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Fruits Fresh and Rotten Detection Using CNN & Transfer Learning

G Anitha and P Thiruvannamalai Shivashankar

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FRUITS FRESH AND ROTTEN DETECTION USING CNN AND TRANSFER LEARNING

Smt Anitha G[1] , P Thiruvannamalai Sivasankar [2]
Department of CSE, Faculty of Engineering and Technology
Jain Deemed-to-be-University, Bengaluru, Karnataka, India - 560069

***Abstract*— The economic development of our nation is significantly influenced by agriculture. Fruit production with high yields and productive growth are crucial to the agriculture sector. 30 to 50 percent of the gathered fruit is wasted because there aren't enough qualified workers. Additionally, fruit identification, classification, and grading are not done accurately due to human perception subjectivity. Therefore, the fruit sector must impose an automation system. In order to save labour, production costs, and production time, this research suggests a method based on recognizing fruit flaws in the agriculture sector. These flawed fruits can infect healthy fruits if we are unaware of them. As a result, we suggested a methodology to stop corruption from spreading. From the input fruit photos, the suggested model distinguishes between fresh and rotting fruits. Apples, bananas, and oranges are the three types of fruits I used in this project. Softmax is used to categories the input fruit image into fresh and rotten fruits, and a convolutional neural network (CNN) is utilized to extract features from the input fruit image. Utilizing the Kaggle dataset, the suggested model's performance is assessed. This results in 81% accuracy. The findings demonstrate that the suggested CNN model can successfully classify both fresh and rotting apples. The suggested study investigated strategies for classifying fresh and rotting fruits using transfer learning models. The suggested CNN model outperforms transfer learning models and prior art methods in terms of performance.**

Keywords*— *CNN, Agriculture, Transfer-Learning models

1. Background

One of the topics currently being researched in the agricultural sector is fruit classification. This fruits classification utilizing image processing techniques was created as a part of the present study topic. This fruit classification can be used to locate a fruit in a store or supermarket and automatically calculate its price. Three fruits were classified as the first step in the suggested approach. If automated machine vision is used to categorize various types of fruits and vegetables in the agricultural industry, even farmers will gain. Fruits play a crucial role in our daily lives as a food. It delivers nutrients that are essential for our health and bodily upkeep. More fruit consumption as part of a healthy diet is likely to lower the risk of developing various chronic diseases. But not all fruits are treated similarly, and it is troubling that not everyone is knowledgeable about each fruit. This study may create an automatic fruit classification system using a convolutional neural network (CNN) and deep learning (DL), together with a dataset containing information about each fruit. This approach can guide us in choosing fruit that is right for us and instruct us on the traits of that specific fruit. These kinds of programmes can aid in educating kids and introducing them to fruits. Additionally, these algorithms can be used to train a robot to find the right fruit for its user, which is crucial for robots that are employed in tasks linked to fruit harvesting. Smart refrigerators are a significant application for fruit identification and recognition. Modern refrigerators with sensors can determine how fresh a fruit is, how many of each type of fruit are still available, and which fruits are in short supply and should be added to the shopping list. It is frequently seen that recommendations of nutritious foods are quite important as people's access to health information increases. An automated method for classifying fruits that is linked to a database of information can assist the shopper in making healthier fruit selections while also providing nutritional information. These kinds of technologies are also used by super stores nowadays to teach customers about each type of fruit, to keep track of what is sold and what is still in stock, and to determine which fruit items are the most popular. Such an automated system can be used quite readily even by online shopping companies. A reliable fruit detection and recognition system is necessary for all these tasks.

Over the years, academics have tried a variety of solutions to the classification issue for fresh and rotten fruit. As will be mentioned below, numerous technologies have been used as well as expensive experimental models.

With an emphasis on the advancement of state-of-the-art, Behera Santi et al. [1], Provide a succinct review of the methodologies put forward in the research articles from the years 2010 to 2019. The associated researches are contrasted with various methods for classifying, identifying, and rating fruits. This essay also discusses the current research's successes, constraints, and recommendations for additional study.

By using a novel way to assess data, Dr. Chandy Abraham et al.[2] al proposed a method assists in obtaining the standard maturity level that is appropriate for importing the fruits.

Hallur, V., Atharga, B., Hosur, A., Binjawadagi,B., Bhat, K.[4], gave this study which created a portable gadget for banana fake ripening detection. They used a stepper motor, banana holder, IR camera, image processing unit, microprocessor, and display, among other things. Positioned in a holder. The micro switch creates an interrupt when the banana is placed in the holder so that the microcontroller can detect it. When the request is accepted, the stepper motor begins to operate and the camera turns on. A picture of the banana is taken. The image processing module processes the collected images, which are then compared to the reference image.

