

Modeling of Solar Based Paddy Harvesting Machine

A Thesis Submitted to the

Department of Mechanical Engineering



SONARGAON UNIVERSITY (SU)

A Thesis Submitted by

Matiur Rahman
ID: BME 1602009357

Soleman Ahmed
ID: BME 1602009358

Md. Azilam Yousuf Azim
ID: BME 1602009370

Md. Hafijur Rahman
ID: BME 1602009373

Supervised by

Pronoy Chowdhury

Lecturer

SONARGAON UNIVERSITY (SU)

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DEPARTMENT OF MECHANICAL ENGINEERING
SONARGAON UNIVERSITY (SU)
147/I Green Road, Dhaka 1215

DECLARATION

Course Title: Project and Thesis

Course Code: ME 400

This is to certify that the thesis work entitled “Modeling of Solar Based Paddy Harvesting Machine” has been carried out by Matiur Rahman, Soleman Ahmed, Md Azilam Yousuf Azim and Md Hafijur Rahman in the department of Mechanical Engineering, Sonargaon University. We also declare that neither this thesis work or any part of the paper has been submitted elsewhere for any degree.

Submitted by,

Matiur Rahman (BME 1602009357)

Soleman Ahmed (BME 1602009358)

Md Azilam Yousuf Azim (BME1602009370)

Md Hafijur Rahman (BME 1602009373)

Supervised by,

PRONoy CHOWDHURY

LECTURER

DEPARTMENT OF MECHANICAL ENGINEERING

SONARGAON UNIVERSITY (SU)

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The report title, “Modeling of Solar Based Paddy Harvesting Machine” has been prepares to fulfill the requirement of my practicum program.

First of all, we are indebted to the almighty Allah for overwhelming all the obstacles and predicament that we faced during the whole research work and for bringing this thesis into its authenticity. Then, I would like to thanks our project supervisor, **PRNOY CHOWDHURY** who has given us much strong logistic support while implementing the project given. He has always assisted me when I handling my project. Besides, I would like to express my sincere appreciation for his valuable advices, guidance and encouragement. This has inspired me to be more confident in trying new things.

At last but not least, I would like to say millions of thanks to all our course mates and those who has lending me their helping hand.

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ABSTRACT

Uses of solar energy attract world-wide attention day by day in the sake of their nonpolluting nature. Now a day's solar collectors are used in the modern world to face the future energy problem. The main purpose of our Project is to help smallscale farmers who having land area less than 5 bigha by designing small scale harvester machine to harvest grains very efficiently. Our project work will focus on ease of harvesting operation to the small-scale farmers for harvesting varieties of grain in less time and at low cost by considering different factors such as cost of equipment, ease of operation, time of operation and climatic conditions. The power is generated from solar panel and stored in battery. The power from the battery is supply to the motor and the motor is running and cut the paddy. This harvester might be the best solution for the problems faced by small scale farmers relating with availability of labors and cost of harvesting.

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Chapter 1: Introduction

1.1 INTRODUCTION:

Solar energy is a renewable energy from the sun, which is available abundantly and freely every day. With fossil fuels disappearing rapidly and likely to be exhausted sooner or later, making use of solar energy is now more important than ever. Agricultural industry is surpassing greater heights. With the inventions of new machinery and new ways of getting better yield has exposed the concerned industry to the fire of competition. Today the farmers have become aware of the modern technologies that can fetch them better yields and also help them manage it with multiple machineries. But the mechanization of farming is not possible in Bangladesh because here the farmers have very small piece of farm which is to be maintained for farming and investment on the machineries are not possible by small farmers. We have to devise the small machines or equipment's which farmer can afford. We are well aware that during harvesting, cutting the crops by hand is by far one of the most laborious and difficult operations of the farmer's profession, and need labors for doing the same and now a days we find shortage in labor. However surpassing technologies have ensured that crop cutting will no longer be a sturdy task but various machines suitably designed for this purpose will perform this action smoothly and in time. Besides saving time and labor, these machines are designed to make agriculture a sophisticated profession. All these machines use diesel as fuel and we have to come with an alternate since fossil fuels are getting depleted and also it is costing us the nation exchequer heavily. The present crop cutting is done by manual process and in mechanized process, heavy machineries are used which are costly and a common farmer cannot afford for such machines. So, we are Designing a machine where small farmers can afford it.

1.2 HISTORY OF PADDY HARVESTING MACHINE:

The combine paddy harvester got its start in Scotland in 1826 when Reverend Patrick Bell designed the reaper machine- a large machine that was pushed by horses and used scissors to cut plants. Unfortunately, Bell didn't patent his invention. So, in 1835, Hiram Moore built and patented the first combine harvester in the United States.

Moore's machine was capable of reaping, threshing, and winnowing cereal grain, with the earlier versions being pulled by horse, mule, or ox. The first version was 17ft long and could cut 15ft of grain at a time, and by 1839, a combine harvester pulled by 20 horses harvested over 50 acres of crops. Then, by 1860, combine harvesters that could cut a width of several meters were used on most American farms.

A few decades later, in 1882, Australian Hugh Victor McKay developed a similar idea for a great invention. He created the first commercial combine harvester called the Sunshine Harvester. However, it wouldn't be until George Stockton Berry that the combine harvest became steam-powered thanks to the integration of the steam engine and straw to heat the boiler.

1.3 AIM:

Aim of this project is to design and develop small scale low cost compact harvester which reduce the overall cost of grain harvesting in the form of labor cost and harvesting cost. To reduce overall harvesting time as that of harvesting time. We will use solar energy as alternate of fossil fuels and reduce the fuel cost. The solar energy is eco-friendly and does not impact in environment.

1.4 PROBLEM STATEMENT:

As we know, Bangladesh is an Agriculture based country and the agriculture is the major source of income of many peoples of Bangladesh, 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 paddy harvesting and named as “Solar Based Paddy Harvesting Machine”. It possesses four criterion ease in manufacturing, ease in handling, low cost, light weight and no pollution (Eco-Friendly).

1. 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.
2. 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.
3. Thus, the objective of the project work is to create a portable, low cost mini harvester which will be user-friendly.
4. 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.

