Design of Web-based Interface for Wireless Sensor Networks

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Abstract: WSNs consist of sensor nodes with limited capacity, low cost and communicating with each other in short distances using considerably low power rate. The nodes can be dispersed randomly into intended region in which they are used for measurement and monitoring purposes within the frame of a common scenario. They are used in many areas ranging from military fields to public health services because of their wide range properties. In this application fields, there are some requirements to appear that the wireless sensor nodes can be monitoring by remote-controlled and the data which are picked up from where the system is placed can be processed. This paper describes the design of web based interface for wireless sensor networks. The proposed web-based interface provide configuration of the network and access to real-time and archived temperature, humidity, light data through any Internet-capable device.

Keywords: WEB-based, Interface, Remote Monitoring, Wireless Sensor Network

Introduction

WSNs (Wireless Sensor Networks) consist of sensor nodes with limited data storage / processing capacity, low-cost and communicating with each other in short distances using considerably low power rate (Akyildiz, 2002). The nodes can be dispersed randomly into intended region in which they are used for measurement and monitoring purposes within the frame of a common scenario. They are used in many areas ranging from military fields to public health services because of their wide range properties (Akyildiz, 2002). For example WSNs are used for remote monitoring of bird life with the 32 sensor nodes in Great Duck Island Project (Mainwaring, 2002, Szewczyk, 2004). The temperature, humidity, pressure, and light parameters have been observed in nesting environment of the birds. WSNs are used to observe the growth of the trees in Redwood forest. The temperature, humidity, and solar radiation parameters are sensed (Tolle, 2005). Welsh, 2005 and Werner-Allen, 2006 has realized to remote monitoring of the active volcano in Ecuador. The processing and delivering to the remote users in real time manner, graphical representation, and storage of sensed data are so important in such as application areas.

Various data processing and visualization tools have been developed in the literature. For examples, Mote-View software was developed by Crossbow can set node configuration and allow to monitoring, plotting and storing of real-time sensed data (Crossbow). But this software is able to support to plotting and visualization service in local manner. Spyglass is java-based and modular WSN visualization software (Buschmann, 2005). jWebDust is also java-based and general-purpose visualization tool (Chatzigiannakis, 2005). However, good Java knowledge is needed to configure them in accordance with the requirements of different applications. Cao, 2009 were designed the general-purpose web interface for WSNs. This interface focuses on data processing capability and congestion avoidance.

In this study, we have designed the PHP and FLASH-based web interface for remote monitoring and controlling of WSNs. The most important difference of this interface than others focuses on flexibility, visuality, and ease of use. Therefore PHP, FLASH and the PostgreSQL database server are used in this web-based interface for receiving, analyzing, processing, visualizing, and showing the data in a web browser.

The rest of the paper is organized as follows. The hardware and software tools used to design of the proposed web interface are introduced in Section 2. In Section 3 are described the design criteria and features of proposed PHP and FLASH based web interface. The paper is concluded by Section 4.

Preliminaries

MicaZ WSN Mote and Sensor Kit

The MICAz (Figure 1) which is a widely used sensor node in WSNs, has an integrated ATMEGA128L microcontroller from AVR family having 128KB code memory and 4KB data memory with the clock speed of 16 MHZ (MICAz, 2009). It can communicate at 250 Kbit / second data transmission speed using Chipcon CC2420 IEEE 802.15.4 compliant wireless transceiver (Crossbow, 2010). In this study, it is also used MTS400 sensor board, which can sense the light, temperature, pressure, humidity and acceleration, together with MICAz nodes.

Figure 1. ***MicaZ motes***

PHP

PHP: Hypertext Preprocessor is a widely used, general-purpose scripting language that was originally designed for web development to produce dynamic web pages. For this purpose, PHP code is embedded into the HTML source document and interpreted by a web server with a PHP processor module, which generates the web page document. PHP is available as a processor for most modern web servers and as standalone interpreter on most operating systems and computing platforms. (Wikipedia, 2010). PHP has widespread use in recent since it is an open source language, has rich document support and ease of use. Therefore in this paper PHP language is used.

Design Stages of WEB-based Interface for Wireless Sensor Networks

System Architecture

The system architecture, which consists of WSN, server, and users, are shown in Figure 2. WNS is consisting of more than one wireless sensor nodes, which sense the phenomenon, and a base station, which ensure communication of the nodes with the server. The nodes regularly collect the information such as temperature, humidity, light and forward them to the server through base station. Server is responsible to evaluate, process, and visualize the data coming from the base station. For this purpose PostgreSQL database, Apache server and PHP language are used. First server record data coming from base station to the PostgreSQL database, then it process the data in the database depending on user requests, and last it display the processed data with the help of Apache Web server and PHP. User can examine the processed data by means of any device connected to the internet.

