

DESIGN AND FABRICATION OF SEMI-AUTOMATIC VEGETABLE CUTTING MACHINE

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Engineering degree in Mechanical Engineering

By

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SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafide work of **R. THARUN (Reg. No. 39150107)**, **M. SAIRAM (Reg. No. 39150114)**, who have done the Project entitled **"DESIGN AND FABRICATION OF SEMI- AUTOMATIC VEGETABLE CUTTING MACHINE"** Under our supervision from December 2022 to April 2023.

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Submitted for Viva voce Examination held on 26.04.2023

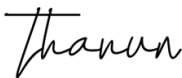
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DECLARATION

We **M. SAIRAM (Reg.No. 39150114)** and **R.THARUN (Reg.No. 39150107)** hereby declare that the Project Report entitled "**DESIGN AND FABRICATION OF SEMI- AUTOMATIC VEGETABLE CUTTING MACHINE**" done by us under the guidance of **Dr. NIVIN JOY M.E., PhD,** is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering in Mechanical Engineering.

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DATE: 26.04.2023

PLACE: CHENNAI

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ABSTRACT

This report deals with problems of manual vegetable cutting in industry. The existing vegetable cutting machines have a few drawbacks such as a big bulky design, high investment cost, additional manpower and time consumption. While manual cutting of vegetables is a laborious task and is prone to food contamination. The objective of the work is to design and fabricate a compact machine for home and small commercial uses in a novel design. The vegetables are kept in the machine and closed to avoid injury; the vegetables are secured and not squeezed. After the vegetables are placed a row of blades are used to cut the vegetables which pass through the gaps present at the rear of the machine to cut the vegetables using a gear mechanism and limit switches to control the blades, after the vegetables are cut, the blades and the bottom plate retract simultaneously so that the vegetables fall in a tray located below, the tray retracts so that you can remove the cut vegetables for the required purpose.

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CHAPTER 1

INTRODUCTION

Vegetables, which are defined as an herbaceous plant or a component of a plant that is eaten whole or in part, have seen a growth in demand over the past few years as a result of consumer health consciousness and technological improvement. Humans have been consuming vegetables from around 10,000BC to 7,000BC when a new way of agriculture developed. At first, plants which grew locally would have been cultivated, but as time went on, trade brought exotic crops from elsewhere to add to domestic types. Nowadays vegetables have been produced globally as climate persists. When we make veggies smaller for human consumption there are several significant issues that arise.

Vegetables were cut using knives as per traditional methods that have been followed for a very long time. On a commercial scale, a lot of labor is needed to cut the vegetables. This labor-intensive process also involves human mistakes, such as uneven vegetable cutting or harm from negligence. Most industries nowadays use automation, and vegetable cutting will soon be one of them. Currently, most work is done manually, but this is gradually changing to semi-automatic or fully automatic processes. In this machine the motor serves as the primary unit when it is originally connected to the supply. We have chosen the Sliding mechanism to convert the motor's rotary motion into linear reciprocating motion. Here, gears are used to develop our prototype.

Many vegetable cutters have been designed and developed. Using these machines requires less work and less time. Currently, most current vegetable cutting systems have the disadvantages of bulky structure, low efficiency and high cost. It is important to develop a time-saving vegetable cutter for all kinds of vegetables. The main goal of the project is to develop a compact and safe vegetable cutter for home and small businesses. The new cutting machine phase begins with researching the existing cutting machine to understand its performance, reliability, durability, mechanism and bring our understanding to create a new machine design.

To prevent damage and contamination of the vegetables while using the machine, the lid is closed once the veggies are placed inside the square cross-segment machine's upward opening chamber. In order to cut the vegetables, a row of blades

is pushed through gaps in the machine's back side. The blades retract once they hit the end of the machine, which is built into the machine. The veggies are held in place using an actuator plunger that is inserted into the machine's inner walls. In tandem with the bottom plate retracting, the sliced veggies fall into a tray that extends out to receive them.

The main aim of the fabrication of this vegetable cutter is to improve the time constraint problem to cut a large number of vegetables into smaller size and to design and fabricate an automated machine for home and small industry usage. This aim is achieved through the following objectives such as a reduction of human effort in the process of vegetable slicing. Allow variation of cutting by the user by removing and reattaching the blades. Ensuring the level of hygiene is maintained that is safe for consumption. This device is designed in such a way that when vegetables are placed and secured inside the machine, the sliding motion of the cutters are made to cut these vegetables thereby, reducing their sizes to its minimum. With the aid of the tray, the cut vegetables are collected.

CHAPTER 2

LITERATURE SURVEY

Justin Bagley et al [1]. designed a spiral slicer with a main body supporting a shaft turned by a crank handle to produce spiral-cut fruits and vegetables. A pusher that is attached to a fruit or vegetable and rotates with the crank handle is selectively moved toward a main slicing blade and a series of julienne blades. The main blade first slices the fruit or vegetable into juliennes, and the sliced section then passes through a space between the main blade and the julienne blades.

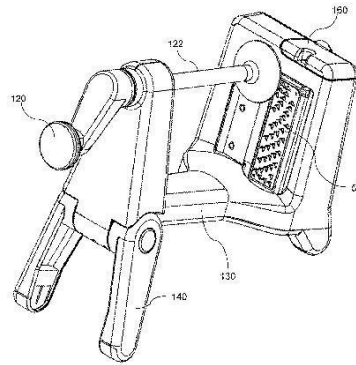


Fig-2.1 Spiral slicer for producing spiral cut fruits and vegetables

S. Gokul et al[2]. designed and Fabricated an Automatic Vegetable Cutting Machine featuring a slider crank mechanism, simple design, time-saving features, inexpensive price, and effective vegetable size reduction. Vegetable manual slicing has turned out to be a tiresome and time-consuming technique that also carries a high risk of food contamination and food-borne illness. Cutting vegetables is essential for nutrition in all homes and cafés. a fully automatic vegetable cutter.

