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Fruits and Vegetables Quality Monitoring Using IoT

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Abstract: The advent of Internet of Things (IoT) technology has revolutionized the agricultural industry, particularly in the realm of fruits and vegetables quality monitoring. This literature survey delves into the innovative integration of IoT and billing systems to ensure the quality and freshness of agricultural produce. The paper focuses on an automated system designed to streamline the monitoring process, employing a methane gas sensor as a pivotal component. The sensor detects gases emitted by fruits and vegetables, specifically targeting methane levels as indicators of ripeness or decay. Upon surpassing a predetermined threshold, the system initiates the segregation of deteriorated produce, ensuring only high-quality items proceed further along the conveyor belt. The paper elucidates the system's workflow, encompassing gas sensing, sorting, weighing, and real-time inventory updates through cloud-based technology. Additionally, the study emphasizes the practical implications of this technology in empowering stakeholders with accurate information for informed decision-making. This survey not only underscores the current state of IoT-driven quality monitoring in agriculture but also explores its potential for future advancements and widespread application in optimizing produce quality, reducing wastage, and enhancing supply chain efficiency.

I. INTRODUCTION

The agricultural sector is undergoing a transformative evolution propelled by technological advancements, particularly the integration of Internet of Things (IoT) applications. Within this domain, one of the critical aspects demanding attention is the quality monitoring of fruits and vegetables along the production and supply chain. Ensuring the freshness and quality of agricultural produce is not only pivotal for consumer satisfaction but also for minimizing waste and optimizing inventory management. This literature survey delves into the innovative convergence of IoT technology and billing systems to address the imperative need for efficient and accurate monitoring of fruits and vegetables' quality. The paper focuses on an automated system meticulously designed to assess produce quality in real-time, employing IoT-enabled sensors and advanced algorithms.

At the heart of this system lies the utilization of methane gas sensors, strategically placed along a conveyor belt to continuously monitor gases emitted by the fruits and vegetables. Methane, being a prevalent byproduct of

organic decay, serves as a crucial indicator of produce ripeness or decay. The system utilizes predetermined thresholds for methane gas concentration to differentiate between fresh and deteriorated produce. Upon detection of gas levels surpassing the set threshold, the system initiates a process to segregate and divert the affected items, ensuring only high-quality produce continues along the production line. Furthermore, the system extends beyond mere quality assessment by incorporating elements of billing and inventory management. This integration facilitates real-time updating of inventory databases via cloud-based technology, enabling stakeholders to access accurate stock levels and sales data remotely.

This paper aims to provide a comprehensive overview of the state-of-the-art in IoT-driven quality monitoring systems for agricultural produce. It examines the operational workflow of the system, discusses its potential applications, and explores the implications of this technology on enhancing efficiency, reducing waste, and empowering stakeholders with actionable insights for informed decision-making in the agriculture industry. Through this exploration, the survey not only highlights the current capabilities and advancements but also aims to envision the future prospects and possibilities in the realm of fruits and vegetables quality monitoring using IoT and billing systems.

II. LITERATURE SURVEY

The IoT based fruits and vegetables storage monitoring and machine learning based shelf-life and disease detection system is a promising solution for ensuring the quality and freshness of stored produce. The system's use of sensors, cameras, and machine learning algorithms accurately detects diseases and predicts the remaining shelf-life of the stored fruits and vegetables, while the web dashboard provides real-time information on the produce's status [1].

In this proposed method, upon powering the device, the initial screen displaying "IOT FRUIT FRESHNESS DETECTOR" appears. Subsequently, the DHT11 sensor detects values and transmits them to the microcontroller, which in turn showcases these readings on the LCD Display. If the temperature exceeds 15°C, the screen will display "HIGH TEMPERATURE," accompanied by a buzzer alert. Similarly, if the humidity surpasses 90%, it will display "HIGH HUMIDITY" with a buzzer alert. Furthermore, upon detecting values from the MQ3 sensor, if the reading exceeds 250ppm, it will display "DON'T EAT," indicating the fruit is unsafe for consumption. Additionally, the MQ5 sensor detects values exceeding 500ppm, displaying "GASES RELEASING," signifying potentially harmful gaseous conditions surrounding the fruits. Testing conducted on common fruits such as Apples and Bananas revealed that highly decayed fruits registered a 300ppm alcohol value [2].

