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Fruit Classification and Grading

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Abstract:- This project aims at classifying fruits according to their quality and then grading them according the same. At present we focus on classifying mango taking its outer physical structure into consideration. Mango is a commercial fruit that is grown and enjoyed all over the world.For business purposes, mangoes must be categorised according to their quality. This classification is currently done manually, which is inefficient and prone to human mistake.It also increases personnel, lowering the overall cost and effectiveness of the mango processing sectors. We presented a classification system for mangoes based on changes in their visual characteristics in this research. The methods proposed can be used on any other mango species that changes colour during the ripening phase. Here we use a CNN model for classification. The dataset was acquired from "The Ministry of Education Artificial Intelligence Competition and Annotated Data Collection Project (MOE AI competition and labeled data acquisition project)". There were three sets of data for training, testing and validation.

I. INTRODUCTION

Image processing is a method of converting a physical im- age to a digital representation and then performing operationson it.It is used to extract enhanced visuals as well as relevant data from photographs. It is a signaling process distribution. In this process, if you take the input as an image and applyan efficient algorithm, you will get the following results: The image, data, or feature associated with that image.The processing stage begins with image segmentation. There is a certain demand for image segmentation algorithms. The first of them is speed. In process Image segmentation, it does not want to spend a lot of time. The second is object. This will improve the results of image verification. If the result of the shape is incomplete,then many properties must be taken for recording the resulting edges of intersections.In the agricul- tural field, image processing and computer vision systems have been widely employed for identification, classification, grading, and quality assessment.

Mango fruit defect detection and maturity detection are difficult tasks for computer vision to reach near human levels of recognition. The proposed framework is beneficial in supermarkets and may be used in computer vision to sort fruits automatically from a set of distinct types of fruits. The goal of this project is to create an automated programme that can identify defects and detect mango fruit ripeness based on form, size, and colour features using digitalimage analysis.The proposed method can be utilised to detectobvious faults, stems, size, and form of mangoes, as well as grade them quickly and accurately. The mango is grown over the largest area, 4312 thousand hectares, with a production ofroughly 15.03 million tonnes, accounting for 40.48 percentof global mango production. India sells mango to more than 40 countries around the world. Its outward appearance has an impact on its market value, so careful fruit management after harvesting is critical.

The colour of the fruit, in general, denotes its ripeness and the existence of faults. In this paper, a CNN is offered asa method for automatically detecting mango fruit defectsusing image processing. This framework can be used in a variety of settings, including manufacturing enterprises that manufacture mango juice and supermarkets. The physical properties of mangoes are used in the grading procedure. This technique is currently carried out by hand and is heavily reliant on the human visual system.Over the last20 years, agricultural fruit categorization has shifted from human grading to automatic classification.

II. LITERATURE SURVEY

Here we look at some of the related works in the field of agriculture and defect detection:

R.Meena Prakash proposed Detection of Leaf Diseases and Classification using Digital Image Processing [1].The K-Means technique is used to segment leaves in this paper. GLCM is used to extract texture features.SVM is then used to classify the data. To begin, photos of various leaves are obtained utilising for higher quality, a digital camera with the needed resolution After that, the input image is downsizedto 256x256 pixels. To improve the quality of the image, pre- processing is performed.It consists of Image improvement and colour space conversion.The RGB L*a*b* colour space is used to convert leaf images. The colour space conversion is employed to improve visual analysis.In SVM, the kernel function converts data from the input space to a high- dimensional feature space.The computational complexity of kernel Hilbert space is reduced (RKHS).The feature vectoris fed into the classifier. The feature vectors in the database images are divided into training and testing vectors. The classifier is trained on the training set before being used to categorise the testing set.The performance of the classifier is assessed by comparing predicted labels to actual values.

Rahul Pralhad Salunkhe [2] proposed a Mango Ripening Stage Detection using RGB and HSV method.The mango processing business is one of the largest in the world.The image's red (R), green (G), and blue (B) components are separated in the second stage. The average values of the R, G, and B components are computed next.Three sets of 24 samples were taken for the testing, each set having mangoes at various stages of ripening. The RGB and HSV tech- niques were found to have 90.4 and 84.2 percent accuracy, respectively, where the result is

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only regarded accurate if the detected stage matches the manually selected stage. A false positive rate of 2.57 percent was recorded for RGB and 7.29 percent for HSV. The RGB and HSV methodshad true positive rates of 89.77 percent and 86.74 percent, respectively.

Edwin R Arboleda published a paper on classification of Coffee Bean Species Using Image Processing, Artificial Neural Network and K-Nearest Neighbor. There were 255 photos utilised in this project. These images have a resolution of 5152 x 3864 pixels and were saved in JPEG (Joint Photographic Expert Group) format. To preprocess and extract characteristics from coffee sample photographs, a computer routine technique was created using the image processing toolbox and vislabels function in MATLAB (version R2012a). Morphological features were retrieved for categorization after the coffee bean images were preprocessed. The coffee bean features taken from the photos were utilised to categorise using an Artificial Neural Network (ANN).Multilayer feed forward neural networks were employed to solve challenges requiring classification and function approximation.Morphology is the geometric property (shape and size) of objects. It was extracted using the following methods: Surface area (As): Counting the number of pixels with a value of one was used to compute the area of a coffee bean. The perimeter (P): was determined by counting the number of pixels on the coffee bean's border. Deq (diameter equivalent): Deq is the diameter of a circle with the same area of the item, also known as Ferret diameter, and roundness is the diameter of a non-circular object (Rs). [3].

