# 지그비를 이용한 시설물 관리 기법

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## The Scheme of Facilities Management based on the Zigbee

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요 약

일반적으로, 고정된 시설물을 관리하기 위하여 관리자가 수동으로 제어하거나 혹은 센서를 이용하여 자동으로 시설물을 제어할 수 있다. 그러나 기존의 구현은 중앙 시스템에서 시설물의 상태 데이터를 수집하기 어려운 문제점이 있다. 이 논문에서는 시설물의 정보를 근거리 통신망인 지그비를 이용하여 수집하는 중앙 관리 시스템에 대하여 제안한다. 제안된 시스템은 시설물의 상태 정보를 수집하기 위하여 다양한 종류의 센서를 사용한다.

ABSTRACT

Usually, it is possible for human administrator to control the facilities manually or automatically using sensors in order to manage the fixed electricity facilities. However, it is difficult to collect the status data of those facilities in the central management system. In this paper, we propose the electricity facility management system to collect the status of facilities using the Zigbee networks. the proposed system exploits the various types of sensors, such as motion, heat, optical, etc, to measure the states of the facilities

키워드

시설물관리, 지그비, 센서데이터베이스, 센서

Key word

facility managements, Zigbee, sensor databases, sensors

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## Ⅰ. Introduction

The Ubiquitous Sensor Network(USN) is composed of sensor nodes which measure the status of a real place like a light, a noise, a temperature or a motion. The measured values are transferred to base nodes through the wireless network. The Zigbee[1], one of the USN, is the network method which exchanges data in 10m ~ 15m ranges and consumes little energy. Since a Zigbee module is small and cheap, it is possible to build the networking paths to transfer the status of electronic facilities at low costs.

Usually, to turn on/off electricity facilities of a large building, the facilities should be turned on/off manually by a human manager or automatically by themselves using motion sensors. Under non-networked environments, it is difficult to transfer the status of places where facilities are placed to the central management system. For the efficient management, it is necessary to acquire the various status of places and transfer the data to the central management system through a network.

[2][3][4][5] shows the system based on the Zigbee to manage electricity facilities. However, most systems do not collect the status of places where facilities are placed and exploit the Zigbee simply in order to control the switches of facilities remotely. Few systems also use only single type of a sensor even though they acquire the states of the places.

In this paper, we propose the electricity facility management system to exploit more than two types of sensors to get the various status of a facility and a place. The acquired data are transferred to the central management system of a server by using the Zigbee network. The user of the server makes a decision based on the collected status and controls the switch of the facility remotely through the Zigbee network.

In section 2, we discuss related works that build a facility management system based on the Zigbee. Section 3 describes the electricity facility management system we propose. The system flow are presented in section 4. Section 5 shows the implementation of the prototype system and section 6 gives a summary.

## Ⅱ. Related Works

The Zigbee[1] network is the standard for a home automation and a data networking which has a low data transfer rate in 10m ~ 20m ranges. It aims for a network market which requires a small size, a low power consuming, a low price unlike IEEE802.11 or 802.15 and provides a simple function at 911/868 MHz or 2.4GHz.

Since the data transfer rate is 40~250bps, the Zigbee can support only the low speed of a data network. However, it has the simple complexity of a circuit structure and supports 255 ~ 650 thousands clients on a single network. Specifically, since it is 1.5$ for each unit and consumes only 5Am, it is expected to be used widely in the application domains such as an automation, a logistics and a monitoring, etc.

In [2], they propose the system which collects and controls the remote facility by using the Zigbee. However, they have problems to make a decision under the limited information because the collected data is only the value of the optical sensitivity.

[3] shows the remote control system of a facility based on the Zigbee. This system can turn on/off each switch separately or all switches at the same time. However, since it does not collect the status of facilities, it is difficult to manage the facilities efficiently. In [4], they present the Zigbee based detection system for a fire. In this work, the system detects the fire by using an infra sensor and a heat sensor. If the fire is identified, the information is transferred to a central station through the Zigbee network. However, this work simply aims for the fire detection, not a facility management.

## Ⅲ. Facility Management System

Using an optical sensor, a heat sensor and a motion sensor, the system acquires the status data of a facility and a place where the facility is placed. The sensors measure and generate the status data under predefined conditions.

To acquire the status of sensors, the system exploit the ZigbeeX sensor module based on ATmega128 CPU. The surge module collect the status transferred by the Zigbee network and send the aggregated data to the management system using RS-232C communication. Table 1 shows the description of exploited sensor modules.

