

## **A study on BEMS-linked Indoor Air Quality Monitoring Server using Industrial IoT**

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### **Abstract**

*In this paper, we propose an interworking architecture for building indoor air quality monitoring server (BEMS) using IIoT (Industrial Internet of Things). The proposed monitoring server adopts IIoT-based standard protocol so that interaction with BEMS installed in existing buildings can be performed easily. It can effectively communicate with indoor air quality measurement sensor installed in the building based on IIoT, Indoor air quality monitoring is possible. We implemented a proposed monitoring server, and confirmed the availability and monitoring of data from sensors in the building.*

**Keywords:** *IIoT, BEMS, Indoor Air Quality, Industrial Standard Protocol, Monitoring*

### **1. Introduction**

Recently, with the rise of the industry, environmental problems have been emerging. In order to mitigate environmental problems, we are striving to solve problems through environmental regulations and agreements at the national level.

In addition to this, related researches have been actively carried out to mitigate environmental problems through efficient management through the introduction of advanced technologies related to the 4th Industrial Revolution[1][2].

In response to international trends, the problem of deterioration of air quality such as fine dust generated from automobiles, industrial plants, etc., recently emerged internationally [3], at the same time demand for detection, treatment, and monitoring of fine dust has increased, and various solutions related to this have been derived [4]. In order to manage the deteriorated air quality, there is a technology that can maintain an optimal indoor condition by measuring and managing the indoor air quality by targeting an intelligent building. However, in order to operate in conjunction with the existing ventilation system in an in-Built form, there is a difficulty in interworking with additional functions and maintenance[5]. Therefore, in this paper, it is proposed IIoT is used to monitor effectively the air quality with connected installed sensors in the required space and the IIoT based BEMS-linked indoor air quality monitoring server interworking structure is

constructed and operated in a form that can be easily interlocked with the existing BEMS system.

The proposed monitoring server is easy to integrate with existing BEMS system by applying MODBUS protocol, which is a standard general communication protocol of industry, and it operates based on IIoT to facilitate communication with BEMS from indoor air quality measurement. In addition, by using the IIoT, it is possible to monitor the indoor air quality more effectively by constructing the monitoring server with the increased scalability.

The order of this paper is as follows. In Chapter 2, BEMS-linked indoor air quality monitoring server using industrial IoT design was performed. In Chapter 3, we implemented a real server and confirmed the operation of monitoring server in conjunction with sensors capable of measuring indoor air quality in buildings. Finally, Chapter 4 concludes this paper.

## 2. The Design of BEMS-linked Indoor Air Quality Monitoring Server using Industrial IoT

In this chapter, BEMS-linked indoor air quality monitoring server using industrial IoT design is performed. The architecture of the proposed system is shown in Fig 1.

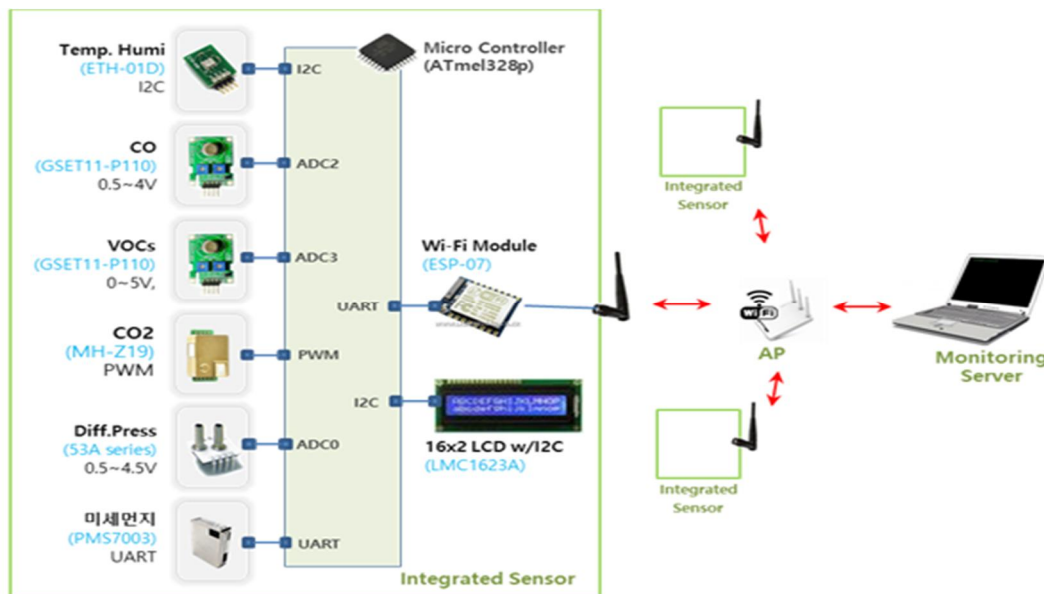


Figure 1. The architecture for the proposed system

Sending collected sensor measurements to the monitoring server, the monitoring server collects, stores, and monitors the data received from the integrated sensor. The sensors that measure indoor air quality and transmit data are integrated with sensors capable of measuring various indoor air quality, so that they can be embedded in one device and transmitted.

