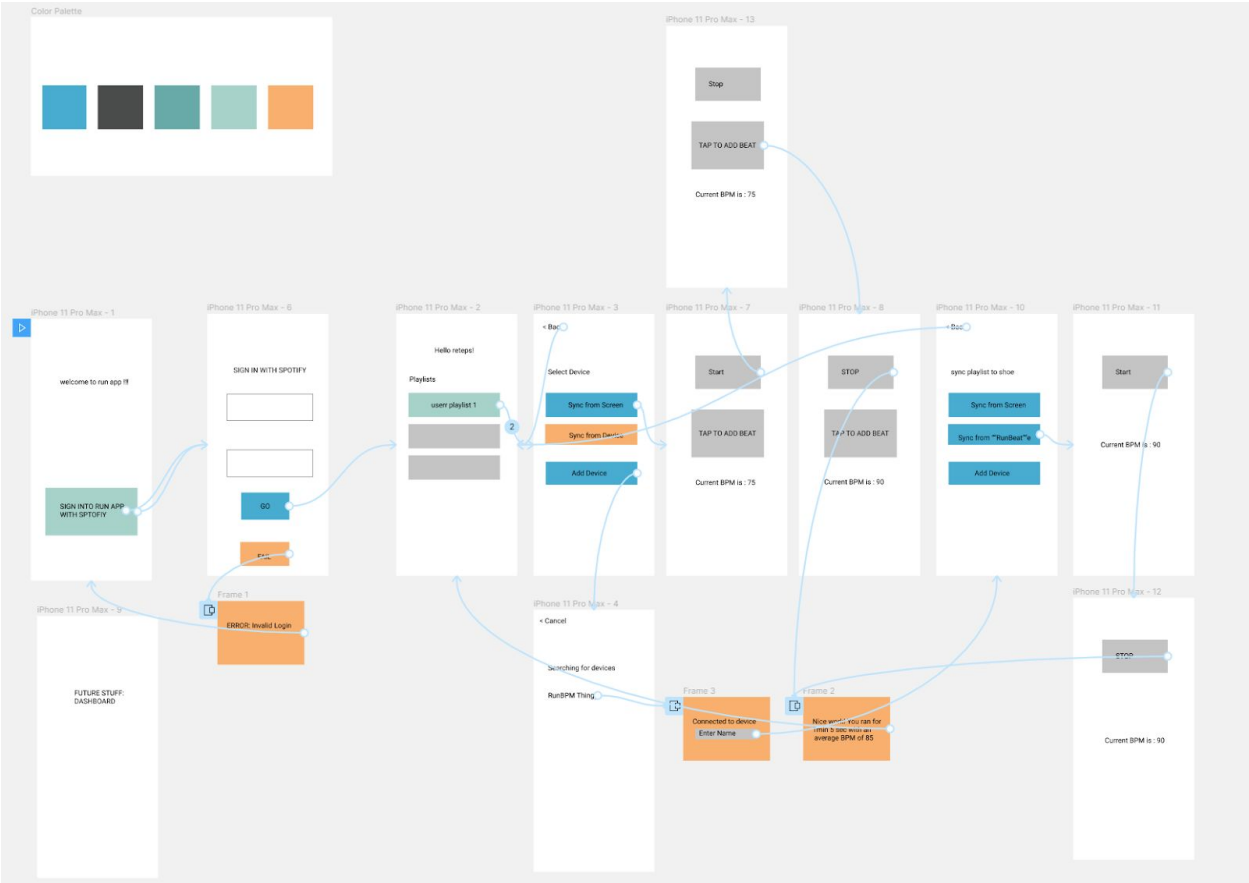


Ideas	Use before run	Use during run	Use after run	Aesthetic	Functionality	Totals
First Sketch	4	2	3	3	3	15
one page display	2	2	4	3	3	14
Figma	4	3	3	4	4	18

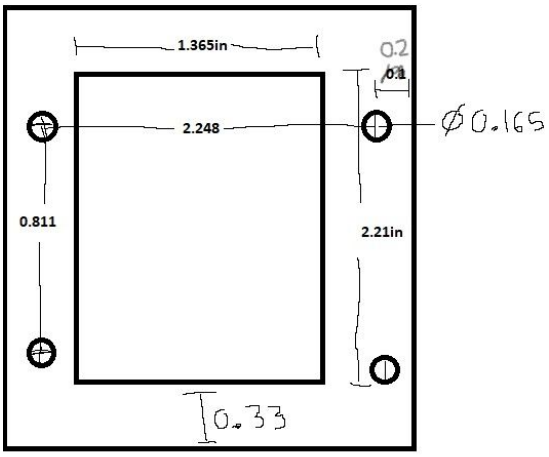

Sign in with spotify
Select Device
A
B
C
ADD
Add device
NAME
GO
Select Playlist
A
B
C
Start Workout
Current BPM
Good Workout!
You ran for 2 hours
Home