In this paper automatic vision-based system is discussed for sorting and grading of fruits based on its colour and respectively. The test performed on banana for defect detection detects defected fruit. And for three

different qualities good, medium and Low. The variation in speed of conveyor and light, camera resolution affects the system [3].

Based on various studies and solutions to the current problem, they have concluded that IOT sector will provide a very cost-effective solution to the current problem. As a result, they have addressed how diverse environmental conditions, such as a food-monitoring system powered by IOT, will be managed. Moisture and temperature levels that must be maintained at a certain level to prevent food from spoiling. It also has a user interface through an app that simply monitors the temperature and humidity parameters so that they can keep the temperature and humidity at a safe level and reduce food waste [4].

In their approach an Automatic Fruit Grading System was designed, which will save time, effort and provide better accuracy than the Manual Sorting. The techniques contains, the colour detection and Edge Detection. Colour detection is used to identify the defected part with the Threshold level. Edge Detection is used for finding the boundaries of objects within images. Their System consists of Mechanical Part such as DC motor, Arduino, Computer and Software such as image processing in Python using Open CV. They are going to design this System to meet the demands in Grading Fruits operation compared to manual grading. In their System, they have one Important Module which is GRADING Module in which they have two sub–Modules A) Colour Module and B) Shape Module. The colour Module is further divided into RGB and Grayscale. In colour Module they have captured an Image it will detect the number of Pixels of RGB an image is having by using the Threshold. In shape Module they will be focusing on the Edges of the Fruits so that they can get the accurate shape of the Fruit. These is how their system is going to work and will provide the Best Image. In addition, since there will have some kind of fruits with same colour such as tomato and apple so, there will be having some misclassification [5].

This project is designed for monitoring conditions of storage houses, which on result maintain the items stored in the warehouse. The safety and quality of frozen products is to be emphasized only when high quality raw materials will be used, good manufacturing practices to be employed in the preservation process, and the products kept in accordance with specified temperatures. In our project we have developed a system by installing Raspberry Pi, in which various sensors are embedded to form the smart food storage [6].

In this method tomato sorting has been implemented using image processing techniques. The machine learning approach is used to generalize the system and merits and demerits are described based on application. The KNN machine learning approach achieved 88% accuracy on validation database. This paper proposes a technique to find out better quality of fruits compare to other fruits sorting technique. This method is very easy and helpful for fruit grading and minimize the time and wastage of fruits [7].

In this paper, the objective of the proposed method is to identify infected region from the input images and classify the infected patterns as per their level of infection aka low, average, medium, high, extreme high and fully infected fruits according to external surface. They have used infected fruit images for the experimental observations and evaluated the introduced method considering all types of fruits (apple, oranges, mangos,

watermelon etc) as a case study. Experimental results suggest that the proposed approach can accurately find out the defected area from fruit images and grading them as per their level of infection and by using KNN. Classifier it can be accurately classify the infected images and store in their respective database. The future work includes processing on multiple images and grading them as per criteria and then sorting will make a number of clusters based on the infection level and store them to respective database accurately [8].

III. METHODOLOGY

This section discusses in detail the description of the work done, modelling and the design of the proposed system. Figure 1 depicts the functional block diagram and Figure 2 depicts the flow chart of the of fruits and vegetables quality monitoring using IoT. This shows how the various components are interlinked.

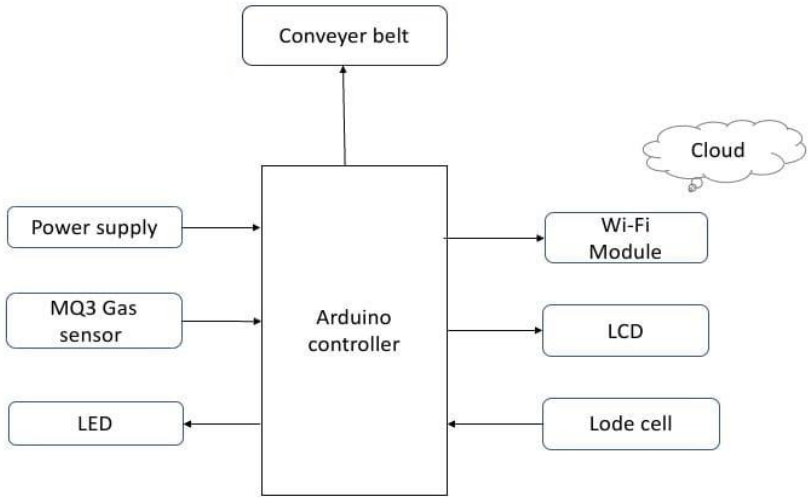

Fig1. Block diagram of fruits and vegetables quality monitoring using IoT .

