International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 05, May-2019

DESIGN AND FABRICATION OF STEP FARMING SLOPE CLEANER

Kamalasish Deb[1] , Himalaya Bhatta[2], Bishal Khatri[3], J Rushwanth[4], Arun Kumar Shah[5]

[1]*Assistant Professor of Mechanical Department, New Horizon College of Engineering, Bangalore, Karnataka, India*
[2]*Student of Mechanical Department, New Horizon College of Engineering, Bangalore, Karnataka, India*
[3]*Student of Mechanical Department, New Horizon College of Engineering, Bangalore, Karnataka, India*
[4]*Student of Mechanical Department, New Horizon College of Engineering, Bangalore, Karnataka, India*
[5]*Student of Mechanical Department, New Horizon College of Engineering, Bangalore, Karnataka, India*

Abstract*— *In mountainous and hilly regions where step farming is done, it's difficult to clean the slope surfaces or remove unwanted plants grown on it. It's very important for the farmers to clean the slope surfaces before doing farming on plane surfaces. Currently, farmers are cleaning or removing the plants from the slope surfaces manually by using traditional tools such as hoe. But it's very difficult for farmers to do manually by using such tools over a wide area. In this project we have fabricated a machine which consists of rotating blade fixed at the front end. This machine makes the surface clean by ploughing the plants which are partially cut from the deep near surfaces. This machine consists of a two sets of rotating discs connected to separate shaft. Both sets of discs are inclined at some angle to shaft which makes the soil loose when it rotates.

Keywords*— *Cutting blade, Threaded shaft, Rotating discs, DC Motor, Battery

I. INTRODUCTION

This Step Farming Slope Cleaner is a machine that can be used in the step farming in order to clean the slope surfaces in mountainous and hilly regions where step farming is done. It's difficult to clean the slope surfaces or remove unwanted plants grown on it. It's very important for the farmers to clean the slope surfaces before doing farming or planting anything on the plane surfaces. This is because of the reason that the plants grown on the slope surfaces contain different types of insects and those insects damages the newly planted plants on the plane surface. Also clean surface makes it easier to do faming. Another reason to remove the plant is that when the plants from those surfaces are removed, those plants gets decayed after some days and gets converted into compost pit. Compost provides the essential nutrients required for the growth of plants. Compost also helps to improve the soil structure because of which soil can easily hold the proper amount of moisture, nutrients and air. Compost contains different varieties of basic nutrient that the plants require for the proper growth.

Currently, the farmers in mountainous and hilly regions are cleaning or removing the plants on the slope surfaces manually by using traditional tools such as hoe. But it's very difficult for farmers to do manually by using such tools over a wide area. It's really a time consuming work with the help of traditional tools. For the plane surfaces different kinds of machines are there which makes the farming better and easier, but for the farmers in the mountainous region it's quite difficult. Because of this reason a machine called as step farming slope cleaner is designed and fabricated to find the solution of this problem and make it easier for the farmers to clean the surface with ease.

The fig 1.1 shows the traditional tool that farmers are using nowadays. By using this type of traditional tool they have to clean the slope surfaces. This type of tool uses more human effort and farmers gets tired in very short period of time. This tool can be used in those areas where farming has to be done in less area and height of slopes is less. Otherwise farmers should spend more time in cleaning those slope surfaces then doing farming on plane surfaces.

The fig 1.2 shows the step farming which is done in mountainous region. It also shows the cleaned slope surfaces that are done manually using traditional tools.

Fig 1.1: Traditional tool (hoe)

Fig 1.2: step farming

Here farming has to be done over the large area as shown in the fig 1.3(a) & (b) below which makes it difficult for the farmers to clean the slope surfaces manually using traditional tools. It takes a longer period of time for completing the job with limited number of farmers working in it. So this machine will help the farmers to complete the job comparably in short period of time by reducing the human effort. According to the farmers they take more time while cleaning the slope surfaces by using traditional tools than doing farming on the plane surfaces. So the machine called step farming slope cleaner can really be very beneficial to the farmers and it can save lot of time.