1.5 OBJECTIVES:

In this system uses a solar based energy source. Which is easier to use, more advantageous comparing to other energy sources especially for gas-based source of power? But our paddy cutter is based on solar because this energy is a renewable energy and it is easy to work. So, we made solar powered paddy cutter. Alternatives to the use of nonrenewable and polluting fossil fuels to be investigated one such alternative is solar energy. In this solar based paddy cutter, the advantage of powering a mower by solar energy rather than by gasoline is mainly ecological. We manufactured this paddy cutter because it is very easy method and many overcome produced from this type of paddy cutter.

1. To manufacture a Multi crop cutter operated on solar power for the ease of cutting crops at higher rate.
2. To simplify the complex driving mechanisms used in earlier projects and giving it simple and high working capability.
3. To achieve crop harvesting process at cheaper side.
4. Another objective of the project was learning how to work the different parts of crop cutter and achieve its optimum working.
5. It should require Less Man Power.

1.6 SCOPES:

1. Source of energy: solar energy collects from sun radiation.
2. Properties: Lighter weight, low cost components and easy operating.
3. Environmental advantages: Solar based paddy harvesting machine are eco-friendly and help to reduce global warming effect.
4. Government support: Legislative/policy commitment to carbon reduction.

1.7 ADVANTAGE:

1. Not using any fossil fuels which are depleting now and becoming costlier.
2. The system is non-programmable.
3. Light in weight, and easy operating.
4. Purchase and operating are very less.
5. Can be operated by unskilled person.
6. It does not require high maintenance cost.
7. Use of renewable energy for the crop cutting action.
8. A single person can do the crop cutting faster than manual process which is tedious and hazardous also.
9. Light weight makes it maneuverable for any aged people and also for women.
10. Has fewer moving parts.
11. Now we are safety with no pollutants emitted. There are also no air filters & spark plugs to bother it.

1.8 LIMITATION:

1. The eventually disposal of batteries is problematic.
2. The motors in cordless cutter lend to be less powerful than gasoline motors of the same total weight.
3. Charging through solar panel will be affected by atmospheric conditions.
4. Difficult to operate in rainy season.

Chapter 2: Literature Review

2.1 LITERATURE SURVEY:

Sarkar Bikash, Kumar U, Chandra N & Mishra J.S “Performance Evaluation of Hand Held Crop Cutter Used in Wheat and Rice Harvesting” Says harvesting of rice and wheat using crop cutter was evaluated. Results showed that the field capacity of crop cutter was 2.44 times higher than the manual operation. The labour requirement was 32.74 and 149.25 man-hr/ha for crop cutter and manual operation, respectively. In case of wheat, the field capacity of crop cutter was 2.23 times greater than manual harvesting and labour involvement was 23.20 and 115.74 man-hr/ha for crop cutter and manual operation, respectively. The cost of wheat harvesting operation for one hectare was Rs. 2340.40/- in case of crop cutter and Rs. 3750/- for manual operation. Whereas in rice harvesting the cost was Rs. 2464.28/- for crop cutter and Rs. 5596.87/- for manual operation respectively. designed blade had 136 teeth with 0° rake angle, 30° clearance angle and 6 mm pitch. A simple windrowing system made from aluminum sheet was designed and constructed. The cutting head installed on existent brush cutter and test was conducted in end conditions. For each type of variety, the cutting energy and critical blade speed was computed. Results indicated that compared to local rice varieties Maximum power consumption of about 1.132 kW was obtained for Khazar variety. Results also showed that rice losses of the portable reaper were lower than manual harvesting and end capacity of machine was 4.20 times greater than manual harvesting.[1]



Figure 2.1: Hand Held Crop Cutter Used in Rice Harvesting

Md. Rostom Ali, Md. Kamrul Hasan & Chayan Kumer Saha Says the Southern region of Bangladesh is lagging behind in adoption of mechanical harvesting of rice due to its agro-ecological characteristics as saline and cyclone prone area. On the other hand, shortage of

labor and delayed harvesting cause huge harvesting losses to the farmer. To maintain timeliness of harvesting and reduce losses “Appropriate Scale Mechanization Innovation Hub (ASMIH)-Bangladesh” with financial assistance of University of Illinois and USAID, has taken initiative to adapt harvesting technologies in the southern region of Bangladesh. An experiment of Aman rice (November-December, 2016) harvesting at Dumuria, and Wazirpur Upazilas of Khulna and Barisal districts, respectively of Bangladesh was conducted using two models (ACI and Metal) of reaper and mini-combine harvester (Glory Engineering). Technical and economic performances of the selected harvesting technologies were estimated based on the field data. Average fuel consumption, effective field capacity and field efficiency of (a) ACI reaper, (b) Metal reaper and (c) Mini-combine harvester were (a) 3.29 L/ha, 0.22 ha/hr, 57.78% (b) 3.87 L/ha, 0.23 ha/hr, 66.43% and (c) 18.12 L/ha, 0.09 ha/hr, 55.40%, respectively for Wazirpur, Barisal, and (a) 3.18 L/ha, 0.26 ha/hr, 65.32% (b) 4.19L/ha, 0.18 ha/hr, 53.5% and (c) 19.52 L/ha, 0.09 ha/hr, 54.16%, respectively for Dumuria, Khulna. The farmers found the mini-combine harvester more attractive as it performs several tasks like harvesting, threshing, cleaning and bagging in a single operation. Further investigation is needed to identify the suitability of these harvesting machines in Boro harvesting.[2]



Figure 2.2: Rice Harvesting by Mini-Combine Harvester

P. Amrutesh, B. Sagar & B. Venu “Solar Grass Cutter with Linear Blades by Using Scotch Yoke Mechanism” Says A Solar grass cutter is a machine that uses sliding blades to cut a lawn at an even length. Even more sophisticated devices are there in every field. Power consumption becomes essential for future. Solar grass cutter is a very useful device which is very simple in construction. It is used to maintain and upkeep lawns in gardens, schools, college’s etc. We have made some changes in the existing machine to make its application easier at reduced cost. Our main aim in pollution control is attained through this. Unskilled operation can operate easily and maintain the lawn very fine and uniform surface look. In our project, Solar grass cutter □ is used to cut the different grasses for the different application.[3]