Cadence / Pace
Title
Cadence pace:
time
vRecent
Dist: 6.03m
Pace: 7:12
Cadence:
Total Time:
eTE:
Recent Run
Previous Run
Previous Run
...
Browse
Saved Playlists
155 tempo
170 - Speed
160 - Tempo
140 - Relaxed
12 day
Workout Series
150 - 160 Avg.
150 - Interval
140-160 Recovery
140-160 H.I workout
140 C.T.
SEARCH
Beat Runner
Help

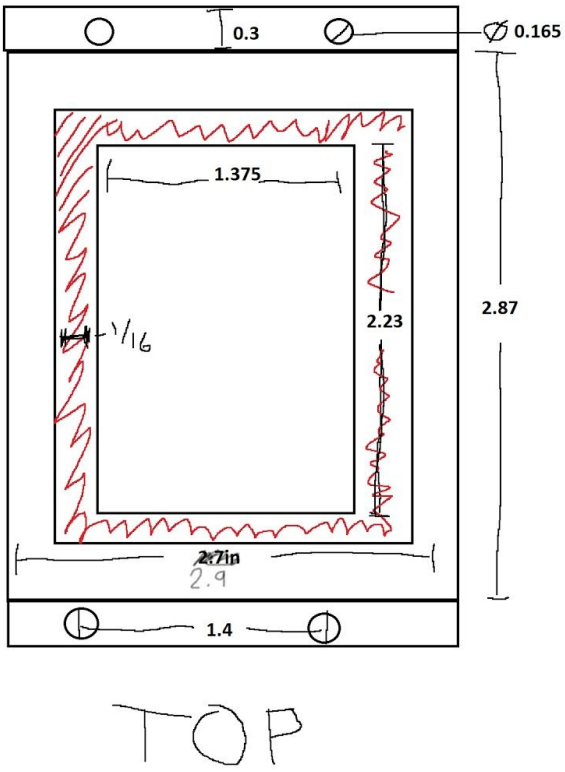
https://www.figma.com/file/N5J1GFomLQKA75fKUcfAu6/robotics-thingy?node-id=0%3A1



a.



b.



Everything except for the round holes gets extruded 1/8in, the red part gets extruded 1/8in further

c.

2. Ari/Rose:
    a. UI Design
    b. Attempt to integrate with app code
3. Eli/Anthony:
    a. Learn React
        i. https://reactjs.org/tutorial/tutorial.html (Peter's recommended tutorial)
        ii. I have this really long tutorial that I never watched https://www.youtube.com/watch?v=DLX62G4lc44
4. Peter/Rose/Ari:
    a. EDD Presentation (Peter/Rose)
    b. Integrate FIRST elements to presentation

Planning:

Project Title/Topic	BeatRunner

Goal	
Goal: Formulate an inquiry question or statement that clearly shows your goal, based on your personal interests. Be concise but specific and clear.	How can runners be motivated to maintain the same pace while staying healthy?

What is the purpose of the goal? What do you hope to achieve?	We hope to make it more attainable for random people to pick up running and stick with it because it is fun and healthy.
What prior learning and subject specific knowledge is relevant to the project? How does the project relate to an academic class you are currently enrolled in or have taken?	What motivates us to run based on personal experience. How to evaluate the BPM of songs on Spotify. Coding knowledge in JS. This can relate to some of the activities we did in personal fitness and Band.

Global Impact	
Identify how this will impact the community/world:	During the covid times many inexperienced people are picking up running. This will help them stick with it. Providing a socially distant and safe way to stay healthy. Promoting running will be good for the overall physical and mental health of society.

Product/Outcome	
What product/outcome will you create in response to the goal, global context and criteria?	We will create a device that goes on a runners shoe as well as an app that synced to the device.
Form: Function: User/Audience: Costs:	● App + Arduino Device ● Track Speed of runner and sync music to speed ● Runners ● Arduino + Battery + 3D Printing Cost + Running Sensor Cost

Research	
What will be the focus of your research?	How to sort music by BPM, existing solutions and the problems to them to provide a stronger new application
Media: (Includes books and articles, etc.)	Music, Websites, Figma
Surveys: Would surveying your potential audience be useful?	- Asking people what type of music they enjoy while running - If they would use it - What functions they would like to prioritize

