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DEVELOPMENT AND FABRICATION OF AN IOT-BASED SMART AIR PURIFIER VEHICLE FOR INDUSTRIES

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Abstract
In this paper, we show how to use a web server and a Smart-Air device for Internet-of-Things interior air quality monitoring. This technology monitors indoor air quality 24/7 using the Internet of Things and cloud computing. Smart-Air uses IoT technology to monitor air quality and send data to a web server.A microcontroller, sensors for detecting pollutants, and a WiFi module make up the device. The device was developed in the study to track temperature and humidity in addition to gas concentration. The reliability of the device was then tested and found to be satisfactory. Additionally, a web server has been outfitted with cloud computing to analyse the device's data and categorise and display the indoor air quality in accordance with the standards. This allows authorised personnel to check the air quality from any location at any time using the server. To facilitate additional research into the state of indoor air, the server stores all data in the cloud.

I. INTRODUCTION

Every year, the atmosphere gets a little dirtier because of human population expansion and the rise in dirty emissions from factories and cars. Air is a vital resource, but many people either don't care or have just lately become aware of the severity of air pollution [1-3]. Air pollution is the most severe and hazardous form of pollution since it contributes to global warming and the spread of diseases like cancer and asthma. According to the World Health Organization (WHO), there are approximately 7 million deaths that occur annually as a direct result of air pollution [4, 5]. This is due to the fact that around 90 percent of the world's population now resides in locations where the air quality is poor. The effects of pollution on human health are terrible, and they include a rise in the incidence rates of stroke, lung cancer, and cardiovascular disease. In addition, recent concerns with global air pollution, such as the depletion of ozone [6-8], demonstrate that contaminants in the air have a negative impact on both human health and the ecosystem of the world. As a direct consequence of this, monitoring and bringing under control the levels of pollution are urgent challenges.

The Environmental Protection Agency of the United States believes that the level of pollution in indoor air is one hundred times higher than that found outside. The quality of the air inside has a far greater direct impact on human health than the air outside [9–12]. This is because the majority of people in the modern world spend between 80 and 90 percent of their time inside. Sick building syndrome, multiple chemical sensitivities, and vertigo are just some of the ailments that can be brought on by interior pollution, which has an over one thousand times greater likelihood of being transferred to the lungs than pollution found outside does.

Effective control of the quality of the air inside a building can allow for proactive precautions to be taken against exposure [9, 13-15]. Monitoring the indoor air in a precise and dependable manner is essential to the control of air quality.

In recent years, advances in technology such as the Internet of Things (IoT) and cloud computing have made it possible to use fresh strategies for real-time monitoring in a variety of contexts. As a consequence of this, a number of researchers have investigated the feasibility of integrating these sensors into an existing network for monitoring the quality of the air within buildings. However, the implementation of an Internet of Things platform architecture for real-time air quality monitoring was the only focus of these research activities. Because these new technologies include a wireless sensor network that can automatically communicate, process, analyse, and visualise data, it is also possible for them to be integrated to great effect in order to improve the air quality within buildings. As a result, the purpose of this study is to present an Internet of Things (IoT) platform that is hosted in the cloud for the purpose of monitoring the quality of the air inside buildings. In addition to that, the Internet of Things sensor network–based Smart-Air indoor air quality monitoring gadget was developed. It sends information to a web server that is housed in the cloud in an effective manner. This system implements a web server that is based on cloud computing, and it analyses real-time data in addition to enhancing it with visual effects in order to show the state of the indoor air quality. The web server was also designed to send out warnings when the air quality decreases into the range of moderate or poor. This makes it possible for users of the mobile app as well as facility management to take immediate action. Using a real-time monitoring system in conjunction with an instant alarm notification system can assist you in bettering the air quality in your building.

The following are some of the major contributions of the planned research:

(i) We advocate for implementing Smart-Air for accurate Air quality monitoring in vehicles.

(ii) We advocate for implementing an IoT for productively keeping tabs on real-time data.

(iii) We suggest using cloud computing to analyse indoor air quality in real time.

(iv) In order to provide the envisioned IoT system with anytime, anywhere capabilities, we originally designed a mobile application.

(v) The platform has been installed in a vehicle to evaluate its viability, and the device's data reliability has been validated.

