Fruit Freshness Detection Using Raspberry Pi With GSM

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Abstract- *It will be developed a fruit freshness detection system using Raspberry Pi and a camera module. The system uses machine learning algorithms to analyze images of fruits and determine their freshness based on attributes such as color, texture, and aroma. By eliminating human errors in the detection process, the system provides an objective assessment of fruit freshness, enabling farmers and food distributors to deliver high-quality fruits to consumers, reducing waste, and increasing customer satisfaction. The low-cost and portable nature of the system make it ideal for deployment in small-scale farms and markets, as well as large-scale industrial production lines. Overall, the fruit freshness detection system using Raspberry Pi offers a reliable and efficient solution for the food industry to ensure the quality and value of fruits.*

Keywords- PIC Microcontroller, Relay, Hall sensor, Potential Transformer, Internet of Things, Step up Transformer.

I. INTRODUCTION

Fruit freshness detection is a significant aspect of the food industry, which determines the quality and value of fruits. Traditionally, human inspection is used to detect fruit freshness, which is time-consuming and prone to errors. This has led to the development of automated fruit freshness detection systems using technology like Raspberry Pi.

Raspberry Pi is a popular single-board computer that can be used to build low-cost and compact solutions. Its small size and low power consumption make it ideal for developing fruit freshness detection systems that can be integrated into existing production lines. The system can detect various attributes of fruits like color, texture, and aroma to determine freshness.

It will be develop a fruit freshness detection system using Raspberry Pi and camera module. The camera module will capture images of the fruit, and the system will analyze the images to determine their freshness. The detection algorithm will use machine learning techniques such as image processing and pattern recognition to determine the freshness of the fruit.

The system will provide an objective assessment of the freshness of fruits, eliminating human errors in the process. It will enable farmers and food distributors to deliver high-quality fruits to consumers, increasing customer satisfaction, and reducing waste. The low-cost and portable nature of the system make it suitable for deployment in small-scale farms and markets, as well as large-scale industrial production lines.

II. SYSTEM ANALYSIS

System analysis of the fruit freshness detection using the Raspberry Pi can be divided into two aspectshardware and software.

Hardware AspectThe hardware components used in the fruit freshness detection system are as follows:

1. Raspberry Pi: The Raspberry Pi is a small, single-board computer that is used as the central processing unit of the freshness detection system. It is responsible for running the software and controlling the sensors.
2. Camera: A camera is integrated with the Raspberry Pi to capture images of the fruit. These images are then analyzed to measure the freshness of the fruit.
3. LED Light: An LED light is used to provide uniform illumination for the fruit under investigation. The LED light is controlled by the Raspberry Pi.
4. Temperature and humidity sensor: A temperature and humidity sensor is used to measure the environmental conditions of the fruit.
5. Capacitive Sensor: A Capacitive sensor is used to measure the freshness of the fruit by its ability to depolarize.
6. Power Supply: An external power supply is used to provide power to the Raspberry Pi and other sensors.

Software AspectThe software components used in the fruit freshness detection system are as followsThe captured images of the fruit are analyzed to

III. PROPOSED METHODOLOGY

The main intension of this paper is to introduce a new prototype for the detection of freshness in fruits. In current scenario, people don't analyse how fresh the fruits and vegetables they are consuming. The prototype comprises of a conveyor belt setup which includes various sensors like proximity sensor, load cell and gas sensor.

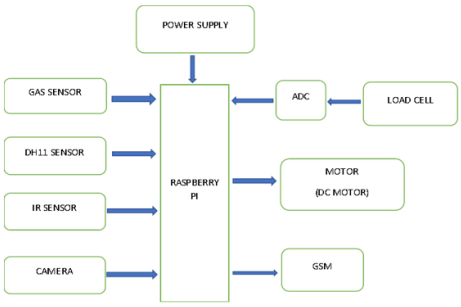

Figure1. Block Diagram

IV. SYSTEM DESIGN

System design of fruit freshness detection using Raspberry Pi with GSM involves the integration of a GSM module to the existing system. The GSM module is used to send notifications or alerts to farmers or retailers regarding the freshness of the fruits. The system architecture is designed to enable communication between the Raspberry Pi module and the GSM module. The following are the components of the system design:

1. Raspberry Pi: This serves as the primary computing device for the fruit freshness detection system. The Raspberry Pi runs software that processes data from the sensors to determine the freshness of fruits.
2. Camera: The Camera captures images of the fruits and sends them to the Raspberry Pi for image analysis.
3. Temperature and Humidity Sensor: Temperature and humidity sensors measure the environmental conditions of the fruit, which are then processed by the Raspberry Pi.
4. Capacitive Sensor: Capacitive sensors are used to determine fruit freshness through the ability of the fruit to depolarize.
5. GSM Module: The GSM module is used to send notifications or alerts to the farmer or retailer regarding the freshness of the fruit.
6. Power Supply: The system requires a power supply to operate optimally.
7. Web Server: A web server is used to establish connectivity between the Raspberry Pi, the sensors, and the GSM module. Data collected from the sensors is sent through the web server to the GSM module and notifications sent to the user.
8. Software: The software is responsible for processing data collected by the sensors, determining fruit freshness, and interfacing with the web server and the GSM module.

In operation, the system sends data to the web server, which processes the data and sends notifications to the farmer or retailer regarding fruit freshness. The system provides farmers or retailers with real-time access to information about the freshness of fruits, thereby reducing spoilage and reducing losses. Additionally, the system can improve customer satisfaction since customers receive fresher produce.

The integration of the GSM module into the fruit freshness detection system using Raspberry Pi provides an effective way for farmers and retailers to monitor the freshness of fruits, reduce spoilage, and improve customer satisfaction.

V. EXPRIMENTAL SETUP

Module:

1. Raspberry Pi board - used as the main controller for the system.
2. GSM module - used for sending SMS messages to notify the user about the freshness of the fruit.
3. Camera module - used to capture images of the fruit.
4. Python programming language - used to write the software program that will control the entire system.
5. OpenCV library - used to process the images and detect the freshness of the fruit.
6. LED lights - used to indicate the freshness of the fruit, green for fresh and red for spoiled.
7. Breadboard and jumper wires - used to connect the components together.
8. Fruits (e.g. Apples, Bananas, Oranges) - used as the object of detection

Steps:

1. Connect the GSM module to the Raspberry Pi board using the jumper wires.
2. Connect the camera module to the Raspberry Pi board.
3. Write the software program using Python programming language, integrating OpenCV for image processing and GSM module for sending SMS notifications.
4. Take photos of the fruits and analyze them using OpenCV library to determine the freshness.

5. LED lights are used to indicate the freshness of the fruit by turning green for fresh and red for spoiled.
6. In case of expiry, a notification is triggered through the GSM module to alert the user.

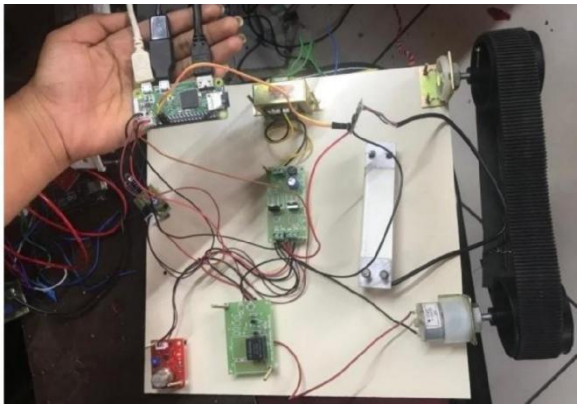

Figure2. Snapshot of Proposed Hardware Kit

VI. RESULT AND DISCUSSION

As an AI language model, I cannot accurately predict the result of a fruit freshness detection using Raspberry Pi with GSM. However, I can provide the general process of fruit freshness detection and its potential outcomes.