Nitin Kothari., and Sunil Joshi [5],They designed and developed a portable sensor-based prototype for real-time fruit ripeness monitoring in crop fields and storage are discussed in this work. The fruit they used are Musa acuminate (Banana- "Kela"), Psidium guajava (Gauva- "Amrood").

2. Methods

The creation of a system based on transfer learning Resnet 50, a Convolution Neural Network, which, in response to input from the user via the user interfaces, accurately predicts when fruit is fresh and when it is rotten.

2.1. Methodology

Figure-1: depicts the system's projected flow of our model for differentiating between fresh and rotten fruits. It is processed using the Transfer Learning Technique. The model for fruits classification according to their categories is trained and tested using the suggested dataset.

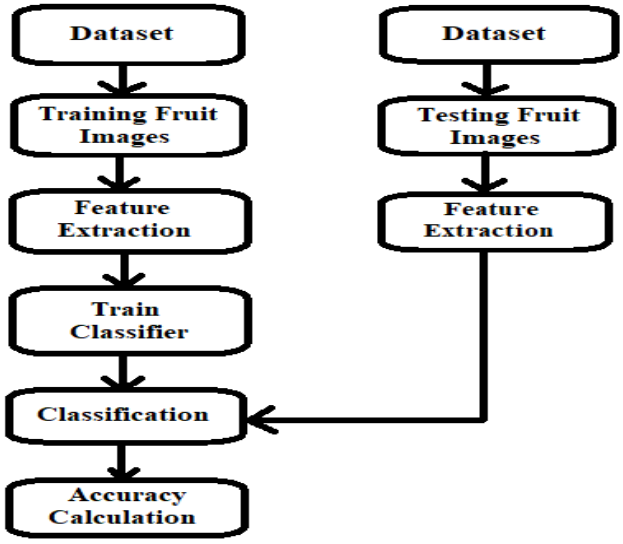

Fig.1 Methodology

2.2 Data Analysis

Three different fruit types—Apple, Banana, and Orange—make up the dataset. The CNN algorithm knowledge is mentioned in the Implementation Section with the suitable figure of flow (Figure 5&6). The approach is consistently used to train a specific model to determine if a fruit is fresh or rotten. There are 10901 images in the training set and 2698 images in the test set.

There are 6 image categories in the dataset.

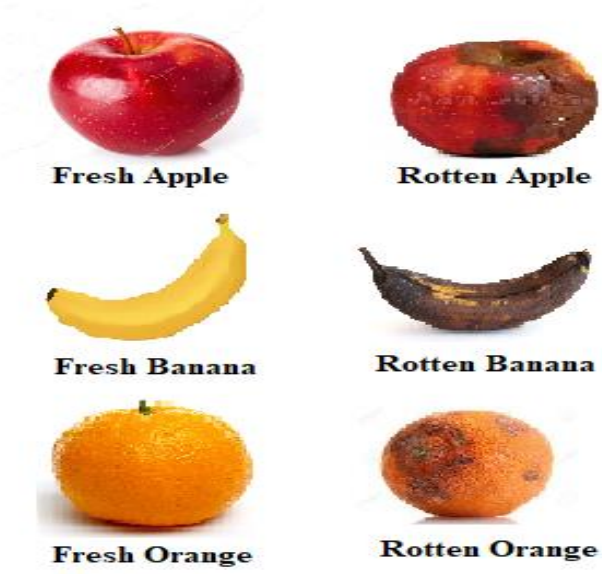

Fig.2 Six Categories of Fruits

3. Results

Using model fit, we are going to train our model on the training set and test set. The model is built for 80 epochs after that we got 81% of accuracy.

Epochs	Accuracy	Loss Value	Val Accuracy	Val Loss
10	0.4133	1.9018	0.5964	2.3018
20	0.6839	1.9920	0.6839	5.0413
30	0.7191	1.8101	0.6101	3.1813
40	0.7299	1.7753	0.7150	2.1511
50	0.7438	1.7542	0.6597	3.8025
60	0.7564	1.6502	0.7005	2.5516
70	0.7659	1.6433	0.7153	2.5270
80	0.7686	1.6964	0.8136	1.3915

Table.1

Loss Function is defined as a function that compares the target and predicted output values. During training our objective is to minimize this loss.

