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Review TMD

Design and Fabrication of Multi-operationVegetable Cutting & Slicing Machine

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Abstract-

The purpose of this gadget is to reduce human effort and make the task of cutting and slicing vegetables considerably easier and faster. Its key characteristics are that it is totally automated, portable, uses less power, and has replaceable stainless, sharp blades. The machine consist of a reciprocating piston arrangement which works is chopping the vegetable and on other hand we constructed a rotating slicer for slicing purpose. A disciplined product design approach was used to create and establish this product. The tools that are mostly used to achieve this activity are product planning, customer needs identification, product definition, concept screening, concept scoring, and bill of materials. The machine is advantageous in that present automatics are expensive and consume a lot of energy.

Keywords: Multi-Operation, Changeble Blades, Portable, LowCost, Automated.

INTRODUCTION

Automation was all the rage in the engineering profession in the late 1990s. The brightest minds came together at all hours of the day and night to produce significant improvements that could have a real impact on people's lives.

Automation is now used in a variety of disciplines, including manufacturing, food processing, biomedical, and pharmaceutical industries. Domestic applications have also been designed with the ordinary man in mind in such a scenario. Processes that were formerly manual are gradually being changed to semi-automated and automated nature.

Automation is now used in a variety of disciplines, including manufacturing, food processing, biomedical, and pharmaceutical industries. Domestic applications have also been designed with the ordinary man in mind in such a scenario. Processes that were formerly manual are gradually being changed to semi-automated and automated nature. Manual vegetable cutting is still common in educational institutions' dormitories, wedding catering services, and even restaurants that cater to a wide range of customer tastes and preferences. The quantity of vegetables to be sliced for the dishes is always greater than what is actually consumed. The related challenges, such as time constraints, contamination, and so on, make it difficult for anyone in charge of the job. There was a need to automate the process of chopping vegetables, and now we have a notion that can help ease the stress on those involved.

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BACKGROUNG AND HISTORY

The mechanical vegetable cutter is a Chinese-made product that is now on the market. The cutter works on the principle of a 'rotating grid,' in which the cutting grid rotates within a casing and is powered by an ac motor. The vegetables are supplied through the top hopper system. The veggies are sliced as they move through the cutting grid, which rotates at a fast speed. Customers' requests are met by customizing cutting grids. The shapes of the chopped vegetables alter as the cutting grids change.

The above-mentioned cutter has a few flaws in terms of functioning. To begin with, vegetable feeding is not automatic; instead, a person must dedicate time to feeding each vegetable individually until the proper quantity is sliced. The grids are then powered by a motor that consumes a lot of energy. The fact that the process must be electrically supplied continually for operation due to the variable power source is a drawback in and of itself. The initial investment in the cutter is the most crucial of all. The cutter is estimated to cost between $ 3500 and $ 3500, including delivery and taxes. It is a substantial investment for individuals who manage a mid-level catering business. As a result of all of these flaws, the idea for a multi-operation vegetable cutting machine emerges.

The high cost of the existing automated system was highlighted as one of the primary challenges that led to the start of this project. Other issues include power fluctuations, additional labour, manual cutting time consumption, and the possibility of contamination during manual cutting.

OBJECTIVES

To protect and stop the viral infection like COVID-19 that can be spread by physical contact through vegetable and fruits. Also, to defend against diseases that can be passed from a person who has been affected by diseases such as flu, bacterial, virus, parasites, and fungi that harm nature directly and indirectly. The machine eliminates the major time consumed by manual cutting slicing. Since there are different machines available in the market for slicing and cutting, we design machine which performs both operations in a same machine. It is now our duty to design such a vegetable cutting machine due to which vegetables and fruits don't come in direct contact to our hands. These machine requires only one or two people to operate which remove the excess labor charge to be paid. Skilled persons are not required to operate this machine, which is easy to operate. Purpose of this machine is to cut the fruit and vegetable in mass quantity in less time. These machines are portable because they are moved from one location to another using wheels (Figure 1).

Various ways for reducing the size of vegetables have been used, ranging from manual to automated.