Fig 1.3(a) & (b): areas to be covered in step farming

Step farming slope cleaner consists of multiple tools which are fixed to it. This machine not only cut the plants grown on the slope surfaces but also makes the surface clean by plugging the remaining plants which are partially cut or not cut from the deep near the surfaces. Step farming slope cleaner consists of rotating blade which are fixed at the front end. This blade is used to cut the plants from the slope surfaces. It can cut larger as well as smaller plants. This machine consists of a two sets of rotating discs connected to separate shaft. Both sets of discs are inclined at some angle to shaft i.e. one set at right and another set at left. When these sets of blades rotate it makes the soil loose. So this machine will help the farmers who are doing step farming in the mountainous and hilly region to greater extent. The power to the rotor and shaft is supplied and controlled separately with the help of rechargeable battery placed just above the rotating shafts. There is a slider on the back portion which helps the machine to slide over a slope surface and that will help in cutting the plants over the length of slope.

This machine is not only limited to clean the slope surfaces but also can be used in the plane surfaces in order to cut the grass. It can be used in the playgrounds, parks, and many other different places. This machine is made automatic for operating in the plane surfaces. To make this machine automatic we have used the aurdino. The program is dumped into the aurdino. The power for both aurdino and motor is supplied by using 12v battery. Here the ultrasonic sensor is used to detect the signals send by the sensors. There is a servo in the aurdino. If there is an obstacle on the right side it rotates towards left side and I there is obstacle on the left side it rotates on the left side. The signal goes to the aurdino and it sends signal to the motor.

II. LITERATURE REVIEW

This implementation of this concept is actually very beneficial for the farmers who are doing farming in mountainous and hilly regions. The literature survey is done with the help of different types of grass cutter which are used to cut the grass cutter in the plane surfaces. The survey was done on the automatic, solar and other different types of grass cutter.

[1] Ashish Kumar Chaudhari

In this paper they have made an automatic operated device which is capable of cutting the grass. In their project they have tried to make a daily purpose robot that is able to cut the grasses on the lawn. The device consists of different types of sensors. The system works automatically and it has the capacity to detect the obstacle with the help of sensors. This device consists of linear blade which is operated with the help of motor and the power required for the motor is supplied from the rechargeable battery. The battery can be charged by using solar panel and power supply. The main objective of this paper is to move the grass cutter automatically in different directions in order to prepare various designs as per requirements. The height of the cut can be adjusted by using different link mechanisms. The unskilled person can also easily operate this device. It can be used in cricket ground, football ground, playground and gardens. The advantage of this device is that the components used are of low cost and adding some more sensors doesn't make any difference to it but the disadvantage is that the response time is very slow.

[2] MS. Lanka Priyanka

In this paper they have fabricated a grass cutting machine system in which the grass cutter motor runs through the power supplied from solar energy. Power plays an important role in running any type of machine. The electricity required for

the world is increasing in a rapid rate due to the industrial growth, increased and extensive use of electrical gadgets. So they choose the best alternative source of power as solar energy in order to run the grass cutter machine. In their project the major parts used to make the grass cutter are DC motor of 75HP capacity, relay switch to control motor, battery for charging it through solar panel. The motor is having 18000 rpm and is connected to the electric supply by using roll of wire. The rpm of motor can be increased with the help of gears. The comparator LM358 is used to control the relay switch of motor when the user switches the supply unit. It also compares the temperature of motor. If the temperature exceeds the threshold limit it switches off the motor and prevents from overheating in its continuous usage. The main advantage of this project is that it is pollution free and uses conservational source of energy. Also it has no moving part and hence little maintenance is required.

[3] Srishti Jain

In this paper they fabricated an automatic solar powered vision based robotic lawn mower that allows the user to the ability to cut grass with minimal effort. Unlike other lawn mower, this doesn't require perimeter wire to maintain within the lawn and also less human effort is required in manual mode operation. Here some pre-set pattern is installed in the robot. So, in automatic mode operation no human effort is required and it helps to cut different types of pattern in the lawn easily with less time. Due to the use of different types of sensors it can detect the obstacle present in the lawn. Here they have used 12v 310mA solar panel in the project. Lead acid battery of 12v 1.2Mah is used which acts as a power source and can be charged from the solar panel. To detect the obstacle they have used 2 IR sensors one on each side. This is because if the obstacle is on left side it moves in the right direction and vice-versa. The main disadvantage of this project is that sometimes response of the system is too slow.