표 1. 센서 모듈 개요
Table 1. The description of exploited sensor modules

| Hardware Item | Description |
|---|---|
| Micro Controller | ATmega128 (program 128Kbyte SDRAM 2KB EEPROM 4KB AD 10bit 8Channel) |
| RF part | CC2420 2.4GHz Zigbee(IEEE 802. 15. 4) |
| Security | DSSS |
| Transfer BPS | Maximum 250K BPS |
| Base sensor | temperatue, moisture, optical, RTC |
| Power | 1.5V AA 2ea 또는 1.2V Rechargeable battery 2ea |
| Length | 40mm × 70mm |

The management system puts together status data which are collected from each sensor and support the decision making of a user to manage facilities. To do these works, the system provides the necessary information such as the present states of facilities where the sensors are attached or the usage histories to the user.

표 2. 관리 시스템 기능
Table 2. The part of functions of the management system

| Process No. | Process name | Description |
|---|---|---|
| PR001 | Search Building | Building search and list display using the name of a building |
| PR002 | Inquiry of building data | Display the property of the searched building |
| PR003 | Modify the building data | Modify the property of the searched building |
| PR004 | Display the location of the building | Display the location of the searched building on the screen. Inquiry the building data on a click |
| PR005 | Display the blue print of the floors | Display the blue proint of a floor in the selected building |
| PR006 | Display the location of the Lab | Display the location of the Lab on the blue print of the floor |
| PR007 | Display the blue print of the Lab | Display the blue print of the Lab on a click |
| PR008 | Inquiry the data of the Lab | Display the Property of the Lab on the blue print of the Lab |
| PR009 | Display the light Data | Display the light data of the Lab |

Table 2 shows the part of functions which the proposed management system provides. The system displays maps of each building and floor to manage and supports the state inquiry and update. It is also possible to search and update the state of rooms on each floor in the building. To know the states of sensors, the system provides a sensor state inquiry and controls each facility separately according to the acquired data of sensors

## Ⅳ. The System Flow

When a facility is turned on, a heat sensor, a motion sensor and an optical sensor are activated systematically. For example, a heat sensor activates a motion sensor if the measured temperature of the facility or the place where the facility is established is beyond a predefined threshold. If a person is identified by the motion sensor, the system turns on the optical sensor and measures the sensitivity of the place. the measured data of sensors are collected to the surge module by the communication between sensors. Fig 1 shows the data processing protocol between sensor modules.

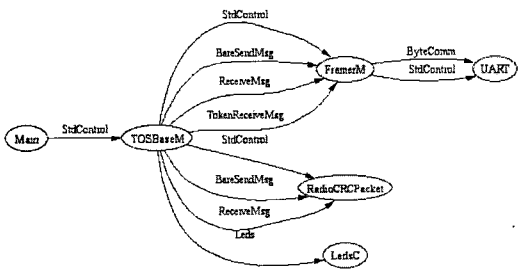


그림 1, 센서간의 통신 프로토콜
Fig 1. the communication protocol between sensors

Fig 2 shows the data collection process from temperature and moisture sensors to the management system.

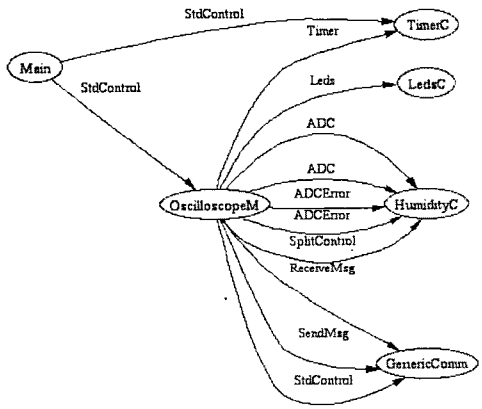


그림 2. 센서 데이터 수집
Fig 2. data collection process from sensors

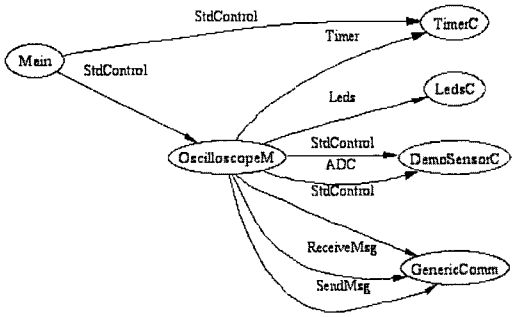


그림 3. 광 센서 데이터 처리
Fig 3. the data processing for the optical sensor.

Fig 3 shows the data processing to acquire data in the optical sensor. When the states are collected, the system notifies the states and asks for the user to make a decision to control the facility. If the user decides to turn on the facility, the system acquires the states of the next place. However, if the user turns off the facility, the system executes the relay actions of the Zigbee modules in order to turn off the facility remotely. Fig 4 shows the data processing to control the facility using the relay module.