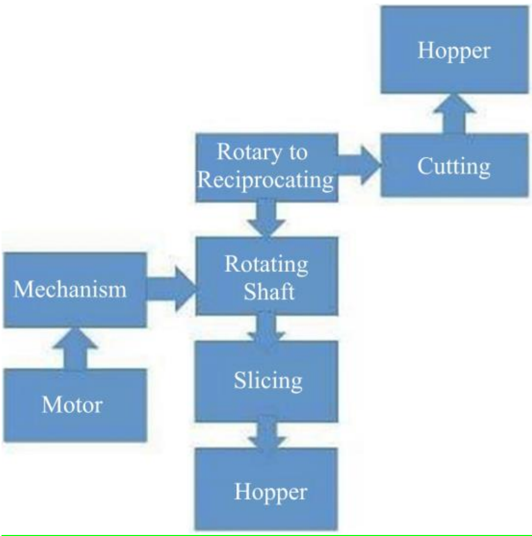

Figure 1. Block diagram of vegetable cutting machine.

LITERATURE REVIEW

Romeo et al. [1, 2] (published in the United States in 2009) depicted a basic arrangement, which has served as the foundation upon which we have built. The patent aided in the development of the concept of chopping vegetables with a cutting grid. *Romeo et al (published in us 2009)* once again by him, More information on the actuation mechanism for a simple cutter with a bok frame and a stack structure at the bottom has been provided.

Javiwe Hidalgo Gargia [3], Aitor Aguirrezwbalga Zubizwrrata, and Aitor Sequrota (Patent on 2012) focused on different cutting grids for cutting operations. For our blade design, we used this patent as a guide.

Pui yean Law at Diss. Tunku abdul Rahman university college, 2016 [4] An automated multipurpose vegetables slicing machine is a device that allows the user to perform multiple is the most important criterian for an automated multipurpose vegetable slicing machine. *2019 Gs Gayari and Tawanda Mushiri* Design of an automated vegetable cutter and slicer Manual cutting and slicing of vegetables takes a long time and exposes the food to contamination, resulting in a high rate of food related disease.

MACHINING

Frame Design

The frame is the main part of the machine which carries all the components and their assembly on it. It is made of mild steel which is square hollow channel of 25 mm with thicknessof 3 mm. the frame is made 1.5 × 2 foot and leg height is 10 inch and the overallheight is 15 inch [5].

Material used

Mild steel, square pipeArea = 1*1 inch = 25.4*25.4 = 645.16 mm^2 Length of link = 48" = 1220 mm

Weight of project = 10 kg = 10*9.81 = 98.1 N Weight of human being 75 Kg = 75*9.81 =735.75 N

Total load = 833.85 N Young's modulus = E = 210 GPa

Solution:

1. Effective length
   Effective length, when both end fixed,Le = L2 = 12202 = 610 mm
2. Internal Area
   Internal width and depth, which have 3 mmthickness,
   d = b = 25.4–2*3 = 19.4 mm
3. Moment of inertia I = $BD3-bd$312 = 25.4∗25.43−19.4∗19.4312 = 22882.048 mm^4
4. Crippling load by Euler's formula
   Pc = $\boldsymbol{\pi 2EILe2}$ = $\boldsymbol{\pi 2*210*103*22.88*10}$^$\boldsymbol{3}$
   $\boldsymbol{6102 =}$ 127442.8251 KN
   Pc = 127442.8251 KN > Total load = 833.85 N
   Hence design safe.

MATERIAL SELECTION

Firstly we select the cutting blades of the machine for slicing and cutting operation. The material of the cutting and slicing bladesare Stainless Steel because stainless steel hasa corrosion resistive, high tensile strength, very durable, attractive appearance and mainpart is environmental friendly [6].

Then we have select the material of the sprocket and chain for the transmission of thepower from motor to shaft. Generally chain drive is made up of alloy steel or 201 stainless steel because stainless steel has good formingand welding properties.

