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TRACEABILITY SYSTEM USING IOT AND FORECASTING MODEL FOR FOOD SUPPLY CHAIN

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ABSTRACT

Nowadays, customer's health awareness is of extreme significance. Food can become contaminated at any point during production, preparation and distribution. Therefore, it is of key importance for the perishable food supply chain to monitor the food quality and safety. Traceability system offers complete food information and therefore, it guarantees food quality and safety. The current study proposes IoT- based traceability system that utilized Node MCU based sensors. The Node MCU is used to measure temperature and humidity during storage and transportation. The results displayed that compared to the traditional methods.

INTRODUCTION

IoT-enabled traceability systems have revolutionized the way food products are tracked and monitored throughout the supply chain. These systems employ a network of interconnected devices and sensors embedded in packaging, attached to pallets or containers, or installed in storage facilities and transportation vehicles. These devices collect real-time data on various parameters, including temperature, humidity, pressure, location, and even the presence of contaminants.

Radio Frequency Identification (RFID) tags play a pivotal role in IoT-enabled traceability systems. These unique identifiers are attached to individual products or batches, enabling precise tracking from farm to fork. As products move through different stages of the supply chain, RFID tags are scanned to capture location and timestamp data, generating a comprehensive history of each product's journey.

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Data Aggregation and Analysis: Unveiling Hidden Insights. The data collected from IoT devices and sensors is transmitted wirelessly to a central cloud-based platform for aggregation and analysis. This platform serves as the backbone of the traceability system, providing real- time visibility into the location and condition of food products across the entire supply chain

Advanced analytics algorithms are employed to process and interpret the collected data, identifying patterns, trends, and potential anomalies. These insights can be used to predict the shelf life of products, optimize storage and transportation conditions, and proactively address potential quality issues.

Forecasting Models: Predicting Demand for a Sustainable Future. Accurate demand forecasting is crucial for optimizing inventory management, reducing food waste, and ensuring adequate supply to meet consumer demands. Machine learning algorithms can analyze historical sales data, seasonal trends, and external factors like weather patterns and economic indicators to generate accurate forecasts of future demand for specific food products.

These forecasts can be used to inform production planning, optimize distribution routes, and ensure that retailers have the right products in stock at the right time. By minimizing stockouts and overstocking, forecasting models can contribute to reducing food waste and increasing profitability.

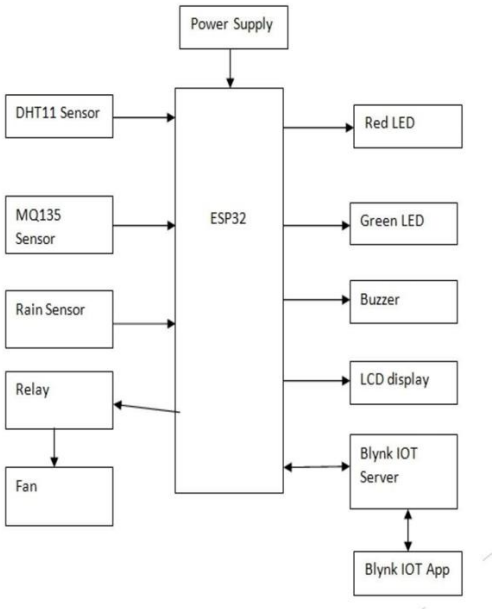

Figure.1 Block Diagram

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LITERATURE SURVEY

Traceability Systems:

Review literature on traceability systems in the food industry, including technologies such as RFID, QR codes, and blockchain.

Discuss the importance of traceability for ensuring food safety, quality control, and compliance with regulations.

Explore case studies or implementations of traceability systems in food supply chains.

IoT Applications for Traceability:

Examine research on IoT-based traceability solutions, focusing on how IoT sensors and devices can capture and transmit data throughout the supply chain.

Discuss the use of IoT for tracking and monitoring critical parameters such as temperature, humidity, location, and condition of food products during transportation and storage.

Forecasting Models for Supply Chain Management:

Survey forecasting models used in supply chain management, such as time series analysis, machine learning algorithms, and predictive analytics.

Explore how forecasting models can be applied to predict demand, inventory levels, and supply chain disruptions in the food industry.

Review studies on the accuracy and effectiveness of different forecasting techniques in food supply chains.

Integration of Traceability and Forecasting:

Investigate literature on the integration of traceability systems and forecasting models in food supply chain management.

Discuss how real-time data from IoT-enabled traceability systems can be leveraged to improve the accuracy of demand forecasting, inventory management, and supply chain planning.

Explore research on decision support systems that utilize both traceability data and forecasting insights to optimize supply chain operations.

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Data Analytics and Visualization:

Review studies on data analytics techniques for processing and analyzing large volumes of data collected from IoT sensors in the food supply chain.

Discuss the role of data visualization tools and dashboards in providing actionable insights for supply chain stakeholders.

