

Next-Gen Cold Storage Surveillance Platform

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Abstract - Every year, a significant amount of food is wasted globally due to inadequate storage and transportation of temperature, humidity, and gas-sensitive goods. To combat this issue, our proposed system leverages sensor-based IoT technology to enable remote tracking and monitoring of produce. Early warning alerts ensure comprehensive visibility and accountability throughout the product value chain. Real-time monitoring aids businesses in managing losses and optimizing operations effectively. The system incorporates Temperature and Humidity sensors, a Wi-Fi-enabled microcontroller board, and a Mobile application for seamless management. Data is securely stored in the Particle cloud and can be accessed remotely through the mobile app. The software allows remote control configuration, empowering businesses to reduce waste and comply with regulations efficiently. Clients can easily set personalized alert limits via the mobile application.

Keywords –IoT (Internet of Things) technology, the lifespan of the food, real-time monitoring, operational efficiency, user-friendly, cost-efficient.

I. INTRODUCTION

In an era where data and information are the lifeblood of businesses and industries, efficient and secure storage of critical assets has never been more vital. The "Next-Gen Cold Storage Surveillance Platform" is a cutting-edge project that addresses the pressing need for advanced and adaptable solutions in the realm of cold storage management. This innovative system represents a significant leap forward in the way we handle and safeguard perishable goods, pharmaceuticals, biological samples, and other temperature-sensitive materials, all while ensuring optimal resource utilization and environmental sustainability. Traditionally, cold storage management has been fraught with challenges such as temperature monitoring, inventory tracking, energy consumption, and security concerns. These issues have significant ramifications for industries such as food and beverage, pharmaceuticals, and healthcare, where product quality, compliance with regulations, and cost-efficiency are paramount. Recognizing these challenges, the "Next-Gen Cold Storage Management System" aims to revolutionize the way we manage and operate cold storage facilities, providing businesses with a powerful and intelligent toolset to streamline operations and minimize risks. This project leverages the latest advancements in IoT (Internet of Things), AI (Artificial Intelligence), and blockchain technologies to create a comprehensive solution that enhances cold storage infrastructure across various sectors. Through real-time monitoring and data analytics, the system ensures precise temperature control, minimizing waste and preserving the quality of stored goods. It offers a user-friendly interface for inventory management, reducing human error and optimizing stock rotation.

Furthermore, the "Next-Gen Cold Storage Management System" prioritizes sustainability by optimizing energy consumption through predictive maintenance and intelligent algorithms. It also enhances security by implementing robust access control mechanisms and block chain-based data integrity measures, assuring the integrity and traceability of stored assets. In summary, the "Next-Gen Cold Storage Management System" is not merely an evolution but a revolution in the way we manage cold storage facilities. With its integration of cutting-edge technologies and its commitment to efficiency, sustainability, and security, this project promises to redefine cold

storage management for industries worldwide, unlocking new levels of productivity, profitability, and peace of mind for businesses and organizations that rely on the safekeeping of temperature-sensitive assets.

II. LITERATURE SURVEY

Extensive research and literature exist on online marketplaces and art platforms, forming a foundational understanding of the project's significance and potential influence. Several pertinent studies and articles contribute to the project's context:

1. An IoT-based Real-time Intelligent Monitoring and Notification System of Cold Storage: The paper introduces an innovative IoT-based monitoring system (RT-IMNS) that effectively addresses the issue of FVs loss in cold storage by continuously monitoring crucial environmental parameters and using advanced AI techniques to classify the status of stored produce. The system outperforms existing models and demonstrates a high level of accuracy and precision, which is critical for reducing food waste and ensuring the quality of stored perishable goods.

AUTHOR: Hina Afreen, Imran Sarwar Bajwa

2. Modular System for Cold Storage Monitoring: In this paper, the author describes the development of an embedded monitoring system that is suitable for cold-storage. The system provides sensor data of temperature, humidity, power consumption, and detection of door position. This system was developed for cold storage that monitors the conditions of products like food, biological samples, or medicines. The system uses modular architecture using both cables and wireless communication for logging and alarm generation systems. The data is collected in CSV format and later plotted using MATLAB. Analysis of data provides information about the significant variations in storage.

