DESIGN AND FABRICATION OF MULTI-CROP CUTTER

A major project report submitted

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CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY

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BACHELOR OF ENGINEERING

in

MECHANICAL ENGINEERING

by

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DECLARATION BY THE CANDIDATE

We are undersigned solemnly declare that the report of the thesis work entitled "**Design and Fabrication of Multi-crop Cutter**", is based on my work carried out during the course of my study under the supervision of Mr. Gulab Verma, Assistant Professor in the Department of Mechanical Engineering

I assert that the statements made and conclusions drawn are an outcome of the project work. I further declare that to the best of my knowledge and belief that the report does not contain any part of any work which has been submitted for the award of any other degree/diploma/certificate in this University/deemed University of India or any other country. All help received and citations used for the preparation of the thesis have been duly acknowledged.

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To the best of my knowledge and belief the thesis

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- Has duly been completed,
- Fulfils the requirement of the Ordinance relating to the BE degree of the University and up to the desired standard both in respect of contents and language for being referred to the examiners.

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Chapter – 1

ABSTRACT

Agriculture is one of the most important sectors of Indian economy since decades. It is the most vital source of employment for majority of human resource in the country. Solar energy abundantly available from sun can be utilized and resourceful farming can be done by designing the equipment's for agricultural purpose, mainly in India to focus in certain situations such as how to increase the production and revenue, how to reduce the cost and labor. To expel these problems, the work aims to conceptually design, select and develop the machine which runs with the help of solar power which targets the small-scale farmers to cut the multi-crops at a time who have land area of less than two acres for farming. The machine is designed for its low cost, rough use and high compatibility. The machine utilizes solar power, which is directed to the rotary blades via solar panel, DC motor and battery arrangement. Thus, providing a portable, cost effective, and pollution free machine to farmer.

Keywords: - Rotary motion, rotary blades, Collecting plate.

Chapter - 2

INTRODUCTION

Agriculture is the backbone of India. In India agriculture has facing serious challenges like scarcity of agricultural Labor, in peak working seasons but also in normal time. In India two type of crop cutting like as manual method (conventional method) and mechanized type of crop cutter: The crop cutting is important stage in agriculture field. Currently Indian farmer used conventional method for crop cutting i.e. cutting crop manually using labor but this method is very lengthy and time consuming. To design and analysis the crop cutting Machine which is help to the Indian farmer to small farm. It will reduce the cost of crop cutting in field. It will help to increase economical standard in Indian farmer: The design of the crop cutting machine will be presented by using Creo software.

Crop harvesting is last stage in farming which takes maximum time of farmer among all farming Process. In India harvesting is generally done manually. Thus, our intention is to provide farmer a "Crop Harvester in Agriculture Approach" This machine consists of simple Mechanism make to run by a solar panel which will be economical to farmer and will take less time for harvesting operation. This crop cutter machine is used for cutting crop like paddy, wheat and also for long grass.

Solar powered Multi-crop cutters can be described as the application of solar energy to electric energy converted and applied to motor which revolve a blade which does the cutting of crop. Solar energy is the renewable energy. It uses solar energy to generate power which is stored in form of battery. This supply is distributed in all section as per our requirement. Using Flat Plat Solar Collector panel generate the energy needed to power the cutter. The dangerous emissions produced by the gasoline spillage in that of the I C Engine into the atmosphere are also eliminated.

Chapter – 3

LITERATURE REVIEW

Dr. Kongre et al (2016) “Fabrication of Multi Crop Cutter”. The machine was manually operated. The uses of it was that it makes the harvesting process faster. Hence reduce most of the cutting time and labor required to operate the machine is also less.

Singh et al (2020) “Performance Analysis of Solar Energy Operated Crop Cutting Machine” in his analysis they are mainly focused on solar penal efficiency and found that the 165W rated solar penal gives the power of 76W that is sufficient for cutting of crop.

Chavan et al (2020) “Design and Analysis of Crop Reaper Machine” which is a engine drive machine in this project they design the component of machine in CATIA and analysis of component in Ansys.

