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Automated System for Detection of Apple Purity and Its Grading

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Abstract: **-** It is always a common problem for all the people to identify the purity of all the fruits that has been purchased from the 'fruit mandi' or local fruit stores. In this paper we would like to propose an idea for identifying the purity of apples. At present, among all the apples that are being sold in a shop, only few samples are collected and tested for purity in the laboratories by food Corporation of INDIA (FOI), which might not ensure that all the apples being sold in that respective shop/market are pure. In this paper we are proposing a device which can sense if the chosen apple is pure or not and which can be used by all the common people who are purchasing fruits from the market. Through this infections and disorders caused by fruits consumption can be eradicated to some extent.

Keyword: **-** *Data Mining, Image Processing, Computer Vision, Data Mining Techniques, USDA, WEKA Machine Learning Tool, multilayered perceptron-neural networks, Fisher's linear discriminant analysis.*

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1. INTRODUCTION

In this generation each and every one are health conscious, which has increased the quality awareness among the consumers of food products. Quality assessment of fruits and vegetable is done based on the analysis of exterior features like color, size, shape, texture and damages on the outer skin of the fruit. As consumers are mostly influenced to choose or reject a particular fruit only by its color (not by inner chemical composition), it is the most common attribute for accessing the quality of fruits which is proved wrong most of the times. The traditional labor, intensive manual inspection process which is subjective in nature is gradually being replaced by computer vision techniques.

The application of computer vision techniques in the field of agriculture has recently increased a lot in these years due to the fact that it gives accurate and required amount of information about the nature (climate changes, weather conditions, etc.) and helps in analyzing the good agricultural practices over that area. It also analyses if the food product is good or not according to the climate condition of that region. Some of the technologies involved in computer vision techniques are: big data analysis, data mining, image acquisition, image processing and image interpretation. These are some of the techniques which helps us in evaluation of quality characteristics of agricultural and food products.

There are so many papers explaining these techniques in the field of automatic inspection in fruits and vegetables [1].

All over the world there are so many varieties of apples with different nutritional values and different chemical properties. Apple exhibits variety of defects and high natural variability of the skin color. Apples undergo skin disorders mainly due to environmental stress and mechanical packing. Apples are spoilt internally due to over ripening, mechanical injuries and exposure to atmospheric oxygen. Apples get defected only when there are not preserved and stored properly.

Sometimes apples look good because of their outer coating but will be spoilt inside. So to fix this problem we are not only evaluating an apple from outer appearance, but also evaluating an apple by its inner chemical composition using scanning and image processing techniques.

2. LITERATURE REVIEW

2.1 Papers **review**

In the recent years a lot of proposals have been raised in the field of automated system for classifying the fruits and vegetables based on purity. All the papers which has been proposed have commonly spoken about the identification of fruits based on external testing of the fruit (i.e.., by color changes and skin disorders).

A method for apple defect detection and quality classification using multilayered perceptron-neural networks has been proposed by Unay [2], in which he analyzed the quality of fruits by taking color, texture and wavelet features of outer skin of the fruits by performing some tests on single-layer and multilayer perceptron. Mainly he focused on the defects of a few selected varieties of apple.

An apple grading system depending on the external features has been proposed by V. Leemans [3]. He employed six major steps for detection, those are: image acquisition; color classification; defect segmentation;

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calyx and stem reorganization; defect characterization and lastly fruit classification according its quality. The techniques used by him for analyzing are: Fisher's linear discriminant analysis; correlation pattern recognition and neural networking techniques.

K.Vijaya Rekha [4] employed multispectral imaging techniques for analyzing the quality of apple, which works with the images of object in several bands of visual and infrared regions of electromagnetic spectrum. The techniques used by her are: image processing; image segmentation and multivariate image analysis. This system classified the defects of so many varieties of apple.

2.2. Common demerits of listed papers

All the papers listed above were mainly focusing on the external features and defects of fruits which might not yield accurate results because fruits might be good by external appearance but spoilt in the fleshy or edible matter. And also they have not been analyzing the validity of fruits. The above proposed systems either refer to the automated classification of fruits or automated detection of defects and disorders of fruits, but not both.

3. Materials And Methods

In the proposed model for automated system for apple purity and grading, some of the current computer vision technologies are used like data mining; image processing and some other scanning techniques.

Proposed model basically consists of four steps: data collection; data analyzing and modeling; outer skin coat scanning and inner needle injector scanning.