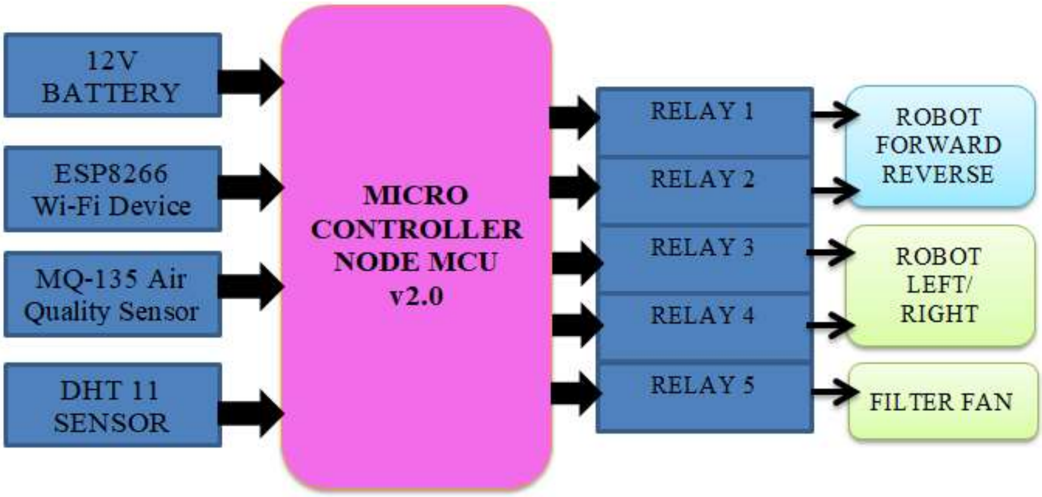
II. METHODOLOGY

The proposed system is a model for a smart air filter management and monitoring setup. We're using a microcontroller board and sensors to monitor things like temperature and humidity levels in the surrounding area. One such sensor is the DHT11. The programme will show the real-world sensor data. By modifying the sensing thresholds, we might perhaps instruct the filter fan to draw out polluted air.

The relay will be used to manage the filter’s ventilation system. The controller will use a transistor to activate the relay. The Blynk app communicates with the Node MCU. A switch connected to a hotspot over the internet sends a signal to the Node MCU when pressed. The motor can be controlled by either a battery or a direct power supply. There are individual motors for each wheel in this setup. There are four wheels total, two at the front and two at the back. There was a separate motor for each wheel. The motor attached to the wheel can be directed using the IoT app’s (mobile) keypad. The DC motor is hardwired into the relay. The motor moves forward when the start button is pressed and reverses when the stop button is depressed. The motor can be controlled in either the forward or backward directions by pressing the corresponding buttons on the remote. When the user presses the stop button, the motor immediately shuts off. All operations are wirelessly controlled by an IoT app.

III. BLOCK DIAGRAM

TRANMITTER UNIT



RECEIVER UNIT

IV. SYSTEM DESCRIPTION

A. Node MCU

There are freely available prototyping board layouts for the NodeMCU firmware. A combination of "node" and "MCU," the moniker "NodeMCU" (micro-controller unit). When discussing "NodeMCU," what is meant is the firmware itself, and not the development kits that go along with it.

Specifications & Features

- The Xtensa LX106 microcontroller from Tensilica features a 32-bit RISC CPU.
- It has a 3.3V operating voltage and a 7-12V input range.
- There are 16 digital I/O pins, 1 analogue input pin, 1 UART, 1 SPI, 1 I2C, and 4 MB of flash memory.
- Clock Speed: 80 MHz
- SRAM Size: 64 KB

B. Gas sensor(MQ-135)

A sensing device is protected by a steel exoskeleton in the gas sensor module. Connecting leads carry current to this sensing device. Heating current is a type of electric current that ionizes nearby gases, making them more susceptible to absorption by a sensor element. As a result, the amount of current leaves the sensing element shifts as its resistance changes.

C. Temperature Sensor-DHT 11

DHT11 is a digitally calibrated sensor for measuring temperature and humidity. It is dependable and stable over time because to its innovative digital-signal-acquisition and temperature/humidity sensing technology. This sensor connects to a powerful 8-bit microprocessor via a high-quality, fast-response, anti-interference NTC temperature measurement component.

