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FRESH FRUIT RECOGNITION USING IOT

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ABSTRACT

The Internet of Things (IoT) has revolutionized various industries, and its application in the food industry has gained significant attention. This paper introduces an innovative IoT-based Food Freshness Detection System designed to address the critical issue of monitoring and ensuring the freshness of perishable food items. The system utilizes a combination of sensors, communication technologies, and data analytics to provide real- time information on the freshness status of food products. The detected freshness levels are then displayed on a user-friendly mobile application, empowering individuals to make informed decisions about food consumptionand minimize waste.

Keywords- Crossover distance, crossover function, LEO, network latency, optical fiber terrestrial networks, optical wire- less satellitenetworks, satellite constellations.

[1] INTRODUCTION

Nowadays we must be concerned about the quality of the food items to get full nutritional values. It’s better to consume fresh food to lead a better life. The quality, safety, and satisfaction offood products are all directly impacted by how fresh the food is. Fresh food preserves its nutritional content and lowers the danger of contracting foodborne illnesses in addition to being more appealing in terms of taste, scent, andtexture. Food that is damaged or past its prime, on the other hand, can result in consumer displeasure, health risks, financial losses, and increased food waste. Therefore, throughout the entire food supply chain, an accurate and timely assessment of food freshness is crucial.

To identify the freshness of the food items we go with the Image recognition technology and Artificial Neural Network.[2] Most of the time we didn't notice the freshness of the food item because of the busy life schedule and some people didn't know how to find the freshness of the food item. To handle this situation, our project helps the user (people who handle the prototype of the project) to identify the freshness within a few seconds. The existing system for the freshness detection in the earlier days is only based on the chemical-based detection later it developed to [13] image-based classification and some existing system based on the sensor-based methods, but however it takes only a single parameter we can't determine freshness based onthe single parameter.

[2] LITRATURE REVIEW

Harshitha S, Mythreyi Manjunath H. K, Neha

B. M (2023): This paper proposes a food spoilage detection system using an Arduino and an MQ4 methane gas sensor. The system detects the presence of methane gas emitted by spoiled foodand displays the results on an LCD screen and LED.Key Points: Uses Arduino UNO and MQ4 sensor,Detects methane gas, a sign of spoilage,Displays results on LCD and LED.

Abhilasha Singh, Ritu Gupta & Arun Kumar (2023): This research paper proposes a technique for automatically detecting rotten fruits in images using a convolutional neural network (CNN). This method aims to reduce human effort, save time, and prevent the spread of spoilage in the agricultural sector. The proposed CNN model, based on MobileNetV2 architecture, achieved an accuracy of 99.56% on training data[1] and 99.69% on the validation set in identifying rottenand fresh fruits (apples, oranges, and bananas).Max pooling achieved lower accuracy (94.97% training, 95.01% validation) compared to MobileNetV2. The results suggest that theCNN model can effectively differentiate betweenfresh and rotten fruits. Reduces manual effort in fruit classification. Saves time and resources. Helps prevent the spread of spoilage in the agricultural sector. Overall, this research demonstrates the potential of using CNNs for automated fruit spoilage detection, which could benefit the agricultural industry.

T. Bharath Kumar,Deepak Prashar,Gayatri Vaidya ,Vipin Kumar ,S.Deva Kumar and F. Sammy (2022): This paper proposes a convolutional neural network (CNN) model to detect the freshness of three types of fruits: oranges, apples, and bananas. The model aims to reduce food waste by helping people identifywhen fruits are starting to go bad and should be consumed or discarded. The paper mentions using a dataset from Kaggle, but does not specify the name of the dataset. The paper discussesvarious parameters used in the model, but could benefit from a more detailed explanation of their impact on performance.[2] The proposed CNN model achieved an accuracy of 98.4% on trainingdata and 97.14% on testing data. The model outperforms existing techniques in terms of accuracy and can classify fruits as fresh or damaged.The model can potentially be used in smart refrigerators or other applications to help reduce food waste.

Overall, this paper presents a promising approachto food waste detection using CNNs. [2] The highaccuracy and effectiveness of the proposed modelsuggest that it has the potential to be a valuable tool in reducing food waste.

Karthickeyan.P, Nikesh.V, Sanjay.V, Dr. K. Devi (2022): This paper proposes a system that uses image and smell data to determine the freshness of food. The system uses a convolutional neural network (CNN) to classify images of food samples and a YOLO object detection algorithm to detect affected areas. It also uses gas sensors to detect the level of gas emitted by rotten food samples. The system was tested on apples, oranges, and bananas and achieved an accuracy of 99.7%. The authors believe that this system could be used in food industries to ensure the quality of food items.