Next we select the rotating shaft material as a carbon steel c-50 because generally carbon steel is used to manufacture the rotating shaftand these is easily available in market [7]

Selected material for the given part or mainparts are as follows:

- Chain drive–Alloy steel
- Sprocket–201 Stainless steel
- Shaft–Mild Steel
- Blades–Stainless Steel
- Base Frame–Mild Steel

COMPONENTS

Components used on machine are;

- DC Motor
- Chain Drive
- Sprockets (Gear)
- Rotating Shaft
- Fixed Bearing unit
- Piston & Cylinder
- Four Slicing Blades
- 24 V Adapter (Power Supply)
- Lead Acid Battery

COMPONENTS ANDSPECIFICATION

DC Motor

A DC motor shown in Figure 2 was utilised to drive our crank in our project. It has a 12 V motor with a 500 rpm speed. In everyday life, a DC motor is a highly common device. It uses the energy conversion concept shown in Figure 3 to achieve the desired result (electrical energy to mechanical energy).It's also known as a rotatory actuator or an actuator [8].

Figure 2. DC Motor.

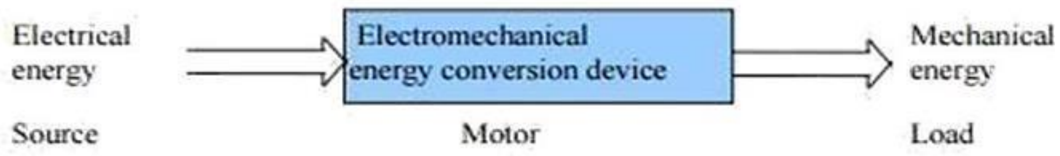

Figure 3. Energy conversion.

The armature winding and the stator winding are the two sets of coils that make up a DC motor. A set of permanent magnets can also be used as the stator. A Dc motor is made up of the following components.

Stator

The stator, commonly known as the "outside section," is the motor's stationary component.

Rotor

- The rotor is the system's rotating component.
- The commutator connects the rotor to the external circuit, and the rotor is made up of armature windings.
- The stator and the rotor are both made of ferromagnetic material.

Working

This is the setup of a DC motor. A battery is used to power this. The conductor receives current from the battery. When looking at the left face, the stream is travelling upward. Given the magnet's orientation, we have a magnetic field that is oriented from right to left. Using the Fleming Left Hand Rule, we can see that the force is being delivered in a top-down direction. The right side of the conductor, on the other hand, is experiencing downward current flow. Using the rule again, the force is in a downward direction. As a result, torques (couples) are applied to the conductor, which causes it to rotate.

CHAIN DRIVE

Chain drive is a method of moving mechanical energy from one location to another. It is commonly used to transmit power to the wheels of a vehicle, especially on bicycles and motorcycles. Aside from automobiles, it can be found in a variety of machines. Here we are using 21 pairs for metal chain.

A roller chain, also known as a drive chain or transmission chain, transmits power by passing over a sprocket gear and meshing the teeth of the gear with the holes in the chain links. When the gear is turned, the chain is pulled, giving the system mechanical force. Another type of drive chain is the Morse chain, which was invented by the Morse Chain Company of Ithaca, New York. This has teeth that are in the wrong order.

SPROCKETS

A profiled wheel with teeth that mesh with a chain, track, or other perforated or indented material is known as a sprocket, sprocket-wheel, or chainwheel. Any wheel with radial projections that engage a chain travelling over it is referred to as a sprocket. It differs from a gear in that sprockets are never directly meshed together, and it differs from a pulley in that sprockets have teeth and pulleys are smooth, save for timing pulleys used with toothed belts.

SHAFT

A shaft shown in Figure 4 is a spinning machine element with a circular cross section that transfers power from one part to another or from a power-generating machine to a power-absorbing machine.

The motor shaft is the most important component in most rotating machines. A shaft is a mechanical component that converts torque and rotate. In these devices, the shaft size has a considerable impact on torque.

