An Onion Grading Machine

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Abstract- *In the economic development of India, agriculture sector plays a key role. For the proper price of any agriculture product, grading according to size is necessary. And it is also value adding technique to the product. To makes the product more attractive and improve its processing qualities uniformity in size is important. At present, size grading of most agricultural products including lemon, garlic, onion, tomato, Orange, mandarin, apple are carried out manually by farmers, agents, whole sellers, retail sellers and customers also. Most of farmers market their products without any grading. Persons engaging in post-harvest crop handling such as collectors, whole sellers, retail sellers, and farmers cannot use high technical and costly grading technique. And also by the local market survey it is found that retail market price of the fruits is significantly varied according to its size. Fruit grading by human is inefficient, labour intensive and error prone. The automated grading system not only time saving but also minimizes error. Improvement of quality and value addition of agricultural produces has gained higher concern in recent times. There is a great demand for fruits in both local and foreign markets. The study is carried out for the design of a machine which can be used to grade multiple fruits by making adjustments. Machine should be simple to use so it can be operated by any illiterate person also so that farmers can also use it.*

Keywords- size grading, sorting, onion.

1. INTRODUCTION

Onion is one of the important crops cultivated in India. India is the second largest producer of onion in the world. Improvement of quality and value addition of agricultural produces has gained higher concern in recent times in India due to creation of new opportunities for sale of agricultural commodities in open market at competitive prices. Until now almost everywhere in India, the onion grading is done manually. This manual grading is increase the cost of onion tremendously to customers and to producers. The manual grading also need more labour. There is also lot of human errors will be in the grading so we cannot clearly guarantee the highest fool proof grading with the present way of grading. Now the need of automation arrives in the agricultural sector also due to the higher competition from across the globe. So we have to increase the quality and efficiency of the grading process. This type of new ideas will surely help a lot of people, to focus back to agriculture and this will lead to new innovations in the agriculture sector.

Grading according to the sizes is an important value adding technique for most agricultural products. And also the price of the many agricultural products varies significantly according to their uniformity in size. Uniformity in size not only makes the product more attractive to consumers but also improve its processing qualities. In order to achieve uniform size of onion the proper grading is required, with the aid of automation that goal can be achieved. This type of grading machines allows the farmers to be more productive by reducing the cost as well as the need of labour. The research on this field is also very much necessary in the future to develop new mechanism that will aid the farmers to be capable to manage their crops themselves. The other area is the creation of awareness among farmers about this type of innovation to proper implementation of advanced technology in the farmland to increase the productivity of farms. The other purpose of grading is the aesthetics effect of the onion that will attract the customer to buy the onion by giving higher amount of money. It will increase the value of the crop and it can survive higher amount of testing, when it is comes to export to advanced nations where they are able to pay very high amount of money for the value added products. On the other side, there is higher chance of banning less quality products which is not meeting the standards given by their respective government. The main gap between the value-added product and the cheap quality product is there post harvest processing capability. This gap can be mended by the newer innovations like onion grading machine.

2. LITERATURE REVIEW

Smitha and Phatale (2013) depicts about the automatic grading machine based on the machine vision. In this project, Authors insist on the quality requirement of onion when it is exporting to foreign country. The concept of onion grading machine used in the project based on the colour and texture. If any onion is satisfying the requirement will be rejected as damaged one. The viewer is introduced to light as an electromagnetic quantity, and to the mechanisms by which light interacts with objects. The processes of producing colours by addition and subtraction of light are introduced. Then the concept of human colour perception and colour description is discussed. The basis of this identification onion will be selected by the machine.

El-Rahman and Magda (2011) presents the onion grading machine which was developed from a small cylinder type grading machine to suit grading of onion sets crop. The

project also considered two parameters for optimum performance. Those parameters are revolving speed and feeding rate. On these parameters four levels of increase in revolving speed and feeding rates The studied parameters included, revolving speed 35, 45, 55 and 65 rpm (0.366, 0.471, 0.576, and 0.680 m/s), and feeding rates (75, 100, 125 and 150 kg/h). The grading efficiency (%), grading productivity (kg/h) and the mechanical damage percentage, were also considered on the effect of machine parameters. This project was successful based on the obtained results in which the maximum grading efficiency was higher on the third set of parameters (55 rpm and 125kg/h).

