

*All that **GLITTERs**: Low-Power Spoof-Resilient Light Anchors for Augmented Reality*

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Motivating Scenario: IoT Configuration Management via AR



AR needs “Tags” To Bridge Virtual and Physical Worlds



AR Anchors/tags

Requirements Of These Tags



Compatible with
existing devices



Dynamic Environment
and Lighting



Long Range



Demonstrative
Identification

Limitations of existing work (eg. AprilTags, QR Codes)



Limited range



Easy to spoof

Our Work : GLITTER

A practical AR tag framework that can accurately link AR content in less than 400ms, using a single LED from hundreds of tags simultaneously on a standard mobile phone

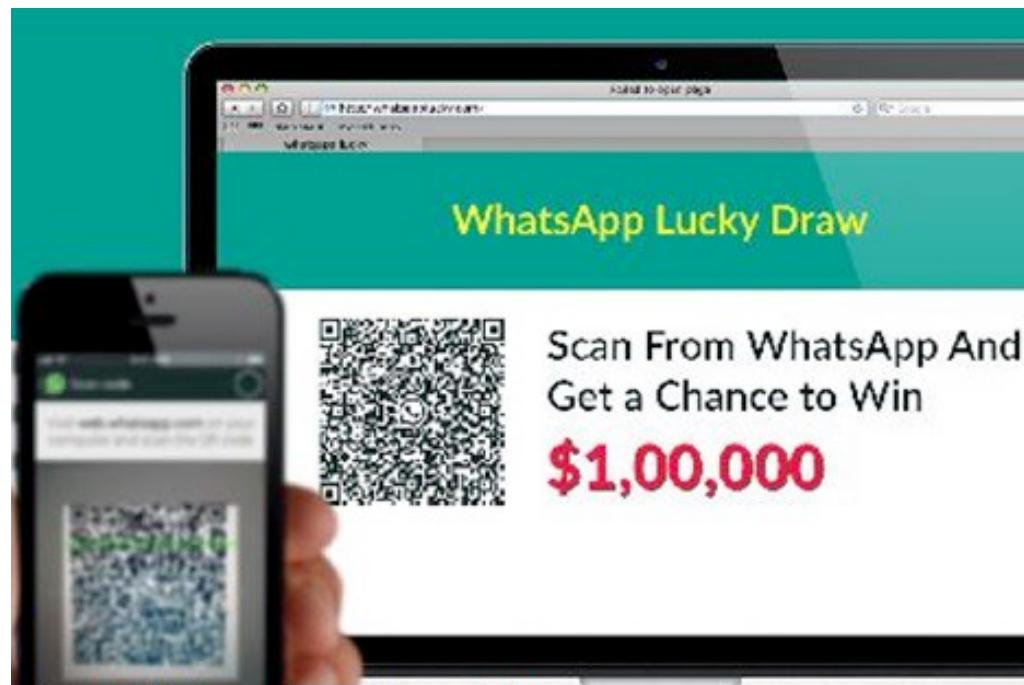
- Robust to changes in dynamic environments and lighting
- Can provide demonstrative identification
- Has a long range of 30 meters with a single 5mm LED

Key Ideas

- Active Visual Markers
- Space vs Time Trade Off
- Hybrid BLE + Visual Anchoring

Idea 1 : Active Visual Markers for Demonstrative Identification

Any static marker is vulnerable to spoofing



To make tags support Demonstrative Identification they need to at least be active instead of passive

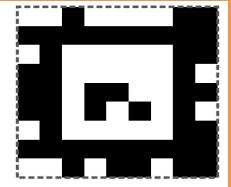
Idea 2: Temporal Encoding Instead Of Spatial For Long Range

Commodity AR devices have a limited resolution that bounds the detection range of visual markers

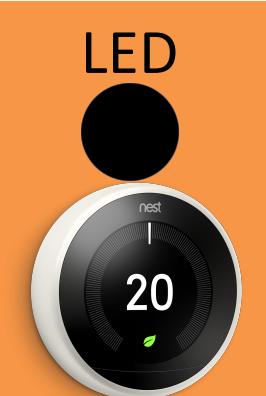
Idea 2: Temporal Encoding Instead Of Spatial For Long Range



April Tag



Idea 2: Temporal Encoding Instead Of Spatial For Long Range



Temporal encoding can achieve longer range and better dynamic lighting performance

