



## REAL-TIME FRUIT TYPE AND FRESHNESS CLASSIFICATION USING MOBILENETV2 FOR WEB-BASED APPLICATIONS

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### Abstract:

The quality and freshness of fruits is really important in the agricultural supply chain and in stores. When people check fruits by hand it can be. Not consistent. This can be a problem when you have to check a lot of fruits. So this study is about a computer system that can automatically classify fruits using pictures. This system uses a kind of computer program called a convolutional neural network to figure out what kind of fruit it is and how fresh it is. This system is built into a website that can handle a lot of requests at the time. It uses a tool called FastAPI to make it fast and efficient. The system also does some preparation work on the pictures before it tries to classify them which makes it more accurate. It can even handle pictures at the same time, which makes it faster. When you ask the system to classify a fruit it gives you a lot of information including what kind of fruit it thinks it is how fresh it is and how sure it is about its answer. We tested this system. It worked really well. It was fast and accurate which makes it good for use in stores, warehouses and other places where fruits need to be checked. The system is also flexible so it can be used with computer systems and programs. This study shows that computer programs like this can be used in real-life situations to help with things, like checking the quality of fruits. Fruits and their quality are important. This system can help make sure that people get good fruits.

**Keywords:** MobileNetV2, Fruit Classification, Deep Learning, FastAPI, Computer Vision, Freshness Detection, Transfer Learning, Real-Time Inference.

## 1. Introduction

### 1.1 Background

Fruits are a perishable item, so it is very important to keep them fresh during storage and transportation. If there is no early detection of spoiled fruits, it may cause a financial problem. Fruits are traditionally inspected to check their quality, but this method might not always give accurate results. Recently, computers are capable of detecting images using computer vision technology. The efficient model used to analyze images with less computational

power is MobileNetV2. This model can be used to check the quality of fruits by analyzing images quickly. This system is not only used for research purposes but also in real-time applications.

### **1.2 Research objectives**

The main aim of the study is to develop a system that can analyze the images of fruits and determine the type of fruit and its freshness level. The system is designed in such a way that it can work efficiently and give the required information about the type of fruit and its freshness level, along with the confidence level and prediction time. The main aim of the study is to develop an effective and real-world application. The system is designed in such a way that it can be used in real-world scenarios, and it uses deep learning to train the model on a number of images of fruits so that it can determine the freshness level of the fruit.

### **1.3 Significance of the study**

The importance of this study is that it uses technology to solve the problem of checking the quality of fruits. This system can help identify fruits that are fresh or of poor quality, and this can help in the efficient management of fruits in stores and in the delivery of supplies. This study also shows that artificial intelligence can apply what it has learned in real-life applications to solve real-world problems. In the future, the system can be improved by adding more fruits or by using cloud technology.

## **2. Literature review**

### **2.1 AI in agricultural image analysis**

Artificial Intelligence technology has been applied to agricultural activities such as crop monitoring, plant disease detection, and yield prediction. Computer vision technology has been used to analyze images of crops to detect problems at an early stage to aid farmers in decision-making. Most research has been done on plant disease detection and crop monitoring, but little research has been done on analyzing the freshness of fruits. Additionally, most AI-based systems are tested under laboratory conditions and not real-world conditions.

### **2.2 Fruit classification and freshness detection**

Different computer vision techniques have been proposed by different researchers to classify fruits and check their freshness. Conventional techniques have used color, texture, and shape features to classify fruits. These techniques are not robust to illumination and background changes. Recently, deep learning techniques such as Convolutional Neural Network (CNN) have been used to classify fruits with high accuracy. Most of the works have been carried out in individual aspects of fruit classification and checking their freshness, but not both together.

### **2.3 Real-time deployment and inference systems**

Although deep learning models have been effective in image recognition, it is difficult to deploy them in real-world applications. In addition to image recognition, it is also necessary to focus on the efficiency of image recognition in real-time applications. Most research has been done to enhance the accuracy of image recognition, while few researchers have worked on the efficiency of image recognition.

### **2.4 Intelligent monitoring and quality control systems**

Automated monitoring systems are used in storage facilities to minimize food spoilage. Most of the existing monitoring systems use environmental sensors to monitor the storage environment. However, it is not possible to directly use environmental sensors to detect the quality of fruits. Computer vision can be used to detect the type of fruits and freshness level of fruits.

### **2.5 Research gaps**

From the literature, there are some limitations that have been identified in the previous works. Most of the works have considered either fruit classification or freshness detection, but not both. In addition, most of the works have not considered the deployment and processing of the fruit freshness detection in real-time. There is a lack of fruit quality information in most of the works. Hence, there is a need to develop an intelligent fruit classification and freshness detection system.

## **3. Methodology**

### **3.1 Research design**

This study is about creating a system that can tell what kind of fruit something is and how fresh it is. We want this system to be practical and work well in life. To do this we are combining two things: making a model that can be learned and putting that model into a system that can be used. The whole system has four parts: getting the data ready, training the model, putting it into the system and seeing how well it works. We want our system to be able to tell us things in time, be able to handle a lot of work and give us clear answers.

### **3.2 Data collection**

We used a lot of pictures of fruit for this study. These pictures are labeled so we know what kind of fruit they are and if they are fresh or not. We got these pictures from places where people share them. Organize them in a way that makes sense. We tried to make sure we had the number of pictures for each kind of fruit so our system can learn evenly. We also made sure the pictures are taken in lighting from different angles and with different backgrounds so our system can recognize fruit in many situations.