Accuracy is defined as the number of classifications, a model correctly predicts divided by the total number of predictions made.
Accuracy = No of correct predictions / Total No of Correct predictions.

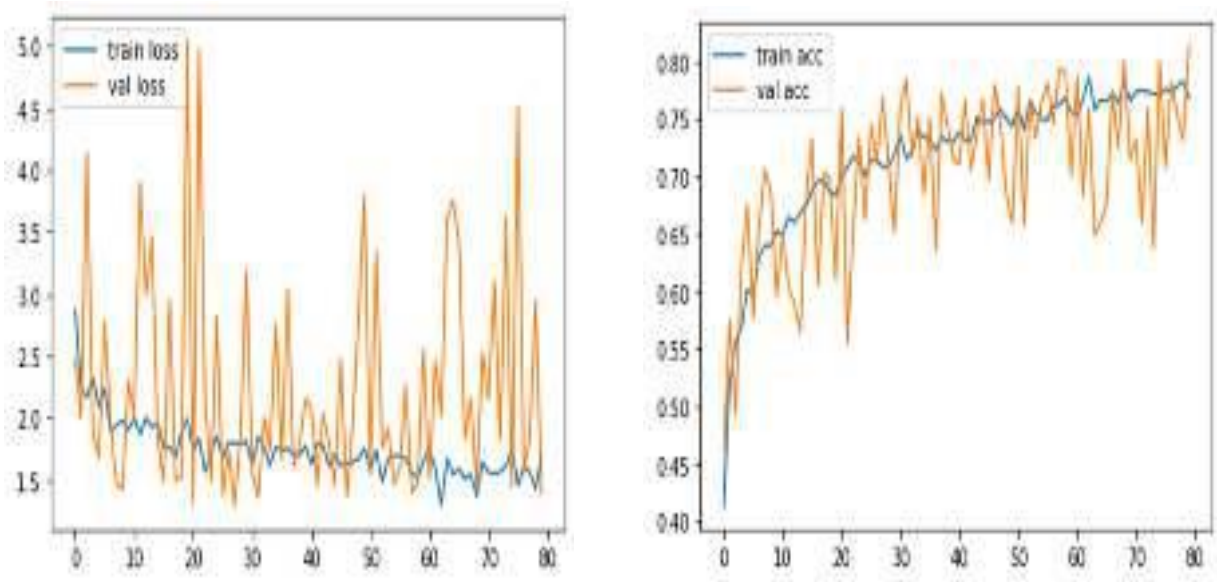

Fig.3 Accuracy and Loss over 80 epochs

Result-l **Result-2**

Fig.4 Fresh Apple and Rotten Banana

4. Discussion

A. Convolutional Neural Network

CNN is a feed-forward deep learning system that can collect an input image, discriminate between objects, and give importance, i.e. biases and learnable weights. The development of CNN was based on the scientific idea that human brain neurons can learn highly abstract properties, classify objects effectively, and have a remarkable capacity for generalization. The capacity of CNN to share weights, which in turn Minimizes the number of parameters required for training, is one of the key arguments for choosing it. This encourages fluid training and solves the over fitting problem. Multiple blocks of convolutional layers, an activation function, pooling layers, and a fully linked layer make up the basic CNN architecture.

