

Indoor Air Quality Monitoring System Based IoT

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Abstract

The accumulated CO₂ is not eliminated out and enough amount of oxygen is not supplied properly inside the indoor stadium. Players are most effected by this limited oxygen level, because they are actively playing continuously for hours. They feel suffocation, muscle cramps, fading etc. due to low content of oxygen in their body. Viewers in the stadium also get effected, especially people with respiratory problems. For the smooth and efficient process the condition of the indoor air should be detected early. Thus, the introduction of IOT based indoor air quality monitoring device (IAQD) will help to overcome this situation. It is helpful not only in the normal conditions, but also as a precaution in some dangerous conditions, for example: fire accidents, leakage of inflammable gases etc. early detection of such problematic condition by the IAQD will reduce the risk and get enough time to take preventive measures.

Keywords: *Indoor air quality monitoring platform, Corrent situation, Iot based plateform.*

INTRODUCTION

Now a days, atmospheric air is polluted a lot by evolving harmful gases from factories, vehicles, burning etc...Uncontrolled urbanization, forced to increase the atmospheric air pollution. Polluted air contains lot of harmful

substances, increasing in this content in the air can causes dangerous respiratory diseases. It effects human badly and big threats to life. About 7 million people dies every year by respiratory diseases caused by continues inhalation of polluted air [1].

Beyond the consequences of the atmospheric air, indoor air is more contaminated about 100 times than atmospheric air [2]. It have a direct impact on humans than outside air, because, indoor air have a limited environment and it is closed. Our system is implement in indoor stadiums. Indoor games are held in indoor stadiums where there is a closed environment and there is also lot of people are gathered inside the stadium. So, the condition of the air inside the stadium may be altered. The concentration of harmful air is high in the indoor air than outside air. So, there is a greater chance to inhale harmful substances directly into respiratory systems, especially to the players where they are actively playing get tired more fastly. The necessity of indoor air quality monitoring system become high at the day present. Advanced technologies are used today for effectively checking the quality of indoor air. Therefore, efficient and effective monitoring of indoor air is necessary to properly manage air quality [3, 4-5].

IOT (internet of things) and cloud computing are modern technologies developed recently to monitoring the indoor air quality. Integrating these technologies give a good effective results in indoor air quality management [6].

These IOT based indoor air quality monitoring system is developed to precisely monitor indoor air quality and efficiently transmit real time data to a cloud computing based web server using an IOT sensor network [7]. The cloud computing based web server introduced in this platform to analyze real time data and adds visual effects to illustrate the conditions of the indoor air quality.

METHODOLOGY

The important factor of this IOT based indoor air quality monitoring device is the accurate data measurement. The monitoring area is not constant it have an expandable interface. The IOT based indoor air quality monitoring device which detect the air quality in the perception layer of the platform. It consist of various sensors such as CO sensor, CO₂ sensor and a temperature humidity sensor. A LED strip are attached to the device and it emits light according to the quality of the air. When the quality of air changes, the LED fixed in the device changes the colure. Normally white color for good quality and red color for the very poor quality. It sends this signal message to web server with the help of Long Term Environment (LTE) modem which attached to the device transmits the detected data directly to the web server for recognizing and identifying

The components which comprised in this platform are:

- Carbon monoxide sensor
- Carbon dioxide sensor
- Temperature humidity sensor
- Microcontroller
- Network mode
- Led strip

Carbon Dioxide Sensor

Increase in the concentration of carbon dioxide inside the indoor stadium cause many problems. Hence the monitoring device uses a CO₂ sensor to monitor the concentration of CO₂. In this system uses a NDIR (non-dispersive infrared) CO₂ sensor to measure the CO₂ in the indoor stadium. An infrared (IR) lamp directs waves of light through a tube filled with a sample of air to words an optical filter in front of an IR light detector. The IR light detector measures the amount of IR light that passes through the optical filter. The band of IR radiation produced by the lamp is very close to the 4.26 micro absorption band of CO₂. Because the IR spectrum of CO₂ is unique, matching the light source wave length serves as signature to identify the CO₂ molecule. As the IR light passes through the length of the tube, the CO₂ gas molecule absorbed the specific band of IR light while letting other wave lengths of tight passes through. At the detector end,

the remaining light hits an optical filter that absorbs every wave length of light except the wave length absorbed by CO₂ molecule in the air sample tube. The difference between the amount of light radiated by the IR lamb and the amount of IR light received by the detector is measured. Since the difference is the result of the light absorbed by the CO₂ molecule in the air inside the tube, it is directly proportional to the number of CO₂ molecules in the air sample tube. This CO₂ measurement range is 0-2000 ppm up to 0-10000 ppm and its accuracy level is 40ppm +2% reading. The responds time is 30seconds.

