Design And Fabrication Of Mint Plucker Using Cam Mechanism

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Abstract: In our country, the agriculture is one of the foremost business which is done by many people. The mint is the important crop which are cultivated in a wide variety of soil and weather conditions. The purpose of the product is to pluck the mint and then it can be stored in a separate tray or container. There are nearly around 60,000 hectares of land with estimated production of 12,000 tonnes of mint is cultivated in India. The mint is used by all class peoples due to its low cost. The operation of the project is the mint is plucked by using a cam operated mechanism. During the first 180-degree rotation of the roller contact in the cam profile the mint leaves gets clamped by the movable arm and then it is plucked. Then during the next 180-degree rotation of the roller in the cam profile the movable arm gets release and then the plucked leaves are stored in the separate tray. For the operation purpose there is no need of any external power source. It is full of manually operated and the design is very simple. So, if there is any wear occurs during the operation it can be replaced easily. The maintenance and the operating cost for the product is very low. The farmers mainly get benefited by this product rather than taking human beings to work in the farm land. This mint plucker might be the solution to the problems faced by a small-scale farmer regarding the cost and labour implementation. After testing this machine in farm, it is found that the cost of mint plucking using this machine is considerably less as compare to manual harvesting.

Keywords: Agriculture, Cam mechanism, Clamping, Collector, Mint, Plucker, Steel roller.

INTRODUCTION

India is a land of vast population, where food is the most necessary for every person. Agriculture has been and will continue to be the backbone of the Indian economy for a long time. Thanks to liberalization and globalization, the agricultural sector is transforming the population's socio-economic environment. Approximately 75% of people live in rural areas and still believe in farming. Approximately 43% of the geographic area is used for agriculture. As the Indian population continues to grow, so does the demand for crop production per hector. In our world, agriculture is one of the most important businesses that many people do. The mint is the largest plant cultivated in a wide variety of soil and weather conditions. Approximately 60,000 hectares of land are currently being cultivated in India with an expected output of 12,000 tons of mint. This crop's average harvest time is 90 days. It is produced mainly in Rajasthan, Gujarat, Madhya Pradesh, Tamil Nadu, Uttar Pradesh. It is used for its medicinal properties as a condiment. Also used for cooking purposes are the yellow mint leaves. During the growth stage, mint crop requires a cool climate and a warm, dry climate at maturity. It can be grown in most soil types, but well-drained loamy soil is well suited to the crop. Cold climate and high altitudes can result in seed of superior quality and a higher content of essential oil. Mint is native to Southern Europe, North Africa and Southwest Asia areas. It is a soft plant that grows to a height of 50 cm (20 in). The leaves are variable in form, lobed wide at the base of the plant, and higher on the flowering stems are slender and feathery.

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The flowers are borne in small umbels, white or very pale pink, asymmetrical, with the petals pointing longer (5–6 mm) away from the center of the umbel than those pointing to it (only 1–3 mm). Originally, India was an importer of menthol, but mint took off as an agricultural product after the green revolution in 1986. Later developments and enhancements made mint growing more cost-effective. Mint is a popular herb that in many dishes and infusions can be used fresh or dried.

LITERATURE REVIEW

Norbert et al. (2002) article is based on “Intake and Plucking Arrangement as well as a Harvesting Machine”. The machine which contains the header that includes the intake and plucking arrangement. This is specially designed to separate the ears from the stalk by the blades which is connected to the drum. During rotation of the drum the blade gets rotated so that the intake of the corn takes place. The harvester has a conventional cutter drum that receives the Stalks and cuts them into short lengths, and has a hammermill which receives the corn ears and chops them into Small pieces. The corn Stalk pieces and the chopped ears can be recombined and discharged from the harvester into a trailer as whole plant Silage, or can be delivered in Separate Streams to Separate trailers or Separate containers of the same trailer. Richard et al. (2002) article is based on the machine is to harvest the bulb crops such as onion and these bulb crops are extracted from the ground by the harvester or the machine. Then the bulb crops are transported by a conveyor to the cutting assembly where the dirt, rocks, and debris are removed from the onion. The cutting blades are assembled according to the leaves and the roots from the bulb crops are cut and then removed. Then the unwanted parts from the bulb crops are dropped to the ground by the manner of gravity. After cutting, the onions are transported through an inspection assembly for inspection, Sorting, grading and further distribution. The onions are then transported rear ward to a sacking assembly for placing the onions into Sacks, to a chute device returning the onions to the ground or to a conveyor System transferring the Onions to an adjacent vehicle. Platforms on the sides and ends of the harvester facilitate the above operations. Michael et al. (1994) article represents a mobile harvester of leafy vegetables has two harvesting sections with a cutter located