Interviews:What human resources can you tap into for your project?	Active runners or athletes that play a different sport but hate running. Really anyone with an opinion on music.
Other sources for research?	Spotify, Google, React Native tutorials

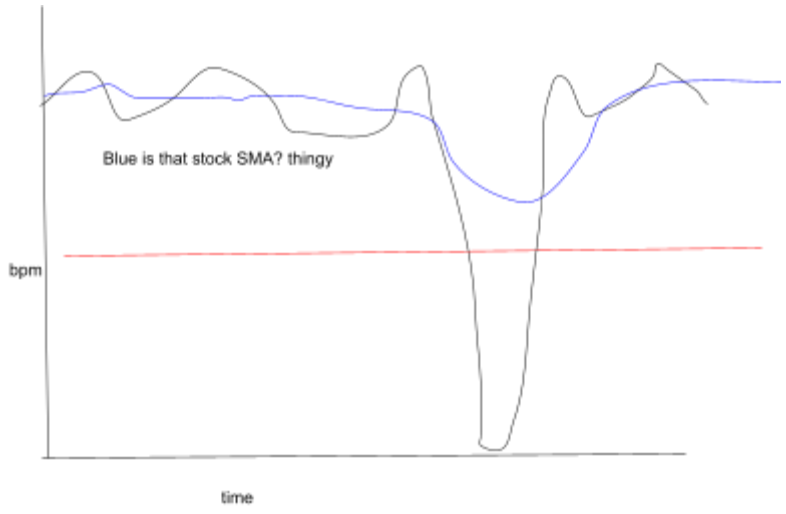
Specifications

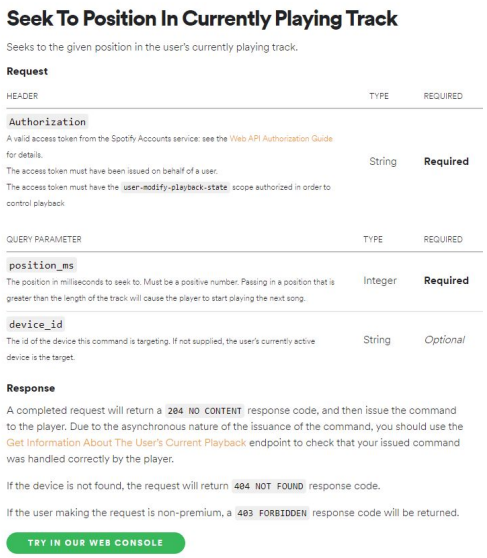
Prompts	Student-Designed Criteria	Test or method of evaluation
Form: What will your project look like? What materials will you use? What size will your project be? What tools will you use? How will you assemble your project?	An app that connects to a physical bluetooth device attached to the laces of the users shoes. Arduino, Battery, 3D printed enclosure, computer 2.9” x 3.4” x 1.1” 3D Printer My hands will screw in the bolts	How durable is the computer/battery casing while running? Can test by actually using it.
Function: What is the purpose of your project?	To motivate runners to maintain a constant pace	Does the user run more after using the application?
User/Audience: Who is your project for? What needs do you expect your project to satisfy? Where/why will you project be used?	Runners Runners or anyone who wishes to start running and is wanting some sort of audio feedback to help them keep a certain pace. The app will be run while runners are running to help them run at a more consistent running pace.	Are runners interested in buying an application of this nature? Does running with a certain BPM or in time with a song actually help people keep pace?
Costs: How much will your project cost to make? ***How much will you sell it for? ***How much profit could be made on your item/project?	30 + 20 + 10 + 5 = $65 $100 $35	We will record the costs as we actually buy the materials to calculate the costs.

Function:

1. Utilize numbers that pressure pads are producing to figure out the speed of the pace they are running. Pressure pad will send its signal to the arduino.
    a. Program records the pressure pad reading and stores it as something (variable, array?, idk how programming works)
    b. Translate into pace groupings within BPMs levels/groupings of 5
2. The arduino will bluetooth that to the phone and the phone will use the number of signals to interact with the Spotify API and get songs with a specific BPM and genre and send them back to the phone!!
3. Detect big changes in the runners cadence and:
    - change song OR speak warning / metronome track if happens
    - Provide user options to change song based on BPM more frequently
    - User provides playlist, app chooses song with close enough BPM to runners cadence
    - key/value store
        - Key being username idk
        - Value being refresh token
        - redis
        - Sign in with spotify?
4. Precreated workout-type / hype playlists!!!!

Major





Seek To Position In Currently Playing Track

Seeks to the given position in the user's currently playing track.

