IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, November 2024

Developing a Real Time Non Invasive Approach to Distinguish Natural and Artificial Ripened Fruits

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Abstract: *In this project we focuse on detecting artificial and natural ripened fruit using the sensor introduces a novel Internet of Things-based method. An ESP32 microcontroller serves as the system's central hub and is responsible for gathering and interpreting data from a wide range of sensors. These sensors include a DHT sensor that measures the temperature and humidity inside the fruit container, a moisture sensor that determines the moisture content of the fruits and vegetables, a weight/load sensor that tracks the weight of the produce, and a MQ2 gas sensor that carefully measures the concentration of ethylene gas released by fruits [7]. This strategy reduces food waste and preserves agricultural products by providing a more effective and sustainable substitute for conventional techniques. A key component of guaranteeing the freshness, quality, and market value of fruits and vegetables is their timely ripening.The ability of the system to continuously evaluate the complex interactions between temperature, humidity, moisture, etc. This project presents the development of an IoT-based system for preventing the premature ripening of fruits and vegetables. The system utilizes sensors to monitor ethylene gas concentration, temperature, humidity, moisture content, and weight, enabling timely intervention to regulate ripening conditions. By detecting changes in these parameters, the system can activate a DC fan to improve air circulation and disperse ethylene gas, and a DC pump to spray ethylene absorbent onto the fruits. This helps to control the ripening process and prolong the shelf life of fruits and vegetables.*

Keywords: Internet of Things

I. INTRODUCTION

The goal of this project is to create a cutting-edge Internet of Things system that can distinguish between artificially and naturally ripened fruits. The system can monitor ambient conditions, identify the subtle release of ethylene gas, and take proactive measures to slow down the ripening process by utilizing sophisticated sensors and actuators [10]. In order to make fruits marketable, the process of ripening gives them color, texture, flavor, scent, and appearance.Fruits are categorized as either climentric or non-climentric depending on how they ripen. Food quality has raised awareness of waysto enhance health and quality of life.The goal of this project is to create an Internet of Things-based system that can track and regulate fruit and vegetable ripening. The system can initiate the necessary steps to stop premature ripening by using sensors to identify changes in the surrounding environment and the amount of ethylene gas. This strategy provides a more effective and sustainable substitute for conventional techniques. A key component of guaranteeing the freshness, quality, and market valueof fruits and vegetables is their timely ripening.The ability of the system to continuously evaluate the complex interactions between the fruit container's temperature, humidity, moisture content, andethylene gas levels is its primary role. The system can precisely measure these parameters by utilizingstate-of-the-art sensors, offering a thorough comprehension of the ripening processes. This project aims to develop an IoT-based system that can monitor and control the ripening of fruits and vegetables

Sensors:

Sensor is the main focused on this project we are using MQ2 sensor(detection of gases),DHT(detection of temperature), moisture sensor,load and weight sensor [7].

Gateways and frameworks:

As the name suggests, it serves as a gateway to the internet for all of the devices and things with which we wish to communicate. Gateways serve as a conduit between the external Internet, oftenknown as the World Wide Web, and the inside network of sensor nodes. They accomplish this bygathering information from sensor nodes and sending it to the internet's backbone [2].

Cloud server:

The cloud server, or data centers, securely store and process the data that is sent through the gateway.All of our devices are now considered smart devices because of the intelligent activities that are carried out using this processed data. All analytics and decision-making in the cloud take user convenience into accounte [3].

II. METHODOLOGY

Hardware Selection: Select the ESP32 microcontroller, MQ-2 gas sensor, DHT temperature and humidity sensor, moisture sensor, weight/load sensor, relay module, DC fan, DC pump, LCD display, and power supply, among other hardware components, in accordance with the project's specifications[12].

Software Development: To communicate with the hardware, gather sensor data, analyze data,operate devices, and send information, write code using the Arduino IDE.

Make use of the Blynk platform, MQ-2 gas sensor, DHT sensor, moisture sensor, and weight/loadsensor libraries.

Create algorithms that use sensor data and preset thresholds to decide what should be done.

System Integration: Put the hardware parts together, attach them to the ESP32, and then program themicrocontroller with the created software.

Sensor Calibration: To guarantee precise readings and set baseline values for typical circumstances, calibrate the sensors [1].

