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DESIGN AND DEVELOPMENT OF FRUITS OR VEGETABLES PEELER CUM SLICER AND DRYER

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Abstract:*Peeling of vegetables and slicing is one of the most frequent processes in the food industry hotels, canteens, and restaurants even for household purposes. Peeling is a method of removing the inedible or unpleasant rind or skin from raw produce. The creation of a portable vegetable grading system based on a microcontroller system for small agro-industries is discussed in this study. The mechanical system is made of low-cost materials and is constructed in the shape of an inclined and segmented plane to eliminate the need for a conveyor belt. The autonomous system gathers IR and ultrasonic sensors, which are positioned on top of the analysis region, and then analyses the microcontroller, which has previously been programmed.*

Key Word*:Grading, IR sensor, Microcontroller, Ultrasonic sensor*

Introduction

Automatic and semi-automatic machines play an important role in all the food industries and other food processing units. By using the automatic machines, the time consumption will be reduced compared to the manual processing. Food processing refers to the process which converts the raw food materials into a final consumable product. Vegetables and fruits are majorly consumed in the world. Major steps involved in the processing are washing, peeling, wastage removal, slicing. In home the fruits or vegetables are peeled and sliced using the knife, but for large quantities it takes much more time in hotels, restaurants and messes. The time needed for cooking is comparatively less than the time needed for peeling and slicing [1] [2]. All vegetables and fruits in the bulk quantity are not good. They may contain some rotten fruits or vegetables. The sensor can be used to detect this.In mechanical operation the, fruits or vegetables are checked before introducing in the peeling process [3]. For peeling of fruits or vegetables different methods are used. They are manual peeling, lye peeling, mechanical peeling and Chemical peeling. Mechanical peeling is the finest for peeling fresh produce sections with minimal damage, which are both desirable aims of peeling operations.Mechanical peeling has different methods. Mainly mechanical peeling is done using abrasive drums, rollers, knifes or blades and milling cutters. Abrasive peeling drums which are mainly used. These

contain a rotating drum with abrasive material present at the surface and motor to operate the machine. The fruits or vegetables are fed inside the drum it will rotate for few minutes then the vegetables or fruits are peeled. The peeled product is used for the cooking and all other purposes [4]. From the peeling process, the peels are separated. The peels are undergoing the drying process using hot air blower. The dried peels are used for the many purposes like the edible coatings, fortified probiotics, metallic nanoparticles, carbon dots, microbiological media, bio char, bio sorbent, fertilizers, etc and also it rich in nutrition, so it has been used for the medical application also [5]. The peeled fruits or vegetables are used for the slicing process. The slicing process is used for the size reduction of fruits or vegetables. In manual slicing process, knifes are used, it will lead to some injury while cutting and the size will not be uniform. The sliced fruits or vegetables are subjected to force by using the sharp knife with different size of blades. It results to give the minimal deformation and rupture of the fruits or vegetables cell walls. It is very quick, easy and hygienic process [6].

Literature review

A electrical motor is placed and its connected to the drum with a v –belt, which helps to rotate the pulley. In the top there is a rod where the wire gauze is placed on the frame and they are rotated when the machine operates. The peeling efficiency is increased when the shaft speed is increased, when the peeling efficiency is good the tubers will be peeled properly the study on the mechanism of the peeler machine the principle used here is surface scratching was conducted [13].

In this article helped in observation about the prototype development of peeler machine ,which involves the following process selection of material ,cutting the material to the desire size and shape, joining material ,drilling process, painting process is done to avoid the rusting of metal and finally machine testing is done the power supply is given to the machine where the electrical energy is converted into mechanical operation then the disk starts to rotate a particular speed has been set for the rotation of the disk the medium for the peeling of the shallots are rubber fingers and rubber mat , when the operation is done the lock is opened the shallots move to the container built up with a rubber brush , the skin peeled shallots are collected at the final result [14].