Request

HEADER	TYPE	REQUIRED
`Authorization` A valid access token from the Spotify Accounts service: see the Web API Authorization Guide for details. The access token must have been issued on behalf of a user. The access token must have the `user-modify-playback-state` scope authorized in order to control playback.	String	**Required**

QUERY PARAMETER	TYPE	REQUIRED
`position_ms` The position in milliseconds to seek to. Must be a positive number. Passing in a position that is greater than the length of the track will cause the player to start playing the next song.	Integer	**Required**
`device_id` The id of the device this command is targeting. If not supplied, the user's currently active device is the target.	String	*Optional*

Response

A completed request will return a `204 NO CONTENT` response code, and then issue the command to the player. Due to the asynchronous nature of the issuance of the command, you should use the Get Information About The User's Current Playback endpoint to check that your issued command was handled correctly by the player.

If the device is not found, the request will return `404 NOT FOUND` response code.

If the user making the request is non-premium, a `403 FORBIDDEN` response code will be returned.

TRY IN OUR WEB CONSOLE

https://developer.spotify.com/documentation/web-api/reference/#category-player

Major programming components:

- **Pressure Sensor/App communication**
  - Arduino / Read from Pressure Sensor ✔️
  - Arduino / Send data over BLE
- **App**
  - React / Receive data over BLE
  - React / Authenticate with spotify / Store key in database (REDIS?)
  - React / Play Spotify songs in playlist from BPM
- Hardware
  - Hardware
  - Hardware
  - hardware
- Songs
  - Spotify / HYPE PLAYLIST!!!!!

Parts:

- Battery (could go in the same case as the arduino)
  - https://www.amazon.com/EEMB-2000mAh-Battery-Rechargeable-Connector/dp/B08214DJLJ/ref=sr_1_5?crid=ZILD7X6XL9JX&dchild=1&keywords=eemb+battery&qid=1612124932&sprefix=eemb%2Caps%2C180&sr=8-5
  - Charger: https://www.amazon.com/Battery-Charger-Channel-Inductrix-Connectors/dp/B074M77J5M/ref=sr_1_10?crid=286VR4JP60NPR&dchild=1&keywords=lipo+battery+charger+connectors&qid=1612124991&sprefix=lipo+battery+charger%2Caps%2C277&sr=8-10
- Microcontroller board
  - https://store.arduino.cc/usa/mkr-wifi-1010
  - CAD file for the Arduino https://grabcad.com/library/arduino-mkr1000-1
- Pressure pads

    - https://www.amazon.com/SENSING-RESISTOR-SQUARE-1oz-22LBS-SPACING/dp/B00B887DBC/
- Wiring to connect them
-

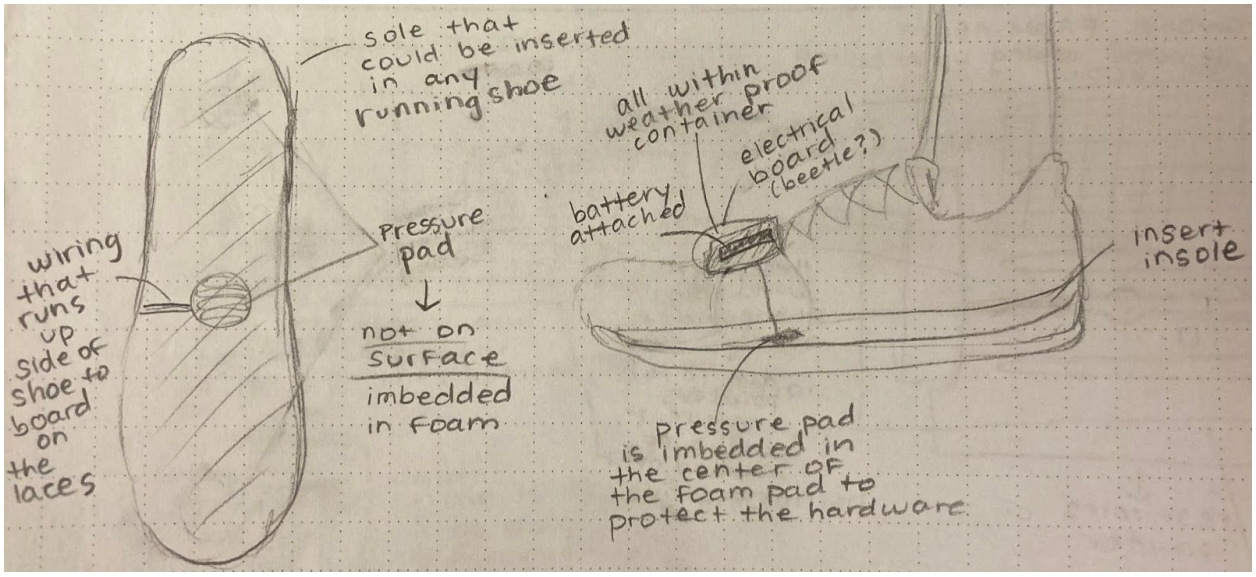
Helpful Resources:
- React Native Docs
- React Native Bluetooth Library

