IOT BASED PREVENTION OF FASTER RIPENING OF FRUIT USING ETHYLENE ABSORBANT SYSTEM

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ABSTRACT

This study project proposes an Internet of Things (IoT) solution for preventing the rapid ripening of fruits by utilizing an ethylene absorbent system. Ethylene gas is a natural plant hormone responsible for the ripening process in fruits. This, excessive exposure to ethylene will automatically accelerate the other fruits to ripening faster and leading to premature spoilage and wastage. To address this issue, we have developed a smart fruit storage chamber integrated with an MQ2 gas sensor capable of detecting ethylene gas levels.

Once ethylene gas is detected, our system initiates an exhaust mechanism to remove ethylene from the storage chamber, allowing other fruits to ripen at their natural pace. Additionally, an ethylene absorbent spray, controlled by an Arduino microcontroller, is activated to mitigate any remaining ethylene residue, thus prolonging the shelf life of the fruits and reducing wastage.

Furthermore, the ethylene gas levels are continuously monitored and logged on the ThingSpeak server. In case of ethylene presence, notifications are sent via SMS using a GSM modem, ensuring timely intervention. The project's status can also be monitored locally through a 16x2 LCD display, providing real-time updates on the chamber's conditions.

Overall, our IoT-based solution offers an efficient and automated method for managing fruit ripening, promoting sustainability, and reducing food loss in storage facilities and distribution networks..

INTRODUCTION

The global food industry faces significant challenges in ensuring the quality and longevity of fresh produce, particularly fruits, during storage and transportation. One critical factor influencing the ripening process and subsequent shelf life of fruits is the presence of ethylene gas. Ethylene, a natural plant hormone, regulates various physiological processes in plants, including ripening, senescence, and abscission. While ethylene is essential for the ripening of fruits, its excessive accumulation can accelerate ripening, leading to premature spoilage and economic losses for producers, distributors, and consumers.

To address this issue, the integration of Internet of Things (IoT) technology with innovative sensing and control systems offers promising solutions. In this context, our research focuses on developing an IoT-based approach for preventing the faster ripening of fruits by effectively managing ethylene gas levels in storage chambers. By deploying a combination of sensors, actuators, and control mechanisms, our system aims to detect ethylene gas, exhaust it from the storage environment, and subsequently neutralize any remaining ethylene residues to extend the shelf life of fruits and minimize wastage.

Key components of our proposed system include an MQ2 gas sensor for ethylene detection, an Arduino microcontroller for control and actuation, and an ethylene absorbent spray for mitigation. Additionally, data on ethylene gas levels are transmitted to a cloud-based server for remote monitoring and analysis. Furthermore, real-time notifications are sent to stakeholders via SMS alerts, enabling timely intervention to preserve fruit quality and reduce losses.

This paper presents the design, implementation, and evaluation of our IoT-based solution for fruit ripening management. By leveraging advancements in sensor technology, wireless communication, and data analytics, our approach aims to optimize fruit storage conditions, enhance supply chain efficiency, and promote sustainability in the food industry

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EXISTING SYSTEM

Traditional Traditionally, the management of fruit ripening and preservation in storage facilities has relied heavily on manual intervention and rudimentary techniques. In many conventional setups, ethylene gas levels are not actively monitored, and ripening processes are left to proceed naturally, often resulting in uneven ripening and increased wastage. Moreover, the lack of real-time monitoring and control mechanisms makes it challenging to prevent ethylene-induced spoilage effectively.

In some cases, rudimentary approaches such as ventilation or chemical treatments may be employed to mitigate ethylene effects. However, these methods are often inefficient, costly, and may introduce harmful chemicals into the storage environment, compromising fruit quality and safety.

Additionally, the absence of automated notification systems means that stakeholders are often unaware of ethylene buildup until visible signs of fruit spoilage appear. This reactive approach to ripening management leads to increased losses and compromises the quality of fruits reaching consumers.

Overall, the existing systems for fruit ripening management lack the sophistication and efficiency required to address the challenges posed by ethylene-induced ripening and spoilage. There is a clear need for innovative solutions that leverage IoT technologies to provide real-time monitoring, precise control, and proactive intervention to optimize fruit storage conditions and minimize wastage.

PROPOSED SYSTEM

Our proposed system introduces a novel IoT-based approach to prevent the faster ripening of fruits by actively managing ethylene gas levels in storage chambers. The system integrates advanced sensors, actuators, and control mechanisms to provide real-time monitoring, precise control, and proactive intervention, thereby optimizing fruit storage conditions and minimizing wastage.