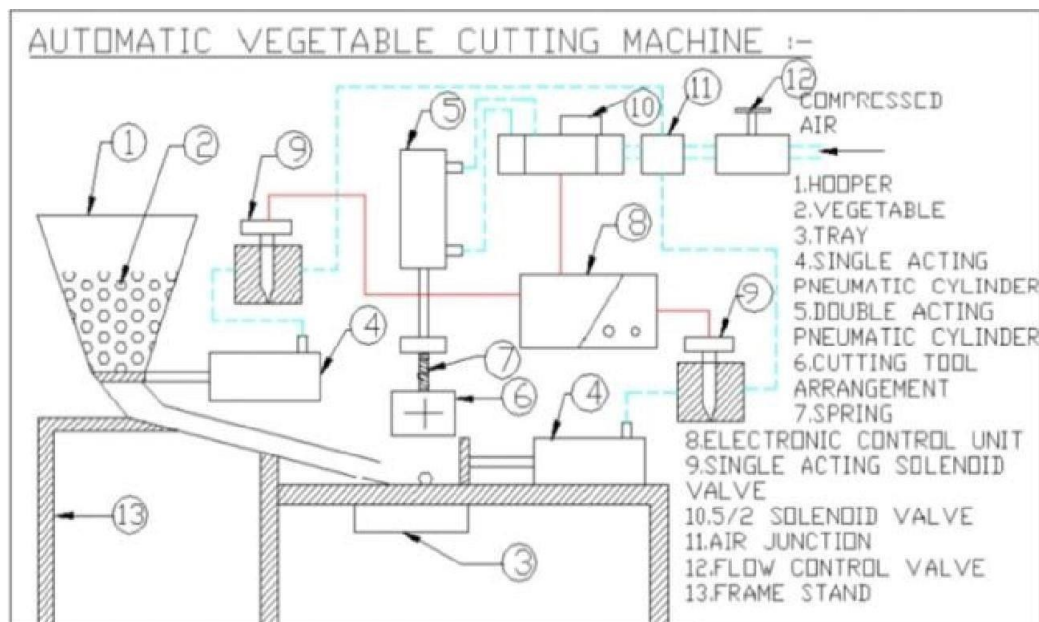


Fig-2.2 Automatic vegetable cutting machine

Ramakrishna Reddy et al[3] Fabricated the Automatic Vegetable Cutting Machine Slicing vegetables are a risky and time-consuming task in our busy lives. This work is aimed at solving above stated problems by introducing a specialized product. This machine is mainly designed to make the job of cutting vegetables easier and faster.

Mr. Krantidip et al[4]. Developed a Fruit and Vegetable Slicer Machine. The crucial unit action is slicing fruits and vegetables. Slices are a type of size reduction that aids in removing useful components from raw materials. For creating chips (wafers), breaking fruit for juice, or fermenting, slicing is best. The fruit and vegetable slicing machine were developed by considering the physical qualities of chosen fruits and vegetables because manual slicing is relatively sluggish operation, unsanitary, low quality, and requires special attention. Banana and potato were chosen to test the performance of the slicing machine. Calculations were made of the physical characteristics of banana and potato. The conceptual design and development of the slicer machine considered the physical characteristics of fruits and vegetables. The slicer device uses a cutting mechanism to reduce size. The device has four individual units viz. Feeding unit, slicing unit, Collection unit and Power transmission

unit Performance of the developed slicer machine for slicing bananas and potatoes has been assessed in terms of slicing capacity, broken percentage, and uniform slicing. In terms of quality and quantity, sliced products produced by a slicing machine are superior to those produced manually.

Ganyani, et al.[5] Designed an Automated Vegetable Cutter and Slicer. Manually slicing and slicing vegetables has been proven to be very time consuming, with a high risk of food contamination and a high incidence of food poisoning. Various methods are in place, including automation. The main objective of the entire project was to seek a simpler, time-saving, relatively inexpensive and efficient design during the vegetable size reduction process. Harmless products are manufactured using UVlight, and this machine has built-in UV light. The working principle of the machine is related to the theory of rotating concave discs. The machine has rotating elements and should always be used with caution.

G. Chandramohan, et. al.[6] Designed and Fabricated of Vegetable Cutter. The examination into this vegetable cutting machine looks at the disadvantages of manual processing, like the high investment cost, contamination, additional labour, and time consumption. The pressure block is actuated by a pneumatic cylinder and features a reciprocator motion along the vertical length of casing, while the cutting grid remains fixed, during this setup. The air supply to the cylinder is controlled by a microcontroller-controlled solenoid-actuated DCV. A pneumatic cylinder and one bar mechanism govern the entry of vegetables into the grid system. Vegetables are fed by an angled tube. After the vegetable pieces are processed, a tray is placed at the underside of the equipment to collect them. The microcontroller controls the pressure for cutting different vegetables. the sort of veggies that such a system can process adds to its complexity. Because present automation is dear and consumes a lot of energy, the system is advantageous. Pneumatic power, which is plentiful, is advantageous to the suggested work.



