Implementation of Cardamom Sorting Machine

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Abstract. Cardamom grading is an imperative agricultural invention handing out conscientiousness which continuously seeks for improve methods of mechanization. Categorization the cardamom includes the process of segregating cardamom based on its skin texture such as the husk size, husk identity and peapod colour. Grading includes the procedure of assigning grades and in this way categorizing cardamom to diverse delivery qualities as the cardamom superiority increases with price, therefore it is required to grade the cardamom. Optimization techniques like K means nearest Neighbour algorithm, decision tree are combined with machine vision to find the cardamom colour and can be used for the purpose of grading. The cardamom is compared with the finest elected cardamom for the cataloguing manages and the cardamom is graded based on the colour of the cardamom. The project deals with the design and fabrication of cardamom sorting machine with the help of machine vision and machine learning process.

Keywords: Cardamom grading, K–means algorithm, cardamom colour

1. Introduction

Visual based defect detection is industrial friendly. It is used to detect the different kinds of errors and defects in the industrial product. This error solving visual based defect detector can be used as three thing, which is Quality Control Program, Data Acquisition and Data Analysis. Visual Inspection is uncomplicated and easiest method but the contribution towards industries is ultimately high as this technology recognizes the standard quality of the product. Visual-based defect detection technology enhances the quality and improves the standard of the product and management. Therefore, this type of technology is more preferably used among the industries. To bring out the promising standard quality and uniformity the product must be produced without any defect. Therefore, this visual based defect detection technology is used. There are two modes of visual based defect detection technology, they are manual inspection and automated inspection. Both the inspection has their own merits and demerits toward the manufacturing industry. Human based manual inspection causes errors and defects in identifying the quality of the produce, so proper training is essential to improve the skill of the inspector.

2. Literature Survey

Bailey t, et al (2018) proposed the theory of distance-weighted K nearest neighbour algorithm. In this article, Bailey proposed that when the number of training sample is small, then the distance-weighted rule would yield only a smaller probability of error, than the majority rule. They show the admissibility of the distance-weighted k-nearest neighbour rule by demonstrating that the probability of error, for a particular dataset obtained by the distance-weighted rule is strictly lower than that for majority rule. This approach reduces the distance between the required and the present data set [1].

Sheela S, et al. (2016) proposed the theoretical model for object sorting on conveyor belt. They proposed the low cost automation for object sorting in conveyor belt using Raspberry pi 3 and a USB camera for detecting the colour and size of the objects. They intend to discard the objects which are not in desired colour or the suitable size by pushing them out of the conveyor belt. They are using a linear actuator for discarding the undesirable object out of the conveyor. This method is suitable for conducting sorting operation on the conveyor [2].
J. Kim, (2012) proposed a structured light camera based 3D visual perception and tracking system application with robot arm grasping for manufacturing. The light camera is used to track geometry of an object based on the shape and creating 3D point clouds of the object. The tracked 3D points are then converted to DXF or 3DS format for the computer to read the shape of the object. This method is advanced version of the machine vision to further improve the perception and accuracy of the system [3].

Tanishka Singh, et al., (2016) proposed a method for object sorting by Robotic arm using image processing techniques. They proposed to use high resolution camera to capture the image of an object. By doing so the images can be used for reading shape and structure of the object and performing the operations accordingly. This proposed concept is simple. The robot arm can be used to separate and this can be used in quality checking and control [4].

A. Gowen, C.P., et al., (2017) proposed an efficient method for food quality and safety control using hyperspectral imaging of the food particles. They provided an introduction for hyperspectral imaging of food using image processing and image acquisition. This proposed method can be used to analyse the food particle such as its nutrients to estimate the date for the food expiry identification in the food processing industry. A simple approach is followed in agriculture to find the defective product [5].

2.1 Problem Description

In agriculture, immense care and time should be taken for sorting and grading which are the basic key sectors. Sorting is nothing but segregating a particle based on size using sieve of required sieve size. Grading is process of assigning grades and categorizing in different qualities. Grading is based on external appearance. Cardamom which is one of the important spices in Indian food takes much time in sorting and grading. It is sorted based on the size and it is graded with its external appearance.

2.2 Solution of the Problem

To overcome this difficulty various machine learning algorithm combined with image processing is used. The advantage by using this machine learning is precession in answering improvises with each learning procession.

3. Machine Vision

Machine vision is the technology and method used to provide imaging based automatic inspection to learn about the physical characteristic of the process. The process includes converting the real time analog signal to digital format so that the computer can process data from the given object.
Figure 1. Machine vision in inspection system

The figure 1 shows implementation of the machine vision in the process of inspection in industrial application. The image obtained from the camera acts as input, the captured image is enhanced for processing and the image analysis is done find out whether the product is defective or not.

4. Working Process

The entire working process is shown in the flow chart figure 2. The each and individual steps will be explained in the following pages.