[4] Basil Okafor

In this paper the author has come with the idea of a lawn mower that is portable, durable, easy to maintain and operate. He also aimed to design a self-powered lawn mower of electrical source. It consists of a system of speed multiplication pulleys that drives the cutting blades. The charging unit comprises of 12v alternator and also a lift mechanism to alter the height of cut. This can be achieved by means of a system of pulleys with minimum slip effect. The collapsible blades are used to reduce the common problem of wear. The use of this type of blades and incorporation of an alternator to recharge the battery make the design unique such that no engine is involved. The performance test of a system gave a cutting efficiency of 89.55% with 0.24KN human effort. Therefore the machine is considered as highly efficient and readily adaptable to various cutting conditions. But below 40 degrees the mower handle becomes very uncomfortable to handle and it makes the mower quite difficult to push. At an angle of 45 degree the handle is found to be most convenient in terms of freedom while moving the mower.

[5] Sridhar .H. S

According to the author the aim of this project is to design, construct and test a manual weeder in order to provide the best opportunity for the crop to establish itself after planting and grow up to the time of harvesting. The machine was made of two implements attachment. The primary cutting edge is in the front to loose soil above and the secondary cutting edge is behind to do cutting and lifting of weeds. There are three blades which are sharpen in front and at the bottom placed vertically on the flat bar 108mm length, teeth to teeth 6.5cm. There is an extra attachment of funnel and circular pipe of height 900mm and diameter 105mm for fertilizing and seeding after cultivation. The overall field efficiency of the machine was found to be 98.67%. This machine is very safe to use and has no threat of hurting to the user. There is no requirement of special maintenance. The disadvantage is that it cannot work where there is a stone or any obstacle.

[6] N.Nagarajan

The main objective of this project is to design and fabricate a lawn mower that is durable, portable, and easy to maintain and operate. This is the new concept mainly used in agricultural field. The different components used in this project are wheel, gear arrangement, motors, bearing, roller and base frame. Cutting blade revolves below the gear arrangement. The reel mover tends to cut the plants and crops when the gear arrangement rotates. The reel consists of different helix shaped blades which are mounted to a rotating shaft. The set-up is placed on a movable base that has a wheel arrangement. This machine doesn't have any engine and is operated by manual pushing. Therefore it can be used in urban and rural areas where electricity is not there. The disadvantage of this machine is that the overall efficiency of the machine decreases when the amount of moisture on the surface or field increases.

[7] Kartik R. Khodke

The main aim of this project is to design and fabricate a manually pushed lawn mower model with simple mechanism and low cost. In this project a large pulley is coupled to the driving wheel and smaller pulley is joined with the larger pulley through belt drive. A bevel gear transmits power from smaller pulley to cutting blade. This is the new innovative concept that can be used mainly in agricultural field. The components used in this machine are motor, gear arrangement, cam, chain and sprocket, lead screw, wheel, control unit. When motor starts running by use of power supply the shaft also rotates which rotates the gear arrangement that is coupled with motor. When the gear arrangement rotates it rotates the cam arrangement which operates the sickle bar that tends to cut the plants of crops. The main disadvantage of this project is that it doesn't make smooth cut.

[8] K.Sravan Kumar
The main aim of this project is to fabricate a grass cutting system machine that makes the grass cutter based motor running through solar energy. Here solar plate generates the solar energy and by utilizing this energy the machine is run. Integrating features of the hardware components that are used have been developed in it. It uses highly advanced IC's with the help of growing technology. The components mainly used are GI sheet, motor, switch, wheels, wire, aluminium sheet square pipe, paint, insulating material and other items like nuts, bolts and revert. To control the whole system a LM358 comparator is used which takes input from the user through switches and switches on a DC motor interfaced with grass cutting blades. The model consists of rechargeable battery, relays switches, temperature sensor and solar panel. The system that depends on the charging circuit can be controlled by using relay switch. The solar power stores energy to the battery and runs a motor through relay switch. The main advantage of this machine is that it doesn't have moving parts and hence require little maintenance. Also it doesn't cause any environmental pollution.

[9] Vikas Mukharaiya
In this project it has been discussed the functionality of different styles over the ages and especially the abilities of the powerful grass cutter. This research was done on two different 4-stroke petrol engine based grass cutters those are used to cut the grass of different sizes on the lawn to find the efficiency of engine. After conducting a test it was found that a 4-stroke petrol engine of kinetic k4100 based grass cutter cuts 7cm height grass of 1000 sq.ft. with the consumption of 1 litre of petrol after taking a time period of 135 minutes. Instead of that if same engine is run with the help of polythene fuel of low density, it cuts the grass of 1035 sq.ft. from the lawn within 140 minutes when runs smoothly. On the other hand a small size engine is used for agriculture sprayer is used as a lawn grass cutter which cuts the grass of 1120 sq.ft. of same size from the lawn within a period of 148 minutes after consuming 1litre of petrol. But the drawback of this grass cutter is that it produces more noise and vibration. The exhaust gases are more toxic and are not environment friendly.

