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FABRICATION OF WEED EXPELLING MACHINE WITH ASSISTANCE OF AN ADJUSTABLE ARM

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ABSTRACT

Weeds are one of the major causes of loss of agricultural produce and botanical plants. Mechanical weeding is one of the forms of weed removal. This kind of weeder would turn into a valuable machine in cleaning of the region around the tree and elevate the dirt around its foundations. Prime goal of the system is to clean and fertilize the surrounding areas of tree and also diminish the manpower. The machine would consist of a 2-stroke petrol engine which will help in transmitting power. An extended arm will be placed which can be adjusted according to the area to be cleaned, the other end of the arm would consist of a clamp which will keep hold of a tree without affecting it. When the framework is turned on it navigates in a circular manner, thereby cutting the weeds in this process. Experimental setup and results indicate good performance of the system resulting in reduction of manpower and uniform expulsion ofweeds.

Keywords— *Mechanical Weeding, Fabrication, Botanical plants.*

I. INTRODUCTION

Agriculture is the backbone of Indian economy since majority of the Indian population depends on agriculture. India being developing nation, agriculture and industries based on agriculture products has prime significance. As Per the 2010 worldagriculturestatistics,Indiaistheworld'slargestproducer of many fresh fruits and vegetables, milk, major spices, select fresh meats and selected fibrous crops. Dominant part of the Indian population depend on agriculture, agro-based industries and agro based ventures. India exported $39 billion worth of agricultural products in 2013, making it the seventh largest agricultural exporter worldwide and the sixth largest net exporter [1]. More than 33 percent of the cost incurred in cultivationisdivertedtoweedingandcleaningoperationsthere by reducing the profit share ofagriculturists.

A weed is any unwanted plant that grows anywhere, more specifically around the root base of crops. It is a plant that competes with crops for water, nutrients and light. This results in reduction of crop production as well as growth. The process of removing unwanted plants in the field crops is called weeding. Weeds decrease the value of land, particularly perennial weeds which tend to accumulate on long fallows.

Different techniques are employed for the isolation of weed, some of them are done by manual removal, chemical, mechanical,soilsolarizationetc.Mechanicalweedingisoneof the prominent forms of weed expulsion. However up-lifting of soil is done by another machine. Smaller weeding machines commonly known as portable weeders are solely used forusedweed removal in agricultural fields, farm plantations, gardens, public parks, etc the weeder is a useful machine in the internal cleaning of crops as well as rehabilitate the different layers of soil. The experimental modification carried on the weed remover incorporates the weed removing function as well as the soil uplifting both integrated in a single machine with the help of an extended arm which would help the machine to move in a circular manner.

II. RELATEDWORKS

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Before Subrata et. al [1] proposed a paper in which they have worked on Rotavators or Rotary tillers which is a tillage machine most suitable for seedbed preparation. Here as the bladesinteractwithdifferentsoilsandduetothisthebladesare subjected to high impact and friction forces which results in wear and tear of blades. The framework presents design and development of rotavator blade through the interrogation of computer aided design (CAD) method. Raut and Deshmukh introduced works on technical as well as the economicbenefits of using a weeder machine against the manual process carried out for weeding and other operations. The research is carried on different plants and trees in different regions thus getting an overallideaofthefunctioningoftheweedermachine[2].

K.Ramesh et. al [3] proposed works on various alternatives for removing the weeds by using semi-automatic equipment in place of manual methods which are difficult, time consuming andcostly.Theweedremoverexpelstheweedalongthelength of field with a cutter edge. In any case a person is required to thrust the machine forward. Their investigation is carried on weedermachine.GavaliandKulkarnirecentlyhavecarriedout research works to evolve technology in mechanical weeding operations by portable weeders using sensors. Their work incorporates various techniques to develop more efficient and cost effective methods of mechanical weeding so as to lessen the use of chemical and manual weed removal methods which is commonly adopted by small scale farmers[4].

To outline the literature review, it depicts that less focus is given on factors such as time, endeavors and capital which were gauged by use of machines which subsequently unravelled the issue of human work and the time required by them. The proposed framework is planned and manufactured based on the weeds developing in and around the coconut tree and the quality of soil required for good yield of the plant.

