PerAda Research Exchange: Real Experimentation with a Self-Synchronized Duty-Cycling Mechanism

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The work of this visit is related to two different topics. On the one hand, recently, Hugo Hernandez and Christian Blum introduced and studied a possible technique for energy-aware duty-cycling in sensor networks with energy harvesting capabilities inspired by self-synchronized sleeping patterns of natural ant colonies. Duty-cycling mechanisms aim at obtaining energy savings thanks to the ability of the nodes to only become active when they need to. In Figure 1 the behavior of a self-synchronized set of nodes is shawn. On the other hand, Tobias Baumgartner is one of the main developers of the Wiselib (WISEBED project), a library of generic algorithms for wireless sensor networks. The main goal of the visit was to experiment with the duty-cycling mechanism using the Wiselib.

This visit to the Braunschweig University follows a previous work by researcher Tobias Baumgartner to my university (Technical University of Catalunya). during his visit we focused on a single goal which was to see if the behavior of the Self-Synchronized Duty-Cycling mechanism that our group had developed could be adapted to suit the Wiselib (WISEBED project). The benefits of this work were many, but noteworthy are, first, the fact that this would allow all other project sites to use the mechanism in their experiments, and second, that this implementation would allow additional testing of the mechanism on a more realistic scenario (as provided by the Shawn simulator) and on real sensor networks. This work will be presented in the forthcoming MSN 2010 conference.

Some months later, during my visit to the Technical University of Braunschweig, we decided to try our development on a real sensor network. We decide to use the network located on the Braunschweig University as part of the WISEBED project. This network is composed of 30 network nodes each one equipped with 4 pressure sensors which form a mesh located under one of the main corridors of the department (see Figure 2). Although there

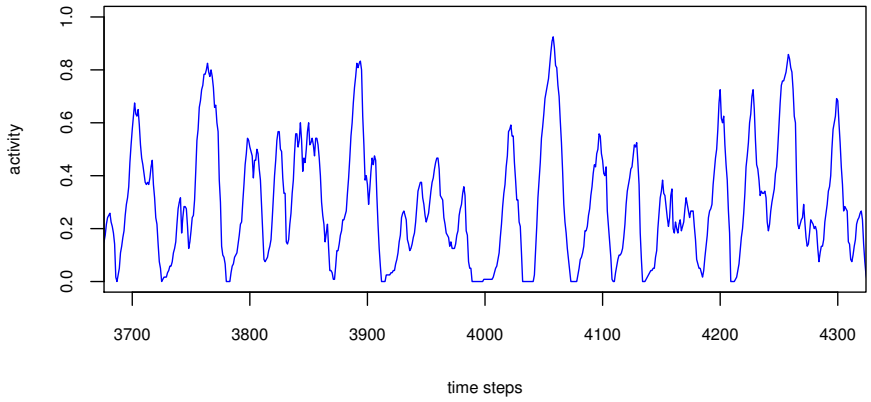

Figure 1: Fraction of active nodes (y-axis) over time (x-axis) when using a self-synchronized duty-cycling protocol. Synchronicity can be observed in the fact that in some moments many nodes are activity at the same time (peaks) while in others any node is active (valleys).

are several applications developed for this network, we decided to focus on people detection. Unfortunately, the duty-cycling algorithm that we have developed focuses on adapting to the available energy resources (expecting energy to be a scare resource) and this particular network was provided with a continuous power supply. Therefore we slightly modified the mechanism to instead of adapting to the energy available adapt to the amount of people crossing the corridor.

This means that the system still tries to reduce energy consumption by means of turning off nodes when convenient but now the probability of nodes being awake increases when the number of people detected on the corridor in the recent past is higher. As we obtain by experimental measures that the minimum time required to cross the corridor in a calm pace was around 15 seconds, we tried to develop a mechanism such that in the lowest activity periods the time lapse between peaks was around 15 seconds. What should be enough to detected any person crossing the corridor although in some cases the person won't be detected when entering the corridor but after a while.

Figure 2: Hallway from the Technical University of Braunschweig were the sensor network was installed.

Correct design of our original algorithm allowed us to easily obtain the new mechanism just requiring small changes and to adjust some parameters. All this could be done in less than an hour. The final system worked just as expected and although the visit was not long enough to extensively experiment with the system, we plan to extend this experimentation next year and see if results deserve publication.