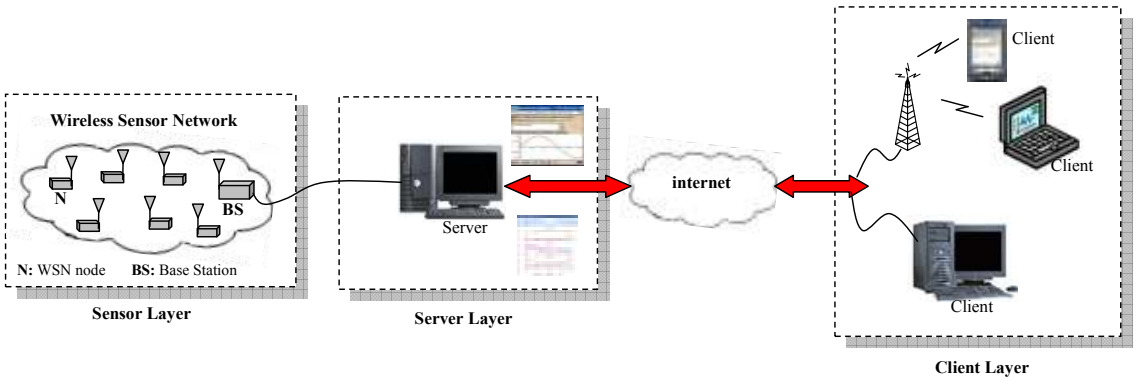

Figure 2. System architecture

Designed WEB-based Interface

In this subsection the properties and usage of proposed general-purpose and web based interface are described. In figure 3, introduction page is shown. This page allows to user securely accessing the web based interface. After the password is approved the general view of the designed web based interface is shown as Figure 4. This page allows monitoring the wireless sensor nodes, examining sensed data of nodes, creating the graphs of sensed data and observing the topology of network. The main purpose of the proposed interface is providing flexibility to the user. Therefore the interface is divided into five main sections.

Figure 3. Introduction page

Data Section

In data section, the momentary value of the temperature, humidity, pressure, light and voltage level information coming from sensor nodes are shown as Figure 4.

Figure 4. Data section.

Chart Section

In chart section, the temperature, humidity, pressure, light and voltage values coming from sensor nodes can be converted the various graphical forms as Figure 5. Moreover, these graphs can be saved by the user.

Figure 5. Chart section

It is shown different physical data (humidity, pressure) belonging to a single node in Fig. 6. Moreover, the proposed interface allows plotting different data (humidity, pressure) belonging to more than one nodes in a single page as shown Fig.7

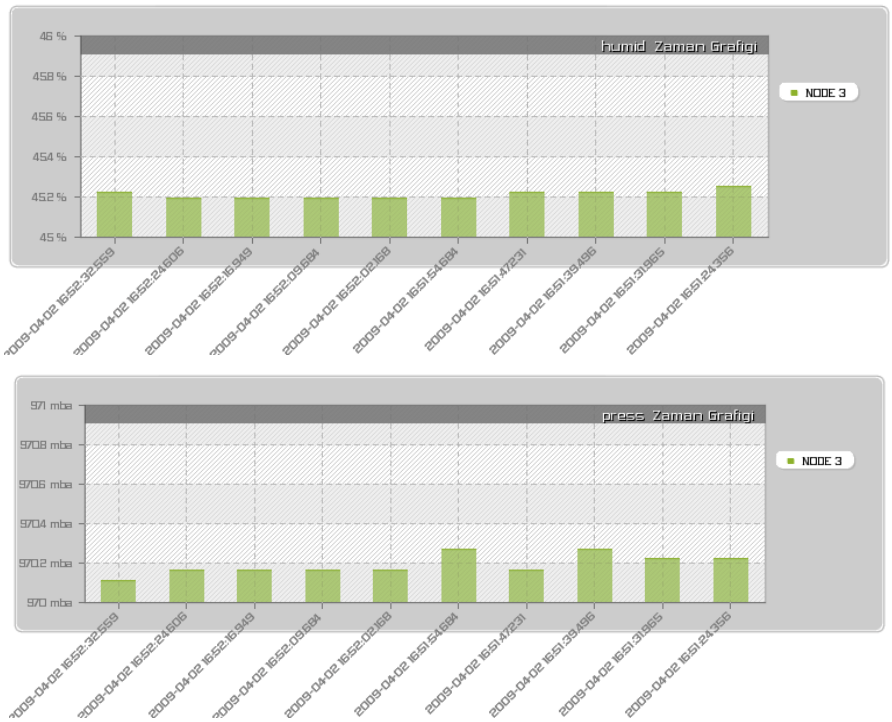

Figure 6. Chart of the different physical data (humidity, pressure) belonging to a single node

