AUTOMATIC AIR QUALITY CONTROL MONITORING SYSTEM IN BUILDING SERVICES

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Abstract

Air quality, temperature, and air humidity are pivotal factors that impact human well-being. These factors hold particular significance for children, especially infants, in comparison to adults. The quality of the air is gauged through the air pollution index, where a normal range falls between 0 and 100 IPUs. Air pollution indexes exceeding 100 are considered poor and are likely to impede respiratory health. Elevated temperature values surpassing room temperature can lead to increased energy consumption when utilizing fans or air conditioners to regulate indoor temperatures. Unnecessary energy wastage can occur if fans or air conditioners continue running even when the ambient temperature drops below room temperature. Excessive indoor air humidity promotes mildew growth, resulting in respiratory issues and potential harm to occupants within the household. An arrangement has been devised employing WEMOS D1 Wifi, alongside MQ135 and DHT11 sensors, with the aim of gauging and overseeing indoor air quality, temperature, and humidity through online connectivity. The obtained readings for air quality, temperature, and humidity levels will be viewable on the Blynk mobile application. This mechanism is geared towards notifying the occupants if the current air quality becomes unsuitable for breathing, subsequently activating the ventilation system automatically. The primary purpose of this system is to vigilantly monitor and enhance the well-being and living conditions of residents, particularly children, and infants. This is achieved by mitigating the risks of respiratory ailments, and fungal contamination, and ensuring more efficient electricity consumption.***Keywords: Air quality, air quality index, WEMOS D1, Blynk***.

INTRODUCTION

Humans require air for survival, and maintaining clean air is crucial for promoting healthy life. The air quality index, or air pollution index (IPU), serves as a tool to assess the quality of the air we breathe. The origins of air pollution are not solely attributed to suspended particles; they also stem from the excessive emission of toxic and harmful gases into the atmosphere. The suspended particles are composed of approximately 70% carbon particles, 20% soil dust, and 10% unidentified elements. On the other hand, harmful gases include carbon monoxide (CO), nitrogen dioxide (NO2), ozone (O3), and sulfur dioxide (SO2) (Mahmud & Abu Hanifah, 2009; Mahmud & Ab Liah, 2010; Mahmud & Mohd Shafie, 2012; Shaharuddin Ahmad, 1990; Mazlan et al., 2015). The Department of Environment (DOE) reports that motor vehicles are accountable for nearly 82 percent of the total emissions of air pollutants, which amounts to over three million tons. Beyond exhaust emissions, air pollutants can also be released in the form of hydrocarbons due to the evaporation of carburetors and oil tanks. Furthermore, the emissions of pollutants are additionally influenced by factors such as engine technology, vehicle age, and the type of fuel employed. The remaining portion, accounting for nearly 9 percent of airborne pollutants, originates from power stations, while 5 percent is attributed to the industrial sector. However, by the year 1998, the proportion of air pollutants stemming

from motor vehicles had decreased to 74 percent. Poor air quality can lead to respiratory issues in humans, particularly in children and infants, causing difficulties in breathing.

The high air pollution index as a result of industrial advancement has increased the environmental temperature and caused discomfort to everyday human life. This will cause an increase in the use of electricity because the fan or air conditioner will be switched to lower the temperature to room temperature or the appropriate temperature. Domestic air pollution caused by biological pollutants such as microbes and fungi is influenced by environmental factors such as temperature and relative humidity (Rh). Most individuals spend almost 80-90% in buildings or indoors (Herberger et al., 2010)

PROJECT OVERVIEW

The focus on overseeing air quality has seen a significant surge, accompanied by an increase in the associated monitoring costs. Additionally, there exists a limited availability of user-friendly home air quality monitoring systems, designed to facilitate users in tracking pollutant levels. In response to this challenge, an indoor air quality monitoring system has been devised utilizing wireless Arduino and IoT technologies. This project primarily aims to design and create an automated system for monitoring and regulating air quality. This endeavour comprises both hardware and software components. The following are the project's key objectives:

1) Construct an indoor air quality monitoring system through the implementation of Arduino and IoT technologies.
2) Evaluate the gathered data encompassing temperature, air humidity, and air quality via the BLYNK platform.

