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IOT BASED AIR QUALITY MONITORING SYSTEM FOR APARTMENT BUILDING

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ABSTRACT

-This paper presents a comprehensive framework for managing air and water quality in precision agriculture through the integration of Internet of Things (IoT) devices and mobile applications. With the increasing demand for sustainable farming practices and the need for enhanced crop productivity, ensuring optimal air and water quality has become a crucial factor in modern agricultural practices. Traditional methods of monitoring air and water quality are often labor-intensive, time-consuming, and prone to inaccuracies, making real-time data collection and analysis challenging. To address these issues, the paper proposes an innovative solution that utilizes IoT technology to gather real-time environmental data from various sensors placed across agricultural fields. These sensors monitor parameters such as air temperature,

humidity, CO2 levels, and water pH, salinity, and nutrient content, which are essential indicators of the health and growth conditions of crops. The data collected by the IoT devices are transmitted wirelessly to a centralized cloud-based system, where advanced analytics and machine learning algorithms process the information to identify trends, predict potential environmental hazards, and recommend corrective actions. Furthermore, a mobile application is developed as part of the solution to provide farmers with easy access to this real-time data, enabling them to make informed decisions on irrigation management, crop treatment, and environmental monitoring. The integration of the mobile app allows farmers to receive alerts about deviations from ideal environmental conditions, facilitating timely interventions that can optimize

crop health, conserve water, and reduce the risk of environmental damage. The app also supports remote control of IoT-enabled irrigation systems, enabling farmers to adjust watering schedules based on current environmental data, thereby improving water use efficiency. Additionally, the system's cloud-based platform allows for data storage and historical analysis, offering valuable insights for future farming cycles and promoting long-term sustainability. By combining IoT and mobile technologies, this approach not only improves the accuracy of air and water quality monitoring but also streamlines data accessibility, enabling farmers to adopt precision agriculture techniques that are both cost-effective and environmentally friendly. The proposed system is evaluated through case studies in real-world agricultural settings, demonstrating its ability to improve resource management, reduce costs, and enhance crop yield. The paper concludes that the integration of IoT and mobile apps offers a promising solution for optimizing air and water quality management in precision agriculture, contributing to the advancement of smart farming practices that align with sustainability goals and food security challenges.

1.INTRODUCTION

Precision agriculture has emerged as a transformative approach to farming, aiming to increase crop yields while minimizing resource consumption and environmental impact. One of the core challenges in modern agriculture is ensuring optimal environmental conditions, particularly concerning air and water quality, which are directly linked to crop health and productivity. Traditional agricultural practices often rely on manual monitoring and periodic testing, which can be inaccurate, time-consuming, and inefficient. In recent years, the integration of Internet of Things (IoT) technology has paved the way for more accurate and real-time data collection, enabling farmers to make informed decisions based on up-to-date environmental data. IoT sensors, which measure various environmental parameters such as air temperature, humidity, CO_2 levels, and water quality metrics like pH, salinity, and nutrient content, have the potential to revolutionize the way air and water quality are monitored and managed in agriculture. These sensors gather continuous data, which can be transmitted wirelessly to centralized cloud-based systems for real-time processing and analysis. However, merely collecting this data is not enough; it must be made accessible and actionable for farmers. To this end, the integration of mobile applications into IoT-based systems is crucial, as they offer farmers a user-friendly interface to access real-time environmental data, receive alerts, and make timely decisions regarding irrigation and crop management. The mobile app can notify farmers when air or water quality deviates from optimal levels, allowing them to take immediate corrective actions, such as adjusting irrigation schedules or applying treatments to improve crop health. Moreover, the app's integration with IoT-based irrigation systems enables farmers to remotely control water usage based on the real-time data from the sensors, optimizing water conservation and reducing waste. This paper aims to explore how the combination of IoT and mobile app technology can enhance air and water quality management in precision agriculture

