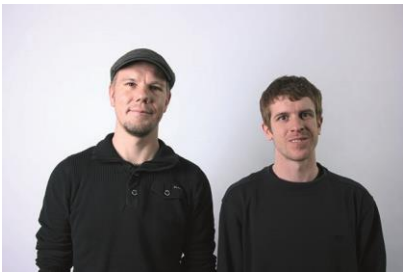
Zurich University
of Applied Sciences

School of
Engineering

InES Institute of
Embedded Systems

Real Time Location



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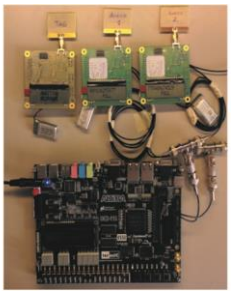
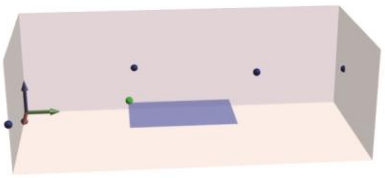
Real time location systems are used in a wide area of applications including military and civil segments. The purpose of such systems is to locate mobile network devices (tags) in their environment. For this purpose stationary devices usually called anchors are used to communicate with the tags. For outdoor applications the commonly used technology is GPS (Global Positioning System). As this technology only works in environments with line of sight to the GPS-Satellites, indoor localization is still a wide field of research. Various approaches to locate a tag based on distance measuring have been investigated in the past. The Irish company DecaWave Ltd developed a chip which adopts the communication with UWB to perform highly precise distance measurements. An Evaluation-Board (EVB1000) with demonstration software is available on the market since the end of 2013.
The goal of this bachelor's thesis was to both theoretically and practically analyze the advantages and disadvantages of the localization techniques ToF (Time of Flight) and TDoA (Time Difference of Arrival) with regard to convenience, stability, accuracy and power consumption. With ToF distances are calculated based on the measured time of flight of a message between the tag and an anchor. Using TDoA the times of arrival at each anchor node are compared resulting in a time difference and thus a hyperbolic curve which represents the possible locations of the tag node.
Based on the results of this analysis, an RTLS (Real time location system) has been developed and successfully tested in a realistic use case. The system allows a 3D positioning using a ToF based approach. In addition a set-up as a proof of concept for an RTLS based on TDoA has been designed and implemented. This set-up has been practically evaluated as well. As a basic requirement for this TDoA technique the timebase of every single anchor node has to be synchronized. To achieve this, a reference clock and a synchronization impulse were connected through a coaxial cable to the anchor nodes. This allows a synchronous reset of their timebases.
It could be shown that stable and precise RTLS can be built with either ToF or TDoA. However, the TDoA technique has essential advantages compared to ToF regarding performance and power consumption aspects. Furthermore the concept of TDoA localization as proposed in this work can be used to develop a fully integrated TDoA environment which can be tested and demonstrated.



Wired clock and sync setup for TDoA



3D application to display the location