Fig-2.3 Vegetable Cutter

A. Nishanth, et al.[7] Designed a Vegetable Cutter Machine. A Vegetable cutting machine was designed and constructed. It is automated to reduce the effort of human and it works with the help of electric DC motor. (Rotation motion & Crank lever mechanism). The vegetable is kept on the cutter bed made of stainless-steel sheet to drum which carries blade made of stainless steel. The chute is constructed of stainless steel. It accepts the chopped vegetable and release it out with the aid of gravitational force and also is used for higher scale vegetable cutting application. It has an innovative emergency switch for the safety while system is under automated control.

James chambos et al [8]designed a machine for slicing potatoes for frying, the potato cutter having a series of parallel scoring knives projecting toward the potato and rising along lines radial to the axis of rotation of the potato. is rotated and moved toward Similarly, radially extending cutting blades are positioned perpendicular to the rotation axis of the potato to continuously cut the scored portions. A carriage is provided which is guided toward and away from the cutting tool in a direction parallel to the axis of rotation of the potato, and a drive motor is mounted on the carriage for movement therewith. terminating in a potato engaging and supporting member having teeth that engage the potato to support it and rotate the potato with the shaft.

Vertical vegetable cutting machine William C et al.[9] A vegetable cutting machine was produced to cut the vegetables vertically rather than horizontally like a hydraulic press.

Rudolf Schillheim et.al.[10] designed Apparatus for spirally cutting fruits and hard vegetables such as apples, radishes, carrots, beets, cucumbers, etc. A manually operated fixing and driving device for the material to be cut, the manually operated fixing and driving device being arranged above the cutting device, the housing being designed as a box and provided with a cover arranged on the housing, the fixing and driving device is attached to a cover, which is provided with a grip-shaped extension and is arranged around the cover.

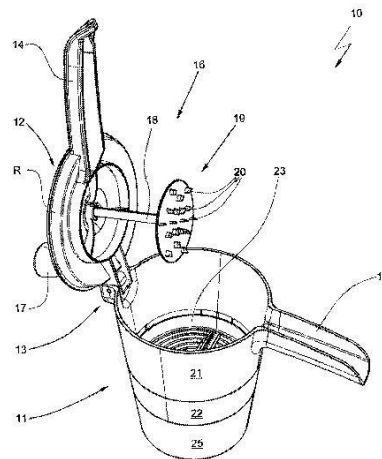


Fig-2.4 spiral cutting of fruits and vegetables

C.P.N. Awili et al[11]. Designed a Manual Vegetable Slicing Machine. Vegetables are fed into the machine via an aluminium sheet hopper and into a cutting drum equipped with stainless steel cutting blades. A stainless-steel chute picks up the cut vegetables and releases them with the help of gravity. The higher the rotation speed, the higher the cutting capacity and the lower the cutting efficiency.

[1] Jain University designed A multimode vegetable reducing tool that mixes the specialized capabilities of diverse vegetable reducing system right into a unmarried tool that satisfies the capability of multi-mode reducing without involvement of the consumer which in flip save you probabilities of harm reasons all through reducing. According to an embodiment of the prevailing work, a multimode vegetable reducing tool incorporates of a cuboidal frame assembled with flaps through motorized hinge having 4 booths to carry out specific mode of operations, a consumer interface set up inside a computing unit linked to tool permits consumer to pick mode of operation and for that reason speaker notifies the consumer to orient tool in suitable manner, a

weight sensor is plugged inside every of the compartment to degree the load of vegetable saved and whilst degree weight crossed threshold limit, speaker alert the consumer, a cover hinged to first compartment cowl veggies vicinity inside first compartment to carry out grinding of vegetable.

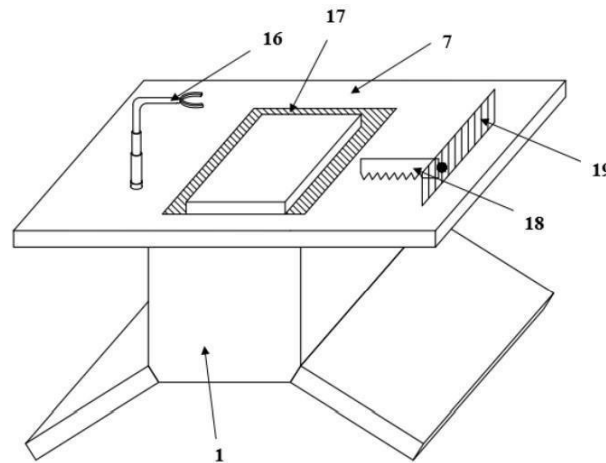


Fig-2.5 multimode vegetable cutting device

Badadal Raghavendra et al.[12] Experimented on the determination of cutting force required for severing fruit stalks. The cutting force required to cut the fruit stem was determined experimentally and the experimental methods are described in the publication. Harvesting of fruits is carried out in various ways. Harvesting the fruit by cutting the stem has its own benefits. The presented method produces stem cutting force and cutting torque data useful when designing harvesting tools. Current work is limited to fruit stalks such as mango, guava and custard apple and vegetable leg stalks. This work can be applied to generate cutting force and cutting torque data required to cut branch tips and small stems. This helps in the development of golden tools.

Subrata Talapatra et al [13]. designed Product Design Tools for the Development of an Automated Vegetable Chopper In today's age of industrialization, automatic machines have become an integral part of human life, significantly reducing the time needed to complete a specific task. With life becoming more competitive and fast-paced, automation, aided by technology, has helped to save a substantial amount of human effort and time. However, chopping vegetables remains a risky and time-consuming task, especially in our busy lives. This is where the Automatic Vegetable

Chopper comes in, designed specifically to make the job of chopping vegetables much easier and faster, while also reducing the need for manual labor. The product's key features include being fully automated, portable, consuming less power, and having a changeable stainless-steel sharp blade. The design and development of this product followed a structured product design process, with the help of a team of design engineers. The process involved product planning, identifying customer needs, establishing product specifications, screening and scoring product concepts, and creating a bill of materials. By following this process, the team was able to design a highly effective product that met the needs of customers while also being efficient .