D. Relay

Electric current activates an electromechanical relay. Driver, power supply, and isolation circuits comprise four relay boards. It includes a relay. Transistors switch the driving circuit. Transistors switch relays. An isolation circuit protects the controller and transistor from relay reverse voltage. Microcontroller pulses switch the transistor.

IV. SYSTEM IMPLEMENTATION

A. Arduino IDE - Software

The Arduino IDE is used to write code for Arduino boards. The Arduino IDE may be run on a number of different OSes. It's possible to set up Windows ide either online or off. The ide.exe file is

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downloadable from the Arduino website. Install the Arduino Software Development Environment (IDE) and connect the Arduino board to your computer. Serial monitor and Serial Plotter are tools for analysing data that are built into the Arduino IDE.

B. Blynk app

Blynk is an IoT platform that allows you to remotely manage your Arduino, Raspberry Pi, or NodeMCU devices from your iOS or Android smartphone. By compiling and providing the correct address on the accessible widgets, this application is used to construct a graphical interface or human machine interface (HMI).

V. RESULTS AND DISCUSSION

An in-vehicle test of the developed IoT-based smart air purifier revealed a notable enhancement in air quality. The number of particles in the air was lowered thanks to the air purifier. The air purifier's ability to produce these outcomes in such a short amount of time demonstrates its viability as a practical approach to the problem of vehicular air pollution.

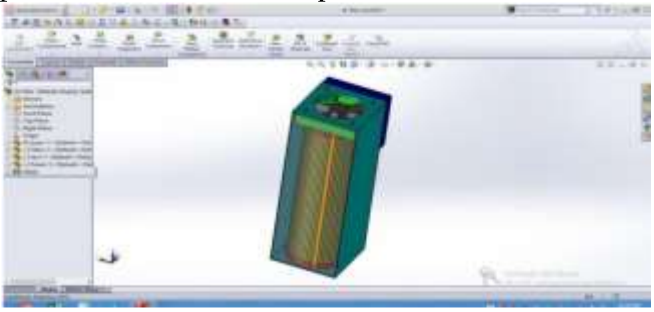

Fig.1 Design of Air purifier

The smart air purifier built on the Internet of Things is an efficient means of combating vehicular air pollution. Many sensors in the air purifier monitor the air quality and regulate the fan speed accordingly. This makes the air purifier more effective and lessens the amount of pollution in the car. The air purifier may be monitored and controlled from anywhere via a mobile app thanks to the Internet of Things platform.

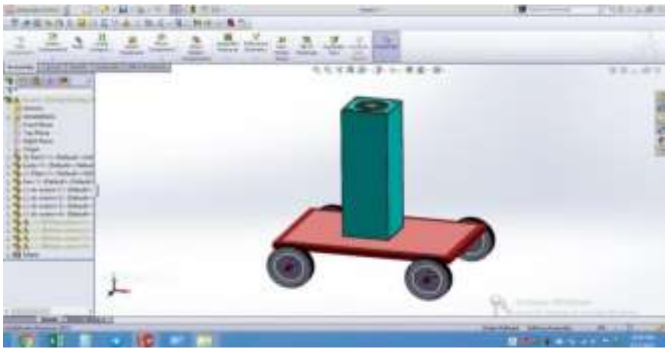

Fig.2 Design of Smart IoT Air purifier for Vehicle

The investigation confirms that the proposed air filter successfully lowers particle levels inside the car. This matters since these contaminants are known to cause health problems in the respiratory and cardiovascular systems. This rapid improvement in air quality is a testament to the efficiency of the air purifier as a tool for mitigating vehicular air pollution.

VI. CONCLUSION

This paper details the process of creating a system for monitoring air quality using the Internet of Things. There are many benefits that people may get from having an Internet of Things-based smart air purifier installed in their vehicles. These air purifiers are convenient, energy efficient, and flexible in that they can remove airborne pollutants and allergens, report on the air quality in real time, and be managed remotely via a smartphone app or online interface. IoT-based air purifiers can help improve public health and create a cleaner, healthier environment as air pollution becomes a more urgent issue in many cities across the world. The more money we put into studying and developing these technologies, the more effective and innovative our answers to the problem of air pollution in our cars and other enclosed places will be.

VII. FUTURE SCOPE

The need for methods to enhance indoor air quality is predicted to grow as air pollution remains a global health crisis. This opens the door for the creation of cutting-edge, effective air purifiers that make use of Internet of Things technologies to deliver real-time data and enable remote management.