III. SYSTEMARCHITECTURE

The design of the proposed framework incorporates different spares such as engine, gear box, chain sprocket, wheels, clutch control, trial wheel adjuster, platform, accelerator and blades which are specified along with their functionality as follows:

A. Engine

The engine is a 1.8 HP powered petrol engine and has an output speed of 3000rpm.The power generated by the engineistransmittedtothewheelandtherotorshaftforcutting operations. The kind of engine that is utilized as a part of our framework is a 2-stroke petroleum controlled engine. The engine is mounted on the platform in a vertical position just above the gearbox.

B. GearBox

The gear box is a mechanical component which comprises of a number compound and epicyclical gears arranged in such way as to obtain the required speed without much loss from the engine. The gear box that is being employed is a Reduction Type of Gear Box. The gear box keeps up a coveted speed of around 2000 rpm. The gear box has one pulley at the information and two sprockets at the yield. The power transmission from the gear box to alternate parts is done through chain sprocket mechanism.

C. Chain sprocketmechanism

Chain Sprocket mechanism is used to transmit power from the counter shaft to the main rotor shaft, here the sprockets are used for transmitting the power to the rotor shaft which are placed inside the chain box. The main rotor shaft consists of blades which is required for cutting operation. Bigger sprocket is associated with the counter shaft which is associatedwiththesmallersprocket.Thisarrangementofchain sprockets is placed inside a chain box which completely seals the chain sprocket mechanisms within it [5]. An Intermediate Chain Sprocket Mechanisms is utilized which are not encased inachainboxandareutilizedtotransmitcontrolfromthegear box to the counter shaft and in addition the wheel. The gear box has two sprockets at the yield. Bigger sprocket is associated with the counter shaft through a little sprocket. The course of action is made in order to build the speed from the apparatus box yield to the counter

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shaft. The sprockets used throughout are made of mild steel [6]. Another set of sprockets at the output of the gear box is connected to the larger sprocket at the wheels which is used to power thewheels.

D. Wheels

Wheelsformthebaseforthewholemachineandhave to be selected based on the heaviness of the machine, various loads acting on it and the velocity with which the machine has to move. This system consists of three wheels, two at the front which are larger in diameter and one at the rear has a smaller diameter. The rear wheel used is part of the trial wheeladjuster and has threading arrangement. The material utilized for the tyres in all the three wheels is made out of rubber so as to have a decent grasp as for the ground[8].

E. Clutch control

Clutch control is used control the speed of the engine. The speed of the motor must be changed under various load conditions relying upon what topographical element it is being utilized, the dirt conditions and the kind of weeds. The clutch control consists of an aluminum cable which is controlled by a clutch lever. The lever has three levels which are adjusted depending on the load. Initially the lever is kept at first level which is the typical one. Under load conditions the lever is pulled and set at the second or third level which fixes the link and consequently builds the speed.

F. Trial Wheel adjuster

Trial wheel adjuster helps in steering action and to modify the profundity of cut. Various soil conditions have different depths of cut for which we have to adjust the distance between the blades and the ground level. The adjuster can adjust the vertical height for about 3 to 4 inches. When the elevation is less, the blades penetrate deep into the ground and pluck the weeds at a greater depth along with the uplifting of soil. When the vertical difference is more the cutting action occurs at a lower rate since the depth of cut is less.

G. Platform

Platform is the principle bolster on which the engine and its components are mounted. The platform is fabricated by welding at the various joints and ends and is made to withstand various loads acting on it. It is fabricated in a rectangular manner. The Frame dimension is 17"*14.5". The height from the platform to the wheel shaft is 11". The material used for the entire platform is Mild Steel. The wheel base and the handles are welded to the main platform thus forming the entirestructure.

H. Accelerator

Accelerator is the mechanical component which is used to vary the speed of the engine under varying load conditions. The speed of the engine is varied depending upon the load and hence adjusted using a clutch arrangement. The accelerator has a knob which is used to adjust the acceleration of the machine. The accelerator uses an aluminum cable of lesser diameter which is connected to the governor of the engine. The governor adjusts the speed of the engine by varying the supply of the fuel [7]. The governor used is a Hartnell governor which uses spring for the control action.

I. Blades

Blades are the mechanical cutting instruments which are utilized for various mechanical tasks, for example, cutting, forming and turning activities. In this framework blades are utilized for cutting of the weeds in a coconut plantation. The blades are welded to the rotor shaft which produces the rotary motion thereby causing the cutting action. The blades are made of mild steel to provide improved hardness and are given a triangular shape at the end which performs both the actionssimultaneously.

