Sonic Pinwheel

## An Interactive Web Instrument Symphony

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CCRMA Master's Capstone Presentation (2024)

Sonic Pinwheel

- Browser-based wind instrument built with Web Audio & WebChucK
  - Blow into your microphone or use allow ambient sound to "blow" Sonic Pinwheel
- Instrument, Installation, Experience, Symphony, Score, a Web-app, a perpetual machine…

Select an instrument   Chimes
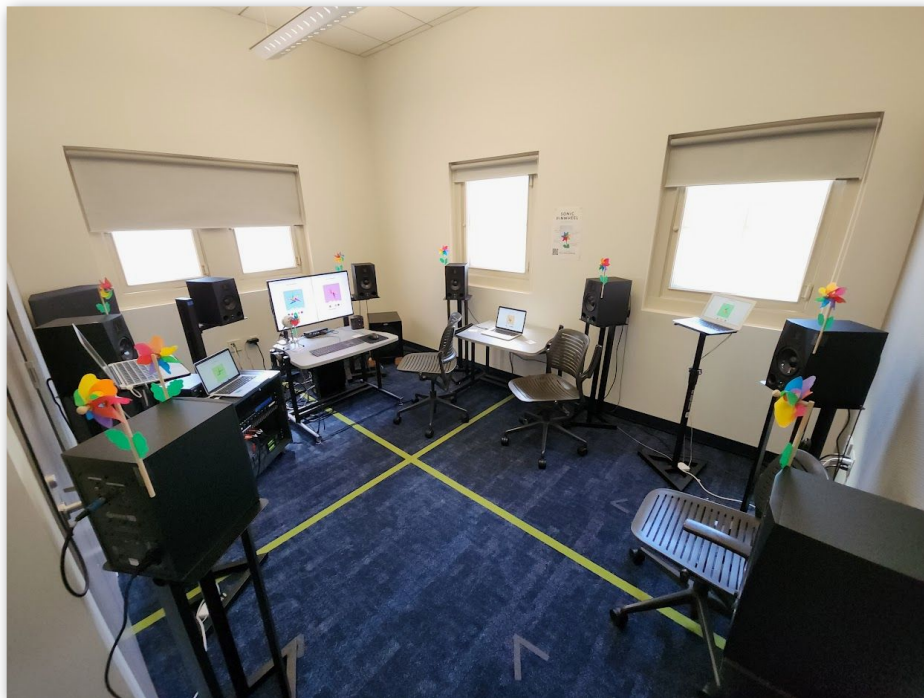
440.00 Hz   0.00 dB
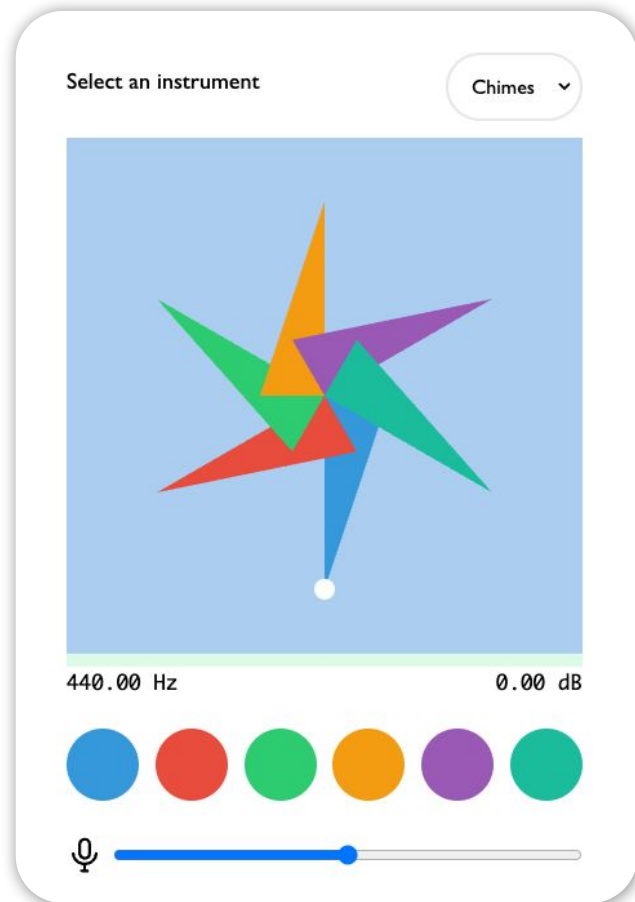
Live Demo