Snehal Chalke, Sowmya Ganesan, Krishna Gajera, Pooja Reshim & Nita Patil (2020): This research paper explores using the Internet of Things (IoT) to detect food spoilage. It utilizes a NodeMCU microcontroller programmed to work with various sensors such as MQ4 sensor, MQ9 sensor: Detects volatile organic compounds (VOCs), another indicator of spoilage.DHT11 sensor: Measures temperature and humidity, which influence food preservation.

If the sensors detect signs of spoilage, a buzzer alerts the user, and an LCD displays the food's condition. Additionally, the system sends data to the Thing Speak platform, potentially notifying consumers remotely. This approach aims to help prevent food waste and promote safer food consumption.

B. V. Ramana Murthy, C. Kishor KumarReddy, P. R. Anisha & RajaShekar Sastry (2020): This paper proposes a system for detecting and identifying food spoilage using Arduino and Internet of Things (IoT) technology.The system addresses the concern of food wastedue to oversight or long-term storage inrefrigerators.[3] Sensors are placed inside the refrigerator to continuously monitor foodconditions. Sensors collect data ontemperature, humidity, moisture, and gas levels. Arduino processes the sensor data and analyzes itfor spoilage indicators. An algorithm determinesthe freshness and quality of food based on sensorreadings.If spoilage is detected, an alert messageis sent to a registered mobile phone. Providesconvenience by remotely monitoring food qualitywithout physically checking the refrigerator.

Horea Muresan, Mihai Oltean (2018): This paper introduces a new dataset named Fruits-360 containing 90,483 images of 131 fruits and vegetables. The dataset was created by filming fruits while rotating them and extracting frames. Fruits were segmented from the background and scaled to 100x100 pixels. Dataset contains 90,483 images of 131 fruits and vegetables. Images were obtained by filming fruits while rotating and extracting frames.[4] Fruits were segmented frombackground and scaled to 100x100 pixels. Dataset is available on GitHub and Kaggle. Autonomous robots for fruit harvesting and inspection. Object recognition in augmented reality applications. Improved food classification and sorting systems.

Mr.A.Venkatesh, T.Saravana kumar, S. Vairamsrinivasan , A.Vigneshwar , M.Santhosh Kumar (2017): This paper proposes a food monitoring system based on Bluetooth Low Energy (BLE) and Internet of Things (IoT) technology. The system uses sensors to collect data on food quality, such astemperature, humidity, and volatile organic compounds (VOCs). The data is then transmitted to a server via BLE, where it can be monitored and analyzed. This system can be used to improve food safety, quality control, and traceability. nRF52832 microcontroller, The system uses three sensors a VOC sensor, a DHT11 temperature and humidity sensor, and a gas sensor, BLE technology, ThingSpeak API.

Hokuto Kagaya, Kiyoharu Aizawa & Makoto Ogawa (2014): This paper proposes a convolutional neural network (CNN) based approach for food recognition and detection. The authors built a dataset of food images from a food-logging system and used it to train and evaluate their CNN model.[6] They found that CNN outperforms traditional methods based on handcrafted features and that color features are important for food recognition. The CNN model also achieved significant performance gains on a food detection task.

Lu Wang, Anyu Li, Xin Tian (2014): This paper proposes a new method for detecting fruit skin defects using a machine vision system. The method is claimed to be more accurate, robust to color noise, and have lower computational cost compared to existing methods.

Problem: Packinghouses need to sort fruits based on the quality of their skin, so a system for detecting defects is necessary. The system uses two cameras positioned above a conveyor belt to capture images of fruits as they pass through. The color space used is RGB, with 16 bins for each channel, resulting in a very high-dimensional feature vector. Fisher-LDA reduces the dimensionality of the feature vector to 64 dimensions. The SVM classifier is trained on a set of labeled images containing both good and bad skin areas. The authors acknowledge the need for further research to address the limitations of the current system.

Benefits: More accurate than existing methods. More robust to color noise. Lower computational cost.

Limitations: Does not distinguish between different types of defects. May misclassify extraneous material as defects.