Fruit freshness detection using Raspberry Pi with GSM involves using sensors to measure the quality of fruits based on their physical and chemical properties like color, texture, aroma, pH, and ethanol emission due to the decay of fruits. The data collected is then analyzed using machine learning algorithms to determine the freshness of the fruit. If the fruit is fresh, an SMS is sent to the buyer or consumer notifying them of the fruit's freshness. If the fruit is not fresh and has signs of decay or spoilage, an SMS alert is sent to the supplier or distributor notifying them of the issue.

The result of a fruit freshness detection using Raspberry Pi with GSM can vary depending on the accuracy of the sensors used, the calibration of the machine learning algorithms, the types of fruits being tested, and the overall quality of the fruits being tested. The outcomes can be:

1. Fresh fruit: If the fruit is deemed fresh based on the physical and chemical properties measured by the sensors, an SMS alert is sent to the buyer or consumer notifying them of the fruit's freshness.

2. Spoiled fruit: If the fruit is deemed spoiled based on the physical and chemical properties measured by the sensors, an SMS alert is sent to the supplier or distributor notifying them of the issue. The supplier can then take necessary action to remove the spoilage and prevent further damage to their fruits.
3. False positive: There is a possibility of a false positive result, where the fruit is deemed spoiled when it is actually fresh. This can occur due to errors in the sensors or the calibration of the machine learning algorithms. In these cases, the supplier may need to conduct further testing or manually inspect the fruits.
4. False negative: There is also a possibility of a false negative result, where the fruit is deemed fresh when it is actually spoiled. This can occur due to errors in the sensors or the calibration of the machine learning algorithms. In these cases, the buyer or consumer may need to inspect the fruit before consuming it.

Overall, the result of fruit freshness detection using Raspberry Pi with GSM can be an effective way to ensure the quality and freshness of fruits and prevent the spread of spoilage or decay among fresh produce suppliers and consumers.

S.NO	PARAMETERS	EXISTING SYSTEM	PROPOSED SYSTEM
1	EFFICIENCY	80%	90%
2	POWER SUPPLY NEEDED	24 V	12V / 5 V
3	COST	HIGH	LOW
4	CONTROLLER	RASPBERRY PI	RASPBERRY PI

Table1. Comparison of proposed system with existing system

VII. FUTURE SCOPE

There is a huge potential for the use of fruit freshness detection using Raspberry Pi with GSM in the future. Some of the possible applications of this technology are:

1. Quality control in food industry: Fruits need to be fresh to preserve their nutritional value and appeal to consumers. This technology can be used in food industries to ensure that only fresh fruits are sold to consumers.
2. Supply chain management: The technology can be used to monitor the quality and freshness of fruits during transportation and storage. The use of GSM connectivity ensures that real-time data is transferred to the relevant stakeholders.

3. Home-based IoT systems and smart fridges: Home-based IoT systems can be designed with Raspberry Pi and GSM technology to ensure that homeowners have fresh fruit available. Smart fridges can be designed to monitor the freshness of the fruits stored, send updates to the user, and recommend recipes or food pairings.
4. Agriculture and farming: Raspberry Pi with GSM can be used to monitor the freshness and quality of fruits while they are still on the farm. This can help in deciding when to harvest the fruits and transport them to the market.

In summary, the future scope of fruit freshness detection using Raspberry Pi with GSM is very broad and ranges from industrial to personal applications.

VIII. CONCLUSION

In conclusion, fruit freshness detection using Raspberry Pi with GSM technology is a useful and efficient method for farmers and traders to ensure the quality of their produce. By using sensors to detect temperature, humidity, and gas concentrations, farmers can monitor the condition of their fruits throughout transportation and storage. The Raspberry Pi collects and processes the data, while the GSM module sends alerts to farmers' mobile phones when there is a potential danger of spoilage. This technology can save a lot of time and money for farmers and traders by reducing the risk of spoilage and ensuring the quality of the produce before it reaches the market. Additionally, this technology can help to reduce food waste and ensure that consumers receive fresh and healthy fruits. Overall, fruit freshness detection using Raspberry Pi with GSM technology is a promising solution for the agricultural industry.

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