bit.ly/sonic-pinwheel

Sonic Pinwheel - Installation

CCRMA 50th Year Anniversary
Open House

- 5 Apple computers
- 6 Pinwheels
- 8 speakers
- + individual mobile devices

Video

Sonic Pinwheel - Symphony & Score

Instrument	wind.ck	chimes.ck	bamboo.ck	bass.ck	voice.ck	drift.ck
Role	Chordal Harmony Pads	Percussion Improvisation	Textured Percussion	Bass	Solo	Pentatonic Rhythmic Meter
Synthesis Notes	4 SinOsc (chord) + Modulated Noise (wind)	Modal Bar (STK) + Additive Synthesis	PhiSEM Shaker (STK)	2 SawOsc (Bass & Sub)	Continuous SinOsc + Noise (BPF Formant)	8 voice chorus (Saw + Tri), Analog LFO frequency drift
Driven	Score Driven	Score Driven + Stochastic Memory	Pitch Tracking & Feedback	Score Driven	Pitch Tracking (Quantized) & Feedback	Score Driven + Stochastic

Pseudo-network Synchronization

Pinwheels share a time-based score to play together

Each Pinwheel is synchronized to UTC time (system time)

Strong time synchronization is maintained by ChucK

Pseudo-network Synchronization (cont)

00:00   00:10

UTC: 00:00

(MM:SS)

Pseudo-network Synchronization (cont)

00:00   00:10

"Start"   P1

UTC: 00:02

(MM:SS)

Pseudo-network Synchronization (cont)

00:00   00:10

"Sync"

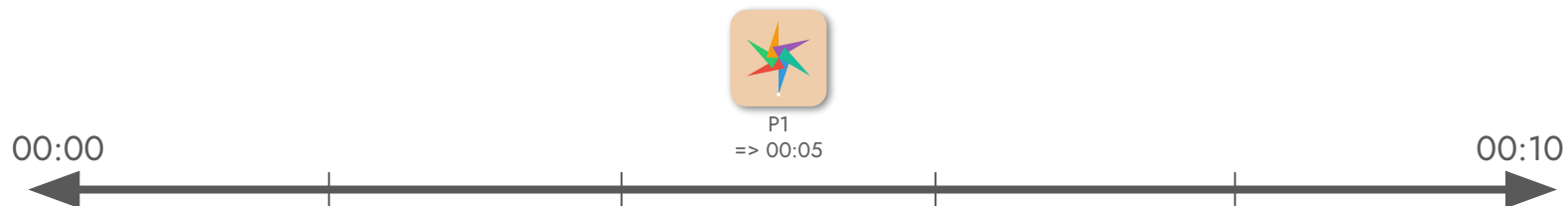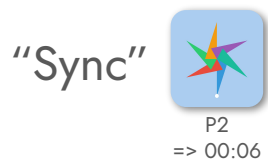P1
=> 00:03

UTC: 00:03

(MM:SS)

Pseudo-network Synchronization (cont)

melody 1

P1
=> 00:03

00:00

00:10

UTC: 00:03

(MM:SS)

Pseudo-network Synchronization (cont)

00:00

P1
=> 00:04

00:10

UTC: 00:04

(MM:SS)

Pseudo-network Synchronization (cont)

00:00

P1
=> 00:05

00:10

"Start"

P2

UTC: 00:05

(MM:SS)

Pseudo-network Synchronization (cont)

00:00

P1
=> 00:06

00:10

"Sync"

P2
=> 00:06

UTC: 00:06

(MM:SS)

Pseudo-network Synchronization (cont)

00:00

P1
=> 00:06

P2
=> 00:06

chord 1

00:10

UTC: 00:06

(MM:SS)

