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Automated Quality Based Onion Sorting Mechanism Using Raspberry pi

Rameshwar B Mhaske[1], Ankit G Mankar[1] and Dr. Syed Sumera Ali[2]*

[1]B.Tech in Electronics and Telecommunication Engineering, CSMSS, Chh.Shahu College of Engineering, Aurangabad, Maharashtra, India

[2]Associate Professor, Electronics and Computer Engineering, CSMSS, Chh.Shahu College of Engineering, Aurangabad, Maharashtra, India

***Corresponding Author:** Dr. Syed Sumera Ali, Associate Professor, Electronics and Computer Engineering, CSMSS, Chh.Shahu College of Engineering, Aurangabad, Maharashtra, India. syed.sumera.ali@gmail.com.

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Abstract

The process of sorting onions systematically is called onion sorting. Manual onion sorting is preferred at the wholesale market and in the farming, sector based on different parameters such as size, shape, quality, etc. It is not however a more efficient, consistent, and time-consuming method. In the market, there are systems that can sort single onions based on a single set of parameters. To replace this traditional way of sorting onions, In this paper we are introducing "Automatic Quality Based Onion Sorting Mechanism Using Raspberry pi". The proposed system combines an automatic onion sorting mechanism with an image processing technique and classification algorithm. E.g., quality-based analysis. This machine can be used for agricultural purposes, and it can also be employed in the food industry.

Keywords: Automatic; Quality; algorithm; image processing; sorting

Introduction

An automatic system for onion sorting is required to improve quality and production efficiency while reducing labour intensity. For the detection of fruits, different technologies are present, and out of those, image processing techniques are more efficient. Quality of fruit, colour, size, and so on are no longer possible to sort on the same line in today's world. To overcome this problem; the proposed system was designed. The system is integrated with mechanical assembly and embedded devices like the single-board computer Raspberry Pi. Traditional quality inspection method is time consuming & less efficient for sorting the food products. The manual sorting and grading are based on traditional visual quality inspection performed by human operators, which is tedious, time-consuming, slow, and non-consistent. Traditionally, harvesting is done through manual sensory observations. The quality attributes often used for deciding on the harvest's maturity are colour, appearance, texture, and odour. A first and important step in the post-harvest chain is the sorting of harvested produce. Commercially, human senses are employed to sort.

Francis found that human perception could easily be fooled. It is pertinent to explore the possibilities of adopting faster systems, which will save time and be more accurate in the sorting and grading of agricultural and food products. Computer Vision automated system used for sorting & grading which is reliable This paper reviews the progress of computer vision in agricultural and food processing. Using computer vision techniques, you can achieve cost-effective, consistent, fast, and accurate sorting. The processing and manufacturing sectors require automated inspection as well as grading systems so that losses incurred during harvesting, production, and marketing can be minimized. Assisted sorting onions is accomplished based on appearance, texture, colour, shape, and size.

Literature Survey

Anuja Bhargava et al., in his paper, highlight the use of image processing in the fields of food industry and agriculture. The author has utilised the different colour-based feature extractions; still, one may explore the combinations or other spaces to improve the performance. It can also be concluded from the work carried out in this paper that one can include images from different regions to make the system bias-free. In this paper, the authors present a methodology for modelling the sorting machine that they adopt and extend to evaluate and model other types of sensors that could be applicable to the sustainable sorting of different objects. The capacitive sensor are more widely used for sorting purpose.

"Automatic sorting machine using delta PLC" by Babita Nanda, In this paper they talk about that all these process is controlled and handled by PLC. Automating every sector of industry is an important step towards increasing efficiency and reducing human related errors, here they try to automate the sorting process by using Raspberry pi.

Image Acquisition

Onions on the conveyor belts are conveyed one by one by the transport roller as per the quantity fixed by the user. Horizontal gates cause them to appear in a line, which the camera captures. The camera is positioned in such a way that the entire onion can be seen and analysed by the system. Images are analysed using YOLOv5, TensorFlow, and other software avis servo motor is operated automatically.

Onion

System is identifying Damaged and undamaged onions. Damaged onion part visible from the outside. Hence, the algorithm developed looks for minima in the projection histogram, which correspond to the onion limits along the abscissa axis. Once onion is delimited along the abscissa axis, we can check for joint onion based on their size and location with respect to the rollers.

Color Processing

We have chosen the RGB representation, mainly because the camera provides images in this representation, although data is further processed and transformed in format to simplify its Both the image and the data have retained their interpretation. Image analysis begins with colour segmentation by means of a look-up table (LUT).

