Monitoring System of Temperature and Humidity

Yong-Cheol Kim[1], Gyu-Sik Kim[2*]

[1,2]*Professor, Department of Electrical Engineering, The Univ. of Seoul, Seoul, Korea*

Abstract – In this paper, an IAQ monitoring system, which uses temperature and humidity sensor modules and a data processing module with CDMA communication capabilities for the transmission and management of the measurement results, was implemented. Through some experimental studies, we believe that the implemented IAQ monitoring system would be helpful in protecting many people from the dangers associated with indoor pollutants exposure.

Keywords – IAQ monitoring system, temperature, humidity, CDMA, subway station .

1. INTRODUCTION

The SHT1x is a single chip relative humidity and temperature multi sensor module comprising a calibrated digital output. Application of industrial CMOS processes with customized post processing ensures highest reliability and excellent long term stability [1]. The device includes two calibrated micro-sensors for relative humidity and temperature which are seamlessly coupled to a 14bit analog to digital converter and a serial interface circuit on the same chip. This results in superior signal quality, a fast response time and insensitivity to external disturbances (EMC) at a very competitive price. Each sensor is calibrated in a precision humidity chamber and the calibration coefficients are programmed into the one time password (OTP) memory. These coefficients are used internally during measurements to calibrate the signals from the sensors. The 2-wire serial interface allows easy and fast system integration. Its tiny (7x5x3mm) size and low power consumption makes it the ultimate choice for even the most demanding applications including automotive, instrumentation, medical equipment, heating, ventilation and air conditioning systems (HVAC), portable consumer electronics and battery-operated controllers.

In [2], they presented an embedded wireless sensor network prototype for remote room temperature monitoring. This network will be used for management of fire rescue operations. In [3], the system is developed which monitors the radon level, using a PIN diode for detecting the radon particles and a data processing module with Wi-Fi communication capabilities for the transmission and management of measurement results. In [4], they presented the development of a radon concentration monitoring system, which used the Safety Siren Pro Series 3 Radon Detector for detecting the radon particles and a data processing module with WCDMA communication capabilities for measurement results transmission and management.

For our experiments, we used a temperature sensor SHT11 connected to ATmega 128L CPU board in order to monitor an indoor air quality, especially for subway stations.

2. TEMPERATURE SENSOR MODULE

Temperature and humidity can also be used for the analysis and prediction of IAQ in a subway station [5, 6]. As for temperature and humidity sensors, the SHT11 manufactured by Sensirion was chosen in this study. It is a single chip relative humidity and temperature multi sensor module, comprising of a calibrated digital output. It is coupled to a 14-bit analog to digital converter and the 2-wire serial interface and internal voltage regulation, which allow easy and fast system integration. The pin assignment of SHT11 is shown in Fig. 1. Fig. 2 shows that the SHT11 is connected to ATmega 128L CPU board, which transmits temperature and humidity data to the desktop PC using RS232C interface. Fig. 3 shows the temperature test using a finger.