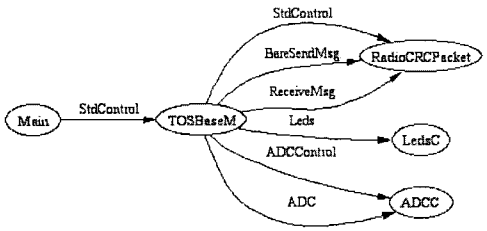


그림 4,시설물 제어 데이터 처리
Fig 4. the data processing to control a facility

## V. Implementation

To simulate the environment of a building where sensors are placed, we built the model of a building. The modeled building is composed of the office, the rest room and the computer room. Fig 5 shows the basic blue print of the modeled building.

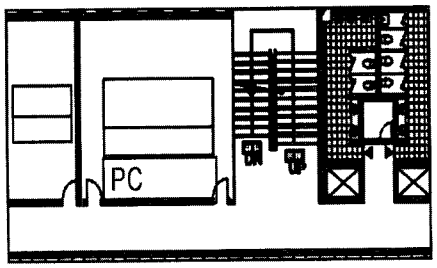


그림 5. 빌딩 모델 청사진
Fig 5. the blue print of the modeled building.

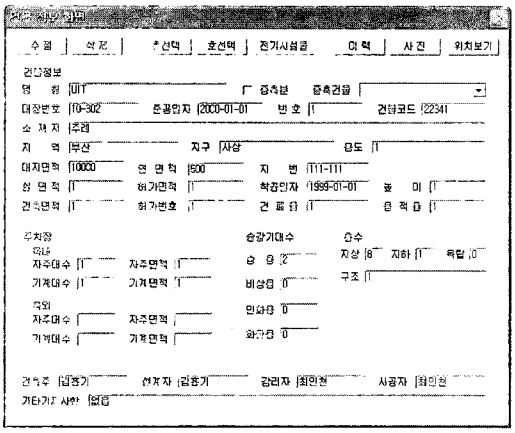

그림 6. 검색된 빌딩 속성
Fig 6. the property display of the searched building.

The implemented system exploits the ZigBex and each sensor is attached by the ZigBex unit. The management system is built on top of the Intel based server which has 1G main memory. Fig 6 shows the property of searched building in the system. when a user select a modify or delete button, the property of the building is modified or deleted

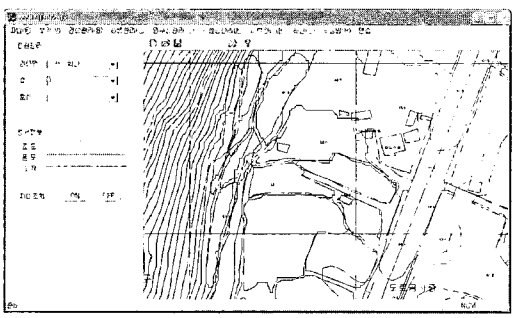

그림 7. 지도 디스플레이
Fig 7. the Map display.

Fig 7 shows the map of whole facilities which the system manages. In the map, it displays the whole lands where the buildings are located, the selected building and the locations of labs, etc.

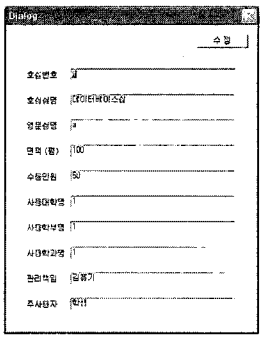

그림 8. 연구실 속성
Fig 8. the property display of the selected lab.

Fig 8 shows the property display of the searched lab. When a user clicks a modify button, the user is able to modify the property of the lab. Fig 9 shows the property of the searched facility.

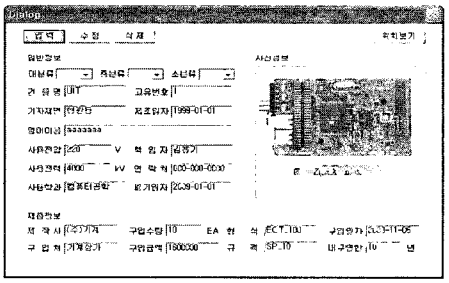

그림 9. 시설물 속성
Fig 9. The Property of the facility.

## VI. Conclusion

Usually, to manage the electricity facilities of a large building, the facilities should be turned on/off manually by a person or automatically by a single sensor. However, under non-networked environments, it is difficult to control facilities effectively because it is difficult to collect the real-time states of places where the facilities are placed.

In this paper, we show the electricity facility management system to exploit more than two types of sensors to get various data of a electricity facility and a place. In the proposed system, the acquired data are

transferred to the management system of a serer by using the Zigbee network. The benefit of the proposed system is to provide the real-time states of places where the failities are placed to a user and help to the efficient decision making of the user.

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