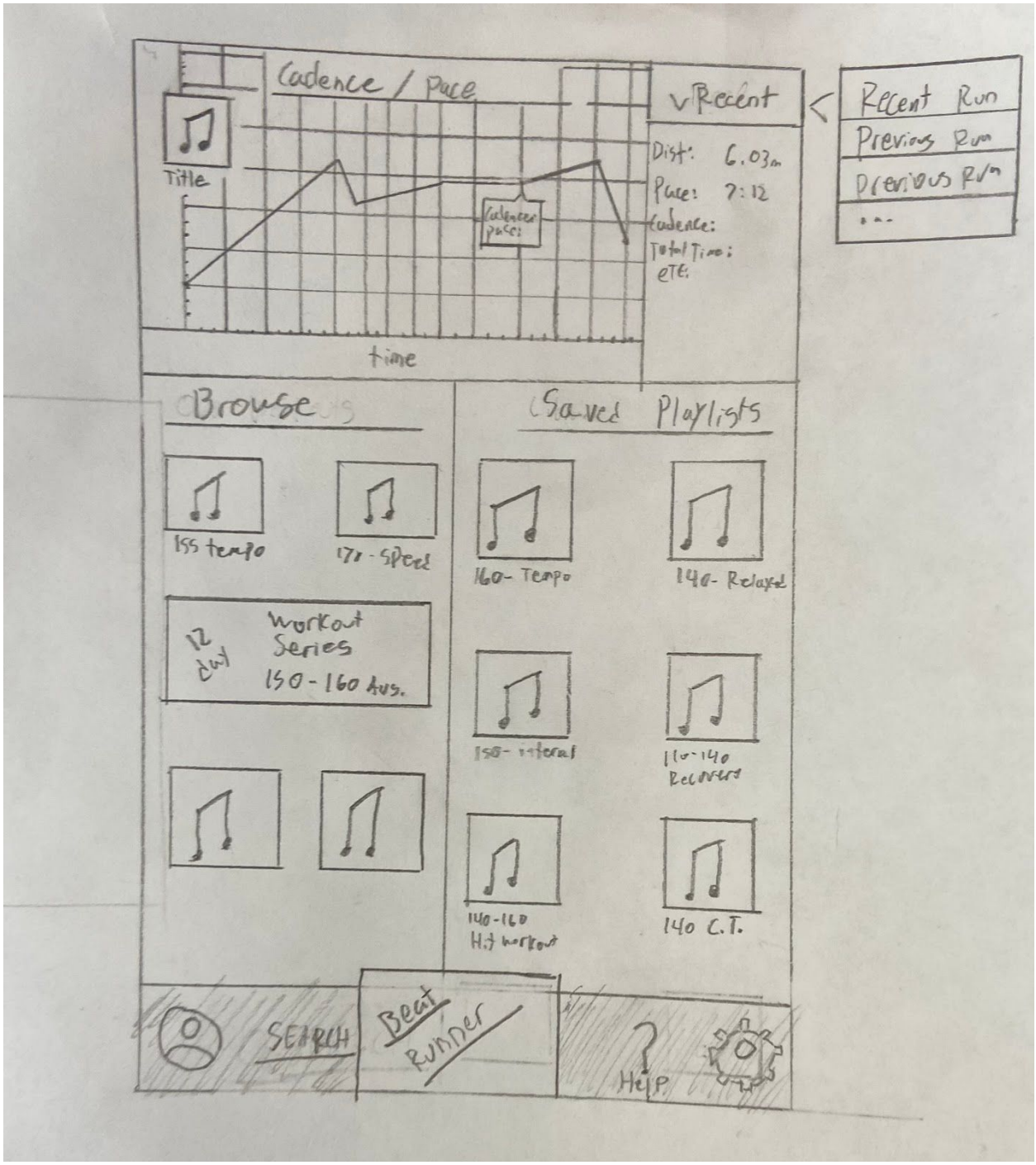
Requirements:
- Don't hurt the runners foot
- Doesn't mess up the runners form
- Time signatures
- Board needs to be able to communicate with the phone
- Battery and system can last an hour and a half on each charge

Considerations:
- How would the beetle board connect to the sole?
- Where will the battery go?