Makavana et al (2018) “Engineering Properties of Various Agricultural Residue”. In this research they performed experiment on rice husk, rice straw and cotton stalk to determine the physical properties like moisture content, bulk density, true density and porosity. Bulk density of rice husk and rice straw is 331.59 kg/m^3 and 380.54 kg/m^3 respectively.

Zhang et al “Physical Properties of Wheat Straw Varieties Cultivated Under Different Climatic and Soil Conditions in Three Continent” (2012). The physical properties (moisture content, particle size, bulk density and porosity) of wheat straws were determined using standard procedures. The average bulk density of the wheat straws was in the range of 90.52-177.23 kg/m^3.

Liu et al “Modeling of Flexible Wheat Straw by Discrete Element Method and Its Parameters Calibration” (2018). A simulation to known the bending behavior of wheat straw, a flexible straw model was developed based on Hertz-Mindl in with bonding model using discrete element method. The elastic modulus calculated from this simulation is 1.8548 GPa, relatively close to the value measured in experiment (1.9363 GPa).

Tavakoli et al research paper “Comparison of Mechanical Properties Between Two Varieties of Rice Straw” (2010). The objective of this work was to compare the mechanical properties like average shear strength, bending strength and young’s modulus. The maximum value of young’s modulus for rice straw is 1. 25 GPa.

Chapter - 4

PROBLEM IDENTIFICATION

India is an Agriculture based country and the agriculture is the major source of income of many peoples of India, which needs to concentrate in some aspects like how to increase productivity and profit, how to reduce cost and how to solve and ease the problems of farmers. To overcome this new Solar powered operated cutter is fabricated for cutting of multiple types of crop during harvesting and named as "Solar Powered Multi-Crop Cutter". It possesses five criterion ease in manufacturing, ease in handling, low cost, light weight and no pollution (Eco-Friendly).

Now a day's pollution is a major issue for whole world. In case Gasoline crop cutters due to the emission of gases its result gives pollution.

Also, recently in rural areas, has seen a shortage of skilled labor available for agriculture. Because of this shortage the farmers have transitioned to using harvesters. These harvesters are available for purchase but they are not affordable because of their high costs, however agriculture groups make these available for rent on an hourly basis.

Due to financial or transportation reasons these combine harvesters are not available in all parts of rural area. Thus, there is a need for a compact and efficient harvester which would be considerably cheaper and also more accessible.

Thus, the objective of the project work is to create a portable, low cost mini harvester which will be user-friendly.

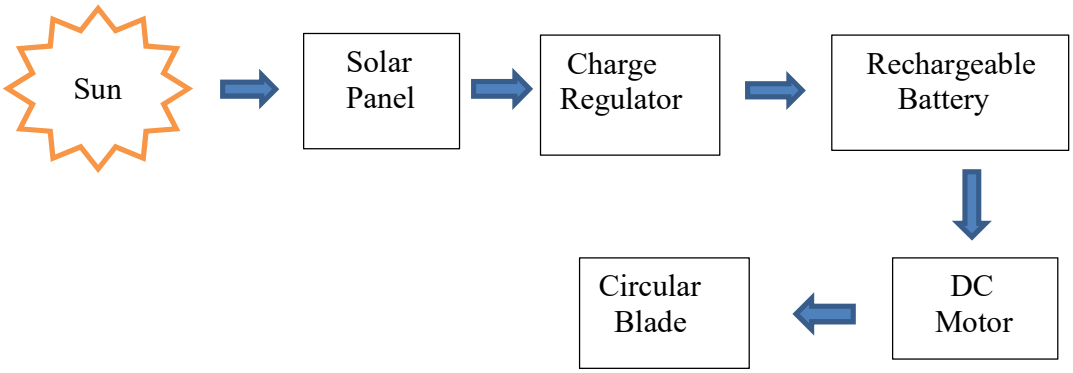
The price of fuel is also, rising hence it is not efficient and economical. So, the Solar powered crop cutters are introduced. All these problems mentioned above, gave us the basic idea about what was required in the current situation. The idea was to create a machine which will reduce the labor required to harvest crops and which is cheap and compact. This machine has the capability and the economic value for fulfilling the needs of farmers. This machine is cost-effective and also easy to maintain and repair for farmers.