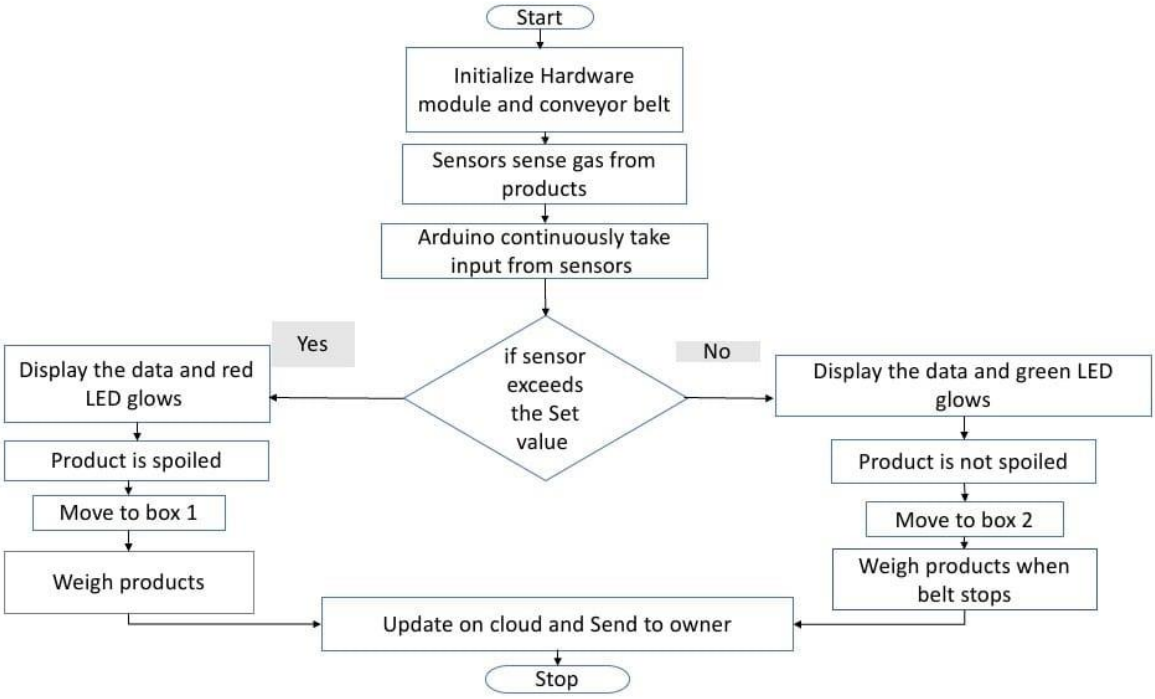

Fig2. Flow chart of fruits and vegetables quality monitoring using IoT and billing.

Here is a step-by-step methodology of proposed project

Initialization of Components:

The system starts with the initialization of various components, including the conveyor belt, methane gas sensors, containers, separation mechanism, weighing system, and the cloud connectivity module. Each component is calibrated and synchronized to ensure smooth operation.

Loading Fruits or Vegetables onto the Conveyor Belt:

Fresh fruits or vegetables are placed inside containers on the conveyor belt. The containers are designed to hold and transport the produce efficiently through the processing line.

Serial Movement on the Conveyor Belt:

The conveyor belt moves the containers serially, presenting each fruit or vegetable to the subsequent processing stages one by one. This ensures that each item undergoes the required quality checks.

Methane Gas Sensing Region:

Positioned strategically along the conveyor belt, the methane gas sensors are placed in a sensing region. As fruits or vegetables pass through this region, the sensors detect any methane gas liberated from rotten produce.

Gas Value Comparison with Threshold:

The methane gas sensor readings are constantly monitored. If the detected methane gas value exceeds the predefined threshold, it indicates that the fruit or vegetable is rotten. The system then initiates the separation process for these items.

Separation Mechanism:

Rotten produce is separated into a designated box. This can be achieved using mechanisms such as diverters or controlled gates that redirect the containers based on the quality assessment conducted by the methane gas sensors.

