Design and Fabrication of Automatic Squeezing Machine for Food Industries

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Abstract: In the food sector, automation is increasingly a requirement to meet the requisite aspects of quality control, delivery performance, labour shortages, and revenue growth. Because of extremely competitive retailers always pulling to low prices, raw costs of raw material, and skyrocketing charges for utilization in an environment of labor-intensive production, food manufacturers are looking to automate their manufacturing operations. The capacity to mimic a product’s aesthetic and quality with the least amount of materials not only increases line efficiency and profits, but it also has the potential to enhance sales. It also decreases the amount of work that has to be done. This food squeezing machine will squeeze food at a fast speed and in a more precise shape. In comparison to manual and traditional processes, the production rate is also high.

Keywords: productivity, quality, safety, adaptability, and precision.

1. Introduction

Computers technologies, robots, and information technology are used for automation system for handling various processes and machineries in an industry to replace a human being is known as industrial automation. Workers feel sophisticated by automation.[1] It is the next step in the industrialization process after mechanization. It increases the rate of production by improving production control. Freedom from microbial contaminants can be achieved by automation. [2] It aids in the production of large quantities by reducing product processing time while improving quality. As a result, a given labour input yields a huge range of outcomes. Depending on the type and proportion of their quantity, the meal comes in a variety of flavors. In the food sector, automation can help to improve hygiene and food quality. It also has a high level of productivity, quality, safety, adaptability, and precision. Maintaining the nutritional value during production is primary task [3] Automating the process can result in high-quality meals with consistent shapes and sizes. It can also help with labour cost, time, and workload reduction. The advantages of using automated machines are less processing time, increases the efficiency of performance, increases the production capacity and reduces the waste and spillage. [4] Automatic machines can produce meals at a faster rate and with a more precise shape. It
reduces the labour cost for production and improves profit. [5] There are numerous advantages to automating food production. The capacity to mimic a product's appearance and quality with the least amount of materials not only improves line efficiencies and profits, but it also has the potential to enhance sales. A fast food processing machine can able to deliver the food products within a short period of time mainly used for customer retention. [6] At the same time, boosting raw ingredient traceability has the extra benefit of improving food safety. The issue that many in the food business are encountering is that line automation in the food sector is not the same like the industries of automobile and pharmaceutical in which automation is streamline and in huge level. During the production of fast food, an automated fast food machine squeezes the duff mixture with the following category efficiency: time, human effort, safety, cleaning, and quality. [7] Components or products in these industries are frequently homogeneous in shape, size, weight, and texture, and can be easily manipulated by artificial hands and placed precisely where they are required at high speeds and without damage. Because many basic products or components of a product — whether pasta, sausages, tomatoes, cheese, or potatoes — differ in length, structure, quality, mass, and appearance, fully automated robots find it very hard to modify them at the point of manufacture, primary pack-aging processes in the food industry, which require the exploitation of raw food into its initial carton or wrapper, are difficult. Raw food product automation requires high levels of machine sterilization. Food squeezing machines take less ability to process, increase capacity and efficiency, and reduce spoilage and wastage. [9] This needs easily accessible and dismantleable components for cleaning or chemical washing. Because the removal process does not always take place at the end of the shift. It's critical to go back into production as soon as possible, because components are frequently deluged throughout the clean-up procedure. In the food industry, waterproofing components and reassembly has proven to be difficult. In most food manufacturing situations.

2. Scope of the project

In general hand squeezing process induces work related muscular skeletal disorders, joint pain and muscle cramps for the workers[10] To reduce fatigue, a detailed design and development of an automated food squeezing machine for big food industry applications is required. During food preparation, an automated food squeezing machine squeezes a thick combination of food with the following category efficiency: time, human effort, safety, cleaning, and quality. The growth and development of the food product selling sectors employing modern selling methods is aided by automation. [11] Most manufacturing businesses seek automation engineers with a basic understanding of machines and the capacity to work on a variety of brand devices. This design primarily informs the user about the machine's cost as well as its efficiency in terms of time. As a result, the food squeezing machine has a high production rate when compared to alternative manual and commercially available options. Food manufacturing automation has enabled workers to complete a batch in almost half the time they were previously required, resulting in higher food unit output, lower dough and electric energy consumption, lower attendance requirements, and improved worker productivity and working conditions. Furthermore, hygiene is improved, and less labour is required, resulting in an increase in profit. Small-scale industries can benefit from this work. The Automatic Food Squeezing Machines are made of high-quality metal to provide maximum durability and smooth operation. The use of cutting-edge technology has helped to promote these automatic food squeezing machines in the food industry.

