

## **IOT-BASED AIR QUALITY MONITORING ALERT SYSTEM IN KINDERGARTEN FOR CHILDREN WITH ASTHMA**

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**ABSTRACT** - Air pollution has become the main concern in the world because it has increased rapidly nowadays. A lot of health issues are caused by the air pollution especially related to breathing such as asthma. Children are much more vulnerable to asthma than adults, especially in a crowded and closed place such as kindergarten. Pollutants in the air are also cannot be seen thus making it more difficult to avoid them. The aim of this research is to develop a prototype of IoT-Based Air Quality Monitoring Alert System to help teachers to monitor the air quality in the kindergarten thus reducing the risk of children getting asthma attacks. The prototype has been developed using NodeMCU ESP32, Adafruit IO, and Telegram. The sensors that have been used are SDS011 sensor for measuring particulate matter and DHT11 for measuring temperature and humidity. This research has tested the functionality of the prototype and tested the network in terms of response time to send the alert notifications. Through the result gained from this research, it was proven that the prototype can successfully monitor the air quality inside the classroom and send the alert notifications to the teachers via Telegram.

**Keywords:** IoT, NodeMCU ESP32, Adafruit IO, SDS011, DHT11

### **1. INTRODUCTION**

According to previous research, there are already a lot of IoT-based air quality monitoring devices that have been developed. This research has implemented the air quality monitoring in kindergarten. The objective of this research is to develop a prototype of IoT-Based Air Quality Monitoring Alert System to help teachers to monitor the air quality in the kindergarten. Other than that, another objective is to evaluate the performance of the prototype using functionality testing, network testing, and Technology Acceptance Model (TAM).

### **2. METHODOLOGY**

There are six phases in total of developing this prototype which are initiation, planning, design and development, experimentation, result analysis, and documentation phases. The experiment was conducted by powering up the prototype for seven hours per day for five days in kindergarten. Data were collected through Adafruit IO website. In network testing, there were eight scenarios involved in the network testing to find the response time for user to receive alert notifications via Telegram. The first three scenarios were set up to test the prototype different in environments while the other five scenarios were testing the impact of increasing distance between the prototype and mobile phone. Each of the scenarios has been tested three times to obtain average response time. A set of questionnaires was created and given to 15 respondents from several kindergartens in Kota Bharu, Kelantan. The questionnaire consists of two sections: Perceived Usefulness (PU) and Perceived Ease of Use (PEU).

### **3. RESULTS AND DISCUSSION**

After running the experiments, all results obtained from the functionality testing, network testing, and TAM were evaluated.

#### **3.1 Functionality Testing Result**

The values of PM10, PM2.5, Temperature, and Humidity obtained are shown in Table 1. It is proven that the prototype was functioning well with the results stated in Adafruit IO website.

**Table 1** Average result

Day	PM10 ( $\mu\text{g}/\text{m}^3$ )	PM2.5 ( $\mu\text{g}/\text{m}^3$ )	Temperature ( $^{\circ}\text{C}$ )	Humidity (%)
Monday	11.29	7.00	34.86	65.57
Tuesday	11.57	6.29	33.71	68.57
Wednesday	13.14	8.29	32.00	77.43
Thursday	22.43	18.00	32.71	76.00
Friday	23.00	19.00	34.00	74.29

### 3.2 Network Testing Result

The average response time obtained from three scenarios that is High Humidity, High Temperature, and High AQI were 3.04, 3.11, and 3.03 seconds respectively. The capability of the prototype in sending alerts through Telegram was influenced by environments. On the other hand, the average response time for the distance between prototype and mobile phone which are 1 m, 2 m, 3 m, 4m, and 5 m were 2.94, 3.59, 4.06, 4.51, and 4.92 seconds respectively. This showed that response time was influenced by the distance between prototype and mobile phone. However, it does not give a significant impact to the performance since the response time is still in acceptable range to notify the user.

### 3.3 Technology Acceptance Model (TAM) Result

The result obtained from TAM concluded that the prototype was shown to help with respondents' daily tasks in terms of PU. The other section, PEU, shows that the respondents feel that the IoT-Based Air Quality Monitoring Alert System is an easy-to-use system.

## 4. NOVELTY OF RESEARCH / PRODUCT

There has been many research that developed air quality monitoring system using IoT but on larger scales and using different hardware and software. For example, research by Sai et al. (2019) was about developing a prototype using Arduino Uno, MQ135 and MQ7 sensors, and ThingSpeak platform for monitoring. Besides, Cieplak et al. (2019) developed a prototype to monitor the air quality in city of Lublin using Raspberry Pi Zero and the data was stored using Apache Cassandra database. Furthermore, Jo et al. (2020) developed a prototype using STM32F407IG from STMicroelectronics and Amazon Web Services for data analyzation, visualization, and presentation. Our research has developed a prototype that not only can monitor particulate matter, temperature, and humidity through Adafruit IO website, but also can give alerts to the user through the Telegram application.

## 5. CONCLUSION

In conclusion, this research has achieved its objectives and the air quality monitoring alert system has worked and has been successfully tested. This prototype eases out the teachers in kindergarten to monitor the air quality that can benefit children health and wellbeing.

## REFERENCES

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