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A Comparative Study of Multiclass Classification Using the Different Machine Learning Techniques for Fruit Species Prediction from Images

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Abstract*:* Fruits play a vital role in our healthy life and are also used for the treatment of various diseases. It also contains an enormous quantity of fibers. It is the application of machine learning that we are using in the fruit classification model. Here we have different fruit images and we have to classify them using multiple algorithms. We are using various algorithms like KNN, random forest, Naive Bayes algorithms, etc. When we are using these algorithms we need our data in numbers or we can say in the numeric format, so we have to convert our fruit image data into a numeric format, and then by applying the various algorithms we can perform the task of classification. In this paper, a machine learning-based approach is presented for classifying and identifying different fruits with a dataset that contains various images. Some images are for training and some images are for validation and for testing. Here we have to take note of one thing while we are dealing with the machine learning and deep learning task or any project we want our data in numeric format. Here we are importing various types of libraries. Food security is a very important topic of discussion in today's society, as improper handling and management of food during production, processing, or distribution have caused increased food wastage around the globe. In addition, it has become clear from statistics gotten from surveys by institutions around the world like the Food Bureau of the United States that it is necessary to increase our rate of food production to meet the needs of our rapidly growing population.

Keywords: Machine Learning

I. INTRODUCTION

In this paper, we are going to classify the fruit images by using machine learning algorithms. The fruits available naturally will be having different colors and shapes in appearance. Humans can identify the type of fruit by seeing their shape and color without any difficulty. Here a practical approach has been offered in this project to classify the fruit images based on the Color and Shape of the fruit.The images were taken from the standard dataset for the experiment; the dataset contains 28 types of fruit classes 'Grape Blue': 984, 'Pear': 696, 'Apple Braeburn': 492, 'Apple Granny Smith': 492, 'Apricot': 492, 'Cantaloupe': 492, 'Cherry': 492, 'Papaya': 492, 'Peach': 492, 'Pomegranate': 492, 'Strawberry': 492, 'Banana': 490, 'Cactus fruit': 490, 'Clementine': 490, 'Limes': 490, 'Mango': 490, 'Passion Fruit': 490, 'Pineapple': 490, 'Raspberry': 490, 'Orange': 479, 'Watermelon': 475, 'Kiwi': 466, 'Blueberry': 462, 'Corn': 450, 'Potato Red': 450, 'Plum': 447, 'Avocado': 427, 'Cucumber Ripe': 392. The color moment and shape of the fruits were considered to extract the features from different fruit images. In this proposed work, three feature vectors are constructed. In the color moment feature extraction, statistical features such as the mean and standard deviation of three-color channels (RGB) are computed here. The binarized images of fruits were used to extract shape-based features, and a multifeatured vector consisting of color moment and shape features was used. In this project, We would be developing a simple training model to identify fruits in images. This would be a baseline effort for the development of a fruit classification system that can eventually be developed to identify bad fruits and vegetables and eventually be able to predict the multiclass of a fruit or vegetable using various classifiers. Machine learning is a powerful tool that has been applied to many fields for the purpose of automation of basic operations and optimization of the results of these operations. Research is ongoing into the application of machine learning for the inspection and grading of fruits and vegetables in retail stores to ensure accurate consistent reports on the quality of the products sold to consumers. In addition, seeing as the visual assessment is the primary basis for a purchase choice in the market, ensuring the visual quality of fruits and vegetables is important to drive sales.