Figure 2.3:Solar Grass Cutter with Linear Blades by Using Scotch Yoke Mechanism

Pathak, T. N, Vidhate T.R.&Jadhav S. S. “A Review on Development of Solar Powered Multi Crop Cutter for Harvesting” Says the project work carried on development of solar power crop cutter. We have developed a compact mechanism for harvesting of crop cutter work on solar power so that we can an easy harvesting in minimum period of time. This set up is used to cut the multi-crops at a time, which help the small-scale farmers. This cutter is been invented because of low cost, high compatibility, and use for rough use. This set up uses the solar power, which is provided with different blades, solar plate, rubber wheel, DC motor and battery arrangement which results in transmission of this solar power into rotary motion of cutter at the end of which the crops get cut easily and perform various task as per requirement. We have made changes in the existing machine to make its application easier at reduced cost. Our main aim in Cost and pollution control is attained through this Project work. [4]



Figure 2.4: Solar Powered Multi Crop Cutter for Harvesting

Automated Solar Grass Cutter (February 2017) Ms. Rutuja A. Yadav, Ms. Nayana V. Chavan, Ms. Monika B. Patil, Prof. V.A. Mane According to the author a daily purpose robot which is able to cut the grass in the lawn. The system will have some automation work for guidance and other obstacle detection and the power source that is battery and a solar panel will be attached on the top of the robot because of this reduces the power problem. Automated solar grass cutter is increasingly sophisticated, are self-docking and some contain rain sensors if necessary, nearly eliminating human interaction. The system is switched to automatic mode in which the robot's infrared sensors make a comparison between, cut and uncut the grass. The mower continues this process until it completes the job. The system uses 12V batteries to power the vehicle movement motors as well as the grass cutter motor. They also use a solar panel to charge the battery so that there is no need of charging it externally. The grass cutter and vehicle motors are interfaced to an 8051-family microcontroller that controls the working of all the motors. It is also interfaced to an ultrasonic sensor for object detection. The microcontroller moves the vehicle motors in the forward direction in case no obstacle is detected. If in case obstacle is detected by the sensor then the microcontroller stops the grass cutter motor so as to avoid any damage to the object/human/animal. [5]



Figure 2.5: Solar Economical grass cutter

T. Moontree, S. Rittidech* and B. Bubphachot “Development of the sugarcane harvester using a small engine in Northeast Thailand” International Journal of Physical Sciences Vol. 7(44), pp. 5910-5917, 23 November, 2012. This research presents the developing sugarcane harvester using small engine in order to focus on its

appropriateness in sugarcane farming for farmers who are encountering problems of labor shortage and sugar factories lacking sugar cane for producing sugar. It is operated by 180 hp (134.28 kW) at 2500 rpm. Sugarcane was harvested at 12 months after planting with an average-stalk length of 1.8 m, and average-stalk diameter of 0.0254 m; each clump consisted of 8 to 12 stalks, the distance of each sugarcane row was 1.20 m. The sugarcane harvester using small engine can perform at an average speed of 1109.73 m²/h with fuel consumption of 20.03 l/h and at a mobile speed of 0.25 km/h. The percentage of sugarcane-cut stalks is 100% since this engine is installed with double blades with a speed of 1,090.5 rpm; a speed of leaf-cutting blades is at 669 rpm with the break-even point of 122,572.8 kg/year and the payback period of 2 years.[6]

Solar Based Grass Cutting (January-June 2017) Ms. Bhagyashri R. Patil, Mr. Sagar S. Patil

According to the author, human enlargement in many countries there are studies and trials going on the solar energy and the wind energy, so they made their new concept solar power grass cutting machine. In this concept they cut the grass on the agricultural land or small plants in lawns and gardens. The design of solar powered agricultural equipment will include direct current (DC) motor, a rechargeable battery, solar panel, a stainless-steel blade and control switch. The automatic grass cutting machine is going to perform the grass cutting operation by its own which means no man power is essential. The purpose of the project here is to design and build a remote-controlled grass cutter. The device consists of linear blades and it does not affect by climatic conditions. They have used many components for preparing grass cutter like DC Motor for rotating the wheels and blade, wheels, battery, Solar panel, Circular blade. There are two main components such as transmitter and receiver. Transmitter continuously transmits the rays if any obstacle come in front of grass cutter then the rays are reflected back towards the receiver. The receiver receives the signal in the serial form from encoder but microcontroller requires parallel data for communication so receiver sends data to decoder to convert data in the parallel form and then it is passed to microcontroller.[7]

2.2 SCOPE OF PRESENT WORK:

Paddy in Bangladesh is an important cereal crop for national food security. Harvesting is the process of collecting mature paddy from the field. Timely harvesting operation is known as crucial and influential processes on quantity, quality and production cost of paddy. The aim of the study was to assess the manual and mechanical harvesting systems of paddy in southern delta region of Bangladesh in terms of labor cost, infield harvesting losses, and time required for harvesting. Several experiments were conducted to compare mechanical and manual harvesting systems.

Chapter 3: Methodology

3.1 INTRODUCTION:

The solar powered multi-crop consists of a base frame, supporting frame, DC motor, solar panel, switch, electric wiring, battery, wheels and sharp blades. All this components are mounted on a frame, along with wheels are fitted to this frame. The movement of this harvester is done by pushing i.e. by using human powered. This crop cutter is highly efficient as it works on solar powered and it is affordable to small farmers due to its simple working. The advantage is it does not require any maintenance, easy to handle and it can cut different crops with the help of simple height adjustment by nut and bolt mechanism. Working of the crop cutter takes place stepwise. The crop cutter comes to rest momentarily after each step. The seven steps of crop cutting are,