Based on the designed system architecture, air quality measurement values are collected from wired / wireless IoT air quality measurement sensor for implementation of monitoring server that is easy to link with BEMS and through the wireless communication, the monitoring server is designed to acquire and control indoor air quality data by linking with BEMS using an industry standard protocol.

### 3. The Implementation and Testing of BEMS-linked Indoor Air Quality Monitoring Server using Industrial IoT

In this chapter, the actual implementation is performed based on the designed BEMS-linked indoor air quality monitoring server using Industrial IoT, and the specifications used for the implementation and testing of the proposed monitoring server are shown in Table 1 below.

**Table 1. The test devices of BEMS-linked Indoor Air Quality Monitoring Server using IIoT**

Item List	Model
PC	Samsung Notebook
OS	Windows 10
HMI	V-EVE
CO2	MH-Z19
Diffrence Pressure	53A Series
Fine Dust	PMS7003

The monitoring server used was a general notebook with Windows 10 operating system, which can be installed and operated in the actual building management room. However, considering the mobility of managers such as inspectiCon/patrol in the building, It is selected and implemented so that it can operate in general purpose equipment, not professional equipment.

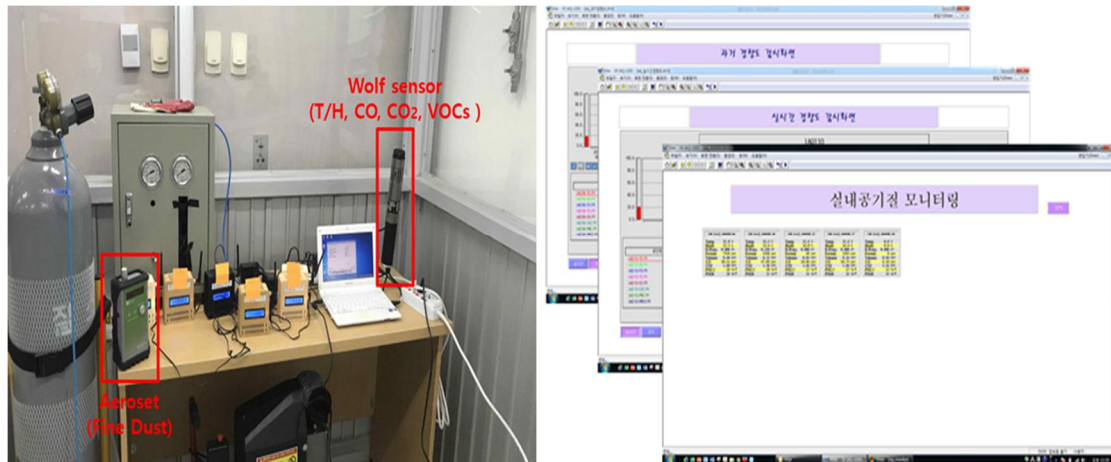
There are various solutions such as EtherNet/IP, PowerLINK, CC-LINK, and Modbus TCP / IP as the IIoT industry standard protocol in order to acquire indoors air quality measurement data and to link with data transmission and BEMS.

In this proposed system, we implemented by applying Modbus TCP/IP. It is a solution that combines IoT with an existing industry standard protocol based on serial communication. It has the advantage of existing Modbus protocol and has advantages of IoT. In addition, the indoor air quality monitoring screen was implemented using the development tool version (V-EVE) of the general-purpose HMI. In the case of the tools used for the development, web and mobile support is possible, so that the building manager is applied in order to obtain convenience in the actual site.



**Figure 2. The user interface of indoor air quality monitoring server**

As shown in Fig. 2, various indoor air quality measurement elements such as temperature, humidity, carbon monoxide, carbon dioxide, volatile organic matter, differential pressure, fine dusts 1.0, 2.5, and 10 are implemented to monitor indoor air quality tendency by time.



**Figure 3. The testbed and result of proposed system**

As shown in Figure 3, we constructed the actual test bed and conducted the monitoring server experiment. The test bed is configured to transmit various types of information to a person who manages indoor air quality by using indoor air quality measuring sensors of different models. Based on the actual environment, we confirmed that the monitoring server and the user interface are operating normally. As a result, it was confirmed that indoor air quality measurement data can be obtained normally. In addition, it is possible to intuitively confirm the tendency when the graph is expressed in units of 1 hour according to the tendency of the indoor air quality, and it is confirmed that the trend can be grasped by retrieving the past acquired data by continuously storing the acquired data.

#### 4. Conclusion

In this paper, we proposed BEMS-linked indoor air quality monitoring server using Industrial IoT which is installed in the required space, effectively monitors it by interlocking with sensors that measure the air quality. For implementation, Industrial IoT based modbus protocol, which is the standard general communication protocol of the industry, was implemented to facilitate interworking with the existing BEMS system. The proposed system was confirmed that indoor air quality monitoring can be more effectively performed by constructing a scalable monitoring server capable of accommodating various types of indoor air quality measurement sensors.

It is expected that it will be able to effectively manage the interior of the building by linking with actual BEMS using this paper, and it can be used as a valuable reference material for various application technologies and services based on Industrial IoT.

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