Although the illumination is controlled, changes in the illumination level at different points on the fruit surface arise from the geometry of the light reaching the imaging device. The highlights on the fruits surface can be avoid as observed in segmentation step. We need to use either some colour representation regardless of the illuminance or any other representation that allows us to identify and characterize them. We adopted a scheme based on characterizing the highlights using a spherical coordinate representation of RGB space, assuming the dichromatic reflection model. The user can either define clusters in this chromatic space or perform a clustering algorithm on a sample image, providing the number of colour clusters. In this case, the clustering is done in the RGB space using a C-means algorithm. In systems with colour and cameras, the intensity limits of the first colour are used to segment the image into pixels of class "Damaged" and "Undamaged." After that, only the pixels in the class onion have to be classified by colour. The resulting segmented or labeled image does not differ in concept from a labeled image computed only from the colour information, and it is used to locate the onions as explained in the previous subsection.

Size Estimation

Size parameters for onions are usually given in terms of their maximum, minimum, or medium diameters. To calculate the maximum and minimum diameters of a onion, they are approximated by the maximum diameters projected on the principal axes of the onion image. The principal axes are the axes of maximum and minimum moments of inertia of the onion outline.

This method works for almost-round onion as well as for elongated onions like pears, regardless of their position. The size in pixel units One of the objectives in the segmentation step is to avoid the problems caused by highlights on the fruit surface. is transformed to millimeters through the calibration factors worked out in the calibration phase during the system configuration.

Size and Color Classification

Once the onion is simulated and located in the image. The area of each color label defined by the user is calculated on the onion surface, and the ratios of every color label concerning the total area of the onion are calculated.

The information for each onion is stored, and after processing up to four views for every onion, a decision about its class is worked out and sent to the control unit via the CAN interface. To discard surface areas of the onion that may have been regarded twice or more times, repeated views of the same surface patch are estimated by estimating the rotation undergone for each fruit. The repeated area of the surface of the onion is calculated by modeling the onion as a sphere and taking its radius as the transversal radius calculated from the onion image. Knowing the translation suffered by the conveyor from image to image, the angle rotated by the fruit concerning the previous view can be estimated. To classify each onion into the classes defined by the user, some classification rules are applied that are derived from an approximation of the classification rules provided by a binary decision tree. The decision tree uses the ratios of colors.

Results and Discussions

Normally onions are sorted manually in India. Manual sorting is time-consuming, inefficient, and costly. Conclusions the designed automatic sorting matching based on raspberry pi will be proven a sufficient way of sorting. Based on above- mentioned criteria comparison with manual sorting efficiency will lack. When we compare those to the naked eye. Our proposed method will sort out the defective product based on RGB. We can compare the data gathered from the image acquisition. Red, brown, and green have their light intensity. When we compare those specimens are tested objects thus we can obtain an efficient way of sorting using an image processing technique.