In this article the researchers used onion , carrot , potato for the removal of the peels and slicing of the vegetables the steel blades was designed to minimize food contamination and prevents corrosion the disc was also made with sharp slits on its surface to prevent the vegetables damage , these steel blades have a length of 150 mm and a thickness of 2.5 mm they were made with grade 304 they are designed to push the product downwards , which is similar to how it falls into the discharge pathway[10].

In this article mentioned the about the importance and needs of peeling of vegetables (potatoes) by using a mechanical method peeling generally is a tedious process and consumes a lot of energy and manpower vegetables like potatoes are exposed to browning reaction once they are peeled this will affect the quality of the product, so manual peeling is not efficient that's why mechanical peeling is more effective and very useful, tank for cleaning and peeling is used in the first step, a inlet pipe is used in which water is allowed to rinse peeled potato skin then they are cut according to the shape ,size, they are controlled by the control panel kept in the machine .In this invention they have proved that increasing the production rate with uniform size ,shape of potatoes and at the same time it prevents browning reaction due to fast processing time compared to manual method [15].

In this article the developers have studied about the importance of using ultrasonic sensor in the manufacturing process during the quality control. An ultrasonic sensor inspects the pieces and select the good ones, among the total products the ultrasonic signal reflected by a piece is mathematically treated and neutral network technology. This is used generally to perform the discrimination between machinable and non- machinable piece. It is automated solution for industrial application in which they use ultrasonic tools are shown to provide a powerful technique for process quality control [16].

Drying is the most commonly used methods to reduce the product moister from the Peels, this is especially for long period of storage & transportation for making the powder from the dried peels. Drying of a product generally involves the following things not to change a lot. They involve colour, shrinkage time taken [17].

Materials and methods

The machine was created with the intention of peeling and slicing fruits and vegetables It can be used in hotels, messes, restaurants, etc. the 2D diagram of the machine was sketched in figure (1) and the materials used for the machine designing was listed in table (1). The machine contains four main sections. First section is used for the quality detection of fruits or vegetables, second section is the peeling device, Sthird section is the peel dryer, Fourth section is the slicing device. The machine was created in such a way that it consumes least amount of energy possible.

Table no 1 Material List

SL. NO	NAME OF THE PARTS	TYPE OF MATERIAL	QUANTITY
1	Vegetable Cutter	Stain steel	1
2.	Ultrasonic sensor	-	1
3	Peeling unit	Mild steel	1
4	Dryer unit (Heater and Fan)	Mild steel	1
5	Conveyor Roller	Mild steel	1
6	Conveyor Belt	Reksin	1

Materials

A. Quality detection

Quality detection means detection of the freshness of fruits or vegetables. It can be detected by using the ultrasonic sensor or IR sensor. The sensors will detect the freshness of the fruits or vegetables by penetrating the rays to the products. If the freshness of the fruits or vegetables is not good. It can be rejected by using the ejector.

B. Peeling device

For peeling the fruits or vegetables, abrasive roller drum is used. The product will be fed into the peeling drum, it's start rotating. By the rotation of the drum, the abrasive sheet present inside the drum will peeled the layer of the skins of fruits or vegetables. The peeling can be done with specific time. After peeling, the peeling door will be open, the abrasive roller drum will be stop rotating. The peeled fruits or vegetables can be collected from the peeled outlet.

C. Peel dryer

The peels that come from the abrasive peeler drum will be collected from the tray, that can be present at the bottom of the abrasive roller drum. The peels are dried by using the hot air dryer. The hot air will be blowed to the trays that the peels should be present. The dried peels will be used for further usage.

D. Slicing device

In slicing section, cam shaft mechanism is used. The different types of blades can be used for the slicing operation. The peeled fruits or vegetables are come to the slicing section, the products are sliced according to the size of blade

present in the machine. The slicing can be done by moving the blades up and down. The sliced fruits or vegetables are collected in the tray.

