(SD2019-199) ULoc: Robust, Scalable and cm-Accurate UWB Tag Localization

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ABSTRACT

Researchers from UC San Diego have developed ULoc, a scalable, low-power, and cm-accurate UWB localization and tracking system in the form of a VR headset tracking, that provides real-time accurate 3D indoor localization.

TECHNOLOGY DESCRIPTION

A myriad of IoT applications, ranging from tracking assets in hospitals, logistics, and construction industries to indoor tracking in large indoor spaces, demand centimeter-accurate localization that is robust to blockages from hands, furniture, or other occlusions in the environment. With this need, in the recent past, Ultra Wide Band (UWB) based localization and tracking has become popular. Its popularity is driven by its proposed high bandwidth and protocol specifically designed for localization of specialized "tags". This high bandwidth of UWB provides a fine resolution of the time-of-travel of the signal that can be translated to the location of the tag with centimeter-grade accuracy in a controlled environment. Unfortunately, we find that high latency and high-power consumption of these time-of-travel methods are the major culprits which prevent such a system from deploying multiple tags in the environment.

Since UWB has been developed as localization specific protocol, there has been a need for infrastructure based, low-power and real-time indoor localization while providing cm-Accurate 3D UWB tag locations. The UCSD researchers have solved these limitations by novel hardware, firmware and algorithm designs.

Researchers from UC San Diego have developed ULoc, a scalable, low-power, and cm-accurate UWB localization and tracking system in the form of a VR headset tracking, that provides real-time accurate 3D indoor localization. In ULoc, the researchers built a custom multi-antenna UWB anchor that enables azimuth and polar angle of arrival (henceforth shortened to '3D-AoA') measurements, with just the reception of a single packet from the tag. By combining multiple UWB anchors, ULoc can localize the tag in 3D space. The single-packet location estimation reduces the latency of the entire system by at least 3×, as compared with state of art multi-packet UWB localization protocols, making UWB based localization scalable. ULoc's design also reduces the power consumption per location estimate at the tag by 9×, as compared to state-of-art time-of-travel algorithms. We further develop a novel 3D-AoA based 3D localization that shows a stationary

OTHER INFORMATION

KEYWORDS

Ultra Wideband, wireless localization, real-time localization, Human-centered computing, Location based services

CATEGORIZED AS

- **Communications**
  - Wireless
- **Sensors & Instrumentation**
  - Position sensors

RELATED CASES

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localization accuracy of 3.6 cm which is 1.8× better than the state-of-the-art two-way ranging (TWR) systems.

We further developed a temporal tracking system that achieves a tracking accuracy of 10 cm in mobile conditions which is 4.3× better than the state-of-the-art TWR systems.

APPLICATIONS

VR headset tracking, real-time accurate 3D indoor localization

ADVANTAGES

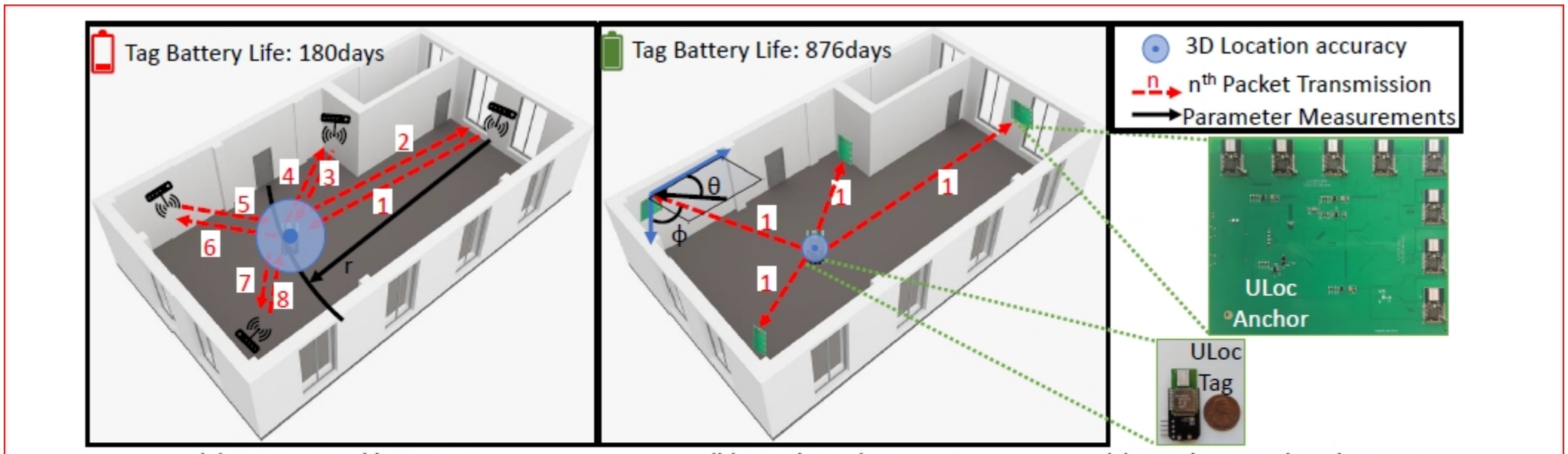

Fig. 1. ULoc: Comparing the traditional UWB localization system to ULoc, showing (a) Low-battery life (180 days) and high latency (8 packet exchanges) (b) High batter life (876 days) and low latency (1 packet exchange) (c) ULoc's custom localization anchor and tag boards, where tag is placed next to a penny, measures only 1.6 × 3.7 cm.

INTELLECTUAL PROPERTY INFO

This technology is available for commercialization through UC San Diego. Contact UCSD for licensing terms. US rights are available.

RELATED MATERIALS

▶ Minghui Zhao, Tyler Chang, Aditya Arun, Roshan Ayyalasomayajula, Chi Zhang, and Dinesh Bharadia. 2021. ULoc: Low-Power, Scalable and cm-Accurate UWB-Tag Localization and Tracking for Indoor Applications. Proc. ACM Interact. Mob. Wearable Ubiquitous Technol. 5, 3, Article 140 (Sept 2021), 31 pages. DOI:https://doi.org/10.1145/3478124 - 09/14/2021

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