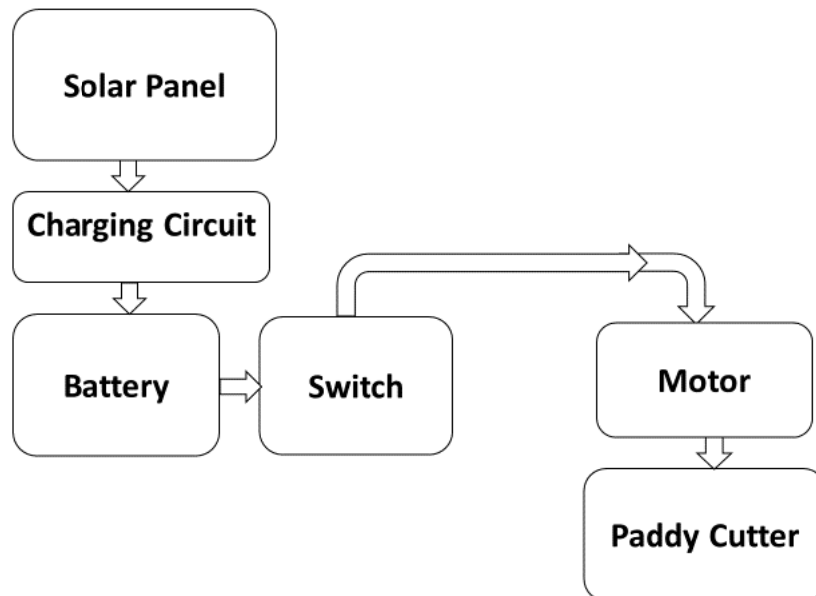


Figure 3.1: Working Flow Diagram

1. Battery connection gets ON.
2. By human effort move the cutter in desired direction.
3. Through the power of battery cutter starts rotating.
4. Cutter cuts the crop and throws it aside.

5. Cutter cuts the crops and works desirably.
6. After discharging of the battery, it is again charged with the help of charging adapter.
7. Battery can be also charged with the help of solar energy from solar panel.

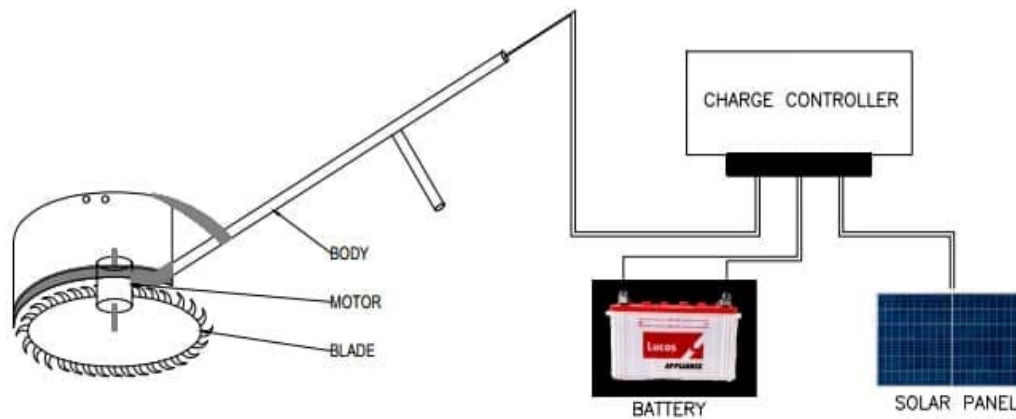


Figure 3.2: Process Diagram of Solar Based Paddy Harvesting Machine

3.2 COMPONENT REQUIRED

For construction this project we need some hardware components and software program.

They are as follows.

3.2.1 Hardware Requirements:

- a) Solar Panel
- b) Solar Charging Controller
- c) Battery
- d) DC Motor
- e) Circular Blade
- f) Push Switch

- g) Mild Steel Pipe
- h) Metal Sheet
- i) Cable Wire

3.2.2 Software Requirements:

Program using MS Word, Power Point&Auto Cad

3.3 INSTRUMENTS:

3.3.1 Solar Panel:

A solar panel is a set of solar photovoltaic module electrically connected. A photovoltaic module is packaged, connected assembly of solar cells. The solar panel can be used as component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Solar panel of 20watts 12volts, 1.4amps. Photovoltaic solar panels absorb sunlight as a source of energy to generate electricity.

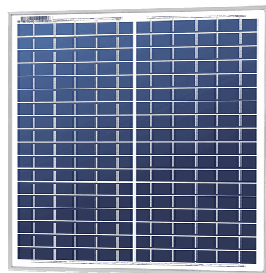


Figure 3.3:Solar Panel

20-watt solar panel has been chosen for this thesis.

Table 3.1: 20-watt solar panel details

Rated Power P-max (W)	20
Voltage (V)	12
Rated Current (A)	1.4
Length (mm)	480
Width (mm)	366
Thickness (mm)	25

3.3.2 Solar Charging Controller:

The power charge regulator is also known as a charge controller, voltage regulator, charge-discharge controller or charge-discharge and load controller. The regulator sits between the array of panels, the batteries, and the equipment or loads. By monitoring the voltage of the battery, the regulator prevents overcharging or over-discharging. Regulators used in solar applications should be connected in series: they disconnect the array of panels from the battery to avoid overcharging, and they disconnect the battery from the load to avoid over-discharging.

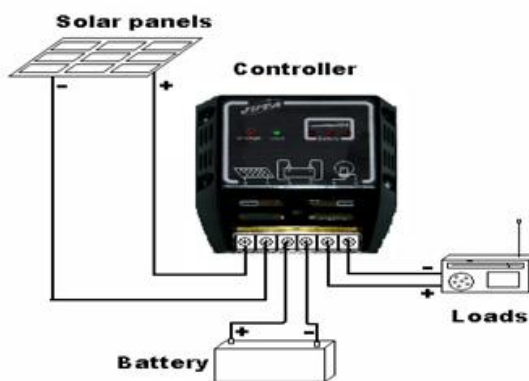


Figure 3.4: Solar Charging Controller

3.3.3 Battery:

Unsealed lead acid battery with voltage 12v and nominal capacity of 9Amp is used for the energy storing purpose. The battery usage and maintenance are of non-free type. The battery is charged during the day in the presence of sun i.e., solar energy and use when necessary. The battery after charging can be used up to 2-3 hours continuously.