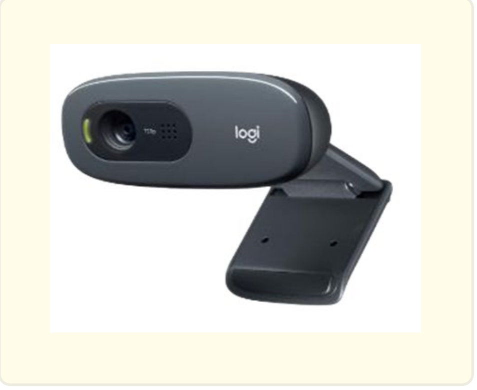
Components specification
Hardware

1. Raspberry Pi-4 (8GB RAM)

2. Servo Motor (MG945)

3. DC Geared Motor (60 RPM)

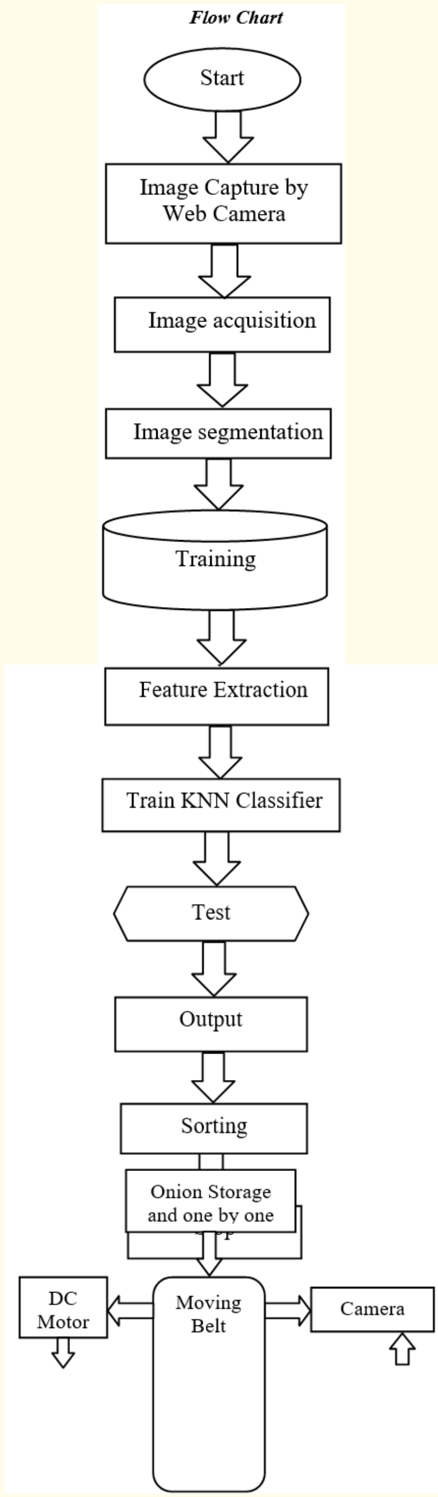
4. Web Camera

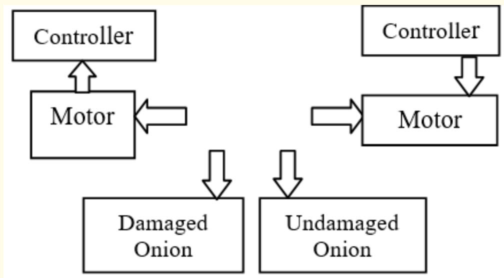


Software

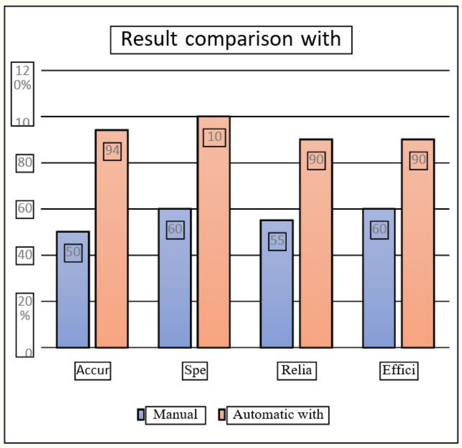
Python IDE (Version 3.10.0).
Raspberry Pi OS (32 bit).
TensorFlow (v2.11.0).
YOLO (Version 5).

Figures and Tables





Result in tabular form with parameters



Hyper-parameter	***Value***
Input Image Shape	(224,244,3)
Kernel Size	(3,3)
Pool Size	(2,2)
Drop Out Rate	0.25
Activation Function	(RoLU) & SoftMax
Batch Normalization	256

Table 1.1

Onion Size	***Average Weight***	***Weight range***	***Diameter (In inches)***
Small	115g	144g or less	1 to 2.25
Medium	170g	144g to 230g	2.25 to 3.25
Large	285g	230g to 345g	3.35 to 4
Extra Large	454g	245g or more	4 to more

Table 1.2

Number of Epochs	*Training Accuracy*	*Testing Accuracy*
Onions (60)	98.75	93.54
Onion (80)	86.80	95.45

Table 1.3

References

1. Moe Win Khaing, Aye Mya Win and Daw Thida Aye. "Automatic Sorting Machine". International Journal of Science and Engineering Applications 7.8 (2018): 138-142.
2. Shreeya Vasant Kulkarni, Swati Rajendra Bhosale and Priyanka Pramod Bandewar. "Automatic Box Sorting Machine". International Journal for Scientific Research & Development 4.4 (2016): 57-58.
3. Yoshito Nagaoka., et al. "Automaic Mackeral Sorting Machine Using Global and Local Features". IEEE Access 7 (2019): 63767-63777.
4. Yunhan Lin., et al. "Automatic sorting system for industrial robot with 3D visual perception and natural language interaction". Measurement and Control 52.1-2 (2019): 100-115.
5. Masao Sugiyama. "Automatic Sheet Sorting Machine". Japan Tappi Journal 52.1 (1998): 88-93.
6. Xian Ke Ren., et al. "Automatic Sorting Machine for Cylinder Length". Advanced Materials Research 706-708 (2013): 1222-1225.
7. Syed Sumera Ershad Ali and Sayyad Ajij D. "Whale Optimized MLP NeuralNetwork And Enhanced Region Growing for Food Product Inspection". International Journal of Advanced Science and Technology (IJAST) (2020).
8. Syed Sumera Ershad Ali and Sayyad Ajij D. "An Efficient Quality Inspection of Food Products Using Neural Network Classification". Journal of Intelligent System (2019).
9. Syed Sumera Ali and Sayyad Ajij D. "MLP-WOA Neural Network Based Automated Grading of Fruits & Vegetable Quality Detection for Food Industry using Artificial Intelligence Techniques (Computer Vision - Image Recognition)". Applications of Artificial Intelligence in Engineering (2021).
10. Syed Sumera Ali and Sayyad Ajij D. AI-Based Smart Innovation in Food Quality Inspection for Smart City, Smart Innovation, Systems and Technologies 243 (2021).

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