II. LITERATURE SURVEY

The way a fruit or vegetable looks is the first basis for which a purchase decision is made. The average person would not be able to track species and genetic traits of a fruit to be sure with any certainty whether a piece of fruit or vegetable is good or would taste sweet. To a good extent however, these conclusions drawn from the basic analysis of the fruit or vegetable by the customer can actually show the quality of the fruit which then means that the supplier or retailer needs to make sure that the fruits and vegetables they put on sale looks desirable, so as to drive up purchases. For this reason, A lot of time and effort is actually put into inspection and grading of fruits and vegetables at supermarkets and stores. For the sake of quality assurance and as a healthcare measure, certified inspectors also inspect and grade fruits and vegetables. However, inconsistencies in their reports can also lead to high levels of wastage or bad purchases. Every false positive (that is bad fruits or vegetable graded as good) leads to a bad purchase, and every false negative (that is good fruit or vegetable graded as bad) leads to wastage. As a result of this, only about 60% of fruits and vegetables produced in the United States actually make it from the farm to the table (Farm Bureau, n.d.). Furthermore, fruit identification also reduces the time and effort needed for sorting of fruits at supermarkets and eliminates the need for direct contact with a lot of the farm produce along the supply chain. With new strains of viruses and bacteria causes health issues globally, being able to eliminate the unnecessary and inappropriate handling of farm produce by nonprofessionals through automation could help to solve problems of food poisoning among others. A lot of fields and industries have seen the intervention of machine learning and taken advantage of its powerful automation and power to increase efficiency and reduce cost and effort needed. As a result, these areas have had their basic operations revolutionized. Although there have been a few areas that have seen more research and work done by artificial intelligence, there are a few other areas that are also beginning to pick up. One of these areas is Agriculture. Fruit and vegetable recognition by fusing color and texture features was proposed by [7]. Their design relies on the background subtraction and classification with a multi-class support vector machine. [17] used fusion of multiple color channels for multi-class fruit detection from pictures with highly complex backgrounds. However, the bottleneck is the detection speed which takes 28 seconds to process one image. Color and texture features were derived for fruit recognition using the minimum distance classifier [2]. The texture features are based on the sum and difference histogram of the neighboring pixels and are presented by [8]. With an exception of [17], all the other papers used images of fruits and vegetables on a white background. They report that the main discriminative features between the different classes of fruit and vegetable are based on color and texture.

III. PROPOSE WORK

Automation of fruit classification is an interesting application of computer vision. Traditional fruit classification methods have often relied on manual operations based on visual ability and such methods are tedious, time consuming and inconsistent. External shape appearance is the main source for fruit classification. In recent years, computer machine vision and image processing techniques have been found increasingly useful in the fruit industry, especially for applications in quality inspection and color, size, shape sorting. Researches in this area indicate the feasibility of using machine vision systems to improve product quality while freeing people from the traditional hand sorting of fruits. This paper deals various image processing techniques used for fruit classification.

Morphology is a discipline of science that focuses on the exterior structure and characteristics of living systems. It is largely concerned with the investigation of plant forms, morphological characteristics, and the relative placements of various plant components. The study of exterior aspects of flowering plants is referred to as the morphology of flowering plants. The root system and the shoot system are the two primary exterior elements of a plant. Plant morphology encompasses the structure, functions, characterizations, and other morphological components of flowering plants' roots, stems, leaves, flowers, fruits, and seedlings.

The Fruit

The presence of fruit distinguishes flowering plants, often known as **angiosperms**. The ripened or mature ovary seems to be the fruit after fertilization. The fruit has two parts: the wall and the seed.

Parthenocarpic fruits are those grown organically without using fertilizers. Banana is a good example.

A wall or pericarp surrounds the seeds in the fruit.

The pericarp might be meaty or dry.

The outside layer is known as the epicarp, middle mesocarp, and inner endocarp are formed when the pericarp is thick and meaty.

In mango, the fruit is called a drupe. They are just one-seeded & grow from monocarpellary superior ovaries.

Mango has three pericarp layers: an outer thin epicarp, a middle squishy mesocarp, and an interior rocky hard endocarp.

The coconut mesocarp is fibrous.

The tree fruit is a kind of fruit that develops from the ovary.

However, certain other floral elements may have a role in the creation of fruit, which is referred to as fake fruits.

The thalamus in an apple, for example, is changed to produce fruit.

True Fruit- True fruits are those that develop solely from the ovary. Mango, Coconut, and other tropical fruits are examples.

Pseudocarp or False Fruit- The fruit is not formed by the ovary in some fruits. Some flower parts, such as the thalamus, inflorescence, and calyx, are modified to become a part of the fruit. These are referred to as false fruits. Apple, strawberry, and other fruits are examples.

