

EEC 284 Embedded Systems

American Sign Language to Speech Translator

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Deaf-Mute Population

Hearing vs. Non-Hearing Workforce and College Grad (2011)

■ Hearing ■ Non Hearing



- ❖ 9 to 22 out of every 1,000 people have a severe hearing impairment or are deaf in the United States (2011)
- ❖ Unemployment Rate:
 - ❖ No-disability: 8.8%
 - ❖ With disability: 16.1%

COMMUNICATION
BARRIER

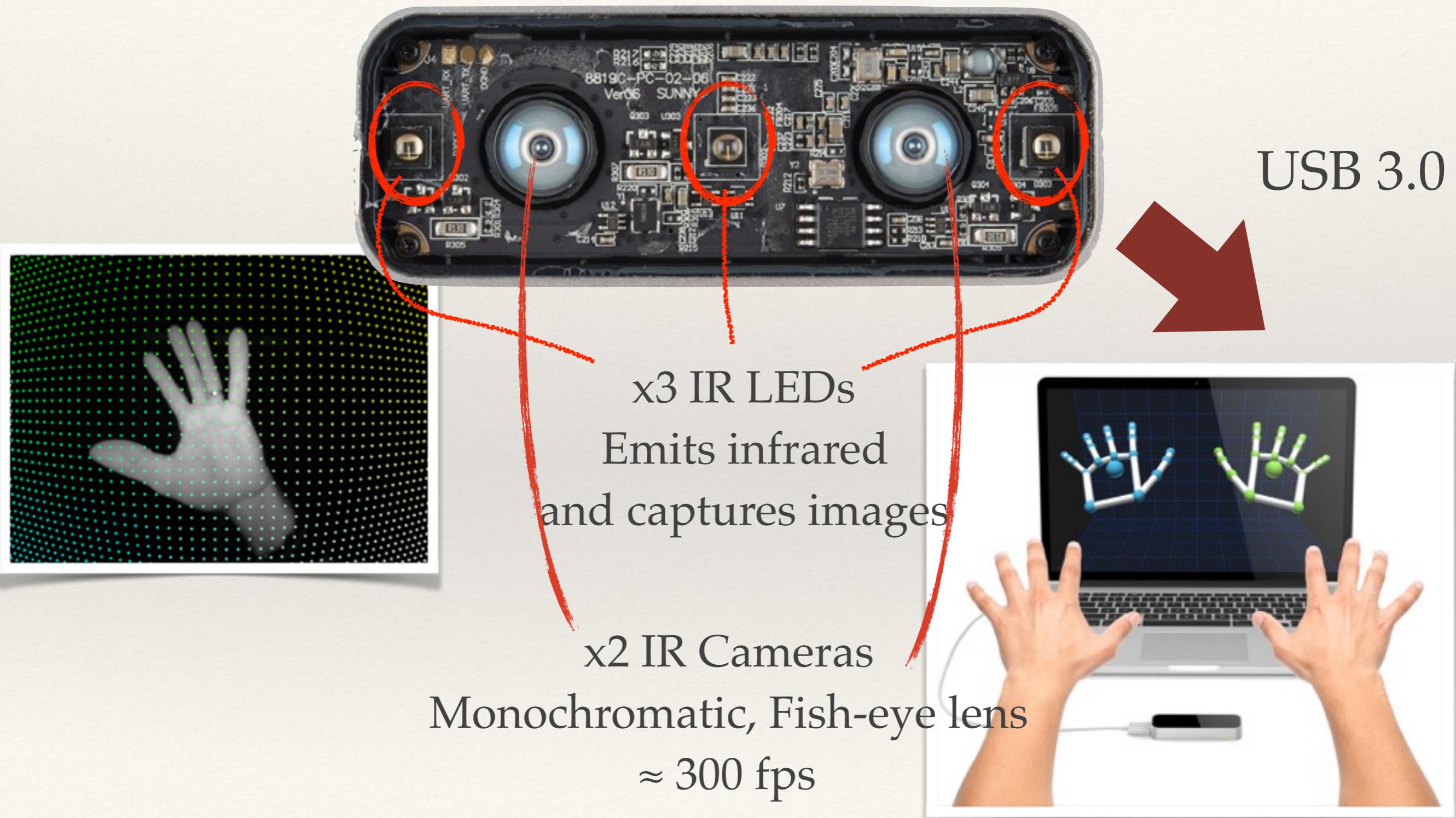
Compiled by:

Charles Reilly & Sen Qi, Gallaudet Research Institute, October 2011

Leap Motion Controller



Leap Motion Controller



Leap Motion Controller

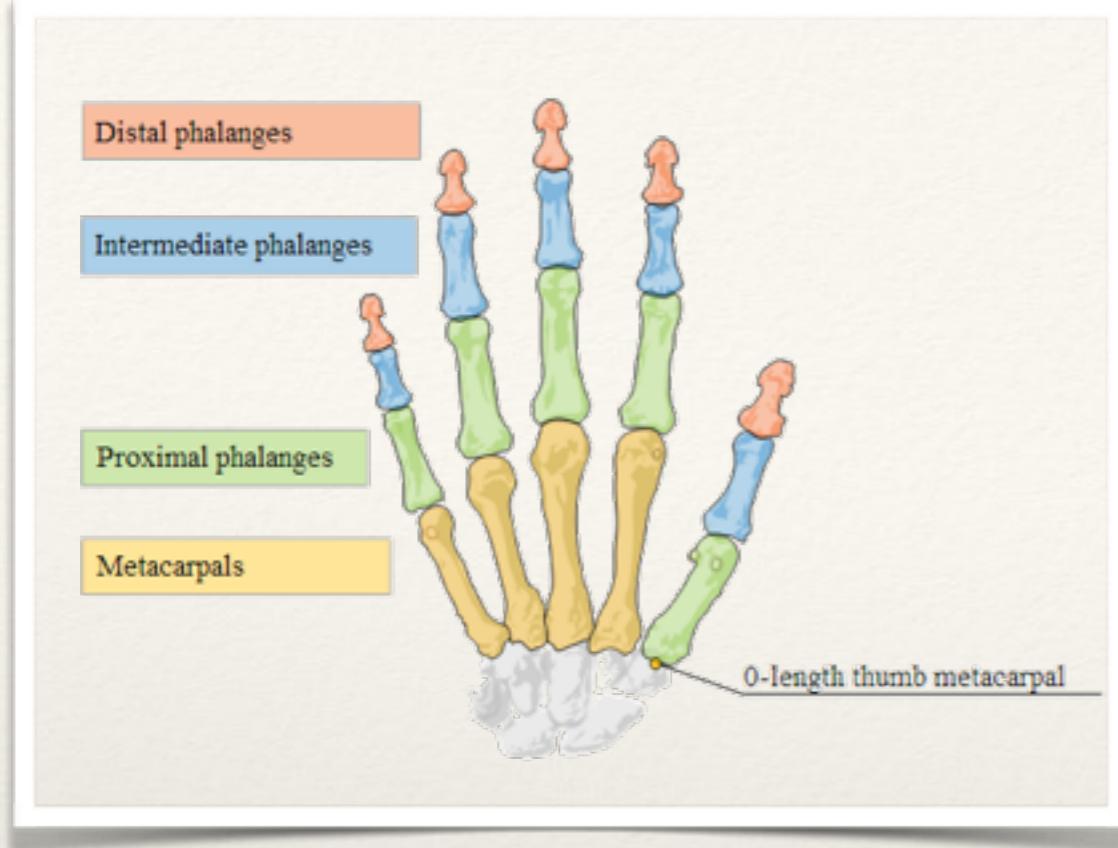
8 cm



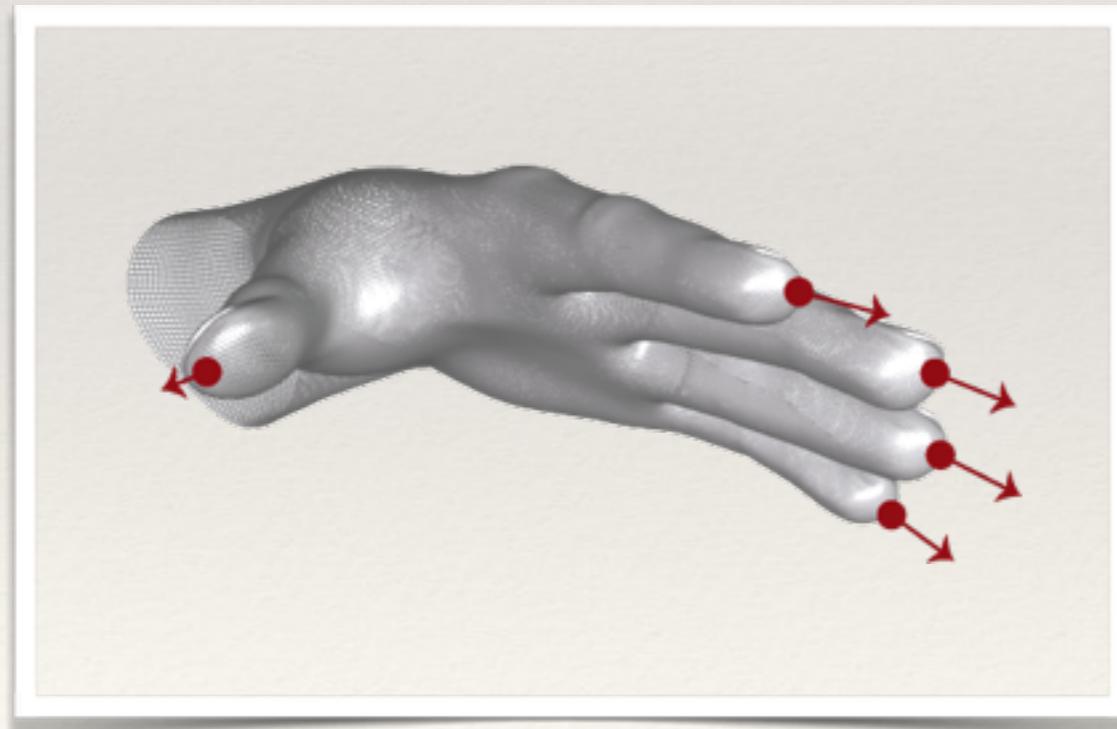
0.5 cm H

2.0 cm