Quality Assessment and Box Assignment:

If the methane gas value is below the threshold, the fruit or vegetable is considered good. The item continues its journey on the conveyor belt and is directed into another box designated for good-quality produce.

Weighing Process:

Once all the fruits and vegetables have been sorted into their respective boxes, the good-quality items are directed to a weighing system. The system accurately measures the weight of each item, providing precise data for inventory and sales management.The collected data, including the quantities and weights of good and rotten produce, is sent to a cloud-based platform.

Owner Notification:

Simultaneously, the system sends a notification to the owner, providing details about the overall quality assessment. This notification ensures that the owner is promptly informed of the status of the inventory and can take necessary actions, such as restocking or adjusting prices.

In summary, this comprehensive system utilizes advanced sensing and automation technologies to efficiently sort and monitor the quality of fruits and vegetables, providing real-time data to the owner for effective inventory management. The cloud connectivity ensures accessibility and quick decision-making based on the analyzed data.

IV. RESULT

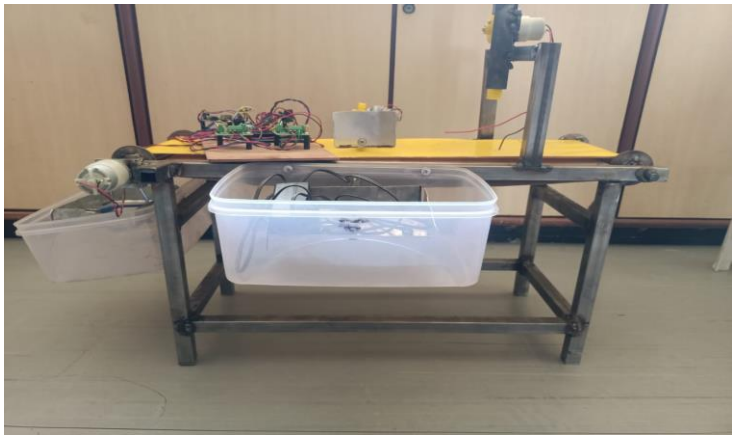

Fig3. Project setup.

Fig4. Detecting whether the fruit is good or bad.

Fig5. Weight of the good and bad fruit displayed on LCD display

Fig6. Weight of the good and bad fruit displayed on Telegram app (IoT)

V. ADVANTAGES/DISADVANTAGES

ADVANTAGES:

- The system automates the quality monitoring process, reducing the need for manual inspection and improving efficiency.
- The use of IoT enables real-time monitoring of produce quality.
- Sending data to the cloud allows for centralized storage and accessibility.
- Continuous monitoring helps ensure that only high-quality produce is delivered to consumers.

DISADVANTAGES:

- IoT systems require regular maintenance and updates.
- The system involves multiple components and technologies.

APPLICATIONS

- Food Processing Industry:

  Quality Control: Implementing IoT-based quality monitoring ensures that only fresh and high-quality produce is used in food processing.

  Inventory Management: Real-time data on inventory levels and quality helps optimize production and reduce waste.

- Retail and Distribution:

  Quality Assurance: Retailers can use IoT data to ensure that only the best produce reaches store shelves, improving customer satisfaction and reducing returns.

  Supply Chain Optimization: Monitoring quality throughout the supply chain enables better logistics planning and inventory management.

- Agriculture and Farming:

  Harvest Monitoring: Farmers can use IoT systems to monitor the ripeness and quality of crops during harvest, optimizing timing for picking.

  Post-Harvest Handling: IoT helps in identifying and sorting out damaged or low-quality produce after harvest, reducing losses.

- Cold Chain Management:

  Temperature Monitoring: Integrating IoT sensors with quality monitoring ensures that temperature-sensitive produce is maintained under optimal conditions throughout the supply chain.

  Quality Preservation: Real-time alerts on quality deviations help prevent spoilage during transportation and storage.

- Food Safety and Compliance:

  Regulatory Compliance: IoT systems can aid in compliance with food safety regulations by providing detailed tracking and monitoring of produce quality.

- Hospitality and Food Service:

  Kitchen Management: IoT-enabled quality monitoring ensures that chefs have access to the freshest ingredients, enhancing the quality of meals served.

  Menu Planning: Data on produce quality and availability assists in menu planning and seasonal offerings.