Chapter - 5

METHODOLOGY

5.1 WORKING PRINCIPAL: -

- Sun light falls on solar panel and solar panel convert it into electrical energy, through charge regulator electrical energy stored into battery.
- Further this electrical energy give power to the motor, where rotary blade is mounted on motor and rotate with motor shaft and cut the crop.
- By pushing the crop cutter machine by handle, it cut the crop and crop fall down on crop collector



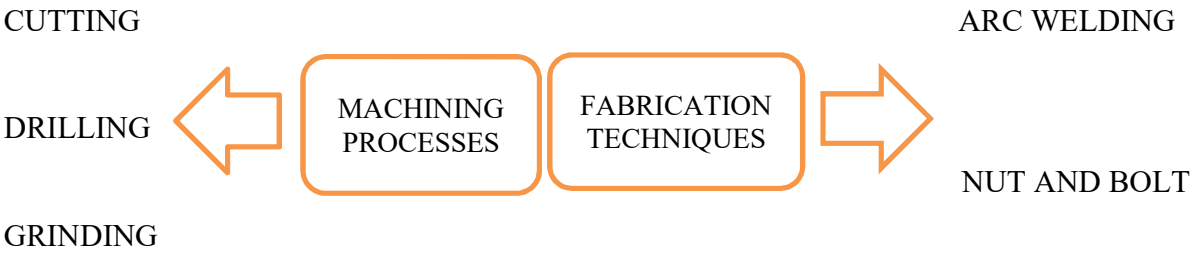
5.2 COMPONENT & ITS SPECIFICATION: -

Selection of required components, frame, crop collector, rotary blade, D.C. motor, wheel and solar panel.

Table 5.1 Specification of semi-automatic crop cutter

S.N.	Component	Parameter	Value
1.	Frame	Length Width Hight	2100.00mm 670.00mm 1130.00mm
2.	Solar Penal	Rated Power Voltage	165watt 12volt
3.	Solar Charger	Rated Current Rated Voltage	20Amp 12V/24V
4.	Battery	Current Capacity Voltage	20Ah 12volt
5.	Motor	Power Speed	60watt 5000rpm
6.	Blade	Diameter Thickness	265.84 mm 2.00 mm
7.	Crop Collector	Length Width	700mm 450mm
8.	Wheels	Diameter Thickness	200mm 60mm

5.3 MACHINING PROCESS AND FABRICATION TECHNIQUES FOR FABRICATION OF MULTICROP CUTTER MACHINE



5.3.1 MACHINING PROCESSES

Machining is a semi-finishing or finishing process essentially done to import required or stipulated dimensional and form accuracy and surface finish to enable to product to

- fulfill its basic functional requirements
- Provide better or improved performance
- Render long service life

5.3.1.1 CUTTING

Metal cutting is a process in which a thin layer of excess metal (chip) is removed by a wedge-shaped single point or multi point cutting tool with defined geometry from a work piece, through a process of extensive plastic deformation.

Types of cutting process –

1. Orthogonal Cutting

In orthogonal cutting, the tool approaches the work piece with its cutting edge parallel to the uncut surface and at right angles to the direction of cutting (90 degree)

2. Oblique Cutting

In oblique cutting, the cutting edge of the tool is inclined at an acute angle with the direction of tool feed or work feed, the chip begins disposed of at a certain angle (less than 90 degree).

Fig. 5.1:- Cutting

5.3.1.2 DRILLING

Drilling is a cutting process that uses a drill bit to cut a hole with a circular cross section in solid materials. The drill is usually a rotating cutting tool, often multi point. The bit is pressed against the workpiece and rotated at speeds of hundreds to thousands of revolutions per minute. As a result, the cutting edge is pressed against the workpiece, which removes chips from the hole during drilling.

