IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Fruit Freshness Detection using CNN

Akanksha A. Narkhede[1], Nilesh Vani[2]

[1]*PG Student, id: 0009-0009-2728-7498*

Godavari College of Engineering, (NAAC Accredited), Jalgaon, Maharashtra, India – 425003

[2]*Assistant Professor, id: 0009-0003-0476-0349*

Godavari College of Engineering, (NAAC Accredited), Jalgaon, Maharashtra, India – 425003

ABSTRACT

The freshness of fruits is critical for maintaining quality in fruit.

This paper represents an automated fruit freshness detection system using YOLOv8 object detection with squeeze-and-Excitation. the freshness of fruits our method balances accuracy and real time performance while detecting the freshness level of fruits the average accuracy is 85.5% with a maximum accuracy of 94.7% for detecting accuracy of 94.7% for detecting the freshness level of single fruits category .the results confirm that the enhanced YOLOv8 – SE model effectively detects and localizes fruit freshness conditions , indicating its suitability for smart agriculture and food quality monitoring applications.

KEYWORDS

Fruit recognition, freshness detection, image classification, MobileNet2, computer vision, K means clustering, deep learning, nutrition analysis, React.js, flask.

INTRODUCTION

Fruits are a fundamental part of providing vitamins, fiber, iron, minerals and antioxidants. However , They get spoiled fast, so keeping, carrying and using them on time becomes difficult people usually check fruit freshness by looking at it , but this method depends on personal judgement and can often be wrong with the rapid advancement of machine learning and computer vision and it is now possible to automated this task with significant accuracy and reliability . This project makes a system that looks at fruit images, tells which fruit it is and checks whether it is fresh or not. Instead of depending only on human guests, this tool is very helpful in places where food quality is important, like grocery stores, market, restaurants, and home. It also teaches users about the health benefits of different fruits and encourages healthy eating habits.

1.1 Background and Motivation

Each year, a large volume is produced. Fruits and Vegetables are the most wasted food items. Sometimes good fruits are thrown away too early and sometimes spoiled fruits are not identified on time. Traditional quality checking methods depend on people to check fruits manually. This process takes time and is not always accurate and requires experience. In recent times, AI helps in making this work more efficient. AI can look at images, identify objects and recognize patterns. A special AI model called CNN is very good at image related tasks like identifying faces or different objects in pictures.

CNN models are used in many areas like face recognition and medical.

Problem Statement

Fruits are easily available, but there is no simple and cheap system that can quickly check their quality. Many systems used in stores are expensive and use special sensors, so normal people cannot use the also most mobile apps can only tell name of the fruit but is fresh or spoiled. Because of this people may choose bad fruits and food can increase.

The main goal of this project is easy to use, low – cost, and accurate system that works on a smart phone or webcam. It will tell the fruit type and also check if it is fresh. The aim is to help everyone check their fruits easily without needing technical knowledge.

1.2 Objectives

The core aims of this project are:

1. To identify different common fruits using deep learning with high accuracy

2. To check how fresh the fruits are by looking at their appearance, especially their color
3. To show nutrition details of the fruit so people can choose healthy food
4. To make an easy app where users can upload a photo or take a live picture
5. To create a system that quickly checks if it is fresh and shows the result fast

1.3 Scope of the Project

This project works only with eleven common fruits: banana, apple, mango, strawberry, orange, pineapple, lemon, peach, grape, and watermelon.

The system uses a pre-trained deep learning model to identify the fruit. It also uses a method called K-means to check freshness like, texture, smell or moisture.

It also works best when the image is clear and taken in good lighting. If the picture quality is poor or the lighting is bad the results may not be very accurate.

1.4 Significance of the study

This project uses deep learning and color checking together to help reduce food waste and improve food quality. It is part of smart food technology.

The system works in real-time and is simple to use and is simple to use so it can be helpful for normal people, students, and even businesses.

In the future, this system can be improved to find fruit problems like damage or mold by using more training data.

This project also shows how tools like React, Flask and TensorFlow can be used together to build useful AI – based application.

LITERATURE REVIEW

In recent years Artificial Intelligence (AI), especially deep learning and computer vision has been widely used in agriculture and food quality checking.

2.1 Fruit Classification Using Machine Learning

Earlier, fruits were checked manually by looking at them or by testing smell, firmness, or internal chemical properties. But now machine learning technique. convolutional Neural Networks (CNNs) are commonly used to classify fruits using images. This method is faster and more efficient.

In a study conducted by Muresan and Oltean (2018), a deep learning method was used to classify different types of fruits. They trained a Convolutional Neural Network (CNN) from the beginning using the fruits 360 dataset which contains many labeled fruit images. Their model achieved very good accuracy after learning from thousands of images.

In another study, Bhole et at (2020) applied transfer learning techniques using popular pre-trained models such as VGG16 and ResNet50. These models were already trained on dataset like ImageNet, so they required less time for training. After fine – turning them with fruit images. the models were able to classify fruits in real – time with high accuracy.

