DESIGN AND DEVELOPMENT OF ONION SEGREGATION MACHINE

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ABSTRACT
Onion is an important vegetable crop which is seasonal in production but grown all over the India. According to journey of market six of bulbs plays an important role in its price large size onion bulbs produced in Gujarat, Maharashtra, Karnataka & Tamilnadu and are exported from Mumbai & Kolkata ports to Dubai, Kuwait, Saudi, Singapore. Small size onion bulbs produced in Karnataka & Andhra is exported from Chennai to Singapore, Srilanka and Other countries while medium bulb type onion stored for long term storage. Roller segregation is fast & accurate but a little damage to bulbs. Literally it is solution over consuming, labor intensive which improves economic considerations of farmer. Grading of onion bulb is usually important steps in processing operations which brings overall improvement not only in Marketing system but also in raising its quality. In India traditional method is followed which is manual segregation. Onion grades were developed but that cost more than usual & is not affordable by ordinary farmers. So, keeping in view we have designed onion segregator based on chain arrangement.

Keywords: Segregation, Onion Bulbs,PLA, 3D Printing, Onion Graders.

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 segregation is done manually.

This manual segregation increases the cost of onion tremendously to customers and to producers. The manual segregation also needs more labour. 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 segregation 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. Segregation 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 segregation is required, with the aid of automation that goal can be achieved.

A simple, manually operated machine is designed and developed for grading onion bulbs. The grader was fabricated in the Arunoday Enterprises, Kolhapur. The following factors were considered while developing the grader: (a) Suitability of machine for the grading of onion bulbs in the fields. (b) Ease of operation and maintenance. (c) Energy efficient and low cost of operation. (d) Minimum damage to bulbs.

The developed prototype On-farm Onion Grader Unit consisted of (i) Feed hopper, (ii) Rollers, (iii) Collection unit, (iv) Mainframe

Feed hopper

The horizontal section of feed hopper is rectangular in shape and is fabricated out of PLA Polylactic Acid of 5 mm thickness. The hopper was inclined for smooth delivery of bulbs over rotating rollers.The feed hopper was mounted on the main frame to feed the onion bulbs on to the grading unit.

Collection unit

The Collection unit partitioned into four compartments on one side. The first compartment was located from the start of feed end of the roller, while the second and the third and fourth compartment were provided at some distances respectively, from the feed end to the rear end. This was arranged based on the required grade of onion and space between the rollers available above the compartment. The overall dimension of the collection unit is measured in millimetres. The collection unit is provided with vertical dividers to guide the bulbs in appropriate compartments.

Main frame

The feeding hopper unit and the collection unit all are assembled on a structural frame. The main frame of the machine was fabricated out of rectangular bar mild steel. The machine is having length of 30-inch, width of 7 inch and height of 15 inch. We have assembled some of the parts with each other with the help of glue gun.

Roller

There are four rollers which are mounted on the four shafts. These shafts are mounted parallelly. Over the first roller we have made holes of diameter 15 mm, 25 mm diameter holes over second roller, 35 mm diameter holes over second roller, 45 mm diameter holes over second roller for the purpose of separation of onion through holes.

Material Selection

PLA

1. PLA material boasts high strength and stiffness, comparable topolystyrene (PS) at room temperature.
2. Energy consumption by PLA while production is less than other plasticand greater thermal processing capabilities.
3. It is a thermoplastic which means it can be reheated several times withoutany significant change in the mechanical properties.

ABS

1. High impact strength and ductility, which combine to give exceptional toughness.
2. Good chemical resistance.

3. Design of Machine

CATIA V5 (Version 5) is primarily a CAD software used for parametric and non-parametric modelling. It is capable of working alongside products with different brands. CATIA V5 is modular, meaning customers can buy as much or as little functionality as required.

We have designed the total model of our project on CATIA V5 Software.

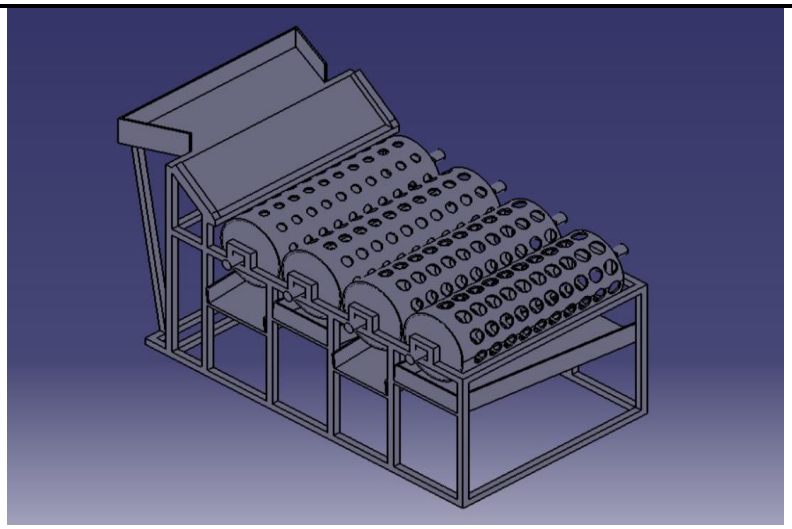

Figure 1: Design of Machine on CATIA V5 Software.

