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Initial title:

"Comparison of two Real-Time Localization System RTLS with ultrasound- and ultrawideband sensors."

Description:

In the Urban computing domain, accurate real-time outdoor localization of moving objects/subjects is challenging. Most applications use Global Positioning Systems (GPS) for urban localization. However, the accuracy of GPS depends on environmental conditions like the weather (atmospheric influences), surrounding structures like buildings and vegetation, or technical system flaws of Global Navigation Systems (GNSS). GPS accuracy, therefore, ranges between 1.5 and 10 meters, and cannot be used indoors.

For several indoor and outdoor localization applications, there is a need for 10 times higher accuracy ranging between 0.1 and 1 meter. Applications can be found in the social sciences domain, health care, human-machine interaction research, location-based retail marketing services, sports enhancement, and urban navigation support services for the disabled to mention a few.

This study has a relation with the breaking-the-cycle and focus-on-emotions project, a research line of the Centre of BOLD cities. Here we try to localize normal and vulnerable children during their recess periods at school with as goal to improve the social safety of vulnerable children [4].

For this study, you can use a self-made positioning system based on Arduino hardware with ultrasound transducers/receivers, and we have an ultrawideband system available. We can follow a moving object in 3D with both systems.

Research questions:

1. How does this ultrasound system perform compared to an RTLS based on ultra-wideband technology?
2. How can we improve the ultrasound RTLS, possibly using machine learning techniques to optimize preprocessing steps? Compensate wind influences on accuracy?
3. How can we extend this system with automatic calibration and setup of the beacons?
4. How can we scale up this system so it can localize subjects in a larger area than the range of one ultrasound beacon which is 4 meters?

We are open to research questions the student may have!

Plan:

The student will experience the typical steps of sensor system setup, data collection, automated preprocessing, feature selection, and trajectory similarity measurement.

The ultrasound- and ultrawideband sensors are available for this study already.

Profile student:

- Bachelor or Master student.
- Interests in programming in Python and C (Arduino).
- Interests in implementing sensor setups for the study.
- Interests in practical data collection.
- Interests in sensor systems for real-time localization.
- Interests in applying machine learning techniques.

References:

[1] Francesco Potorti et all, “Comparing the Performance of Indoor Localization Systems through the EvAAL Framework.”, www.mdpi.com/journal/sensors, Sensors 2017, 17, 2327; doi:10.3390/s17102327.

[2] Carlos Medina et all, “Ultrasound Indoor Positioning System Based on a Low-Power Wireless Sensor Network Providing Sub-Centimeter Accuracy”, www.mdpi.com/journal/sensors, Sensors 2013, 13, 3501-3526; doi:10.3390/s130303501.

[3] Jimenez A.R., et all, “Comparing Decawave and Bespoon UWB location systems: indoor/outdoor performance analysis“, 2016 int. Conf. on Indoor Positioning and Indoor Navigation (IPIN), 4-7 October 2016, Spain, doi:10.1109/IPIN.2016.7743686.

[4] Breaking the Cycle | Centre for BOLD Cities (centre-for-bold-cities.nl)