- Consumer Applications:

  Smart Kitchen Appliances: IoT-enabled devices can provide consumers with real-time information about the freshness and quality of fruits and vegetables at home.

  Healthy Eating: Data on produce quality can encourage consumers to make healthier food choices based on freshness and nutritional value.

VI. CONCLUSION

In conclusion, the integration of IoT and billing systems for Fruits and Vegetables Quality Monitoring represents a pivotal advancement in modern agricultural practices. This fusion of technology offers multifaceted benefits, revolutionizing the way produce is monitored, assessed, and delivered across the supply chain.

The seamless combination of IoT sensors, advanced analytics, and billing systems presents a robust framework for ensuring the freshness and quality of fruits and vegetables. By utilizing methane gas sensors and IoT-enabled devices along conveyor belts, the system effectively distinguishes between fresh produce and items at risk of spoilage or decay. This real-time monitoring and automated sorting ensure that only high-quality produce moves forward, significantly reducing waste and enhancing consumer satisfaction.

As the technological landscape continues to evolve, the future holds immense promise for further innovations in sensor capabilities, predictive analytics, and interoperability among devices. Advancements in AI-driven analytics, smart packaging, and robotics will propel the efficiency, accuracy, and sustainability of these systems.

In essence, the convergence of IoT for Fruits and Vegetables Quality Monitoring not only enhances the quality control measures but also drives efficiencies throughout the agricultural supply chain. The future advancements in this field will undoubtedly continue to redefine the standards of produce monitoring, ensuring fresher, safer, and more sustainable fruits and vegetables for consumers while empowering stakeholders with actionable insights for informed decision-making.

VII. REFERENCES

[1]. Akash AM, Sanjana Honnappa Harikantra, Thrupthi PR, Vandana Annappa Alur, Prof. Gourish S Hegde," IoT based fruits and vegetables storage monitoring and machine learning based shelf-life and disease detection system". June-2023

[2]. Soham Katare, Dip Paliwal, Shreyas Suryawanshi, Rushab Humane, Hitesh Meshram, Rajesh Thakare," IoT based monitoring of fruit freshness using Arduino Nano". April-2023

[3]. Maria Suzuki, Kanae Masuda, Hideaki Asakuma, Kouki Takeshita, Kohei Baba, Yasutaka Kubo, Koichiro Ushijima, Seiichi Uchida, Takashi Akagi, "Deep Learning Predicts Rapid Over-softening and Shelf Life in Persimmon Fruits", Volume 91 Issue 3 2022.

[4]. Shaik Naziya 1, Dr. C Sivaraj Ph.D., "Fruit Disease Detection and Classification Using Artificial Intelligence", International Research Journal of Engineering and Technology (IRJET) Volume: 09 Issue: 08, Aug 2022.

[5]. Riyaz S, Venkatesh T, Maheshwar Reddy S, Dr.Radhika K," Image Processing Based Fruit and Vegetables Quality Analysis on Machine Technology". June-2022

[6]. D.Venkata Lakshmi, N.Harshitha, S.V.R.Chaitanya, K.Madhu Babu," Food Monitoring System Using IOT". May-2022

[7]. Hina Afreen And Imran Sarwar Bajwa, "An IoT-Based Real-Time Intelligent Monitoring and Notification System of Cold Storage", March 12, 2021.

[8]. Ashraf Shaikh, Asim Sayyed, Mehvash Shaikh," Grading and Sorting of Fruits Based on Image Processing". January-2020

[9]. Shata Rupa Sinha, Ashutus Singha, Muhiuddin Faruquee, Md. Abu Sayem Jiku, Md. Arifur Rahaman, Md. Ashraful Alam & Mohammad Abdul Kader, "Post-harvest assessment of fruit quality and shelf life of two elite tomato varieties cultivated in Bangladesh", 11 December 2019.

[10]. S.A.Khumkar, A.S.Bhujbale, S.B.Khandar, S.P.Deshmukh, Dr.M.A.Pund," IoT Based Monitoring and Control for Vegetables and Fruits Storage". 2018

[11]. Yadav Kadam,Sandip Khansole, Abhijeet Jadhav, Prof. Dr.Arati J Vyavhare," Real Time Fruit Sorting Using Computer Vision and Machine Learning". April-2018

[12]. Miss. Anuradha Gawande, Prof.S.S.Dhande," Implementation of Fruits Grading and Sorting System by using Image Processing and Data Classifier". June-2015