A System To Detect Fruitfreshnessusingmachine Learningand Iot Approach

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Abstract: Food spoilage is a big problem in today's culture, as consuming spoiled food can be dangerous to one's health.Our study intends to detect rotten food at an early stage and improve accuracy to reduce food waste by using sensors and analysing gases released by specific food products.When a microcontroller detects gases, it communicates data to the internet of things, enabling for the necessary action to be taken..In the food business, where food identification is currently done by hand, this offers a wide range of uses.We used machine learning and IoT, as well as sensors, to anticipate how frequently a food will spoil.This will increase supermarket competitiveness, resulting in more organic and natural products being sold.This study looks at how Machine Learning and IoT can be used to determine food freshness.The Wi-Fi module connects this IoT system to the internet, and it begins reading data from the connected sensors.The system consists of a microprocessor, as well as electrical and biosensors such as a moisture sensor and an ethanol gas sensor.This technology detects moisture as well as harmful gases.A convolutional neural network (CNN), a sort of deep learning neural network, is a type of deep learning neural network..CNNs are a big step forward in image identification.They're most usually utilised to examine visual imagery, and they're regularly involved in picture categorization behind the scenes.We get an accuracy of 89% while using CNN in detecting ripen fruit and 96% in rotten fruit.The result of both CNN and sensors valve comparing that both the result it is declard as fresh or rotten.

Keywords: Fruit, Feature Extraction, Neural Network, Convolution Neural Network (CNN), Fruit Classification, ESP32,IOT,Gas Sensors,Moisture Sensor.

1. Introduction

Nowadays, every one in several travellodge mess and kitchens,hotels is impacted by the food they eat. fruits , and other commonly consumed foods do not have quality because their moisture levels and toxic gases fluctuate.It should be tracked at any point of the supply chain to ensure food safety.changes can affect the taste,flavour, and shelf life of fruits.When fruit begins to decompose, it releases gases such as ethanol,methane,Ammonia,Through the passage of time, these gases become more prevalent.The aim of this system is to detect spoilage of food before significant symptoms appear..According to the study, food emits certain gases that can be measured by IOT sensors as it decays, and the amounts of these gases can differ depending on the degree of the decay.To evaluate the freshness and consistency of food, criteria such as oxygen ,moisture, and gas levels must be measured in food products.The food will not often seem to be safe.The aim of the paper is to identify changes in food's nutritional value.The proposed methodology would assist people in determining the quality or consistency of foodOur goal for the system is to have improved food freshness and quality.The buyer must have a general understanding of the nutrients in food.Infection has been related to several other diseases that have a detrimental effects on one's health.We use sensors and machine learning together to assess the freshness of fruits and vegetables, which can help prevent food spoilage.In this article, we look at a secure and cost-effective method for detecting fruit freshness based on size, form, and colour. Fruits should be tested in a non-damaging manner since they are delicate objects.When it comes to fruit sizing, the most important physical property is its colour, which also serves as a visual property.As a result, fruit freshness classification is critical for rising market share and establishing higher quality levels.If classification and ranking are performed by hand, the procedure will be sluggish and prone to errors.Humans classify the freshness of fruits based on colour, height, and other factors.If these consistency indicators are laid outThe job would be easier and error-free if these quality controls are mapped into an integrated framework using a compatible programming language.As a result, the fruit sorting process becomes faster and less expensive.Machine Learning methods have recently been discovered to be increasingly useful in the fruit industry, primarily for applications in fruit freshness detection.For perceptible examination, fruit characteristics such as form and colour are critical.Both criteria must be easily identified by a formally separate framework for fruit scoring based on freshness.The aim of this research is to provide a classification model for fruit spoiled or fresh and by using suitable sensors and measuring gases emitted by the specific food object, our project aims to detect spoiled food.When a microcontroller detects this, it sends data via the internet of things, allowing necessary action to be taken.The interoperability and application of IoT and Machine Learning are only enhanced when they are combined.The ESP32 is a family of low-cost, low-power system-on-a-chip microcontrollers that have built-in Wi-Fi and dual-mode Bluetooth.