Key components of our proposed system include:

MQ2 Gas Sensor: The system is equipped with an MQ2 gas sensor specifically calibrated to detect ethylene gas levels within the storage chamber. This sensor provides accurate and timely measurements, enabling proactive intervention to prevent ethylene-induced ripening.

Arduino Microcontroller: An Arduino microcontroller serves as the central control unit, orchestrating the operation of the system based on sensor readings. It activates the exhaust mechanism to remove ethylene gas from the storage environment once detected, allowing other fruits to ripen naturally.

Ethylene Absorbent Spray: Upon exhausting ethylene gas from the storage chamber, the system activates an ethylene absorbent spray to neutralize any remaining ethylene residues. This helps prolong the shelf life of fruits and minimize spoilage, reducing overall wastage.

ThingSpeak Server Integration: Ethylene gas level data is transmitted to a cloud-based ThingSpeak server for remote monitoring and analysis. This integration enables stakeholders to access real-time information on ethylene levels and storage conditions, facilitating informed decision-making and proactive intervention.

SMS Notifications via GSM Modem: In the event of ethylene presence exceeding predefined thresholds, the system sends automated SMS notifications to stakeholders via a GSM modem. This ensures timely intervention and allows for corrective actions to be taken to prevent fruit spoilage.

Local Monitoring through LCD Display: The system features a 16x2 LCD display for local monitoring, providing real-time updates on ethylene levels, system status, and alerts. This allows onsite personnel to monitor the system's operation and take immediate action if necessary.

Overall, our proposed system offers an efficient, automated, and proactive solution for managing fruit ripening in storage facilities. By leveraging IoT technologies, the system enhances control, reduces wastage, and promotes sustainability in the food industry, ultimately ensuring the delivery of high-quality fruits to consumers.

DATA FLOW DIAGRAM

The data flow diagram of “IOT BASED PREVENTION OF FASTER RIPENING OF FRUIT USING ETHYLENE ABSORBANT SYSTEM" uses the following modules for its functionality as shown in the figure below.

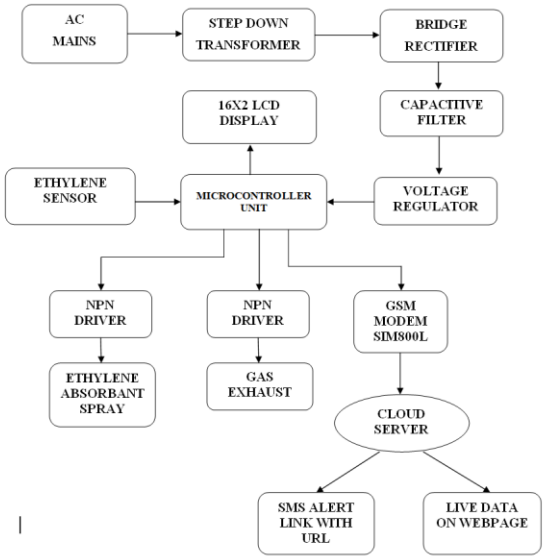

Figure 1: Data Flow Diagram

DATA FLOW EXPLANATION

MQ2 Gas Sensor: The MQ2 gas sensor is the primary component responsible for detecting ethylene gas levels within the fruit storage chamber. It continuously monitors the concentration of ethylene gas and provides analog or digital output signals corresponding to the detected levels.

Arduino Microcontroller: The Arduino microcontroller serves as the central processing unit of the system. It receives input signals from the MQ2 gas sensor and processes this data to determine the presence and concentration of ethylene gas. Based on the sensor readings, the Arduino activates the appropriate control mechanisms for ethylene mitigation and sends commands to other components.

Exhaust Mechanism: Upon detecting ethylene gas, the Arduino triggers the exhaust mechanism to remove ethylene from the storage chamber. This may involve activating fans or vents to facilitate the expulsion of ethylene gas from the chamber, allowing other fruits to ripen at their natural pace.

Ethylene Absorbent Spray: After exhausting ethylene gas from the storage chamber, the Arduino activates the ethylene absorbent spray system. This system releases a chemical solution or absorbent material designed to neutralize any remaining ethylene residues in the chamber, thereby slowing down the ripening process and extending the shelf life of fruits.

ThingSpeak Server Integration: The system communicates with a cloud-based ThingSpeak server to transmit ethylene gas level data for remote monitoring and analysis. This integration enables stakeholders to access real-time information on ethylene levels and storage conditions through web-based interfaces or applications.

