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IOT-ENABLED SMART ROOM FRESHENER FOR ENHANCED INDOOR AIR QUALITY MANAGEMENT

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Abstract - *The smart room freshener is an IoT-based system that purifies the indoor air by making use of a connected platform which senses the polluted environment and adjusts its operation based on real time sensor data. It know when to turn on using fuzzy logic and operates as needed only. Thanks to a built-in motion sensor, the system can also tell whether or not anyone is in home and automatically block unnecessary use. In addition to monitoring via the stabilizer shaft moves, an electronic warning will inform your customers when it is necessary to replace one of these pads. Air quality vs use you can access the user friendly Air web, for a greater view from PC or laptop. Using the versatile and scalable Arduino microcontroller, this system represents a solution that brings wider ranges of air-quality improvement as well user comfort. It also offer some customization, enabling people to determine the air quality levels that amount to a warning. And you simply have the smart freshener, thinking ahead to increased efficiency efforts and potential for longer-term use based on some energy-saving specs with this nifty design.*

***Key Words*:**

IoT (Internet of Things),Air quality management, Fuzzy logic, Real-time monitoring, Arduino microcontroller, Motion sensor, Adaptive control, Energy efficiency, User interface, Smart home automation, Environmental sustainability, Freshener usage tracking, Indoor air quality.

1.INTRODUCTION

Such, the IoT-based smart room freshener system is actually a breakthrough to the aim of improving indoor air quality to be maintained automatically. Contrary to this, traditional air fresheners usually rely on manual modification or a scheduled on/off cycle that wastes some product and does not yield well in conditions of fresh air. This system addresses all these issues head-on; it makes use of fuzzy logic to make it just activate when it's actually necessary.

Sound very sensible, old-fashioned common sense perhaps, but the system knows whether a room is occupied or not through its built-in motion sensor and will not be operating, thus saving energy as well as resources. This is not all it does: it also keeps track of how much freshener has been used and sends in timely reminders when it is time to change.

This system, based on the Arduino microcontroller, allows for an amicable interface that displays information related to air quality and usage in real-time. From here, data can easily be monitored from a PC or laptop for more detail.

This system, thereby integrating smart technology with friendly user features, avails a practical and sustainable approach towards improved healthier indoor environments.

1.1 INSIGHTS AND INNOVATIONS ABOUT IOT-DRIVEN SMART ROOM FRESHENER SYSTEMS

There was a need to work on coming up with ways to manage indoor air qualities that would be more potent and viable. Our preliminary research showed that traditional air fresheners lacked efficacies due to mostly handling work on rigid schedules or even from any simple sensors. This manner creates unnecessary waste and inconsistency in air quality. As part of the efforts towards overcoming the said challenges, we carried out a comprehensive research in search of ideas to include real-time air quality information in an automated system.

We had a lot of fun working out one of our exciting discoveries: the application of fuzzy logic, which allowed the system to respond better in changes of air quality than systems which rely on fixed thresholds. It actually leads to smoother, more typical control, inasmuch as the freshener would only activate whenever air quality drops to a certain level. It reduces unnecessary usage yet guarantees a pleasantly comfortable and fresh environment.

Another interesting role is represented by a motion sensor that optimizes the usage of resources. It detects the occupation of a room and avoids inoperative operation in rooms that are not occupied, therefore boosting energy efficiency quite a lot. This capability is very essential in ensuring good air quality without compromising resources.

The third and most crucial reason is that it monitors the consumable quantity of the freshener it contains and sends notifications to the user when it is due to be replaced. Users

love this feature because they will never again run out of freshness.

Real-world testing in several home environments showed that such a system can successfully maintain superior air quality standards compared with conventional methods. Its flexibility through the Arduino microcontroller presents well towards adaptation and scale to various environments as well as user preferences. The intuitive interface can show real-time air quality data and usage statistics that will not be difficult for the users to know and operate their indoor air quality.

2.EXISTING SYSTEM

IoT-Based Air Freshener Solutions:
The existing air freshening solutions developed for the management of indoor air quality can essentially be said to amount to some fixed schedule, where control is either manual or semi-automatic. Such systems basically offer only basic functionalities but fail when it is required to be adaptive and responding in real-time to environmental conditions. The systems can broadly be categorized into the following subheads:

1.Time-Cycled Fresheners:
Conventional fresheners are pre-programmed to work according to a scheduled performance that delivers fragrance regardless of the change in indoor air quality. The systems are programmed and therefore not in a position to automatically respond in relation to changing indoor air quality and occupancy, thus becoming inefficient. They would release the freshener without objective, waste, and also shorten the product life cycle.

2.Threshold-Cycled Fresheners:
Threshold-based freshener air intake begins to act once the quality indoors decreases to below a set threshold. This mechanism contains an element of sensitivity but never takes into account the slight fluctuations within indoor quality. There is no realistic way to set thresholds because the system reacts either by overreacting or underreacting and fails to provide freshness at the same level.