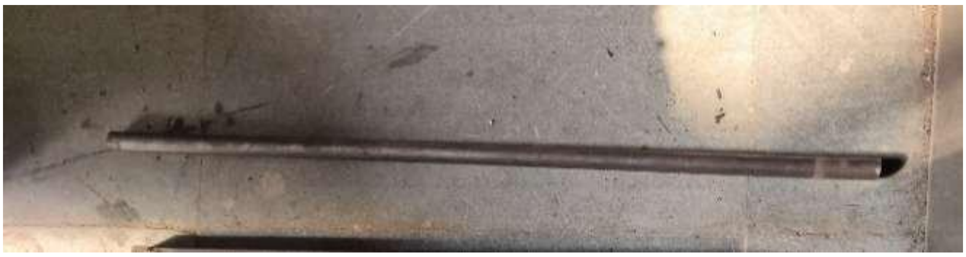

Figure 4. Shaft.

At least two bearings support a rotating shaft: one is usually a ball bearing and the other is usually a roller bearing.

Here we are using 25 mm diameter of mildsteel shaft

Calculation of Shaft

(Reference: Design of machine element. V Bhandari. Chapter 9. Shaft, key, couplings. 9.7)
Shaft is made of MS. Standard values of MSare as follows.
Young's Modulus of elasticity = E = 2.0 *105 Mpa.
Mass density = ρ = 7850 kg/m^3
Yield stress = σy = 250 Mpa & Sut = 841 Mpa Kb = Kt = 1.0
Permissible shear stressBy shear stress theory
0.30 syt = 0.30 * 250 = 75 N/mm^2
0.18 sut = 0.18 * 841 = 151.38 N/mm^2
Taking minimum
Tmax = 0.75 * 75 = 56.25 N/mm^2
Power required to rotate the steering byhuman efforts, P = 75 W
Average rpm by human hands, N = 60 rpmTorsional moment
Mt = 75 $*$ 602$*$ $\pi$$*$ 60 Mt = 11.9366 Nm
Mt = 11936.6 Nmm
Mass of pinion,M = 0.3 kg
W = 2.943 N
Mass of bevel gear,M = 0.6 kg
W = 5.886 N
Total length of shaft is 1120 mm

Reactions at Support

Moment at X
-2.943 * 100 + 5.886 * 100–Ry * 920 + 2.943 * 1020 = 0
Ry = 3.58 N
Resultant force in vertical
Rx + Ry - 2.943–5.886–2.943 = 0
Rx + 3.58–2.943–5.886–2.943 = 0Rx = 8.192 N

Shear Force Calculation

SFAL = 0 N SFAR = -2.943 NSFXL = -2.943 N
SFXR = -2.943 N + 8.192 N = 5.294 NSFBL = 5.294 N
SFBR = 5.294–5.886 = -0.637 NSFYL = -0.637 N
SFYR = -0.637 + 3.58 = 2.943 N
SFCL = 2.943 N
SFCR = 2.943–2.943 = 0 N

Bending Moment Calculations

Bending moment at A, initial point,BMA = 0
Bending moment at X
BMX = 8.192 * 100 = 819.2 Nmm
Bending moment at B
BMB = 8.192 * 100–5.886 * 200 = -358 Nmm
Bending moment at Y
BMY = 8.192 * 100–5.886 * 200 + 3.58 *
1020 = 3292.6 Nmm
Bending moment at CBMC = 0 Nmm

Bending moment is maximum at point Y Therefore, Resultant Bending moment = Mb = 3292.6 Nmm

Calculate the shaft diameter

τ max = $16\pi * d3 \sqrt{}(Kb*Mb)2+ (Kt*Mt)2$ d3 = $16\pi * \tau\ max \sqrt{}(Kb*Mb)2+ (Kt*Mt)2$

d3 = $16(\pi)(56.25)\sqrt{}(1*3292.6)2+(1*11936.6\ )2$

d = 7.019 mm

d = 15 mm for safe design and availability assume F.S. = 2 approx. we have 20 mm shaft(std)

ADAPTER;

In audio, lighting, and sensor applications, the linear 24V Power Supply remains popular. Switching 24 Volt Power Supplies are commonly utilised in medical, communication, automation, and other OEM systems where equipment portability, low heat, and intrinsically fail-Safe operation are sought.