CHAPTER 3

AIM AND SCOPE OF WORK

3.1 AIM

The aim of a semi-automatic vegetable cutting machine is to efficiently and effectively cut various types of vegetables into consistent and uniform shapes, sizes, and thicknesses. The machine is designed to automate the cutting process, reducing the amount of manual labour required and increasing productivity.

Semi-automatic vegetable cutting machines are commonly used in commercial kitchens, restaurants, and food processing plants. They can cut a wide variety of vegetables, such as potatoes, carrots, cucumbers, onions, and more, into various shapes, including cubes, strips, slices, and julienne cuts.

The machine is designed with a variety of cutting attachments and blades, which can be easily swapped out depending on the type of vegetable being cut and the desired cut style. The vegetable is fed into the machine through a hopper or chute, where it is then automatically sliced or diced by the machine.

The aim of a semi-automatic vegetable cutting machine is to streamline the vegetable cutting process, saving time and increasing efficiency in the kitchen or food processing facility. By automating the cutting process, the machine can also help to reduce labour costs and improve the consistency and quality of the vegetable cuts, resulting in a more appealing final product for consumers.

The aim of this work is to provide an alternative to the current vegetable cutting market in terms of cutting the vegetable for home and small industry applications. It takes less time when compared to manual cutting process, the variety of cuts is done by removing the unnecessary blades for the process.

3.2 SCOPE OF THE WORK

The scope of semi-automatic vegetable cutting machines is broad, and they have a wide range of applications in the food industry. They are used in restaurants, cafeterias, food processing plants, and other food-related businesses to increase productivity, reduce labour costs, and improve efficiency in the vegetable cutting process.

In the future, the scope of semi-automatic vegetable cutting machines is expected to expand as demand for processed foods and convenience foods continues to grow.

The global market for vegetable cutting machines is projected to grow at a significant rate over the next few years, driven by factors such as rising disposable income, changing lifestyles, and increased demand for convenience foods.

One of the major trends in the food industry is the increasing demand for healthy, fresh, and minimally processed foods. This trend is expected to drive the development of semi-automatic vegetable cutting machines that can produce precise and consistent cuts for salads, stir-fry dishes, and other healthy meal options. As consumers become more health-conscious, the demand for fresh, nutrient-rich vegetables is likely to increase, and semi-automatic vegetable cutting machines can play an important role in meeting that demand.

Another trend that is expected to drive the future scope of semi-automatic vegetable cutting machines is automation. The food industry is increasingly turning to automation to increase efficiency, reduce labor costs, and improve productivity. Semi-automatic vegetable cutting machines are already a part of this trend, and they are likely to become even more automated in the future, with advanced features such as computerized controls, sensors, and robotics.

Overall, the future scope of semi-automatic vegetable cutting machines is bright, as they continue to play an important role in the food industry. With the increasing demand for healthy, fresh, and convenient foods, as well as the trend towards automation, these machines are likely to become even more important in the years to come.

The main scope of the project is to reduce the use of manual cutting and to automate the process furthermore this machine can be used in the case of weddings, hotel chains, restaurants, mess halls and places where a large gathering of people are expected to consume food and to provide a simpler alternative to the vegetable cutter market where most of the vegetable cutter in the market are big and clunky.

CHAPTER 4

MATERIALS USED

4.1 STAINLESS STEEL

Stainless steel is an alloy of iron that is resistant to rusting and corrosion. It contains at least 11% chromium and may contain elements such as carbon, other nonmetals, and metals to obtain other desired properties. Stainless steel's resistance to corrosion results from the chromium, which forms a passive film that can protect the material and self-heal in the presence of oxygen.

The alloy's properties, such as luster and resistance to corrosion, are useful in many applications. Stainless steel can be rolled into sheets, plates, bars, wire, and tubing. These can be used in cookware, cutlery, surgical instruments, major appliances, vehicles, construction material in large buildings, industrial equipment (e.g., in paper mills, chemical plants, water treatment), and storage tanks and tankers for chemicals and food products.

The biological cleanability of stainless steel is superior to both aluminium and copper, having a biological cleanability comparable to glass. Its cleanability, strength, and corrosion resistance have prompted the use of stainless steel in pharmaceutical and food processing plants.

Different types of stainless steel are labelled with an AISI three-digit number,[4] The ISO 15510 standard lists the chemical compositions of stainless steels of the specifications in existing ISO, ASTM, EN, JIS, and GB standards in a useful interchange table.

Stainless steel has been used with phenomenal success in various industries for over 70 years. More applications are being discovered with every passing year as its advantages become more widely identified. With an increase in demand, production has increased making it more affordable than ever. Increased demand results in availability in standard as well as non-standard sizes. Also, a wide range of stainless-steel finishes is available for choosing. Besides polished finishes, a whole range of patterned and coloured surfaces are available. This makes finding a suitable option for your needs possible. Stainless steel is also 100 per cent recyclable. In fact, half of all stainless-steel production is from scrap metal. This makes it a relatively eco-friendly material.

In this work the machine contains a 300 series stainless-steel. This series is used to name austenitic stainless steels with carbon, nickel, and molybdenum as alloying elements. The addition of molybdenum improves corrosion resistance in acidic environments while nickel improves ductility. AISI 304 and 316 are the most common grades in this series. AISI 304 is also commonly known as 18/8 steel as it contains 18% chromium and 8% nickel.