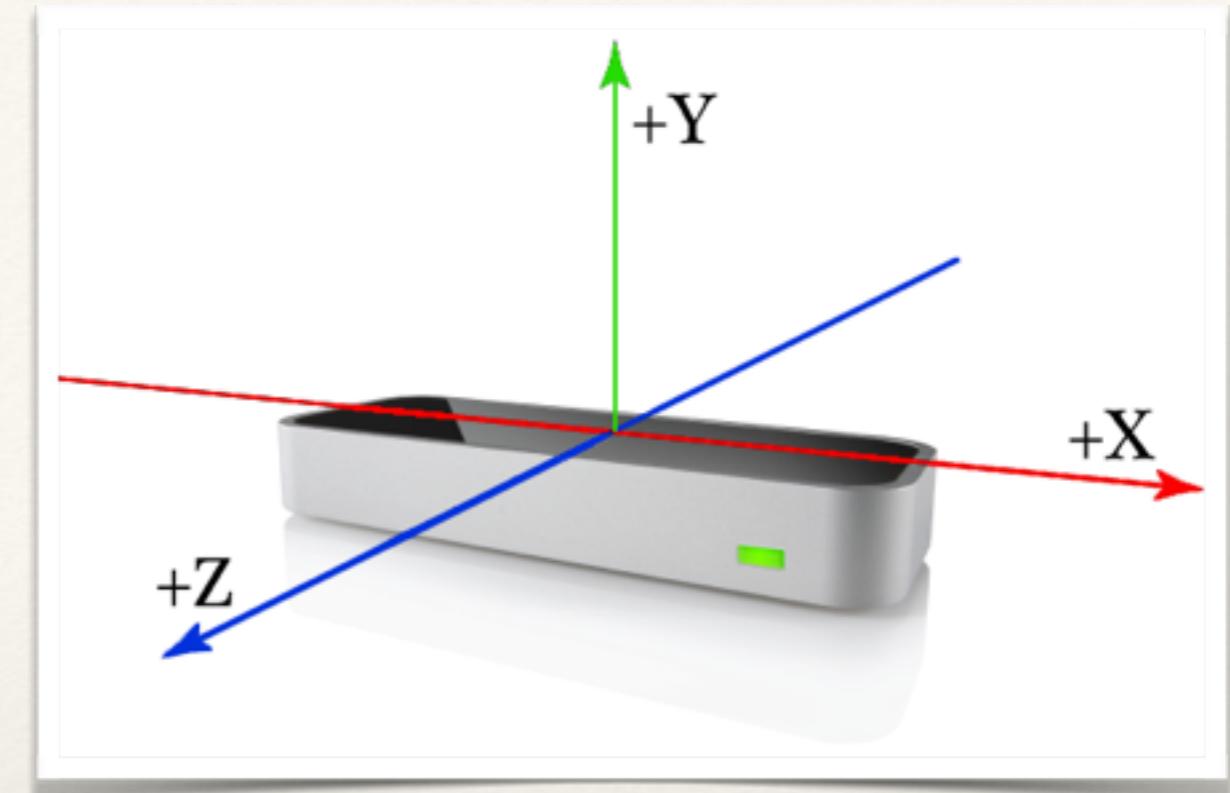
4.0 cm



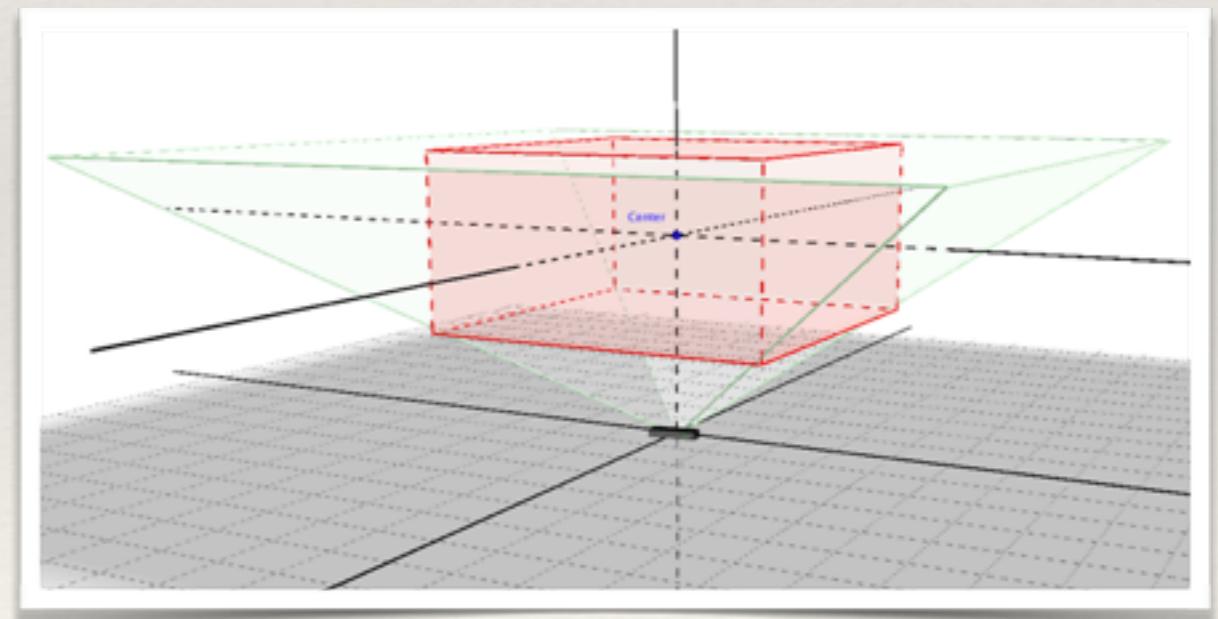
Skeletal Modeling Tracking



Vector positions and Directions



Cartesian Coordinate System



Interaction Range
vs.
Guaranteed Interaction Box

Software APIs

- ❖ C++ native backend
- ❖ Connects as a service to the OS and forwards data via PubSub.
- ❖ OpenAPIs
 - ❖ Objective-C, Java, JavaScript, Python, Unity, and C#



Text-to-Speech Translator

- ❖ **FreeTTS v1.2**
 - ❖ Speech Synthesizer written in Java.