[10] A R Deepak
The main aim of this project is to make a portable solar operated grass cutter machine that is environment friendly and overcome different problems facing currently. Here the solar panel is connected to the battery and battery in turn is connected to a DC motor. The motor is connected to the blade shaft with the help of spur gear. This will make the blade to rotate in high speed as per the gear ratio and cut the grass. The main component used in this project are solar panel, battery, 12v DC motor, cutting blades, spur gears, bearing, sheet metal and metal rods. The cutting blades are covered with sheet metals so as to prevent from spreading the cut grasses and basket kept at the back collects the cut grasses. Here the power consumption of the grass cutter has been modified. The main advantage of this project is that it is pollution free and uses conservational source of energy. Also it has no moving part and hence little maintenance is required.

[11] Rubentheran Sivagurunathan
In this project, a hand-held operated machine for cutting grass was designed and fabricated by using locally available materials. Some of the important aspects such as durability, light weight and strength were taken into design considerations for better performance characteristics. Here the lawn mower was powered by a 12V/1.35A rechargeable battery that drives the DC motor up to a high rotational speed of 19,300RPM. Therefore the generated torque in the motor will be transferred to the cutting head mechanism for efficient grass cutting. The entire configuration set up was mounted on a base of wooden which is attached together with a bicycle frame and a set of wheel arrangement. The use of this machine makes grass cutting process faster by reducing the operation time. It can be used for both commercial and non- commercial use.

[12] Aaqib Gulzar Khan
This paper presents the main functional requirements, design and manufacture of grass cutting and collecting machine. This design is one of its kind which facilitates both the cutting as well as collecting of the commercial grass usually more than four feet long. The advantage of this machine design is that apart from cutting the grass it helps in the formation of bunches, without any loss of grass arising due to scattering of the grass on an account of strong cutting forces, which can be collected in a proper way. The important parameters for the selection of blade are durability, corrosion resistance, strength and hardness. During the analysis the maximum stress attained by the blade against the fluctuating pressure is 25MPa gravity was 7.36Mpa which is very much less than the yield strength. According to the paper the machine was successfully fabricated and is under the trial at National Institute of Technology, Srinagar. The machine will be launched shortly for the commercial use.

[13] Pratik A. Jain
The main purpose of this project is to develop a system which performs the both function like soil cultivation means break the upper layer of soil and cutter. The system is powered by an electrical AC motor. It gives advantages on existing IC engines and also minimise limitation of existing cultivators. The proposed system will be useful for the agriculture sector specifically those farmers who were suffered from weed management in their planted crops. The design of system is done by a software called creo parametric 2.0. The main parts of system are AC motor, shaft, pulley, bevel gear, sprocket, rotary hoe etc. The analysis of main parts is done using ANSYS 15. During the testing time, two on field tests

were conducted; one was weed cutter test and another was soil tiller test. After comparing rotary hoe system and manual tilling and weeding it has been observed that rotary hoe system is almost five times faster than manual and more than two times faster than 2-stroke weeder on semi-moisture land. It is a highly innovative design by modifying the existing tillers and cutters such that it is capable of uprooting the weeds rather than just mowing them. It has a compact design with the help of which it can run in uneven and narrow fields also.

III. EXPERIMENTAL EQUIPMENTS AND INSTRUMENTATION

There are different components that has been used for this project. Some of the important components used are cutting blade, shaft and discs, joints, DC motors, battery, arduino, wheels and sliding handle. These components are discussed below for the better understanding.

3.1 Cutting blade

There are different types of blades available in the market. The blades which are used in this project are combined saw blade as well carborundum cutter with few blades made up of high speed steel attached to it. The combination blade consists of different sets of teeth. It consists of specially configured teeth, and tooth angles allow us to use the blade for cutting different types of plants grown on the surfaces. This blade consists of non-stick coating that reduces the friction, provides smooth cut, prevents rust and improves overall blade life. Carborundum cutter is characterized by high thermal conductivity and high temperature strength. It has low thermal expansion, resistance to chemical reaction and has the ability to function as a semiconductor. It is very hard substance. With this carborundum 4 blades are attached which are made up of high carbon steel.