Testing and Debugging: Test the system thoroughly to find and fix any problems or defects.

Data Collection and Analysis:

Data Collection: Gather sensor data under a range of circumstances, such as different fruit and vegetable varieties, shifting ambient conditions, and distinct ripening phases [8].

Data Analysis: Examine the gathered information to find trends and connections between sensor readings and the ripening of fruit [8].

Algorithm Refinement: Based on the findings of the data analysis, improve the algorithms that areused to decide what should be done.

III. LITERATURE REVIEW

Srividhya, V. & Sujatha, K. & R.S., Ponmagal. Ethylene Gas Measurement for Ripening of Fruits UsingImage Processing. Indian Journal of Science and Technology. 2016 This research focuses ondetecting ethylene gas levels for fruit ripening using a soft sensor and Artificial Neural Networks (ANN)algorithms **[1].**

K. Sujatha, R. S.Ponmagal, V. Srividhya and T.Godhavari, K. Sujatha, R. S.Ponmagal, V. Srividhya and T.Godhavari, 2016 Ripening is the process oftransforming starch into sugar infruits and vegetables. This work aims to detect ethylene levels using a soft sensor,based on fruit color, to identify stages of ripening and prevent overripening.[4],

Jayaraman, Kathirvelan & Vijayaraghavan,Rajagopalan. An Infrared based sensor system for the detection of ethylene for the discrimination of fruit ripening. Infrared Physics & Technology. 2017 A prototype ethylene sensing device was developed for fruit ripening applications,using infrared thermalemission to detect ethylene levels [2].

Yuki Hasegawa, Anita Lloyd Spetz and DonatellaPuglisi Ethylene Gas Sensor for Evaluating Postharvest Ripening of Fruit 2017 The study uses a SiC-FET gas sensor to detect ethylene from fruits, evaluating its selectivityand sensitivity, with thehighest response achieved at 200°C [11].

S. Bala Naga Pranav, T. R. Kaushek Kumar, J. Hari Prakash, S. Sharan and M.Ganesan. Freshness Estimator for Fruitsand Vegetables Using MQ Sensors. 2021 S. Bala Naga Pranav,
T.R. Kaushek Kumar, J. Hari Prakash, S. Sharanand M. Ganesan [5].

Maged Mohammed andNashi K. Alqahtani . Design and Validation of Automated Sensor-Based Artificial Ripening System Combined with Ultrasound Pretreatment for Date Fruits 2022 This paper presents a device that automates detecting the freshness offruits and vegetables using Arduino UNO, MQ2, MQ4, and IR sensors. The device detects Methaneand Ethylene concentrationsin ppm, revealing that excess ripening leads todecomposing fruits andvegetables [7].

Ambika V Review on fruit ripeningdetection technique 2022 Image processing [10].

Hernandez et al Machine learning algorithmsfor classifying fruit ripness stages based onimage data. 2022 Machine learning.

Jian Song Real time monitoring methodof strawberry fruit growth based yolo improved model. 2022 Dataset construction anddata inhancement.

Ankita Jena State of the art non destructive approaches for maturity determination in fruits and vegitable principleapplication and future direction. 2023 Computational techniqueand machinelearning [9].

IV. EXISTING SYSTEM

Research on the difference between naturally and artificially ripened fruits is expanding as a result of consumer expectations and health concerns. Artificial ripening, which is frequently accomplished with chemicals like ethylene or calcium carbide, can result in health risks and deterioration of quality.Using a variety of technologies, a number of real-time, non-invasive methods are being developed and improved for identifying artificially ripened fruits [9].

4.1 Existing Systems and Technologies

Spectroscopy-Based Techniques:

- **Near Infrared (NIR) Spectroscopy**: This technique detects variations in the chemical composition (such as sugar, moisture, and ripening agents) between naturally and artificiallyripened fruits by measuring the fruit's absorption of light in the near-infrared (NIR) region (700 nm to 2500 nm). Because NIR sensors are portable, real-time, non-invasive detection ispossible [9].
- **Raman Spectroscopy**: This method determines the structural variations and molecular makeup of the fruit's flesh and skin. It can identify chemical leftovers from synthetic ripeningagents like ethylene or calcium carbide and is non-destructive [9].
- **Visible/Near-Infrared (Vis/NIR) Hyperspectral Imaging:** separates naturally ripened fruitsfrom artificially ripened ones using internal chemical differences by combining imaging and spectroscopy to collect comprehensive spatial and spectrum data

4.2 Machine Learning:

Patterns and anomalies linked to artificial ripening can be detected by sophisticated machine learning algorithms that have been taught using sensor data (spectroscopy, hyperspectral imaging, e-nose). These systems are being developed to improve fruit recognition accuracy.