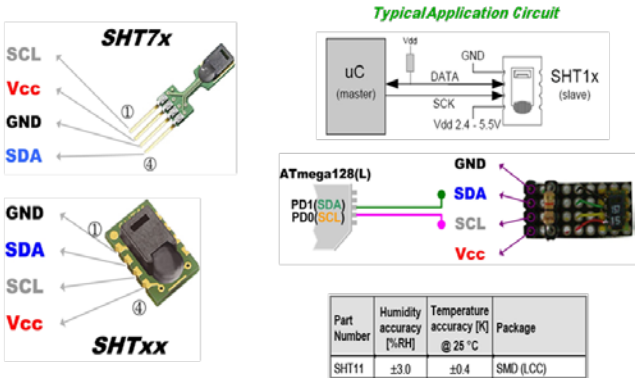


Fig. 1. Typical application circuit and pin description of SHT11

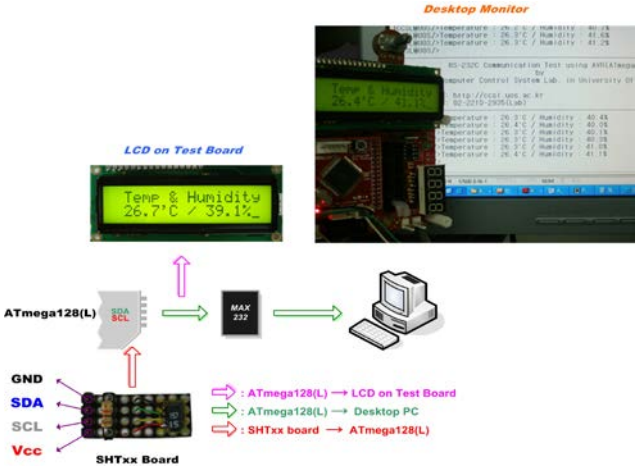


Fig. 2. Implemented temperature sensor module connected to ATmega128 CPU board

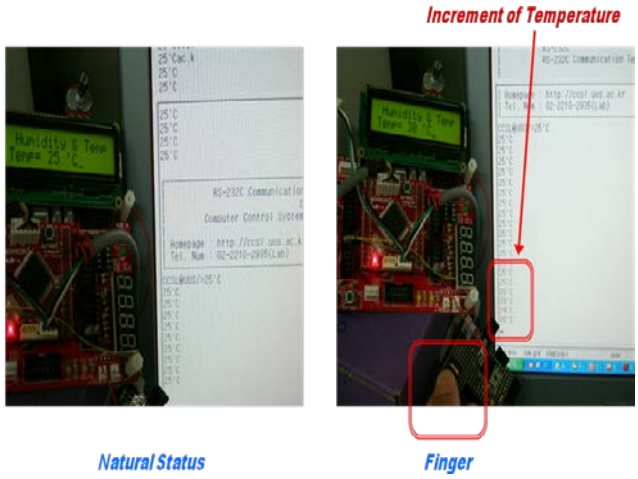


Fig. 3. Temperature test using a finger

3. TEMPERATURE SENSOR BASED MONITORING SYSTEM

This paper presents the implementation of an IAQ monitoring system, which uses temperature sensor modules and a data processing module with CDMA (Code Division Multiple Access) communication capabilities for the transmission and management of the measurement results. The need for air quality measuring over large underground subway areas, such as waiting rooms, platforms and tunnels, necessitates wireless connectivity for the measuring device. Wireless sensor networks represent a vast and active research area in which a large number of applications have been proposed, including indoor air quality monitoring and control, structural health monitoring, and traffic monitoring. Fig. 4 shows an air quality monitoring system for subway stations. The sensor and CDMA modules were installed at a waiting room, a platform, an outdoor site, and tunnels. MDT-800 (Telit, UK) is used for CDMA communication modules, while the MDT-800 is a complete modem solution for wireless m2m applications.

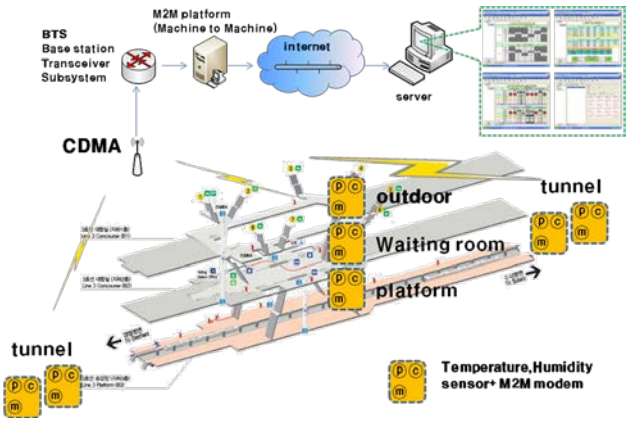
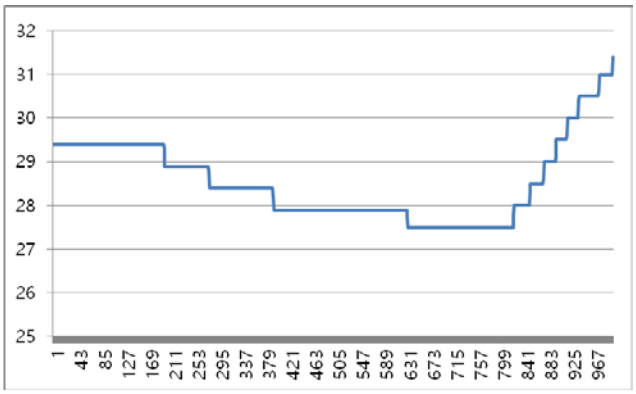


