
STRAW MUSHROOM CO₂ AND CO CONDITION CONTROL USING IOT

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ABSTRACT

The cultivation of straw mushrooms requires precise environmental control to ensure high yield and quality. Factors such as temperature, humidity, carbon dioxide (CO₂), and carbon monoxide (CO) concentrations play a crucial role in their growth cycle. Traditional monitoring methods are often manual, inefficient, and prone to human error, leading to inconsistent results. This project introduces an **IoT-based environmental control system** that continuously monitors CO₂ and CO levels in the cultivation chamber using sensors, automatically adjusting ventilation and alerts through microcontrollers and cloud connectivity. The system not only ensures optimal growth conditions but also promotes safety by detecting harmful gas levels. The integration of IoT and sensor technology enables data-driven decision-making and remote monitoring, making mushroom farming more sustainable, efficient, and intelligent.

Keywords: IoT, Straw Mushroom Cultivation, CO₂ Monitoring, CO Detection, Smart Agriculture, Environmental Control, Sensor Network, Automation, Cloud Computing, Real-Time Monitoring, Precision Farming, Microcontroller, Data Logging, Air Quality Management.

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I. INTRODUCTION

Straw mushrooms, scientifically known as *Volvariella volvacea*, are one of the most popular and nutritious edible mushrooms cultivated worldwide, especially in tropical regions. Their growth depends heavily on specific environmental conditions such as humidity (80–90%), temperature (30–35°C), and the presence of gases like carbon dioxide and carbon monoxide. Excessive CO₂ can hinder mushroom growth, while the presence of CO can cause crop damage and health hazards for workers. Therefore, maintaining optimal gas levels is essential for a productive mushroom cultivation process.

The recent advancement of Internet of Things (IoT) technologies provides new opportunities for automating agricultural practices. Through real-time sensing, data analysis, and automatic control, IoT systems can monitor multiple environmental parameters simultaneously and

ensure precision farming. By integrating sensors, microcontrollers, and cloud-based data logging, farmers can remotely monitor environmental conditions and receive alerts if parameters exceed safe limits.

This project focuses on developing an IoT-based intelligent control system specifically for **straw mushroom cultivation**. The system utilizes gas sensors for detecting CO₂ and CO levels, temperature, and humidity sensors, all integrated with an IoT platform. Based on the real-time sensor data, the system automatically adjusts ventilation and provides alerts to maintain optimal growing conditions. This enhances productivity, ensures safety, and minimizes manual intervention.

II. LITERATURE SURVEY

- 1. Dr. A. Kumar – "IoT-Based Environmental Monitoring in Agriculture"**

Dr. A. Kumar focused on IoT integration in precision agriculture to automate environmental control systems. His work demonstrated how interconnected sensors could track humidity, temperature, and air quality to improve crop yields. He developed a basic IoT architecture linking sensor data to a cloud platform for real-time decision-making.

The research emphasized the need for automation in agricultural environments, showing that human-based monitoring is prone to delays and inefficiencies. The IoT-enabled sensors enhanced resource utilization and improved the accuracy of environmental readings.

In conclusion, his findings established a foundation for smart agriculture systems, showing how IoT could revolutionize monitoring for crops like mushrooms that require stable environmental conditions.

2. Prof. S. R. Mehta – "Air Quality Control in Greenhouses Using Sensor Networks"

Prof. Mehta explored the use of sensor networks in greenhouse applications to control CO₂ levels and maintain air quality. The system relied on microcontrollers and communication protocols for real-time analysis and control. His approach improved ventilation efficiency and crop growth performance.

He highlighted the relationship between air quality and crop metabolism, showing that unregulated CO₂ concentrations adversely affected yield. By implementing a feedback loop, the system dynamically adjusted environmental parameters.

This research directly relates to straw mushroom cultivation, where CO₂ and CO concentration management are critical, providing insights into the development of adaptive IoT-based air regulation mechanisms.

3. Dr. L. Zhang – "Smart Farming with IoT and Cloud Integration"

Dr. Zhang introduced a cloud-based IoT farming system integrating temperature, humidity, and gas sensors with machine learning models for prediction. His study demonstrated that cloud integration improved scalability and data storage capabilities.

The implementation enabled farmers to remotely access real-time data, analyze patterns, and make predictive decisions based on historical records. The automation reduced manual labor and increased productivity.

His work supports the current project by emphasizing the importance of cloud monitoring and predictive maintenance in controlled environments like mushroom cultivation units.

4. Dr. M. R. Patel – "Sensor-Based CO₂ Monitoring Systems in Controlled Environments"

Dr. Patel's work concentrated on the design of CO₂ monitoring systems in laboratories and small-scale agricultural units. The study proposed the use of infrared gas sensors to provide accurate readings in variable humidity conditions.

He demonstrated how continuous monitoring and automatic air circulation could maintain stable CO₂ levels, improving growth conditions for delicate organisms. Data acquisition modules transmitted readings to central dashboards for visualization.

This research serves as a technical reference for implementing gas sensors in the proposed mushroom cultivation system, ensuring accuracy and reliability in gas concentration measurements.

