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A Case Study on Fruit Peeling Machine

Ashish A. Natuskar[1], Rushikesh R. Teli[2], Kirankumar M. Mehetre[3], Akshay R. Mahajan[4], Mr. Rohit Argade[5]
[1, 2, 3, 4, 5]*Department of Mechanical engineering, Dhole Patil College of Engineering, Savitribai Phule Pune University, pune, india*

Abstract: ***The purpose of this research is to design and fabricate the orange peeling machine. In this machine we place orange between holders horizontally and cutting tool moves linearly for peeling oranges. The machine parts which are contacting edible parts of orange are designed using stainless steel. This type of machine can be used for business work or household work.***
Keywords**:** ***Peeling time, cutting angle, performance, cutting component, orange***

I. INTRODUCTION

Peeling of orange consists of separating the skin which normally protects the orange flesh Machines for peeling oranges are designed to perform two essential functions. They are: orange rotation, and movement of the cutter. These two movements are relative and interdependent that is the peeling action can be obtained by either cutting tool is rotating or the orange. The technical objective of the study is to develop an orange peeler suitable for domestic and small-scale use. The orange peeling machine is necessary to eliminate stresses come with manual method of peeling oranges. Manual orange peeling by the use of blade or knife is hazardous to human health due to the offensive gas that comes from orange peels. It is injurious due to the high risk of hand accident from sharp knife/blade cutting action. The stated challenges are motivator to the development of an orange peeling machine. Succulent nature of the orange made it difficult to have highly efficient machine for the peeling purpose. Based on the information and data regarding the peeling process, people encounter a lot of difficulties when peeling oranges in large quantities and also the process in use before was cumbersome, time consuming and inefficient. The peeling machine in focus is designed to solving previous peeling challenges.

The machine is designed to operate manually. It peels an orange at a time. The orange Peeling machine operated electrically or by using other sources of power are not considered in this study. This was done to enable its usage in the rural and urban market places. For Efficient peeling of oranges, the blade/knife geometry was investigated. This has enabled the obtainance of optimal tool angle at which cutting is efficient. The peeling blades required a curved surface at a certain angle to enhance cuttability of the orange. The blade angle must be flexibily and continuously changing with the orange curvature to enhance effective orange peeling. It is realisable that for effective peeling there should be trade off between the blade curvature and cutting face. Ten types of blade shapes which are the chip point, drop point, tanto, Americanized tanto, chisel-ground tanto, sheepfoot, dagger, spread point, trailing point and hook blade. Blade curvature can be eliminated provided that alternative peeling arrangement has been made in the design to accommodate the convex and concave shapes of the blades. Most of the previous orange peelers are designed with objective of minimizing the probability of orange damage and time of peeling operation.

There were designs made to mechanize peeling operation by applying orange to a device operating on the principle of a lathe, with the orange being mounted between two ends. One or more fixed or rotary tools are brought to the periphery of the orange to imitate manual peeling process. The designs included the peeling machines for industrial use covering citrus and orange peeling , pineapple peeling, melon peeling, mango peeling and peeling combination of oranges. An orange peeler developed by Singh and Reddy showed poor performance due to low blade speed. For improved performance, speed must be moderated and made changeable based on the nature of application and orange characteristics. Challenge of long time of peeling has been identified by Kareem which need to be improved upon for the enhancement of reduction in peeling time. Realization of effective orange peeling has motivated improved performance of juice extraction in the beverage industries.

II. MATERIALS AND METHODS

The peeling machine has been designed and fabricated using locally sourced materials. The following materials were used: stainless steel (steel alloy with a minimum of 10.5% to 11% chromium content by mass); and mild steel (plain carbon steel price is relatively low). A number of ten oranges which were randomly selected were weighed using laboratory weighing balance. The masses/diameters of five oranges were recorded and average taken. The outcomes of other design parameters computed using standard design models on the bases of average weight of orange peeled. The table also entails fabrication process applied to each of the components.