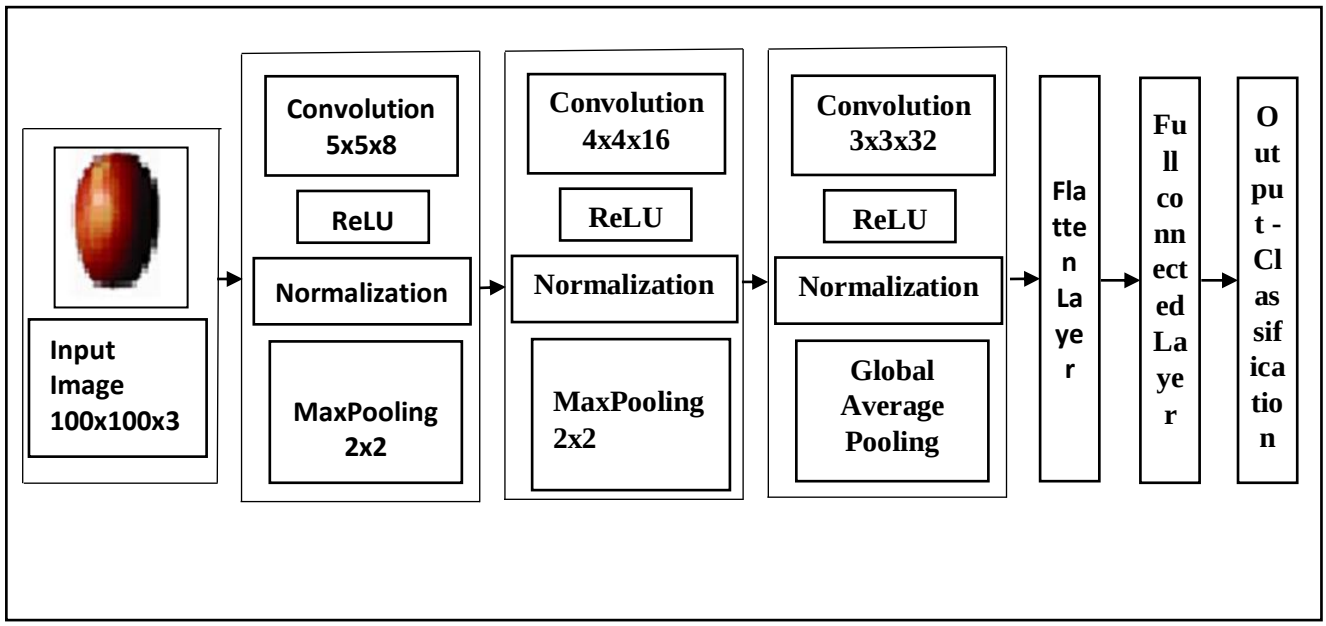

Fig.5 CNN Architecture

B. ResNet50 Architecture

One of the well-liked deep learning models, ResNet (also known as Residual Networks), also took first place in the ImageNet challenge. This model, which has 50 layers as its name says, is far deeper than the Prevision 2 models utilised in this project. Convolutional, ReLu, and batch normalisation layers make up a typical residual network block. Utilizing ResNet50 has the advantages of promoting feature usage, enhancing feature propagation, and drastically reducing the amount of parameters. The identity connection, a feature of ResNet, skips connections between layers and adds the output from the layer it is connected to, resulting in a richer model.

