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Cloud kitchen Inventory System

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Abstract- Fast growth in cloud kitchens, driven by increased demand for food delivery services, is coupled with massive challenges to inventory management. Traditional inventory systems usually cannot meet dynamic requirements like those of cloud kitchens—fast-moving environments needing precise, real- time tracking of ingredients to ensure minimal wastage and resource optimization. This paper investigates how an IoT- enabled inventory management system can be implemented in a cloud kitchen setting. The system provides real-time observations of inventory levels, expiration dates, and storage conditions through the use of IoT technologies such as smart sensors, and other connected devices. It provides a holistic solution to inventory management problems within cloud kitchens since it allows for the automation of replenishment, demand prediction using data analytics, and compliance with food safety standards. The integrating technology will increase operational efficiency, generate cost savings, and sustain them by decreasing food wastage. This paper also discusses the possible challenges of IoT adoption related to data security and system integration, proposing strategies for successful implementation.

Index Terms- ESP 32 Miicrocontroller, Ultasonic Sensors, LCD Display,Shelves.

I. INTRODUCTION

The evolution of the food service industry has given rise to cloud kitchens, also known as ghost kitchens, which exclusively cater to online food orders. This business model, unburdened by the need for dine-in spaces, offers significant advantages such as reduced overhead costs and greater operational flexibility. However, the success of a cloud kitchen hinges on its ability to manage inventory efficiently, ensuring that ingredients are available when needed, while minimizing waste and controlling costs.

In a rack-based inventory system, ingredients are systematically arranged on racks within the kitchen or storage area, with each rack dedicated to specific types of ingredients or products. This method not only maximizes the use of space but also facilitates faster retrieval of items, thus enhancing the overall efficiency of kitchen operations. Furthermore, when integrated with barcode scanning or RFID technology, a rack-based system can enable real-time tracking of inventory levels, alerting kitchen staff when stock is running low.A critical component of inventory management in cloud kitchens is the organization and storage of ingredients. Traditional inventory systems, which often rely on manual tracking and periodic audits, can be inefficient and error- prone, leading to stock discrepancies and potential disruptions in kitchen operations. To address these challenges, a rack- based inventory system can be implemented, providing a structured and easily accessible method for storing and managing ingredients.

This System deals with how a rack-based inventory system can be effectively utilized in cloud kitchens, improving both inventory accuracy and operational efficiency. The subsequent sections will discuss the design and implementation of such a system, the integration of technology for enhanced functionality, and the benefits and challenges associated with this approach.

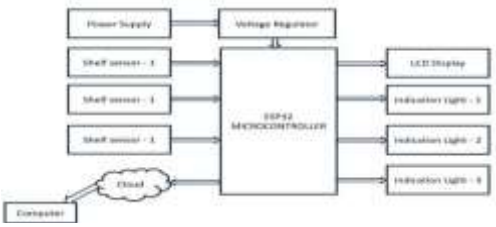

Fig 1: Block diagram of cloud kitchen inventory system

- **Power Supply:** Provides electrical power to the system. The power is regulated by the Voltage Regulator to ensure a stable supply to the ESP32 microcontroller and other components.
- **Shelf Sensors (1, 2, 3):** These sensors, like ultrasonic sensors, are attached to shelves to detect the quantity of items (inventory level) on each shelf. They send data to the ESP32 microcontroller for further processing.

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- **ESP32 Microcontroller:** Acts as the central processing unit of the system. It receives inputs from the sensors and controls the output devices.
- **LCD Display:** The LCD display is connected to the ESP32 microcontroller. It shows real-time information about the stock levels (Quantity) of each shelf.
- **Indication Lights (1, 2, 3):** Three indication lights are connected to the ESP32.These lights can provide visual feedback about inventory status. For example, If LED gets off it indicates sufficient stock and for LED ON it shows that stock has run out or shelf is empty.
- **Cloud Integration:** The ESP32 sends data to the cloud for remote monitoring and data storage. This data can be accessed from a computer or any other connected device, allowing real-time inventory monitoring.

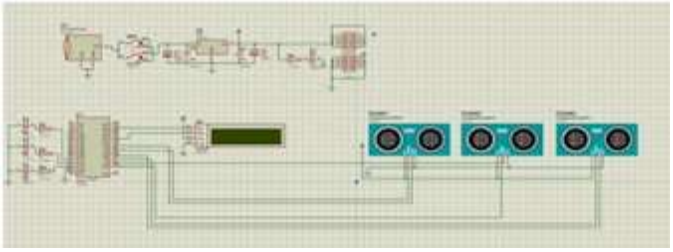

Fig 2: Circuit diagram of cloud kitchen inventory system

Objectives

- The system will provide timely alerts on display of the web page when inventory levels are low, prompting users to take action.
- Users can access accurate, up-to-date information about the quantities of food items on the shelves through the display.
- The system eliminates the need for daily manual checks, saving users valuable time that can be redirected towards other tasks or activities.
- Users can make informed decisions about placing orders with food stores based on real-time inventory data, optimizing the replenishment process.

II. EXPECTED RESULTS

1. Increased Accuracy
The system is anticipated to significantly improve inventory accuracy by automating the tracking process with ultrasonic sensors, thereby reducing errors associated with manual counts and periodic audits.

2. Real-Time Inventory Monitoring
Retailers will benefit from real-time visibility into inventory levels for each shelf, enabling them to make timely and informed decisions regarding restocking and inventory management.

3. Reduced Labor Costs
By automating inventory tracking, the system is expected to decrease the need for manual checks and audits, thereby reducing labor costs and freeing up staff to focus on other critical tasks.

4. Enhanced Data Accessibility
The integration with Google Firebase will provide secure, cloud-based storage of inventory data, allowing for easy access to real-time and historical data for trend analysis and strategic planning.

5. Improved Decision-Making
The immediate access to current inventory counts via the display will facilitate better decision-making regarding promotions, stock levels, and inventory optimization.

6. Higher Customer Satisfaction
With more accurate and efficient inventory management, retailers can better maintain stock levels, reducing instances of stockouts and overstocking, which in turn enhances overall customer satisfaction and loyalty.

7. Strategic Insights
The ability to analyze historical inventory data will provide valuable insights into product performance and inventory trends, aiding in strategic decision-making and planning.

When the Shelves are Empty

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When the Shelves are not Empty

III. CONCLUSION

In conclusion, integrating IoT into cloud kitchen inventory management provides substantial benefits. It enables real-time tracking of inventory levels, reducing the risk of shortages or overstocking. The use of IoT sensors ensures accurate and automated data collection, which minimizes errors and enhances inventory precision. Centralized management through cloud systems simplifies inventory control across various kitchen locations. Predictive analytics derived from IoT data helps in forecasting demand, optimizing stock levels, and reducing waste, leading to increased efficiency and cost savings. Overall, IoT in cloud kitchen inventory management enhances operational accuracy, efficiency, and scalability, contributing to improved decision-making and reduced operational costs.

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