PROJECT COVERAGE

The creation of the Automated Air Quality Monitoring System integrated with the Internet of Things (IoT) aims to curtail the incidence of Sick Building Syndrome. To accomplish this, the project utilizes ARDUINO, NODE MCU ESP8266, and the BLYNK system for control mechanisms. The assessment of air pollution can be conveniently accessed via the Blynk application. The accumulation of data serves to evaluate the outcomes yielded by the system's development.

Automatic Air Quality Monitoring System using Arduino Microcontroller

To facilitate air quality monitoring, a novel framework is proposed, leveraging a Wireless Sensor Network (WSN) for data collection and transmission. This framework targets the acquisition and transmission of various environmental parameters, including temperature, humidity, levels of CO and CO2, as well as the detection of potential gas leaks such as smoke, alcohol, and LPG. Utilizing Zigbee Pro (S-2) communication, these parameter values are relayed to a base station for continuous monitoring. Moreover, temperature and humidity values are also transmitted via Bluetooth, enabling individuals within the system's range to access this data via their smartphones and laptops, as these parameters hold relevance for a

wide audience. Notably, the monitoring of CO levels, a hazardous parameter, is conducted with an added layer of caution. Should its volume surpass a predefined safe threshold designated for specific applications, an alert text message is dispatched to the base station through a GSM module.

Automatic Air Quality Monitoring System using Arduino Yun

The aim of this project is to develop the system of house air quality monitoring system. The project will describe the process of monitoring the system that can detect the level of pollutants existing around the house area that will affect human health. Thus, it can reduce the health effect of environmental hazards to people for some pollutants such as CO, PM10, and NO3 that contribute significant effects to respiratory health. This whole complete system consists of sensors to detect the level of pollutants and a controller to process the signal from sensors.

The information can be observed through a Graphical User Interface (GUI), while simultaneously being transmitted to a Google Spreadsheet for monitoring through the corresponding application. The Google Spreadsheet will present both pollution levels and trends. Additionally, it will display pollutant readings and indicate the air quality status, highlighting potential health risks associated with elevated pollutant readings. The collected data will inform recommendations and advice based on the observed patterns.

METHODOLOGY

The development of the system consists of the hardware and the software requirement. The working environment to set up the application is then developed which will later be tested on hardware thoroughly.

Operational flow

The operational flow can be described in the flow chart below. The automatic air quality control monitoring system covers the methods and procedures of the project. Related studies and required circuits and programs are programmed to be tested to ensure that the planning and operations of the project could be completed.

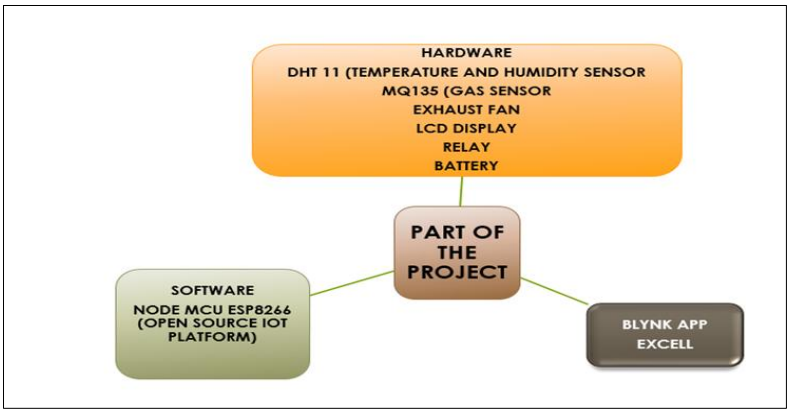

Figure 1: Operational Flow

Picture block diagram

Input - Comprises of DHT11 Sensor and MQ135 sensor. DHT11 sensor is a digital temperature sensor and low cost. It uses a capacitive moisture sensor and a thermistor to measure the surrounding air humidity. The MQ135 sensor is an air quality sensor for detecting various types of gases, including NH3, NOx, alcohol, benzene, smoke, and CO2. Suitable for use in, a home, office, or factory. MQ135 gas sensors have a high sensitivity to Ammonia, Sulphide, and Benze steam, also sensitive to smoke and other harmful gases.

