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Design and Fabrication of Citrus Fruit Sorting Machine

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ABSTRACT

Sorting of the fruits is performed primarily by visual inspection using size as a particular quality attribute. Many industries with large scales buying and selling citrus fruits are using image processing technology for sorting purpose. But image processing system of sorting requires very high developed technology and processing which is very costly and not suitable for small traders. The purposed sorting system in this paper offers an economical solution for such level of automated citrus fruit sorting. In this system, which comprises of mechanical structure is designed to be used in small agricultural industries. By dealing with a sorting system, it aims in classifying the fruits by weight which coming on chute through hopper, by moving the fruit near its respective packing place. There by monotonous work done by human is eliminated, achieving accuracy and speed in the work. Weight of fruit is used as a design metric to sort the fruit in food processing and for sorting using lever mechanism with dead weight is ideal. This sorting system presents a precise, simple, reliable, consistent, and portable sorting technique for citrus fruit sorting based on weight of fruit.

Keyword: citrus fruit, sorting, weight, lever principle, dead weight, visual inspection, small traders.

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I. INTRODUCTION

Agriculture sector plays an important role in economic development of India. India being an agricultural country, exports a huge quantity of fruits abroad. Citrus production in India increasing every year and according to national reports, India ranks sixth in production of citrus fruits in the world. Citrus fruits occupy third position in the production of fruits in India after mango and banana. These fruits originated tropical and sub tropical region of south East Asia, particularly India and china. North India is the native place of many citrus species of the various types of citrus fruits growth in India.

Sorting of fruits is accomplished by using external quality parameter and internal quality parameters. In the present scenario manual sorting is more popular. Sorting of fruits performed primarily by visual inspection using size as a particular quality attribute. It is noteworthy that fruit size can be expressed in terms of volume, weight and diameter. Sorting of fruits is necessary in evaluating agricultural produce, meeting quality standards and increasing market value. It is also helpful in planning and packaging. If the sorting and grading is done through manual techniques, the process will be too slow and sometimes it will be error prone.

Now days, human power, especially in agriculture sector is critically and widely used. Usually a lot of human error occurs during the process of fruit sorting. To overcome this error many industries are using image processing technology for sorting purpose. Industrial automation is increasingly getting important in the sorting process because computer or machines are capable of handling repetitive task quickly and effectively. Thus machines are also capable to sort fruits according to grade without mistakes. But this sorting system requires very high developed technology and which is very costly and this technology not suitable for small agricultural industries.

This paper develops a sorting machine for citrus fruits based on their weights. Although, the designed machine could be widely employed for several fruit application, this paper focuses on citrus sorting. The aim is to design a citrus fruits sorting machine which is portable. For this the main task is to make machine simple and light weight. This

machine uses simple weighing mechanism by using lever principle.

II. METHODS

1. Study and analysis of product -

We gathered an information overall dimension and weight about citrus fruits. This all information is shown in table no.1

A	B	C	D	E	F	G	H	I
Sr.No	Weight	Diameter	Height		Sr.No	Weight	Diamete	Height
1	122	70	60		31	142	68	66
2	132	75	62		32	152	76	55
3	108	69	52		33	148	71	65
4	100	70	56		34	120	69	58
5	124	71	60		35	144	68	61
6	136	69	64		36	142	71	60
7	134	70	55		37	134	65	65
8	142	68	61		38	148	69	60
9	148	72	65		39	142	68	62
10	132	69	56		40	134	70	58
11	130	69	55		41	166	68	70
12	142	74	59		42	146	73	60
13	128	69	60		43	148	72	58
14	144	70	59		44	148	68	61
15	154	73	59		45	144	68	65
16	124	69	60		46	116	64	54
17	140	70	60		47	152	71	59
18	144	70	71		48	142	72	54
19	132	68	53		49	168	72	64
20	152	70	63		50	156	71	61
21	136	71	58		51	140	70	58
22	148	73	61		52	126	68	58
23	124	70	54		53	142	69	64
24	138	65	62		54	200	78	75
25	164	74	68		55	134	66	64
26	150	69	65		56	116	75	58
27	124	68	58		57	140	66	62
28	140	70	60		58	140	65	62
29	152	70	64		59	122	65	56
30	120	65	54		60	142	70	62

Table 1. Dimensional Analysis

We analyzed the dimension and weight of the fruits, and observed that maximum weight of fruit is 200 gm and minimum weight of fruit is 100 gm. According to that citrus fruits are divided into four different weight categories.

1) 200gm – 175gm
2) 174gm – 150 gm
3) 149 gm -125 gm
4) 124gm -100gm

Mechanical system is generated by reference of physical dimensions of the fruits.

2. Design and fabrication of citrus fruit sorting machine-

A model is designed for the purposed machine in PTC/CREO 2.0 as depicted in figure 1. According to the suggested model experimental model is fabricated. The stages of the model are shown in block diagram.

