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DESIGN AND FABRICATION OF FRUIT SORTING MACHINE

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ABSTRACT
In day-to-day applications, manpower is required for sorting and packaging of different types of fruits. The objective of our project is to reduce the manpower required and increase the productivity by developing a mechanism for automatic sorting of the fruits. The fruits will be initially loaded in a hopper, then these fruits will be transferred by chain drive to the next station where the image processing sensor will be used for recognizing the types of fruits. Then a sorting mechanism will sort different types of fruits based on signal received from the image processing sensor. The fruits will be further loaded in a different compartment after sorting and then appropriate labelling will be done on the compartments according to their types of fruit. The aim of this project is to also decrease the time taken for sorting of fruits. This project can be modified to include vegetables and other agriculture produced with suitable attachments.

Keywords:
Sorting, Labelling, Image processing sensor, Agriculture produces.

INTRODUCTION

In recent years, fruits (of any variety) have become one of the most dependable organic products produced by farmers across the world; this lived much to its expectation as it serves not only for direct consumption, but also as a raw material for other products. Organic products grading and sorting is a vital procedure for producers, which influences the natural products quality assessment and export market. Despite the fact that the grading and sorting can be and has always been done by human, it is slow, tedious and prone to error, hence the need to evolve a smart fruit grading and sorting machine system. Researchers, at various level had come up with various designs with different algorithms for fruit grading by utilizing textural and morphological elements to distinguish the healthy fruits from the defected ones. Subsequently, these features, otherwise known as optical sorting, is the automated process of sorting solid products using sensors. Such sensors utilize product driven knowledge of the picture preparing system, by detecting the colour of fruits, shape and other auxiliary properties. The sensor (sorter) compares fruits based on client's characterized acknowledgment to distinguish, sort and expel defected fruits and other foreign material from the creation line or to isolate result of various evaluations.

India is an agricultural nation with large agricultural produce. Various types of fruits and vegetables are produced throughout the year. All the agricultural produce has to be sorted and graded, and majority of it is done through manual labor. Manual labor creates various problems like subjective grading, tedious work, inconsistencies, and low productivity. Most of the above problems can be minimized using machine vision. The sorting system used in many foods processing industry sorts using one of the following features like color, shape, weight and size and it requires specific environment for its efficient working. The background color of the conveyer system needs to be of specific color for easy segmentation of the particular fruit from its background, proper lighting, and a high-performance camera. The values for grading must be manually fed into the system prior to the grading process.

OBJECTIVES

The objective of the project is to reduce the manpower required and increase the productivity by developing a mechanism for automatic sorting and packaging of the fruits. The machine will be able to sort different types of fruits according to their shape, size and colour. Existing machines do not have sorting feature for different types of fruits. There is also no provision in existing machines for sorting and packaging of product in a single unit.

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Manual labour for sorting and packaging has to be reduced or eliminated whereby staff can be utilized for other tasks. Time taken for sorting and packaging also should be reduced to increase customer satisfaction.

METHODOLOGY

India produces 44.04 million tons of fruit annually. Several sensors primarily based on optical characteristics at near-infrared levels are used along with the spectroscopic method for grading fruits. Fruits kept in piles and stock houses need more sophisticated robotics manipulators for in-house inspection or other machinery. The reading obtained from sensors or the inline cameras is feed for image processing methods and algorithms for sorting.A system wherein a sensor unit was developed and used to detect and display the complete freshness status of fruit. The basic concept and technologies associated with a computer vision system and automatic based technology used in image analysis.The research work for automated sorting of fruits using pattern recognition technique applied to a single color image of fruit. Four features are used to classify fruits into four classes according to size shape color and maturity.

RESULTS AND DISCUSSION

Finite Element Analysis

Steps of Finite Element Analysis :

FEA solution of engineering problems, such as finding deflections and stresses in a structure, requires three steps:

1. Pre-processing
2. Solution
3. Post processing

Pre-processing

Using a CAD program that either comes with the FEA software or 3D CAD modelling tools like Pro-E, Catia, and solid Edge etc. provided by another software vendor, the structure is modelled. The final FEA model consists of several elements that collectively represent the entire structure. The elements not only represent segments of the structure, they also simulate its mechanical behaviour and properties.

Regions where geometry is complex (curves, notches, holes, etc.) require increased number of elements to accurately represent the shape, whereas, the regions with simple geometry can be represented by coarser mesh (or fewer elements). The selection of proper elements requires prior experience with FEA, knowledge of structure's behaviour, available elements in the software and their characteristics, etc. The elements are joined at the nodes, or common points. In the pre-processor phase, along with the geometry of the structure, the constraints, loads and mechanical properties of the structure are defined. Thus, in pre-processing, the entire structure is completely defined by the geometric model. The structure represented by nodes and elements is called "mesh".

Solution

In this step, the geometry, constraints, mechanical properties and loads are applied to generate matrix equations for each element, which are then assembled to generate a global matrix equation of the structure. The form of the individual equations, as well as the structural equation is always,

$$\{F\} = [K]\{u\}$$

Where

$\{F\}$ = External force matrix,

$[K]$ = Global stiffness matrix,

$\{u\}$ = Displacement matrix.

The equation is then solved for deflections. Using the deflection values, strain, stress, and reactions are calculated. All the results are stored and can be used to create graphic plots and charts in the post analysis.

Post processing

This is the last step in a finite element analysis. Results obtained in step 2 are usually in the form of raw data and difficult to interpret. In post analysis, a CAD program is utilized to manipulate the data for generating deflected shape of the structure, creating stress plots, animation, etc. A graphical representation of the results is very useful in understanding behaviour of the structure.

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ANSYS Software

In present research for analysis ANSYS (**An**alysis **Sys**tem)software is used. Basically, its present FEM method to solve any problem. Following are steps in detail

1. Geometry
2. Discretization (Meshing)
3. Boundary condition
4. Solve (Solution)
5. Interpretation of results

ANSYS Workbench 21.0 platform to perform modal analysis of thrust coupling. ANSYS Workbench 21.0, as the most advanced CAE software, provides users with simulation modules including: structure, fluid, electromagnetic, heat transfer, and other fields. It is the industry's most advanced engineering simulation technology integration platform, with intuitive and friendly interface, convenient pre-processing and post-processing functions, and its extensive solution functions.

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CONCLUSION

While concluding this report on fruits & vegetable shorting machine, we feel quite fulfil in having completed the project assignment well on time, we had enormous practical experience on fulfilment of the manufacturing schedules of the working project fruits & vegetable shorting machine model. We are therefore, happy to state that the in calculation of mechanical aptitude proved to be a very useful purpose. Although the design criterions imposed challenging problems which, however were overcome by us due to availability of good reference books. The selection of choice raw materials helped us in machining of the various components to very close tolerance and thereby minimizing the level of balancing problem. Needless to emphasis here that we had lift no stone unturned in our potential efforts during machining, fabrication and assembly work of the project model to our entire satisfaction to solve the problem in field for social welfare.

Hence, we selected this project to contribute for sustainable machine. This work presents a new technique for sorting and grading of fruits using pure mechanical approach. This technique begins with shorting the fruits. The features are efficiently extracted from the mechanical arrangements. The size of the fruit determines its class and fruit’s grade is determined. The proposed technique accurately classifies and grades the fruits. The results are good for the chosen fruits of same sizes. This kind of system can be employed in Agriculture Produce Marketing Corporation, etc.

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