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Automated SCARA Based Fruit Categorization

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ABSTRACT: This paper discuss about a conceptual idea of an "Automated SCARA based Fruit Categorization" which can be used for picking, analysing the fruit & categorizing fruit based on their size. The automation of the SCARA based pick and place robot will be done through online programming method using a "Teach Pedant". The identification for the quality of fruit will be done with the support of vision system attached to the end-effector and categorized to two levels of quality. The good quality fruits are further sorted in accordance with their size using the simple size sorting structure presented here.

KEYWORDS: Automation, SCARA, categorize, online programming

I. INTRODUCTION

Robot, nowadays the most searched word in search engines is creating a new trend to the world by making things more easier in such a way that Robots are transforming as an assistant to human. Robotics is a branch of technology which deals with the design, construction, operation and application of robots. Recently Robots are used in automobile industries to perform repetitive tasks. An industrial robot is a general- purpose, programmable machine with certain human-like characteristics that resemble the human physical structure with response to sensory signals in a manner that is similar to humans. The anthropomorphic characteristics present in them makes it usable for various industry tasks, or sensory perceptive devices, such as sensors, and allows communication and interaction with other machines and make simple decisions.

II. ROBOTIC STRUCTURES

For creating a robot we have to be familiar about robotic structures which can be selected as per the requirement of the desired robot. Basically it means types of robots based on their mechanical structure[3]. They are;

    i. Cartesian
    ii. SCARA
    iii. Cylindrical
    iv. Articulated
    v. Parallel (delta)

In general mechanical structure means their joined structures. These structures are occupied by linking rotary or linear motions or joints.

    i.   Cartesian
    This includes linear drives for the main axes movements which will be according to Cartesian coordinate system. This mainly includes gantry machines like linear pick and place devices.

    ii.   SCARA
    SCARA means Selective Compliance Assembly Robot Arm. It is generally faster than Cartesian robot. It's a superior for robotic automation. Commonly used for pick and place applications. Basically it was developed from assembly applications. It provides

- High speed performance
- Compact design

- Reliable
- High accuracy

Hence is used commonly for pick and place operations.

iii. Cylindrical

These robots can perform rotary movements. They are easy to program and visualize. Mostly they are used in electronics industry. This one is more popular in Asia. They are also applicable in pick and place sections.

iv. Articulated

This is the most common configurations which were used recently. This is also called jointed arm and it's like a human hand which is very flexible. They are difficult to visualize because of the complex structure. This robots are mainly used for processes like welding, painting etc

v. Parallel

This is applicable for machine which have concurrent rotary joints. This can reduce weight within the arms and thus it will have high acceleration and speed. This applicable for picking and packing especially in food industry.

Nowadays industrial robots are mainly engaged in pick and place applications because of their fast working style and also of better efficiency. They are flexible and can easily reprogrammed for various tasks. Robotic arms are highly competitive when compared with conventional multi-axis configurations.
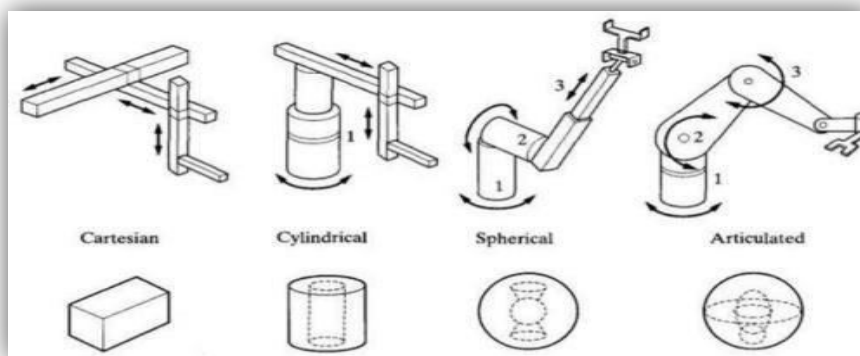

Figure 1 : Robotic structures

III. ROBOTIC PROGRAMMING

For dealing with robot we have to be conscious about robotics programming. Robotic programming are of two types[1] :

i. Online Programming
ii. Offline Programming

Online programming

This uses the robot to generate program or in other words it requires access to the robot. This is performed using

- Teach Pedant
- Lead through programming

Figure 2 : Teach Pedant

People are interested to do assisted online programming . Using assistant teaching devices usually means introducing additional sensors and calibration procedures to an already very complex robotic system and they are of two types;

- operated assisted online programming

  This can improve the efficiency of Teach pedant for walk through teaching.

