
Event Based Acoustic Location

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Motivation and Objectives

Project Vision: Making smart surface out of everyday flat surface

Deliverable: With a projector and some old phones, we can make touchscreen

Goals:

- Familiarize ourselves with low level code design
- Practise writing time critical code on ESP32
- Get a working sample that is cool

Technical Approach and Novelty

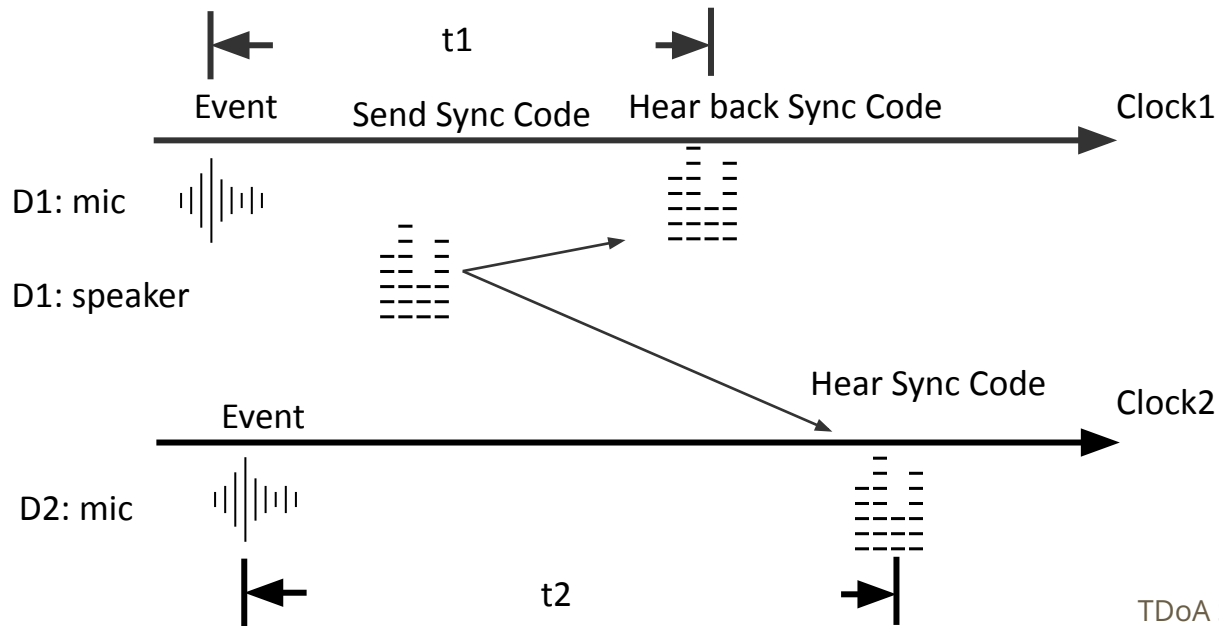
Approach: 3+ sensors timestamp touch event with different time delay, then solve for the touch location using delay information

Current approach: AoA estimation, fingerprinting, microphone array, etc.

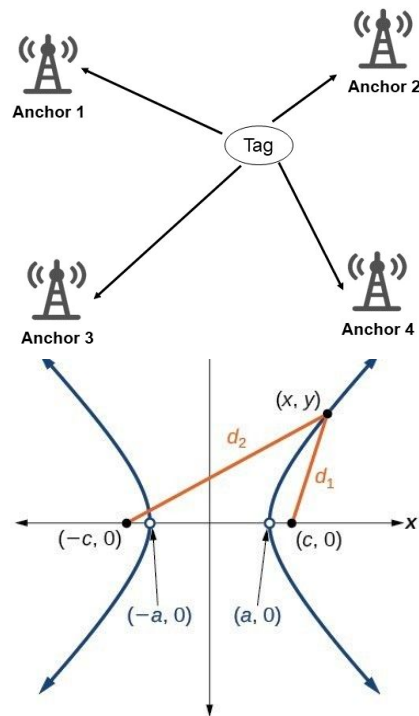
Novelty: Use a bunch of independent devices instead of one device

- Install an app on old phones to turn it into sensors
- Potential accuracy improvement from multiple sensors
- Do detection and syncing all acoustically

Methods



$$\text{Event time different } \Delta t = t1 + \frac{d_{d1,d2}}{c} - t2$$



TDoA Solving for Location:

- TDoA: Time difference of arrival
- → Distance difference for the same signal
- → Hyperbolic equation for each pair of sensors
- → Localize the event

Evaluation and Metrics

We aim at get it really working!

Evaluate 2D positioning accuracy and time synchronization accuracy using all 4 devices. Get some fancy video.

If 2D failed, fallback on measuring distance accuracy on a line and time sync between a pair of devices.

Current Status and Next Steps

Timestamping and synchronization:

- ✓ ESP32 development environment
- ✓ Speaker and microphone working together
- ✓ Waveform generator for sync sequence
 - Event timestamping
 - Sync sequence timestamping
 - In-band or out-of-band communication to host

Solving for Location:

- Simulation Correctness: max deviation < **0.5**
- Low latency: **0.03s** without graph
0.5s with graph
- Work on removing noise and determine the timestamp algorithm