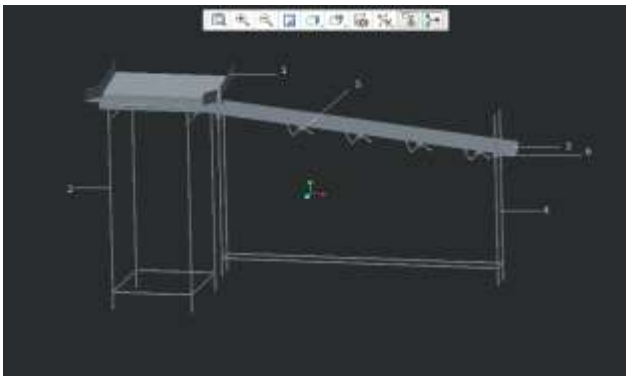

Fig.1 Design of machine, 1.Hopper, 2.Hopper Stand, 3.Chute, 4.Chute Stand, 5.Lever, 6.Nut

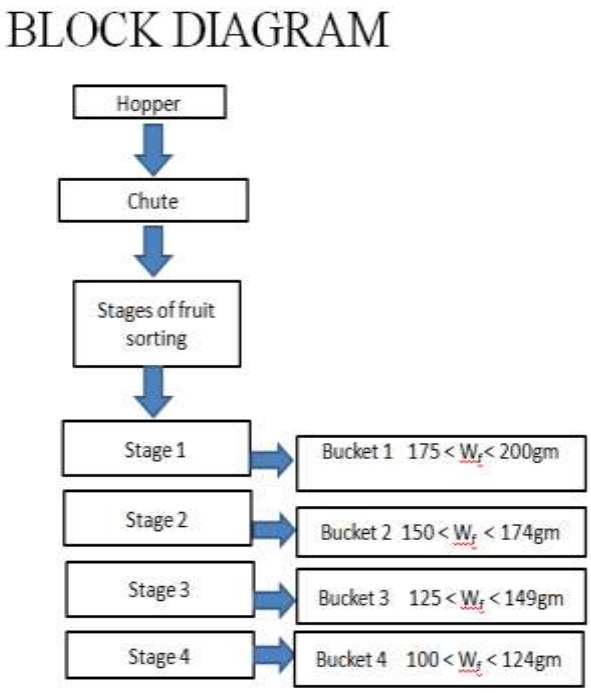

Figure 1: Block diagram of system

Hopper –

In order to placement of citrus fruit and for the better ergonomics the special hopper is designed. The height of hopper is 4.5 feet and for better rolling action hopper is maintained at 9^0. The hopper has two rectangular parts that is entrance of fruits. Hopper is designed to place fruits from both sides. The mid section of hopper is provided with hopper chute for the discrete flow of citrus fruit. The area of hopper is developed by considering placement of 130 fruits (65 fruits in one hopper section). Reduction of fruit damage is important issue, to reduce fruit damage and smooth flow of fruits galvanized steel sheet is used for hopper.

Lever mechanism –

Lever mechanism is fabricated by connecting two rods of 100 mm length at pivot having a 160^0angle between them. One rod has threading to clamp the weight, second rod attached to rectangular pan which cut from the chute. The mechanism is attached beneath the chute by arc welding. The material of rod is mild steel.

Chute –

The chute is designed such a way that it conveys the fruits to weighing system for sorting. Chute is maintained at an angle ranging from 6^0 to 12^0.Angle range is calculated by experimental setup of chute, observations are shown in table 2. Chute angle is adjusted by changing the height of bolt. Length of chute is 4.5 feet & width 14 cm, on which three rectangular sections (13cm x 9 cm) are cut. Galvanized steel sheet metal material is used for chute.

Sr. No	Time (s)	Height (cm)	Angle	Velocity (m/s)	Remark
1.	1.21	20	11.53	0.82	Velocity is high
2.	1.32	18	10.36	0.757	Velocity is high
3.	1.23	17	9.78	0.813	Velocity is adequate
4.	1.25	16	9.20	0.8	Velocity is adequate
5.	1.38	15	8.62	0.73	Velocity is adequate
6.	1.37	14	8.0	0.72	Velocity is adequate
7.	1.51	13	7.46	0.64	Velocity is low
8.	2.15	11.5	6.60	0.46	Velocity is low

Table no.2.Angle Measurement of chute

Fig 2.Citrus fruit sorting machines

III. RESULTS

Based on the results of the evaluation of each element of the innovative capacity, the comprehensive assessment of the innovative capacity of the "Tretiy Park" OAO, one of the largest road transport enterprise of the North-Westwas performed (Table 2) by the grade method, integral method, and in the graph form, and the points were calculated based on the base element by the method of simple average.

IV. CONCLUSION

In our opinion, a thorough examination of the market and the assessment of the probability and the degree of impact of the risk and uncertainty conditions on the operational activity of the enterprise are required during the preparation for the development of the innovation policy. Analysis and risk assessment play an important role in the analysis of the innovation activity of the road transport enterprises. The accounting of the risks associated with the innovations, is required not only in the course of analysis and management decision making, but also in the course of implementation of the preliminary and follow-up control. The organization of the risk analysis and the innovation risk control are particularly important because the innovations are the most risky type of business activity.

In general, the innovation management system at the Russian road transport enterprises is a subsystem of authoritarian management and that is why it is personified, and lacks formal mechanisms to monitor the progress and the results of the innovation process. At most road transport enterprises the Director dominates completely at the beginning (the initiative, the decision making) and at the end of the innovation process (the assessment of the prospects for innovation, the decision on further production or suspension). At most enterprises the organization of work and control over the "internal" stages are not separated and are carried out by the Technical Director (the Chief Engineer). Sometimes, the technical and financial management functions are distributed, in this case the financial management is provided by the Chief Economist or the Sales Director. The structural and organizational, marketing and other events are not always reflected in the documents, the monitoring is carried out "in operational order", that is during the planning meetings or operational meetings the reports from the units involved in the implementation of the projects are presented and discussed (where appropriate), and based on them the management decisions are made. Thus, the instability of the institutional environment makes it difficult for the managers of the road transport enterprises to make competent strategic management decisions, able to ensure the development of the innovative business structures.

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