The ESP32 series in addition to alcohol.ut we figured out a means to figure it out.The MQ-3 alcohol sensor may be used to test for alcohol, benzine, hexane, or LPG levels in the air, but solely for alcohol levels."ThingSpeak is an open-source Internet of Items (IoT) application and API for storing and retrieving data from things over the Internet or over a contains built-in antenna switches, RF baluns, power amplifiers, low-noise receive amplifiers, filters, and power-management modules, as well as a TensilicaXtensa LX6 CPU in dual-core and single-core versions. The MQ-3 alcohol sensor is sensitive to a variety of gases Local Area Network utilising the HTTP and MQTT protocols.ThingSpeak allows developers to create sensor recording apps, location tracking apps, and a social network of things with status updates.A convolutional neural network (CNN) is a specific type of artificial neural network that uses perceptrons, a machine learning unit algorithm, for supervised learning, to analyze data and to classify images .

2. Literature survey

In this work, a CNN-based fruit identification system is suggested.For classification, the suggested method employs deep learning techniques.This work investigates a CNN-based fruit identification classifier. [1]
The different image processing approaches used for fruit categorization are discussed in this research.

The evolution of computer vision has made it feasible to train the computer to categorise pictures based on specified features, and this paper discusses numerous approaches and algorithms used for fruit detection and classification..[2]

Using a Convolutional Neural Network, this paper proposes a classification model for orange images.The deep learning CNN approach is used to classify five different types of oranges: good-orange-grade-1, good orange, immature-orange, rotten-orange, and damaged-orange.To achieve better fruit classification, CNN needs to perform better. [3]

In this paper, we used Tensorflow, one of the most popular deep learning libraries to classify dataset, which is frequently used in data analysis studies.UsingTensorflow, which is an open-source artificial intelligence library compared the effects of multiple activation functions on classification results.[4]

The author proposed sensing designs and their analytical features for measuring freshness markers, allergens, pathogens, adulterants and toxicants are discussed with example of applications.[5]

Monitoring of perishable food products and early detection of degradation will avoid loss due to food wastage and also ensures the freshness of food. In this scenario, remote monitoring of fruits during transportation from field to shelf can ensure the quality of fruit. In this work, a wireless sensor network was designed for monitoring of fruits during transportation and even after storage[6]

Monitor the gas levels coming out of the food, when the food is about to get spoiled. The amount of the gas level released from the food is monitored through the gas sensors and converted into analog values to be displayed on the IoT platform to be monitored wherever required[7]

The writers focused on the classification of bacteria in street food.Market food has a huge cultural influence, but the cleanliness and quality of street food are often underestimated due to a lack of awareness about proper food production.Since it's exhausting to use an optical nose and image scanning to see whether the microorganism is already there, a bad microorganism that causes diarrheal diseases.The aim of this paper is to develop an electronic nose with gas sensors that can detect three types of bacteria commonly found on street foods: Enterococcus faecalis, Escherichia coli, and Staphylococcus aureus, as well as classify whether the bacteria are present before and after cooking.[8]

3. Methodology

1.ML USING CNN

CNN

A convolutional neural network (CNN) is a specific type of artificial neural network that uses perceptrons, a machine learning unit algorithm, for supervised learning, to analyze data. CNNs apply to image processing, natural language processing and other kinds of cognitive tasks.CNN is a multilayer, feed-forward neural networks (FFNN) which can quickly identify, classify, and recognize any features in an image. It is used mainly with visual data, such as image classification. A CNN can be prepared to do image analysis tasks including object recognition, segmentation, classification, and image processing. Large-scale image recognition has been become possible because of large public image databases such as ImageNet. CNN are networks made up of neurons similar to the human brain. Figure 3 shows an example of a CNN. These neurons consists of weights and biases that form layers and fire in a particular order to end up with a final output. The networks can be trained in order to recognize particular patterns by feeding them large amounts of data. This is very useful in the field of computer vision since it means that a computer can be trained to recognize different objects.