forwardly for severing the produce from the ground. A large number of openings are present in the belt continuously facing the upward surface that moves in the closed path. A low-picking up severed produce. To protect the leaves from the wind that are passing over the belt a separate enclosure is used. The two harvesting sections are individually adjustable for proper height above the ground. Amar et al. (2018) represents the "Design and Manufacturing of Harvesting Machines" in which the machine is specially designed for farmers who have less than 2 acres of land. This unit is lightweight and can cut soybean plant up to two lines. With the aid of cutting blades, the scissoring method of motion is used to cut the plant. The different blades for cutting are set at 20 degrees here. It operates on a 3HP diesel engine, this power from the motor, is supplied to the cutter by means of a pulley and a gearbox. A system for harvesting crops on one side after cutting is given. Also operated by pulley arrangement is this mechanism. This lightweight harvester is made using local spare parts, making it easy to maintain. This harvester could be the solution to a small-scale farmer's problems in terms of cost and labor implementation.

MATERIALS

The list of the materials used are explained here. One of the most important parts of the cam system is the cam plate required for the implementation of new innovation. The cam plate that is taken from a piece of flat metal or sheet (also known as a disk cam or radial cam). The follower passes here in a direction perpendicular to the camshaft's axis of rotation. The material chosen for the cam plate is a lightweight nylon material, and nylon is a synthetic plastic with super-long heavy molecules made up of small, endlessly repeated pieces of atoms, just as a heavy metal chain is made up of ever-repeating bonds. The nylon material has no properties of tensile. Nylon is very solid when rotted in several strands and is impervious to dry rot and mildew. Spring is an elastic element of the machine that can deflect when load is applied. It regains its original position when the load is removed. In other words, spring is a mechanical device made of very high yield to restore elastic content. A roller is a tool used in the cam profile to direct the movement. The roller's main purpose is to create frictionless contact between the arm and cam that can be moved. It provides the cam direction with unusual movement. Steel rollers are chosen because of their high resistivity to friction. A shaft is a rotating machine component, generally circular in cross-section, used to transmit power from one part to another, or from a machine generating power to a machine absorbing energy. A sprocket or sprocket-wheel is a profiled tooth or cog wheel that has a chain, track or other perforated or indented wire. In bicycles, motorcycles, cars, tracked vehicles and other machinery, sprockets are either used to transmit rotating motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape, etc. Plummer block used to stabilize the rotating shaft with the aid of compatible bearings and various accessories. In this design, four Plummer blocks are used to assist the rotation of two rollers. Chain drive is a way from one location to another to transfer mechanical power. It is often used to transmit power to a vehicle's wheels, particularly bicycles. A ball bearing is a type of rolling-element bearing that uses balls to keep the distance between the bearings ' moving parts. A ball bearing's function is to minimize rotational friction and to accommodate radial and axial loads.

pressure vacuum provides the attraction to the belt upwardly facing for

METHODOLOGY

In this chapter first studying the present mechanism involved in the mint plucking machine then identifying the potential problems. Then planning for the implementation of the new mechanism. Selection of the materials. Designing the parts and assembly Fabrication of the parts. Assembling the parts. Final Experimental setup.

FABRICATION PROCEDURE

At first the frame of mint plucker is manufactured as per the designed load by square tubes. Wheels are attached to that frame by means of shaft and pedestal bearings (Plumber block). The sprocket is placed on the wheel shaft and in the main shaft by which the chain drive is used to transmit the rotary motion. The transmission shaft is supported by using bearings with frame. The cam profile is fabricated by using the nylon material to perform the rotation with the roller contact. The moving and fixed arms are manufactured by using High carbon steel plate. The cam plate will be kept fixed at certain position only the main shaft will rotate. The contact between the cam plate and the main shaft is given by the ball bearing. Finally, all the components are assembled together from base frame, wheels, sprockets, chain, shaft, cam plate, fixed arms and movable arms. The cam plate is fabricated by the CNC milling operation by generating the G and M codes from the MASTER CAM software.