4.2 MILD STEEL

Mild steel, also known as low-carbon steel, is a type of steel that contains a low percentage of carbon, usually less than 0.3%. This type of steel is widely used in a variety of industries, including construction, manufacturing, and automotive.

Mild steel is a relatively soft material that can be easily shaped and welded. It is used in the construction of buildings, bridges, and other infrastructure projects, as well as in the production of appliances, machinery, and transportation equipment. It is also commonly used for structural applications such as pipes, tubing, and beams.

One of the key benefits of mild steel is its affordability. It is one of the most inexpensive types of steel available, making it a popular choice for large-scale projects where cost is a major consideration. Additionally, mild steel can be easily cut and shaped using common tools, which makes it a versatile material that can be adapted to a wide range of applications.

Another benefit of mild steel is its ductility. Mild steel is a malleable material that can be easily formed into various shapes without cracking or breaking. This property makes it ideal for fabrication and welding, as it can be bent, twisted, and formed to fit a variety of needs.

However, mild steel does have some drawbacks. It is less durable than some other types of steel and is more susceptible to rust and corrosion. To prevent rust and corrosion, mild steel is often coated or painted. Additionally, its relatively low strength and hardness may make it unsuitable for certain high-stress applications, and it can deform under heavy loads.

Overall, mild steel is a versatile and widely used material that is ideal for many applications where affordability and ease of fabrication are important considerations. Its ductility, affordability, and versatility make it a popular choice for a wide range of industries and applications. However, it is important to consider the limitations of mild steel when choosing a material for a specific project.

In our project work mild steel is used in blades for cutting of vegetables as stainless steel cannot be sharpened as much as mild steel for cutting vegetables.

4.3 FRAME

Stainless steel is a popular material used for a variety of applications, including the construction of frames for structures such as buildings and bridges. A stainless-steel frame offers numerous benefits, including strength, durability, and resistance to corrosion. One of the key advantages of using stainless steel for a frame is its strength. Stainless steel is a very strong material, capable of withstanding significant amounts of weight and stress without bending or breaking. This makes it an ideal material for structures that need to be strong and stable, such as high-rise buildings, bridges, and other large structures. In addition to its strength, stainless steel is also highly durable. It can withstand exposure to a range of environmental factors, including moisture, extreme temperatures, and even chemicals. This makes it an excellent choice for use in harsh environments, such as coastal areas where salt water can corrode other materials.

Another key benefit of stainless-steel frames is their resistance to corrosion. Stainless steel contains chromium, which creates a thin layer of oxide on the surface of the metal. This layer of oxide protects the metal from corrosion, which means that stainless steel frames can last for decades without rusting or deteriorating. Stainless steel frames are also aesthetically pleasing, with a sleek and modern appearance that can enhance the overall design of a building or structure. They can be polished to a high shine, or left with a brushed or matte finish, depending on the desired look. However, there are also some potential drawbacks to using stainless steel frames. The main disadvantage is the cost, as stainless steel is generally more expensive than other materials such as aluminium or carbon steel. This can make it a less attractive option for budget-conscious projects. Another potential drawback is the weight of stainless-steel frames, which can be heavier than other materials. This can make transportation and installation more difficult, and may require additional support structures to be put in place.

In conclusion, stainless steel frames offer a range of benefits for a variety of applications, from high-rise buildings to bridges and other large structures. Their strength, durability, and resistance to corrosion make them a reliable and long-

lasting choice, while their modern appearance can enhance the overall design of a project. While there are some potential drawbacks to consider, such as cost and weight, the advantages of using stainless steel for frames make it a popular choice for many constructions' projects



Fig 4.1 Stainless steel frame

The stainless-steel frame keeps all the parts of the machine intact and is of the dimensions of 1400mmx740mm

4.4 MOTOR

An electric motor is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding to generate force in the form of torque applied on the motor's shaft. An electric generator is mechanically identical to an electric motor, but operates with a reversed flow of power, converting mechanical energy into electrical energy. Electric motors can be powered by direct current (DC) sources, such as from batteries, or rectifiers, or by alternating current (AC) sources, such as a power grid, inverters, or electrical generators.

Electric motors may be classified by considerations such as power source type, construction, application, and type of motion output. They can be powered by AC or DC, be brushed or brushless, single-phase, two-phase, or three-phase, axial or radial flux, and may be air-cooled or liquid-cooled. Standardized motors provide convenient mechanical power for industrial use. The largest are used for ship

propulsion, pipeline compression and pumped-storage applications with output exceeding 100 megawatts. Applications include industrial fans, blowers and pumps, machine tools, household appliances, power tools, vehicles, and disk drives. Small motors may be found in electric watches. In certain applications, such as in regenerative braking with traction motors, electric motors can be used in reverse as generators to recover energy that might otherwise be lost as heat and friction.

Electric motors produce linear or rotary force (torque) intended to propel some external mechanism, such as a fan or an elevator. An electric motor is generally designed for continuous rotation, or for linear movement over a significant distance compared to its size. Magnetic solenoids are also transducers that convert electrical power to mechanical motion, but can produce motion over only a limited distance.

In our use case we use a Brushed DC motor. DC brush motors are one of the simplest and are found in many appliances, toys, and automobiles. They use contact brushes that connect with a commutator to alter current direction. They are inexpensive to produce and simple to control and have excellent torque at low speeds (measured in revolutions per minute or RPM). A few downsides are that they require constant maintenance to replace worn out brushes, have limited in speed due to brush heating, and can generate electromagnetic noise from brush arcing.