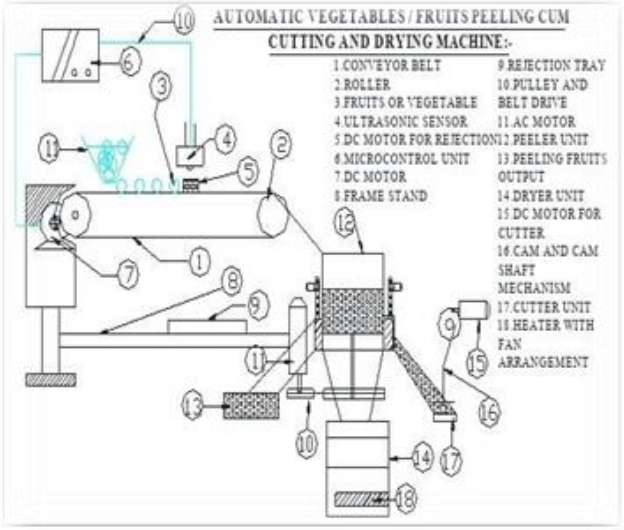

Figure 1: 2D diagram of machine

Working Principle

The battery will be switched on. After getting the supply from battery, the programmed Arduino board connection will be started the operation. The operation can be displayed on the LCD display. The peeling and slicing time intervals, quantity is given according to the feeding product, the peeling or slicing process are also selected in this section. After setting the parameters, the fruits or vegetables fed inside the hopper, then the products will be roles on the conveyor belt. In the conveyor quality detection of fruits or vegetables can be detected by using the ultrasonic sensor and IR sensor, this can be placed on the above of the conveyor belt. By passing the fruits or vegetables, rotten vegetables will be detected according to the level of maturity and quality and it can be rejected. The fresh quality vegetables will be going for the peeling and slicing process. For peeling process, the abrasive rollers are used. The abrasive roller drum will roll at the specific speed. By using the roller drum the fruits or vegetables are peeled. The peeled vegetables will be collected from the peeled outlet. For the slicing process, the fruits or vegetables are peeled, and go for the Slicing section, in that fruits or vegetables are sliced with different types of blades, by using the cam shaft mechanism. The sliced fruits or vegetables are collected from the outlet. The peels that can be come out from the abrasive roller drum, will be sent to the dryer, that can be fixed at the bottom of the peeler. The peels are dried by using the hot air blower. The dried peels will be stored in the tray and it can be used for further application.

Result and Discussion:

The performance and evaluation of the machine can be evaluated in terms of the peeling capacity, peeling efficiency, slicing capacity, slicing efficiency, and drying efficiency. The performance of the fruits or vegetables can be tabulated for the manual and machine process. The manual and machine peeling calculations of fruits or vegetables is tabulated in table 2, the manual and machine slicing calculations of fruits or vegetables is tabulated in table 3, the tray drying and machine drying calculations of fruits or vegetables is tabulated in table 4.

Table no2 Calculations for peeling

Sample Name	Weight of Initial Sample (g)	Weight of peeled sample (g)		Weight of peels (g)		Time Consumption (sec)		Peeling Capacity (g/sec)		Peeling Efficiency (%)	
		Manual	Machine	Manual	Machine	Manual	Machine	Manual	Machine	manual	Machine
Onion	500	464	477	36	23	187.8	25	2.66	20	92.8	95.4
Potato	500	400	480	20	20	511.2	24	0.97	20.83	80	96
Beetroot	500	460	474	40	26	480.6	23	1.04	21.73	92	94.8

Tableno3 Calculations for slicing

Sample Name	Weight of Initial sample (g)	Weight of Uniform pieces(g)		Weight of Damaged pieces (g)		Time Consumption (sec)		Slicing Capacity (g/sec)		Slicing Efficiency (%)	
		Manual	Machine	manual	Machine	Manual	Machine	Manual	Machine	Manual	Machine
Onion	500	446	470	54	30	685.2	84	0.65	30	87.8	94.06%
Potato	500	439	475	61	25	486	95	0.90	25	86.1	95
Beetroot	500	450	472	50	28	565.2	90	0.79	28	88.8	94.46

Table no4 Calculation for drying

Sample Name	Time Consumption (mins)		InitialTemperature(c)		FinalTemperature(c)		InitialWeight(g)		FinalWeight (g)	
	manual	Machine	Manual	Machine	Manual	Machine	Manual	Machine	Manual	Machine
Onion	60	120	90	35	140	120	27	23	5	10
Potato	60	120	90	30	140	130	35	20	6	12
Beetroot	60	120	90	34	140	135	25	26	6	8