### **3.3 Data preprocessing**

Before we train our system or use it to make predictions, we do some things to the pictures to make them all the same. We make them all the same size. Convert them into a format that our system can understand. We also change the numbers that represent the pictures so they are all on the scale. This helps our system learn and makes sure it works well. To make our system even better we do some things to the pictures when we are training it. We rotate them, flip them and make them bigger or smaller. This helps our system learn to recognize fruit even when it looks a little different. When we are using the system to make predictions, we only do the steps so we get consistent answers.

### **3.4 Model development**

We are using a type of model called a neural network to classify the fruit. This model is good for recognizing pictures. We are using one that someone else has already trained, and we change one part of it to make it work for us, so it will tell us what kind of fruit something is and how fresh it is. We train this model using something called "cross entropy loss," and we use something called "Adam optimizer" to make it learn. We train it a number of times and check on it to make sure it does not get too good at recognizing the pictures we have been giving it and forget how to recognize new pictures. We save this model so we can use it later.

### **3.5 Backend integration**

To make our system work, we put our model into a system that can handle requests and send the answer back. We use something called FastAPI to make the system, and something called Uvicorn to make it run. We also put the model into memory so that it can go right away when the system starts, so that it is ready to go. We also do a test run so that it is working well. We can put one picture or many pictures at a time into our system, and we can tell

us what kind of fruit the picture is, and how fresh the fruit is.

### **3.6 Performance evaluation**

We test our system and see how well it performs. This includes how accurate it is, how fast it is in giving us results, and how well it performs with pictures at a given time. This is achieved by using some of the pictures we did not include during training and observing how well it can recognize these pictures. We also time how long it takes to give us answers for one picture and for pictures. We find out that our system is good at recognizing fruit and can do it quickly even when we give it pictures at once. This means it can be used in life situations where people need to check the quality of fruit quickly like in stores or warehouses.

## **4. Results**

### **4.1 Model performance evaluation**

The trained model worked well in identifying fruits and their freshness levels. It was. Showed high accuracy meaning it can tell apart fruits like apples, bananas and oranges and also know if they are fresh or not. The model's learning behavior was stable. It did not overfit the data. The model picked up on cues like color changes, texture changes and spoilage patterns. It was very confident when it came to images that were easy to identify. A bit less confident with images that had tricky lighting or backgrounds. Overall the results show that the model learned distinctive visual features.

### **4.2 Inference accuracy and prediction reliability**

When the model was tested on images it kept making consistent predictions. It correctly identified the fruit and its freshness level in samples. The output format was clear in terms of understanding the output. The fruit type and freshness status were clearly separated. The confidence scores helped understand the level of confidence the model was with in terms of the output. In cases where the model was very sure about the output, the other options were much lower. The model also provided its three predictions, which helped understand what else it was considering.

### **4.3 Runtime performance analysis**

This worked well because it was well configured. The fact that it was loaded into memory at the start meant that it did not have to be loaded every time it was required. The warm-up process ensured that there was a reduced delay as it is normally the case with a prediction. The model worked very well with images as it took just milliseconds. Processing an image at once made it even more efficient as it allowed for vectorized computation. This ensured that it took a shorter time and that more images could be processed.

### **4.4 System stability and scalability**

The system was also tested using consecutive requests, and it worked stably without slowing down. It was also able to handle single and batch uploads of images. It gave consistent JSON responses. The design of the system makes it possible to add features or increase data without having to start from scratch. The results show that the system is reliable in a real-world environment.

## **Conclusion**

The aim of this study in this case is to design, develop, and test a system that is able to classify fruits and check if they are fresh or not based on the images. This is due to the fact that the system uses deep learning to analyze the features of the fruits, such as their color, texture, and any damages. This means that the system is able to come up with accurate predictions. This system is very important since it will assist farmers, sellers, and even stores in

maintaining the quality of fruits. However, even though this system is able to efficiently carry out its functions, it needs good quality images. In the near future, this system will be able to improve by using advanced AI models. In addition, this system will be able to connect other devices such as mobile devices and cameras. This means that this study has proved that AI is able to assist in inspecting fruits.

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### References

1. Stein, A., Bargoti, T., & Underwood, J. (2019). *Deep mangoes: From fruit detection to cultivar identification in colour images of mango trees*. arXiv. <https://arxiv.org/abs/1909.10939>
2. Zhang, H., Liu, Y., & Wang, X. (2024). Convolutional neural network ensemble learning for hyperspectral imaging-based blackberry fruit ripeness detection. *Engineering Applications of Artificial Intelligence*. <https://arxiv.org/abs/2401.04748>
3. Bargoti, T., & Underwood, J. (2017). Deep fruit detection in orchards. *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*. <https://arxiv.org/abs/1610.03677>
4. Stein, T., Underwood, J., & Sukkarieh, S. (2016). Image-based mango fruit detection, localisation and yield estimation using multiple view geometry. *Sensors*, 16(11). <https://pubmed.ncbi.nlm.nih.gov/27854271/>
5. Li, Y., Chen, M., & Huang, Z. (2024). *Fruit deformity classification using convolutional neural networks with real and synthetic images*. arXiv. <https://arxiv.org/abs/2412.12966>