Types of drilling-

1. Percussion or Cable Drilling

Percussion drilling is an oft used manual drilling technique in which a hammering bit is attached to a long cable that is then lowered into a wide open hole. The technique is also known as cable drilling, wherein the driller uses a tripod to support the tools.

2. Rotary Drilling

Rotary drilling is also one of the most common methods of drilling, especially for digging up exploratory and production wells, which boast of depths that exceed five miles below the ground. In this method, lightweight drills are used to drill low depth wells on land. Rotary mobile and

floating drills of various sizes are then used for drilling exploration wells.

Fig.5.2:- radial drill machine

3. Dual Wall Reverse Circulation Drilling

It is a type of rotary drilling itself in which two concentric drill pipes are used to crate a controlled flow. The drilling fluid is pumped through an outer swivel to reach the bottom of the bit, and then ricochets upward into the main pipe. All cuttings are carried upward through an internal pipe and with the help of swivel. The method also allows for geologic sample collection, with samples usually delivered through the cyclone crated at the surface.

4. Electro Drilling

In this method, rotary tables, winches and the like are driven by electric motors, thus leading to better flexibility in operations along with remote-controlled drilling. These drills are new methods of oil and gas exploration, as they provide more direct power to the drill bit by connecting the motor above the bit, below the hole.

5. Directional Drilling

Directional drilling is actually an extension of the rotary drilling technique, which guides the drill on a curved path with the deepening of the hole. Directional drilling can help oil explorers reach

deposits that cannot be extracted by vertical drilling. Reduced costs is the major driver, as several wells can be drilled in all directions on a single platform. This also allows one to tap into undersea reservoirs and now, by using computers to guide the automatic drilling machines, without connecting and disconnecting sections.

5.3.1.3 GRINDING

Grinding is the abrasive machining that uses grinding wheel or grinder as the cutting tool and an abrasive material rubs against the metal parts and removes tiny pieces of material.

Grinding is used to the finishing process of the workpiece which must show high surface quality, accuracy and shape, and dimension. With the use of this process also removes little metal 0.25 to 0.50 mm and the accuracy in dimension in the order of 0.000025 mm.
Grinding is done on surfaces of almost all conceivable shapes and all kinds of materials.

Fig: - Grinding

Types of Grinding-

1. Surface Grinding

Surface grinders are used to produce flat, angular and irregular surfaces. In the surface grinding process, the grinding wheel revolves on a spindle; and the workpiece, mounted on either a reciprocating or a rotary table, is brought into contact with the grinding wheel.

2. Cylindrical Grinding

Cylindrical grinding is the process of grinding the outside surfaces of a cylinder. These surfaces may be straight, tapered or contoured. Cylindrical grinding operations resemble lathe-turning operations. They replace the lathe when the workpiece is hardened or when extreme accuracy and superior finish are required. As the workpiece revolves, the grinding wheel, rotating much faster in the opposite direction, is brought into contact with the part. The workpiece and table reciprocate while in contact with the grinding wheel to remove material.

3. Centerless Grinding

Centerless grinding machines eliminate the need to have center holes for the work or to use work holding devices. In centerless grinding, the workpiece rests on a work rest blade and is backed up by a second wheel, called the regulating wheel. The rotation of the grinding wheel pushes the workpiece down on the work rest blade and against the regulating wheel. The regulating wheel, usually made of a rubber-bonded abrasive, rotates in the same direction as the grinding wheel and controls the longitudinal feed of the work when set at a slight angle. By changing this angle and the speed of the wheel, the workpiece feed rate can be changed.

4. Internal Grinding

Internal grinders are used to finish straight, tapered or formed holes accurately. The most popular internal grinder is similar in operation to a boring operation in a lathe: The workpiece is held by a work holding device, usually a chuck or collet, and revolved by a motorized headstock. A separate motor head in the same direction as the workpiece revolves the grinding wheel. It can be fed in and out of the work and also adjusted for depth of cut.

