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# CARDAMOM GRADING USING MACHINE LEARNING

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**Abstract**—Cardamom grading is a vital agricultural product processing industry which always seeks for better methods of mechanization. Sorting is the process of segregating cardamom based on its size using sieve of required sieve size. Grading is the process of assigning grades and thus categorizing cardamom to different shipment qualities. Machine learning techniques like k-NN, Decision tree and combined with image processing can be used as a platform to the purpose of grading. The applications of machine learning can be divided into two major areas classification and clustering. In classification there is a list of labels as the target set available, and the goal is to map to any of these labels in the set. The aim is to distribute data into different groups.
**Keywords**—cardamom; grading; image processing; k-NN

## I. INTRODUCTION

Agricultural product sorting and grading is a key sector in the field of agriculture that need time and immense care. Cardamom (Elettaria cardamomum Maton) is such an important spice which needs much time and care in sorting and grading. Sorting is the process of segregating cardamom based on its size using sieve of required sieve size. Grading is the process of assigning grades and thus categorizing cardamom to different shipment qualities. Grading is based on external features like color, pod finishing, insect attack etc, which is as of now done manually. For addressing this problem various machine learning algorithms like kNN, Decision Tree etc. combined with image processing can be used. The advantage in using machine learning is that the precision in answering improvises with each learning process.

## II. FIELDS INVOLVED

### A. Image processing

An image is a form of art that depicts or records our visualperception. Image can usually be represented as a matrix or array. A normal greyscale image has 8 bit color depth i.e., 256 grayscales. A "true color" has 24 bit color depth i.e., 8 x 8 x8 bits = 256 x 256 x 256 colours = ~16 million colours.Image processing can be divided into optical, digital and analog. Here in this paper the concern is digital image processing.Graphics and Computer Vision are closely related to image processing.

### B. Machine Learning

Machine learning can as simply be said as machine inhibiting the human behavior of learning that is improvising through experiences. This learning process is performed with the aid of certain special algorithms known as machine learning algorithms. Presently there are many such algorithms in existence namely k-Nearest Neighbour, Support Vector Machine, Decision Tree, Case Based Reasoning etc. The applications of machine learning can be divided into two major areas classification and clustering.


 

Classification is a supervised learning process where there is a predefined label for an instance whereas clustering is an unsupervised or unguided machine learning process where there are no predefined labels available. In classification there is a list of labels as the target set available, and the goal is to map to any of these labels in the set. In clustering the aim is to distribute data into k different groups such that data points similar to each other are in the same group. Similarity between data points is defined in terms of some distance metric. The criteria for dividing into clusters, the number of clusters etc are not at all predefined. Examples for classification is classifying proteins according to their function, pattern categorization etc.

## III. PROBLEM STATEMENT

The objective is to grade the cardamom based on its external characteristics. The algorithm that is used to implement is machine learning algorithm. This algorithm is combined with image processing. The proposed system considers the attributes of the cardamom seed like pod size, Pod color, Pod finishing, Pod volume, Pod shape. The grading can enhance the grading efficiency and precision.

Fig 1: Green cardamom image

Fig 2: Infected cardamom image

## IV. LITERATURE SURVEY

A computer machine vision system that can be used for automatic high-speed fruit sorting and grading was proposed by Yogitha .S et. al. The objective of the project was to develop the advanced quality control inspection system that makes use of distributed network architecture to interface the camera unit to a computer system through GigE LAN environment in a flexible way. Crop disease detection using machine learning was introduced by Anuradha Badage.The proposed system provides the solution for regularly monitoring the cultivated area and provides the automated disease detection using remote sensing images. The proposed system intimates the agriculturist about the crop diseases to take further actions. The objective of the proposed system is to early detection of diseases as soon as it starts spreading on the outer layer of the leaves. The proposed system works in two phases: the first phase deals with training data sets. This includes, training both healthy and as well as diseased data sets. The second phase deals with monitoring the crop and identifying the disease using Canny's edge detection algorithm.


 

An Artificial Neural Network (ANN) model was developed in order to classify varieties belonging to grain species. Varieties of bread wheat, durum wheat, barley, oat and triticale were utilized. 11 physical properties of grains were determined for these varieties as follows: thousand kernel weight, geometric mean diameter, sphericity, kernel volume, surface area, bulk density, true density, porosity and colour parameters. It was found that these properties had been statistically significant for the varieties. An Artificial Neural Network was developed for classifying varieties.

Cotton leaf diseases shows visual symptoms on it leaves. Image processing can give solution to detect the diseases on the basis of their visual symptoms. The diseases like Bacterial blight, White fly and Curl Gemini are affecting the crop from early stage of cultivation. It reduces the production and quality of product drastically.The system proposed is developed on Raspberry pi module. Raspberry pi is powerful credit card sized single board computer can be used for many applications. It is the popular board format for small dedicated applications.

