OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG | INF | FAKULTÄT FÜR INFORMATIK

Distributed and Operating Systems Group

Integration of a Phase Differential Ranging System in a Wireless Sensor Network Development Framework

Type of work:	Teamproject
Estimated work time:	180 Hours
Advisor:	Christoph Steup

1 Introduction

Wireless sensor networks are closely related to the famous ”Internet of Things”, which promises a seamlessly digitalized world. Besides communication the nodes of these networks need temporal and spatial relations to fulfil their task, since a sensor's value is only useful in the context of time and space. Therefore these two values need to be provided within each node to enable processing and aquisition of data.
Even though the current and time and geospatial coordinates may be inferred through a GPS receiver, this approach is not generally valid. As an example a building may occlude the direct line of sight to the satellites disabling the GPS. Additionally, embedded devices need to be very limited in their power usage, which poses problems with current GPS receivers.
Another approach towards the localization of the individual wireless sensor nodes is the usage of the wireless communication. However, basic approaches using the Received Signal Strength Indicator (RSSI) fail due to the limited coupling between distance of two nodes and the signal strength. Therefore, other approaches need to be investigated. One technical solution uses phase differential measurement between the sender and receiver of the communication to derive the distance.
This approach proved to be a viable mechanism to estimate the distance between multiple nodes, which can afterwards be used to derive the position of the nodes.
Therefore, this team project shall integrate this feature into an existing wireless sensor network development framework based on the Contiki Operating system. Afterwards the necessary communication overhead as well as the bandwidth difference trade-off need to be evaluated.

2 Related work

Students should revise the contiki operating system[4] as well as the the hardware description of the wireless sensor nodes[3]. Additionally the reference implementation[2]

of the difference estimation needs to be evaluated as well as the used communication system (compatible to IEEE 802.15.4)[1].

3 Detailed task description

The individual work consists of the following subtasks:

Review of the Contiki Operating System : The students should look into existing Contiki Operating System and understand the used network abstractions..

Review of the existing software : Students shall revise the existing reference implementation of Atmel to isolate and understand the software routines necessary to implement the phase differential distance mesaurement.

Structuring of the implementation : Afterwards the implementation of the measurement needs to be structured in a way that it fits into the existing network abstraction of contiki.

Implemtation of a prototype : A prototypical implementation needs to be provided.

Evaluation of the implementation : The evaluation of the implementation shall be based on experiments on the embedded hardware.

References

[1] IEEE standard for local and metropolitan area networks–Part 15.4: Low-rate wireless personal area networks (LR-WPANs). *IEEE Std 802.15.4-2011 (Revision of IEEE Std 802.15.4-2006)*, pages 1 –314, 2011.

[2] Atmel Corporation. Atmel AVR2152: RTB Evaluation Application Software User's Guide. Technical report, February 2013. Online: http://www.atmel.com/Images/Atmel-8443-RTB-Evaluation-Application-Software-Users-Guide_Application-Note_AVR2152.pdf.

[3] dresden elektronik ingenieuretechnik GmbH. User manual - software programming. Technical report, April 2014. Online: http://www.dresden-elektronik.de/funktechnik/products/radio-modules/oem-derfsam3/description/?L=%2525270%25253DA&eID=dam_frontend_push&docID=1917.

[4] Adam Dunkels, Björn Grönvall, and Thiemo Voigt. Contiki - a lightweight and flexible operating system for tiny networked sensors. 2004.