Process - WeMos D1 is an ESP8266 WiFi-based microcontroller based on Arduino arrays. This microcontroller has 13 digital input-output and 1 analog input and is equipped with wifi chips to connect to the internet

Output - The output is in the form of an exhaust fan ie the fan will live and the buzzer will sound when the temperature, humidity, and air quality are too high. The lcd screen will display temperature readings, air humidity, and air quality. Data temperature, humidity, and air quality can be converted into graphs using blynks and excel applications.

Figure 2: Picture Block Diagram

Program Development

Users need to first develop digital display by using the Blynk app on smartphones to get the confirmation of the micro-saling connection to the internet. Programming is done by using Arduino IDE part by part such as the following algorithm. First we must build program development for the MQ125 sensor, Second, build program development for DHT11 sensors. Third, build program development for Wemos D1 Wifi micro controller with internet.Next build program development to control fan or air conditioner. And last step is,build program

development for LCD display for MQ135, DHT11, air quality status, current temperature status and current air humidity status.

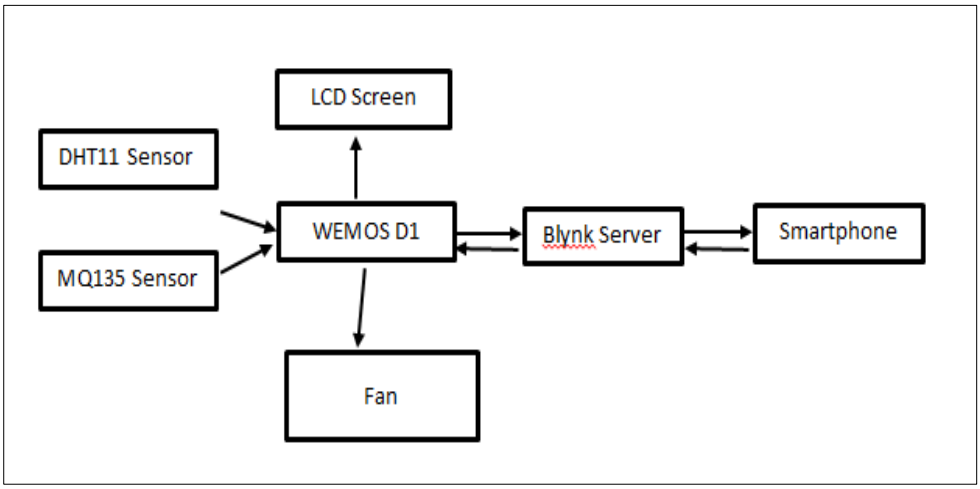

Figure 3: The project block diagram

RESULTS AND DISCUSSION

Development Of the System

Result of MQ135 sensor

The MQ135 sensor will be connected to the D8 pin at Wemos D1. Arduino Wemos D1 will process the data read by this sensor. This sensor will produce data in digital form where the value of 0 will indicate the value of the measured air quality is below the 100 IPU level and the LCD will display the air status inside the house is good. If the IPU value exceeds 100 then the data 1 will be released and the air status on the LCD display will be written poorly. The message will also be sent to the user to warn that air is bad for respiratory and ventilation fans have been switched on. The value issued by this sensor will be displayed on the Blynk app on the user's phone.

Table 1: Output to be issued by MQ135.