SDF Chart



c (speed of light)

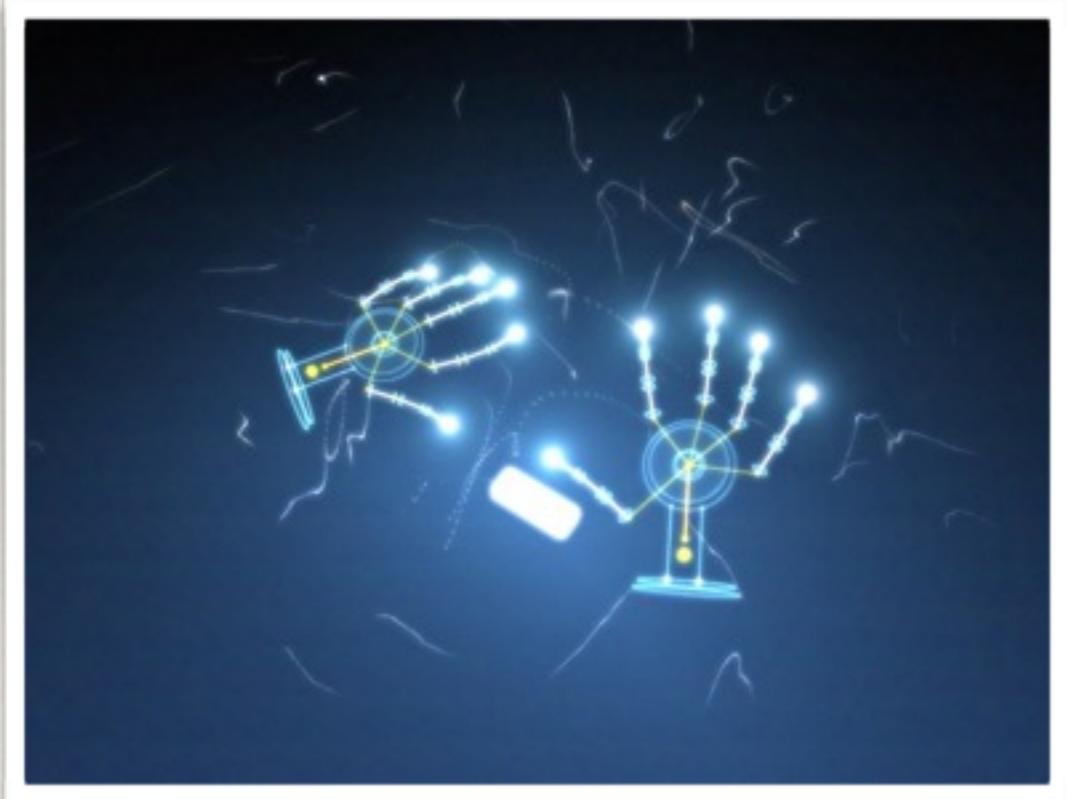


≈220 frames per second



Sync every 16 ms (62.5 Hz)