3. Purpose of the project

The ultimate purpose of the project is

- The number of labors is reduced.
- As the amount of labour required decreases, so does the cost of labour.
- In comparison to the old method, it reduces production time.
- In comparison to other machines on the market, it is less expensive.
- The linear actuator is critical in the automation of squeezing processes, allowing the
food sector to improve and maximize production.

4. Parts of food squeezing machine

This machine consist of various parts such as, Hydraulic cylinder, Motor, Pressing plate, Relief valve Pressure gauge.

4.1. Hydraulic cylinder

A hydraulic is a mechanical actuator that delivers force along in an unique direction through a single-direction stroke. It is the base of most of the construction equipment, including engineering machines, automobiles and civil engineering equipment’s. The fixed and regulated flow of oil to the hydraulic cylinder by the hydraulic pump is the "generator" side of the hydraulic system. The types of hydraulic pumps used in industrial applications are hand pump, electrical and pneumatic. The piston pushes the oil back from the chamber to the reservoir. The force F on the piston rod equals The pressure in the cylinder is equalized by the piston rod force times the area of piston A if the oil enters from the cap end during the extension stroke and the oil pressure in the rod end/head end is almost zero. Hydraulic and pneumatic cylinders are pneumatic and hydraulic devices that convert fluid pressure energy into useful mechanical energy. Actuators, as they are often known, are frequently utilized in a variety of control devices. Hydraulic or pneumatic cylinders for unique motion motors for rotational motion, reciprocating actuators for rotational motion. The pneumatic cylinder converts the gas's pressure energy into mechanical energy by using compressed air as a supply of gas. Hydraulic and pneumatic cylinders are classed based on how they move, as indicated in the diagram. Single acting cylinders and double acting cylinders can be classified into hydraulic or pneumatic cylinders.

![Figure 4.1 Hydraulic Cylinder](image)

4.2. Pressing Plate

The primary function of pressing plates is to apply pressure to an object while maintaining a high level of strength. Mostly the work done by the machine is by pushing a plate or die against a work item. Depending on the type of machine the pressing action mechanics may vary. The machine press pushes the plate or die against the work piece's surface with hydraulic pressure, causing the work piece's shape to distort. Metal Forging, sizing, compression moulding, sheet metal blanking, die punching, for thin wire like structures deep drawing, and metal forming are all frequent uses for hydraulic presses. In manufacturing, and in food industries the hydraulic press is most commonly used as it allows for the creation of more complicated designs with material efficient. The pressing plate will revolve as a result of the pressure applied by the hydraulic motor. The food is
then squeezed according to user input by the pressing plates, which are connected to the hydraulic press via a connecting rod. Only the pressing will move, while the rest of the parts will remain motionless.

![Pressing Plate](image)

**Figure 4.2 Graphical Illustration of Pressing Plate**

4.3. Pressure Gauge

The type of material used to create the gauge is primarily determined by the pressure range at which it will be utilized. Gauges that operate at greater pressures are usually constructed of steel, whereas those that operate at lower pressures are usually composed of bronze. Gauges abound in pneumatic and compressed air systems, as pressure is recorded at numerous points throughout the system. FRL or regulator alone in the system, are all monitored for pressure. Hydraulic actuators are monitored for pressure as it decides the desired shape of the squeezed object. Pneumatic pressure gauges are typically rated for not greater than the value of 300 psi, while most systems operate at around 100 psi. Depending on the type of gauge and the material it is composed of, the hydraulic gauge may sustain a wide range of pressures. As a result, two of the most essential selection factors for gauges are gauge style and material.