V. LIMITATIONS OF EXISTING SYSTEM

Energy Cosumption: A number of continually powered electrical parts, including as fans, pumps, and sensors, are essential to the system. In places with expensive energy prices or little accessto electricity, this energy requirement can cause issues. Running the pump to spray ethylene absorbent and the fans to disperse ethylene gas might result in continuous energy use, which over time, especially for large-scale applications, could constitute a substantial
Operating expense.

Complexity of the System: Hardware Complexity: The system consists of a number of hardware parts, including a moisture sensor, DHT temperature and humidity sensor, MQ-2 gas sensor, and ESP32 microcontroller. To work properly, all of these parts need to be combined, adjusted, and maintained. Software Complexity: Complex algorithms are needed to manage the data from several sensors and process it for decision-making. This intricacy could make maintenance difficult, particularly in settings with little technical know-how. Troubleshooting: If any sensor or component fails, it may take a while to find and fix the problem, particularly for people who are unfamiliar with IoT

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systems. 4. Existing system limitations: 4.1. Energy Consumption: A number ofcontinually powered electrical parts, including as fans, pumps, and sensors, are essential to the system. This energy need may present.

VI. MOTIVATION

- **Reduction of Food Waste:** Preventing fruit rotting due to premature ripening is one ofthe main goals of this system. The system regulates ethylene gas and environmental elements including humidity and temperature. increases the fruits' and vegetables' shelf life. Post-harvest losses are a major problem in the agricultural sector, especially in developing nations, and this immediately lowers them. Additionally, by guaranteeing that more product reaches consumers before spoiling, this supports international initiatives to increase food security and decrease foodwaste.

Sustainability:

- **Less Chemical Use:** Traditional methods to control ripening, such as using artificial ripening agents or chemicals, can have negative effects on the environment and human health. The system's approach, which involves automating the regulation of ethylene without the need for chemicals, is a more sustainable solution.
- **Optimized Resource Use:** By automating the control of environmental conditions, the systemensures that only the necessary amount of energy is used to preserve the solution.

Remote Monitoring and Control:

- **IoT Integration:** The system is integrated with the Blynk IoT platform, which allows users to monitor real-time data from sensors, track the status of devices, and adjust settings remotely. Thisis especially useful for farmers and suppliers who manage large inventories or multiple storage locationfreshness of fruits. This reduces wastage of both the produce and the resources used to maintain their condition.

Cost Efficiency:

- **Decreased Losses:** The system helps farmers, retailers, and consumers save money by reducing theamount of produce lost during storage and transportation.
- **Labor Savings:** By automating the ripening process, the system reduces the need for manual intervention, which is especially advantageous for large farms or distribution centers where managing fruit ripening manually can be expensive and time-consuming.
- **Improved Market Value:** The system helps maintain or even increase the market value of the produce by ensuring that fruits and vegetables reach consumers in the best possible condition. Fresher, higher-quality produce usually commands higher prices.
- **Real-Time Data and notifications:** In the event that specific parameters are surpassed, such as elevated ethylene gas levels or an abrupt temperature increase, the platform has the ability to issue notifications. This makes it possible to act quickly to stop spoiling.