## V. EXISTING SYSTEM

Cardamom, biologically named as Elettaria cardamomum Maton is basically the native of India. It is a spice known for its flavour in various native and continental dishes. It is an indigenous ingredient in many ayurvedic medicines right through the ages. The processing of cardamom undergoes different stages ofprocedures namely cleaning, washing, drying, sorting, grading and packing. In the current working scenario, as per a survey conducted, cardamom grading is performed completely manually. The small cardamom is transported from the fields to thegrading centers in other states where it is cleaned, sorted and graded. Simple and small scale machinery is used for sorting purpose. The traditional handpicking method is used to realize this problem in most places. Sieves of different pore sizes are used to sort the cardamom based on its size. Such sieves are locally called as "chillada". A full scale semi mechanized form of cardamom sorting is performed only at Spices Board of India, Puttady unit.

There the functional units can be divided to two, a size grading unit and a colorgrading unit. First thecardamom which is preprocessed i.e. washed, cleaned and dried are put into the size grading unit where the cardamoms are passed through an equipment with a specified air blow rate which would segregate loaded cardamoms and vacant cardamoms. Further it's passed to another unit which works with gravitational principle which would segregate stones and dirt from seeds. This is then passed through a tapering mechanism to constantly vibrating sieve blocks. The constant vibration will enhance the sieving mechanism. Sieves are arranged as larger pore sized sieves above smaller ones. There are minimum 4 sieves with pore size 7mm, 6mm, 5mm and 4mm. The outputs from different sieves are collected in sacks through different outlets. These sacks are fed manually to a color sorting unit which resembles a huge Xerox machine. In the color sorter there is a one at a time mapping i.e., a single cardamom is sorted out at atime. The intensity of colors can be manually adjusted.

## VI. PROPOSED SYSTEM

The simple working of the proposed system can be shown in the figure. The cardamom images are collected and are processed. The features are extracted using image processing. These are features are compared with the datasets. The features include size, color, weight, appearance. The KNN algorithm is used to build the model using which the final grading is obtained.The K-nearest neighbors (KNN) algorithm is a simple, easy-to-implement supervised machine learning algorithm that can be used to solve classification problems. It is a supervised machine learning algorithm, which relies on labeled input data to learn a function that produces an appropriate output when given a new unlabeled data.

**Algorithm:**

Step 1: Collect the sample cardamom data – images.
Step 2: Apply image processing to extract the features. Features of cardamom include edge detection, size.
Step 3: Features are to be stored in a feature database/vector. Step 4: Apply KNN or other classification algorithm to build the model.
Step 5: The test samples of cardamom to be graded go through the same processing steps, but use the knowledge from the model to compute the final grading label.

The size, shape, finishing, volume and color of the cardamom seed can the determined using image processing. The input to the proposed system is an image. Our proposed system takes images of a cardamom seed. The image is given to the image processing interface either by wireless or wired means and the feature vector or the needed attributes like color, surface finishing, size, shape etc are extracted.


 

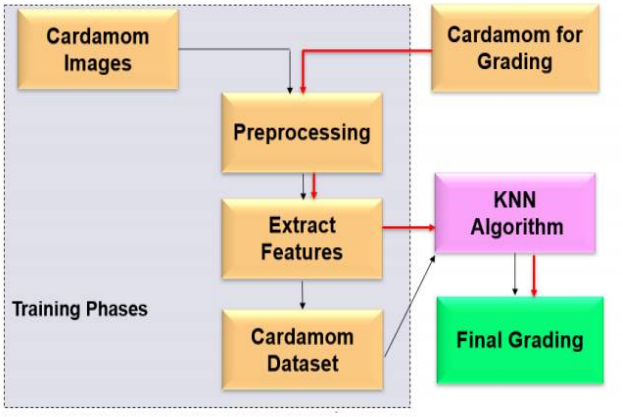


Fig 2: Block diagram for proposed system

The extracted attributes are given as input to the machine learning algorithm which runs in the computer. According to the algorithm the system is already trained by some datasets. When a new input comes, those entries that are of close proximity to the input one are segregated and from them a conclusion is drawn about the grade of the cardamom.

The algorithm that is used to implement machine learning is K-Nearest Neighbor Algorithm. 'K' in KNN Algorithm stands for the number of most similar cases that are considered to draw a conclusion to a real problem. KNN is a Supervised Machine Learning Technique which means that the output is known when the problem is defined and we try to converge to the optimized solution. The accuracy of the process can be further improved by implementing ensemble of different algorithms and using a confusion matrix to deduce the result. Let us take moremachine learning algorithms say decision tree etc along with the conventional k-NN algorithm. The same input will be given to all the algorithms and the output will be concluded as the maximum occurring target value using a confusion matrix.

## VII RESULTS

The input will be the image of the cardamom. The image is compared with the preprocessed images. The features are extracted and using the machine learning algorithm, final grading is done.

## VIII CONCLUSION

The proposed system will be able to grade the given cardamom samples. Manual process is totally eliminated. Cardamoms can be segregated accurately which is often required for export. The algorithm can be embedded into a machine so that cardamoms can be graded on-the-fly. Saves time, human requirements, increases accuracy, etc. This will not give a fully bounded commercial scale implementation level solution to the problem of cardamom grading. Rather the paper gives a simple underlying technique that can be run beneath to grade cardamom. The software and hardware that are employed for this purpose are real time realizable.

## VIII FUTURE ENHANCEMENT

The accuracy of the process can be further improved by implementing ensemble of different algorithms and using a voting mechanism to deduce the result.

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