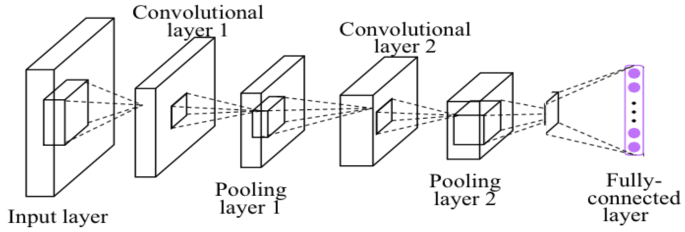


Fig3.1: Architecture of CNN

In this section we directly discuss about how is the system is
Select the fruit Images.
Resize all fruit images to standard size.
Changing the dataset from having (n, breadth, height) to (n, depth, width, height).
Split dataset into training, test & validation set using kerastrain_test_split command.
Transforming our data type to float32 and normalizing our data values from 0-255 to the range [0, 1].
Preprocess class labels.
Define our model architecture.
Compile model with stochastic gradient descent optimizer and categorical-cross entropy and also the learning rate=0.0001.
Fit and train data.
Evaluate model on test dataset and calculate the confusion matrix
Classification is done through python 3.6.

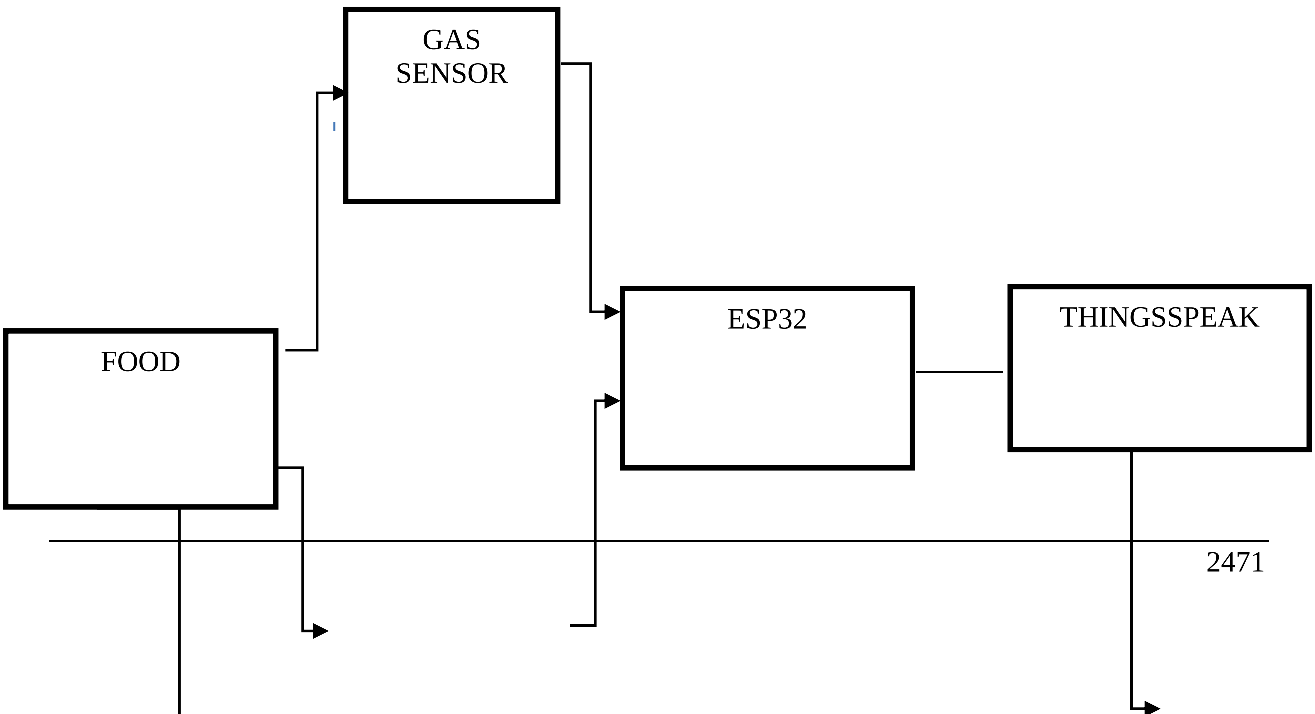
2.methodology using sensor and iot

Sensors are used to calculate food properties like moisture, ethanol, and methane levels.