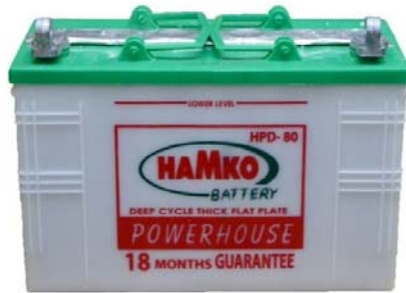


Figure 3.5: DC Battery

3.3.4 DC Motor:

Almost every mechanical movement that we see around us is accomplished by an electric motor. Electric machines are means of converting energy. Motors take electrical energy and produce mechanical energy. Electric motor is used to power hundreds of devices used in everyday life. The motor used for controlling the cutter, the permanent dc motor with 12V is used having the speed 7000rpm without load. This single-phase motor generates electric current and this electric current converted to mechanical work like to rotate the blade.



Figure 3.6: DC Motor

3.3.5 Circular Blade:

Different types of blades are used for operation to be done and these blades are made by cast iron, Stainless Steel, carbide steel. We are using Tungsten cutter blades for cutting purposes. The blade is fastened to the motor and rotate rapidly with the motor. The blades are mounted according to the need. After the blade mount was finished being fabricated, inserted it on the shaft. Then to make sure the mount was supported vertically drilled a small hole completely through the mount and shaft. This allowed me to insert a bolt as an added safety measure. It is easy to cut the grass and the moving the blades will be freely. The blade moves with the help of dc motor which is connected with the blade, due to dc motor blade moves very fast which use to cut. Motor capacity is 12 watts and there is a blade arrangement in front of the frame.



Figure 3.7: Circular Blade

3.3.6 Push Switch:

A push button switch is a small, sealed mechanism that completes an electric circuit when you press on it. When it's on, a small metal spring inside makes contact with two wires, allowing electricity to flow. When it's off, the spring retracts, contact is interrupted, and current won't flow.



Figure 3.8: Push Switch

3.3.7 MildSteel Pipe:

1. Mild Steel pipes or tubes have high tensile strength.
2. These pipes comply with ASTM (American Society for Testing and Materials) specification.
3. MS pipes are extremely stronger.
4. Low percentage of carbon.
5. They can be easily welded.
6. Easy to fabricate and available readily.
7. Not too costly in comparison to other metals.



Figure 3.9: Mild Steel Pipe

3.3.8 Metal Sheet:

Sheetmetal is metal formed by an industrial process into thin, flat pieces. Sheet metal is one of the fundamental forms used in metalworking and it can be cut and bent into a variety of shapes. Countless everyday objects are fabricated from sheet metal. Thicknesses can vary significantly; extremely thin sheets are considered foil or leaf, and pieces thicker than 0.25 mm are considered plate steel or "structural steel.



Figure 3.10: Metal Sheet

3.3.9 Cable Wire:

An electrical cable is an assembly of one or more wires running side by side or bundled. Wire is a single electrical conductor, whereas a cable is a group of wires swathed in sheathing. The term cable originally referred an electrical context, cables (like wires) are used to carry electrical currents.



Figure 3.11: Cable Wire

3.4 PROCEDURE:

Coming to the working of solar powered paddy cutter, it has panels mounted in a particular arrangement at an angle of 45 degrees in such a way that it can receive solar radiation with high intensity easily from the sun. These solar panels convert solar energy into electrical energy as studied earlier. Now this electrical energy is stored in batteries by using a solar charger. The main function of the solar charger is to increase the current from the panels while batteries are charging, it also disconnects the solar panels from the batteries when they are fully charged and also connects to the panels when the charging in batteries is low. The motor is connected to the batteries through connecting wires. Between these two electrical push switches is provided. It starts and stops the working of the motor. From this motor, the power transmits to the mechanism and this makes the blade to slide on the fixed blade and this makes to cut the paddy. The motor is holding the wheel cutter which is of 120mm diameter which is rotating at high speed of almost 2300rpm with load, backed by the dc battery, and powered by solar panel. The cutter holder is with the collet of the machine which holds the axle holding the cutter. A metal sheet is used in upper side of the motor to be able to divert the crops cut to the left side, so that the crop cut is dropped aside without disturbing for the movement of this machine ahead. This chute is fixed on the vertical arm which is holding the rotary cutter as required. The motor working on DC batteries provided on this machine which are chargeable and is getting charged by solar module. We are fixing the solar panel on the machine which will be charging the battery and these batteries can be recharged by A/c mains also. We are providing the handle for pushing the machine ahead smoothly and all the equipment's are placed in proper balancing of the machine.

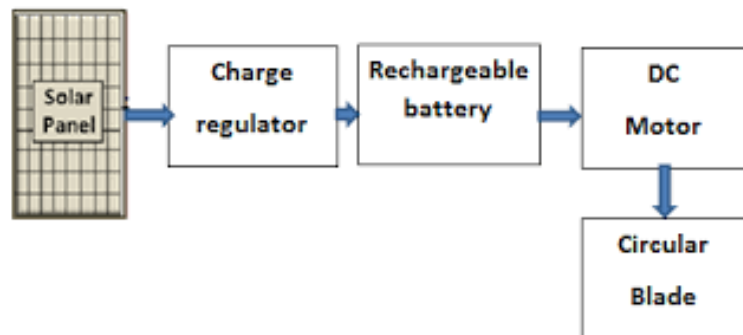


Figure 3.12: Block diagram of solar operated paddy harvester

Chapter 4: Fabrication

4.1 INTRODUCTION:

A solar based paddy cutter system design and sizing process passes through the following two stages depending upon the level of details used in components sizing:

- Approximate design.
- Precise design.

In the approximate design several simplifying assumptions are made with respect to the component performance, solar radiation data, and seasonal variation in the load of PV panel with season etc. In the precise design, however, attention is given to accurate details of the above factors. The overall design can be divided into six steps as given below:

Step 1: Determine the PV system configuration.

Step 2: Determine the power and torque required to cut paddy.

Step 3: Selection of DC motors, by considering the output torque and power input.