![Pressure Gauge](image)

**Figure 4.3 Pressure Gauge**
4.4. Relief Valve

The fluid pressure in the hydraulic circuit is monitored and regulated by the relief valve, in which they are positioned. The valves seat are made in the form of ball shaped, poppet valve, or spool that is designed to mounted in a hollow or ported body and is resisted by a spring. A poppet is a disc or cone-shaped device that rests within an opposing machined seat and produces very minimal leakage when squeezed closed by spring pressure. A spool is a spring-loaded, cylindrical steel rod having measuring grooves or notches. The combination of pressure acting due to loading, pressure due to backpressure, and the energy required to flow through the valve causes a rise of pressure in relief valves. When the initial fluid force exceeds the seated force of the spring, cracking pressure occurs. The rate of pressure rise is stable as the valve flows additional fluid to the tank because the pressured fluid forces offset the spring's compression rate. As the valve bottoms out and is subjected to flow forces, pressure rises again as it approaches fully open. As the work or backpressure reduces, the valve begins to close at a different rate than when it first opened. The hysteresis of a curve is the difference between its opening and closing points, and it indicates the quality of its construction. Valves of higher quality with more advanced construction have a reduced pressure rise and better hysteresis. As hydraulic pressure in the circuit where the valve is situated rises, force against the spool or poppet begins to override the spring's opposing force, allowing a flow path to the tank to open. Energy is diverted (in the form of heat) as pressured fluid escapes the relief valve until downstream pressure meets the spring value force, which could be droplets of flow or the entire pump flow, depending on the application and state of the circuit.

4.5. Hydraulic Motor

In most cases the speed and torque required for squeezing operation at actual cases may sometimes be varied while keeping the required horsepower, the application of the hydraulic motor generally defines the required horsepower and motor speed range. The type of motor chosen is determined by the level of reliability, longevity, and performance required. Once the type of fluid has been decided, the actual size is chosen depending on the estimated life and the overall cost of the machine installation. A fluid motor running at less than rated capacity will have a service life extension that is more than proportionate to the lower operating capacity. When a motor is operating at maximum system pressure and maximum shaft speed, it produces its maximum horsepower. The motor's original cost will be the lowest if it is always used under these conditions. However, in cases where the output speed must be reduced, the entire cost of the motor with the reduced speed must be considered in order to reduce overall drive installation costs. The hydraulic motor will supply circular motion to the pressing plates attached to it, and the pressing plates attached to the hydraulic motor will rotate and squeeze the food to obtain the appropriate output.
5. Working Methodology

Figure 5.1 Fabrication of Squeezing machine

This food squeezing machine uses a hydraulic press to squeeze the food fed into the machine and generate the desired output. The hydraulic press principle is based on Pascal's law, which states that the strength of pressure in a static fluid is distributed evenly in all directions. Two cylinders of different diameters make up the hydraulic press. One cylinder has a big diameter and houses the Ram, while the other has a smaller diameter and houses the plunger pipe runs between the two cylinders. A liquid is contained in the cylinders and pipe and is used to convey pressure. When a modest downward force is given to the plunger, a pressure is created on the liquid in contact with the plunger. This pressure is distributed evenly in all directions and acts in an upward direction on the RAM. The ram is then hoisted up by the larger weight that has been placed on it. Due to this the food is squeezed easily from the die with the desired shape without much effort.

6. Advantages of squeezing machine

Considering the proposal, it has numerous advantages, including
- Increased productivity and food manufacturing efficiency.
- Labor's workweeks are becoming shorter.
- Due to a reduction in manpower, labour costs are also lowered.
- Time Efficiency is a factor that contributes to reduce downtime.
- A higher standard of product
- Increased process control results in more efficient material usage and less scrap.
- Enhanced security
7. Conclusion
A low-cost food-preparation machine. This project work has resulted in the development of a squeezing machine. All small-scale industrialists can use the built equipment as an affordable machine. Normally, the proposed system provides a cost-effective and long-term way for processing a variety of foods, as well as a hygienically safe approach for ingesting squeezed food for all developing countries. Automatic equipment have been a boon to the food processing industry, allowing for hygienic, high-quality food processing. A basic automatic machine can correctly and efficiently perform the work of several humans. Humans are being displaced by automated robots in every field, from agriculture to aerospace. With the introduction of this squeezing machine, both quality and quantity have improved.

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