5. Creep Feed Grinding

Traditionally, grinding has been associated with small rates of metal removal and fine finishing operations. However, grinding also can be used for large-scale metal-removal operations, similar to milling, broaching, and planning. In creep-feed grinding, developed in the late 1950s, the wheel depth of cut is as much as 0.25 in. and the workpiece speed is low.

5.3.2 FABRICATION TECHNIQUES

5.3.2.1 ARC WELDING

Arc welding is a welding process used to join metal to metal by using electricity to generate enough heat to melt metal and the melted metals, when cooled, resulting in a bond of the metals. It is a type of welding that uses a welding power supply to create an arc between a metal stick (electrode) and the base material to melt the metals at the point of contact. Arc welders can use either direct current (DC) or alternating current (AC) and consumable or non-consumable electrodes.

Fig.5.3:- Arc Welding

Types of Arc Welding-

1 MIG – GAS METAL ARC WELDING (GMAW)

MIG welding is used in the auto industry for repairing vehicle exhausts and is also used in creating homes and buildings. It is one of the most common types of welding. This is a type of arc welding that uses a continuous wire called an electrode. You will also use a shielding gas that travels through the welding gun and protects against contamination.

2. TIG – GAS TUNGSTEN ARC WELDING (GTAW)

TIG welding also uses electric arc like MIG. When working with TIG welding, you use an electrode made of tungsten. Tungsten is one of the toughest metal materials. It will not dissolve or burn off. Welding can be done through a process known as fusion which is using or not using a filler metal. TIG also uses an external gas supply, such as argon or helium.

3. STICK- SHIELDED METAL ARC WELDING (SMAW)

Stick welding is used in construction, maintenance and repair, underwater pipelines, and industrial fabrication. The stick softens and combines metals by heating with an arc between a covered metal electrode and the base metal workpiece. As the stick melts, its protective cover also melts and shields the weld area from oxygen and other gases that may be in the air.

4. FLUX-CORED ARC WELDING (FCAW)

Flux-cored arc welding is similar to MIG welding because both use continuous wire and power supplies. You will combine a continuous electrode with a base metal. The electrode is a hollow tube filled with flux that is fed through the weld gun and into the weld pool. When welding outdoors, a flux shield offers protection against weather elements. This type of welding is used for welding thicker metals and is used in machining industries.

5.3.2.2 NUT AND BOLT JOINT

A bolt is a type of fastener that is used to hold two or more mechanical components either stationary or under motion. Unlike screws, it requires a nut to get fastened. That's why a nut and bolt are said to be a pair that is used to hold different components.

Fig.5.4: - nut and bolt joint

Chapter 6

Result and Discussion

6.1 FABRICATION COMPLETED

Fabrication completed using all the technique described in the methodology and image of machine shown below.

Fig.6.1: - solar operated multi crop cutter machine

6.2 FIELD WORK EXPERIMENT AND CALCULATION

After completed fabrication work for knowing the working condition and performance of the machine field work experiment is done. On the basis of field work experiment some data are collected, which are as follows-

1. Average velocity of machine in field

   The velocity of machine is depending upon various parameters.

   a. Force applied by the operator.

   b. Type of crop.

Observation tables:

Table 1. velocity by changing the operator for same type of crop

Sr. No.	Operators	Distance covered in 5 min. (in meter)	Velocity (in m/s)
1.	Operator 1	126.0	0.420
2.	Operator 2	147.5	0.492
3.	Operator 3	155.0	0.516
4.	Operator 4	135.5	0.452

Table 2. velocity by changing the crop for same operator

Sr. No.	Types of crop	Distance covered in 5 min. (in meter)	Velocity (in m/s)
1.	paddy	118	0.393
2.	wheat	127	0.423
3.	mustard	144	0.480

