APPLICATION OF USAN TECHNOLOGY
FOR MONITORING TEMPORARY CONSTRUCTION

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ABSTRACT: Temporary structure is prone to construction accident due to the dynamics in construction. Any unexpected adversary effect can cause construction failure in temporary structures. Therefore, the structure should be continuously monitored to understand its behavior during construction. The objective of this study is to test the feasibility of the ubiquitous sensor network (USN) technology in collecting construction data during the construction operation of temporary structures. This study presents the research result at the Construction System Integration Laboratory (CSIL) at the Pusan National University. In the study, various sensors were integrated into the USN to collect data of a temporary structure in a concrete operation. Using a monitoring system, the structure was monitored to find out whether any excessive structural behavior occurred. The data were used to provide a warning signal for evaluation as well as repair.

Keywords: Temporary Structure, Monitoring, USN, Structural Behavior

1. INTRODUCTION

Contractors should be aware of safety to avoid accidents during concrete placement operation. They are, however, often negligent in paying necessary attention to the temporary work because it is not the permanent deliverable on contract. Without the proper planning and execution, any negligent management can lead to a catastrophic construction failure (Fig. 1). The structure, therefore, should be continuously monitored to understand its behavior during construction. Researchers have tried to utilize ubiquitous sensor network (USN) technology in monitoring structural behaviors [1].

This study presents a USN-based monitoring system in collecting construction data during the construction operation of temporary structures. A number of sensors were mounted onto the USN board to collect data of a temporary structure in a concrete operation. Using the monitoring system, a temporary structure was monitored to find out whether any excessive structural behavior occurred.

Fig. 1 A case of construction failure

2. RESEARCH GOAL

The research goal in this study is to test the feasibility of the USN-based monitoring system when it is applied to temporary work during construction. The USN technology was used to wirelessly transmit collected data from the formwork to a host PC station (Fig. 2). The study was done on a in-door test bed to simulate the temporary construction formwork.
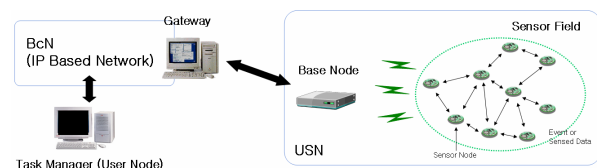

Fig. 2 Ubiquitous environment to collect field data

3. RESEARCH METHOD

The USN technology is based on a wireless local network that can help collect real-time data. The USN can connect multiple sensor nodes in a certain area. Many applications were developed in such areas as fire protection, remote observation, and health monitoring. ZigBee is a standard of operating systems for building a Wireless Personal Area Networks (WPANs). The USN board is connected to a host PC through serial interfaces. The collected data were transmitted to the USN board connected to the PC. A local wireless networking environment was setup in the host PC using the TinyOS [2].

A test bed was developed to test data acquisition in a laboratory environment. Four types of sensors were used in this study: 1) ultrasonic sensor, 2) strain gauge, 3) load cell, and 4) inclinometer (Fig. 3). The sensors were connected into the USN boards to form USN nodes. These sensors generated data of distance, strain, load, and inclination, respectively. The USN nodes wirelessly transmitted the data in a form of radio frequency signals to the data acquisition board of the host PC.
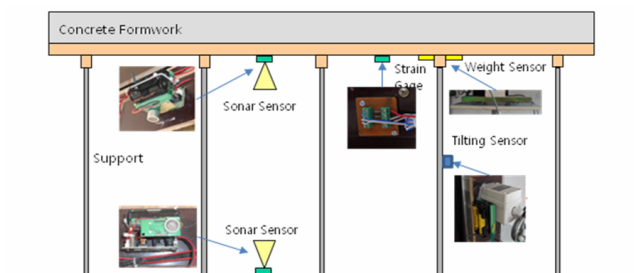

Fig. 3 USN test beds for data acquisition

4. DATA ACQUISITION

An interface program was developed for the host PC to communicate with the USN boards in the wireless network using the TinyOS program. The program displays the collected data to describe the condition of the temporary structure. The contractors can use the information displayed on the monitoring system, and find out whether the operation is being executed as planned during the concrete placement operation.
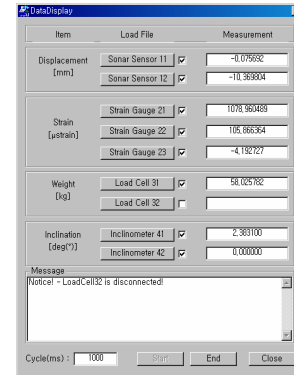

Fig. 4 Data acquisition from USN boards

4. CONCLUSION

The USN technology is being implemented in various purposes because its effectiveness in wireless collecting field data. Since data acquisition is important in construction, the technology can be provide a promising opportunity to improve construction technology in remote monitoring, and needs to be further studies to reap the benefits.

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