- sensor guided online programming

Offline Programming (OLP)

This means creating the robot code without the presence of robot. It's a quick programming. It will be more effective when dealing with repetitive tasks. It uses 3D CAD data of workspace to generate and simulate robot programmes and are broadly used for automation system with large product. Programs generated offline are more flexible. The errors occurred while dealing with offline programming is less than that of online programming because programs can be pre-checked . Robotic work cell simulation is considered as a significant tool that OLP software packages bring to the robotic programming.

So here for programming we use a "Teach Pedant" which is under online programming. Teach pedants are used to control these pick and place robots. It is a control box for programming the motions of a robot. Also called a " Teach box ", the robot is set to learning or teach mode, and the pedant is used to control the robot step by step. Teach pedants are typically handled devices and may be wired or wireless. It's a simple device which can be managed very easily especially for simple movements.

IV. HARDWARE ASSEMBLY OF ROBOT

A pick and place robot can pick up an object and place it to a desired location. Now we are concentrating to implement a pick and place robot which will be applied for arranging fruits according to their size. This is a repetitive task for the sellers and so most of them are skipping this in order to save time. Here we use MATLAB technology in order to check whether fruit is of good quality or not.

The structure of this concept is simply made up of PVC pipes by making holes on it. Holes are arranged in a particular order which is from smaller holes to bigger holes and fruits are applied at the side which has smaller holes. The technique is that when we place a fruit the fruit will move through the pipe and then it moves and fall down through the hole in which its shape is matched. If it is a bad quality fruit it will be detected firstly since MATLAB technology is used at the starting end for better efficiency. For a pick and place robot normally three or four Degrees of freedom are required.

Degrees of freedom (DoF) means the total number of independent aspects of motion. This term indicates the capability of robot. It can be classified as ;

i. *One axis* - It can pick up an object and shift it along a straight-line.
ii. *Two axis* - It can pick up an object and lift it by moving horizontally and vertically and place it down without changing the object's orientation on X,Y plane.
iii. *Three axis* - Without changing the object's orientation, we can pick up an object by lifting and moving it horizontally and vertically and locate it down anywhere in X,Y,Z space within reach of robot.
iv. *Four axis* - It can pick and lift an object and move it horizontally and vertically and locate it down

anywhere in X,Y,Z space by changing object's orientation on one axis.

v.   *Five axis* - It can pick and lift an object and move it horizontally and vertically and locate it down anywhere in X,Y,Z space by changing object's orientation along two axis.

vi.   *Six axis* - It can pick and lift an object and move it horizontally and vertically and locate it down anywhere in X,Y,Z space by changing object's orientation along three axis.

vii.   *Seven axis* - All movements of six axis robot is possible in addition to this, the robot can move from one place to another in a linear direction.

V. FRUIT QUALITY IDENTIFICATION

The identification of fruit's quality whether it is good or bad will be achieved by using the image processing methods available in MATLAB[2]. Initially an image of the fruit is taken and from it certain features of the fruit are extracted. Later using different method like thresholding, segmentation, k-means clustering a database is generated. The data is thereafter compared with several trained databases, to determine the quality of fruits. The detailed stages in the proposed methodology is shown below :
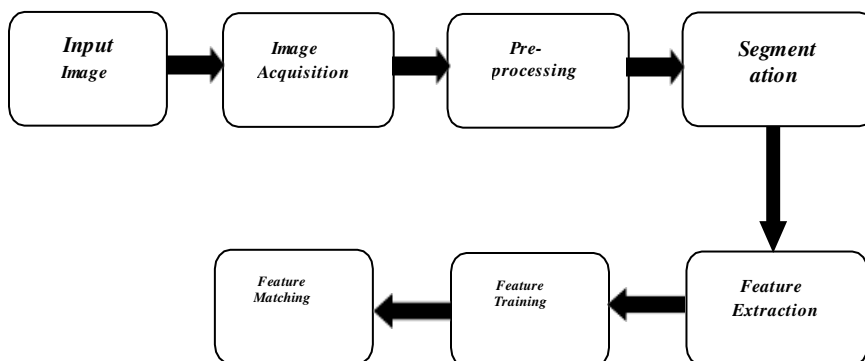