Fruit Classification

Fruits are categorized based on two criteria:

The presence or absence of carpels in the gynoecium.

Fruit is produced when one or even more flowers work together.

There are 3 types of fruit which are classified on the basis of the development of fruit.

Simple fruit

The monocarpellary or multicarpellary syncarpous ovary produces these fruits. The gynoecium produces only one fruit. Simple fruits are as follows:

Fleshy Fruits: Fleshy fruits have three layers of fruit wall: epicarp, mesocarp, and endocarp. These fruits are produced by superior or inferior syncarpous gynoecium.

Simple Dry Fruits: The pericarp of simple dry fruits is typically dry and hard. It does not have the three layers of epicarp, mesocarp, and endocarp. This pericarp is broken down in some dry fruits, and the seeds are scattered or dispersed. Those are fruits that are dehisce.

The pericarp is further divided into one or more seeded segments in some fruits. All of those are a fruit that seems to be schizocarpic. Even after maturing/ripening, the pericarp in some fruits is not dehisced.

Aggregate fruit

The multicarpellary apocarpous ovary produces the fruits. Because each carpel is separated from the others in the apocarpous ovary, it develops into a fruitlet. These fruits produce a cluster of fruitlets known as etaerio.

Follicle etaerio: A follicle is a fruit or etaerio. Calotropis, Catharanthus, and Magnolia -e are some examples. Calotropis occurs when the stigma is fused or joined in the carpellary ovary and the ovules' ovaries are separated. In etaerio, there are only two follicles.

Achene etaerio: Each fruit in this aggregate fruit is achene. For example, Ranunculus, Strawberry, Rose, etc. The thalamus becomes spongy in the lotus, and some achenes become embedded in it. The thalamus in strawberries is fleshy, with small achenes on its surface.

Berrie's etaerio is a grouping of tiny berries. Polyalthia, Custard-apple, etc. All of the berries in Annona's etaerio are arranged densely on the thalamus.

Drupe etaerio: Many small drupes develop from different carpels in this type of fruit like raspberry. The drupe fruit is formed by the carpel of an apocarpous ovary.

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Composite fruit

False fruits are all composite fruits. In general, many ovaries and other floral parts combine to form the fruit in these fruits. There are two kinds of these:

Sorosis: These fruits form from the spike, spadix, or catkin inflorescence. Examples include Jackfruit and Kevda (screwpine). Pistillate flowers develop around the peduncle of jackfruit (Kathal). The pericarp becomes spongy and fused during fruit formation.

Sycosis: The hypanthium inflorescence produces these fruits. The receptacle hollows out and develops a pore. The orifice is surrounded by a swarm of microscopic scales. For example, the Ficus species Peepal.