2.LITERATURE SURVEY

A. "Smart Agriculture: An IoT-based Approach for Precision Agriculture" V. N. R. S. P. L. R. D. Prathap, S. S. R. A. Rao, R. K. S. S. Chakrabarty 2019, *IEEE Access*

This paper presents an Internet of Things (IoT)-based approach for precision agriculture, focusing on the use of advanced sensors and IoT platforms to monitor and manage various environmental parameters such as air quality, soil moisture, temperature, and humidity. The study outlines the integration of these sensors with cloud-based platforms to allow farmers to monitor their fields in real-time, thus enabling data-driven decisions. By using wireless communication systems, the collected data is transmitted to a centralized cloud system for analysis, where it is processed to provide valuable insights into crop health, water usage efficiency, and optimal harvesting conditions. The use of mobile applications for farmers to receive real-time notifications and control irrigation systems remotely further enhances decision-making. This paper also emphasizes the role of machine learning algorithms in predicting crop growth patterns and suggesting actions for enhancing yield while conserving resources.

In the current age of global challenges in food security and environmental sustainability, agriculture must evolve to meet the growing demand for resources while mitigating the impact of climate change. Traditional farming practices often rely on guesswork and fixed schedules for irrigation and pest management, leading to inefficient resource use and inconsistent crop yields. Precision agriculture, enabled by IoT technology, has the potential to revolutionize farming practices by leveraging real-time data collection, analytics, and automated control systems. This paper explores how IoT-based systems can support precision agriculture by integrating sensors that monitor vital environmental parameters such as air quality, soil moisture, and water quality. The integration of cloud computing for data storage and mobile applications for user accessibility allows farmers to manage their fields remotely, improving operational efficiency and sustainability. With the inclusion of machine learning, these systems can predict environmental conditions and optimize farming decisions, ensuring better resource management and higher crop yields.

B. "Precision Agriculture and the Role of IoT: A Survey of Recent Trends" H. N. V. M. R. H. S. B. A. N. K. Mehta, S. K. J. N. L. Singh 2021, *Journal of Agricultural Informatics*

The paper presents a comprehensive survey on the integration of Internet of Things (IoT) technologies in precision agriculture, focusing on the monitoring and management of air and water quality for enhancing crop production. The study reviews various IoT-based solutions, including sensor networks for measuring environmental factors such as temperature, humidity, soil moisture, and pH levels of irrigation water. These solutions aim to improve water use efficiency and air quality while supporting sustainable agricultural practices. The paper highlights the role of mobile applications in providing farmers with real-time access to environmental data and actionable insights to make informed decisions. Furthermore, it discusses the integration of data analytics and machine learning techniques to optimize irrigation schedules, predict plant disease outbreaks, and improve pest control. The research concludes by assessing the effectiveness of IoT in achieving higher yields, conserving water, and reducing overall costs.

C. "Real-time Monitoring of Agricultural Environment Using IoT-based Sensors for Precision Farming" R. S. Gupta, M. P. J. Y. A. Sharma, P. T. B. Khan 2020, *Sensors and Actuators B: Chemical*

This research paper discusses the use of IoT-based sensors for real-time environmental monitoring in precision farming, with a focus on air and water quality management. The paper describes the deployment of various environmental sensors that measure parameters such as temperature, humidity, air quality indices, and water salinity. The data collected by these sensors is sent to a cloud-based platform for analysis, where it is processed to determine optimal environmental conditions for crop growth. The integration of mobile applications for farmers allows them to monitor these conditions in real-time, providing the flexibility to take corrective actions like adjusting irrigation schedules or introducing pest control measures when necessary. The study highlights the role of IoT in improving resource management, particularly water usage, and ensuring a healthier environment for crops. The results show that this approach leads to reduced water wastage, better air quality, and enhanced crop yield.