A. Peeling Capacity

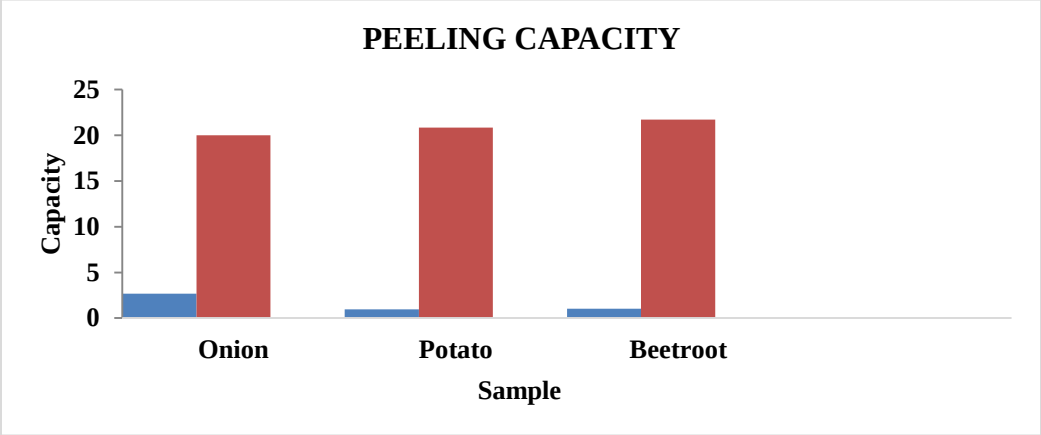

Figure 2: Graph for peeling capacity

The peeling capacity deals with the time needed for peeling the product. From table 2 and Figure 2, It understood that, the peeling capacity for manual operation ranges between 0.97 to 2.66g/s. The Peeling capacity for machine operation ranges between 20 to 21.73g/s. the peeling capacity of onion ranges between 2.66 to 20g/s , for potato it ranges between 0.97 to 20.83g/s and for beetroot it ranges between 1.04 to 21.73 it is seen that the machine has better peeling capacity.

B. Peeling Efficiency

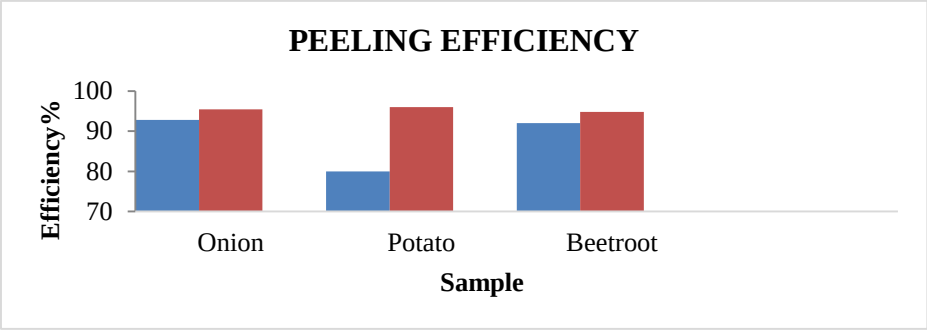

Figure 3: Graph for Peeling Efficiency

From figure 3, we understood that, the peeling efficiency for manual operation ranges between 80 to 92.8% and for the machine operation it ranges from 94.8 to 96%. the peeling efficiency for the samples, onion 92.8 to 95.4%, ranges between 92.8 to 95.4%, for potato, it ranges between 80 to 96%, for beetroot, it should be ranged from 92 to 94.8%. So, it is concluded that the machine operation has better peeling efficiency.