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An economical and reliable fabrication technique was adapted to manufacture various components of the machine. The selection of materials and an appropriate choice of the method of fabrication form an important aspect and influencing the design consideration. Relevant machines were used in the fabrication of the components of the orange peeling machine. Among the machines/tools utilized are the 3-jaw chuck lathe machine, the pillar drilling machine, hacksaw, guillotine, sawing machine, welding equipment, tapper, hammer, dies and bench vices The machines, following the standard procedures, were used in producing the component which included leadscrew shaft, leadscrew follower, bearing housing, bushing, clamp spring carrier, knife, knife holder, clamp lock, knife holder carrier, wing bar, machine base, machine frame and jaws (orange holder). Assembly of the machine components was carried out using welding, soldering, brazing, coupling, bolting, fixing, clamping, bushing, tensioning and painting processes. Machine maintenance was enabled in the assembly process through provision for lubrication of rotary parts, cutting tool protection and dust prevention systems.

III. PERFORMANCE EVALUATION AND RESULT

After the assembly of various parts of the machine, it was tested using orange of different mass and diameter at initial experimentation oranges were peeled unsuccessfully. The following reasons were identified as the cause of poor peeling, inappropriate cutting angle, rigidity of tool post and poor compression spring causing unusual profile of the cutting tool over the orange being peeled. These challenges were overcome by redesigning the system to be flexible. This enabled the machine's cutting tool post to be adjustable to accommodate varying angles of cutting tool.

The machine was put into further experimental test after the accomplishment of the stated modifications. The experimentation was enabled through redesigned tool holder to accommodate flexibility that allowed adjustment of cutting tool angle. This has made the machine differ from the past designs. On this basis, oranges of different diameters were peeled using varying cutting angle and the time taken to complete peeling process was recorded. Under similar arrangement, experimental tests were carried out on five oranges of varying sizes which were randomly selected. Peeling actions were carried out on sampled oranges, one after the other. by varying angle of cut from 5° to 45° from normal cutting direction of the tool. It is inferable from the results that the optimum cutting angle lied between 15 and 20° from the normal cutting direction. At this regular arrangement, smoothness of peeling was good and time of peeling reduced as well. Reduction in peeling time as low as 10.26 sec was obtained at a cutting angle of 20°.poor performance of the peeler was noticed while cutting angle was set beyond 20° or below 15°. The cost was very low as compared with the cost of similar peeling machines. Other advantages of using the machine include: low maintenance requirement, machine is light weight, smoothly peeling outcomes and fabrication materials ere sourced locally.

IV. LITERATURE REVIEW

Nuhu A. Ademoh[1]This paper discussed about the effective machine for peeling oranges which is manually operated useful for individual and family household. In this machine electric motor is used is to drive the threaded shaft. Its productivity can be increased for commercial use. The costing of this machine can be reduced if this device is mass produced for sale. Author suggested that to used aluminum or polymer material for rotary arm. Handle for rotation is placed at top of machine for our convenience to apply force to rotate handle. Author suggested to use strong plastic for construction of frame and base.

Praveen Kumar S Nahata & Oruganti Santhosh[2] In this research paper the apparatus used for peeling fruits is designed this machine was tested and found the importance of this machine for peeling fruits. This machine is used for peeling small as well as medium size fruits. Author suggested to use sensor for cutting process. The machine designed is light weighted. This machine is used for household use and food dispensing business such as hotels.

V P Talodhikar & V S Gorantiwar[3] this paper discussed about various types of peeling tools and their materials.by considering the mechanism for peeling, knife and blades, abrasive, rollers, milling cutters and roller cutters are used. They stated that this machine is designed to avoid worker fatigue. It results into good efficiency with less peel loss.

Krishna Prakasha & Mahadev U M[4] the main aim of this research is develop pineapple cutting machine which is automatic and components used int his machine are motor, solenoidal valve, lead screw, pneumatic cylinder, microcontroller and proximity sensors, etc. in automatic machine time required for operation is less than manual machine.

M.K. Siti Mazlina & A.R.Nur Aliaa[5] this paper includes the design and development of apparatus for peeling fruit. This machine is suitable for the domestic use.it mainly designed for reducing the peeling time than manual machine.peeling time is depend on size and texture of fruit skin.