Possible microcontrollers:
- Beetle BLE
    - Very compact
    - No mounting holes
- Arduino Mkr WiFi 1010
    - Small
    - Mounting holes
    - Pins sticking out of the bottom (will need to be covered)

Brainstorming Sketches:


sole that could be inserted in any running shoe
all within weather proof container
electrical board (beetle?)
battery attached
Pressure pad
wiring that runs up side of shoe to board on the laces
not on surface
imbedded in foam
insert insole
pressure pad is imbedded in the center of the foam pad to protect the hardware


Cadence / Pace
Title
time
vRecent
Dist: 6.03m
Pace: 7:12
Cadence:
Total Time:
ETE:
Recent Run
Previous Run
Previous Run
...
Browse
Saved Playlists
155 tempo
171 - Speed
160 - Tempo
140 - Relaxed
12 day
Workout Series
150 - 160 Avg.
150 - Interval
140 - 160 Recovery
140-160 Hit workout
140 C.T.
SEARCH
Beat Runner
Help

The prompt: "Challenges us to revolutionize the traditional world of sports and fitness, innovating the way we play and move to reach our individual physical and mental health goals."

Topic: Sports / Fitness
Looking for a tool to help us

- Play, move
- Reach physical health goals
- Reach mental health goals

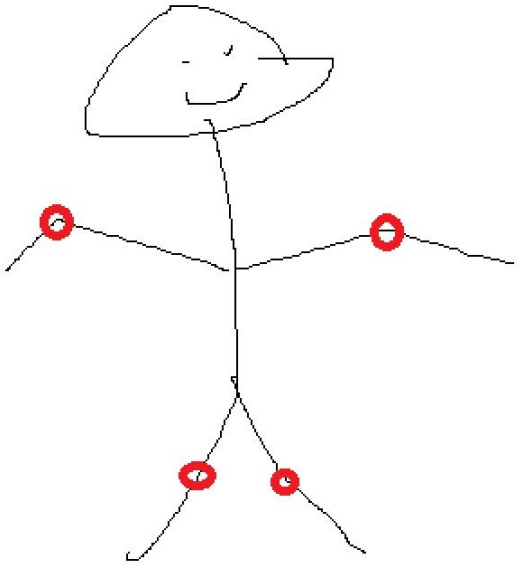
Please start brainstorming topics and problems you see in our community!

Final Idea?: Using pressure pads on the bottom of shoes to calculate running bpm, and choose songs that match to put on a spotify playlist

- The slower you run, it makes annoying sounds and/or throws insults at you
- Use them to track the form of how your foot is landing on the ground?
- Make an app that could connect to your phone to control something
- Put an accelerometer in the shoe or around there (maybe easier to integrate than pressure pads)
    - Would allow for it to work for people with different form
        - Concern from Evan: some people land on the front of their foot first, vs. some on back
- Relatively hard to make custom shoes, might be easier to pursue making an armband that would use a similar motion tracking concept to play certain songs

- Tap into existing technology like an apple watch
    - You could take the steps per minute count from there to transition into a bpm
- https://getsongbpm.com/running is a website where we can find songs at certain bpms to compile our playlists?
- acousticbrainz
    - We can create a song database where all of the songs will be pulled from by our app then the app would then connect it all back to spotify
- Songs should be sorted by their bpm, a genre (that the user can control), and the popularity of the song to prevent low quality ones from popping up
    - Song list with genre, bpm, name can be downloaded from acousticbrainz (2 million songs!)
    - The song genre should have a good pulse (feel of the music's beat) so that way it's easier to hear and easier to run to. (Additionally, songs that are selected shouldn't have any tempo changes within them to keep the flow)
    - With ISRC (universal song code) we can look up popularity on platforms such as spotify, deezer, or lastfm.
    - Estimated scenario to rebuild our own database with popularity: 10 req/sec, 50% of songs have ISRC. 1 million / 10 / 60 / 60 = 28 hours not bad
    - It may be worth investigating an easier solution: creating it manually

- Looking at existing solutions and kinda concerned because these all look similar to what we would be doing… except we are making it so ours will just be better ok never mind they look like pretty good apps yeahhhh hmm maybe we can adapt ours a lil to add something extra like something with running form had been talked about but idk if an apple watch could track motion like that mine was the highlighted idea you can see the little comments me ari eli and jerry (i think?) left after our discussion but maybe if you explained the idea more we could go with that? But honestly that idea sounds more useful and unique so i like it ig yall right it is really hard to track movements https://venturebeat.com/2020/08/27/move-ai-enables-motion-capture-without-the-hassle-for-video-game-production/ i just skimmed it but that seems to be talking about whole body motion, maybe there is a way to simplify it and just look at specific joints? Possibly im not sur
- We can use this as our demo



https://www.youtube.com/watch?v=PWV14l1pplY
Its called “Markerless 3D motion analysis” https://www.youtube.com/watch?v=l8_ZpU5Xew0