The system is made up of a microcontroller, as well as electrical and biosensors such as a moisture sensor and an ethanol gas sensor. It detects moisture and harmful gases.Moisture is detected using a moisture sensor, and alcohol gas levels are detected by the MQ3 gas sensor, both from food samples.Through the Wi-Fi module, this IoT system connects to the internet and begins reading data from the interfaced sensors, MQ3 sensor, and moisture sensor.Ethanol-related gas emissions are measured with the MQ3 sensor.Food and fruits emit ethanol-like fumes when they deteriorate.

The MQ3 sensor detects changes in the environment. Certain gases are detected by the MQ3 sensor.The data is uploaded to a server via the system's Wi-Fi module, where it is processed.By comparing the values to the threshold values, the results are obtained

4. Proposed system



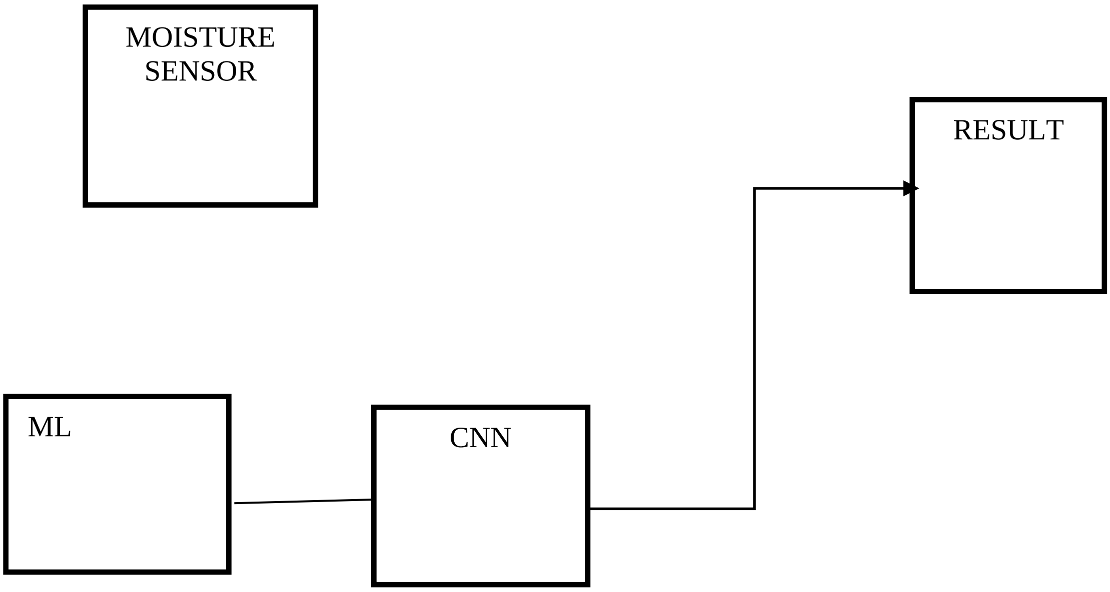


FIG4.1 Block diagram of proposed systemThe aim of this proposed system is to create a device that includes sensors and ML for early detection of food spoilage.The use of sensors to calculate various food parameters such as pH, moisture, ethanol, and methane levels.A microcontroller, and moisture sensor, and ethanol gas sensor, make up the system.The suggested solution detects moisture, and toxic gases in the vicinity.The moisture sensor detects moisture using a moisture sensor, alcohol gas levels using the MQ3 gas sensor, from food..The MQ3 sensor senses ethanol-related gas emissions.When food or fruits spoil, they produce ethanol-like gases.and moisture sensor detect the increase in the moisture level when the fruit is rotten .and the data gathered from the esp32 is send it to the thingsspeak server where authorized user can view the real time changes in the food .Using ML we can detect the food from external features such as texture ,color, size ,which help to early classification of food using both this approaches we can compare both external as well as intenalfeatures and come to a conclusion if the food is spoiled or not.This system increases the accuracy of detecting fresh food.