C. Slicing Capacity

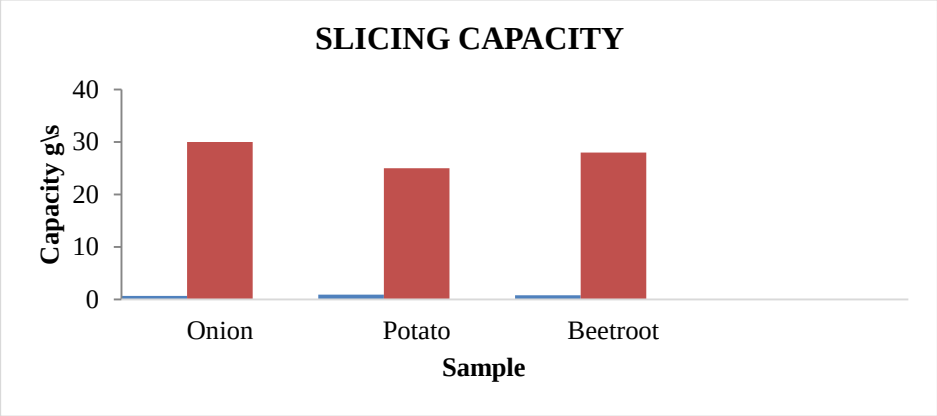

Figure 4: Graph for Slicing Capacity

The slicing capacity deals with the time needed for slicing the product. From table 3, and figure 4, the slicing capacity for manual operation it ranges between 0.65 to 0.90 and for the machine operation ranges between 25 to 30. the slicing capacity, for onion, it ranges from 0.65 to 30, for potato, it ranges between 0.90 to 25, for beetroot, it ranges between 0.79 to 28. it is concluded that the machine operation should having a better slicing capacity.

D. Slicing Efficiency

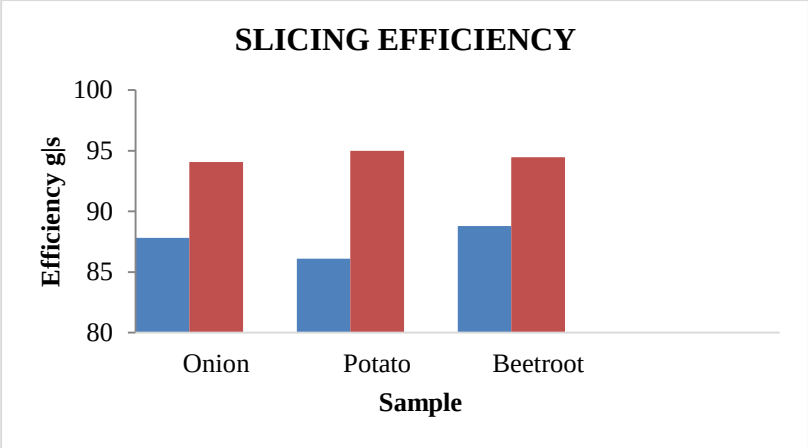

Figure 5: Graph for Slicing Efficiency

From table 3 figure 5 it is interpreted that, the slicing efficiency for manual operation ranges between 86.1 to88.8% and for the machine operation it ranges between 94.06 to 95%. the slicing efficiency, for onion, it ranges between 87.8 to 94.06%, for potato, ranges between 86.1 to 95%, for beetroot, it ranges between 88.8 to 94.46%. it is seen that the machine operation has a better slicing efficiency.

E. Drying Efficiency

The drying can be done using the tray drier, from the table 4 we understood that the tray drying consumes 60 mins for drying whereas the machine drying consumes more time of 120 mins for drying. It is seen that the efficiency of machine drying has to be improved.

I. Conclusion:

The peeler cum slicer and dryer machine was designed, developed and tested. The time consumption will be very low when compared to the manual process. The tested machine contains the maximum peeling and slicing efficiency of about 94 to 96% compared to the manual peeling and slicing efficiency. The tested machine having the high peeling and slicing capacity of about 20 to 30 g/sec compared to the manual peeling and slicing capacity. The tested machine has low drying efficiency compared to the tray drier. So, the dryer can be developed in the further research. It is concluded that the machine has high efficiency, capacity, and hygiene. The fabricated machine should be very helpful for the small-scale industries, hotels, canteens, etc.

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