Step 4: Determine the size of solar PV module required, the motor rating taking in consideration.

Step 5: Selection of storage battery and charge controller circuit.

Step 6: Development of the model.

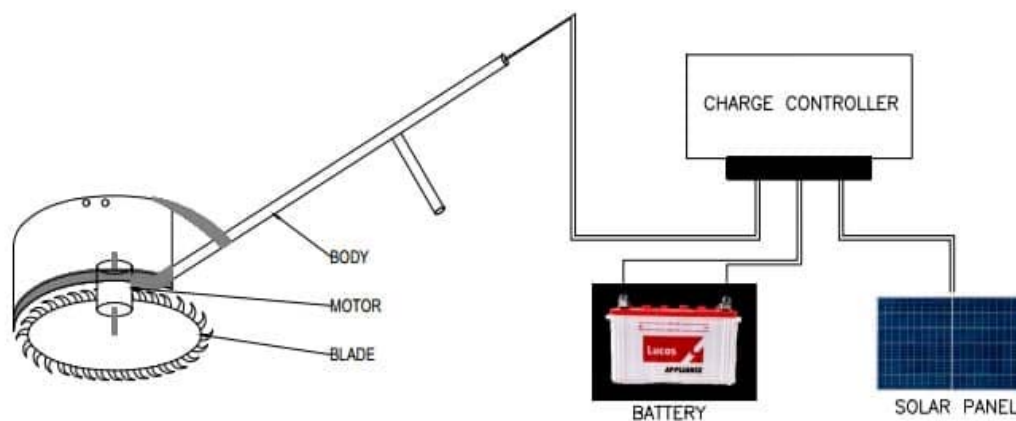


Figure 4.1: Proposed Diagram of Solar Based Paddy Harvesting Machine

Solarenergy is very large, inexhaustible sourceof energy. The power from thesun interrupted byearth is approximately 1.8/10MW, which are manythousandsof times larger than the presentconsumption rate on the earth of all energy sources.Solar energy is an important, clean, cheap andabundantly available renewableenergy. The sunradiates heat and light. The sun produces enormous amount of energy ofheat and light through sustained nuclear fusionreactions. The solarenergy received on the earth inthe form of radiation is used for heating andproducing an electrical energy.Among the non-conventional sources of energy solarenergy is the most promising. Hence our project isbased on the solar energy conversion to mechanicalenergy to run a normal paddy cutter.

Table 4.1: Comparison Between Solar System and Fuel System

SL. No	SOLAR SYSTEM	FUEL SYSTEM
1	Totally free from pollution	Pollution is a great factor
2	No fuel consumption	Fuel is the important need
3	No. of reciprocating parts are less	No. of reciprocating parts are more
4	Friction is greatly reduced	Frictions between the parts are high
5	Low cast and maintenance	Maintenance is difficult & costly
6	Load carrying capacity is low	Load carrying capacity is high
7	Continuous ride for hours together is not possible	Continuous ride is possible
8	Ratio of speed reduction more when weight increases very much	Speed reduction ratio is less and it does not vary

4.2 FABRICATION:

4.2.1 Solar Panel:

20-watt solar panel has been used for this project.A solar panel is a set of solar photovoltaic module electrically connected. A photovoltaic module is packaged, connected assembly of solar cells. The solar panel can be used as component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Solar panel of

20watts 12volts, 1.4amps. Photovoltaic solar panels absorb sunlight as a source of energy to generate electricity.

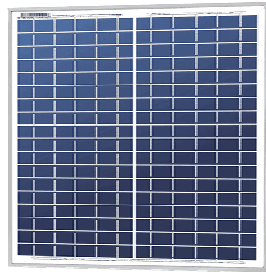


Figure 4.2: 20 Watts Solar Panel

4.2.2 Charging Controller:

The charging controller connected in solar panel to series. The charging controller sits between the array of panels, the batteries, and the equipment or loads. By monitoring the voltage of battery, the regulator prevents overcharging or over discharging. Regulators used in solar applications should be connected in series: they disconnect the array of panels from the battery to avoid overcharging, and they disconnect the battery from the load to avoid over discharging.



Figure 4.3: Connection with Solar Panel and Charging Controller

4.2.3 Battery:

Unsealed lead acid battery with voltage 12v and nominal capacity of 9Amp is used for the energy storing purpose. The battery usage and maintenance are of non-free type. The battery is charged during the day in the presence of sun i.e., solar energy and use when necessary. Battery are connected to charge controller in series. Battery output connection is connected to the dc motor.



Figure 4.4: Connection with Solar Panel, Charging Controller and Battery

4.2.4 DC Motor:

Motors take electrical energy and produce mechanical energy. The motor used for the controlling the cutter, the changeable dc motor with 12V is used having the speed 7000rpm without load. The DC motor is connected to the battery and the cutter is connected to the motorshaft. This motor power from battery and this power converted to mechanical work like to rotate the blade.



Figure 4.5: DC Motor

4.2.5 Circular Blade:

The circular blade is connected to motor output. The blade is fastened to the motor and rotate rapidly with the motor. The blade moves with the help of dc motor which is connected with the blade, due to dc motor blade moves very fast which use to cut. Motor capacity is 12 watts and there is a blade arrangement in front of the frame.