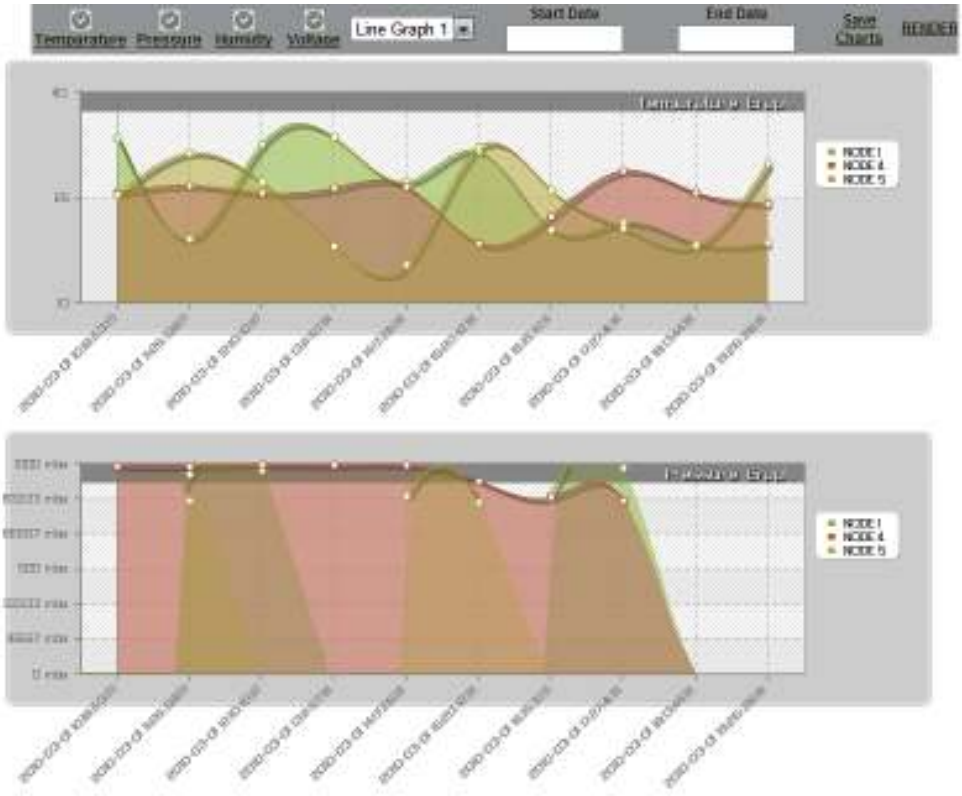

Figure 7. Chart of the different physical data belonging to multiple nodes

Health Section

This section allow monitoring the parameters belonging to the sensor nodes such as number of dropped packets, number of retries, number of received packets as shown Fig. 8

Figure 8. Health section

Topology Section

This section allows observing logical connection of the sensor nodes deployed in the environment. Further, sensed data of the nodes can be easily seen as a summary.

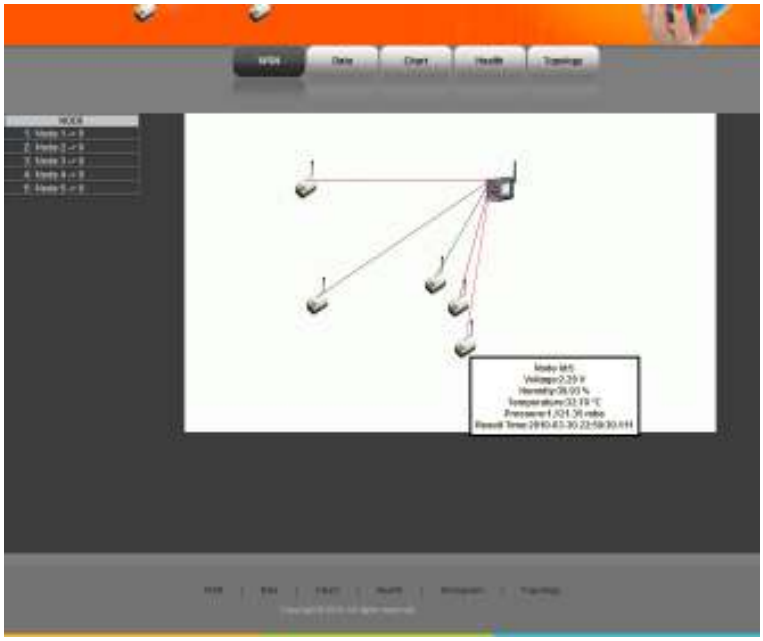

Figure 9. Topology section

Summary and Final Remarks

In this paper, the design of general purpose and PHP based web interface for wireless sensor networks are presented. Proposed web interface allow monitoring sensed data, creating the graphs, and observing the topology of network. The main advantage of the proposed interface is user friendly. Depending on the user's request it can be plotted and saved the graph of different physical values.

Designed web based interface can be acceptable as a prototype for WSNs, and can be easily used in various application areas such as environment monitoring, military surveillance systems, habitat monitoring.

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