Pseudo-network Synchronization (cont)

00:00

P1
=> 00:07

00:10

P2
=> 00:07
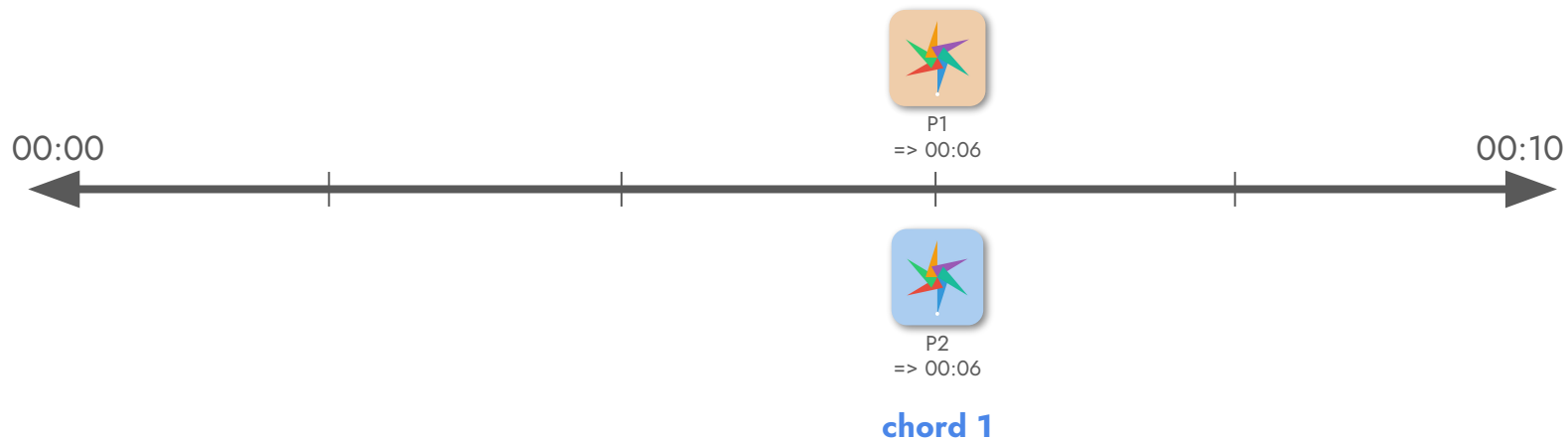
UTC: 00:07

(MM:SS)

Pseudo-network Synchronization (cont)

melody change!