Calculation of cutting area covered per hour

From table 1,

Average cutting velocity = (0.42+0.492+0.516+0.452)/4

= 0.47

From table 2,

Average cutting velocity = (0.393+0.423+0.48)/3

= 0.435

Average of average cutting velocity = (0.47+0.435)/2

= 0.452 m/s

Diameter of cutting blade = 0.265m

Cutting area covered per second = average of average cutting velocity * diameter of cutting blade

= 0.452*0.265

= 0.119 m2/s

Cutting area covered per hour = 0.119*3600

= 431.2 m2

2. Charging and discharging time of battery through.

   Data from specification of component and some standard value from research paper

   1. Rated power of solar panel = 165Watt
   2. Rated capacity of battery = 20Ah
   3. Rated voltage of battery = 12Volt
   4. Rated power on motor = 120Watt
   5. Operating factor of PV system = 0.75 (from research paper)

Calculation

Assume that the battery is fully empty, which would be the worst case:

Total energy in battery when fully charged = rated voltage of battery * rated capacity of battery

= 12 Volt * 20 Ah

= 240Watt hour

Approximate charging time for battery = 240Watt hour / 165 Watt

= 1.454 hour

Actual battery charging time = 1.454 / operating factor for PV system

= 1.454 / 0.75

= 1.938 hour

Assume battery is discharge up to 80%

Discharge time of battery through motor for 5 hour

= total watt hour capacity / (amount of discharge * battery voltage)

= (120 * 5) / (12 *0.8)

= 62.5 Ah

Hence 20 Ah battery can run for duration of

= (20*5) / 62.5

= 1.6 hour.

6.3 RESULT

After the field work data collected and calculation done which is shown in earlier. On the basis of that got some results which are as follows-

1. The machine covered cutting area **431.2 m2** in **1 hour.**
2. The charging time for battery is **1.938 hour** and Discharging time is **1.6 hour.**

6.4 DISCUSSION

Experiment performed by changing operator, it is observed that the speed of machine is depends upon the capability of operator. If operator is stronger than push the machine faster and if operator is not strong enough than the speed of machine is slow. As shown in table 1 operator 3(0.516 m/sec) runs the machine faster and operator 1(0.420 m/sec) runs the machine slower comparatively to others.

It is also observed that speed of machine as shown in table 2 depends upon the crop. As every crop have its own properties like strength of stalk, elasticity and distance between plant in field area etc. For calculation of average cutting velocity the selection of crop is mainly based on the most available crops in India (wheat, paddy etc.). This machine is also capable to cut the crop like sorghum plant, corn plant pigeon pea plant etc.

6.5 ADVANTAGES: -

- **Reduce the human efforts: -** Crop harvesting mostly designs for reduce the human efforts in which only one operator can be operate or handle the machine.
- **Reduce the time: -** When worker is cutting the crop they have more time for cutting but when the use of the crop cutter harvester they increase the capacity of the working and cutting and it can possible the maximum crop cutting within minimum time.
- **Easy to handle: -** Crop cutter machine is easy for handling and can easily start the machine and no skill person required for operating the machine.
- **No Pollution: -** This machine is eco-friendly so doesn't affect the environment**.**

Chapter – 7

CONCLUSION

7.1 CONCLUSION: -

- This solar operated crop cutter machine is capable to cut the crops of different types which include most grown crops in India like wheat, paddy etc.
- According to the calculation, the machine cuts 1acre crop area in 9.38 hours but in conventional method it took 2 days (16 hour) and 4 labors to complete cut the 1acre crop (vary with crops).
- The design of this machine is so simple that for the maintenance any training is not required.
- This is cost efficient machine which is durable, reliable and can be easily manufactured.

7.2 FUTURE SCOPE: -

- This crop cutter is semi-automatic, further additional work can do on this crop cutter and make it fully automatic.

- It can be made also large size by increasing the power source, so that the machine can also use for large area of crop cutting.

- This type of machine can also useful for road cleaning, floor cleaning by changing the mechanism of cutter blade.

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