Wang and Li (2014) present the grading concept of onion based on the RGB-Depth sensor. The post-harvest handling of the onion has a great role in the profit of onion. This paper clearly mention the onion grading using advanced technology such as measuring of the RGB- depth sensor. The authors used the RGB- depth sensor to measure the volume and diameter of the onion based on the colour of the onion and the density of the onion in regard with the measured parameters. Images were acquired when onions were placed at six different orientations. The colour and depth images helps to get the maximum diameter of the onion. The volume of the onion was estimated using the depth images. The onion diameter estimated by depth images achieved a higher average accuracy and robustness (RMSE = 2 mm) than those calculated by colour images (RMSE = 3.4 mm). Two types of onion varieties were measured in this project are Mexican sweet onion and Vidalia sweet onion. The results obtained from this project was shown the effectiveness of this model where the depth is finding non-destructively. The proposed methods can be applied to improve the efficacy and efficiency of size estimation in onion phenotyping and postharvest sorting/grading.

Tripathi (2006) presents about the need of the onion grading. The demand of graded onion and how much is the need of onion. In this paper, the classification of onion based on size was described. The size of the onion were classified to three that are A, B and C. The global production rate of onion was also described. The onion grading prototypes which were used around the country also included in this presentation.

Gunathilake et al (2016) introduces a new prototype for onion grading machine. In this new prototype, the inclined angle against the horizontal axis was within a range of 2° 4°. The revolving speed of the grader was from 10rpm to 20 rpm. The optimum result was obtained at the revolving speed 15rpm and at an inclined angle of 3°.The capacity of the grader under optimum operation conditions was 630 Kg/hr. The grading efficiency/qualities of small, medium and large grades were 84.47%, 93.46% and 90.14 respectively.

Moreda et al., (2009) presents the size of fruits and vegetables is an essential physiological property that can be described by different parameters such as volume, weight, length, and diameter Size determination is often mandatory to the sorting of many fruits and vegetables for various reasons, such as requirements of processing machine, regulatory rules of sorting standards, and consumer preferences. Size is also an important quantitative factor to evaluate for phenotyping of fruits and vegetables. Many machine vision methods have been proposed to non-destructively measure the size of various fruits and vegetables including apple, citrus, pear, tomato, etc.

Onions are graded into three types; they are basically classified based on the bulb diameter. (Onion Grading in India by Prakash Tripathi, Indian Institute of Horticultural Research)

Table 1. Grades of Onion

Grades in Onion Bulb grade	Bulb diameter (mm)	%Proportion in a good crop
A	>60	40-50
B	50-60	30-40
C	5-50	10-20

This chart given by the government of South Africa about the onion grading

Table 2. Onion Sizes

Category	Size
Extra Large	Over 90 mm
Large	70-90 mm
Medium	40-70 mm
Small	35-50 mm
Prickle	10 -35 mm

Fig. 1: Grade onion-A

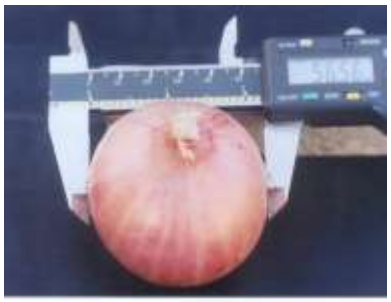


Fig. 1: Grade onion-B

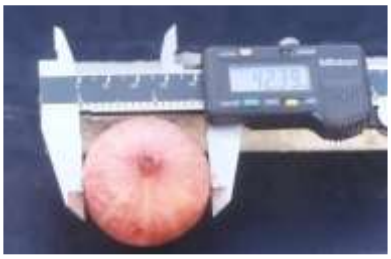
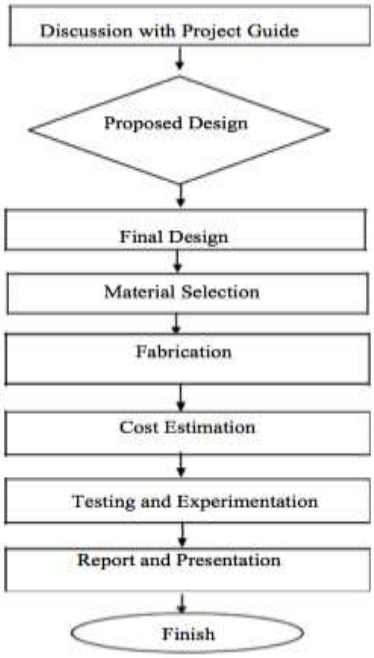


Fig. 1: Grade onion-C

3. METHODOLOGY



3.1 COMPONENTS

a. **Motor**

An AC motor is an electric motor driven by an alternating current. It commonly consists of two basic parts, an outside stationary stator having coils supplied with alternating current to produce a rotating magnetic field, and an inside rotor attached to the output shaft that is given a torque by the rotating field. There are two main types of AC motors, depending on the type of rotor used. The first type is the induction motor or asynchronous motor; this type relies on a small difference in speed between the rotating magnetic field and the rotor to induce rotor current. The second type is the synchronous motor, which does not rely on induction and as a result can rotate exactly at the supply frequency or a sub-multiple of the supply frequency. The magnetic field on the rotor is either generated by current delivered through slip rings or by a permanent magnet.