MQ 135		**OUTPUT**		
Value IPU Output	Output Exhaust Fan	Exhaust Fan	Air Status	Buzzer
<=100	0	Off	Good	Off
> 100	1	On	Not Good	On

Result of DHT11 sensor

The DHT11 sensor is connected to the D4 pin at Wemos D1. Current data of temperature and humidity will be displayed on the LCD display and applied Blynk is phoned. The message will be sent to the user when the current temperature measured exceeds the room temperature

value of 270C. This temperature and humidity value will be measured every 10 minutes. Users can switch on or off the fan or air conditioner by simply pressing the button on the Blynk app on their smartphone.

Table 2: Output to be issued by DHT11

DHT11					
Temperature	**% Air Humidity**	**Blynk Messages (Temperature)**	**Blynk Message (Humidity)**	**Exhaust Fan**	**Buzzer**
< =27^{o}C	<= 60 %	NO	NO	0	0
< =27^{o}C	> 60 %	NO	YES	0	1
> 27^{o}C	<= 60 %	YES	NO	1	0
> 27^{o}C	> 60 %	YES	YES	1	1

Overall result of MQ135 and DHT11 output

This system has been successfully developed and installed in the building. It has been able to display API values, air status, temperature and air humidity while on LCD displays and Blynk applications on users' handsets. The user has been able to turn on the fan from which location by pressing the button on the Blynk app they are smartphones.

Table 3: Overall sensor output of MQ135 and DHT11

Air Humidity	**Temperature**	**IPU**	**Blynk Messages (Humidity)**	**Blynk Messages (Temperature)**	**Exhaust Fan**	**Buzzer**
<= 60%	<= 27	<=250	NO	NO	0	0
<= 60%	<= 27	> 250	NO	NO	1	0
<= 60%	> 27	<=250	NO	YES	0	0
<= 60%	> 27	> 250	NO	YES	1	0
> 60%	<= 27	<=250	YES	NO	0	1
> 60%	<= 27	> 250	YES	NO	1	1
> 60%	> 27	<=250	YES	YES	0	1
> 60%	> 27	> 250	YES	YES	1	1

