E4: Run With It

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Problem Statement



Running with a phone a **hassle**

Running with music that is too fast or too slow an **interference**

Manually matching music to an unknown pace **NOT** feasible

Solution

Run with **JUST** a watch

Run with music that MATCHES your pace

Run with **ANY** music of your **CHOICE**



Process Diagram

Song Choice, Steps

Warped Music



Accelerometer Data

Runner Pace

Step Detection Algorithm

Song, Pace, Start Time

Warped Music

Time-warping Algorithm

Solution Approach

Phone/Watch App	Time-Warping Algorithm	Step Detection Algorithm				
 Android Studio Default list of music tagged with tempos 	Wavelet TransformPlan B:Phase Vocoder	 Parse accelerometer data Try built-in step detector function 				

Design Requirements & Specifications

- Step detection of at least 95% accuracy
- Music will begin playing within 250 milliseconds after button-press
- Music should be warped every 20 footsteps
- Pitch should stay accurate within 25 cents, or ¼ semitone
- Music tempo range: 95-153 BPM

Trade-offs

	Power	Ease-of-use	Comfort	Storage		
¹ Smartphone	✓	X	X	/		
² Smartwatch	X	/	✓	X		

Metrics, Testing, & Verification

- Step detection error
 - Validate smartphone accelerometer measurements with pedometer
- Time between tempo updates
 - Real-time feedback every 20 footsteps
- Pitch changing annoyance
 - Range of +/- ¼ semitone relative to the original music
- Pace and tempo difference
 - Maximum music tempo: 150 BPM

Challenges

- Artifacts from time-warping music
- Smartwatch and phone compatibility
 - Different GUIs
 - Different accelerometers
- Processing music quickly to allow for seamless warping & real-time feedback

Risk Mitigation

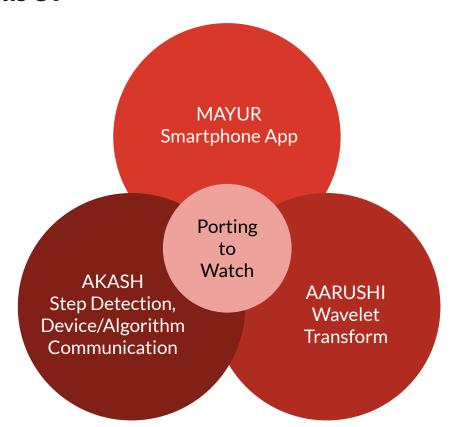
Wavelet Transform has undesirable properties

Android step detector is inaccurate

Compute accelerometer data with an attached sensor

Complete music processing on a phone

Division of Labor



GANTT CHART

Spring 2020	Aarushi		Akash		Mayur :		Aarushi + Akash		Akash + Mayur		Aarushi + Mayur		Everyone		l .
	1/27/2020	2/3/2020	2/10/2020	2/17/2020	2/24/2020	3/2/2020	3/9/2020	3/16/2020	3/23/2020	3/30/2020	4/6/2020	4/13/2020	4/20/2020	4/27/2020	5/4/2020
TASK TITLE	Wk 0	Wk1	Wk 2	Wk3	Wk4	Wk 5	Wk 6	Wk7	Wk 8	Wk 9	Wk 10	Wk 11	Wk 12	Wk 13	Wk 14
Preliminary Testing and Design															
Work on Proposal Presentation															
Rehearse Presentation															
Order Pedometer															
Investigate how to Extract Step Count															
Test Phone's Built-in Step Counter															
Running Music Research															
Smartwatch Power Investigation															
Wavelet & Artifact Research															
Work on Design Presentation			- 1												
Rehearse Design Presentation															
Individual Area Implementations		ĺ										12			
Implement Pace Detection															
Implement Wavelet Transform					i i										
Create Splashscreen for App															
Shuffle Play Music on App															
SPRING BREAK															
Integration/Porting															
Integrate Step detection with Phone App								10							
Integrate Warping with Phone Music															
Design UI for Watch															
Port Accelerometer Code											,				
Port Rest of Code															
Slack 1															
Miscellaneous & Testing															
Benchmark Testing															
Compose/Rehearse Final Presentation															
Slack 2															
Demo Day															