4.1 Initializing

Prior to taking care of the cardamom to the container, the associations are checked and the physical dependability of the surface is checked. Presently the switch is turned on, which thus gives flexibly to the principle engine of the transport. Presently the cardamom is taken care of into the container. If it's not too much trouble guarantee that the container isn't flooding with the cardamom, feed for the most extreme holding ability to lessen sticking of the cardamom.

4.2 Sensor input

When the transport begins moving the cardamom took care of to the container tumbles to the outside of the transport. Presently the transport pushes forward and the cardamom is isolated and sent independently by the plan of the transport. At the point when the cardamom interacts with the light of TCS230 the shade of the cardamom is found. Subsequent to finding the shade of the cardamom the sensor imparts the sign to the microcontroller in the computerized design which is prepared to peruse by the regulator.

4.3 Decision making

At the point when the cardamom interacts with the sensor, the choice must be made. In first case if the cardamom is acceptable, the regulator detects it and doesn't do anything. Then again, if the nature of the cardamom is awful, a 12V straight actuator is utilized to jump out the cardamom from the line. This choice is significant as it straightforwardly influences the arranging cycle and thus this cycle is considered as the fundamental factor in arranging the cardamom.
4.4 Timing
Exactly when the cardamom collaborates with the sensor, the decision must be made. In first case if the cardamom is worthy, the controller identifies it and doesn't do anything. On the other hand, if the idea of the cardamom is dreadful, a 12V direct actuator is used to leap out the cardamom from the line. This decision is noteworthy as it direct impacts the masterminding cycle and consequently this cycle is considered as the essential factor in orchestrating the cardamom.

4.5 Display
Show unit is LCD screen; which is utilized to show the RGB estimations of the current cardamom. By showing we can examine with the hypothetical outcomes whether the test results are the equivalent. The Typical showing of the values are around 20's. However, the showed qualities can be roughly the real qualities along these lines, the genuine qualities will be near + or – 5 of the real qualities.
4.6 Separation of cardamom

After the sign from the sensor arrives at the direct actuator, the actuator pushes ahead which thus pushes the awful cardamom out of the line. The awful cardamom can be gathered from the different zone while the great quality cardamom is permitted to move in the line. the dismissal system relies on the measure of awful quality cardamom in the transport line. In the event that there is all the more terrible cardamom, at that point the proportion of creation to dismissal will be low. Under ordinary conditions the dismissal proportion will be 5:1, where the measure of the terrible cardamom will be 20 percent of the delivered sum. The isolated cardamom can again be sent to the transport for partition however with the diverse dismissal esteems set. Again, the dismissal is legitimately needy upon the pre-set RGB estimations of the cardamom.

4.7 Testing environment

Before testing the right condition must be set to get the strong qualities and the same about qualities ought to be consistent, as the dismissal system is relying on the steady shading qualities, nature with consistent lighting must be set. Theshading esteems are in a roundabout way identified with the surrounding lighting henceforth the room ought to consistently be kept up with steady light source.

4.8 Steps Involved in KNN Algorithm

K Nearest Neighbour is a supervisor machine learning algorithm used to solve regression problems

1. Find the number of nearest number needed(k)
2. Distance between Labelled and Unlabelled new data should be calculated
3. Based on the shortest distance and K-Neighbour the labelled data should be used.
4. Compare the new data with labelled data
5. The new data should be categorized under any one of the labelled data

5. Product Design

The detailed 2D design of the entire cardamom sorting machine is shown in figure 3. The colour sorting cardamom machine separates the cardamom based on the colour of the cardamom. The product has a conveyor which moves the cardamom for sensing colour and sorting. A colour sensor or a high resolution camera is used to take multiple images of the cardamom, the images are read by the microcontroller computer like raspberry pi. This product uses a machine learning algorithm like KNN algorithm to check the multiple images taken. The colour code values after checking the image will act as a source of input to the controller. After finding out the colour of the cardamom, the controller acts immediately. A 12V dc linear actuator is used to pop out the poor quality cardamom. The separated cardamom can again be sent to the queue separately for second quality sorting. Now the colour values should be adjusted based on the cardamom that have been rejected.

![Figure 3. Detailed 2D design](image)
The Design is done using AutoCAD software and is labelled in paint software. The detailed dimension in mm are shown in figure 4 and figure 5.

Figure 4. Top view

Figure 5 shows the front view design of the project. The height of the frame is 250mm and the hopper is tapered to 40 degrees. The hopper has the box pipe installed at the end and the dimension of the pipe is 25x25mm.

Figure 5. Front view

6. Conclusion

In the areas where cardamom plantation is carried out after the long drying process this cardamom sorting machine can be applicable. Sorting of the cardamom according to color and storing separately helps in fixing high price for the green colored good quality seeds and the brown colored faded cardamom. By using this type of method the owners will be highly profitable comparatively. Visual inspection of the cardamom is done using the KNN Algorithm and simulated. The experimental values may vary depending upon the ambient lighting of the surrounding.

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