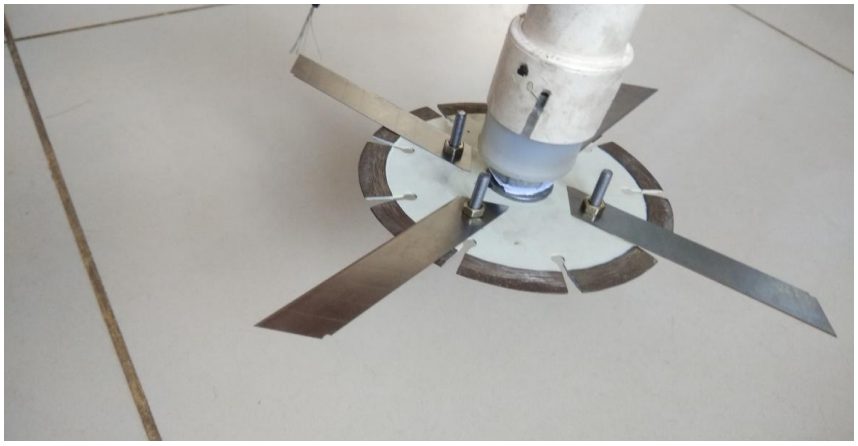

Fig 3.1: Cutting blade

3.2 Shaft rotating with discs

This machine consists of a two sets of rotating discs connected to separate shaft. Both sets of discs are inclined at some angle to shaft i.e. one set at right and another set at left. When these sets of blades rotate it make the soil loose and helps to remove the remaining plant easily. The shaft is selected as aluminium so as to reduce the weight. In both of the shaft threading is provided that helps to hold discs properly. In order to get tight grip between discs and shaft m-seal is used. The discs are attached along the axis of both the shaft. The reason for making the discs inclined is that it makes easier to remove unwanted and partially cut plants from the surface by making the soil loosen. The discs are made up of high speed steel. The motor of 500rpm is used in order to rotate these shafts.

Fig 3.2: Cutting discs attached with rotating shaft

3.3 Joints

Here, we are using different types of joints such as T-joints, L-joints and I-joints. T-joint is used for extending as well as adding any component within the machine. L-joint is used at the bends. I-joint is used in order to increase the length, width and height of the machine.

Fig 3.3: Different types of joints

3.4 DC Motors

A DC motor is a mechanically commutated electric motor powered from direct current. The stator is a stationary in space by definition and therefore is its current. The current in the rotor is switched by a commentator to be stationary in space. This is how the relative angle between a stator and a rotor magnetic flux is maintained near 90 degrees, which generates the maximum torque. DC motors is having a rotating armature winding but non-rotating armature magnetic field and the static field winding or permanent magnet. There are different types of motor available in the market. The motor which is used in this project is high torque 12v dc motor. Here we are using different rpm motor for different locations. For rotating the tyres we are using 60rpm, 12v high torque motors. For rotating the cutter we are using 1000rpm, 12v low torque motor. In order to rotate the shaft with discs 500rpm, 12v high torque motor. The high torque motor has a shaft which is eccentric. The reason behind using high torque motor is that if the load becomes more it doesn't affect the movement.

Table 3.1: Motor specification

Item :		High torque DC Motor
Voltage :		12v
Speed:		60rpm, 500rpm
Current	No load current	800mA (Maximum)
	Stall Current	9A (Maximum)

Fig 3.4(a): motor with shaft eccentric

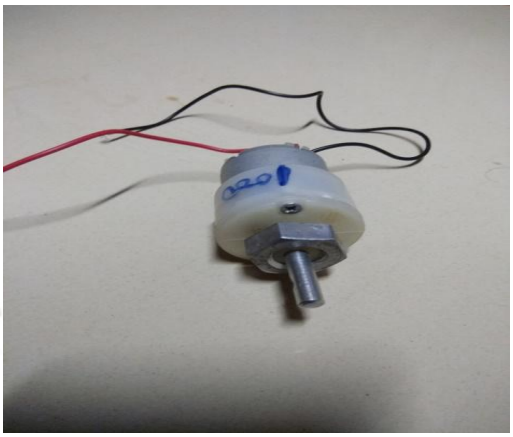

Fig 3.4(b): motor with shaft at centre

3.5 Battery

The battery converts chemical energy into electrical energy. A battery consists of number of voltaic cells and those voltaic cells consist of certain chemical composition where chemical reaction takes place. Each of the cells consist of two half cells connected by a conductive electrolyte containing anions and cations. One half-cell includes electrolyte and negative electrode, the electrode to which anions (which are negatively charged ions) migrate, the other half-cell includes electrolyte and positive electrode to which cations (which are positively charged ions) migrate. Redox reactions power a battery. Cations are reduced (to which electrons are added) at cathode during charging, while anions are oxidized (from which electrons are removed) at anode during charging. During discharging, the process is reversed. The electrodes do not touch each other, but they are electrically connected by an electrolyte. The battery used in this project is of 12v. This is a rechargeable battery and supplies power to 4 different motors placed at different locations.

