A Design and Implementation of Ubiquitous Campus Environment Information Service

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Abstract

Recently, many researches of various fields that used a ubiquitous sensor network are going on. Specially, various experiment had a function of monitoring without human is preceded in the environmental fields where access of a person is difficult. For example, in Korea, various pilot u-city projects are driven by nation. This paper designed a service as it used a wireless sensor network to measure and monitor environmental information in the campus.

1. Introduction

Wireless sensor network technology grew recently up we are able to forecast an action pattern of surrounding environment and people. A wireless sensor network is the network that composed by radio the data which measured by various heterogeneous sensors so as to be able to exchange information.

Wireless sensor network configuration has characteristics like limited resource, a heterogeneity of sensor nodes, expansibility of a sensor network and unmanned operation [1, 2].

One of most important characteristic of WSN is limited resource of a sensor node. A sensor node is composed to limited CPU, memory, a communication module and the battery because which was composed to limited scale due to cost and the purposes of use. Specially, efficient control of a battery directly affect in a lifetime of WSN if it is installed wild environment that cannot recharge. Therefore, all hardware, software of WSN shall be designed considering the energy efficient way [3].

The WSN adaptation regarding a change of initial state setting and network topology of a network shall be possible without interventions of a person. In case of regions where access of persons are difficult, sensors are throwing down by the airplane, and sensor nodes are should recognizes a neighbor node by independently then compose a network. If topology is changed because of the trouble or out of power etc. must adapt to change.

Also, a group of sensor node has different sensor is general than all other group's nodes has same sensor.

A user can get an information by integrate various and heterogeneous sensor. The node that has different sensor among the nodes there can be a different waste of energy. Therefore, if we collect information without considering a resource difference there can be a node consumes energy excessively, and as a result, it decreases a lifetime of network.

This paper utilizes wireless sensor to design a wireless sensor network in order to test USN structure and monitor environment of an academic campus. Information collected at sensor saved at monitoring server and processes it so that a general user can easily get environmental information.

Specially, environmental information can be offered during a movement through PDA in mobile environments through wireless LAN environments of a campus.

Configuration of this paper is as follows. In the Chapter 2, we look into related study, and describe about structure of an information system and wireless PDA service based on WSN at Chapter 3. Finally, we describe about conclusions and future directions in a Chapter 4.

2. Related researches

A sensor network is composed to the nodes that are densely deployed in the interior or nearby place of target monitoring zone. Figure 1 shows to sensor network structure and application field.

The field that a wireless sensor network is applied primarily to is currently machine breakdown monitoring of the industrial section which used sensor, security of a home/building and an automatic air conditioning part, and becoming gradually expansion to a safety of public facilities, vehicle, agriculture, a medical field [4].
There is further application fields that is asked an intelligent system are weather observation, monitoring local restriction of a visitor, position recognition of man in the indoor, biochemistry monitoring, ecosystem observation, production quality control. It is an limited examples, and it is enlarged to all fields of every day according to applications [5].

The Korean Meteorological Administration's meteorological observation system is composed to unmanned AWS(Automatic Weather System) has meteorological sensors and LAU(Local Acquisition Unit) that gathering an information form all AWS. Currently Korean Meteorological Administration's aims to achieve decentralization of weather/marine observation, fine-grain and efficiency through Wireless Mesh Network-based USN construction plans, and finally have a goal to provides high quality forecast service and cost decrements. However, there are increased network installation and operation cost problem and also electric power supply problem because electric power is consumed very much. Also, there are some problems of preparation of installation ground is not easy due to large volume of sensor, and need incidental equipment for fixing of sensor [7].
Cultural assets have unchangeable value to money such as rareness and historicity. Theft/intrusion detection regarding cultural assets or plunder are very seriousness levels as they appear at some instances, and there is a problem that building of cultural assets protection plan is difficult because of restricted manpower and cultural assets damage worries. Therefore, we can establish cultural assets theft/invasion detection plan, a plunder prevention system to minimize cultural assets damage in addition to monitoring regarding the current state of cultural assets with an USN. At this time a technology supplementation for low electric power operation and extension of battery life is necessary for wireless network-based reliability and recognition distance and need to allocate a USN frequency suitable for USN [7].

