ALPS: An ultrasonic localization system

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ABSTRACT

We demonstrate ALPS, an ultrasonic zone-based and time-of-flight localization system for mobile devices. ALPS capitalizes the ability for smart-phones to detect audio above the human hearing range and does not require any additional hardware. Synchronized transmitters deployed in the environment periodically send identification sequences encoded as a combination of ultrasonic chirps. Each mobile device runs an application that records a snapshot of audio, decodes data sequences and then uses out-of-band map data to compute a location. The confinement of ultrasound within walls is ideal for zone-based localization and the relatively slow propagation of sound allows for accurate time difference of arrival (TDOA) ranging in larger open spaces.

1. SYSTEM DESCRIPTION

ALPS uses an ultrasonic modulation technique described in [1] where multiple transmitters can simultaneously send unique identification codes to any number of mobile receivers. The overall architecture shown in Figure 1 shows the main components which include the transmitters, the mobile device that is being localized along with the localization and mapping backend. In large areas, the transmitters are time synchronized using an 802.15.4 radio to enable high resolution TDOA ranging given the geographical origins of the signals. Additional information from inertial measurement sensors is used to filter location estimates.

Figure 2 shows an ALPS transmitter. In our deployment, the transmitters are mounted on tripod stands that will be placed in the corners of large rooms or in any single zone-based areas. The receivers can be any mobile device sensitive to up to 23KHz or audio bandwidth that runs our demodulation software. The user downloads an application which includes a map constructed during installation. As the user walks around the room, the application tracks the user and provides the current location. The application will be demonstrated on an iOS device.

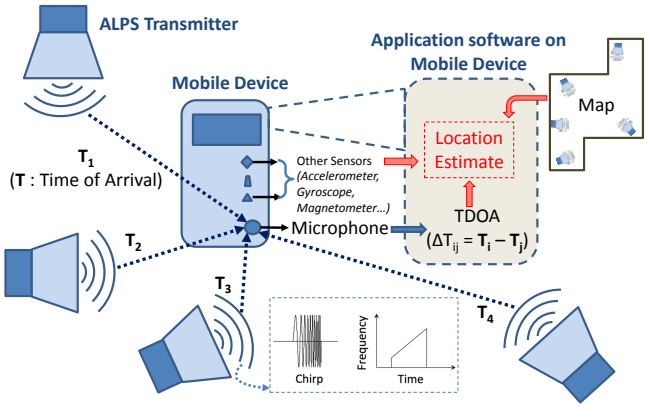

Figure 1: System Architecture

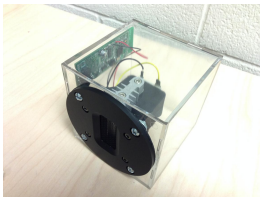

Figure 2: ALPS Transmitter

2. REFERENCES

[1] P. Lazik and A. Rowe. Indoor pseudo-ranging of mobile devices using ultrasonic chirps. In *Proceedings of the 10th ACM Conference on Embedded Network Sensor Systems*, pages 99–112. ACM, 2012.