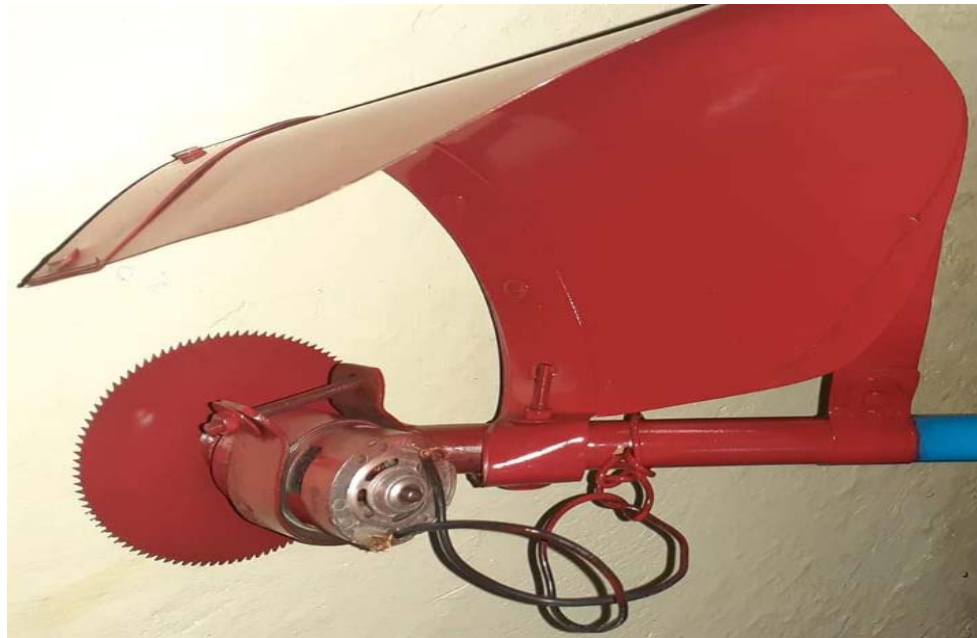


Figure 4.6: Connection with DC Motor and Circular Blade

4.2.6 Body or Handle:

The body or handle is used to hold the cutter and the motor. Push switch is attached to one end of the handle and the motor is connected to the other end. We are conduct the project through the handle.

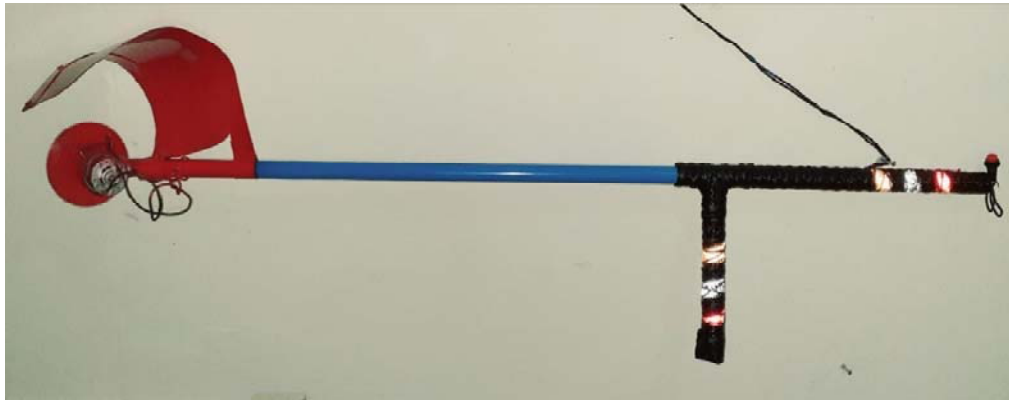


Figure 4.7: Connection to Handle with DC Motor and Circular Blade

4.3 SCHEMATIC DIAGRAM:



Figure 4.8: Schematic diagram of solar based paddy harvesting machine

4.4 CIRCUIT DIAGRAM:

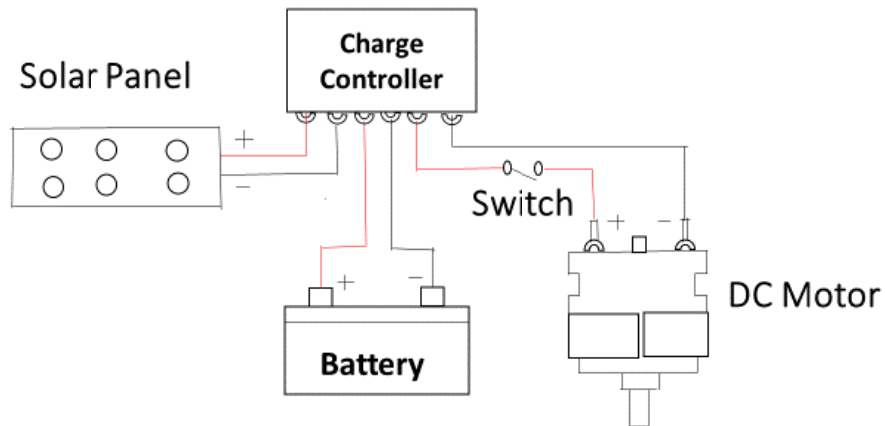


Figure 4.9: Circuit diagram of solar based paddy harvesting machine

4.5 WORKING PRINCIPLE:

The working principle of solar based paddy cutter is it has a panel arrangement at an in such a way that can receive solar radiation with high intensity easily from the sun. The solar panel converts solar energy into electrical energy. This electrical energy is stored in batteries by using a solar charger. The main function of the solar charger is to control the current from the panel while batteries are charging. The motor is connected to battery through connecting wires between this electrical push switch is used. It starts and stops the working of the motor. A blade is connected to the motor as paddy cutter. The blade is rotating with the motor and cut the paddy. The machine is operated with help of the Electric Motor which is connected with battery. The machine is taken out in sun rays to generate electric current and to charge the battery. The Motor is transmitted power to cutter will be rotated. The rotating motor is in turn connected to the cutter through vertical rod which rotates the cutter. To cut the paddy then we select a row of paddy and machine move on this row manually.

A metal sheet is used in upper side of the motor to be able to divert the crops cut to the left side, so that the cropcut is dropped aside without disturbing for the movement of this machine ahead.