Temperature, air humidity and air quality reading from blynk message

Figure 4: Temperature , air humidity and air quality reading from Blynk message

Graph temperature data in the form of excel

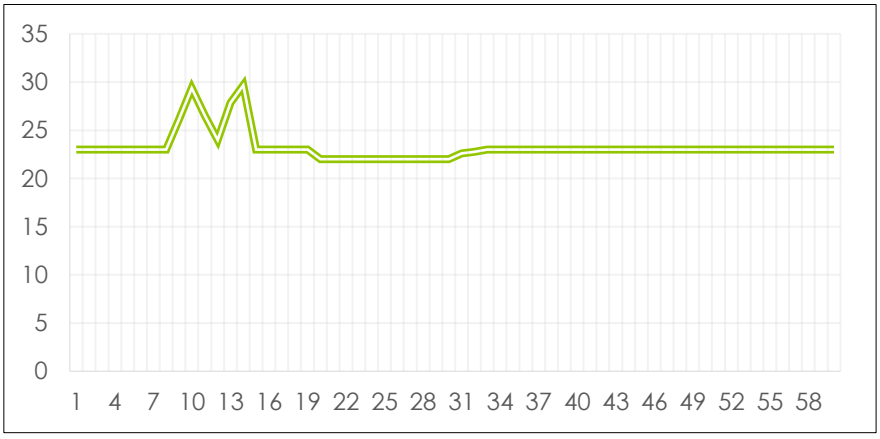

Figure 5: Temperature data in the form of excel

Graph humidity data in the form of excel

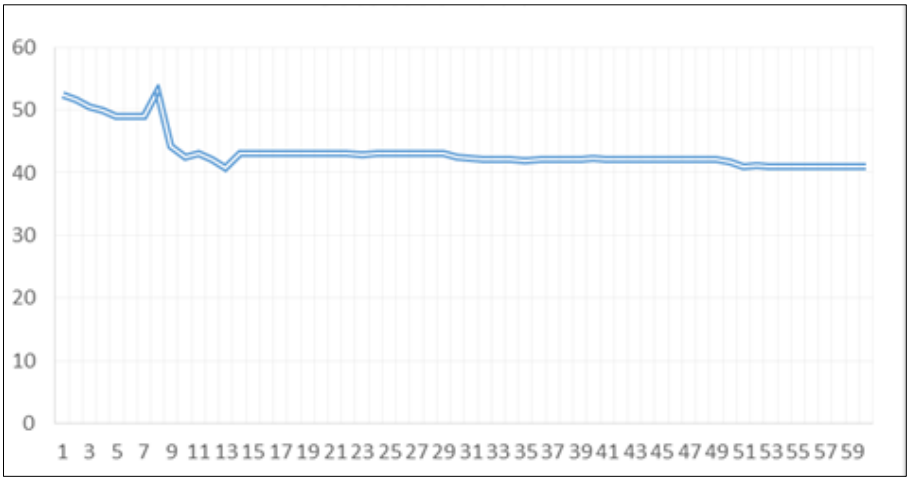

Figure 6: Humidity data in the form of excell

Graph air quality data in the form of excel

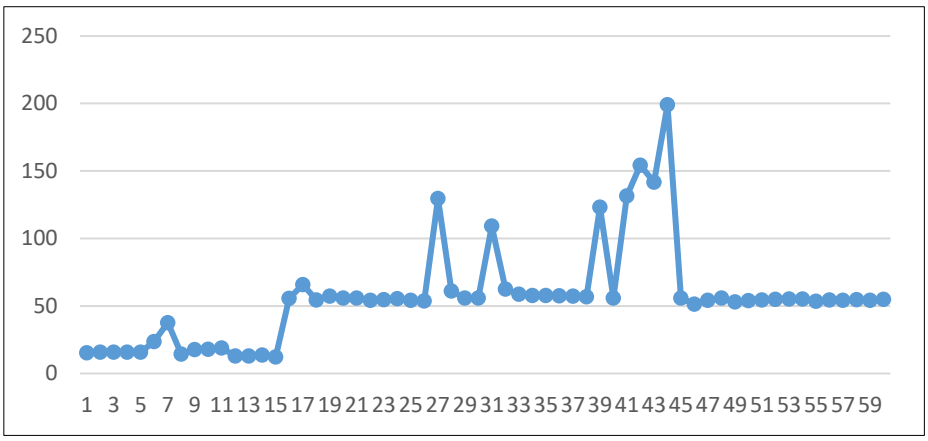

Figure 7: Air Quality data in the form of excell

CONCLUSION

Utilizing wireless technology, the automated air quality monitoring system is created through the integration of Node MCU ESP8266 and sensors designed to detect pollutant levels, particularly for CO and harmful gases, providing precise measurements. This system introduces an effective approach to address the challenges posed by pollutants, specifically within indoor air quality concerns. By mitigating elevated pollutant concentrations, the system contributes to safeguarding human well-being. Furthermore, the system ensures user convenience and ease of use, effectively tackling health-related issues.

This solution offers remote pollution level monitoring, accessible from computers or mobile devices. Its installation versatility allows it to be deployed anywhere, and it can activate devices such as an exhaust fan when pollution exceeds a certain threshold. Additionally, it can trigger alert messages via SMS or email to notify users of critical pollution levels.

