Research Article

Design and Implementation of a Low-Power Noncoherent UWB Ranging System for Asset Tracking

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Abstract

A two-way ranging system based on non-coherent ultra-wideband technology has been designed and implemented. This system employs a low-power non-coherent UWB radio along with STM32L051 microcontroller to achieve high accuracy, fast update rates, and minimal energy consumption. By employing a clock period division technique into four smaller overlapping windows, the signal reception timing accuracy was improved fourfold, leading to a ranging accuracy of 10cm after averaging. Morever, averaging just 100 raw ranging samples reduced the standard deviation of measured distances to 12cm. While increasing the averaging window further improves the standard deviation, it reduces the update rate and increases the target's power consumption. Measurements show that with 100 samples and a 1Hz update rate, the tag's power consumption is as low as 24 μW, significantly lower than comparable systems. Practical experiments and comparisons with state-of-the-art systems demonstrate that the proposed method is highly suitable for real-time location systems (RTLS) and low-power applications. This work offers a cost-effective solution for indoor applications such as warehouse, medical, and industrial tracking.

Keywords: Two-way ranging, Smart market, Asset tracking, UWB positioning.

Highlights

- Development of a non-coherent UWB ranging system with ultra-low power consumption (24 μW).
- Using clock division into four overlapping windows to improve ranging accuracy to 10 cm.
- Evaluation of environmental factors, such as temperature and electromagnetic noise, on system performance.
- Adaptation to dynamic and harsh industrial environments with robust noise and interference immunity.