

## Soundness monitoring system of livestock facility based on wireless sensor network

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**Abstract.** This paper suggested the soundness monitoring system of livestock facility based on wireless sensor network. Recently, the methods that evaluate the soundness of structure are being researched frequently. The system that forecasts the damaged parts by analyzing the data acquired from the sensor the acceleration sensor combined with GPS sensor and forwards that to the users was suggested in this paper. For that, the integrated sensor and client were designed and implemented and it was checked if the system operates normally through the test.

### 1 Introduction

The soundness monitoring system of livestock facility based on wireless sensor network was suggested in this paper. In case of the system that uses optical fiber displacement sensor, the system was implemented by using the bending loss phenomenon of optical fiber to carry out the structure soundness monitoring announced in 2011. Bending loss is the physical phenomenon that the light is lost by bending when the light processes in the straight optical fiber core. The displacement of the structure was estimated in reverse by measuring the strength of bending loss generated from the displacement at the state light intensity that spreads the inside of optical fiber displacement sensor does not have the loss using such phenomenon. And GUI-based real-time monitoring system was developed using LabVIEW software[1][2]. In 2009, the soundness of the bridge was evaluated by using speed & impedance-based wireless sensor nod. The type of damage was analyzed using vibration characteristics acquired from the structure and impedance characteristics acquired from surrounding of tendon and the proper detailed search method was applied along the damage[3][4]. A number of system that manages the specifications or controls the facilities by jointing ICT technology with cattle shed were developed in general. The wireless sensor network-based cattle shed management system that uses bio and environmental sensors suggested the environment monitoring and environment improvement in 2013. The system consists of monitoring nod and environment controlling nod and the effectiveness was evaluated. Now that it enables massive livestock industry environment and environment improvement, real-time data

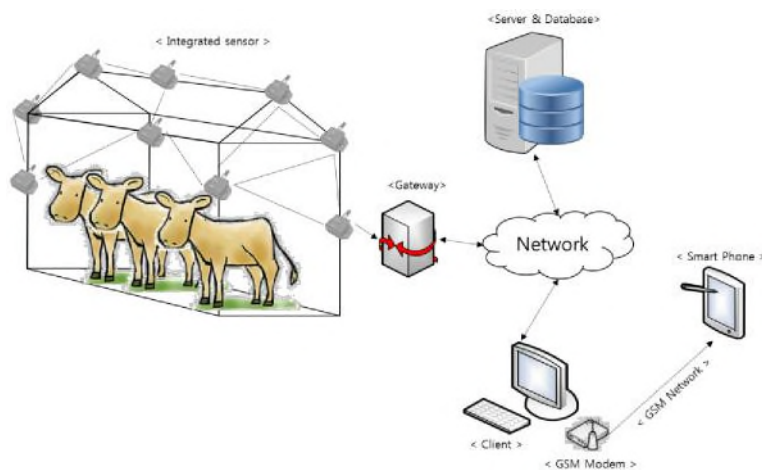
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was collected along the environment and optimized environment was controlled in case of active correspondence along the situation, optimized living requirement of livestock and occurrence of diseases[5]. A number of systems that manage the specifications of cattle shed or control the environment were researched but the researches that prevent the damage caused by natural disaster such as heavy snow, heavy rain and gale were carried out rarely. In this paper, the system that forecasts the damaged parts by analyzing the data acquired from the sensor that acceleration sensor combined with GPS sensor and forwards that to the users were suggested not like the existing system. The composition of this paper was as following. The design and implementation of the system suggested in the main subject were explained. And the results from the test and expectancy effect were offered in the conclusion.

## 2 Soundness monitoring system of livestock facility

The composition of livestock facility soundness monitoring system based on wireless sensor network suggested from this paper is as shown in Fig. 1. It consists of the sensor that measures the positional change and vibration of facility materials, gateway that plays the transit role, database that stores the transferred data, middleware that analyzes data, client that forwards the analysis results and alarm, GSM modem to transfer the text and smart phone that the users have. The system stores the data measured by the sensor that GPS combines with acceleration at database of server through gateway. Server analyzes the data stored at database. The client indicates the weak point based on the position of sensor using the analysis results and notices the users the fact that weak point occurs. The user recognizes the fact that weak point occurs at the livestock facilities through the data forwarded from client and takes follow-up action.



**Fig. 1.** Configuration of livestock facility soundness monitoring system

Block diagram of integrated sensor that combines GPS with acceleration data is shown as Fig. 2. The integrated sensor nod consists of MCU that is the processing unit, Zigbee module for communications, memory for data storage, power to supply electricity, GPS sensor to know the location, 3-axes acceleration sensor that detects the vibration and ADC that converts the measured sensor value to digital.