A commutated DC motor has a set of rotating windings wound on an armature mounted on a rotating shaft. The shaft also carries the commutator. Thus, every brushed DC motor has AC flowing through its windings. Current flows through one or more pairs of brushes that touch the commutator; the brushes connect an external source of electric power to the rotating armature. The rotating armature consists of one or more wire coils wound around a laminated, magnetically "soft" ferromagnetic core. Current from the brushes flows through the commutator and one winding of the armature, making it a temporary magnet (an electromagnet). The magnetic field produced interacts with a stationary magnetic field produced by either PMs or another winding (a field coil), as part of the motor frame. The force between the two magnetic fields rotates the shaft. The commutator switches power to the coils as the rotor turns, keeping the poles from ever fully aligning with the magnetic poles of the stator field, so that the rotor keeps turning as long as power is applied.

In this work a three phase 1hp motor is used to power the machine. A three-phase motor is a type of electric motor that operates on three-phase power, which is a type of alternating current (AC) power that provides three separate sinusoidal waveforms that are 120 degrees out of phase with each other. Three-phase motors are widely used in industrial and commercial applications because of their high efficiency, low maintenance, and reliable operation.

The basic components of a three-phase motor include a stator, rotor, and bearings. The stator is the stationary part of the motor, consisting of three separate windings that are evenly spaced around the inside of the motor casing. The rotor is the rotating part of the motor, consisting of a shaft and a set of conductive bars or coils. The bearings are used to support the shaft and allow it to rotate smoothly. When three-phase power is applied to the stator windings, a rotating magnetic field is created that interacts with the magnetic field produced by the rotor. This interaction causes the rotor to rotate, which in turn drives the load connected to the motor.

One of the key advantages of three-phase motors is their high efficiency. Because three-phase power provides a balanced set of sinusoidal waveforms, the motor can operate more efficiently than single-phase motors, which must rely on a single sinusoidal waveform that may not be as smooth or consistent. Three-phase motors are also more efficient than DC motors, which require additional components such as brushes and commutators that can introduce friction and reduce efficiency. Another advantage of three-phase motors is their low maintenance requirements. Because they have no brushes or commutators, three-phase motors have fewer moving parts that can wear out or require replacement. This can result in lower maintenance costs and longer motor life.

Three-phase motors also offer reliable operation, with fewer issues related to power fluctuations or voltage drops. Because the three-phase power supply provides a balanced set of waveforms, the motor is less likely to experience power surges or drops that can cause damage or reduced performance. This makes three-phase motors an ideal choice for industrial and commercial applications where reliable operation is critical.

There are several types of three-phase motors, including induction motors, synchronous motors, and wound-rotor motors. Induction motors are the most

common type of three-phase motor, and are widely used in industrial applications such as pumps, fans, and compressors. Synchronous motors are used in applications where precise speed control is required, such as in clocks or servo systems. Wound-rotor motors are used in applications where high starting torque is required, such as in crane and elevator systems.

In conclusion, three-phase motors are a reliable, efficient, and low-maintenance choice for industrial and commercial applications. Their high efficiency, low maintenance requirements, and reliable operation make them ideal for a range of applications, from pumps and fans to servo systems and cranes. While there are different types of three-phase motors, each with its own advantages and disadvantages, the overall benefits of using three-phase motors make them a popular choice for many industries.



Fig.4.2 Three phase 1 horsepower motor

4.5 GEARBOX

Gearboxes, also known as transmissions, are a fundamental component of many machines, vehicles, and industrial equipment. These devices use a system of gears to transmit power from a source, such as an engine or motor, to a load, such as the wheels of a car, the blades of a wind turbine, or the conveyor belt of a factory. Gearboxes play a critical role in controlling the speed, torque, and direction of the power being transmitted, allowing the load to operate efficiently and effectively.

The basic design of a gearbox includes a casing, gears, bearings, and seals. The casing is the outer shell that houses the other components, while the gears are responsible for transmitting the power from the input shaft to the output shaft. The gears can be designed with different sizes, shapes, and configurations, depending on the specific application. For example, some gears are designed to provide a high torque at low speeds, while others are optimized for high speeds with lower torque. The bearings support the rotating shafts and help reduce friction, while the seals prevent lubricant from leaking out of the gearbox.

One of the primary advantages of gearboxes is their ability to change the speed and torque of the power being transmitted. By using different gear ratios, a gearbox can increase or decrease the speed of the output shaft relative to the input shaft, while also increasing or decreasing the force or torque being applied to the load. For example, a car's gearbox is responsible for translating the high-speed, low-torque output of the engine into the low-speed, high-torque output needed to turn the wheels. This allows the car to accelerate quickly, climb hills, and maintain a consistent speed. In addition to their ability to control speed and torque, gearboxes also offer several other advantages. For example, gearboxes are highly versatile and can be used in a wide range of applications, from small machinery to large vehicles and industrial equipment. They can be designed to handle different power levels and speeds, and can be configured with different gear ratios and types of gears to meet the specific requirements of the application. Gearboxes are also highly reliable and durable; with proper maintenance and lubrication they can operate for many years without significant wear or damage. This makes them a cost-effective and reliable choice for many industries, where downtime and equipment failure can have significant financial and operational consequences.

Despite these advantages, there are also some potential drawbacks to gearboxes. One of the main disadvantages is their complexity. Gearboxes contain many moving parts, which can make them difficult to design, manufacture, and maintain. They also require regular maintenance and lubrication to ensure optimal performance, which can add to the operational costs of the equipment.

