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HydroSNet4D

HYDROPONIC SENSOR NETWORK FOR DEVELOPING

Hydroponic Sensor Networks for Developing project is incorporated on the Fraunhofer Portugal ICT4DCC, more precisely on the hydroponic farming project, whose primary goal is to develop a low cost mechanism for mobile monitoring of hydroponic farms.

Motivation

Considering the increase on the world food demand, traditional farming is becoming unsustainable. In fact, it is estimated that by 2050 the world cereal need will grow 51% compared to the value recorded in 2000. If other agricultural techniques are not explored, this food demand might not be met, because the cultivation area of the traditional agriculture is continuously decreasing, due to human occupation or soil erosion. This is particularly true on African countries, where it is expected a loss of 50 tons of soil per hectare per year.

A solution being explored as an alternative to traditional agriculture is hydroponic agriculture – cultivation without soil. However, this is a precision agriculture technique that needs constant monitoring, because a minor deviation on its ecosystem can have a huge impact on the farm crops.

Fig1. Hydroponic Farm.

Several hydroponic monitoring systems exist, but they are designed having in mind developed countries, so they are too expensive or complex to be adapted to the developing countries needs.

HydroSNet4D proposes a wireless communication network to be applied to the Fraunhofer Portugal hydroponic low cost monitoring solution for developing countries.

Description

HydroSNet4D Wireless Sensor Network and mobile application was developed with the objective of being easily and effectively used by farmers to reduce the time involved in the monitoring process of hydroponic cultures.

Contact

Rua Alfredo Allen, 455
4200-135 Porto, Portugal

+351 220 430 300
info@fraunhofer.pt
www.fraunhofer.pt

Main Features

- Low cost and low power consumption
- Easily adaptable to any type of planting
- Scalable for different areas of a farm

System Autonomy

- Sensing device: 3 Months of Autonomy with a 3.7V/ 2000mAh battery
- Gathering device: 800mW Photovoltaic System to charge a 3.7V/335mAh battery

Communication Coverage

- Maximum distance between elements 100m

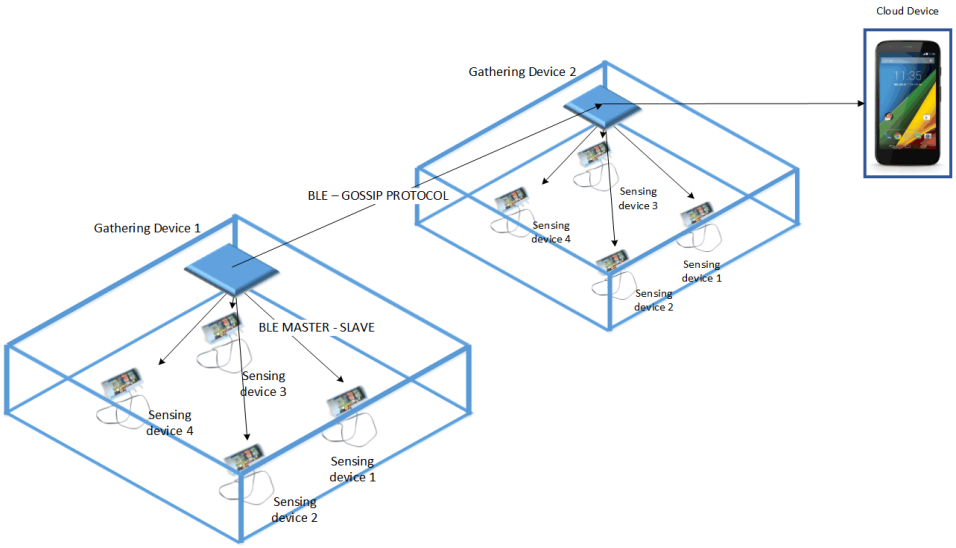

Fig2. System Architecture.

With this objective in mind, it was implemented a distributed wireless communication architecture based on Bluetooth Smart and on a cooperation model whose major characteristics are: 1) easy installation; 2) low and easy maintenance; 3) low energy consumption.

System Architecture

The wireless communication architecture developed is composed by three hierarchical layers: 1) Sensing Layer; 2) Gathering Layer; and 3) Cloud layer; each with its own responsibility and with a communication scheme adapted to that responsibility.

The Sensing Layer, as the name says, is composed by battery powered sensing devices that periodically monitor the quality of the water in the hydroponic farm, and reports to the upper layer – Gathering Layer – as soon as one of its elements – Gathering Devices – requests. In order to extend the life time of the battery of the Sensing Devices this communication is done on a master-slave cooperation system, in which the Gathering Device is the master, and the Sensing Device the slave.

The Gathering layer is composed by solar powered devices installed on top of each hydroponic greenhouse. They collect the information reported by the Sensing Devices, and propagates it to the upper layer – Cloud Layer – by broadcasting it to the other Gathering Devices until the information reaches the Cloud Layer, i.e., the Cloud Device. The cooperation model used to broadcast the information is based on the GOSSIP epidemic communication protocol that allows to minimize the energy consumption of the Gathering Devices during broadcast.

The Cloud Layer is composed by a GSM/WiFi device – Cloud Device – whose responsibility is to collect the messages from the Gathering devices and store them in a Cloud service.

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