Idea 3 : Hybrid BLE + Visual Anchoring To Handle Noisy Visual Channel

Impractical to use a device's camera as a traditional communication channel for Demonstrative Identification

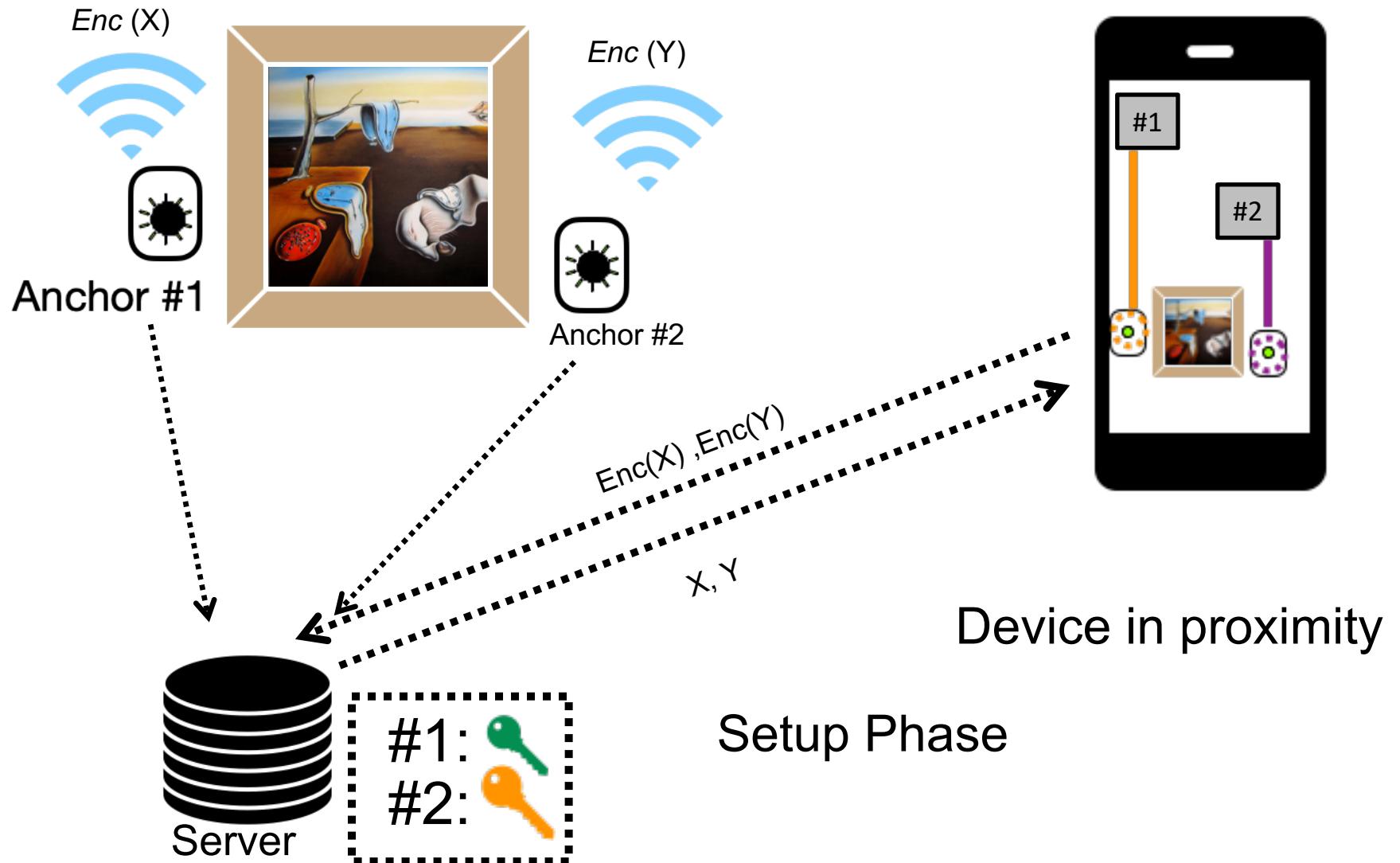
- noisy visual channel

- limitations imposed by commodity phones

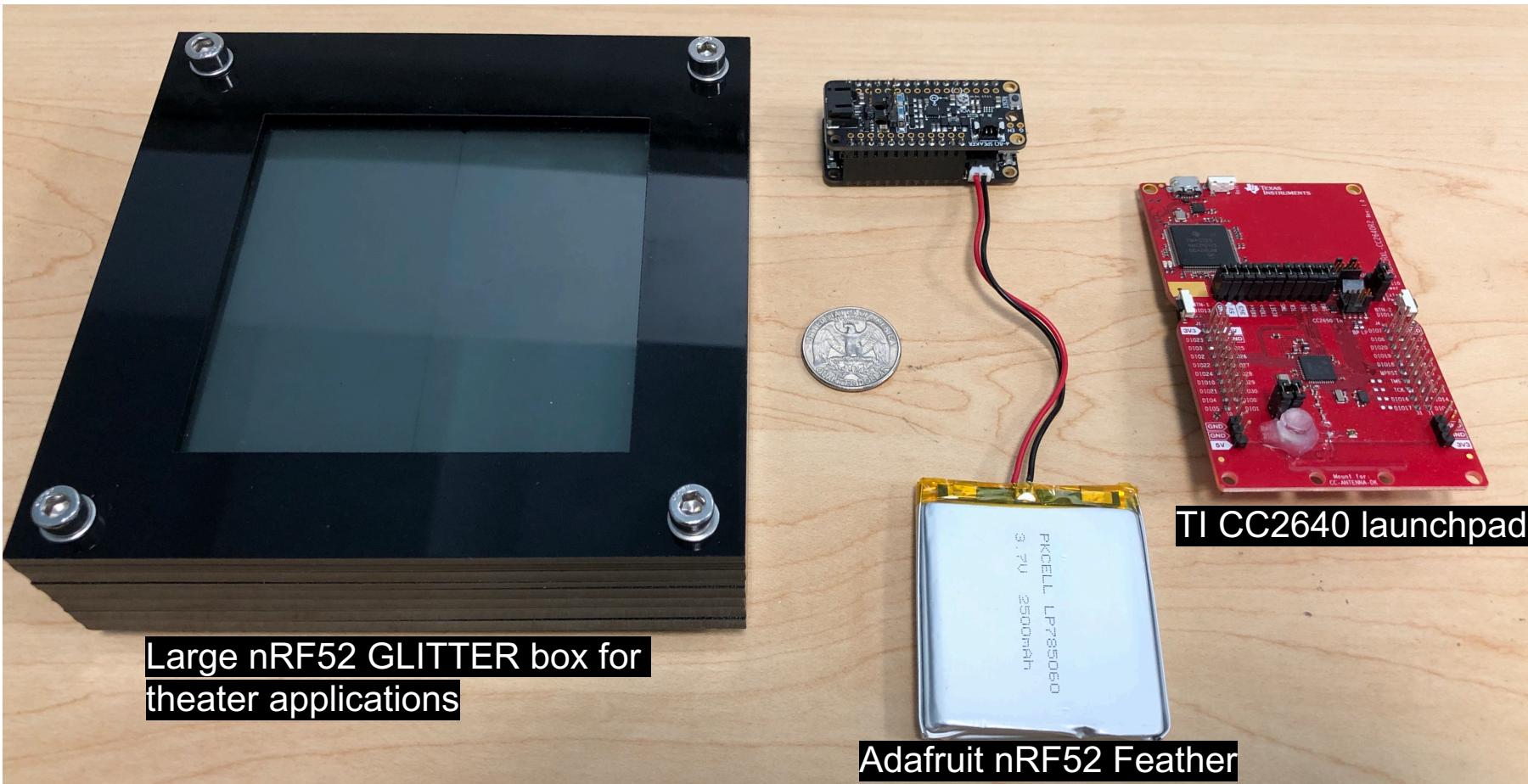