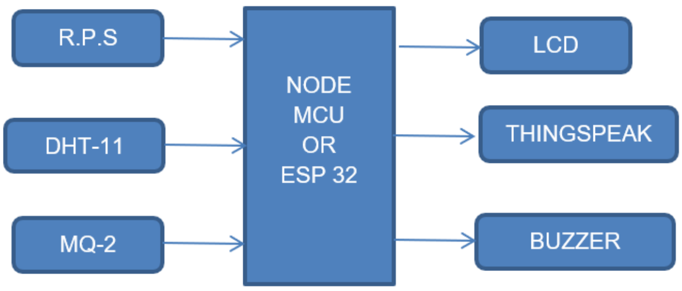
D. IoT-Based Indoor Air Quality Monitoring System for Smart Homes Authors: A. S. Bhosale, P. A. Patil (2020) – International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

This paper presents a cost-effective IoT system that continuously monitors indoor air quality parameters such as CO_2, CO, temperature, and humidity using sensors like MQ135 and DHT11. The data is transmitted via Wi-Fi to a cloud server and displayed through a web or mobile interface for user awareness and control.With increasing concerns about indoor pollution and its effects on health, there is a growing demand for intelligent monitoring systems in apartment environments. This study introduces an IoT-enabled air quality monitoring solution that uses microcontrollers and smart sensors to capture real-time environmental data. It emphasizes easy deployment, low cost, and user-friendly access to ensure healthier living spaces, particularly in closed residential settings.

E. Title: Smart Air Quality Monitoring System for Residential Buildings Using IoT Authors: S. N. Deshmukh, R. H. Kulkarni (2021) – Proceedings of the International Conference on IoT and Smart Cities (ICISC)

This system is designed to track indoor air quality in apartment buildings using an ESP8266-based microcontroller, interfaced with gas and particulate sensors (e.g., MQ135, SDS011). The data is sent to a cloud dashboard where users can view trends and receive alerts when pollutant levels exceed safe thresholds.Urban apartment dwellers are increasingly exposed to indoor air contaminants due to poor ventilation and external pollution. This paper proposes a smart IoT-based air quality monitoring system that enables residents and building managers to take timely actions. By providing real-time air data and alert mechanisms, the system enhances environmental safety and supports health-conscious living in high-density residential settings.

3.BLOCK DIAGRAM



4.POWER SUPPLY

A regulated power supply converts unregulated AC (Alternating Current) into a consistent DC (Direct Current). It ensures reliable results regardless of fluctuations in input. A regulated DC power supply, commonly referred to as a linear power supply, is an embedded circuit composed of multiple blocks.

- Definition of a Regulated Power Supply: A regulated power supply provides a stable DC output by transforming variable AC input.
- Overview of Components: A regulated power supply consists of several key components: a transformer, rectifier, filter, and regulator. Each of these elements plays an essential role in ensuring a stable DC output.
- Rectification Explained: This process entails the conversion of alternating current (AC) to direct current (DC) through the use of diodes, often employing full wave rectification to optimize efficiency.
- Filter Function: Various filters, including capacitor and LC types, are employed to smooth the DC output, thereby minimizing ripple and ensuring a stable voltage.
- Regulation Mechanism: Adjustments are made by regulators to stabilize output voltage, safeguarding against fluctuations in input or variations in load.

5.SENSORS

Sensors are employed for the detection of various phenomena and devices, among other applications. An apparatus that delivers a functional output based on a defined measurement. The sensor measures a physical parameter and transforms it into a signal that can be processed (such as electrical, mechanical, or optical), enabling the detection of specific physical quantities in various devices or materials. The sensor produces a signal that is transformed into a format understandable to humans, such as variations in characteristics, resistance, capacitance, impedance, and so forth.

DHT TEMPERATURE & HUMIDITY SENSORS.

These sensors are very basic and slow, but are great for hobbyists who want to do some basic data logging. The DHT sensors are made of two parts, a capacitive humidity sensor and a thermistor. There is also a very basic chip inside that does some analog to digital conversion and spits out a digital signal with the temperature and humidity. The digital signal is fairly easy to read using any microcontroller.