3.Drawbacks from Current Systems:
Rigidity:
Fixed-schedule and threshold-based systems cannot respond to time-varying environmental changes in real time.
Wastage:
Both the systems are prone to overuse of air fresheners, which later turns out to be utilized at a faster rate and increases the operational expenses
Lack of User Awareness:
Seldom, there is an option to inform the users about the installation of a new air freshener, which again causes idle runs.
Manual Control:
Most systems are still based on manual inputting, which is not ideal and less compatible with the ecosystem of smart homes.
4.Scalability Issues:
These systems are difficult to scale among a large population of users, especially in environments in which air quality demands differences from space to space. Here, size does not fit all; conditions differ in various rooms-enthusiastic, based on their size, occupancy, or sources of indoor pollutants.

3.PROPOSED SYSTEM

This is IoT-Based Smart Room Freshener which aimed to eliminate the weaknesses of the conventional and threshold-based systems using an efficient adaptive air-freshening solution by the aid of IoT technology.

1.Key Features of the Proposed System:
Real-Time Monitoring:
Indoor air quality is kept under continuous monitoring by sensors that measure the parameters such as temperatures, humidities, and levels of CO2.
Adaptive Control:
The gadget utilizes a fuzzy logic algorithm such that it processes data on real-time air quality; therefore, it only calls the freshener when necessary because slight changes in air qualities trigger it.
Energy Efficiency:
The freshener system saves the important resources since it prevents the wasteful use and consumption of energy through the use of a motion sensor that ensures the system will not have anything to do when there is no person who happens to be in the room.
Tracking Freshener Usage:
It monitors usage of the air freshener and goes ahead to give a message to the user on when to change the freshener so as not to block the operation.
User Interface:
Friendly interface offers real-time data about the usage of the freshener and the air quality of the indoor environment, which can be monitored by users for necessary actions at proper time. For convenient connectivity with the PC or laptop, the data can be presented.
It is flexi and expandable on the Arduino platform and ready for future functionalities

2.Benefits of the Proposed System:
Adaptive and Efficient:
It utilizes the air freshener only when it is called by the fuzzy logic algorithm, thus conserving its energy and more efficient systems.
User Awareness:
The monitoring of the use of the system, and the freshener, can determine its timely performance and avoid wasteful time consumption that is non-productive.

Energy Saving:
Use of motion sensors will prevent wasting by only coming on when somebody is in the space
Scalability:
The Arduino-based system was scalable and combined into a much bigger smart home system.
3.Overcome Limitations:
Customization:
In comparison with the threshold-based systems, the algorithm in the fuzzy logic system can be more intimately controlled by making changes at minute changes in air quality.
Waste Prevention:
It minimizes freshness overuse by the live data brought together with motion detection, hence offering much better life to the product with the reduction of cost
Smooth User Experience:
The user interface allows for an all-inclusive view of air quality and usage patterns to be in place, hence making the user informed about the indoor environment.

4. SYSTEM IMPLEMENTATION

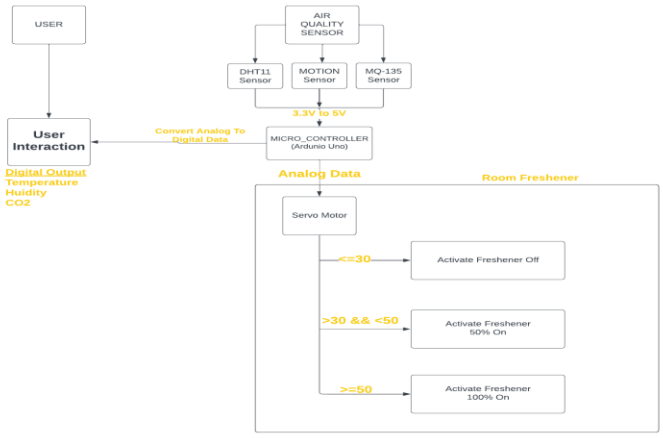

Figure 1: System Architecture Diagram

System Implementation Overview

The following is an outline of IoT-based smart room freshener system that gives an overview of important entities and their interrelationship.

1. User Interface

Description : The system initiates interaction at user-level. In this scenario, the user is able to monitor and control the system. Users get output data in terms of temperature, humidity, and CO2 levels.

Output: This data is necessary to acquire familiarity of environmental conditions and will let the users take proper decisions for air quality management .

2. Air Quality Sensor

Components: Air Quality Sensor Sub-sensor The air quality sensor is comprised of a number of sub-sensors, which include the following:

Temperature and Humidity
DHT11 Sensor
Gas Concentrations MQ-135 Sensor
Human Presence Motion Sensor

Function: Parameter conversion of physical parameters (temperature, humidity, gas concentration) to electrical signals with a level of 3.3V to 5V for further processing.

3. Microcontroller Arduino Uno

Role: In this project, the Arduino microcontroller acts as the central processing unit, in that it receives the analog signals from the air quality sensors .

Handling of Data: It converts all the analog signals to digital data to study the real-time environmental conditions.

4. Data Analysis and Control

Analog Data Processing: In this application Arduino processes all the analog data that received by sensors; then he specifies what to do based on thresholds already predefined.