To achieve 24 volts from a 12 volt supply, you'll need a "DC-DC converter," sometimes known as a "boost" or "step-up" converter. In a DC-DC converter or boost converter, a chopper circuit (oscillator) feeds current to an inductor via a diode. The current flows for a short time before being cut off.

Product Description.

Any thermostat can be powered by the 24VAC power converter, which can be plugged into any ordinary electrical socket. This can be used if you do not have an existing C-Wire coming up from your furnace to your thermostat. The 24VAC power converter, which can be put into any conventional electrical socket, can power any thermostat.

ASSEMBLY

Figure 5 shows the assembly of vegetable cutting machine.

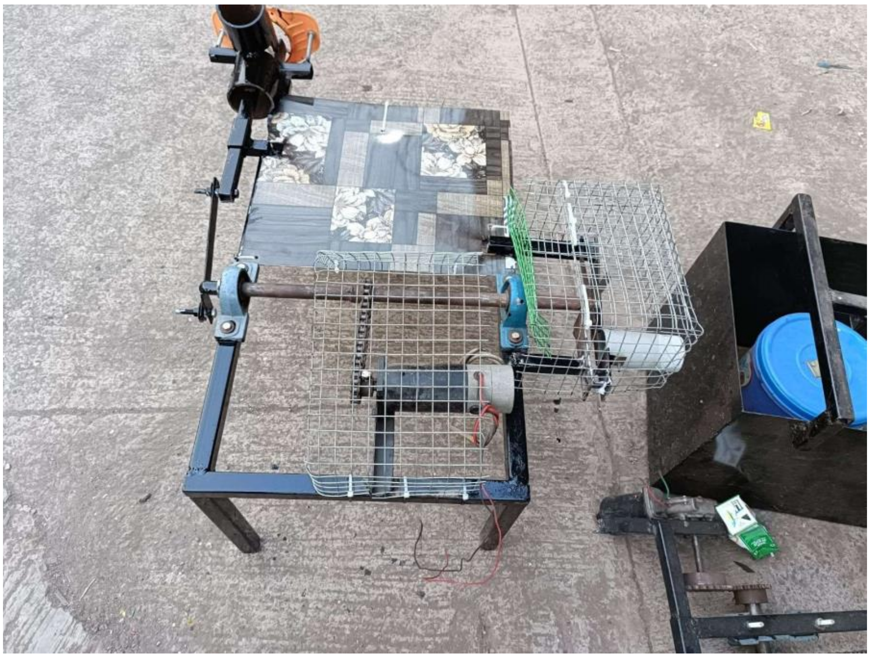

Figure 5. Assembly of vegetable cutting machine.

SUMMARY

In terms of automatic vegetable entrance into the cutting equipment, this study presents an alternative to the existing automatic vegetable cutter and slicer, eliminating power fluctuations and requiring a lower initial investment. When opposed to manual cutting and slicing, time is saved. This job produces the required result, and different cutting and slicing blades are used to create a variety of cuts and slices.

Maintaining the health & hygiene by eliminating the physical contact between the person & vegetable/fruits during their cutting and slicing operation. Increasing portability of the machine by reducing the weight and size of machine. The machine comes with direct electric supply as well as with emergency battery supply connected to solar panel.

CONCLUSION

In the period of world wide pandemic of COVID-19, Manual cutting poses a significant risk to those who consume food cooked or cut by those infected with the COVID-19 virus, from those who are infected with the virus cutting/slicing vegetables and fruits to those who consume food cooked or cut by people infected with the virus. By eliminating the risk of physical contact of person affected by COVID-19 the vegetable cutting and slicing can be Operated automatically. Market has the machines available that performs two different operation, are fixed to its positiondue to their heavy weight, And costing veryhigh above the average buying level. Our designed machine is portable at any place, it is light weight and is very cost friendly.

Also reducing the risk of injury and cuts caused by knife in manual cutting/slicing. Reducing time consumption as manual cutting/slicing requires more time.

Eliminating the labour fee as this machin requires 1/2 person. Mass production is possible by working of this machine.

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