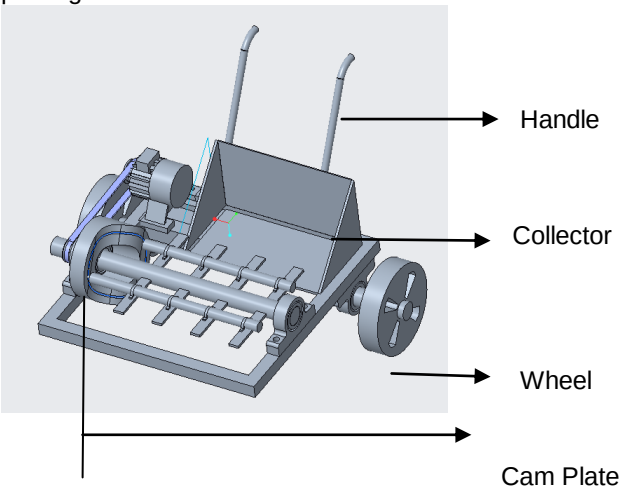
Nylon Material to Make Cam Plate

Final Part of The Cam Plate After Milling Done by CNC L-MILL

DESIGN MODEL

A design is a plan or specification for the construction of an object or system or for the implementation of an activity or process, or the result of that plan or specification in the form of

a prototype, product or process. This 3D model has been drawn using CREO PARAMETRIC version 5.0 software package.



DESIGN CALCULATION

CALCULATION OF CHAIN DRIVE

Teeth of Smaller Sprocket, Z1=21

Teeth of Larger Sprocket, Z2=30

Speed of Wheel Shaft, N1=400 rpm

Transmission Ratio, I=1.43

Speed of Main Shaft, N2=280RPM

Centre Distance a=370mm

Pitch Lies Between 7.4 TO 12.33 mm

Therefore, Standard Pitch P=9.525mm

Preferred Chain:

06B-3/TR957

Diameter of Smaller Sprocket, D=69.90mm

Velocity of Chain, V=1.34m/s

Tangential Load, Pt = 76.12 kgf

Compressive Load, pc = 76.12 kgf

Shear Load, PS = 2.42 kgf

Length of the chain = 980 mm

Exact centre distance after calculation a, = 369.99mm

CALCULATION OF SPRING

Diameter of steel rod, D = 12mm No. of turns in spring, n = 14 assume W = 100N assume C = 80GN/m2

Radius, R =6mm

Deflection of the spring, δ= 47.7mm

Strain energy, u = 2.38 Nm

Maximum shear stress, τ = 905.414MN/m2

CALCULATION OF SHAFT

Motor Speed = 400 rpm

Motor Power = 1000 W Power = (2 πNT)/60

Torque = (60×1000)/(2× π×400)

Torque = 23.8 Nm

Force = 117 N
Distance = 0.4 m

Moment = force × distance

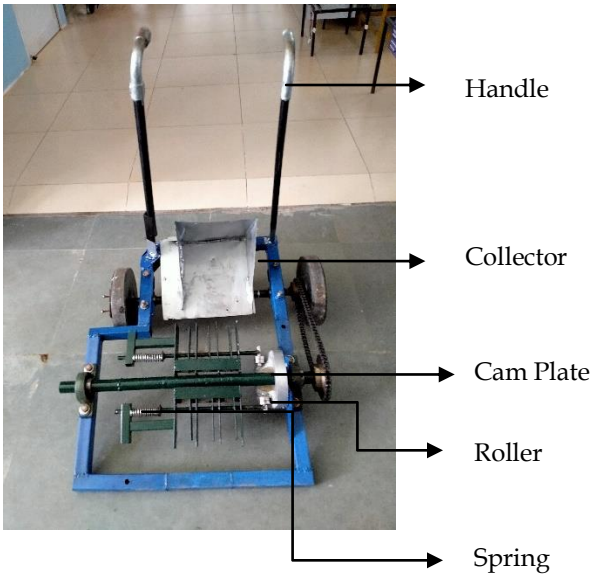
M = 47.08 Nm

Teq = √T2+M2

Teq = 57Nm
Teq = (π/16) × τ × d3
Shaft Diameter =35mm (approx).

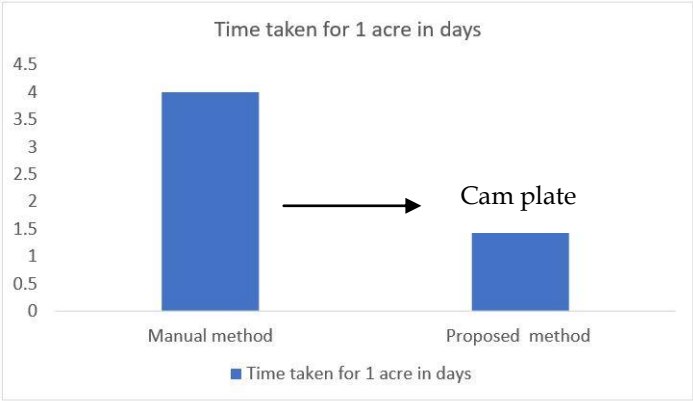
EXPERIMENTAL SETUP

The fabrication of each component is made according to the procedure. The arrangement of the part includes the cam plate, fixed and movable arms and the structure of the collector capacity. The collector is arranged in such a way that they are used for collecting the plucked mint leaves. The arrangement of the cam plate is done in the main shaft. Then the path in the cam plate is given by steel roller, such that the spring is placed for the clamping and releasing the mint leaves when the roller moves in the elongated and the normal surface of the cam profile.