00:00

00:10

P1
=> 00:08

P2
=> 00:08

chord change!
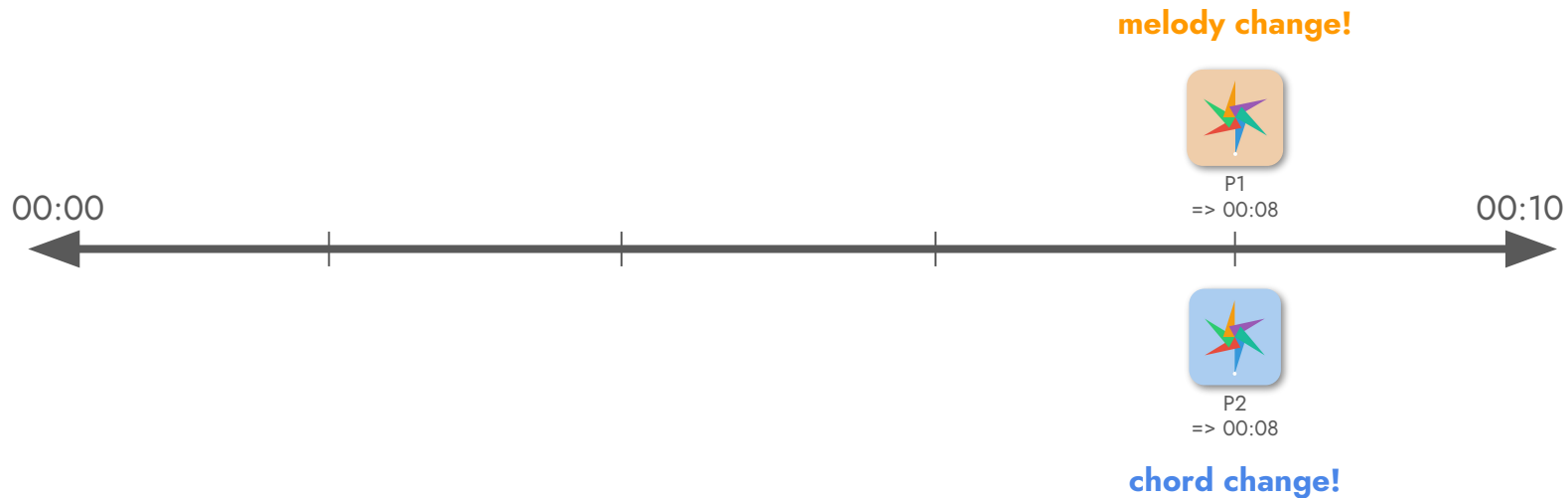
UTC: 00:08

(MM:SS)

How accurately can we keep time?

How accurately can we keep time?

- What happens if the Pinwheel (WebChucK) loses time?
  - Refresh the page
  - Pinwheel will re-synchronize with your system time
- Is your system time accurate?
- How accurate do two devices need to be?

Time.is

Computer 1

Computer 2

The Atomic Clock and Network Time Protocol (NTP)

Atomic Clocks keep accurate time (Stratum 0)

Network Time Protocol ensures that devices synchronize time accurately

- `time.apple.com` is a Stratum 1 time server
- Apple devices operate at Stratum 2*
- WebChucK syncs with device on "Start"
  - Sonic Pinwheel runs at Stratum 3
- **Pinwheel: <20ms time difference**

Image: https://www.ntp-zeit.de/index-en.htm
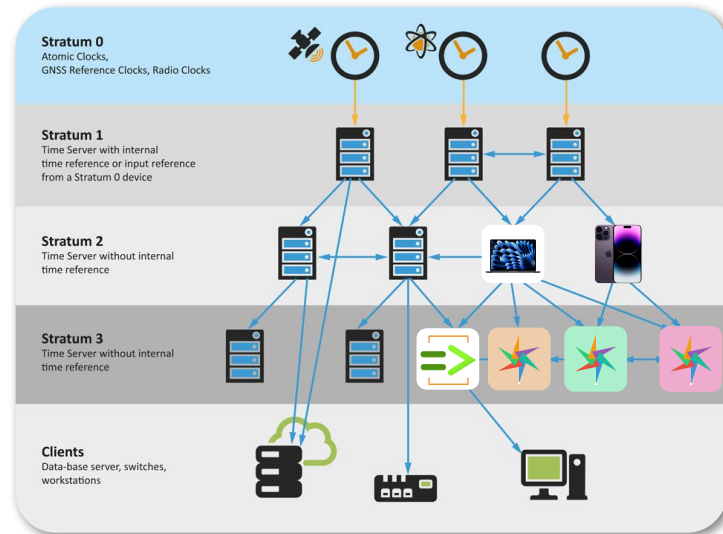
*can also be Stratum 3 depending on geolocation

NTP: Link
Apple Time Servers: Link

D. L. Mills, "Internet time synchronization: the network time protocol," in IEEE Transactions on Communications, vol. 39, no. 10, pp. 1482-1493, Oct. 1991, doi: 10.1109/26.103043.