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VII. PROPOSED SYSTEM AND ALGORITHM

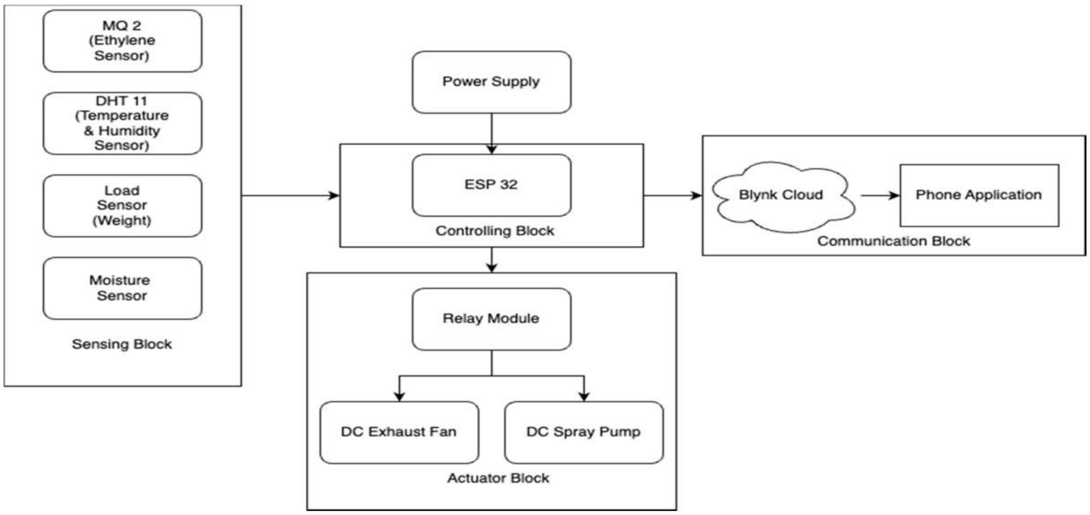

Fig: Proposed system

The ripening is a process dependent on step by step color change of the fruit, initially from green to yellow color stands as a base for this work. Color image processing inds application in this area to measure the ethylene and CO2 gas levels with respect to the color of the fruit4,5. he video of the fruits image is acquired using the infra red camera [4]. he video is converted into frames using video splitter and these frames are further analyzed [6].So, In This system We have to used the Real time Non-Invansive Fruits. This System Are not used the image processes. We have Check the fruits without Damaging.

In This System first create a Sensing blocks this sensing block fruits sensing the load,Measure the Tempetures, Monitoring the Fruits, Next we have to going the Controlling blocks 'ESP 32' It is a IOT devices, It is a Build the Capability of your devices or Wi-fi. Next Relay Module That transfer

the Signals and Information That transform between different devices or Systems. Next we have go to the Communication Block this system provide the messages and Cloud server and user mobile .

Cloud server this Messages are stored [5].

Key Points:

1.Monitors and controls fruit ripening: Utilizes sensors to track ethylene gas, temperature, humidity, moisture, and weight.

2.Prevents premature spoilage: Activates fan and pump to regulate ripening conditions.

3.Improves quality and shelf life: Ensures fruits and vegetables remain fresh for longer.

4.Remote monitoring and control: Uses Blynk platform for real-time data and device management.

5.Sustainable and efficient: Reduces food waste and promotes agricultural sustainability.

6.Cost-effective: Provides a cost-effective solution for farmers and growers.

7.Scalable: Can be easily adapted to various fruit and vegetable types and storage conditions.

8.User-friendly: Features a simple and intuitive interface for easy operation.

9.Reliable and durable: Built with high-quality components for long-term performance.

10.Data-driven decision-making: Provides valuable insights and data for informed.

VIII. ALGORITHM

1. Initialize sensors and devices: Set up the fan, pump, relay module, sensors, and ESP32.Analyze the sensor data: Read data continuously from the weight/load, moisture, DHT, and MQ-2 gas sensors.Examine sensor data:Determine the average concentration of ethylene gas for a given time frame [11].

2. Check the recorded humidity and temperature against predetermined limits.
3. Determine the fruits' weight and moisture content.
4. Make decisions: To increase air circulation, turn on the DC fan if the concentration of ethylene gas rises above a certain point.
5. Turn on the DC fan to change the environment if the humidity, temperature, or moisture content are not within the desired range.
6. Turn on the DC pump to spray ethylene absorbent if the concentration of ethylene gas and the surrounding factors suggest a high danger of early ripening.
7. Control devices: Depending on the decision-making process, turn on or off the DC fan and pump.Revise the user interface: Show device status, system alerts, and real-time sensor readings on the Blynk app and LCD screen.Send information to Blynk: For remote monitoring and control, send sensor data and device status to the Blynk cloud.Repeat steps 2–7: Keep an eye on the system and make necessary adjustments in response to evolving conditions.

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