AUTHOR: P.J. Sousa, P. Abreu and M. R. Quintas

3. Temperature Control System of Cold Storage: Cold storage uses cooling facilities to maintain the proper humidity and temperature of warehouses and is used for the storage of agriculture and livestock products. In this paper, the author has proposed a design based on the STC89S52 microcontroller and uses the DS18B20 sensor to detect the current temperature of cold storage and also provides the LCD Display which shows the current values of the storage system. If the measurement value is above or below the limit value the system will alarm and then stops the actuator from making the temperature quickly reach the present range. The system saves the results of values in the database

AUTHOR: Ting Lu and Zeliang Liu

4. Monitoring food storage humidity and temperature data using IoT: In the food industry, cold storage is a necessity and the main objective behind this kind of storage is to preserve the raw foods for a certain time. But due to lack of technology and ignorance in the system raw foods are not maintained well. In this paper, the author proposed a system based on IoT to monitor the real-time data of temperature and humidity using sensor DHT11 with ESP8266 Node MCU module. Node MCU is a cheap alternative for Arduino and provides Wi-fi capabilities. The data from the warehouse can be viewed on Thing Speak cloud service that gives a dashboard with all real-time values. This IoT system focuses on controlling electronic devices remotely and also to monitor devices around the world.

AUTHOR: Asif Bin Karim, Md Zahid Hassan, Md Masum Akanda, Avijit Mallik

5. Monitoring of Temperature in Retail Refrigerated Cabinets Applying IoT Over Open-Source Hardware and Software

The control of refrigeration in the food industry is rudimentary in all stages and implementation of IoT based solution is a revolution in the food industry. In this paper, the author proposed a low-cost IoT solution based on the



use of ESP8266 Wi-fi with a DS18B20 temperature sensor. The system uses the Thing Speak IoT platform for storing and processing data in the cloud. An alarm system is present if any abnormality is detected in cold storage it can be notified to cold storage operations rooms.

AUTHOR: José Ramírez-Faz, Luis Manuel Fernández-Ahumada, Elvira Fernández-Ahumada, Rafael López-Luque

III. PROPOSED SYSTEM

Our proposed Next-Gen Cold Storage Surveillance Platform, stands out as a beacon of innovation in the realm of food storage and transportation. Its distinguishing features lie in its commitment to being both low cost and low maintenance, addressing crucial pain points that have long plagued the industry. This comprehensive solution leverages the power of the Internet of Things (IoT) to create a robust ecosystem that seamlessly integrates hardware, software, and advanced data management. By doing so, it promises to usher in a new era of efficiency and precision in the monitoring and management of temperature-sensitive goods within cold storage facilities.

At the core of the Next-Gen Cold Storage Surveillance Platform is its Sensor Integration mechanism. This feature involves the deployment of cutting-edge sensors strategically placed within the storage environment to constantly monitor key parameters such as temperature, humidity, and gas levels. These sensors act as the eyes and ears of the system, providing real-time data that forms the foundation for informed decision-making. The integration of sensors ensures a granular level of monitoring, enabling early detection of deviations from optimal conditions and facilitating proactive interventions to prevent spoilage and food wastage. Complementing the Sensor Integration is the inclusion of a Microcontroller Board, a pivotal component responsible for processing and interpreting the data collected by the sensors. This board serves as the brain of the system, orchestrating the seamless communication between the sensors and the central data management hub. Its efficient processing capabilities contribute to the overall responsiveness of the platform, ensuring that deviations from optimal storage conditions are identified and addressed in real-time. The Microcontroller Board forms the technological backbone that empowers the Next-Gen Cold Storage Surveillance Platform to deliver on its promise of precision and reliability. The platform extends its functionality to end-users through a dedicated Mobile Application, offering a user-friendly interface for monitoring and managing perishable inventory. This application provides stakeholders, including business owners and operators, with real-time visibility into the status of their cold storage facilities. Users can access critical information at their fingertips, receive instant alerts on deviations, and even remotely configure the system settings.