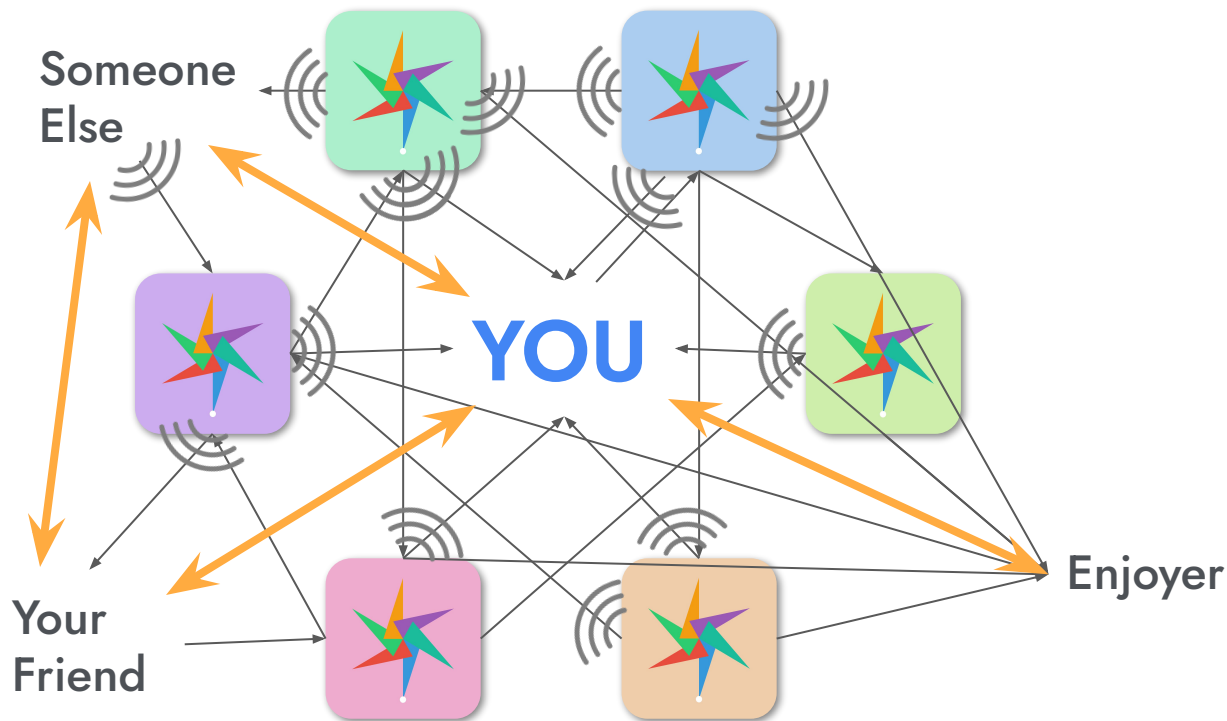# Who needs accurate time anyways

¯_(ツ)_/¯

You play the Sonic Pinwheel

You are the performer. You are also the audience.

Time synchronization simply provides a framework for structure and score. It doesn't need to be perfect.

Interactive Feedback Web

Sonic Pinwheel - Takeaways

- Sonic Pinwheel is a simple instrument
  - Easy to play—just blow on a pinwheel
  - Strength in numbers, community of pinwheels
- Discover, interact, and play with sound
  - Technical complexity is abstracted away yet transparent to explore
  - Make music, sonify the world, create calm, share calm
  - Create something with others, find something for yourself
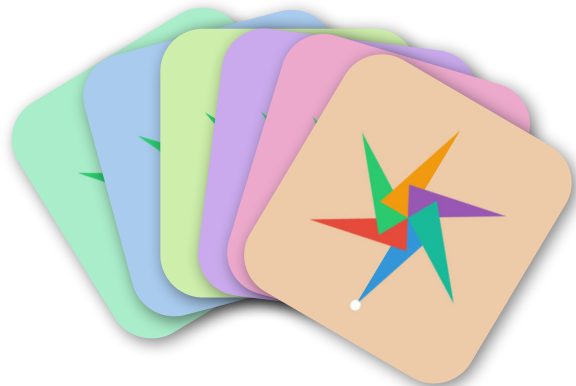
Special Thanks

Thank you to Patricia Alessandrini, Jonathan Berger, Ge Wang, Hongchan Choi, Hans Kretz, Chris Chafe and many more for inspiring, supporting, challenging me during my time at CCRMA

Pockets of CCRMA: CKC, WARE, & SNE :D

Thank You!

Take home a Sonic Pinwheel!

bit.ly/sonic-pinwheel

GitHub Repo

github.com/terryzfeng/Sonic-Pinwheel