# Fruit Freshness Detection Using Raspberry Pi

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**Abstract: -** The quality of fruits or vegetables performs an essential role in customer consumption. This project explains the importance of system for detecting the degradation of fruits that may be required at industrial level, for packaging, etc. This proposed paper sheds light on the system which is a low cost yet effective fruit quality detecting system in terms of freshness and rottenness using Raspberry Pi. The developed method can recognize the fresh fruits from rotten fruits and is an advantage over the current traditional method of identifying the fruits quality which is more time consuming and has reasonably less rate for classifying fruits. Besides, hand sorting of rotten fruits from fresh fruits is more time consuming, tiring and tedious work. This project focuses on creating a smart AI camera using Raspberry Pi for effective sorting of fresh fruits from rotten fruits. Fruit quality detection system involves steps like image capturing, image processing, feature extraction, training, image classification and then recognition. Here, CNN algorithm (Convolutional Neural Network) is used to train the Machine learning model. A Raspberry Pi camera is used to capture an image of particular fruits then the trained model detects the quality of fruits and sorts them accordingly as fresh fruit or rotten fruit. In this project, software which includes Python code is used.

**Key Words:** ***Raspberry Pi, AI, Machine Learning, CNN, Python.***

## I. INTRODUCTION

Fresh fruits are always essential for living a healthful life. Often fruits are rotten and need to be sorted for finding good quality amongst them. The traditional way of identifying freshness is by checking every fruit, which is already in use in markets, but it is time consuming and at many times this process results in less accuracy. Technology is getting updated day by day. Multiple approaches are coming by the researchers to solve and overcome various issues.

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Machine Learning and Deep Learning machine are important part of technology, which gives several methods to solve any concerns with less labour cost by training machines. The trained machines in both technologies can smartly work through provided functions. Identifying fruit with the help of algorithms or trained machines can be a way to identify fruit quality easily. Hand sorting rotten fruits from fresh fruits in mixed fruits is a tiring and tedious work. Despite being time consuming, most food processing factories carry out this way for making jams and other fruit-based products. Hence, to provide a much less demanding solution, this project focuses on creating a smart AI camera using a Raspberry Pi Development Board for fresh and rotten fruit detection.

## II. OBJECTIVE

The main objective is to build a cost-effective system by using some of the electronic devices such as Raspberry Pi and Raspberry Pi camera to give more accurate results then the present systems are available. This system will also reduce the hand work for a human being and can give more productivity.

## III. METHODOLOGY

### *3.1 Convolution Neural Network (CNN)*

Convolutional Neural Networks (CNNs) are a type of deep learning algorithm commonly used for image processing tasks, including fruit freshness detection. CNNs are specifically designed to automatically learn patterns and features from images, making them well-suited for tasks that require image analysis and classification. The architecture of a typical CNN consists of multiple layers, including convolutional layers, pooling layers, and fully connected layers. Here's a brief overview of each type of layer Convolutional layers: These layers apply convolution operations to input images, which involves sliding small filters or kernels across the image to extract local features. These features may include edges, textures, or other patterns that are relevant for disease detection in fruit images. Convolutional layers help the CNN to learn hierarchical representations of the input images. Pooling layers: These layers down sample the feature maps generated by the convolutional layers, reducing their spatial dimensions. Common pooling techniques include max pooling and average pooling, which help to reduce the computational cost and increase the model's translation invariance, i.e., the ability to recognize features irrespective of their position in the image. Fully connected layers: These layers are traditional neural network layers, where all neurons are connected to every neuron in the previous and subsequent layers. Fully connected layers are typically used in the final layers of a CNN to make predictions and classify the input images into different disease classes based on the learned features. The general workflow of a CNN for fruit freshness detection involves feeding the pre-processed fruit images as input to the CNN, passing them through the convolutional, pooling, and fully connected layers to learn relevant features, and finally making predictions about the presence or absence of diseases. The CNN is trained using a labelled dataset of fruit images, and the model parameters are optimized through backpropagation and gradient descent to minimize the prediction error.