Transfer learning is useful because it reduces training time and improves performance. since the models are already trained on models are already trained on large datasets. They can easily adapt to new tasks, such as fruit classification when trained with specific fruit images.

2.2 Lightweight Deep Learning Models: MobileNetV2

Although complex CN models give very high accuracy. they require a lot of computational power Because of this. It becomes difficult to use them on small devices like smartphones or Raspberry Pi. To solve this problem, researchers introduced lightweight deep learning models such as Mobile Net and its improved version, MobileNetV2. These models are specially designed to work faster and use less memory. which makes them suitable for mobile and real-time applications.

MobileNetV2 uses special techniques called inverted residual connections and linear bottlenecks. These techniques help in reducing the number of parameters in the model while still maintaining good accuracy. In 2018, Sandler and his team showed that MobileNetV2 can perform almost as well as larger and more complex models but requires much less computational power. Because of its speed and efficiency. MobileNetV2 is good choice for systems like the fruit freshness checker, where real-time detection is needed on devices with limited resources.

2.3 Freshness Detection Using Color Analysis

Color is one of the most important signs of fruits freshness especially in image-based systems. Many researchers have studied how the surface color of a fruit changes as it becomes ripe or starts to spoil. For example, Ting et at (2014) developed a method that used color histogram analysis to identify different ripeness stages of bananas. Their method was able to classify bananas into various ripeness levels with good accuracy.

K-means clustering is another commonly used technique in image processing. It is an unsupervised learning algorithm that groups similar pixel colors into clusters. This helps in identifying the main or dominant colors in

an image. By analyzing these dominant colors, it becomes easier to estimate the freshness of fruits detect damaged areas in 2016, Singh and his team used K-means clustering to find defects in apples by studying changes in color patterns and intensity.

In the Fruit Freshness Checker System, this method is used to find the main color of the fruit. The detected color of the fruit. The detected color is them compared with a predefined range of colors that represent different freshness levels. Although this method does not consider other factors like texture or smell, it provides a simple and fast way to estimate freshness using only images.

2.4 Fruit Datasets for Training and Evaluation

Good quality datasets are very important for training the learning models. One popular dataset used for fruit classification is the fruits 360 dataset available on Kaggle. It includes more than 70000 images of different fruits and vegetables. All images are taken with similar lighting and background which helps the model learn faster and achieve good accuracy.

However, because the images are captured in controlled conditions, the model may face problems when used in real-world situations. In real life, lighting, background and camera angles are different, which can affect the performance.

To solve this problem, researchers use data augmentation techniques. These techniques include rotating images, flipping, then zooming in or out and changing brightness levels. Such methods create more variations in the dataset and help the model become stronger with more variations in the dataset help the model become more adaptable.

In this project, similar image augmentation methods are used to improve the system performance, especially for images captured using a webcam in real world conditions.

2.5 Comparative Systems and Gaps

Many apps have been created to identify fruits or check if they are spoiled. However, most of these apps have some limitations. Some of them need special and expensive hardware like near-infrared sensors to work properly. Others can only identify the fruit type, but do not check whether the fruit is fresh or not.

For example, apps like Plantix and PlantDoc mainly focus on detecting diseases in plants, not on checking the quality of fruits for eating. On the other hand, general object recognition tools like Google Lens can recognize different objects including fruits, but they do not tell whether the fruits is fresh or spoiled.

METHODOLOGY

This chapter explains how the fruit freshness checker system was designed and developed. It describes the structure of the system like how the data was prepared, how the dataMobileNetV2 model was used to identify fruits and how freshness of fruits was estimated using K- Means, clustering and color analysis.

3.1 System Architecture

The fruit freshness checker system has two main parts.

i. Fruit Classification Module:
   This module identifies the type of fruit using a pre-trained MobileNetV2 deep learning model.
ii. Freshness Estimation Module:
   After identifying the fruit, this module checks the freshness of the fruit. It analyzes the main colors of the fruit using K-Means clustering to determine whether the fruit is fresh or not.

The system works through a simple graphical user interface (GUI).

The user can either:

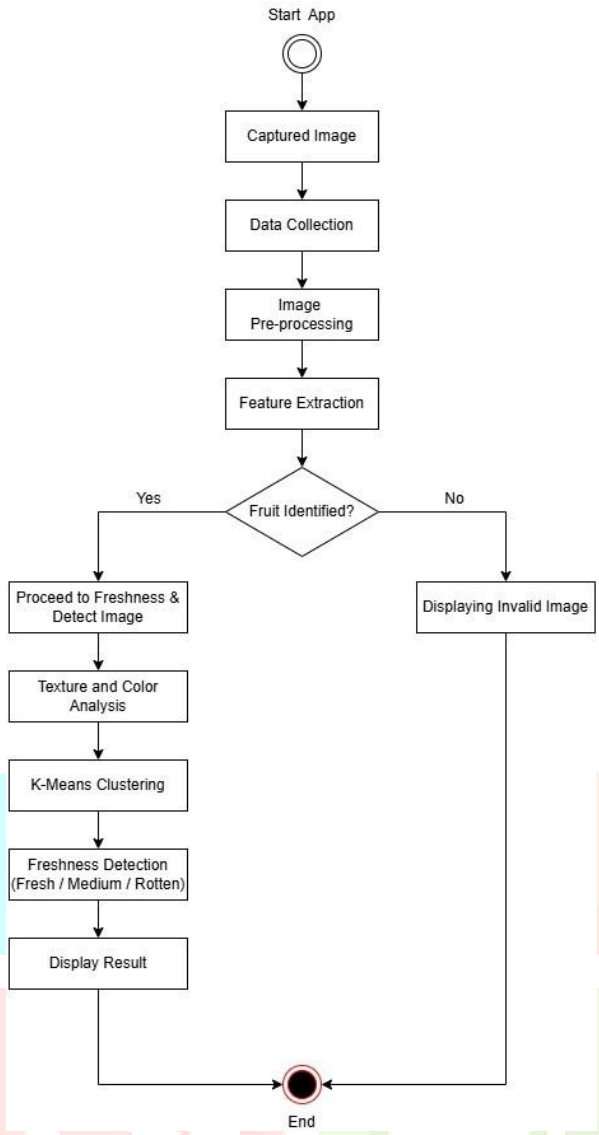
- Capture an image using a webcam or
- Upload an image of a fruit

After the image is processed, the system displays

- The fruit name and
- The freshness status of the fruit

The system is designed in a modular way which makes it easy to use and deploy. It can run on devices with low computing power such as laptops or mobile phones.

The overall workflow of the proposed system is illustrated using a flowchart as shown,



3.2 Dataset Preparation and Augmentation

For training the fruit classification model, the fruits 360 dataset contains more than 70000 images of 131 different fruits and vegetables.

However, for this project only common fruits such as:

- Apple
- Banana
- Orange

were selected. This was done to make the system more practical for real-world use.

To make the model perform better on different types of images, data augmentation techniques were used. Data augmentation means creating slightly modified versions of images to increase the training data.

Some augmentation techniques used were,

- Rotation (±40°) – Images were rotated slightly to help the model recognize fruits from different angles.

RESULTS AND DISCUSSION

Based on the experiments conducted, it was observed that the freshness of fruits and vegetables can be identified by measuring changes in their ion concentration using the sensor to minimize any harm to the samples. Future designs can use electrodes with reduced scaling. Additionally, the system can be enhanced by including threshold values for milk and dairy products, which would expand its application range. From the literature review, it was found that no existing freshness sensor operates using these principles.

CONCLUSION:

The developed model showed strong performance in identifying and labelling objects in images, even in situations where the objects were partially or completely hidden. It was able to maintain reliable classification and accuracy under such challenging conditions. Additionally, the model processes each image very quickly, taking around 20 milliseconds, which makes it well suited for real time use. Due to its accuracy and fast response time, the model can be effectively applied to various image recognition tasks.

REFERENCES

[1] *ChenLing, Cheng Guodong,Xu JianhaNG, Hu Zhiming, Jia Youdong.Fruit freshness detection based on hyperspectral technology 2feasibility study [J]. Journal of electronic test, 2021 (24): 41-43. DOI: 10.16520/J.carol carroll nki. 1000- 8519.2021.24.014*

[2] *Sindhi K, Pandya J, Vegads Quality evaluation of apple fruit: a survey Int J compute Apple. 2016; 975:8887*

[3] *Fu Y. Fruit freshness grading using deep learning (Master's Thesis). New Zealand: Auckland university of Technology ;2020*

[4] *Muresan H, Oltean M. Fruit recognition from image using deep learning. Acta University Sapientiae Inf. 2018; 10(1):26-42*

[5] *Zhong Z, Zheng L, Kang G, Li S, Yamng Y (2017) Random erasing data augmentation. arXiv:1708.04896*

[6] *H. Ayasso and A. Mojammad Djafari," Joint NDT Image Restoration and Segmentation Using Gauss Markov-potts prior Models and Variational*

Bayesian Computation,"IEEE Xplore, http://www.ieee.org.[Accessed Sept. 10,2010].

[7] ImanMorsi, A Microcontroller Based on Multi Sensors Data Fusion and Artificial Intelligent Technique for Gas Identification, The 33rd IEEE Industrial Electronic Society (IECON), Taiwan, Nov.5,2007.

[8] ImanMorsi, Discrimination of some Atmospheric Gases Using an Integrated Sensor Array, Surface Response Modeling Algorithms, and Analysis Variance (ANOVA), IEEE Se (ANOVA), IEEE Sensors Applications Symposium (SAS 2008), Atlanta, Feb 12,2008.

[9] Clifford L.Ho, Alex Robinson, David R, Miller and Mary J. Davis, Overview of sensors and Need for Environmental Monitoring, Sensors 5,28Feb.2005.