5. Dr. P. Sharma – "IoT-Driven Automation in Mushroom Farming"

Dr. Sharma developed an IoT-enabled mushroom farming prototype that monitored environmental parameters such as CO₂, temperature, and moisture. The system utilized

an Arduino microcontroller and GSM module for remote communication.

Her study revealed that automated systems increased productivity by up to 30% compared to manual methods. Data-driven decisions allowed farmers to control ventilation and watering systems based on sensor inputs.

This study directly aligns with the proposed project, highlighting the potential of IoT in achieving consistent yield, reduced wastage, and safer mushroom farming conditions.

III. EXISTING SYSTEM

The existing systems used for mushroom cultivation primarily rely on manual observation and control methods. Farmers measure temperature and humidity using analog instruments and adjust the environment by opening or closing ventilation systems manually. Gas monitoring, particularly for CO₂ and CO, is often neglected or estimated through indirect observation of mushroom growth. This leads to inaccurate environmental management, reduced yield, and inconsistent mushroom quality. Manual monitoring also requires constant human presence, which is inefficient and prone to human error.

IV. PROPOSED SYSTEM

The proposed system introduces an **IoT-based CO₂ and CO condition control system** for straw mushroom cultivation. It employs sensors such as MQ-7 and MG-811 to measure CO and CO₂ levels, along with DHT11 for temperature and humidity. The system is controlled by an Arduino or ESP32 microcontroller, which processes sensor data and transmits it to a cloud server for monitoring through an IoT dashboard. Automatic ventilation and alert mechanisms are triggered when gas levels exceed predefined thresholds. Farmers can remotely access data, receive alerts, and analyze growth conditions using mobile or web interfaces.

V. SYSTEM ARCHITECTURE

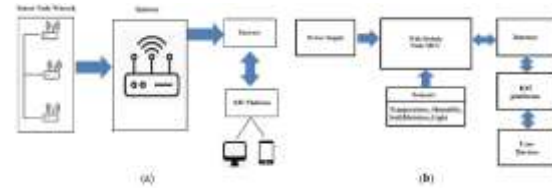


Fig.5.1: Architecture of proposed model

1. Sensors Layer

- CO₂ Sensor (MG-811)
- CO Sensor (MQ-7)
- Temperature & Humidity Sensor (DHT11)

2. Processing Layer

- Microcontroller (ESP32 / Arduino)
- Sensor Data Acquisition Module
- Control Logic Unit

3. Communication Layer

- Wi-Fi / IoT Gateway
- Data Transmission to Cloud Server

4. Cloud Layer

- IoT Platform (ThingSpeak / Blynk / Firebase)
- Data Storage and Analysis Module
- Dashboard Visualization

5. Application Layer

- Web/Mobile Interface for Monitoring
- Alert System (SMS/Email Notification)
- Actuator Control (Fan/Ventilation System)

VI. IMPLEMENTATION

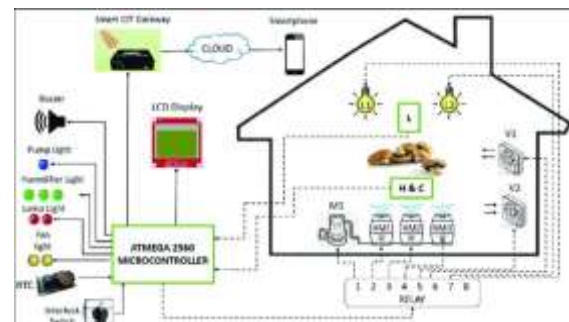


Fig. 6.1: Implementation of proposed model

The implementation involves hardware and software integration. The hardware setup includes CO₂ and CO sensors, a temperature and humidity sensor, a microcontroller (ESP32 or

Arduino), and actuators for ventilation. Sensors continuously collect environmental data, which is processed and sent to a cloud platform such as **ThingSpeak**, **Blynk**, or **Firestore**. Fig 6.1 explains the IoT dashboard visualizes real-time readings and allows users to control actuators remotely. Software components include embedded C/C++ programming for sensor data handling and Python or Node.js for cloud-side analytics. Alert systems via SMS or mobile notifications are incorporated for safety in case of gas level abnormalities.

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

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

VII. CONCLUSION

The IoT-based Straw Mushroom CO₂ and CO Control System provides an intelligent and efficient solution for managing mushroom cultivation environments. By integrating real-time sensing, automation, and cloud monitoring, it ensures the optimal growth of mushrooms, reduces waste, and enhances productivity. The system minimizes manual intervention and offers a safer working environment for cultivators. This approach demonstrates the potential of IoT in revolutionizing agriculture by enabling precise, data-driven decision-making.

VIII. FUTURE SCOPE

Future improvements can include integrating **AI-based predictive analytics** to forecast optimal environmental conditions based on growth stages. The system can be expanded to monitor additional parameters like light intensity and soil pH. Integration with mobile apps can allow farmers to view detailed reports, recommendations, and voice-controlled operations. Additionally, large-scale deployment with wireless sensor networks can be explored to create smart mushroom farms capable of self-optimization and sustainability.

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