Fig 3.4: 12v battery

3.6 Arduino

Arduino is an electronics device which consists of both physical programmable circuit board called microcontroller and a piece of software that is used to write and upload the computer code to a physical board. Arduino is able to read different types of inputs like light on a sensor, activating a motor, publishing something online turning on a LED etc. It works on electric impulse input from the sensor as shown in the given table.

Table 3.2: Arduino specification

Board	Arduino
Operating Voltage	5V
Input voltage	7-12V
Output voltage	6-20V
Digital I/O Pins	14
Analog input Pins	6

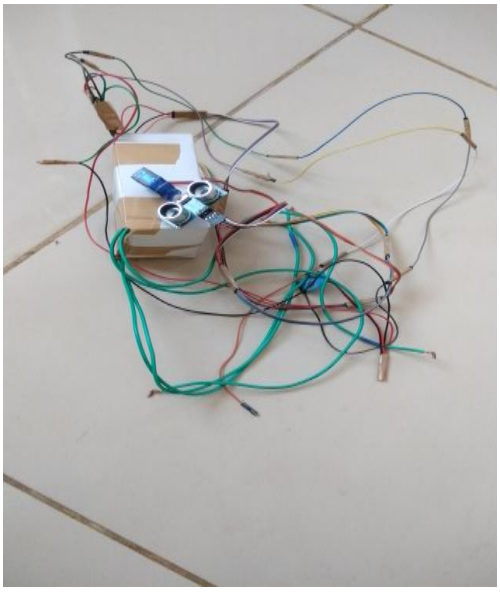

Fig 3.5(a): Arduino circuit

Fig 3.5(b): Arduino board

IV. DESIGN AND CALCULATION

4.1 DESIGN

4.1.1 Isometric view

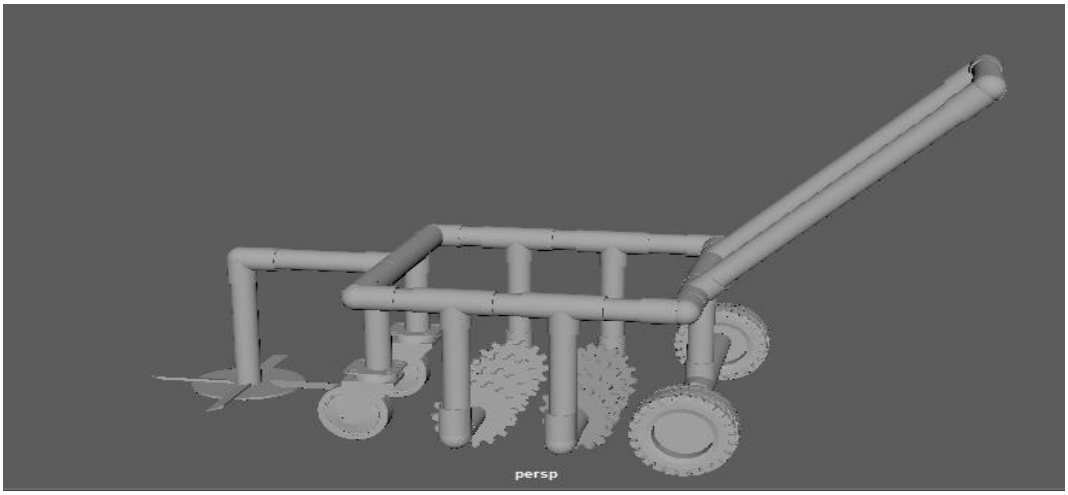

Fig4.1.1: Isometric view

4.1.2 Rotating discs

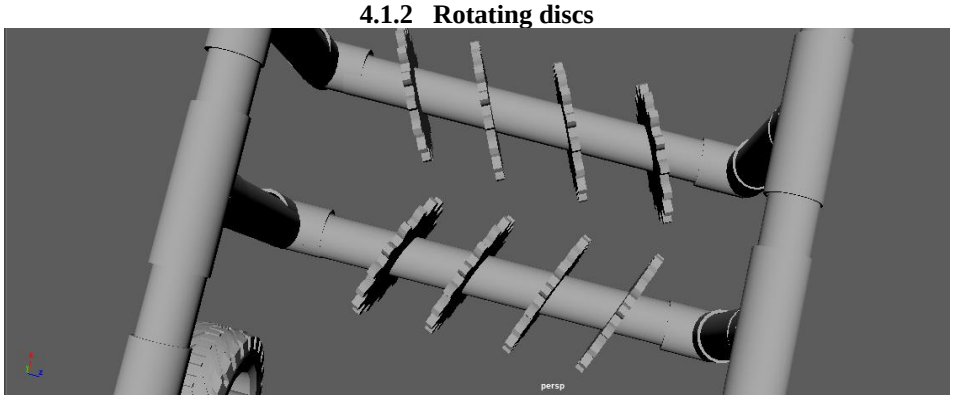

Fig4.1.2: Rotating discs

Table 4.1: Design parameters with dimensions

S.N	Parameters	Dimensions (in mm)
1.	Length	480
2.	Width	350
3.	Height	300
4.	Blade length	250
5.	Length of shaft	225
6.	Diameter of shaft	20
7.	Diameter of discs	40
8.	Diameter of front wheels	100
9.	Diameter of rear wheels	50

4.2 CALCULATION

4.2.1 Power generated by motor at wheel
Speed(N) = 60rpm
Stall torque(T) = 25kg-cm = 2.4525watt
Shaft length = 25mm
Diameter = 6mm

Now,