Carbon monoxide sensor

CO sensor which detects the level of carbon monoxide in the particular environment. This unit has special time of electro chemical sensor which senses the presence of CO in the surrounding. It give out put in the form of two wire loop power. This device give accurate and reliable reading even in a critical surrounding. This measurement range is 0-300 ppm (analog device), 0-500 ppm (Modbus device). Accuracy level is + or -5 ppm or 5% of total reading from 0-300ppm, and its operating temperature range is -200 C to 500C. Humidity range is 15% RH to 95% RH.CO level should not exceed 25ppm as

per the standard guidelines of any health organization. Responds time is less than 35sec. it is connected to IOT based air monitoring system and it will control CO level in the indoor air.

AN IOT BASED INDOOR AIR QUALITY MONITORING PLATFORM

The IOT based indoor air quality monitoring platform is based on integration of cloud computing and IOT. The sensing devices sense and collect data to analyze air quality comprised of CO sensor, CO₂ sensor, and a temperature humidity sensor. Each device transmit data to webserver via the LTE module to determine air quality and visualize the result. The cloud computing based web server is faster and more flexible data processing functions. It can manage large amount of data. The cloud computing webserver have a greater accessibility and it is accessible through more number of browsers. The webserver provides a data base to store that data in the cloud.

The IOT platform is comprised of mainly three components:

1. Perception layer : The presentation layer is the sensing components to collect data using sensors or any measuring device.

2. Network layer: The network layer is responsible for transmitting the detected data using a wireless network module.
3. Presentation layer: The presentation layer allows data visualization and storage for efficient monitoring.

For the perception layer of the platform, multiple IOT based indoor air quality monitoring devices are used for detecting the data needed to analyze the air quality [8-9]. Also, the LTE modem is mounted in the devices as the network layer. The data collected from each of these devices were sent to the web server via LTE. For the presentation layer, a cloud computing-based web server is used for the platform. The server gathered the data to evaluate air quality based on the Indoor Air Quality. Managers and users with specified access to the monitoring data can continuously monitor air quality anytime and anywhere via smart devices. Another feature of the server is that it automatically sends a warning message to managers and other related personnel whenever the quality of air decreases. Therefore, they can react immediately to improve the air quality.

RESULT

IOT based indoor air quality monitoring platform is wirelessly transmitted the data

which is detected, to the web server. It detect the condition of the indoor air of the specific location where the device is placed. According to the quality of air it display different colors through LED strip attached to the device. The data also were saved in the database of the web server, which is useful in further studies and can be performed on trends of air quality. Based on the condition of air such as good, poor or moderate, the device which changed the color of LED to which yellow or red respectively. Immediately an alert message (popup message) will send to the manager. Then, the manager can monitor the air quality of the building and take steps to improve the air quality.

CONCLUTION

In this paper, the development of an IOT based indoor air quality monitoring platform is presented. Our system is implement in indoor stadiums. Indoor games are held in indoor stadiums where there is a closed environment and there is also lot of people are gathered inside the stadium. So, the condition of the air inside the stadium may be altered. It makes many breathing difficulties and problems especially to the players where they are actively playing and need sufficient oxygen. Oxygen is limited in this closed system of indoor environment, where the

CO₂ gas is accumulated, which is expelled out from lot of people. The contaminant dominated inside the stadium may vary according to the conditions inside. For example CO, temperature humidity etc... There comes the importance and application of the IOT based indoor air quality monitoring platform. Where it classify and detect the quality of the air inside the building where it is good, moderate or poor. It detects early as possible the quality of the air inside the indoor stadium whether an unhealthy or unfavorable condition may develop and it becomes difficult. At the real time an alert message will send by the server to the approved person. So, he is able to take steps to improve the quality of air.

FUTURE PERSPECTIVES

Now a days also, the indoor stadiums especially in Kerala are not much bothered about the indoor air quality, where the concentration of the harmful substances present in the indoor air is more harmful than the outside air. Sometimes players actively playing inside the indoor stadium get tired more fastly and they suffered by chest pain and breathing difficulties because they do not get enough oxygen. The closed indoor stadium is limited in free oxygen. The limited amount of oxygen is inhaled by the people inside the

stadium and large amount of carbon dioxide is expelled out. The accumulated CO₂ is not eliminated out and enough amount of oxygen is not supplied properly inside the indoor stadium. For the smooth and efficient process the condition or quality of the air can be detected early. Then the introduction of this indoor air quality monitoring platform will help to overcome this situation in Kerala indoor stadiums. It will helpful not only in the normal conditions, but also as a precaution the some dangerous conditions for example fire accidents, leakage of flammable gasses etc. During fire burning lot of smoke is evolved and it contain CO, in the case of gas leakage the inflammable gas may accumulate which help in burning, both this conditions may develop to fatal. Early detection by the IOT based indoor air quality monitoring platform will reduced the risk and get enough time to take preventive measures.

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