

Design and Fabrication of Boiled Egg Shell Removing Machineintegrated with Vegetable Chopper

Mr. R. Senthilkumar^{#1}, G. Lakshman ^{*2}, S. V. Nitin Sanjeeth ^{#3}, T. Rikesh^{#4}

Department of Mechanical Engineering, Sri Sairam Engineering College, West Tambaram, Chennai
600044

Abstract

This paper presents the design and fabrication of an innovative automated machine capable of efficiently removing boiled eggshells while simultaneously functioning as a vegetable chopper. The integration of these two functionalities aims to streamline kitchen processes, saving time and effort for users. The machine consists of several key components working in harmony to achieve its dual purpose. The boiled egg shell removal mechanism employs a combination of gentle agitation and water jets to loosen and dislodge eggshells from the cooked eggs. This process is carefully engineered to ensure the shells are removed without damaging the underlying egg whites or yolks. Simultaneously, the vegetable chopping functionality utilizes a high-speed rotary blade system capable of precisely slicing various vegetables with different textures and densities. Components are carefully assembled and calibrated to guarantee optimal performance and consistent results.

Keywords :automated machine, boiled egg shell removal, vegetable chopper, design, fabrication.

Introduction

From the research we conducted on restaurants and hostels, we came to know that we have to peel more

number of eggs on a daily basis, it takes them longer than 15 seconds on average to peel one egg and lose 15% of eggs they peel as unsellable eggs due to the damage caused during peeling. So, it coststhem 25 minutes and 15 eggs every business day, just on the egg-peeling job. These eggs are soft and easy to break. So, we'd need to be focused and engaged when peeling eggs. Now imagine you'd need to keep peeling 100 eggs or more in a row. It is very time consuming and labor intensive. And, you need to do it or have someone do it every day. Cracking, breaking, and removing the eggshells from the eggs without damaging the egg whites is a difficult task to realize and in-the end, we are just losing time and eggs in this laborious job. On the research we conducted some restaurant owners spends 2 hours every day just on hand-peeling 420 eggs, 15% of which they end up being unable to sell due to the damage to the eggs. They pay extra money to their labors for this time-consuming job. They lose 15% of 420 eggs on average every time because of the damage done to the eggs during peeling. That's 63 eggs that turn unsellable on average every time.

Methodology

The machine is designed in a way that on the left side there is an egg shell remover and on the opposite side there is a vegetable chopper. This product has undergone multiple phases of development. The model was created in the CAD software once the material was selected based on the resources which were available and the material's calculations had

been accomplished. The draft plan for the motor was obtained using the power and parts such as rollers, and pathway. Then the prototype of the egg shell remover based on the design considerations was made using the low cost materials and the components was tested individually to ensure that the functions of egg shell remover the satisfies the design intent. Next there was a prototype made for the vegetable chopper based on the design considerations and the materials used. Ultimately, the product was manufactured in accordance with the CAD design and then the pump, tank, and tubes were assembled and the seals were made tight such that the tubes are aligned correctly. The pumps are assembled onto the tank and it is linked to the electrical outlet and the nozzles are attached at the appropriate interval along the spray boom and their angles are adjusted such that the pipes are aligned correctly. An appropriate battery has been identified and we made sure that the sprayer is operational before using by testing all the parts and the adjustments were made. The blades were fixed on to the motor shaft and the rotation of the blade was tested according to the speed required to chop the vegetable. The rollers and the pathway were attached with the motor and was fixed in its position. After the fixing the speed of the motors were controlled according to the speed required for removing the egg shell. Then both sides of the machine were tested at the same time for knowing the balance of the machine.

The Various Types of Egg shell remover and Vegetable chopper are

Vegetable chopper

The vegetable chopper is a very tiny, compact device. It is used to chop the vegetables such as onion, potato, etc., The vegetable chopper has very sharp blades in such a way that the chopped vegetables are chopped very precisely. It works on the press mechanism in such a way that when it is pressed the blades will rotate, which is connected through electrical supply. The vegetable chopper are designed and used in household works as well as industries.



Fig 3. Vegetable chopper

Egg shell remover

Eggs peeling machine is a special peeling machine for shelling boiled chicken eggs automatically. It can shell eggs in high efficiency and with little breakage. It is the best choice for manufacturers to make boiled eggs, spiced eggs, other egg products, etc. This egg peeling machine can be used in the eggs processing production line or used alone.



Fig 4. Egg shell remover for household works



Fig 5. Egg shell remover for industrial purpose

Overall Design

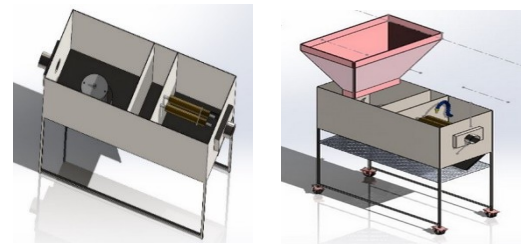
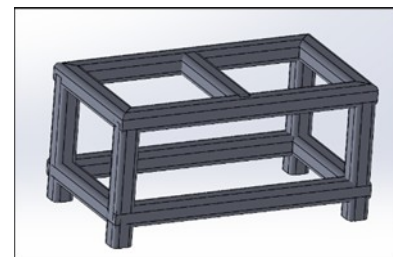


Fig 6. Overall design of the machine in top view

Parts used in the machine

The Frame

The frame is made up of pressed steel to carry contents. These withstand any temperature, climates and time of operations. The chassis is made up of mild steel considering the properties like corrosion, cost, density, weldability etc.