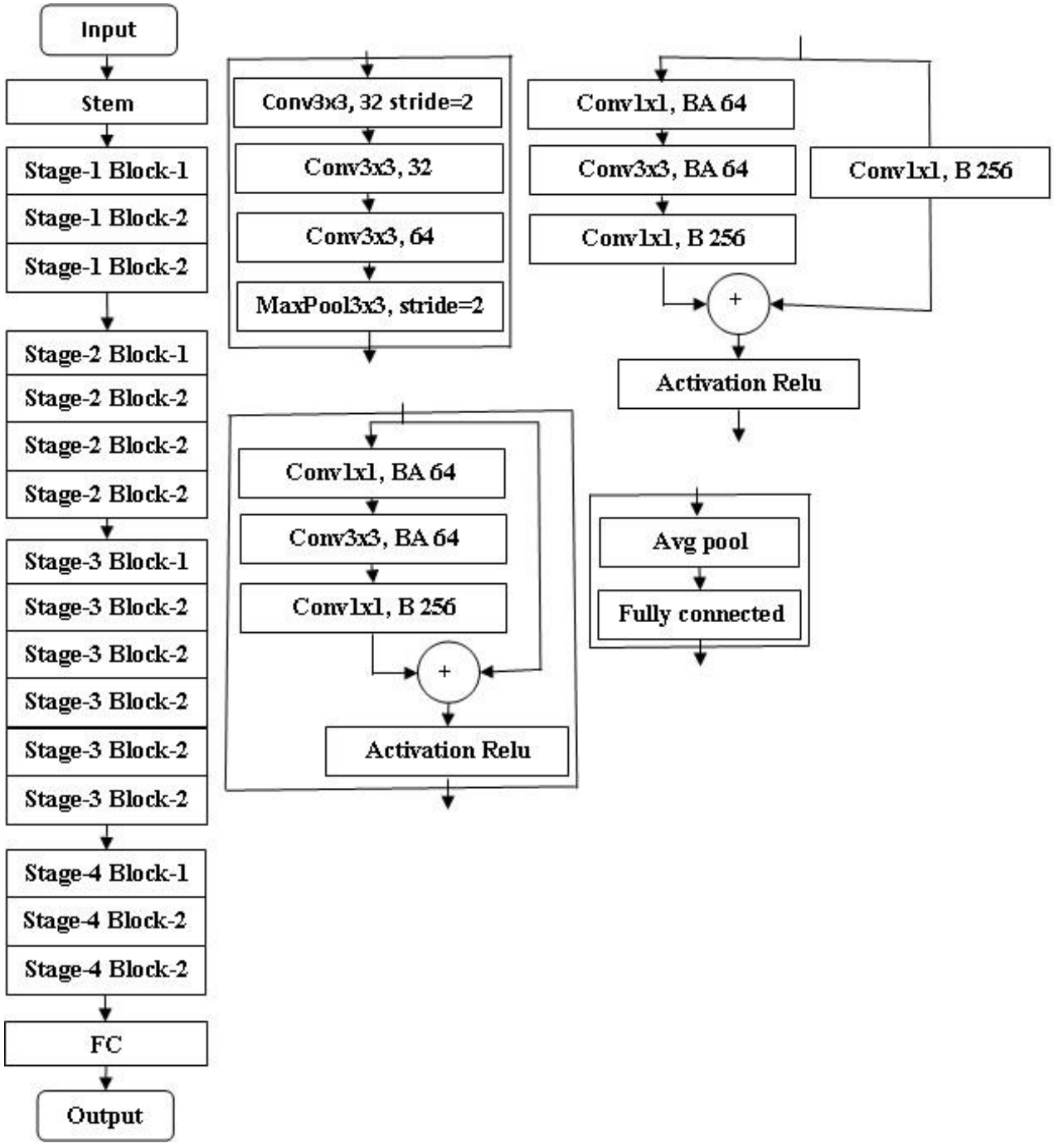

Fig.6 ResNet50 Architecture.

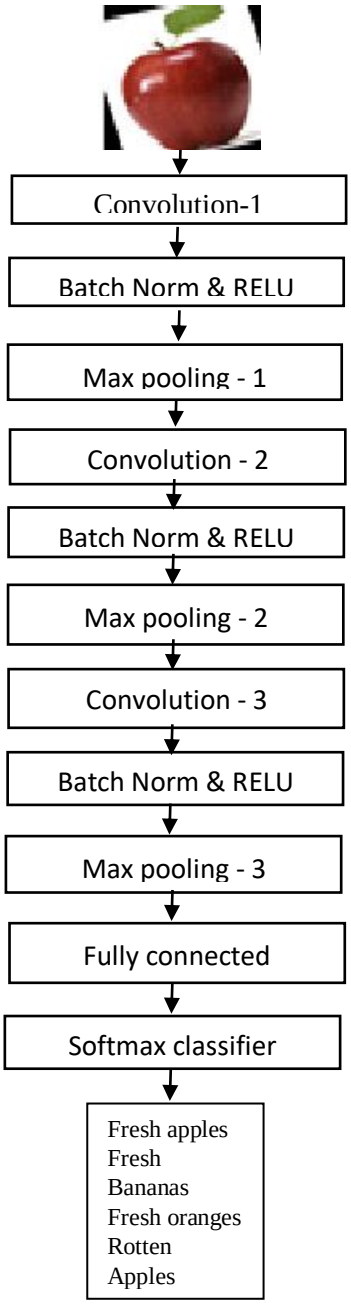

Fig.7 Implementation Architecture

5. Conclusion

Agriculture places a lot of importance on the distinction between fresh and rotting fruits. In this research, we developed a transfer learning model for the classification of fresh and rotting fruits using a CNN-based model. In this case, the accuracy-proposed CNN model is compared to the transfer learning model ResNet50. We will examine the effects of different hyper parameters in this task, including batch size, number of epochs, optimizer, and learning rate. The findings demonstrate that the suggested CNN model, which has higher accuracy than the transfer learning model, can distinguish between fresh and rotting fruits with clarity. As a result, the proposed convolutional neural network model is used by someone to automate the process of 81% accuracy.

6. Abbrevation

CNN, Convolutional Neural Network ; ResNet, Residual Network ; DL, Deep learning (DL)

7. Competing Interests

The Authors declare that they have no Competing interests.

8. Consent for publications

Not Applicable

9. Ethics approval and consent to participate

Not Applicable

10. Funding

Not Applicable

11. Availability of data and materials

Plant Village Dataset: https://www.kaggle.com/datasets/emmarex/plantdisease

12. Authors Contributions

AG designed, carried out research and drafted the manuscript. PTS participated in research coordination.

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