$$\text{Power generated at the wheel} = \frac{2\pi NT}{60} \text{ watt}$$

$$= \frac{2\times\pi\times60\times2.4525}{60}$$

$$= 15.4095 \text{ watt}$$

$$\text{Power generated by 2 wheels} = 15.4095\times2$$

$$= 30.819 \text{ W}$$

4.2.2 Power generated by motor at shaft
Speed(N) = 500rpm
Stall torque(T) = 6kg-cm = 0.5886watt
Shaft length = 25mm
Diameter = 6mm
Now,

$$\text{Power generated at the shaft} = \frac{2\pi NT}{60} \text{ watt}$$
$$= \frac{2\times\pi\times500\times0.5886}{60}$$
$$= 30.819 \text{ watt}$$
$$\text{Power generated by 2 shafts} = 30.819\times2$$
$$= 61.638 \text{ W}$$

4.2.3 Power generated by motor on the cutting blade
Speed(N) = 1000rpm
Stall torque(T) = 0.5kg-cm = 0.049watt
Shaft length = 25mm
Diameter = 6mm
Now,

$$\text{Power generated on the cutting blade} = \frac{2\pi NT}{60} \text{ watt}$$
$$= \frac{2\times\pi\times1000\times0.049}{60}$$
$$= 5.1312 \text{ W}$$

4.3 FINAL FABRICATED MODEL

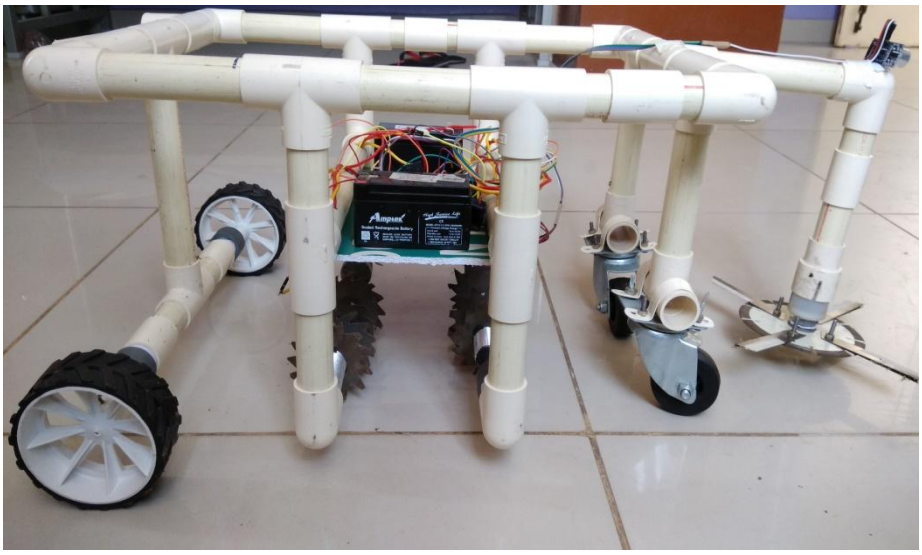

Fig 4.3: Final fabricated model

V. EXPERIMENTAL RESULTS AND DISCUSSION

This machine can be used in step farming to clean the slope surfaces. This machine is not only limited to clean the slope surfaces but can also work on plane surfaces. The machine is made automatic for operating in the plane surface. This machine can be used in playgrounds, parks and different other plane surfaces where plants are grown.