In the remote inspection of a meter fields, USN is applied with a condition of a person is hard to continuously monitor and control. The remote voltage-meter inspection system is combines with electronic watt-hour meter and ZigBee module, and it checking remotely electric power consumption. Measurement data are saved to power supply company's database through the Internet, and end-user and power supply company can confirm periodically electric power need amount of each house or factory. Data to occur at each watt-hour meters were small scales, and ZigBee was used because it is suitable solution between measuring instrument and data collection unit as a short distance wireless network was required. Interconnection to outdoor network use an existing access network or CDMA network [8].

A paddle bridge, an important building, the road that an accident risk is high, continuous interests such as a tunnel are applied to a necessary structure, and the structure control which used WSN attaches vibration, temperature, strain, street measurement, the direction of the wind, manners and customs measurement sensor, and I compose a multi-hop network.

The structure control which used WSN is applied to a various fields like an old bridge, an important building, the road that an accident risk is high and tunnel that needed continues monitoring. In this case, monitoring system attaches vibration, temperature, transform measurement, the direction of the wind and wind speed-meter sensor and it compose a multi-hop network. Transmit data through Internet /CDMA networks to the central control center at the same time of sensing, overcome a restrictions between economic, distance and a limitation in time, and to make the 365 days and 24 hours monitoring, can efficiently performs a diagnosis of a structure [8].

3. An u-campus environmental information system

The u-campus environmental information system is deployed at university campus that gathering sensing data and processing to providing to users through Internet

3.1. System configuration

The configuration of an u-campus environmental information system is shown in the figure 4. The data that sensor collected is transmitted to Gateway, and received data are saved to server DB, and provides environmental information to users through wireless PDA. Our environmental information system is composed to two parts. A wireless communication part from sensors to Gateway uses 2.4GHz frequency designed to low power consumption forms an IEEE 802.15.4 Wireless sensor network. A wired communication part collects the data value which sensor measured at Gateway, and then it is transmitted to server by an IOCP communication model. The processed and saved in the server DB is provided environmental data to users.

3.2. Environmental information management system

This system is a system that saves and managing sensor information collected at database. Data collected through Gateway are saved to database environmental server, and it provides environmental information to users through PDA. Figure 5 shows...
structure of an environmental information management system.

Figure 5 is categorized greatly to three layers. A platform for Web service is located to high rank layer. In the middle layer, there is a Data Monitoring, Gateway and environmental database to process data. And the low layer all kinds of environmental sensor are located. The environmental sensor of low layer there is humidity, air pollution, precipitation, direction of the wind/the velocity sensor and soil sensor. Structure of environmental information management system seems to be a figure 6.

Figure 6. The Design of Management System

- Server - Server start, request for sensor data by user demand, routing reset upon addition or removal of sensors.
- Sensor - can confirm data value administrator selects sensor, and monitor state of the current sensor.
- Layout - manages position of a sensor node, sensor registration and information change is possible, and it is also manages sensor trouble information.
- Application - PDA, web site, working with DB.

Figure 7 is the main screen of a server administrator mode to have been implemented. In the administrator modes, we can check and monitor environmental management system, and confirm sensor data.

Figure 7. The Screenshot of WSN based Monitoring Service

3.3. Environmental information database

Environmental information database provides a function for save and efficiently search for sensing information.

Figure 8. Design of Environment Monitoring DB
If saved every sensor type data on one table, when users accessed at the same time, time delay occurred and management is difficult, so we design a table by sensor types like figure 8. At this time, table join is easy with primary key and foreign key and also we can minimize duplication of data. The example measured sensor data that saved to DB is shown in the figure 9. The relay node number (CELL_ID) and sensor node number (NODE_ID), temperature value and battery value is shown.

4. Conclusions and future works

We installed real sensors on the campus, and collecting the environmental data, and designed a u-campus environmental information system providing environmental data to users through PDA. At present, one type sensors are deployed with small quantity. Hereafter, we will install various type sensors, and develop the web-based desk-top service. We will study structure of a sensor network, efficiency, utilization and etc. through these works.

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References