PROPOSED SYSTEM

To achieve the project's objectives, several key components will be crucial. The selection of appropriate hardware, including sensors for food quality, temperature, and humidity, is paramount. This will be complemented by the choice of a reliable communication protocol for data transmission to the IoT platform, where data collection, storage, and analysis will take place. Data processing algorithms will be developed to provide real-time updates, including food quality indices. The user interface, which could be a web or mobile application, will enable users to access and interpret data. Additionally, the system will incorporate an alerting mechanism to notify users of hazardous food quality conditions. Historical data will be stored for trend analysis, and regular testing and calibration will ensure sensor accuracy. Data security measures, such as encryption and access controls, will be implemented to protect sensitive information. The deployment of the system in the target monitoring area and the establishment of a maintenance plan are critical for system reliability.

The IoT-Based food Quality Monitoring System operates on the fundamental principle of collecting, processing, and presenting real-time environmental data to users. It begins with a network of sensors strategically placed to measure food quality, temperature, and humidity in the surrounding environment. These sensors continuously monitor the conditions and convert them into electrical signals. The collected data is then transmitted to a central IoT platform using a reliable communication protocol. This platform acts as the brain of the system, processing the incoming data, calculating food quality indices, and storing the information. Users access this valuable information through a user-friendly web or mobile application, allowing them to monitor the environmental conditions in real time, visualize data trends, and receive alerts in the event of hazardous food quality conditions. The historical data stored by the platform provides a deeper understanding of environmental changes over time, aiding research and decision-making.

The system's effectiveness relies on data security measures, including encryption and access controls, to protect sensitive information. Regular maintenance ensures the accuracy of the

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sensors and continuous system operation. This IoT-based solution not only enhances environmental awareness but also contributes to public health by providing real-time data.

The reliable data that can drive informed decision-making and contribute to research in the field of food quality and environmental policy. In essence, the IoT-Based food Quality Monitoring System is a comprehensive platform that leverages IoT technology to provide valuable insights into the environment, thereby benefiting both individuals and the broader community.

RESULTS

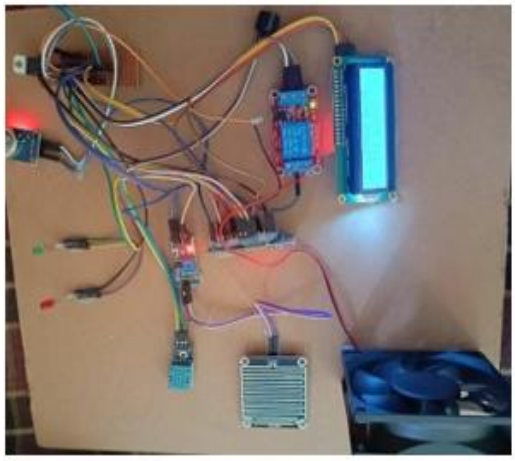

Figure.2 Food Supply Chain Kit

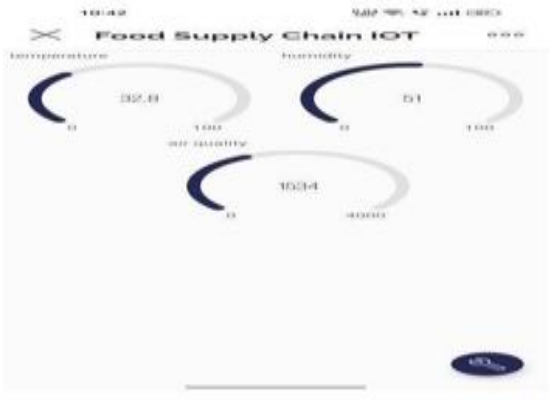

Figure.3 Food Supply Chain

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Element	Input	Output
DHT11	>36%	Red LED ON, Green LED Off, Buzzer ON, Notification
Humidity	>80%	Red LED ON, Green LED Off, Buzzer ON, Notification
MQ135	>1500%	Red LED ON, Green LED Off, Buzzer ON, Notification

Figure.4 Output of LED's

ADVANTAGES

- Sensors are easily available.
- Detecting a wide range gas like CO2, CO etc.
- Simple, compact and easily handle.
- Continuous update of change in percentage of quality.

APPLICATIONS

- Lab monitoring.
- Industrial perimeter monitoring..
- Site selection for reference monitoring stations.
- Indoor food quality monitoring.

CONCLUSION

This paper aimed to develop an efficient IoT based food supply chain management system in the aspect of food safety. The proposed work TANB- PSO provides reliable, faster response time, efficient, accuracy, transparency for the solution of managing the demand of the customer in dynamic real-time of environment and it is compared with existing algorithm. The proposed system is expected to help the management to track and trace the product thus it can help to avoid counterfeiting and distribution of low-quality food products along the supply chain.

FUTURE SCOPE

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In future work, other type of low cost IoT sensors might be utilized, while machine learning methods can be used to improve the performance of food supply chain.

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