When the clearance (distance of blade from the ground) is kept 30mm, it can cut the grass properly but when bumps come on the way the blade is touching the ground. So the clearance was increased to 50mm. The depth of cut by the disc varies from 8mm to 12mm depending upon the even or uneven condition of ground. The depth of a cut can be increased by increasing the diameter of rotating discs. While testing it was found that keeping discs at some more angle could be more better for removing plants. While operating the machine into the slope surface separate handle is required. Therefore there is no need of power from the battery in order to move the machine. But while operating it in the plane surface, the power supplying unit is required. The machine was tested on different surface condition and the average

speed was found to be 0.6m/s. On the surfaces where there was less grass, the speed of machine was more. So, that speed can be reduced by setting program in the aurdino. On the surfaces where there is more grass, it may be difficult for a machine to generate the required torque for moving. In that case the motor which are used in the wheels can be replaced by high torque motor. The power generated by the rotating shaft is enough to loosen the soil and make it easy to remove the plants. The blade can cut the plants smoothly of stem diameter of approximately 7mm. Here we can use high torque motor and the blade having high strength in order to cut the plants having larger stem diameter.

The table shows some of the result obtained by the cutting blade under different surface conditions.

Table 6.1: Different results for different clearance conditions

Clearance (Distance of blade from surface) in mm	Conditions	Results
30	Plane surfaces	Runs smoothly
	When small bumps comes on the surface	Blade strikes the bumps of surface
	When suddenly slope surface comes	Blade hits the surface
50	Plane surfaces	Runs smoothly
	When small bumps come on the surface	Doesn't affect the rotation of blade
	When slope surface comes on the way	Runs good when the slope angle is upto 30 degree (approx)
100	Plane surfaces	Runs smoothly
	When bumps come on the surface	Doesn't affect the rotation of blade
	When slope surface comes on the way	Runs good when the slope angle is upto 50 degree (approx)

After the testing is done successfully we saw the difference on the surface as shown in the fig 6.1(a) and fig 6.1(b). Here the first figure was after the testing and the second figure was after the testing.

Fig 5.1(a): Surface before testing

Fig 5.1(b): surface after testing

From the figure we can see the difference before the testing and after the testing. In the first figure there was more grass on the surface. While testing the blade cuts to the height according to which clearance is given. While cutting the grass it was found that most of the grasses were lying down the ground that made it difficult for the cutter to cut into equal length. After the cutting operation is over the rotating discs runs over that surface and make the soil loosen. Since the testing was done in the wet surface the grasses were sticking to the surface. Fig 6.1(b) shows the surface after testing that it has removed the plants from the surface to greater extent.

Since the machine is designed mainly for cleaning the slope surfaces in step farming, the plants fall from the slope surfaces. If the plant doesn't fall we can remove the plants manually since those plants would already be loosen by the rotating discs. Generally if small plants remain on the slope surfaces, it doesn't make any trouble for the farming. The main aim is to clean the larger plants from the slope surfaces so as to make the step farming more easier than the

traditional methods which the farmers are following from long time. Also it is already discussed that the depth of cut into the soil can be increased by increasing the diameter of discs.

VI. CONCLUSION

The machine was tested on different surface condition and the average moving speed of machine was found to be 0.6m/s. On the surfaces where there was less grass, the speed of machine was more. So, that speed can be reduced by setting program in the aurdino. On the surfaces where there is more grass, it may be difficult for a machine to generate the required torque for moving. In that case the motor which are used in the wheels can be replaced by high torque motor. After successfully testing it was concluded that it was a bit difficult for the machine to operate when the surface is wet. This problem can be reduced by using the wheels which provide more grip. But when the surface is dry the machine can run smoothly. The machine tested under different slope conditions as well as plane conditions. Testing was done by changing the clearance between blade and the surface. The clearance of 30mm was found to be more favourable for most of the surface conditions.

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