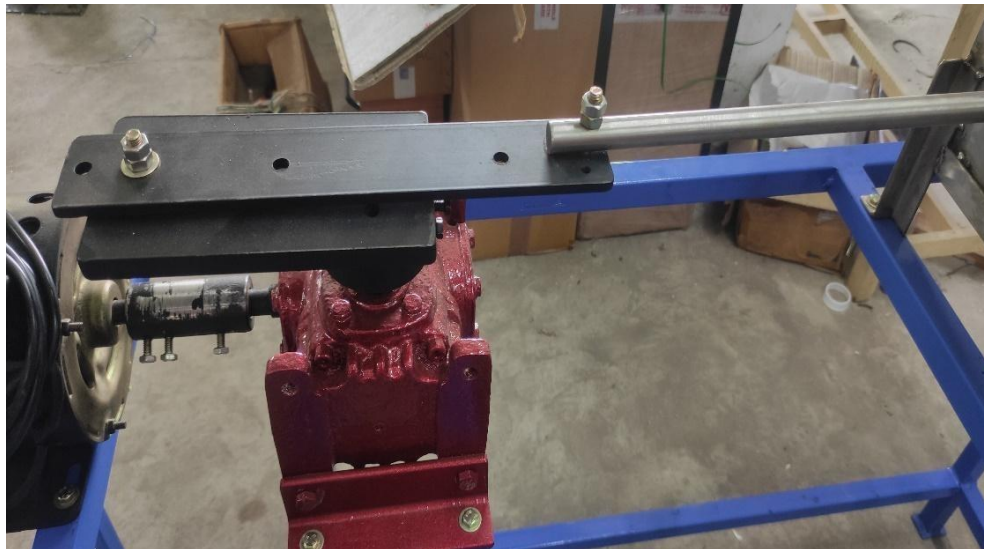


Fig 4.3 The gearbox converts the rotational energy of the motor to linear energy in this machine the gearbox is connected to 2 different objects to imitate the motion of the piston in combustion engines

Gear ratios are an essential aspect of gearboxes and transmission systems, allowing machines and vehicles to operate efficiently and effectively. The gear ratio is the ratio between the rotational speed of the input shaft and the rotational speed of the output shaft, and it plays a crucial role in determining the speed, torque, and power output of the system.

The gear ratio is expressed as a ratio of the number of teeth on the input gear to the number of teeth on the output gear. For example, if the input gear has 10 teeth and the output gear has 20 teeth, the gear ratio is 1:2, meaning that the output shaft will rotate at half the speed of the input shaft. Similarly, if the input gear has 30 teeth and the output gear has 10 teeth, the gear ratio is 3:1, meaning that the output shaft will rotate three times faster than the input shaft.

One of the primary reasons for using different gear ratios is to adjust the speed and torque of the output shaft. A higher gear ratio, such as 3:1, will provide a higher output speed and lower torque, while a lower gear ratio, such as 1:3, will provide a lower output speed and higher torque. This is because the input power is distributed over a larger or smaller number of teeth on the output gear, depending on the gear ratio.

Gear ratios are also used to optimize the efficiency of a transmission system. In general, the efficiency of a gearbox decreases as the gear ratio increases. This is because higher gear ratios require more teeth to be engaged at any given time,

which can cause more friction and energy loss. As a result, gearboxes are typically designed with multiple gears and gear ratios, allowing the system to operate at the most efficient gear ratio for any given situation.

Another important aspect of gear ratio is their effect on the overall power output of the system. The power output of a system is equal to the torque multiplied by the rotational speed. As a result, changing the gear ratio can affect both the torque and the speed, and ultimately the power output. For example, a car's transmission system may be designed with several different gears, each with a different gear ratio. When the car is accelerating from a stop, the low gear ratio provides high torque to overcome the inertia of the vehicle. As the car speeds up, the transmission shifts to a higher gear ratio, which provides a higher speed but lower torque, allowing the car to maintain its speed more efficiently.

Gear ratios are also critical in applications where precision and accuracy are essential. For example, in a machine tool, the gear ratio between the motor and the spindle may need to be carefully controlled to ensure that the tool cuts the material at the correct speed and with the correct force. In a robotic system, the gear ratio between the motor and the end effector may need to be precisely adjusted to ensure that the robot moves with the required precision and accuracy.

In our machine our gearbox has a gear ratio of 1:20 meaning the input gear (the gear that receives power from the engine) rotates 1 full turn and the output gear (the gear that delivers power to the wheels) rotates 20 full turns. This is also known as a 20:1 gear ratio.

In other words, the output gear rotates at a much slower speed than the input gear, but with a proportionately higher torque. This is because the gear ratio determines the relationship between the speed of the input gear and the output gear, as well as the amount of torque (rotational force) that is transmitted between them.

The gearbox is then connected to a pair of plates that act as a guideway from the gearbox to the blades.

A guideway is an essential component of many types of machines, including machine tools and measuring instruments. It provides a precise path along which a movable element, such as a cutting tool or a probe, can move with high precision and accuracy. The guideway is designed to ensure that the movement is smooth, repeatable, and free of any unintended deviations or errors.

The choice of guideway depends on various factors, such as the type of machine, the application, and the required level of precision. Linear guideways are the most common type, and they consist of a rail and a carriage that rides on the rail. The carriage contains rolling elements, such as balls or rollers, that reduce friction and wear during movement. Linear guideways are ideal for applications that require high-speed and high-precision movement, such as CNC machines and linear actuators.

Dovetail guideways, on the other hand, have a trapezoidal cross-section and rely on the precision of the mating surfaces to provide accurate movement. Dovetail guideways are commonly used in milling machines, lathes, and other machine tools that require high rigidity and accuracy.

Box guideways are the most robust type, and they consist of a rectangular box-like structure that houses the movable element. Box guideways are typically used in heavy-duty machine tools that require high rigidity and load-bearing capacity, such as horizontal boring mills and vertical turning lathes.