5. Result

I.RESULTS WITH CNN

When we show the image or real tomato the ML identifies the tomato is ripen or rotten .fig 5.1shows the ripen tomato with 89%accuracy

Fig 5.1: Ripen tomato of 89%

When we show the image or real tomato the ML identifies the tomato is ripen or rotten .fig 5.2 shows the rotten tomato with 96 %accuracy

Fig 5.2: Rotten tomato of 96%

When we show the image or real tomato the ML identifies the tomato is ripen or rotten .fig 5.3 shows the rotten tomato with 73%accuracy

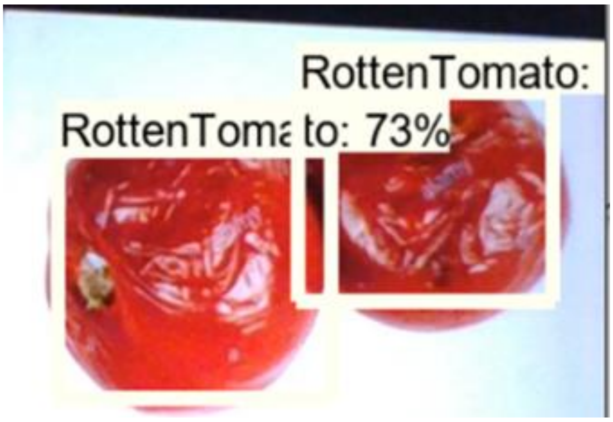


Fig 5.3: Rotten tomato of 73%

II .results with sensors and iot

On the basis on the reading obtained by the sensor fig 5.4shows the result as food is fresh as it does not detect any gases

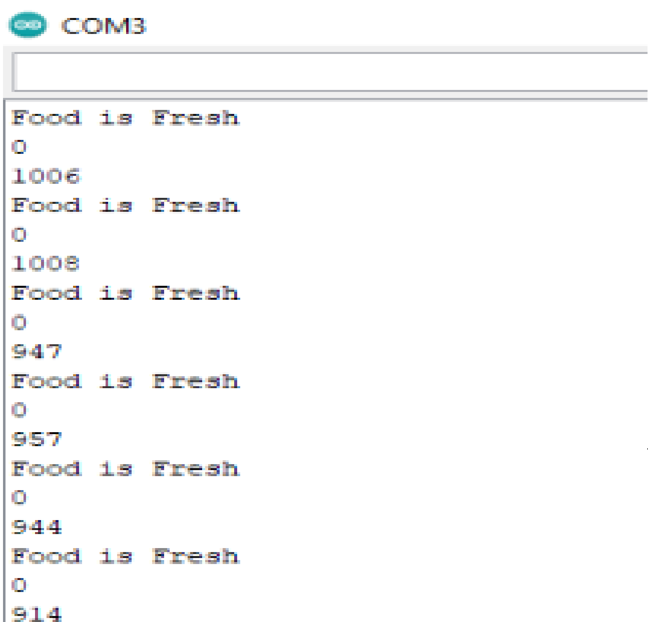


Fig 5.4Food is Fresh

Fig5.5: shows the graph genereated in thingsspeak by the data send by the sensor using wifi it shows there is no abnormality in the moisture level and gas level when fresh food exposed.