*note- modern projectors and screens at 60-120Hz refresh rates



JavaFX Visualizer

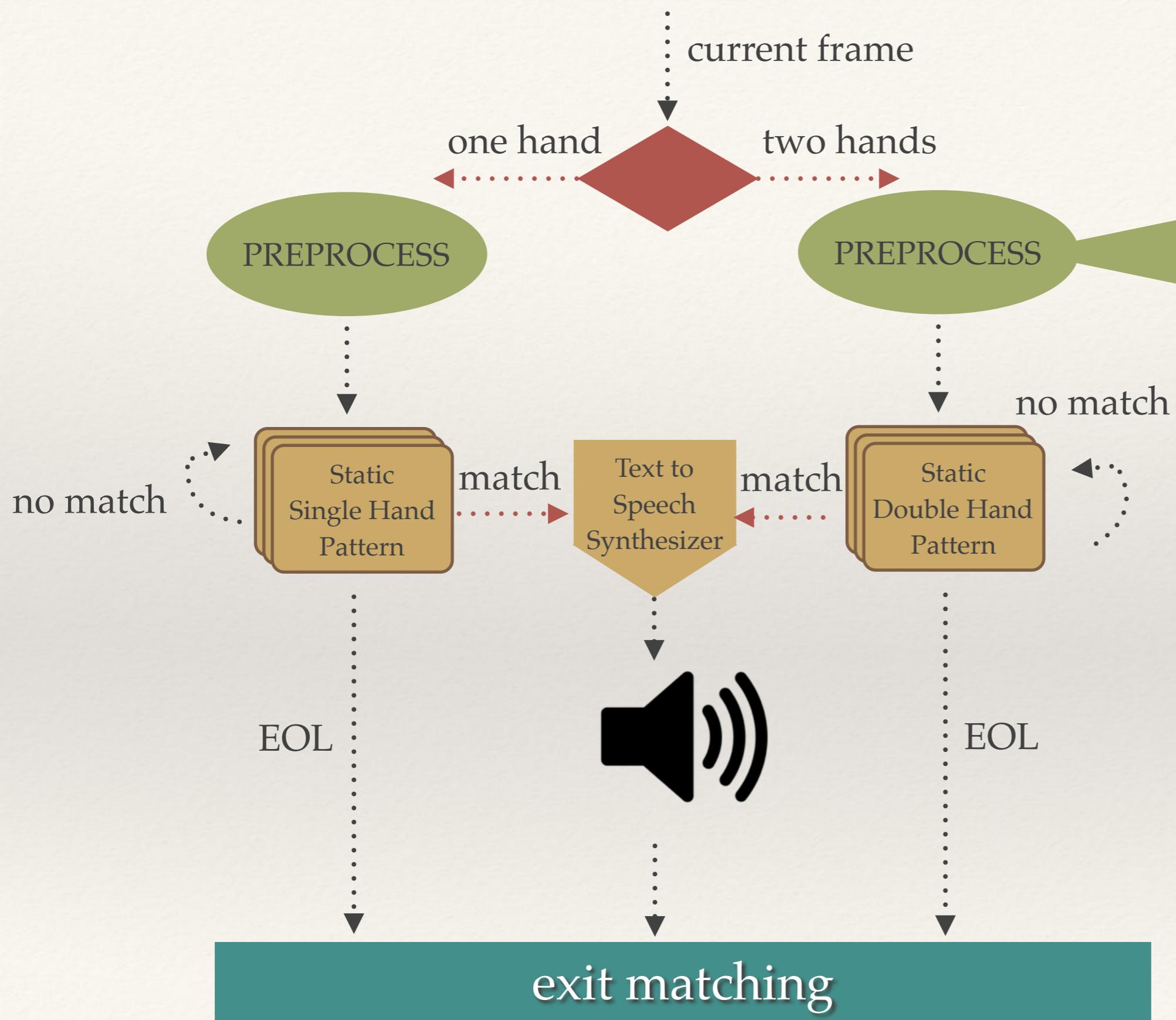


Pattern Matching Thread
Sample every $\frac{1}{2}$ second



PATTERN MATCHING

PATTERN MATCHING

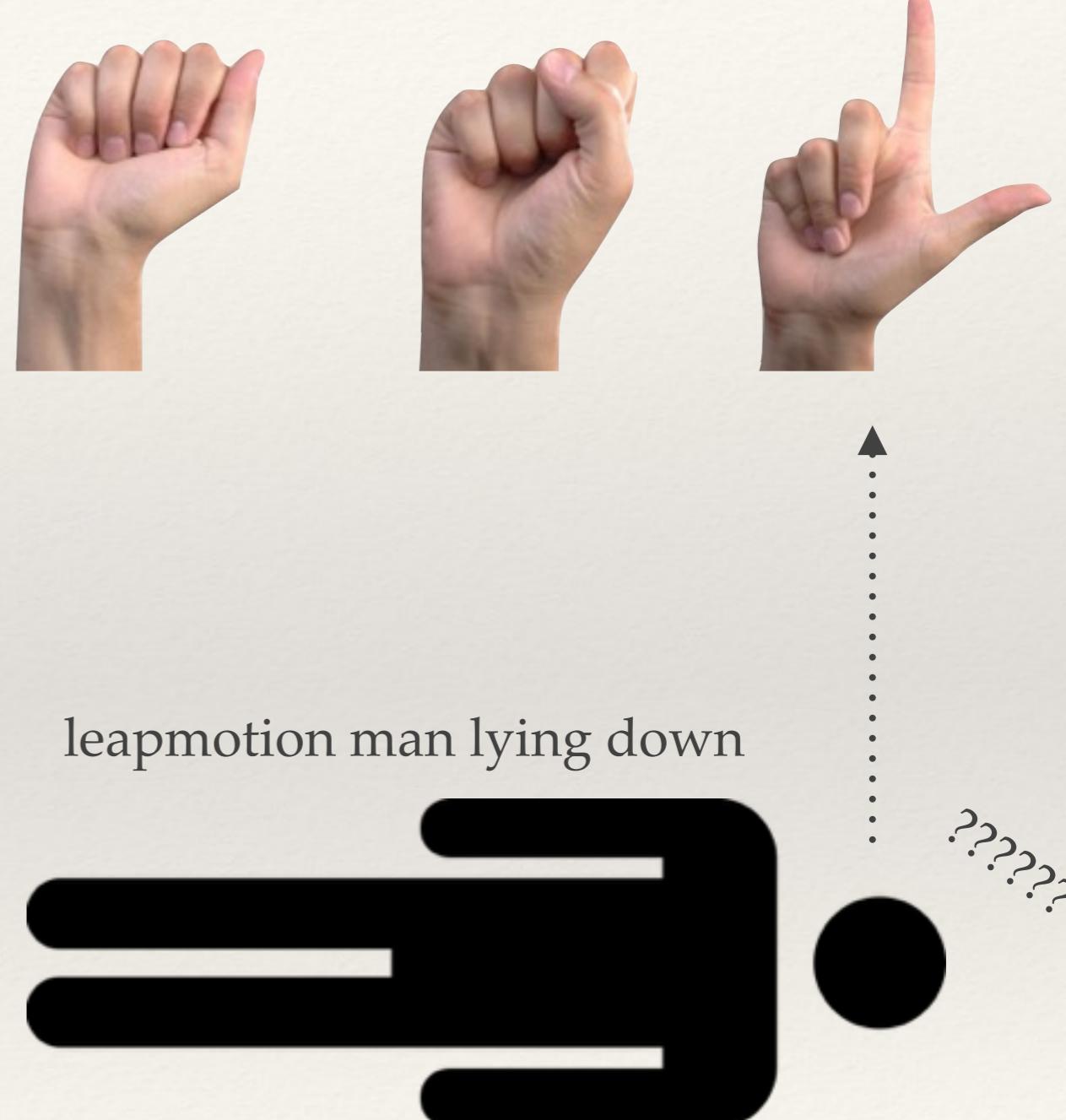


- Determine L/R Hand.
- Process fingers by type (thumb, index, etc.)
- Process roll, pitch, yaw of hands.
- Process angles from finger direction vectors to unit vectors for quick estimation.
- Create convenience methods.

****NOTE:**
lazy evaluation of angles might improve performance, but would each pattern would then add another comparison to see if already evaluated, thereby decreasing performance after some number upper bound.

Difficulties

- ❖ ASL signs with **motion**
 - ❖ tried integrating some hysteresis, with previous 100 frames, but:
 - ❖ $O(n) \rightarrow O(n^2)$
- ❖ ASL signs that involve **more than the hand (ear, head, chest, etc.)**
- ❖ Signs that **wrap other fingers (m/n)**:
 - ❖ Line of sight for hand and viewing area.
LeapMotion controller pretty much like eyes looking from bottom, whereas human would be viewing from front.
- ❖ Signs that involve **CONTEXT**.
 - ❖ i.e. - Who, what, where, when all same sign.
- ❖ **IR interference** with natural light
- ❖ **MARKETING IS ALWAYS BETTER THAN ACTUAL. Grr...**



Future Work

- ❖ LeapMotion, Inc. has been talking about integrating multiple controllers to extend the interaction area and confidence levels of finger placement in the near future.
- ❖ Virtual Reality headset.
- ❖ Would be interesting to integrate a neural networking process, to make the pattern matching more efficient by not having to go through all of the patterns.
- ❖ Encapsulate more generic gestures (fist, open palm, etc.) to allow for a quicker development time of patterns.

DEMO
(hopefully)