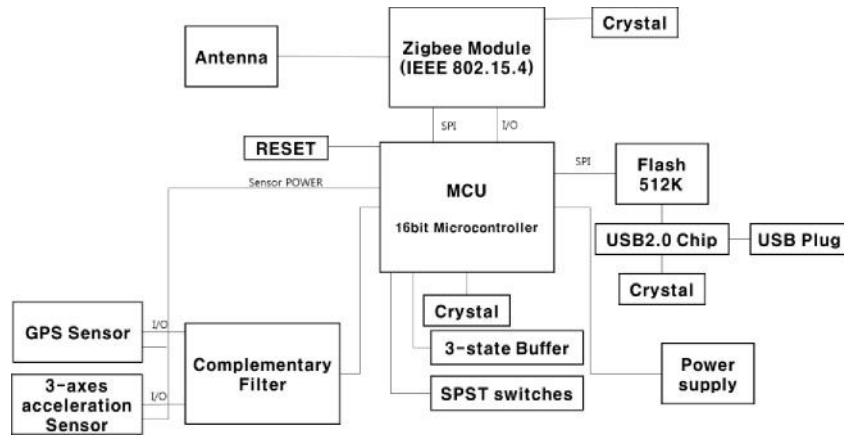


Fig. 2. Block Diagram of Integrated Sensor

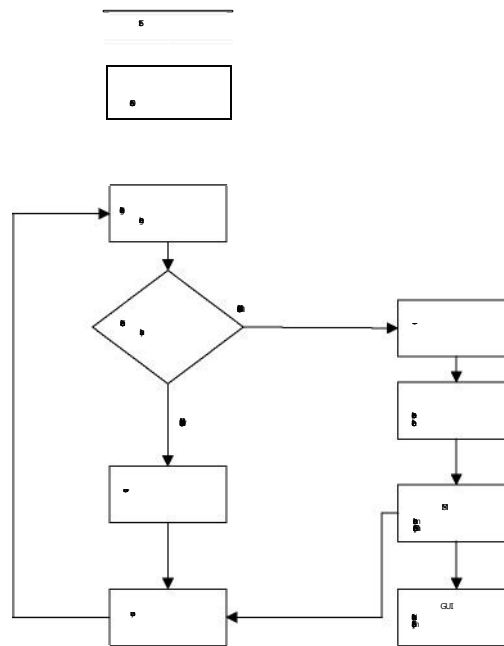


Fig. 3. System Process  
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The suggested system operates like Fig. 3. If the data is acquired at the integrated sensor, it is saved at database through gateway and server indicates the position generated from the change through client in case there is a positional change comparing it to the existing designated position. And, if the change occurs, it is supposed to notice that the disorder occurs with smart phone of the set user through MMS. In case positional change or vibration is not detected, it is supposed to operate in standby mode.

The client that shows the location that the displacement is generated is as Fig. 4. The position of each sensor is indicated in greenhouse located in the center and it shows the occurrence of disorder in red color. And, phone number of smart phone of the user can be saved in the text box at bottom.

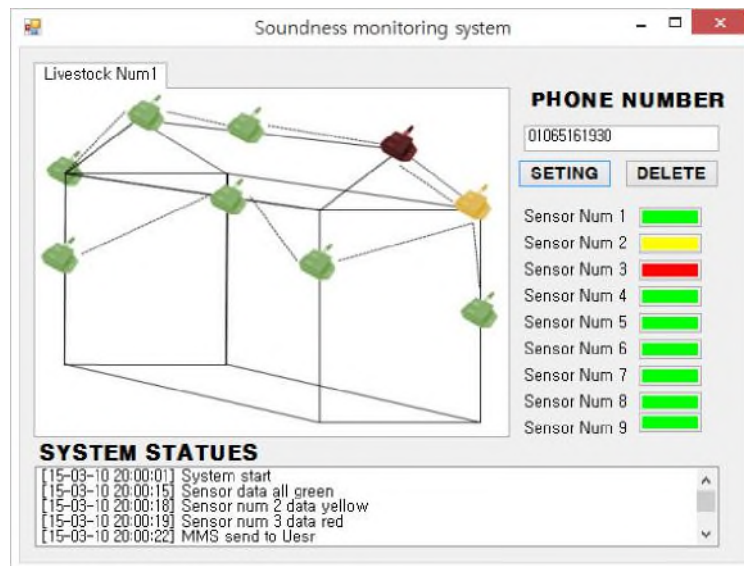


Fig. 4. Client Graphics User Interface

### 3 Conclusion

In this paper, wireless sensor network-based soundness monitoring system of livestock facilities was suggested and the test was carried out by attaching the sensor to stick. The sensor collected data at the accuracy of 97% when bending the stick or change its location and it was recognized that it took time of 3 seconds to forward that to client. And, it showed that the client changed and it took about 5 seconds to send MMS to smart phone. It could be checked that the system operated normally from that. The system suggested in this paper could save the cost required for recovery by decreasing the damage of facilities now that it enabled prompt correspondence to natural disaster such as heavy snow.

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