Servo Motor : This subunit controls the turning ON/OFF of room freshener.

5. Room Freshener Activation

Result: Considering the processed data along with the conditions, this freshener will be in the ON or OFF position. Thus, at that time also, utilization of resources will be optimum along with the quality air. It works on its own terms of real-time change based upon the environment of the room.

5. SYSTEM REQUIREMENTS

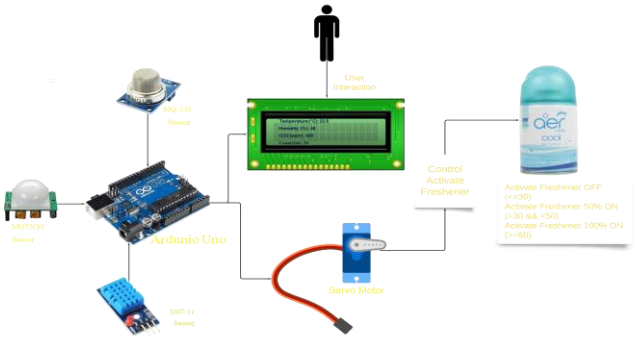

Figure 2: Block Diagram of Hardware Components

1.Arduino Microcontroller:
Arduino is a microcontroller at the heart of the system because it tends to process data from sensors and even controls the mechanism of the air freshener. It is capable and easy to program and supports fuzzy algorithms for adaptive control of air quality.

Figure 3: Arduino Microcontroller

2.Sensors:
1. MQ-135 Sensor:
These are harmful gases detection sensors; these include CO2, NH3, and benzene, and they will provide live data on air quality to automatically trigger the freshener only when needed.

Figure 4: MQ-135 Sensor

2. DHT11 Sensor:
The temperature and humidity are sensed so that the system can take decisions based on the comfort of the indoor environment.

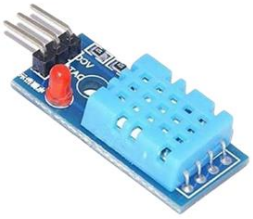

Figure 5: DHT11 Sensor

3.Motion Sensor (PIR):
A PIR motion sensor detects the occupancy of the room to avoid activation of the system repeatedly and saves resources.

Figure 6: Motion Sensor

3.Freshener Mechanism:
1.Servo Motor (e.g., SG90, MG996R)
Controls the direction of spraying and amount of air freshener spray depending upon real-time air quality. The use of this motor would be to regulate the air freshener dispenser.

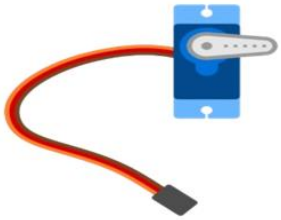

Figure 7: Servo Motor

2.Air Freshener Dispenser
Holds and dispenses the freshener simultaneously with the servo motor for the automated operation of the dispenser.

Figure 8: Air Freshener Dispenser

4.Power Supply
The system uses a 5V or 9V adapter to stabilize the power that enters into the Arduino and sensors, hence the system performance.

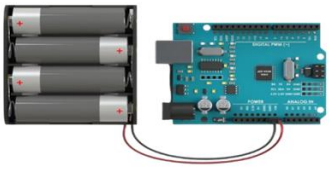

Figure 9: Power Supply

5.User-Interface:
The display shows the real-time data of air quality along with temperature, humidity, and alerts for the usage of fresheners. It is a user-friendly interface.

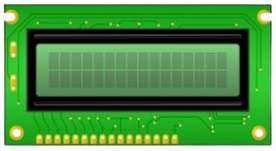

Figure 10: User-Interface

6. RESULT

Figure 11: Output

7. CONCLUSIONS

The IoT-based smart room freshener is a new solution toward the improvement of indoor management of air quality while encouraging healthier indoor atmospheres. It continuously gives real-time feedback on the quality of the air, empowering the customer to make proper choices for their environment through an interactive interface. Contrasted with the traditional modes of air fresheners that use scheduled or manually controlled mechanisms inefficient and not consistent-these intelligent fresheners activate themselves again on real-time air quality readings. In this only when the air qualities go below defined bounds, it does this efficiently turns itself on and then gives optimal freshness.

It takes a fuzzy logic algorithm on the air quality data and provides an adaptive response to environmental condition variations. It counts the number of times the freshener has been utilized and updates the user about its replacement time to minimize wastes and make it even convenient. The efficiency is enhanced by combining a motion sensor; it senses whether a person is in the room, thus eliminating ineffective activation when nobody is present in the room.

It shows both the monitored data regarding air quality and count of freshener usage besides the functionality of displaying it on a PC or laptop so that users are well-informed of their indoor atmosphere. The system, built on an Arduino microcontroller, gives flexibility and ease of expansion, hence adaptable to the prospect of future enhancement.

The IoT-based smart room freshener system is successfully deployed in various settings of home environments and easily increases the freshness of air and user comfort. It overall provides real-time data and adaptive control to get the freshest condition with a waste of the least possible amount-in other words, it presents a good contribution toward healthier indoor living environments.

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