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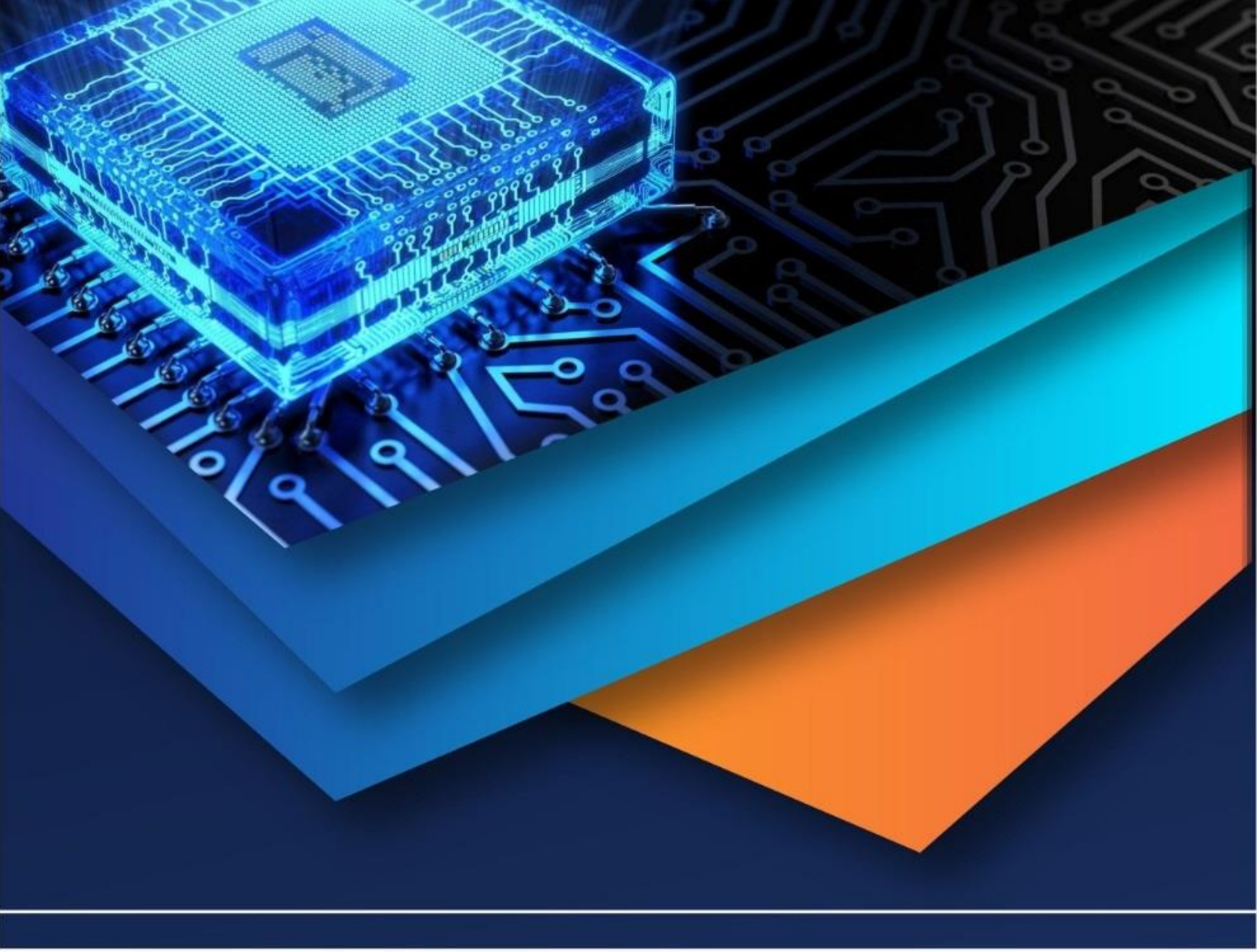
V. CONCLUSION

The improvement made on the traditional orange peeling machine has successfully erased the challenges encountered in its application for orange peeling purposes in small scale businesses. In the new design, peeling time was highly reduced as compared with what was obtained in the past. The new design is cheap, maintainable, flexible, lightweight, and safe to handle/operate as compared with the past designs that are operationally complex, costly and unaffordable to the low-income business populace of developing economy. The cost of the machine can be reduced further under mass production arrangement. This can serve as entrepreneurship drive for those people interested in orange business at domestic, small-scale and medium-scale industrial levels. The design outcomes can be a starting point for system automation with target of enabling continuous production of peeled oranges at a minimum possible time. Attainment of this objective will break new ground towards installing effective processing system in the small and medium scale beverage industries that will enable high level of productivity that will bring about low price of goods and services.

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