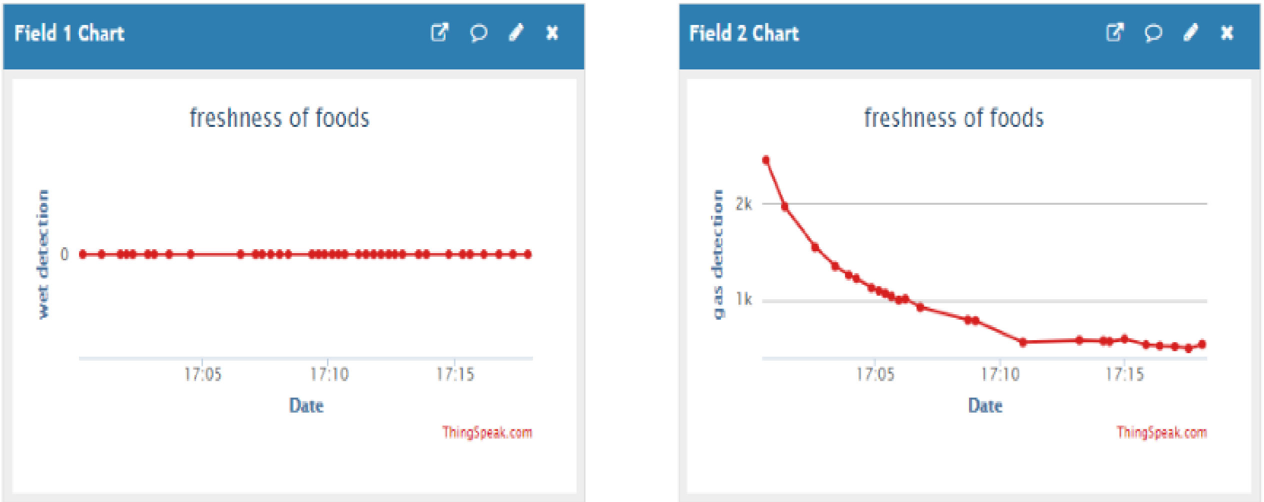


Fig5.5:Graph generated by Thingsspeak when food is fresh

On the basis on the reading obtained by the sensor fig 5.6 shows the result as food is spoiled as it detect changes in gas level and moisture level above threshold

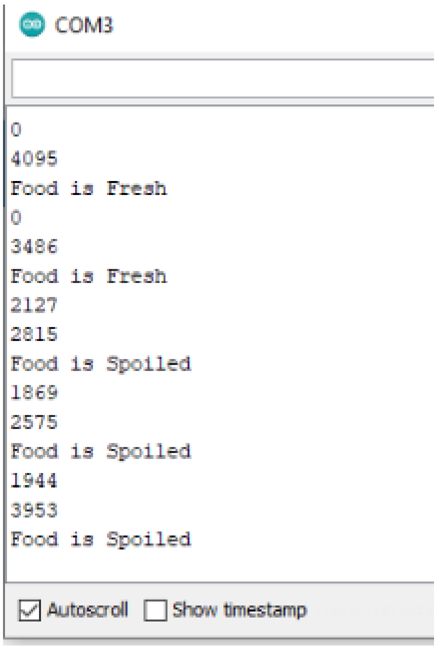


Fig5.6:Food is spoiled

Fig 5.7shows the graph genereated in thingsspeak by the data send by the sensor using wifi it shows there is abnormality in the moisture level and gas level when rotten food is exposed.

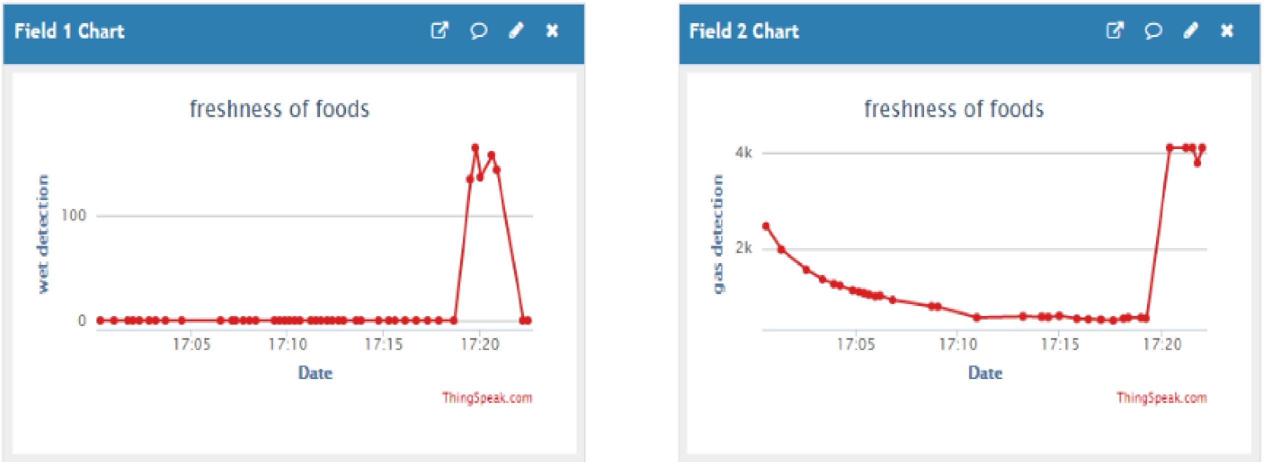


Fig5.7:Graph generated by Thingsspeak when food is spoiled

III.Combined Result of IOT and ML

Fig 5.8 shows the combined results obtained by the the ML and iot based sensor system to come to a conclusion that the food is fresh or spoiled.