3.1. Current Technologies Used

Data mining – It is a field of intersection of computer science and statistics, used to discover patterns in the huge information. The main aim of data mining process is to extract the useful data and mold it into an understandable structure for future use. There are different process and techniques used to carry out data mining successfully [5].

Image processing – It is processing of images using mathematical operations by using any form of signal processing for which the input is an image, a series of images, or a video; the output of image processing may be either an image or set of characteristics or parameters related to the image.

Most image processing techniques involve treating the image as a two-dimensional signal and applying standard signal- processing techniques to it [6].

3.2. Basic Steps of Proposed Model

3.2.1 Data collection

At the beginning, we will collect all the information related to apples such as varieties of apples and their color textures; types of skin disorders of apple and their skin textures; chemical present in different varieties of apples and its nutritional values; valid period of varieties of apples according to storage conditions; types of coating done on apples; pesticides used for cultivation of apples; attributes of unaffected apple (fresh apple directly from tree), such as color, shape, size, weight etc. and lastly all the respective images. Some of the data collected of various types of fruits and its storage conditions according to climate are depicted in table 1.

Table-1: Data of few varieties of apple and its storage condition [7]

Name	Eating fresh	Storage
 Gala	Very good	Must refrigerate; even then only keeps for a few weeks
 Lodi	X	Must Refrigerate
 Golden Delicious	Very good	Must Refrigerate
 Red Delicious	Very good	Must Refrigerate
 Cameo	Very good	Must Refrigerate
 Granny Smith	X	Must Refrigerate
 Jazz	X	Must refrigerate; even then only keeps for a few weeks
 Sun crisp	X	Must refrigerate; even then only keeps for a few weeks
 Fuji		Very good Great keeper, stores well in garage or basement

3.2.1.1. Nutritional and chemical composition

According to the USDA Nutrient and chemical Database, 100 g of apple contains the following values:

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- 13.8 g Carb
- 2.4 g Fiber (10% RDI)
- 0.2 g Fat (nag)
- 0.3 g Protein (1% RDI)
- 54 IU Vitamin A (1% RDI)
- 4.6 mg Vitamin C (8% RDI)
- 0.2 mg Vitamin E (1% RDI)
- 2.2 mg Vitamin K (3% RDI)
- Thiamin (1% RDI)
- Riboflavin (2% RDI)
- Vitamin B6 (2% RDI)
- 3 mg Folate (1% RDI)
- mg Pantothenic Acid (1% RDI)
- 6mg Calcium (1% RDI)
- mg Iron (1% RDI)
- 5 mg Magnesium (1% RDI)
- 11 mg Phosphorous (1% RDI)
- 107 mg Potassium (3% RDI)
- Copper (1% RDI)
- Manganese (2% RDI)

If any apple is detected containing chemical other than the listed chemicals, then that apple may not be pure.

Apples are coated with vegetable wax for longer preservation. This coating must be very thin and edible. Over coating of wax on an apple makes it dehydrate from inside and lose the pulpiness of the fruit. The most common wax used on apples is vegetable wax called 'Canauba' wax or 'shellac'.

During apple cultivation only a few suggested pesticides must be used namely, 'Chlorpyrifos', 'Diphenylamine' and

'Captan'. If any apple is detected containing wax and pesticides other than the listed then that apple may not be pure.

3.2.1.2. Physiological disorders of an Apple

Scald, Bitter pit and Internal Browning are some common disorders which occurs in apple. Scald is favored by hot dry weather before harvest, high and poor ventilation in storage rooms or in packaging. Bitter pit occurs during storage and is characterized by small sunken spots on the fruit surface. Internal browning is characterized by brown discoloration in the flesh usually originated in or near the core.

All the images of the apples affected from different skin disorders are taken and recorded for identification of pure apple by scanning and image processing techniques.

3.2.2. Data analyzing and modeling

We will group all the data and attributes of apples that are collected and we design a model based on this data and attributed by data-warehousing and data mining techniques in editors like WEKA, MATLAB etc.

After the model has been designed we test it for few sample data available with us and later we test it for big data.