- The normal way for movies and stuff is the reflective whhite dots, this is the alternative. Seems to complicated for us to pursue yeah it uses the silhouettes https://github.com/lambdaloop/anipose

Terminology seems to be ‘motion capture’ for this idea of tracking joints: https://en.wikipedia.org/wiki/Motion_capture like how feasible would it be to code something if we used the reflective tape and vision code to track motion cause that came up but none of us last sunday knew enough about it
Sounds hard cuz its in 3d anything in 3d sounds hard hm unless we split it up from two angles and made two different axis like one from the front and one from the back but honestly like it might not be worth it to go that hard ewww research

how else can form be tracked

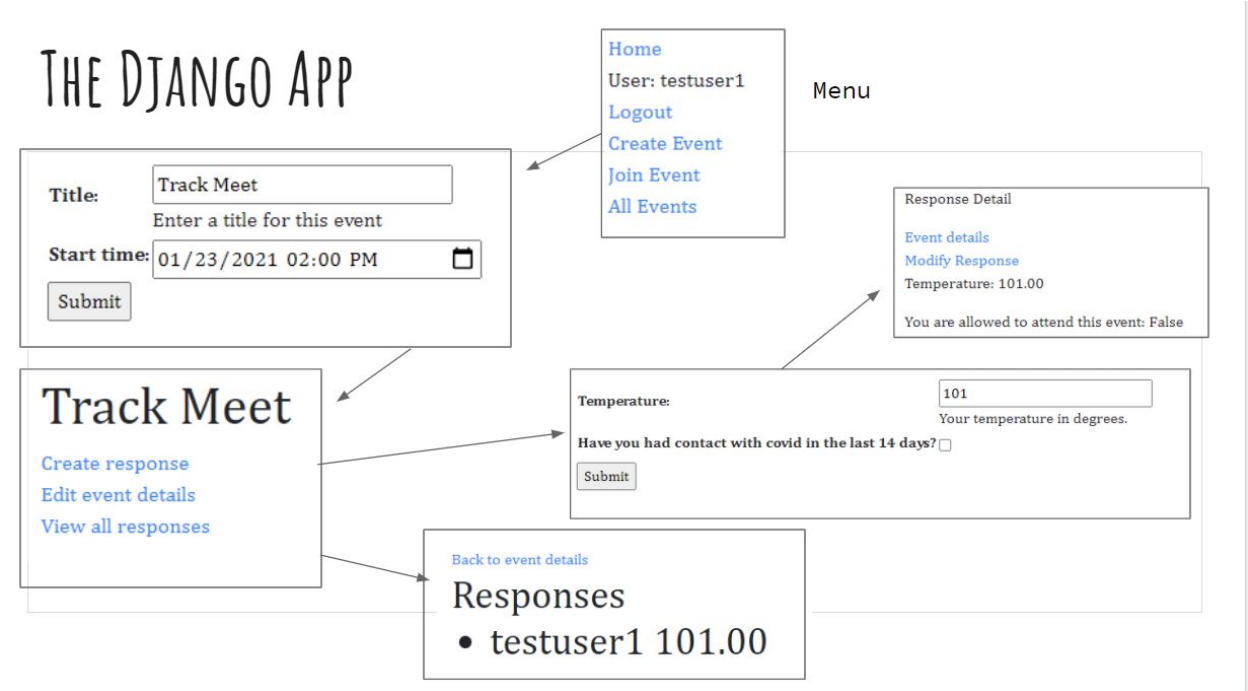
just dance that could be used by older people or something to follow a yoga routine or a dance or a simple workout but just that idea that we could do that kind of motion capture maybe
Maybe make a vest out of retroreflective tape that could be worn by the user so they would be able to see themselves on a bigger screen next to a lead video that could be doing anything. It would be cool to add feedback about form or something to how they're moving

use an xbox kinect for some of this, since it has distance sensing basically OP ultrasonic so that might be worth looking into
But yeah that does seem to have leg and hip tracking

Maybe we could somehow utilize wii motion sensors?
https://hexus.net/tech/tech-explained/peripherals/19458-motion-sensing-game-controllers-explained/?page=2

https://www.un.org/development/desa/dspd/2020/05/covid-19-sport/
Covid on Sports

- **TLDR; we could create a COVID-related solution and say that it helps sports**
- **So in my opinion there are two main directions like making in-person sports safe, promoting activity at home with a game or smth**