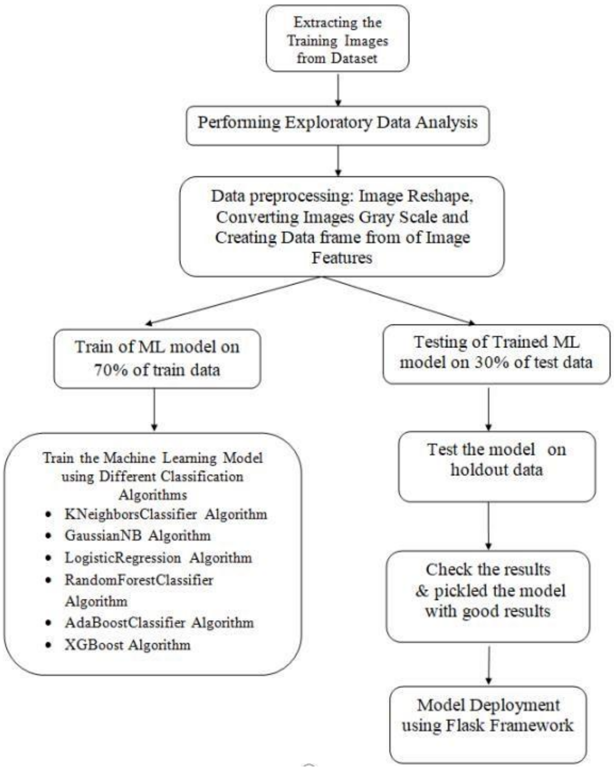

Fig1: Application Workflow

IV. CONCLUSION

In this paper, a review was presented for fruit prediction and estimation studies as well as their applied multiple algorithms. Discussed the challenges and countermeasures of fruits prediction based on the classification model. Here we have different fruit images to classify them using algorithms such as KNN, random forest, Naïve Bayes algorithms etc. After studying all the algorithm KNN algorithm gives highest recognition accuracy it will be used to predict the fruit and result indicates about diseases and vitamins for healthy life. More features may be considered in future work, and an attempt has been to apply deep learning techniques on the fruit images.

V. FUTURE SCOPE

A few organizations like Amazon and some large-scale farms have been able to see the value of including machine learning to aid in their daily operations. This application has shown many benefits to them and helped them reduce cost and increase efficiency, however, there is still more that can be done. Computer vision experts at Amazon are still doing research into how this system can be improved to predict when a fruit is going to go bad and to tell if a fruit would be sweet. This would require much more data and computation power, the like that provided by Amazon with the Amazon Web Services (AWS). In conclusion, Fruit classification is important research are that should be looked into and have more research and development resources because its development and improvement can have a far-reaching effect on agriculture and the quality of fruits provided at markets and retail stores.

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REFERENCES

[1] A. Nosseir and S. E. Ashraf Ahmed, "Automatic classification for fruits' types and identification of rotten ones using k-NN and SVM," Int. J. online Biomed. Eng., vol. 15, no. 3, pp. 47–61, 2019, doi: 10.3991/ijoe.v15i03.9832.

[2] S. K. Behera, A. K. Rath, A. Mahapatra, and P. K. Sethy, "Identification, classification & grading of fruits using machine learning & computer intelligence: a review," J. Ambient Intell. Humaniz. Comput., no. Kondo 2010, 2020, doi: 10.1007/s12652-020-01865-8.

[3] C. C. Patel and V. K. Chaudhari, Comparative Analysis of Fruit Categorization Using Different Classifiers. Springer Singapore.

[4] S. Sakib and Z. Ashrafi, "Implementation of Fruits Recognition Classifier using Convolutional Neural Network Algorithm for Observation of Accuracies for Various Hidden Layers," pp. 8–11, 1980.

[5] H. M. Zawbaa, M. Hazman, M. Abbass, and A. E. Hassanien, "Automatic fruit classification using random forest algorithm," pp. 164–168, 2014. Journal of University of Shanghai for Science and Technology ISSN: 1007-6735 Volume 22, Issue 12, December - 2020 Page-1354

[6] A. Rocha, D. C. Hauagge, J. Wainer, and S. Goldenstein, "Automatic fruit and vegetable classification from images," vol. 70, pp. 96–104, 2010, doi: 10.1016/j.compag.2009.09.002.

[7] S. P. Deenan and J. Satheeshkumar, "A Study on Image Processing Methods for Fruit Classification A Study on Image Processing Methods for Fruit," no. December 2012, 2016.

[8] "RECOGNITION ALGORITHMS FOR DETECTION OF APPLE FRUIT IN AN ORCHARD FOR EARLY YIELD PREDICTION "Rong Zhou .

[9] C. Pl, DEFECT IDENTIFICATION IN THE FRUIT APPLE USING K-MEANS COLOR IMAGE SEGMENTATION ALGORITHM," no. August 2017, 2019, doi: 10.26483/ijarcs.v8i8.4735.

[10] J. P. Mercol, J. Gambini, and J. M. Santos, "Automatic classification of oranges using image processing and data mining techniques," XIV Congr. Argentino Ciencias la Comput. XIV Argentine Congr. Comput. Sci. (CACIC 2008), pp. 1–12, 2008.