3.2.3. Scanning and image processing of apple

We propose a system that takes an apple as an input, firstly extracts all the outer coat details of apple using various sensors which are connected to the system. The system classifies that the given substance is apple or not. If this substance is detected as apple by the system then it proceeds for next step else it sends a suitable message to the user. Once the system detects that the given substance is an apple then it captures the image of the apple using charge coupled device (CCD) camera. Later it processes the information and checks if any extra coating is applied on apple except wax and pesticides except Chlorpyrifos; Diphenylamine and Captan. And also checks for the different types of skin disorders of apple. If the inputted apple is detected that it contains extra coating other than the listed coatings or if it detects any skin disorder, then it sends the message to the user that the apple is unhealthy due to respective reasons or else it jumps to the next step, that is chemical needle injector detection, in which a needle is injected into an apple which has a certain mechanism to find out all the chemicals present inside. If the system detects that the apple contains any harmful chemicals or the chemicals that are not listed in data modelling system then it sends a message to the user that the apple is spoilt or else it sends the message to the user that the apple is

Pure and tells its purity level.

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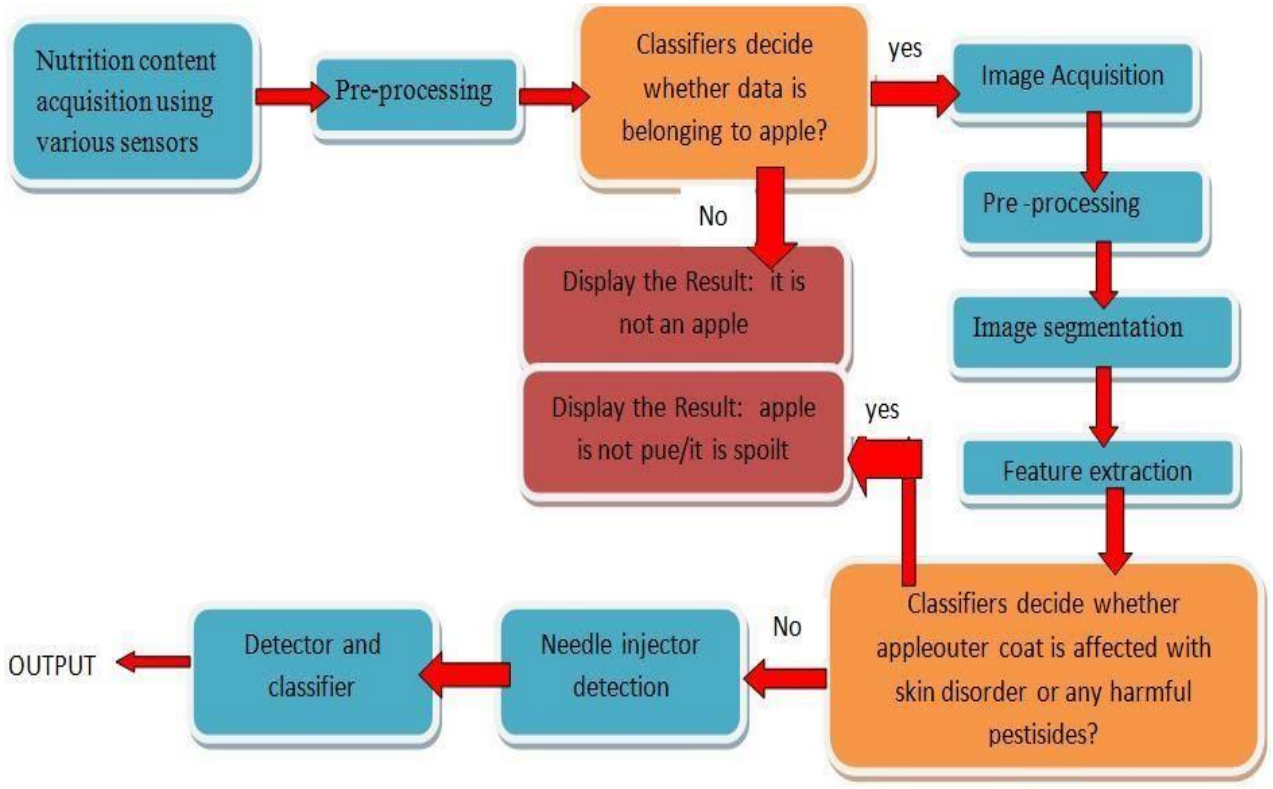

3.1 System architecture

4. CONCLUSION

Proposed system aims to identify the purity of apples and classify them according to their nutritional values and to find that apple is edible or not by detecting both external and internal features of apple by various techniques to ensure the accuracy in automatic detection of purity of apple. Since the proposed system can be used by common people, it helps them to choose a good quality apples and avoid purchasing contaminated ones. This method can also be applicable for various other fruits and vegetables.

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