- Technically you could spin something COVID-related as working for this too because covid has had a big impact on sports
- https://www.consumerreports.org/cell-phones-services/running-apps-for-music-lovers/

Old Brainstorming:

- Increasing accessibility for people with disabilities
    - Working on user interface design (of something, ie a video game because maybe that could loosely be about movement. Since FIRST claims to be like a sport I think we could make the argument)
        - **Game controller for the blind??**
    - **Making a robotic arm that could allow someone who wouldn't normally be able to throw a frisbee and play disc golf**
- **Tool to improve ones running, swimming or weightlifting form**
    - App would have user record self doing activity
    - Then have them place dots on relevant body parts for sport. For running, e.g. knees, hips, head
    - Motion-track the dots through movement
        - This would help the athlete see what is moving
    - IDEA BRAINSTORM:
        - Kinda unrealistic to be able to track movement
            - Putting reflective tape and using vision code
        - What type of movement are we actually tracking?

https://www.arrc.com/3-ways-technology-changed-world-sports-fitness/
Traditional areas are:

- Wearables
- Apps
- Gadgets

https://onlinemasters.ohio.edu/blog/how-technology-is-revolutionizing-sports-training/
Traditional areas of innovation:

- Tracking Performance
- **Perfecting Athletic Movements**
- Enhancing Communication
- **Eliminating Injuries**

Another idea: allowing previously incapable motion

https://www.forbes.com/sites/cognitiveworld/2019/03/15/heres-how-ai-will-change-the-world-of-sports/?sh=6e04f7d7556b
AI in sports:

- Training and performance analysis
- Scouting and recruitment
- Maintaining player health - predict injuries before they happen

-

Play/Move

- Some robotic aid to play a sport / do something
    - Someone with a disability broke their arm, how will they play frisbee!!!

Physical Health goals:

- Obvious things that come to mind are fitness trackers
    - Food intake, weightlifting progression, running tracker, sports stats tracker, guide to workout plans
    - aggregate data from multiple sites and display it, e.g. swimming / running times

Mental Health goals:

- https://www.psycom.net/25-best-mental-health-apps

https://www.rockmyrun.com/ucsd-research-study.pdf
details: http://bit.ly/1yndAve

Results

For a complete list of average/mean values and standard deviations, please refer to Appendix A. There were no significant differences in physiological measures of heart rate (HR) during exercise, HR recovery, or breathing rate (BR) across the 4 music conditions. There was also no significant difference in performance measured as speed during the 4 music trials, however, speed as calculated by total distance covered in 30 minutes approached significance. Averages, standard deviations, and confidence intervals for these performance data are shown below in Table 2.

Table 2: Speed by Music Condition (p=.122)

Music Condition	Mean Speed (m/sec)	Std. Deviation	Mean Speed (mi/hour)	95% Confidence Interval	
				Lower Bound	Upper Bound
No Music	2.972	.084	6.65	2.791	3.154
Standard Playlists	2.971	.077	6.65	2.804	3.139
Optimized Playlist	3.050	.090	6.82	2.856	3.244
Adaptive Playlist	3.021	.073	6.76	2.864	3.179

We found a significant difference on the IMI and three of its four subscales, including Interest/Enjoyment, Perceived Competence and Perceived Choice. Additionally, the IMI's Pressure/Tension subscale approached significance. POMS composite scores were not significantly different, but the vigor subscale did show a significant difference with higher scores observed in the optimized Static BPM compared to standard playlists. Near significance was also observed for the fatigue subscale of the POMS. There was no significant difference between music conditions for the FSS, whereas the Challenge/Skill Balance approached significance.

Table 3 shows the confidence intervals of the differences between specific conditions that were statistically significant. For a complete list of average/mean values and standard deviations, please refer to Appendix A.

Table 3 Conditional Differences

Scale	Condition	P value	Total Possible	CI low	CI high
IMI (Total)	3>2	.024	154	2.1	35.7
IMI (Interest/Enjoyment)	3>1, 3>2, 3>4	.032 .014 .029	49	0.5 1.03 0.2	14.2 10.8 5.5
IMI (Perceived Competence)	3>2	.035	35	0.3	9.7
IMI (Perceived Choice)	3>2	.026	35	0.5	9.5
POMS (Vigor)	3>2	.027	35	0.5	9.5

IMI=Intrinsic Motivation Inventory;
CI=Confidence Interval;
Condition 1= No music; Condition 2=Standard Playlists, Condition 3= Optomized Static BPM; Condition 4=My Beat Adaptive BPM.