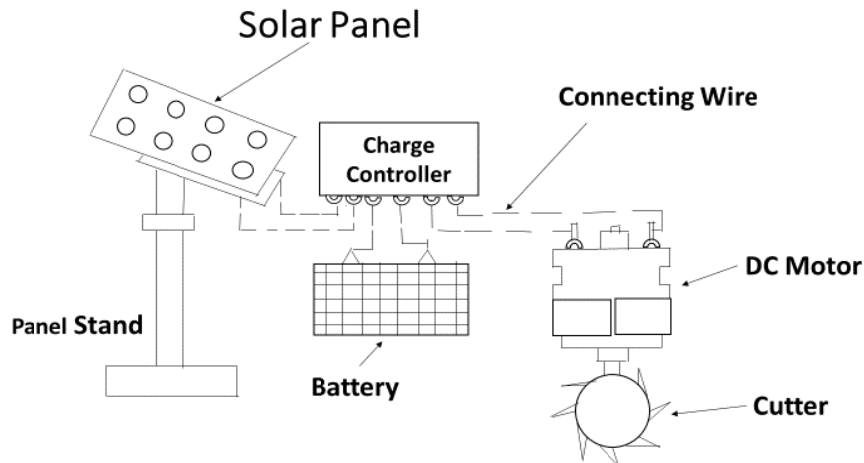


Figure 4.10: Solar paddy harvesting machine components and workflow process

4.6 PRODUCTS DESCRIPTION:

Table 4.2: Specifications of Products

Sr. No.	PARTS	Material
i.	Motor power	12 V, 7000 rpm
ii.	Battery specification	12 v, 9 Ah
iii.	Solar panel	12 V ,20w
iv.	Power Switch push on type	Plastic
v.	Frame	Mild Steel Pipe
Vi	Cutting blades	High carbon steel
viii.	Battery type	Unsealed lead acid battery

Chapter 5: Data Collection, Analysis & Discussion

4.1 DATA COLLECTION:

Table 5.1: Data Specifications of Battery

Capacity	9Amp
Normal Voltage	12V
Discharge Voltage	11.5V
Max Charge Voltage	11V-12V
Standard Charge Current	1.5Amp
Rapid Charge Current	3.5Amp
Standard Discharge Current	1.7Amp
Rapid Discharge Current	4Amp
Battery Weight	2 Kg
Battery Height	14cm
Battery Wide	7.25cm
Battery Length	13.5cm
Battery Dia	41.5cm
Operating Temperature (Charge)	48°C
Operating Temperature (Dis-charge)	55°C

Table 5.2: Data Specifications of Motor

Type	775 Motor
Operating Voltage	6V-18V
Nominal Voltage	12V
No Load RPM	7000RPM
With Load RPM	2300RPM
NO Load Current	2.5Amp
With Load Current	7Amp

Table 5.3: Data Collection

20Watts Solar Output Per Hour	1.35Amp
Charging Time	6Hours&40Min
Battery Output Time (With Load)	50Min
Battery Output Time (Without Load)	1Hour & 40Min
RPM Without Load	7000RPM
RPM With Load	2300RPM
Current Without Load	2.5Amp
Current with Load	7Amp
Voltage	12V

5.2 RESULT AND DISCUSSION:

$$P = 2\pi NT / 60\text{watts}$$

Where,

P = power

N = Speed of motor

T = Torque

$$\text{Then } P=V*I$$

V=voltage

I=current

❖ TORQUE AND POWER OF A MOTOR WITH NO LOAD CONDITIONS:

$$P=V*I$$

$$=12*2.5$$

$$=30W$$

$$N= 7000 \text{ RPM}$$

Then

$$P = 2\pi NT / 60$$

$$30 = (2 * \pi * 7000 * T) / 60$$

$$1800 = 2 * \pi * 7000 * T$$

$$T = 0.04 \text{ N-m}$$

❖ TORQUE AND POWER OF A MOTOR WITH LOAD CONDITIONS:

$$P = V * I$$

$$= 12 * 7$$

$$= 84 \text{ W}$$

$$N = 2300 \text{ RPM}$$

Then

$$P = 2\pi NT / 60$$

$$84 = (2 * \pi * 2300 * T) / 60$$

$$5040 = 2 * \pi * 2300 * T$$

$$T = 2.87 \text{ N-m}$$

OBTAINING RESULTS

Torque with No Load Conditions = 0.04 N-m

Torque with No Load Conditions = 2.87 N-m

Chapter 6: Conclusion and Further Study

6.1 CONCLUSION:

Our project entitled Modeling of Solar Based Paddy Harvester is successfully completed and the results obtained are satisfactory. It will be easier for the people who are going to take the project for the further modifications. This project is more suitable for a common man as it is having much more advantages i.e. no fuel cost, no pollution and no fuel residue, less wear and tear because of a smaller number of moving components and this can be operated by using solar energy. This will give much more physical exercise to the people and can be easily handled. As we are nearer to Equator, the solar energy (nonconventional energy) is vastly available, so it is easy to charge the battery and is also pollution free. But the initial investments of the solar powered paddy cutter are high. At present in order to curtail global warming and ozone depletion, the Government of Bangladesh is offering subsidy for the solar equipment. The industries are producing these components in mass production, so the cost of the system may come down. So, in future it is expected to run all equipment's by using solar energy. This system is having facility of charging the batteries while the solar powered grass cutter is in motion. So, it is much more suitable for grass cutting also. The same thing can be operated in night time also, as there is a facility to charge these batteries in day light. This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries. We are proud that we have completed the work with the limited time successfully. The Paddy Cutter is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities. In conclusion remarks of our project work, let us add a few more lines about our impression project work. In conclusion remarks of our project work, let us add a few more lines about our impression project work. Thus, we have developed a "Solar Paddy Harvesting Machine" which helps to climb up the walls of high-rise buildings at a significant low cost which may be used for several applications. By using more techniques, they can be modified and developed according to the applications. The cost of the machine is less and if the farmer buys this machine, farmer can recover the invested money back. By using this machine problem of the labor crises can be reduced. Comparing with manual harvesting only 20% of labors are required. It makes the process faster hence reduces most of the harvesting time and labor required to operate the machine is also less. This machine is helpful for both small and big farms.

6.2 FURTHER STUDY:

We completed our project successfully with the available sources. But the results and modifications are not up to the expectations. This can be further improved by incorporating the following modifications to obtain better results. This efficiency can be increased by using some other mechanism. and speed of motor is reduced because we have used heavy material and this material can be replaced by using light weight material and design of blades should be done based on types of grass and paddy is used to cut. The project which we have done surely reaches the average families because the grass and paddy can be trimmed with minimum cost and with minimum time. Finally this project may give an inspiration to the people who can modify and can obtain better results.

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