Artificial intelligence and machine learning algorithms will likely be included into the design and operation of IoT-based air purifiers in the near future to enhance filtration efficiency and reduce energy consumption. Further consideration may be given to allowing users to adjust air purifiers to their specific requirements and preferences in response to changes in the surrounding environment.

There is potential for air purifiers to become standard equipment as the car industry continues to move towards electric and hybrid vehicles. This has the potential to lessen the prevalence of respiratory ailments caused by air pollution in both private and public modes of transportation.

In conclusion, there is a lot of room for growth in the research and production of Internet of Things-based smart air purifiers for vehicles, which might have a major impact on interior air quality and public health. We can all benefit from a cleaner, healthier environment and smarter, more effective solutions to air pollution if we fund research and development in this area.

VIII. REFERENCES

[1]. G. Parmar, S. Lakhani, and M. Chattopadhyay, "An IoT based low cost air pollution monitoring system," in 2017 International Conference on Recent Innovations in Signal processing and Embedded Systems (RISE), Bhopal, India, October 2017.

[2]. K. Okokpujie, E. Noma-Osaghae, O. Modupe, S. John, and O. Oluwatosin, "A smart air pollution monitoring system," International Journal of Civil Engineering and Technology, vol. 9, pp. 799–809, 2018.

[3]. K. A. Kulkarni and M. S. Zambare, "The impact study of houseplants in purification of environment using wireless sensor network," Wireless Sensor Network, vol. 10, no. 03, pp. 59–69, 2018.

[4]. World Health Organization, Air Pollution and Child Health-Prescribing Clean Air, WHO, Geneva, Switzerland, 2018, September 2018.

[5].G. Rout, S. Karuturi, and T. N. Padmini, "Pollution monitoring system using IoT," ARPN Journal of Engineering and Applied Sciences, vol. 13, pp. 2116–2123, 2018.

[6]. B. C. Kavitha, D. Jose, and R. Vallikannu, "IoT based pollution monitoring system using raspberry–PI," International Journal of Pure and Applied Mathematics, vol. 118, 2018.

[7].D. Saha, M. Shinde, and S. Thadeshwar, "IoT based air quality monitoring system using wireless sensors deployed in public bus services," in ICC '17 Proceedings of the Second International Conference on Internet of things, Data and Cloud Computing, Cambridge, United Kingdom, March 2017.

[8].J. Liu, Y. Chen, T. Lin et al., "Developed urban air quality monitoring system based on wireless sensor networks," in 2011 Fifth International Conference on Sensing Technology, pp. 549–554, Palmerston North, New Zealand, December 2011.

[9]. C. Arnold, M. Harms, and J. Goschnick, "Air quality monitoring and fire detection with the Karlsruhe electronic micronose KAMINA," IEEE Sensors Journal, vol. 2, no. 3, pp. 179–188, 2002.

[10]. S. Abraham and X. Li, "A cost-effective wireless sensor network system for indoor air quality monitoring applications," Procedia Computer Science, vol. 34, pp. 165–171, 2014.

[11]. O. A. Postolache, D. J. M. Pereira, and S. P. M. B. Girão, "Smart sensors network for air quality monitoring applications," IEEE Transactions on Instrumentation and Measurement, vol. 58, no. 9, pp. 3253–3262, 2009.

[12]. Y. Jiangy, K. Li, L. Tian et al., "MAQS: a personalized mobile sensing system for indoor air quality monitoring," in Proceedings of the 13th international conference on Ubiquitous computing, pp. 271–280, Beijing, China, September 2011.

[13]. G. Marques, C. Ferreira, and R. Pitarma, "Indoor air quality assessment using a CO2 monitoring system based on Internet of Things," Journal of Medical Systems, vol. 43, no. 3, p. 67, 2019.

[14]. Y. J. Fan, Y. H. Yin, L. D. Xu, Y. Zeng, and F. Wu, "IoT-based smart rehabilitation system," IEEE Transactions on Industrial Informatics, vol. 10, no. 2, pp. 1568–1577, 2014.

[15]. C. Stergiou, K. Psannis, B. Kim, and B. Gupta, "Secure integration of IoT and cloud computing," Future Generation Computer Systems, vol. 78, pp. 964–975, 2018.