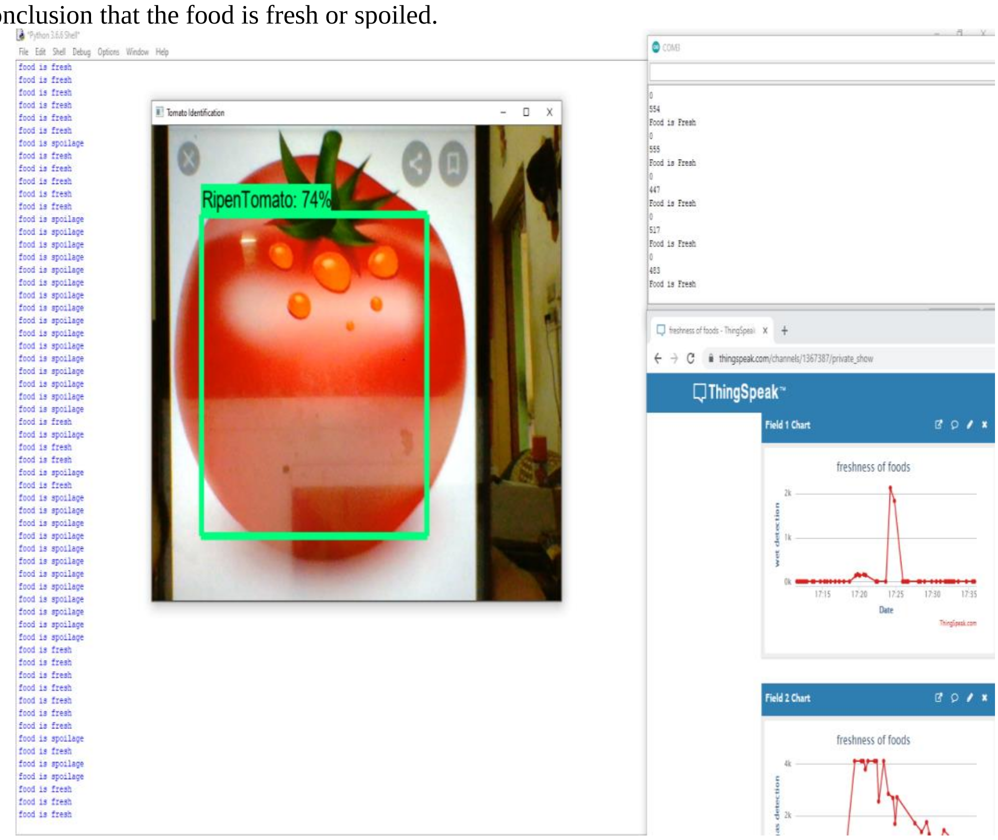


Fig5.8:combine result of system using Machine learning and IOT

6. Future enhancement

Furtermore, this technique can be combined with biosensors such that the freshness of food can be determined not only by external factors such as colour, form, texture, and scale, but also by internal factors such as chemical and biological changes in the food using various sensors.

To view the results of food item inspections, a webapplication can be created.

Hopefully, in the future, the analysis will be expanded with a wider dataset that includes more fruit and vegetable groups.

Plan to use several other CNN-based models to compare their accuracy on the same dataset

More features for ranking and classification that can classify types of disease and/or texture composition of fruits can also be worked on.

7. Conclusion

This paper focuses on the use of convolutional neural networks (CNNs) and sensors to detect any visible signs of spoilage, the sensors can detect gas pollutants and other essential constituents including pH and moisture levels from food products in the food and agriculture industries. The CNN identify characteristics such as Size, colour, and form to distinguished between ripe and rotten fruits.In order to improve the functionality and versatility of our dataset, we included several real-world exanples . The use of sensors to monitor the presence of these values in foods can aid in the early detection of food spoilage and the avoidance of spoiled food intake.To improve the sensitivity of such detection systems, these approaches may be expanded to include other types of gas sensors and foods.As a result, the proposed approach effectively increases the rate of fruit detection.

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