Slider Crank Mechanism

It's a mechanism in which crank is pivoted about any fixed link and is rotated about the same. This rotary motion of crank is transmitted to the slider by means of connecting rod. Simply this mechanism is used to covert rotary motion into a reciprocating motion in this project. In this project crank is mounted on the one shaft of gear box. One end of connecting rod is connecting with the crank and other end of the connecting rod is connected with the sliding cage which supports the trays.

Fig 2: Motor

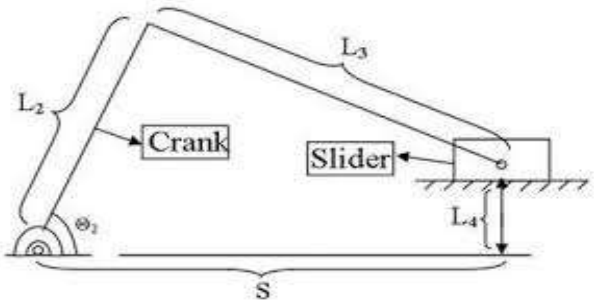


Fig. 3: Slider crank mechanism

Grading Tray

Onion grading is the important task in this machine. Grading tray is made up of stainless Steel. The grading tray is oscillating to keep the standard sized onion and grade the non-standard sized onion out of it

Chain and sprocket:

A sprocket or sprocket-wheel is a profiled wheel with teeth, cogs, or even sprockets that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth.

Sprockets are used in bicycles, motorcycles, cars, tracked vehicles, and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc. Perhaps the most common form of sprocket may be found in the bicycle, in which the pedal shaft carries a large sprocket-wheel, which drives a chain, which, in turn, drives a small sprocket on the axle of the rear wheel. Early automobiles were also largely driven by sprocket and chain mechanism, a practice largely copied from bicycles.

Sprockets are of various designs, a maximum of efficiency being claimed for each by its originator. Sprockets typically do not have a flange. Some sprockets used with timing belts have flanges to keep the timing belt centered. Sprockets and chains are also used for power transmission from one shaft to another where slippage is not admissible, sprocket chains

being used instead of belts or ropes and sprocket-wheels instead of pulleys. They can be run at high speed and some forms of chain are so constructed as to be noiseless even at high speed

Fig. 4: Chain and Sprockets

4. WORKING MODEL SETUP

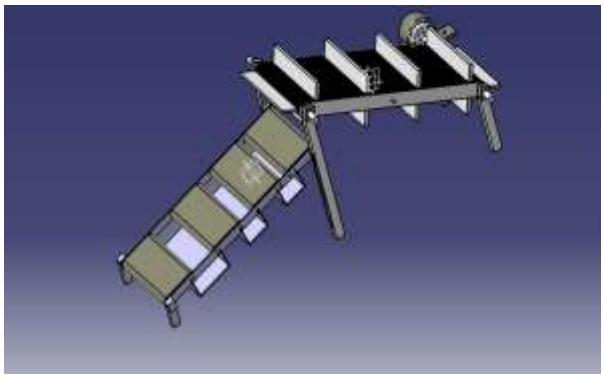


Fig. 5: 3-D Model of Onion Grading Machine

Working:

Onion grading machine consist of belt conveyor system in which eight buckets are attached to carry onion. These buckets are attached equidistant in the conveyor belt. At a time, four buckets are loaded and four will be in unloaded position. The loading of one bucket is happening at the same instant where the other bucket is unloading the onion into the grading tray.

This conveyor system is powered by the motor. The conveyor system consist of roller and conveyor belt. The conveyor belt slides over the roller. The roller is giving support to the conveyor belt. This onion in the conveyor system falls on the grading tray. The grading tray is oscillating in the horizontal direction. The motor is connected to the grading tray through the chain drive which is connected to the crank plate, where the rotary motion of the crank plate is converted to the oscillatory motion of the grading tray.

ADVANTAGES**:**

- The system is automatic. Speed of the separation process is high.
- Accuracy of the process is high.
- Highly Reliable.
- Easy to use.
- System is cost effective.
- High Flexibility.

APPLICATIONS**:**

This system can be used in food industry and in farms for agricultural use.

5. CONCLISION

Fast, automatic and precise system for Grading of different types of onions. The system can replace the conventional methods with better efficiency. We have successfully develop a model of onion grading machine with better efficiency. From the existing prototype we have studied all the mechanical process which comes under the project.

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