Figure 3 : Basic Steps involved in Image Processing

The steps involved in any robotic vision systems are also presented here : namely image acquisition, pre-processing, segmentation, feature extraction, feature training and finally feature matching.

Image Acquisition : The image acquisition is done using a digital camera. Here the input image got is an RGB image.

Pre-processing : Here we have to input the image and have to clear the background. Then the RGB image is converted to gray and then to binary.

Segmentation : It is used to divide the image to several parts and so the edges will be more clear for better quality checking.

Feature Extraction : It is related to dimensionality reduction and then it is transformed into a reduction set of features.

Feature Training : It is a set of techniques that allows a system to discover the representations needed for feature detection or classification from raw data automatically.

Feature Matching : This is an effective method to detect the exact image which will be matching with corresponding features. With these values we can identify whether the fruit is good or bad.
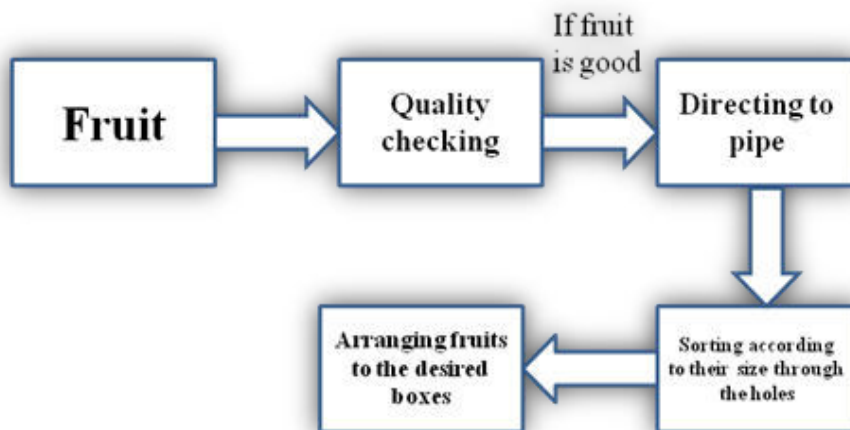
VI. BLOCK DIAGRAM

Figure 4 : Block Diagram

Step 1 : Applying fruit for checking whether food is good or bad.
Step 2 : Checking the quality of fruit by vision system , if fruit is bad that fruit is placed separately and if it is good directing it to for grouping according to their size.
Step 3 : Placing the fruits according to four size levels on desired boxes .

The generalized conceptual working of the system can be explained as follows : Initially the robotic arm picks up a fruit and places it at the desired position of the platform. The platform is equipped with a good quality vision system which captures the image of the fruit. The image is then passed to the system placed aside, where the identification of fruit quality is done using image processing techniques with the help of MATLAB software in the system. If the quality determined is BAD, then the robotic arm picks the fruit and drops it to a separate bin. Otherwise, if the quality determined is GOOD, then the fruit is picked and placed to the separator tray, where the fruits is separated based on its size. The design consists of segregating fruits based on 4 different sizes.

Later on, from the segregated baskets, the fruits are picked and palletized by the robotic arm itself.

VII. CONCLUSION

In this paper we introduced a technology which will be more useful to farmers especially for those who are cultivating fruits. This technology is also focusing for the enhancement of health of human by eating healthy fruits which are of good quality. Since robots are examples of programmable automation, we can reduce labor costs. By using this product we can avoid repetitive task which was a bored task to human. The main advantage of our product will be speed and reliability.

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