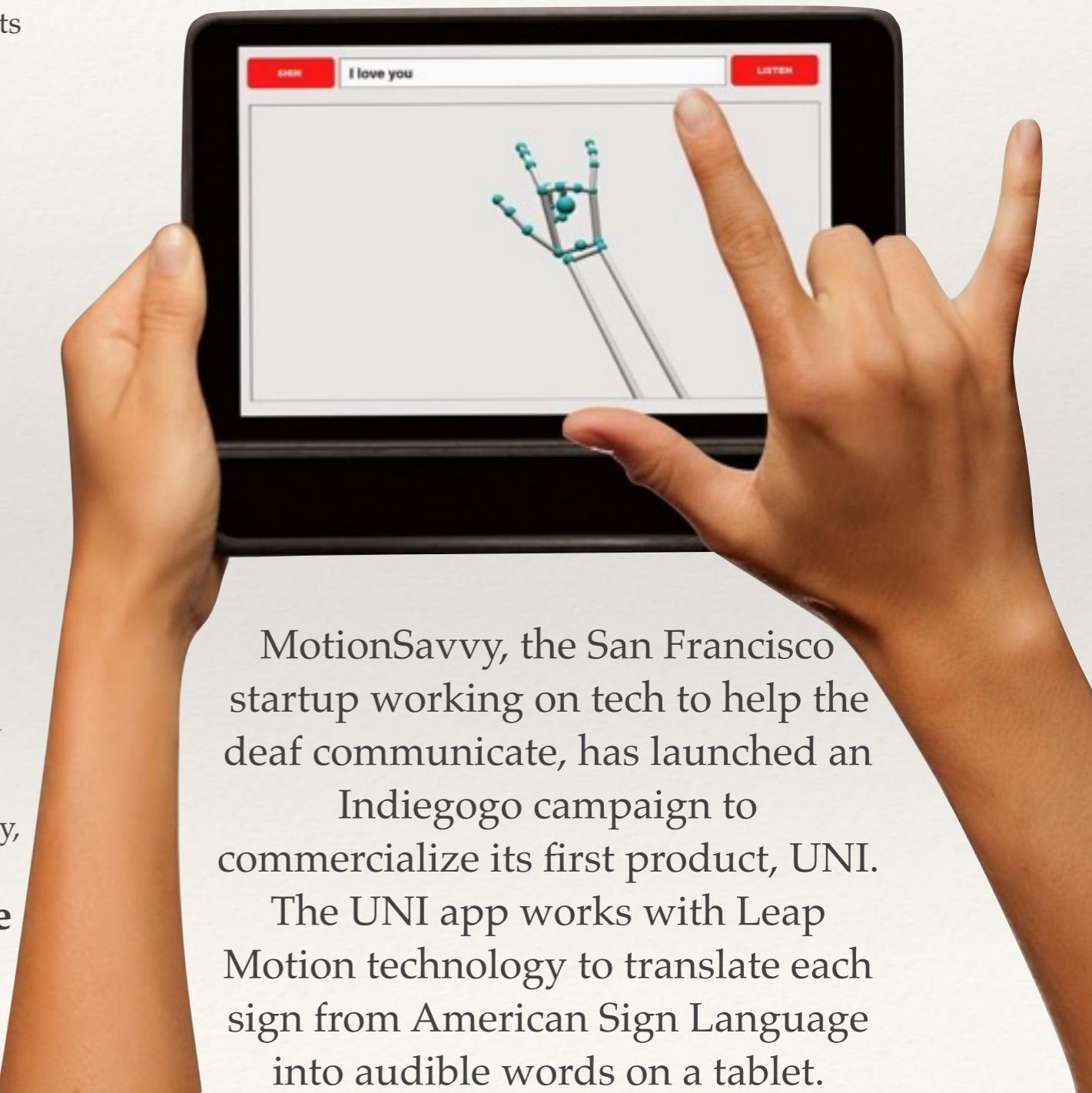
...GAH....SCOOPED....

<http://www.assistivetechnologyblog.com/2014/10/uni-device-that-converts-sign-language.html>

<http://techcrunch.com/2014/10/23/heres-a-sneak-peak-at-motionsavvys-uni-sign-language-interpretation-device/>

- ❖ **MotionSavvy** is partnering with Indiegogo to launch its pre-order campaign today, with a goal to raise \$100,000 to understand market fit and begin manufacturing. **UNI** will retail for **\$799**, but early bird pricing starts at \$499 while limited supplies last, and is expected to ship in the **Fall of 2015**. To learn more and pre-order a UNI, visit: www.motionsavvy.com.

- ❖ Translates **sign language into audible speech**: Powered by motion gesture recognition technologies, UNI translates signs into audible speech for hearing individuals.
- ❖ Converts **spoken word to written text**: Using voice recognition technology, UNI identifies audible speech and converts it to text for Deaf and Hard of Hearing individuals.
- ❖ Recognizes your signing: Every person signs a little differently, even if they sign in the same language. The smart recognition feature allows users to **train their device to recognize different gestures by adding new signs and words** to the MotionSavvy Sign Language Database.



MotionSavvy, the San Francisco startup working on tech to help the deaf communicate, has launched an Indiegogo campaign to commercialize its first product, UNI.

The UNI app works with Leap Motion technology to translate each sign from American Sign Language into audible words on a tablet.

questions???

