# PROJECT REPORT: FRESH AND ROTTEN FRUITS CLASSIFICATION

## 1.Introduction

Detection of defective or the rotten fruits is one of the major problems of the agricultural sector. It can cause major impact on the productivity if not classified correctly and at early stage. Rotten fruits if kept longer can also affect other fresh fruits. The classification of fruits has been relied upon manual operations which is one of the tedious works to perform.

For this reason, the development of a new classification model is required which will reduce human effort, cost, and production time in the agriculture industry by recognizing defects in the fruits. In this project we have used deep learning models to classify the fresh and rotten fruits.

In the paper [1], a CNN model is proposed for feature extraction from an input image of fruits that are apple, banana, and orange.

A fruit classification problem was re-introduced based on a pre-trained MobileNetV2 CNN model, in which different kinds of fruits were classified. We compared the accuracy rate for our model by using MobileNet transfer learning with changing hyper parameter value.

After running it for 20 epochs, with learning rate 0,01 we found our training accuracy to be 0.9992 and our training loss to be 0.0092. And we got a validation accuracy of 0.75 and a validation loss of 1.28.

## 2. Related Work

K. Roy et al. [2] proposed a method that implements the segmentation technique to detect rotten fruits. Marker-based segmentation, color-based segmentation, and edge detection techniques are utilized after the image data is converted to greyscale, and filtering and thresholding to reduce noise. In the final output, rotten fruit is detected and marked.

The authors in the paper [3] proposed a semantic segmentation technique using uNet and En-UNet deep learning architecture to detect rotting in fruit from image data.

The objective of the paper [4] is to propose a method that uses a segmentation method to detect rotten or fresh fruits. The image of the fruits is rectified by detecting the foreground using 'YCbCr' color space to segment out the essential portion Pre-Print of the image, 'L*a*b*' color space and KNN clustering method is used. Finally, to identify the rotten portion, segmentation is done using a color map.

# 3. Materials and Experimental Evaluation

### 3.1 Dataset

**1. Dataset** source is https://www.kaggle.com/datasets/alihasnainch/fruits-dataset-for-classification

**2. Image dataset:** The dataset used in this project contains images of strawberries, peaches, pomegranates of fresh and rotten. Total 1500 images.

**3. Preprocessing:** The dataset obtained for this study was obtained from Kaggle.Strawberries, peaches, pomegranates are among the three different fruit varieties in the dataset. Each fruit was further sub-grouped into fresh and rotten fruits. This means we had altogether of 6 other classes. The six classes were Rotten peaches, Fresh peaches, Rotten pomegranates Fresh pomegranates,Rotten Sstrawberries , and Fresh Sstrawberries. ImageDataGenerator was used to separate the images in the training, validation and testing set after applying the proper data augmentation technique.

**4. Number of Classes:** There are 06 different classes in the data.

**5.Class Distribution:** fresh_peaches=16%, fresh_pomegranates=14%, fresh_strawberries =19%, rotten_peaches =19%, rotten_pomegranates=19% and rotten_strwberries=18%