3. Vegetable
er for industries



Fig 8. Frame of the machine

Physical property of steels are :

- High tensile strength.
- High impact strength.
- Good ductility and weldability.
- A magnetic metal due to its ferrite content.
- Good malleability with cold-forming possibilities.

Suitable for various heat treatment options to improve properties

Roller Wheels

The wheels are made of tube less tires to have free movement and reduced weight of the overall machine. These have bigger surface to move on rough surfaces and smooth surfaces. The wheels would have a lock which will help to keep the machine in one place.



Fig 9. Roller Wheels

Motor

The motor that are fixed in the machine are used for the rotation of the rollers in the egg shell remover and used in the rotation of the glide way in the egg shell remover in which the egg travels.



Fig 10. Motor for vegetable chopper

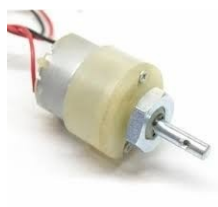


Fig 11. Motor used in egg shell

Rollers

The rollers that are fixed in the egg shell remover are used to remove the egg shells. The rollers have a rough surface which helps to create friction between the surface of the roller and the surface of the egg shell.

Glide way

The glide way is the pathway for eggs through



Fig 12. Rollers of egg shell remover



Fig 13. Rollers used in existing design



rotates up to 360degrees and it has sharp edges in which the shells are removed.

Fig 14. Glideway for egg shell remover

The Battery

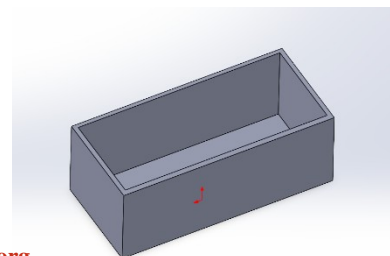
Chemical energy is stored in the battery and converted into electrical energy using its 12V capacity. A variety of factors have been taken into account when selecting the right battery. The battery power is used only for the pump.



Fig 15. Battery

The Tank

The removed egg shells are stored in the storage tank. Those stored egg shells can be used as manure or a additive for the cement after drying it.



Conclu Fig 16. Design of tank for storing egg shells

In conclusion, careful evaluation of a number of elements, including design, functionality, safety, is necessary for the development of an efficient machine for industries. We have worked hard to develop a solution that tackles these issues and satisfies the requirements of all places from household to industries through extensive study, prototyping, testing, and refinement. Efficiency and accuracy are given first priority in our design, which ensures effective design. We hope to improve our machine's accessibility and usage while protecting the safety of users and the surrounding ecosystems by including features that are easy to use and safe. Our commitment to responsible stewardship of resources is further demonstrated by our adherence to best practices in industrial application and regulatory compliance. When compared to manual type of cutting and peeling, time taken for egg shell removing and vegetable cutting for this machine is reduced. Through collaboration with relevant parties and the utilization of technological and scientific developments, we can endeavor to realize a time when egg shell management is not only efficient but also ecologically sustainable.

Reference

- [1] Loretta L. Williams Dr. Kam Leang, Outta the Shell: The Automatic Boiled Egg Peeler May, 2012 <https://www.mdpi.com/2076-3417/12/13/6606/pdf>
- [2] Evgenii M. Shcherban, Sergey A. Stelmakh, Alexey N. Beskopylny 2, Levon R. Mailyan Enhanced Eco-Friendly Concrete Nano-Change with Eggshell Powder Dec 2022 <https://doi.org/10.3390/app12336606>
- [3] S. Ramya, S. Vijayakumar, E. Vidhya Najat A. Bukhari, Ashraf Atef Hatamleh, M. Nilavukkarasi b , S. Vijayakumar, Thi Huong Najat A. Bukhari, Ashraf Atef Hatamleh , M. Nilavukkarasi b , S. Vijayakumar, Thi Huong Pham d TiO₂ nanoparticles derived from egg shell waste: Eco synthesis, characterization, biological and photocatalytic applications July 2022 <https://doi.org/10.1016/j.envres.2022.113829>.
- [4] Thuy T. Le, Kumari Shilpa, Choongsze Lee, Sungmin Han, Conan Weiland, Simon R. Bared, Paul J. Dauenhauer b , Jeffrey D. Rimer Core-shell and egg-shell zeolite catalysts for enhanced hydrocarbon processing January 2022 <https://doi.org/10.1016/j.jcat.2021.11.004>.
- [5] Hussein M. Hamada, Bassam A. Tayeh b, Alyaa Al-Attar, Fadzil M. Yahaya, Khairunisa Muthusamy A, Ali M. Humada. The present state of the use of eggshell powder in concrete November 2020.
- [6] Zhenxiang Huang and Dapeng Ye Cooked egg sheller based on ADAMS optimization October 2018 [doi:10.1088/1742-6596/1074/1/012176](https://doi.org/10.1088/1742-6596/1074/1/012176)