Practical Low Power Hybrid BLE + visual based communication protocol

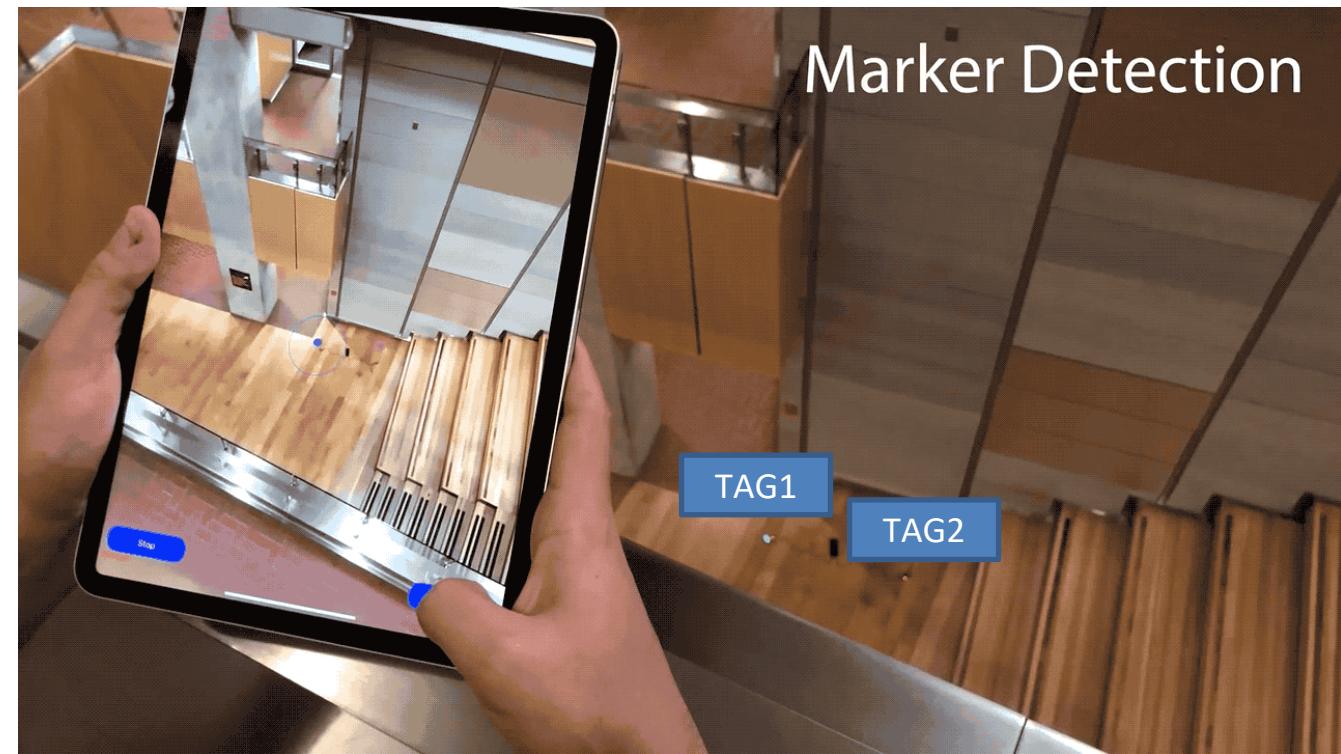
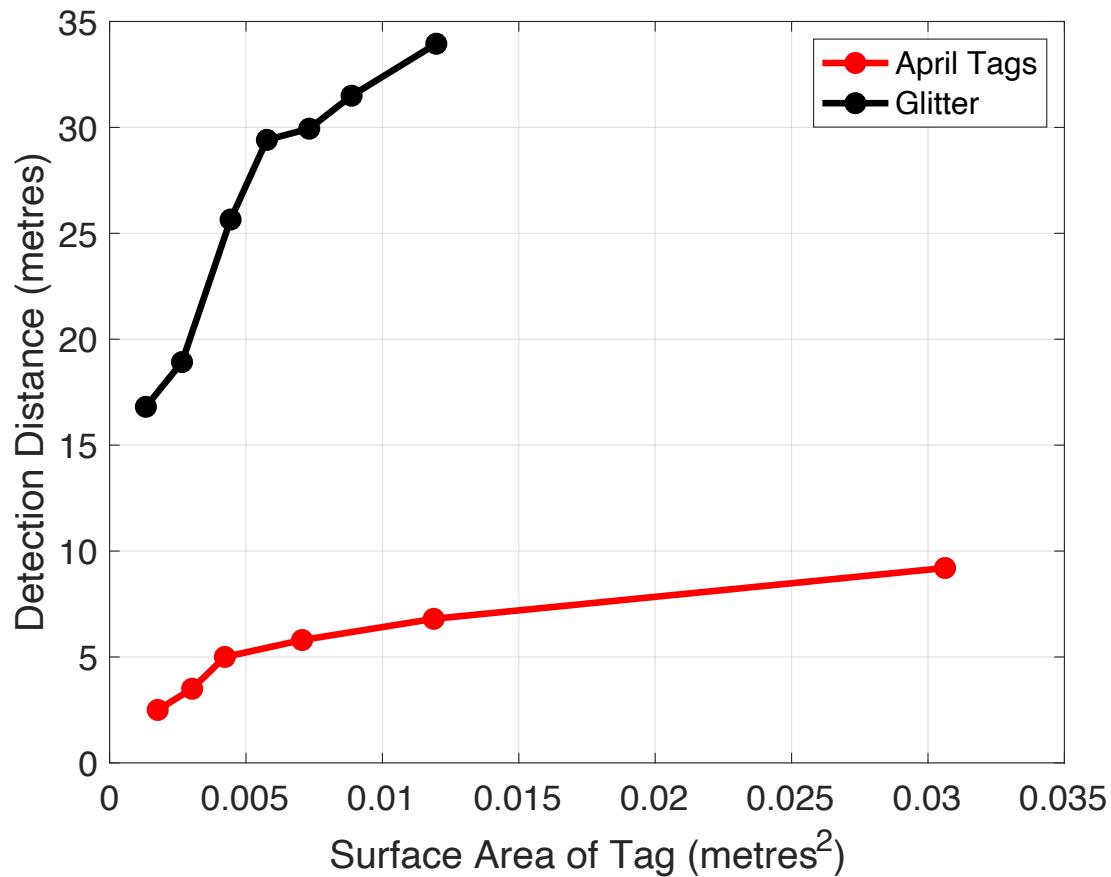
GLITTER System Overview



