Fabrication of Pineapple Peeling Machine Using Pneumatic Solenoid Valve

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Abstract
Pineapple peeling device which used for slicing the pineapple to create a cylindrical pulp. The key goal of this research is to implement a pineapple peeler system to overcome the challenges encountered by small and medium-sized businesses, in which the system produced will minimize its time needed for the pineapple operation. From an engineering viewpoint, ergonomic concerns relevant to peeling have been discussed. For this project, the concept of the pineapple peeler has a cylindrical blade being used to strip the pineapple flesh. The benefits of this pineapple peeler established throughout this venture are that it can remove the leaves as well as the core of the pineapple, and also can peel the outer surface of that same pineapple. Before starting the device, the pineapple is installed in the holder of the machine. So, the first cutter is to remove the ends as well as the base of the pineapple. Following that, the pineapple surface can be extracted by using a cylindrical knife. The mechanism within that device has been used to monitor the entire function of the pineapple peeler system and therefore is interfaced with dual pneumatic tubes to operate the tool. The mechanical and electrical elements are the essential parts of this unit.

1 Introduction
The pineapple (Ananas comosus) is really the third biggest native fruit in the world behind banana & citrus. This is a tasty crop with a strong orientation as well as a strong nutritious value. That was one of India's largest commercial tropical fruits [1]. Pineapple has been a strong great source of vitamin A and B and quite high in folic acid and nutrients such as potassium, magnesium, calcium and titanium. It is indeed a number of quality of polysaccharides [2], a proteolytic juice [3]. Besides being consumed raw, the fruit might well be dried and cooked in various ways. Pineapples are eaten as a fruit or included in the processing of jams, jelly and lettuce [4]. The pineapple peeler has become a device that might eventually cut along with slice through pineapple it into tubular pineapple pulp [5]. Pineapple appears to have been the internal substance of the pineapple between both the external skin as well as the middle. The outer layer over its pineapple is harsh as well as thick to expel instantly [6]. The soul of a pineapple seems to be the strongest or perhaps the major ingredient of said pineapple. The core including its pineapple is sturdy and robust. The automatic pineapple filet knife and drilling device can remove the whole outer layer of its pineapple yet at the same time scrape the core of pineapple [7]. Pineapple pulp is being used for the production of syrup [8], flavoring, pineapple gin and tonic, pineapple mash as well as pineapple packaged mush [9]. The biggest benefit of the automated pineapple slices and colonizing system is that the unit could handle a pineapple through full mode. A fully automated slicer and the colonizing pineapple device would do all the necessary technology to convert the pineapple pulp [10], which implies that perhaps the external surface, as well as the pineapple central, could be erased by the device [11]. This same product performance but instead employment expenses can be minimized using the instantaneous pineapple peeler as well as drill piece of equipment. The autonomous pineapple filet knife as well as drill device is used in small and medium-sized enterprises.
The main objective of this project is to fabricate an automated pineapple peeler for overcoming abovementioned issues. For this project, the concept of the pineapple peeler has a cylindrical blade being used to strip the pineapple flesh. The benefits of this pineapple peeler established throughout this venture are that it can remove the leaves as well as the core of the pineapple, and also can peel the outer surface of that same pineapple.

2 Construction
There are two pneumatic cylinders mounted on a mild steel frame, where one cylinder is vertically mounted under the frame which is used to lift the pineapple. This cylinder is connected with the frame using U shaped clamp. Another pneumatic cylinder is placed in a round ram at the end of the piston ram. There is a blade mounted vertically. There is another conical blade which is used to peel the pineapple. Two 5/2 solenoid valves which are used to control the pneumatic cylinder. A tray is used to collect the pineapple.

The whole system is controlled using an electronic circuit consisting of a micro controller which is programmed using Arduino. It also consists of a relay circuit which runs the sequenced program. A step-down transformer is used to reduce the voltage to 12 volts. There is also another circuit used to reduce the voltage from 12 volt to 5 volts. The whole circuit is controlled by a push button switch. The whole system works on the principle of pneumatics which requires air compressor ranging from 8 bar to 12 bars. Fig. 1a shows the components of pineapple peeling device for construction and Fig. 1b shows the fabricated image of pineapple peeling machine.

Figure 1. Peeling machine components

3 Working
First, there is an electronic push switch which is used to start the electronic sequence, the sequence is already programmed into the microcontroller. The step-down transformer is used to reduce the current from 230 volts to 12 volts which are further reduced to 5 volts when passed to the Arduino. The pineapple is placed on a U- shaped holder which is welded to a vertical pneumatic cylinder. There are two vertical blades that are used to slice the leaf and root of the pineapple. There is another horizontal pneumatic cylinder which is controlled by a 5/2 solenoid valve which acts as a ram to slide the pineapple into the conical blade which will peel off the outer rough skin of the pineapple. The skin will be dropped off the edge of the table, the pulp of the fruit will be collected in the tray placed under the frame.
4 Design calculations
The design calculations were done for determining the dimensions, features, materials and so on of pineapple peeling machine [12], [13]. The beam and beam calculations of device as well as the design of cylinder and piston are presented below.

The reaction forces are at the supports of the peeling machine ends are 112.45 N. This will be calculated using shear force and bending moment diagrams [14]. The maximum bending moment is at center of the device, the value is 61.25 Nm. The dimensions the column is calculated using bending equation (1),

\[ \sigma_b = \left( \frac{\sigma}{y} \right) = \frac{E}{R} = \frac{Mb}{I} \]  

(1)

The diameter and breath values are 97.2 cm and 194.4 cm respectively. The factor of safety value for this machine is 3.4. Then, slenderness ratio relation is used to identify the column is short or long [15]. From calculations, identifying that the given column is long column. For long column crippling load formula is used,

\[ P = \frac{n\pi^2EA}{(L)}^2 \]  

(2)

From the above equation (2), the piston rod length has been calculated. The value got as 19 cm which is standardized using PSG design data book page number 7.20 [16]. Next the cylindrical blade dimensions are calculated. The radius of the blade is 4.5 cm. Finally, the dimensions of cylinder are calculated with the help of pressure terms. The standardized diameter of the cylinder and stoke length are 40 mm and 130 mm respectively. Based on these design calculations, the peeling device was fabricated which has been shown in fig. 1b.

5 Conclusions
The pineapple peeling machine was fabricated successfully with the help of some components and the system can be improved with a help of a safety circuit and sensors which could be used to improve safety when operating. Furthermore, improved slideways can be developed to move the pulp into the collecting tray. Conveyors can be used to input the pineapple in the semi-circular clamp. It is noted how much time is needed to slice and core the pineapple by operating effectively. The full description is provided down. Installation i.e. putting the pineapple mostly on tray takes roughly 5sec. The time necessary for upstroke is approximately around 2 sec. as well as the time necessary for utilizing two additional cylinders is almost 5 sec. The overall time duration is therefore 12-15 seconds. Given the device and the ergonomics of the device, the device should be quite simple to run. The one pineapple requires fifteen seconds, such as although in 60 minutes, 300 pineapples could be worked and also in 7 hours, roughly 2100 pineapples could be used.

Acknowledgments
This work was supported by the Sri Krishna College of Engineering and Technology, India - 641008 as part of the motivation towards research and development of modern technologies.
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