SMS Notifications via GSM Modem: In case of ethylene presence exceeding predefined thresholds, the Arduino sends commands to a GSM modem to trigger SMS notifications. These notifications are sent to designated stakeholders, alerting them to the presence of ethylene gas and prompting timely intervention to prevent fruit spoilage.

Local Monitoring through LCD Display: A 16x2 LCD display is integrated into the system for local

monitoring purposes. The Arduino sends data to the LCD display, providing real-time updates on ethylene levels, system status, and alerts. This allows onsite personnel to monitor the system's operation and take immediate action if necessary.

Overall, the block diagram illustrates the interconnected components of the proposed system, each playing a crucial role in detecting, mitigating, and monitoring ethylene gas levels to prevent the faster ripening of fruits and minimize wastage in storage facilities.

HARDWARE IMPLEMENTATION

The below figure represents the overall hardware implementation of our project work "IOT BASED PREVENTION OF FASTER RIPENING OF FRUIT USING ETHYLENE ABSORBANT SYSTEM"

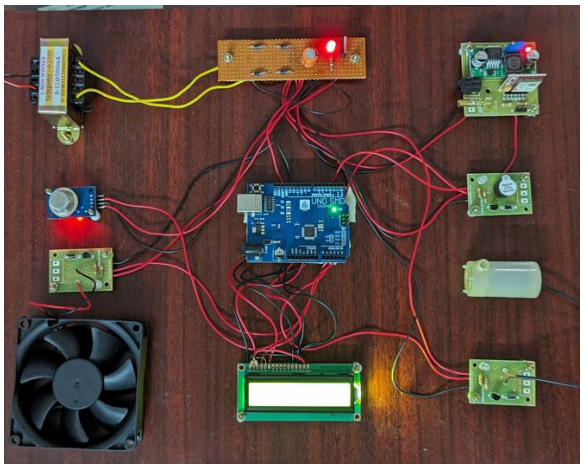

Figure 2: Hardware Setup

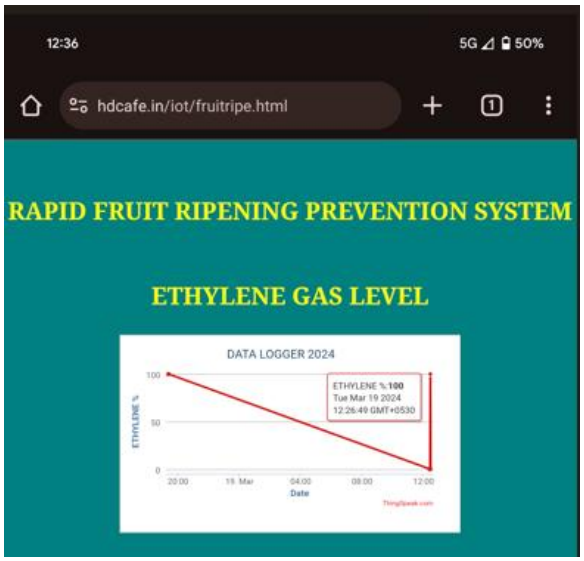

Figure 3: Thinkspeak Data

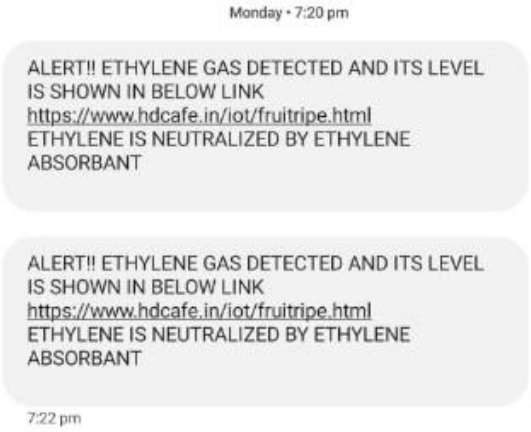

Figure 4: Message Notification

CONCLUSION

In conclusion, the proposed IoT-based system offers a comprehensive solution for effectively managing ethylene gas levels in fruit storage chambers, thereby mitigating the risk of faster ripening and reducing wastage. By integrating advanced sensors, control mechanisms, and communication technologies, the system enables real-time monitoring, precise control, and proactive intervention to optimize fruit storage conditions. With features such as ethylene detection,

exhaust mechanisms, absorbent spray activation, remote monitoring via ThingSpeak server, SMS notifications, and local display, the system provides stakeholders with the necessary tools to ensure the delivery of high-quality fruits while promoting sustainability in the food industry.

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