RECOMMENDATION

This system has been beneficial in terms of comfort and security against diseases related to respiration in buildings as consumers can monitor the air quality, temperature, and air humidity during the home. Users will be warned by the system via messages when the inside of the house is not liveable. This system has also been able to reduce the waste of electricity and save in electricity usage where electronic current bills are not too high. This is because the user can control the use of a fan or air conditioner by simply switching on or off this device by using the Blynk app on their mobile**.**

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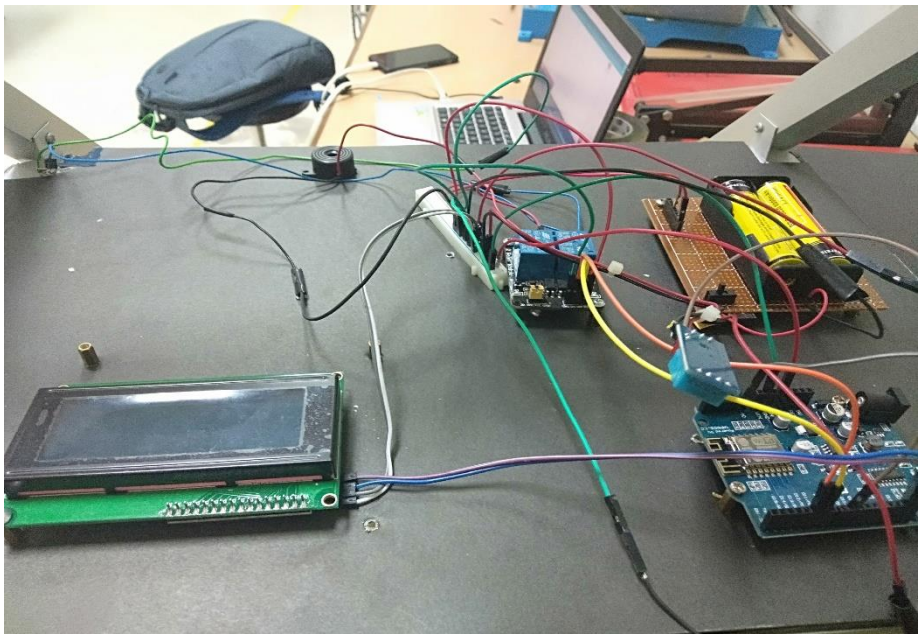
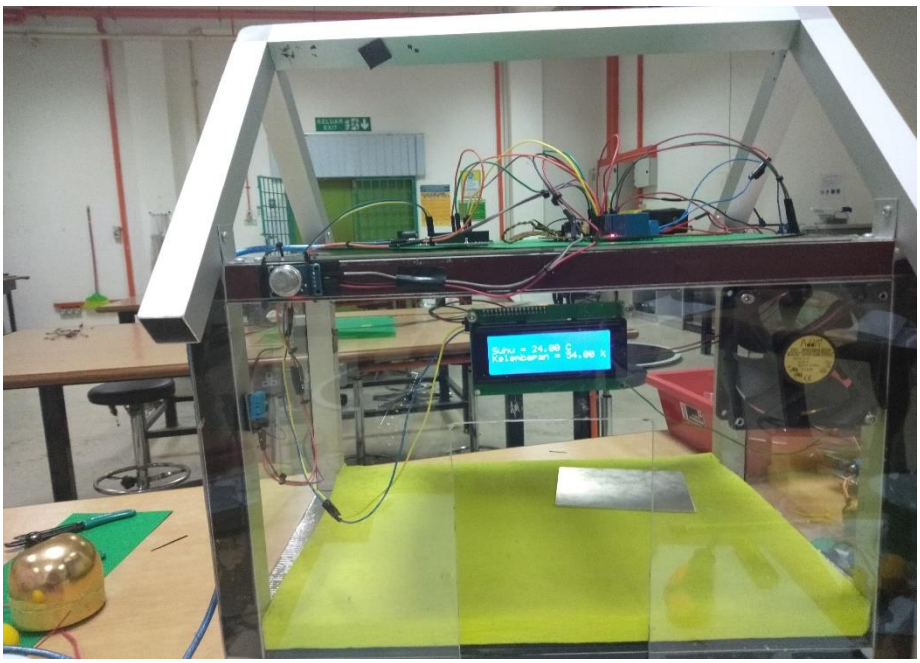
APPENDIX



Circuit connection of Automatic Air Monitoring Systems



Automatic Air Quality Control Monitoring System