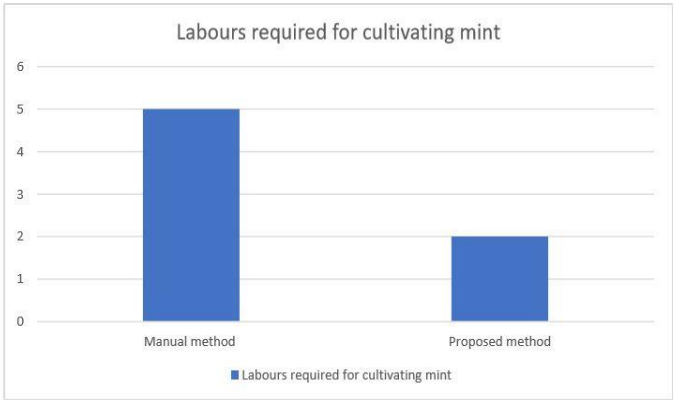


RESULT AND DISCUSSIONS

In this chapter, results and discussion of the present project work will be discussed. Initially time required for various method. Further, the no. of labors required for mint plucking is discussed respectively. Finally, the comparison of all method will be discussed by different labors.



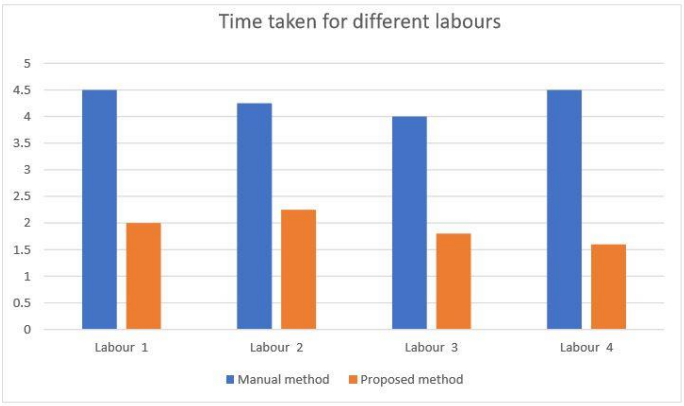
Time Taken for Various Method



Labours Required for Various Method

The above figure discusses about the labors required to pluck the mint leaves by various method. In the manual method if it takes more than 5 labors to cultivate the mint leaves in the 1 acre of land. Then in the proposed method it takes approximately 2 labors to pluck the mint leaves from the land.

The variation between the method is shown in the graph.



Time Taken for Different Labour

The above figure discusses about the time taken for different labors based on their capacity to pluck the mint leaves. The blue colour in the graph represents the time taken by a person to pluck the mint leaves in one acre of land by manual method. Then the orange colour represents the time taken by the same person by proposed method to pluck the mint leaves in the same acre of land based on the capacity of a person to travel the machine in the field. For every labour there will slight changes in the time taken to pluck the mint leaves because some of them will travel the machine with high speed in the land and some of them will travel the machine slowly compared to other. So, by considering these results the graph we plotted between the manual method and the proposed method.

CONCLUSION

Thus, the whole product is fabricated as per the requirements. The purpose of mint plucker is to reduce the cost of labours for harvesting and also to eliminate the situations that faced because of the lack of labours. Due to back pain and blisters on hand labours are not work in harvesting field. In order to overcome this situation, it gives out following benefits. This system reduces the cost of harvesting as that of conventional method. It is suitable for both the small as well as big scale farmers having 2-5 acres of land area. It is also reducing the timing of harvesting as that of conventional method. Ease of maintenance, ease of operation. Particularly economical activity as it removes the extra power of the human being. High degree of operational safety. The machine is operated by a single labour. The machine will eliminate the labour problem in peak session during mint plucking period. By using this simple mechanism, we can easily pluck the mint leaves thereby reducing the human effort and time.

FUTURE SCOPE

"The mint plucking machine" provides wide range for future advancements. Some of these are as follows:

- By just keeping the blades at the bottom of the arm we can use the mint plucker as lawn mover. We can make the mint plucker to work under the different crops as per the loads (Just we have to change the power and blade size.
- By providing the curved collectors at sides of mint plucker to collect the plucked crops and also the

bunch of crops is get tying together by using automation and throw at backside of cutter.

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