[3] PROPOSED METHODOLOGY

In today's rapidly evolving landscape, ensuring the freshness and quality of fruits stands as a critical concern across various sectors such as agriculture, food processing, distribution, and retail. Traditional methods of assessing fruit freshness, primarily reliant on subjective visual inspection, pose challenges including inconsistency, time inefficiency, and susceptibility to errors. In response, the integration of Internet of Things (IoT) technology presents innovative solutions for efficient and objective fruit freshness recognition.[10] In today's dynamic environment, preserving the freshness and quality of fruits is critical across multiple sectors, including agriculture, food processing, distribution, and retail. Traditional methods of assessing fruit freshness often rely on subjective visual inspection, leading to time inefficiencies and potential errors.[8] To tackle these challenges, the integration of Internet of Things (IoT) technology provides innovative solutions for efficient and objective fruit freshness recognition. The implementation process of a food freshness detection system involves several key components. Firstly, the utilization of the MQ4 sensor, designed specifically for methane gas detection emitted during food spoilage, operates based on metal oxide semiconductors. It provides an analog voltage output proportional to the concentration of methane gases detected. Predefined threshold values and algorithms are established to determine food freshness levels, comparing [9] the analog voltage output to these thresholds. The system incorporates the ESP8266 microcontroller, a low-cost Wi-Fi module with an integrated TCP/IP protocol stack. This microcontroller receives data from the MQ4 sensor, processes it using the predefined algorithm, and communicates locally. LED indicators and LCD display panels provide visual feedback and user-friendly interfaces for displaying freshness levels and methane concentrations, facilitating quick decision- making.

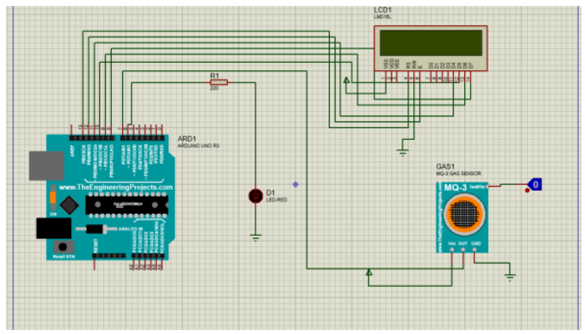

Fig 1 - Circuit Diagram

The proposed module integrates various technologies for comprehensive food freshness detection. The physical setup includes a rotating arm with a camera capturing a 360-degree view of the food sample while MQ2 and MQ135 gas sensors detect emitted gases. Data capture and processing involve the Raspberry Pi processing input from the camera and [12] gas sensors.

Image processing utilizes trained models stored in the Raspberry Pi's SD card, including a Convolutional Neural Network (CNN) withImageNet architecture for food itemidentification and YOLO (You Only Look Once)architecture for object detection on the food surface.

Gas emission analysis employs an Artificial Neural Network (ANN) model to assess gas sensor readings, determining the level of emissions detected.

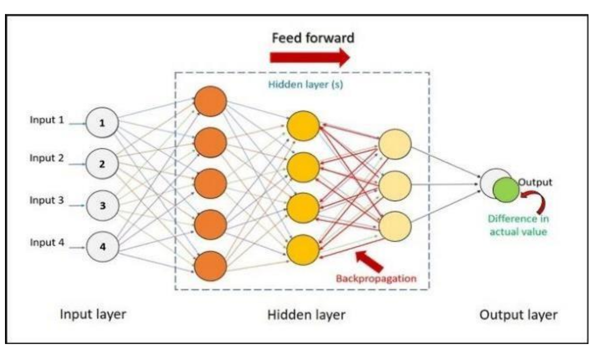

Fig 2 - Artificial Neural Network (ANN)

Decision-making processes involve comparing outputs from image processing and gas emissionanalysis to determine food freshness. This sophisticated system ensures accurate and efficient analysis of visual and gas emission data, providing valuable insights for quality control and preservation efforts across the food supply chain.

By integrating hardware components, software algorithms, and IoT technology, the food freshness detection system offers a comprehensive solution to ensure the quality andsafety of fruits in various industries. Its ability to monitor and analyze freshness levels in real-time enhances efficiency, reduces waste, and ultimately improves consumer confidence in the quality of food products.

[4] CONCLUSION AND FUTURE SCOPE

The proposed module for food freshness detection combines various technologies and algorithms to accurately assess the freshnessof food items. By integrating physical setup, data capture, image processing, gas emission analysis, and decision-making components, the system offers a comprehensive approach to freshness assessment. Through the use of Convolutional Neural Networks (CNNs) andYOLO V5 Architecture for image processing, as well as Artificial Neural Networks (ANNs) for gas emission analysis, the system can accurately identify food itemsand assess their condition based on visual andgas emission cues. The system's ability to compare outputs from both image processingand gas emission analysis enhances the accuracy of freshness assessment, making it suitable for applications in food packaging and manufacturing industries. In the future, we plan to expand our system to include moretypes of food items such as vegetables and different varieties of meat. This means our system will be able to check the quality of a wider range of foods quickly and accurately.We aim to use this system in industries that package food products to ensure they meet high quality standards. Additionally, it can behelpful in industries that produce food-basedproducts by allowing us to detect any defectsin the manufacturing process. We can easily update and modify the system to meet the specific needs of different businesses in the future. This flexibility means we can adapt tochanges and improvements as required.

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