Proper maintenance and lubrication of guideways are critical to ensuring their longevity and accuracy. Dirt, dust, and other contaminants can accumulate on the guideway surfaces, leading to increased friction, wear, and loss of accuracy. Regular cleaning and lubrication can help to prevent these issues and ensure that the guideway continues to provide accurate and repeatable movement.

In summary, guideways play a crucial role in ensuring the precision and accuracy of machine tools and measuring instruments. The choice of guideway depends on various factors, such as the type of machine, the application, and the required level of precision. Regular maintenance and lubrication are essential to ensure the longevity and accuracy of the guideway.

CHAPTER 5

FABRICATION PROCESS



Fig 5.1 Vegetable Cutting Machine





Fig 5.2 and 5.3 A row of blades



Fig 5.4 Stainless steel casing

CHAPTER 6

METHODOLOGY

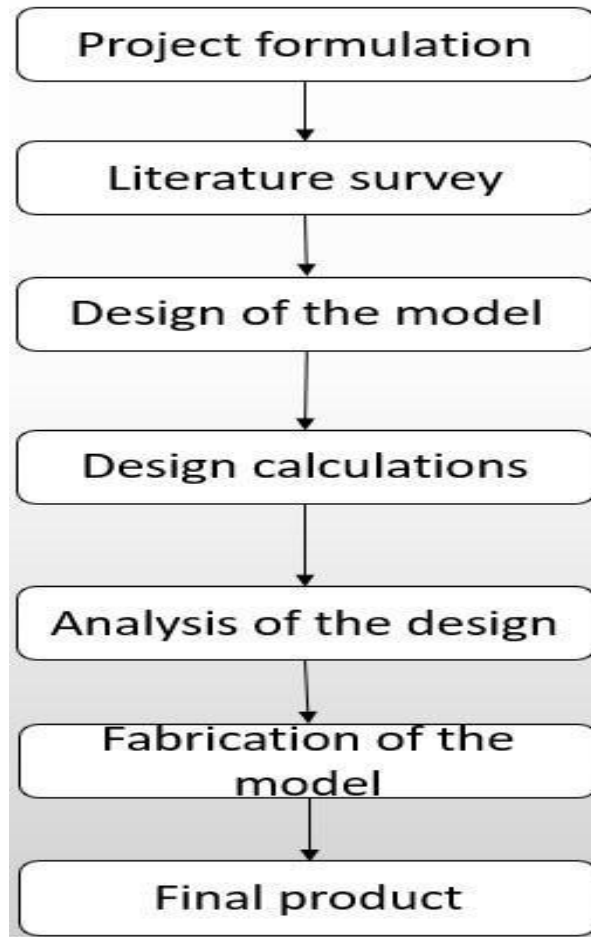


Fig.5.1 methodology

CHAPTER 7

SUMMARY AND CONCLUSION

6.1 SUMMARY

A semi-automatic vegetable cutting machine is a kitchen appliance that automates the process of cutting various vegetables into consistent and uniform shapes, sizes, and thicknesses. The machine is designed to reduce manual labour and increase productivity in commercial kitchens, restaurants, and food processing plants. It uses a variety of cutting attachments and blades to cut vegetables into various shapes, including cubes, strips, slices, and julienne cuts. The machine is designed to be easy to use and versatile, with the ability to cut a wide variety of vegetables. It is a cost-effective and time-saving solution for food businesses that require large quantities of vegetable cuts. In the future, the scope of semi-automatic vegetable cutting machines is expected to expand as demand for processed foods and convenience foods continues to grow.

Automation is the growing technology of the engineering world. Automation by innovation has reduced human effort and time to higher rate. The main objective of the project is to manufacture an automatic vegetable cutting machine using slider crank mechanism, with simple design, that saves time and that is of affordable cost and efficient during the process of size reduction of vegetables. Manual slicing of vegetable has ended up to be a tedious and time-consuming process and is prone to the risk of food contamination leading to high risk of food borne diseases. These sorts of issues can be prevented by building up a semi-automatic vegetable cutting machine.

6.2 CONCLUSION

In conclusion, the semi-automatic vegetable cutting machine is an essential tool in modern-day food processing. This machine has revolutionized the way we cut and process vegetables, making it easier, faster, and more efficient than ever before. Its semi-automatic functionality allows for a high degree of precision and consistency in vegetable cutting, resulting in perfectly uniform cuts every time. Furthermore, the machine's safety features and user-friendly design make it a great choice for commercial kitchens and food processing facilities where efficiency and safety are paramount.

One of the most significant benefits of the semi-automatic vegetable cutting machine is its ability to save time and labour costs. By automating the cutting process, this machine significantly reduces the need for manual labour, allowing staff to focus on other aspects of food preparation. The machine's precision and consistency also help to reduce waste and increase productivity, ultimately saving businesses both time and money.

Another advantage of the semi-automatic vegetable cutting machine is its versatility. This machine can handle a wide variety of vegetables, from soft leafy greens to dense root vegetables, thanks to its adjustable blade system. This flexibility allows food processing facilities to expand their menu offerings without needing to invest in additional equipment.

In conclusion, the semi-automatic vegetable cutting machine is an excellent investment for anyone in the food industry looking to streamline their operations, increase productivity, and reduce costs. Its many benefits, such as precision cutting, safety features, versatility, and labor-saving capabilities, make it an asset for any commercial kitchen or food processing facility.

This study offers an alternative to the current vegetable cutting market in terms of cutting the vegetables. It takes less time when compared to manual cutting process. In this paper the designing and manufacturing of the vegetable cutting machine was successful.

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