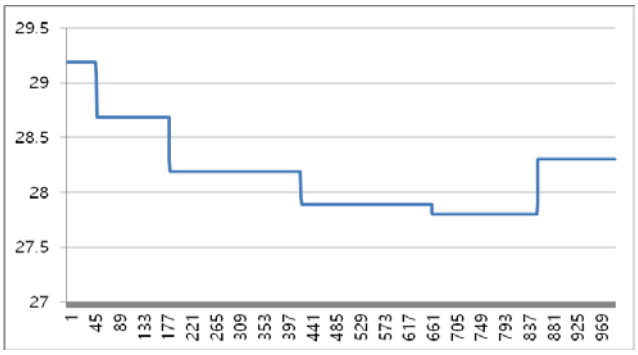
Fig. 4. Temperature sensor-based IAQ monitoring system for subway stations

The MDT-800 with a frequency band of about 800MHz is ideally suited for real-time monitoring and control applications without the need for human intervention between remote machines and back office services. The measured air quality data were transmitted to the m2m platform via the CDMA Repeater and the BTS (Base station Transceiver Subsystem), eventually reaching the air quality monitoring server through the internet. Fig. 5 and Fig. 6 show the measured temperature in an outdoor site and a tunnel of a subway station which were monitored for 1000 minutes. Fig. 7 and Fig. 8 show the measured relative humidity in an outdoor site and a tunnel of a subway station which were monitored for 1000 minutes.



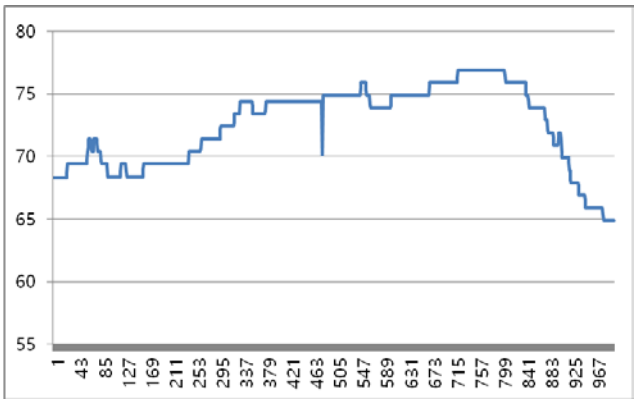
(x-axis : minute, y-axis : ^{o}C)

Fig. 5. Temperature in an outdoor site of a subway station



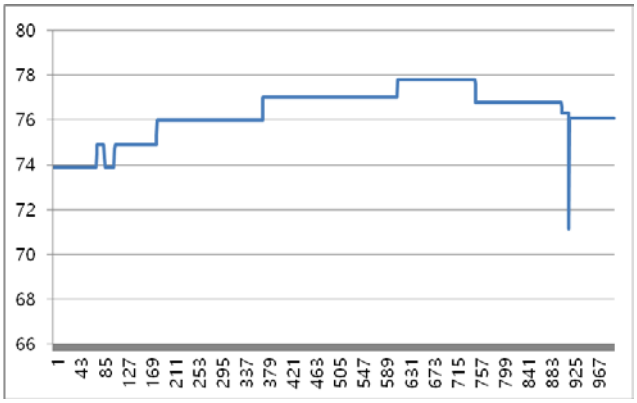
(x-axis : minute, y-axis : ^{o}C)

Fig. 6. Temperature in a tunnel of a subway station



(x-axis : minute, y-axis : %)

Fig. 7. Relative humidity of an outdoor site of a subway station



(x-axis : minute, y-axis : %)

Fig. 8. Relative humidity of a tunnel of a subway station

4. CONCLUSION

Wireless sensor networks represent a vast and active research area in which a large number of applications have been proposed, including indoor air quality monitoring and control, structural health monitoring, and traffic monitoring. In this paper, an IAQ monitoring system, which uses temperature and humidity sensor modules and a data processing module with CDMA communication capabilities for the transmission and management of the measurement results, was implemented. Through these experimental studies, we believe that the implemented IAQ monitoring system would be helpful in protecting many people from the dangers associated with indoor pollutants exposure.

5. ACKNOWLEDGEMENTS

This work was supported by the Korea Ministry of Environment (MOE) as ‘‘the Environmental Health Action Program.’’ This work was also supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIP) (No. 2016011249).

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