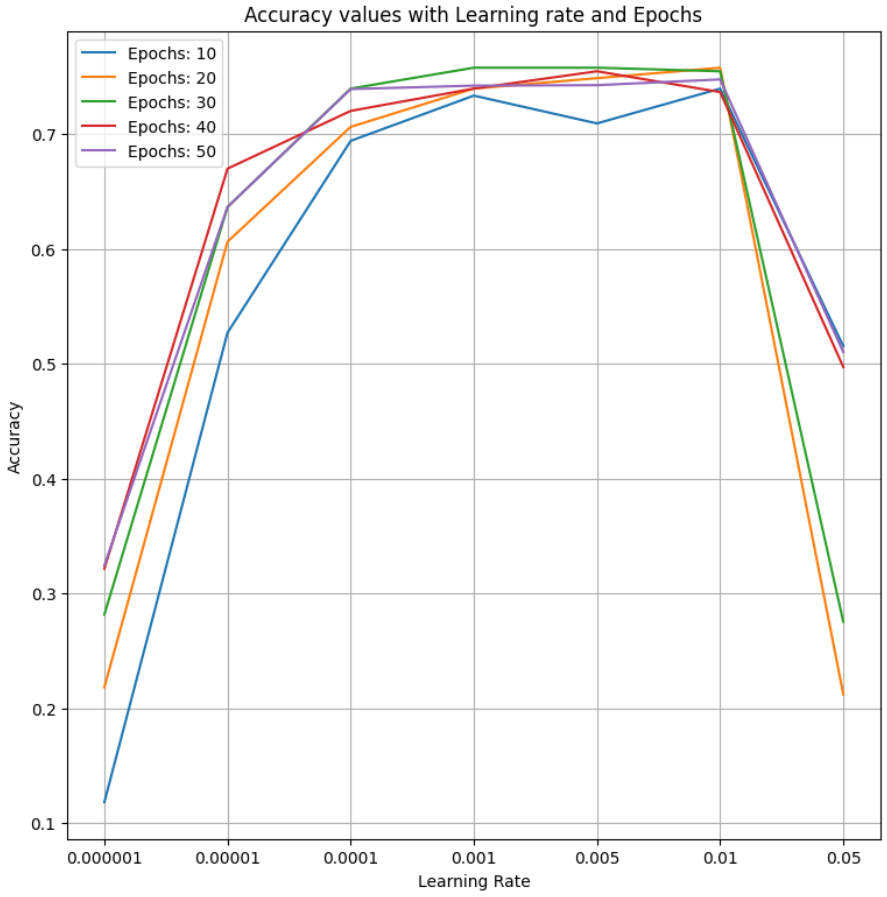
**6. Training and validation:** used 80% of the data for training and 20% for Validation

### 3.2 Methodology

In this MobilenetV2 model is used. MobileNetV2 can be used for transfer learning. Its lightweight architecture and pre-trained models make it an excellent choice for fine-tuning on specific tasks or datasets. Initially a basic model is created with the number of classes (in this case : 6 classes) with the help of pretrained models. The activation is relu in case

of layers in the pretrained models and the activation is softmax in the final layer. After this an optimizer is selected to minimise the loss function during the training process.

To create the image classification model the hyper parameters selected are: Epochs, Learning-rate. Based on the validation accuracy of various combinations of the hyper parameters (the table is given CSV file) for the 06 classes.