Han Yang et al proposed an improved encoder-decoder network for ore image seg- mentation[4]. Three convolution oper- ations make up the encoder's fundamental convolution layer. The encoder is then followed by a ReLU activation function. VGG16 was pre-trained on ImageNet and was used to start the model. The decoder is a device that decodes data. 3 convolution operations make up the basic convolutionlayer. Batch normalisation and ReLU activation to improve segmentation The decoder section has been redesigned to provide improved performance. a more extensive multi-scale data collection and analysis Mechanism for fusing . Stride1 is utilised with maximum pooling. to minimise the size of the feature map in the encoder To acquire the final pixel-perfect result In the decoder part, the nearest-neighbor interpolation up-sampling with multi-times is used.To build feature maps with 512 channels, the input image travels through five encoder stages. There are two paths for the encoder's final stage and the decoder's stages. The suggested encoder-decoder network is used to segment an ore image. as shown below.The result is based on a combination of multi- scale contextual features.

III. PROPOSED SYSTEM

Here we use convolutional neural network for classification. This is much simpler model compared to other image classification algorithm. CNN consists of mainly four components: Convolution Maxpooling Padding and Striding Fully connected layer In this the first three ie, convolution, maxpooling, padding and striding is for feature extraction or feature learning. The classification takes place in the fully connected layer. In fully connected layer each neuron in one level is fully connected to each layers at the next level. The number of convolutional layers depends upon the number of features that we consider. Here we consider features that deals with the outer appearance of the fruit. Before convolu- tion we perform downsampling.Downsampling is a technique for reducing the number of training samples that fall intothe majority category. As it aids in the balancing of target category counts. We tend to lose a lot of essential information.

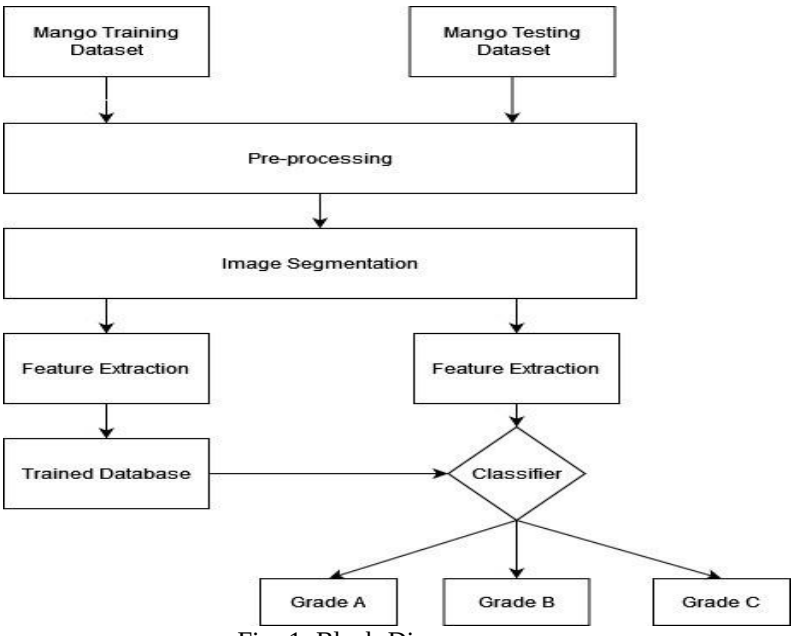

Fig. 1: Block Diagram

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when we remove the acquired data.After downsampling the output is given to the model. The convolutional neural network is composed of three regions namely backbone, neck and head. Among this regions backbone and neck deals with feature extraction and the head region consists of fully connected layers that deals with classification. This network was given a fixed size (224 * 224) RGB image as input, implying that the matrix was of shape (224,224,3).The only preprocessing done here was subtracting the mean RGBvalue from each pixel, which was computed throughout the entire training set. Kernels of size (3 * 3) with a stride size of 1 pixel were used. They were able to cover the entire concept of the image as a result of this. To keep the image's spatial resolution, spatial padding was applied. Max pooling was done with stride 2 over a 2 * 2 pixel window. Following that, the Rectified linear unit (ReLu) was used to inject non- linearity into the model in order to enhance classification and computational time. Previous models had employed tanh or sigmoid functions, but this proved to be much better.

IV. CONCLUSIONS

Mango is one of the most popular tropical fruits in the world, with annual production trends increasing. Mango is India's most popular fruit and is known as the "King of Fruits." The mango is grown over the biggest area, 4312 thousand hectares, and produces roughly 15.03 million tonnes, accounting for 40.48 percent of global mango production. India sells mango to more than 40 countries around the world. Its outward appearance has an impact on its market value, so careful fruit management after harvesting is critical. The colour of the fruit, in general, denotes its ripeness and the existence of faults. Using image processing,a method is suggested to automatically determine flaw and ripeness in mango fruit.This framework can be used in a variety of settings, including manufacturing enterprises that manufacture mango juice and supermarkets.

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