The Mobile Application adds a layer of accessibility and convenience, empowering users to stay connected and in control of their operations irrespective of their physical location. Data Management constitutes another crucial facet of the proposed system, ensuring that the wealth of information generated by the sensors is organized, stored, and analyzed effectively. The platform employs sophisticated data analytics tools to derive actionable insights from the collected data, enabling businesses to make informed decisions regarding inventory management, quality control, and operational efficiency. By harnessing the power of data, the Next-Gen Cold Storage Surveillance Platform not only addresses immediate challenges but also provides a foundation for continuous improvement and optimization. An integral component of the proposed system is its Alert System, designed to provide timely notifications to stakeholders when deviations from optimal storage conditions are detected. These alerts are customizable, allowing businesses and clients to set personalized thresholds based on their specific requirements. This customization ensures that the system caters to the diverse needs of different stakeholders, enhancing its adaptability and relevance across various industry segments. Finally, the Next-Gen Cold Storage Surveillance Platform boasts a Remote Configuration feature, empowering users to adjust system settings and parameters remotely. This functionality adds a layer of flexibility and responsiveness, allowing businesses to adapt to changing circumstances without the need for physical intervention. The Remote Configuration feature aligns with the overarching goal of creating a system that is not only efficient but also user-centric, catering to the dynamic nature of the food storage and transportation industry.

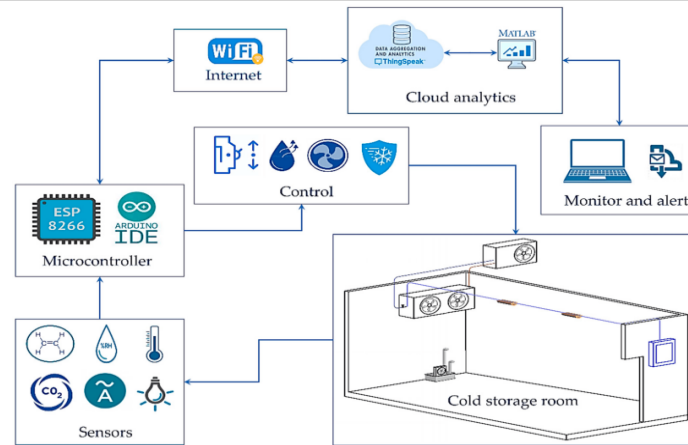


Fig. 1 Remote access and control system

IV. CONCLUSION

In conclusion, the "Next-Gen Cold Storage Surveillance Platform" represents a cutting-edge solution to address the critical challenges of monitoring and managing cold storage facilities. By leveraging state-of-the-art technologies such as IoT sensors, cloud computing, data analytics, and robust software modules, this platform offers a comprehensive and efficient means to ensure the integrity of temperature-sensitive goods. With real-time monitoring and data analysis, the platform empowers users to maintain ideal storage conditions, minimize losses, and improve overall operational efficiency. The alerting and notification system provides timely warnings about temperature deviations and critical events, enabling quick response and intervention.

Furthermore, the platform's user-friendly interface, both web-based and mobile, facilitates seamless interaction and accessibility for administrators and operators. Integration capabilities with external systems enhance data exchange and streamline logistics and compliance processes. Security and compliance are at the forefront of the platform's design, with data encryption, access controls, and audit logging to ensure the confidentiality and integrity of sensitive information.

In a world where food waste and product spoilage are major concerns, the "Next-Gen Cold Storage Surveillance Platform" stands as a powerful tool to revolutionize how we manage and preserve perishable goods. Its scalability and adaptability make it suitable for a wide range of industries and applications, ultimately contributing to the reduction of waste, improved resource utilization, and enhanced product quality. In essence, this platform represents the next generation of cold storage management, offering a holistic, data-driven, and technologically advanced approach to ensure the safe and efficient storage of temperature-sensitive goods in cold storage facilities. It heralds a future where cold storage management is not only more effective but also more sustainable and environmentally responsible.

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Volume: 07 Issue: 02

March to April 2024

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