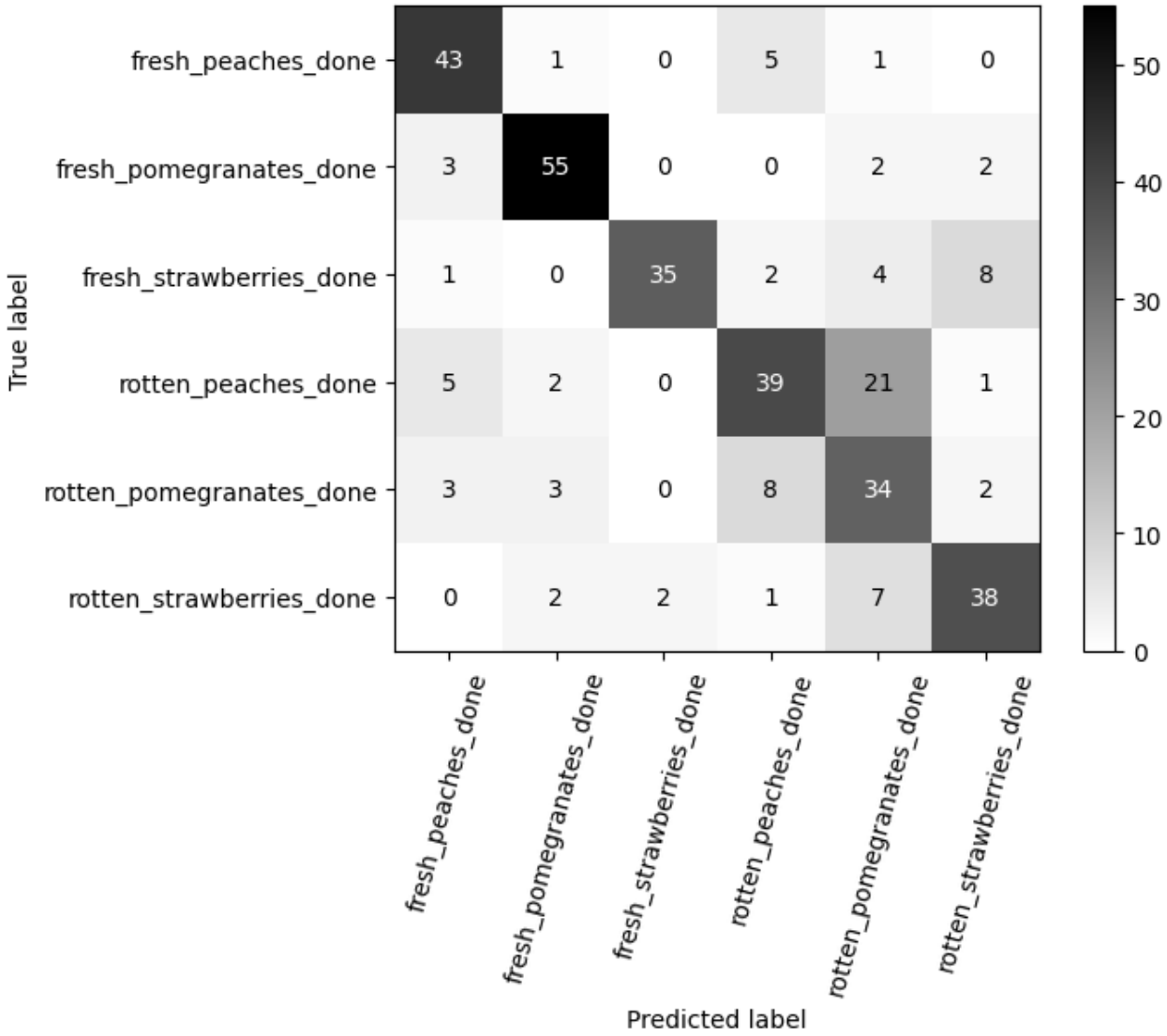



### 3.3 Results

Classification Report :

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 0.83 | 0.88 | 0.85 | 50 |
| 1 | 0.87 | 0.97 | 0.92 | 62 |
| 2 | 0.92 | 0.70 | 0.80 | 50 |
| 3 | 0.64 | 0.65 | 0.64 | 68 |
| 4 | 0.49 | 0.50 | 0.50 | 50 |
| 5 | 0.74 | 0.74 | 0.74 | 50 |
| accuracy | | | 0.74 | 330 |
| macro avg | 0.75 | 0.74 | 0.74 | 330 |
| weighted avg | 0.75 | 0.74 | 0.74 | 330 |

**Confusion Matrix:**




### 3.4 Discussion

The experimental results show that the TL-MobileNetV2 has performed well on the fruit dataset by attaining good accuracy.

## 4. Future Work

In future work, a mobile-based application will be further enhanced using a larger number of different fruits, which aims to lead to a wider range of fruit classification. This application will help people with limited knowledge to classify different types of fruit and their different

varieties. Furthermore, different CNN models will be trained on the dataset, and their results will be compared to identify the best-fit model in terms of accuracy and efficiency.

## 5. Conclusion

With the application/ implementation of MobilenetV2 which is a light weight convolutional layered network, using an optimiser, by tuning the hyper parameters to the optimal combination, the model gave better results with average prediction accuracy of nearly 75%.

## References:


1. Palakodati, S.S.S., Chirra, V.R., Dasari, Y., Bulla, S. (2020). Fresh and rotten fruits classification using CNN and transfer learning. Revue d'Intelligence Artificielle, Vol. 34, No. 5, pp. 617-622. https://doi.org/10.18280/ria.340512

2."Segmentation Techniques for Rotten Fruit detection," 2019 International Conference on Opto-Electronics and Applied Optics (Optronix), Kolkata, India, 2019, pp. 1-4, doi: 10.1109/OPTRONIX.2019.8862367.

3.Roy, K., Chaudhuri, S.S. & Pramanik, S. Deep learning based real-time Industrial framework for rotten and fresh fruit detection using semantic segmentation. Microsyst Technol (2020). https://doi.org/10.1007/s00542- 020-05123-x

4. K. Roy, A. Ghosh, D. Saha, J. Chatterjee, S. Sarkar and S. S. Chaudhuri, "Masking based Segmentation of Rotten Fruits," 2019 International Conference on Opto-Electronics and Applied Optics (Optronix), Kolkata, India, 2019, pp. 1-4, doi: 10.1109/OPTRONIX.2019.8862396.