3.Development of Machine

Rollers

Rollers of the machine are made using material called PLA (PolylacticAcid).

Figure 1: Different Types of Rollers.

Figure 2: Top View of Machine

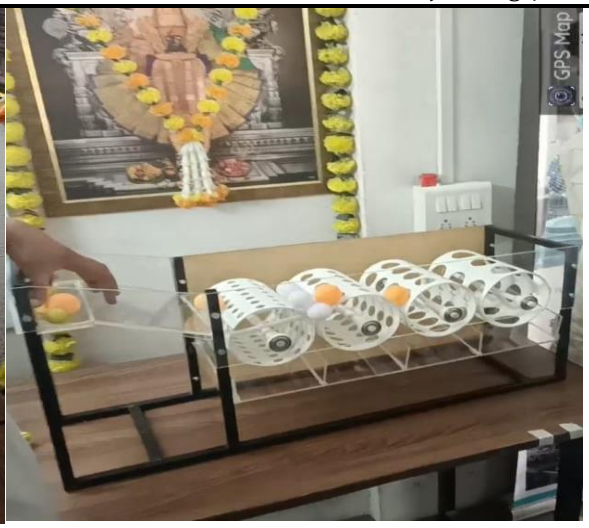

Figure 3: Front View of Machine.

4. Result and Discussion

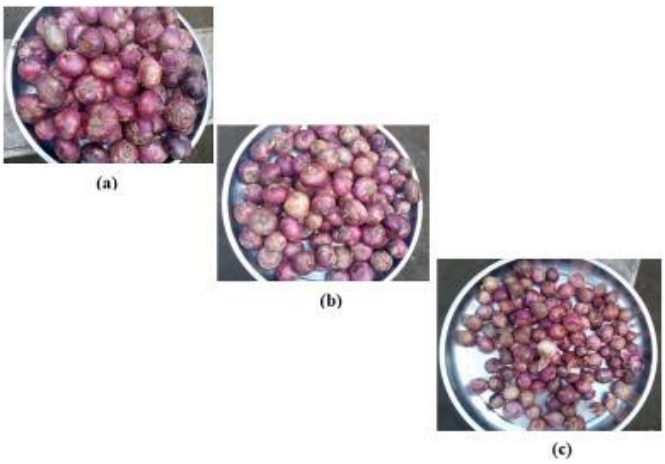

Figure 4: Result after Sorting.

The first roller separates the onion having diameter size less than 15 mm, second roller separates the onion having diameter size less than 25 mm, third roller separates the onion having diameter size less than 35 mm and fourth roller separates onion having diameter size less than 45 mm.

The percentage of feed collected and percentage of target onion size collected from a particular outlet was calculated by using the following relationships:

Feed collected (%)= (Weight of onion in the outlet (kg) /Weight of feed (kg)) * 100

[Target onion size collected (%)] = Weight of target size collected in the outlet (kg) / Weight of onion in the oulet (kg) x100

Bulb damage

The mechanical damage to onion bulbs during grading operation was determined by visual observation.

The graded bulbs were manually sorted for damage of bulbs due to abrasion and the weight of total damaged bulbs collected in each outlet was noted. Thereafter, the damage percentage was computed using the following relation:

$$\text{Mechanical damage (\%)} = (D/W) \times 100$$

Where,

D = Weight of damaged onion bulbs in all outlets, kg

W = Total weight of onion bulbs in all outlets, kg

Grading capacity

The grading capacity of the onion grader was estimated by weighing the total onion bulbs collected per unit time from the all outlets of the grader and was calculated by using the following relationship:

Grading capacity (kg/h) = Weight of onion bulbs collected in all outlets(kg) / Grading time (h)

5. Conclusions

An efficient, fast, precise and automatic system for Grading of different varieties of onions. It can be an alternative to the traditional methods with better productivity and effectiveness. We have developed and implemented a working model of onion grading machine successfully with very effective performance. From this model of onion grading machine, we have studied many the mechanical concepts which comes under this project.

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