IR-UWB based Indoor Localization System

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ABSTRACT

Today, location and proximity information are key to a number of emerging applications.Our localization system uses impulse-radio ultra wideband technology to estimate the location. The indoor localization system is implemented based on 3dB Midas IR-UWB chipset. The distance between two nodes is estimated using two-way Time of Flight (TOF) measurement. The chipset provide accuracy of about 15 cm in line of sight.

1. IR-UWB FOR INDOOR LOCALIZATION

Today, with the rapid deployment of wireless systems, a wide variety of new applications depend on location and proximity. In addition to outdoor location, today several applications such as warehouse asset tracking, augmented reality, indoor navigation, etc. demand precise indoor localization. Numerous ranging and localization technologies were developed in the last decade [4] they differ in communication channels (e.g., radio frequency, optical), localization-related parameters (e.g., received signal strength (RSS), time-of-arrival (TOA), time-difference-of-arrival (TDOA)), precision and reliability. Impulse-radio ultra wideband based ranging technique has recently emerged as a prominent techniques and were standardized in IEEE 802.15.4a [3]. Impulse-radio ultra wideband (IR-UWB) systems use pulses of very short time duration (typically 2-3 ns long) to transmit and receive data. This physical characteristic of IR-UWB make them a preferred choice over other signalling techniques. The high bandwidth of IR-UWB enables centimeter-level precise distance estimates. Additionally, the distance estimates are less prone to the channel interferences such as multipaths and today, it is possible to develop low-complexity, low-power IR-UWB transceivers.

2. SYSTEM OVERVIEW

Our system comprises of ranging nodes implemented using 3DB Midas IR-UWB chipset [1] and Arduino DUE boards [2]. The nodes are configured either as anchor nodes or mobile nodes. The anchor nodes are fixed and deployed in indoor environment at strategic locations. The anchor node locations are chosen such that at least 4 anchor nodes are visible to the mobile node from any location of interest within the environment.

The localization of the mobile node takes place as follows. The anchor nodes periodically broadcasts *beacon* frames containing the location of the anchor nodes. As soon as the mobile node detects anchor nodes in its vicinity, the mobile node starts ranging with the visible anchor nodes. Ranging is performed by the mobile node individually with each of the visible anchor nodes and as soon as sufficient number of distance measurements are available the mobile node estimates its location using our customized localization algorithm. Our algorithm is based on the trilateration algorithm presented in [5]. The complete setup is illustrated in Figure 1.

3. REQUIRED SETUP

Our system is an infrastructure-based indoor localization system. Therefore, we need to deploy several anchor nodes in the competition area at locations that will achieve the maximum coverage enabling the mobile node (whose location is to be determined) to localize itself without any restrictions. No prior measurements such as fingerprinting is required for our setup. In order to be able to localize the mobile node, the anchor node's locations have to be known. A blueprint of the competition area will enable these anchor nodes to be precisely deployed. In the case of unavailability of the blueprint, the anchor nodes determine their positions by mutually ranging among themselves with one of the anchor nodes acting as the master at origin. The mobile node can be configured to display its location locally or can transmit its estimated position to a remote laptop for visualization.

4. REFERENCES

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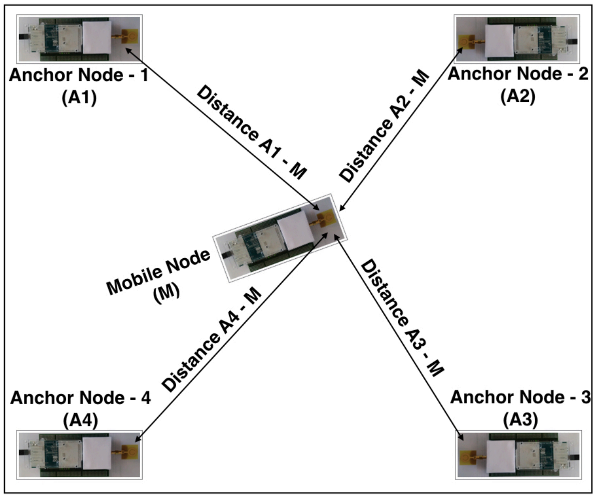

Figure 1: The mobile node perform ranging with multiple anchor nodes to estimate its location

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