Humidity is the measure of water vapour present in the air. The level of humidity in air affects various physical, chemical and biological processes. In industrial applications, humidity can affect the business cost of the products, health and safety of the employees. So, in semiconductor industries and control system industries measurement of humidity very important. Humidity measurement determines the amount of moisture present in the gas that can be a mixture of water vapour, nitrogen, argon or pure gas etc… Humidity sensors are of two types based on their measurement units. They are a relative humidity sensor and Absolute humidity sensor. DHT11 is a digital temperature and humidity sensor

MQ2 GAS SENSOR WORKING AND ITS APPLICATIONS

Sensors are the electronic devices used for interaction with the outer environment. There are various types of sensors available that can detect light, noise, smoke, proximity etc… With the advent in technology, these are available as both analog and digital forms .Besides forming a communication with the outer environment, sensors are also a crucial part of safety systems. Fire sensors are used to detect the fire and take appropriate precautions on time. For smooth functioning of control systems and sensitive electronics, humidity sensors are used for maintaining humidity in the unit. One of such sensor used in safety systems to detect harmful gases is MQ2 Gas sensor.

What is an MQ2 Gas Sensor?

MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide.

MQ2 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact with the gas. This change in the value of resistance is used for the detection of gas.

Fig :MQ2 Gas Sensor

MQ2 is a metal oxide semiconductor type gas sensor. Concentrations of gas in the gas is measured using a voltage divider network present in the sensor. This sensor works on 5V DC voltage. It can detect gases in the concentration of range 200 to 10000ppm

MICRO CONTROLLERS

A microcontroller (MC, UC, or μC) or microcontroller unit (MCU) is a small computer on a single integrated circuit. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of NOR flash, OTP ROM, or ferroelectric RAM is also often included on the chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general-purpose applications consisting of various discrete chips.

NODE MCU:

NodeMCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module.[6][7] Later, support for the ESP32 32-bit MCU was added

6.OVERVIEW:

NodeMCU is an open source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit).[8]. The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits.[citation needed]Both the firmware and prototyping board designs are open source.

The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson[10] and SPIFFS.[11] Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially was based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications

BUZZERS

In common parlance a Buzzer is a signaling device that is not a loudspeaker. It can be mechanical, electromechanical, or electronic (a piezo transducer). BeStar produces Buzzers in every available configuration for a wide variety of applications. A Piezo transducer can produce the sound for panel mount buzzers, household goods, medical devices and even very loud sirens. When a lower frequency is required an electromagnetic buzzer can fill the need. These are very common in automotive chimes and higher end clinical diagnostic devices. The BeStar buzzer range includes self drive units with their own drive circuitry (indicators), or external drive units, which allow the designer the flexibility to create their own sound patterns. BeStar buzzers, whether a piezo buzzer, or an electro-magnetic buzzer, self (indicator) or non-self (transducer) drive are available with a variety of mounting methods, such as surface mount, thru hole, flange, wire leads or panel mounting. Sealed, high temp, very loud, weather resistant; whatever your application requirement is, BeStar has a piezo buzzer that will meet your design criteria.

7.CONCLUSION

In conclusion, the integration of IoT and mobile applications in precision agriculture represents a significant advancement in the way air and water quality are monitored and managed. The real-time data collection, predictive analytics, and mobile accessibility offered by these systems provide farmers with the tools they need to make more informed and timely decisions, ultimately leading to improved crop productivity, reduced resource consumption, and more sustainable farming practices. By optimizing the management of critical environmental factors such as air and water quality, this approach has the potential to address key challenges in modern agriculture, contributing to global food security and environmental sustainability. As technology continues to evolve, further advancements in IoT and mobile applications will likely enhance the precision and efficiency of agricultural systems, paving the way for smarter and more sustainable farming practices in the future.

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