### *3.2 Dataset Discussion*

This project basically classifies the fruit into fresh and rotten. The data set has been downloaded from Kaggle website. The data set consists of 2698 sample images. Up next 80-20 split is performed on the data sets. That is 80% of data set is used for training Machine Learning model and 20% is used for testing purpose. Steps performed to build the Machine learning model are: import predefined libraries, model definition, weights initialization, compile the developed model, train model using 80% data of our downloaded data sets. Model test to check if model predicts correctly using remaining 20% of data, and the final prediction.

## IV. RESULTS AND DISCUSSION

Fig 1. Shows the model build for detection and classification of fruit freshness using image processing.

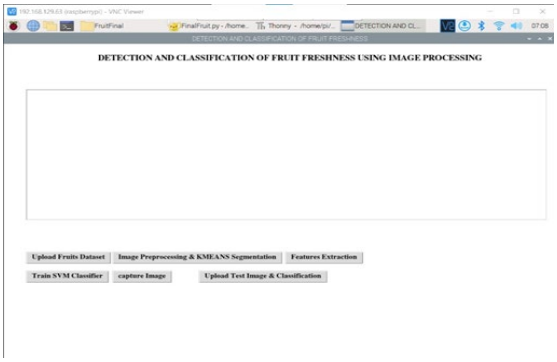


Fig.1. Detection and classification of fruit freshness using image processing

Fig.2. Shows the method of handling the fruit to find out whether it is fresh or rotten.

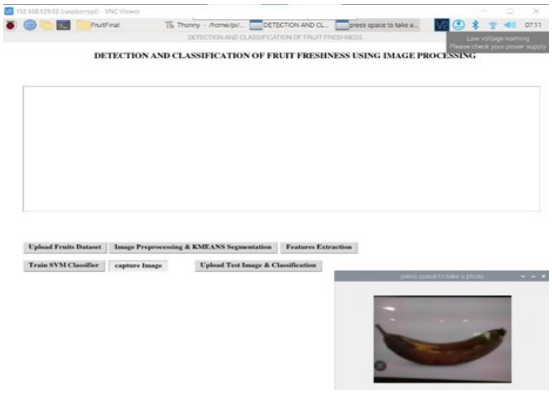


Fig.2. Capturing the fruit

Fig.3. Shows the final result of fruit that is rotten banana.

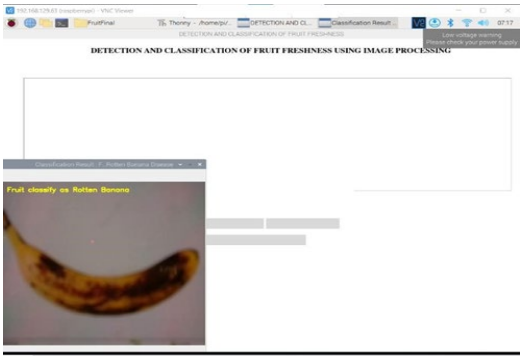


Fig.3. Result of captured fruit

## V. CONCLUSION

Many techniques have been developed over the years for the fruits-detection and quality maintenance. With the availability of the machine learning frame works such as Tensor Flow Lite, the fruit detection has been implemented using Raspberry Pi to make easy enough for enthusiasts to use machine learning. The objective of this research is to introduce a system for detecting freshness of fruits. To provide a much less demanding solution, this project focuses on creating a 4 smart AI camera using a Raspberry Pi Development Board for Fresh and Rotten Fruit Detection and automatically sort it out.

This project will recognize and sort the fruits into fresh and rotten. This project can overcome the traditional way of identifying and sorting fruits thereby reducing the manual work and time. This work can present a system that classifies three types of fruits named apple, banana, and orange. It will also separate the fresh and rotten ones. The mechanism that will be used in this project to classify the fruits is CNN algorithm. This project will be based on Machine Learning and Deep Learning algorithms, which can provide real-time information of fruits; it lowers labor costs. Factories can use it for fruit counting purposes.

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