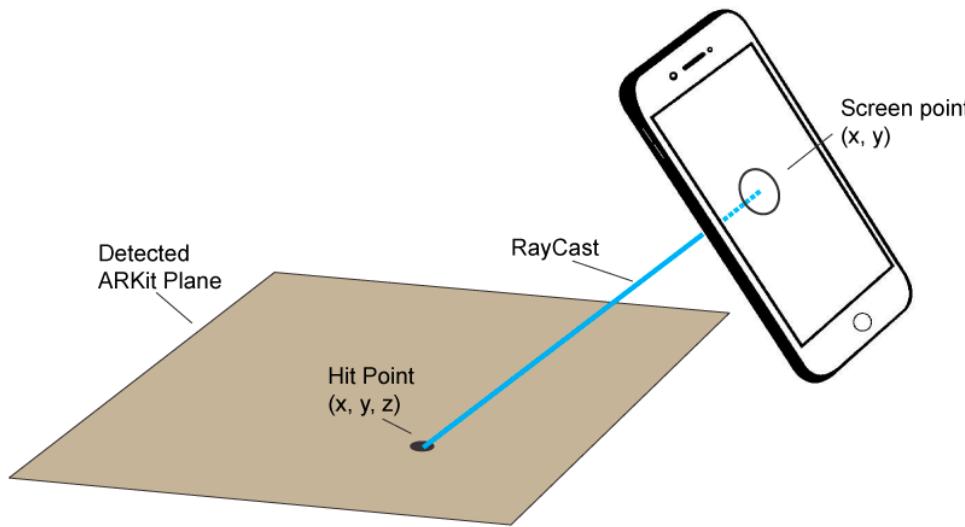
GLITTER is portable across platforms



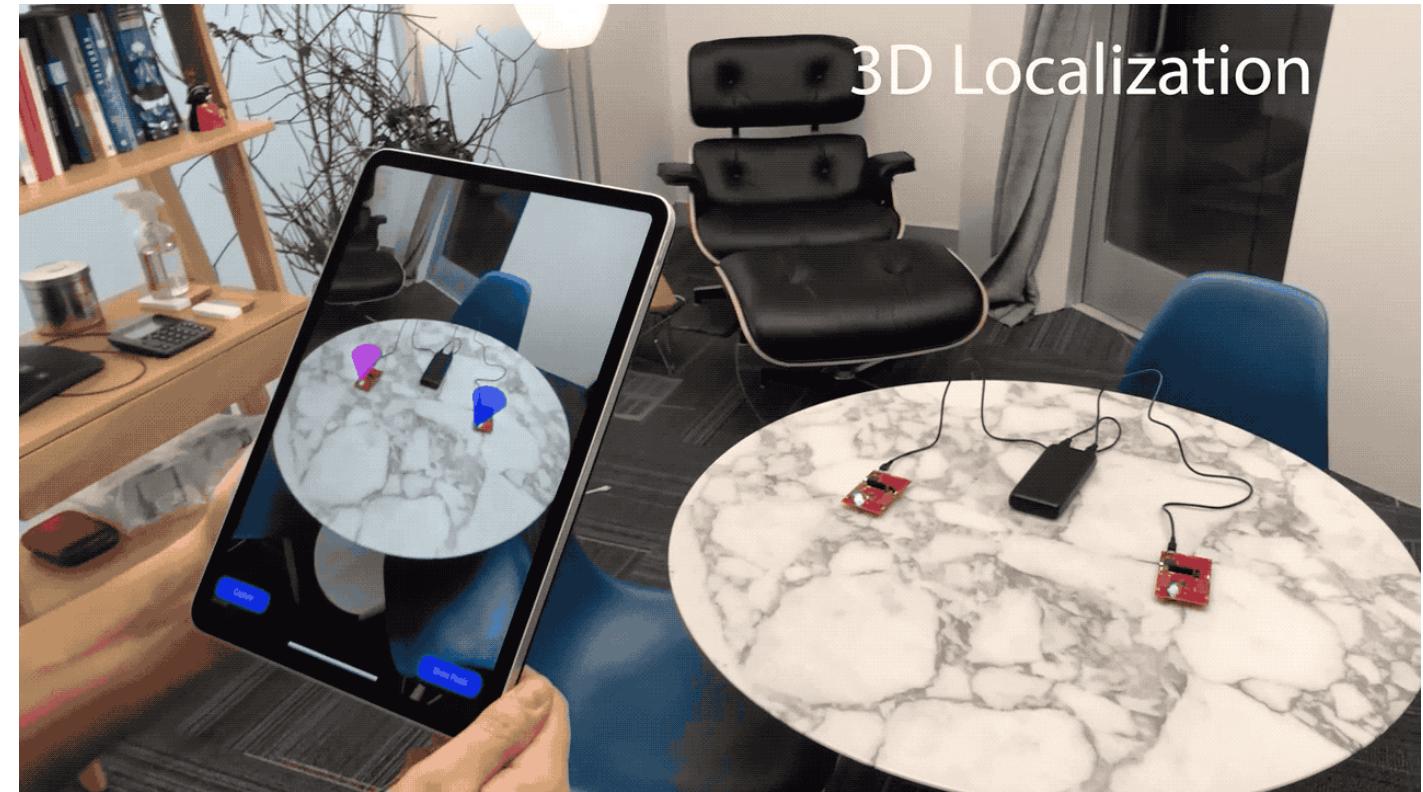
GLITTER works at Long Range



GLITTER Can Render 3D Content From a Single Point Source



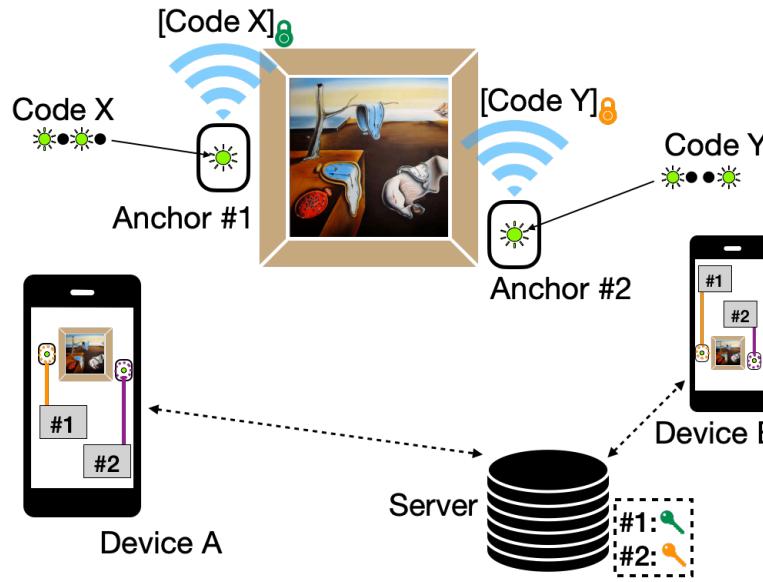
Hit Testing



GLITTER Can Be Used For Device Localization By Multiple Anchors



Conclusion



- AR needs “Tags” to bridge virtual and physical worlds
- Existing approaches such as AprilTags fail to meet the requirements
- **GLITTER:** A robust approach to identify many spoof-resilient active light anchors in an AR video from a mobile device
- **Challenges and Key Ideas**
 1. Active markers for Demonstrative Identification
 2. Temporal encoding instead of Spatial for long range
 3. Practical low power hybrid BLE + Visual protocol to handle noisy visual channel



<https://github.com/conix-center/LightAnchorFramework>