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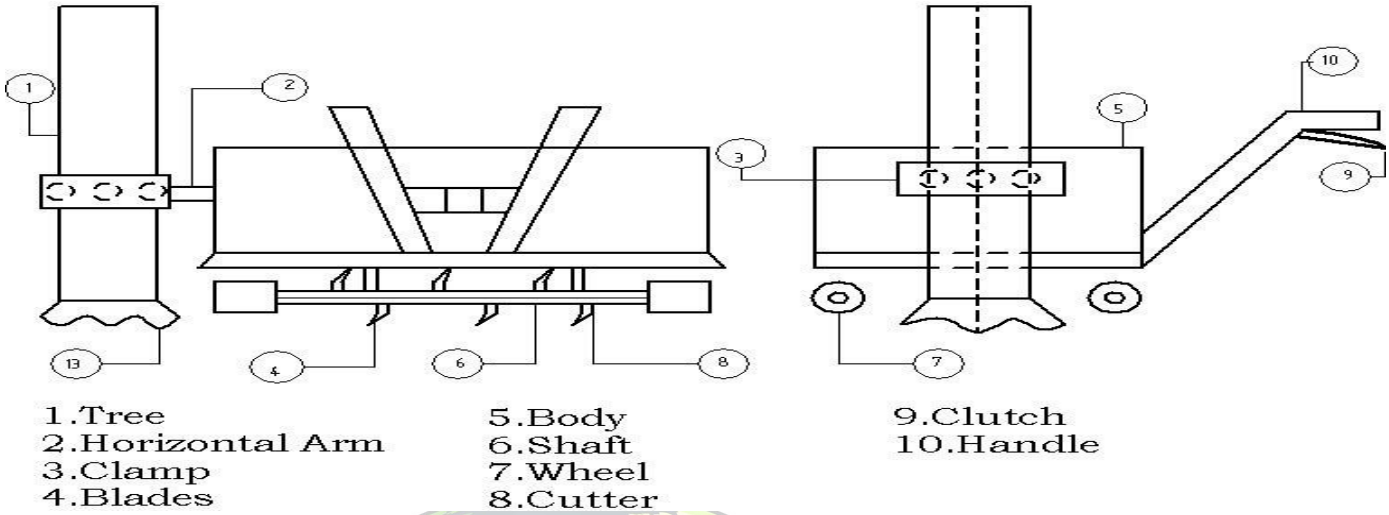

Figure 1: Design of the proposed framework

*J. **Adjustable extendedarm***

An arm would be fitted at one end of the machine which would consist of a clamp that will hold the trunk of the coconut tree due to the adjustable arm an appropriate radius can be set which will effectively help in cleaning weed as the machine will rotate in a circular manner.

IV. METHODOLOGY

Figure 2: Snapshot of Proposed System

The equipment or the machine is used to exorcize or clean the weeds and the unwanted plants, shrubs growing around theareas surrounding the trunk adjacent to the roots and simultaneously uplift the soil layer by layer in order toincrease or retain the level of fertility of the soil thus increasing its nutritional content for the areca nut tree which would help the tree to grow more efficiently. The machine moves in a linear motion under normal conditions when it is not clamped and its direction can be however steered in various directions by the flexible wheel fitted in the trial wheel adjuster. The machine when clamped to the tree rotates in a circular motion because of the adjustable extended arm fitted at one end of the machine. Two handles (made of mild steel) are attached to the main body of the machine at the back end. The left handle consists of a clutch with clutch lever and is used under different load conditions.

The speed of the engine under various load conditions is varied with the assistance of an accelerator which is controlled with the help of a knob which is fixed on the right handle. The main body has a platform made of mild steel which is fabricated by welding operation, the platform acts as a rigid support on which various parts are mounted. A shaft made of mild steel is linked to the primary body of the machine which encompasses a number of rotavator cutting blades assembled on it at equal distances and along different axis to provide the cutting action at different angles. The blade geometry is such that along with the cutting operation it also uplifts a certain quantity of soil thus mixing both the uprooted weeds and the layer of soil. The shaft has wheels made ofsteel

With rubber tyres which provide better grip to the machine when it is under operation on uneven surfaces. The wheels are placed at the end of shaft such that while cutting operation is under progress the wheels just move next to roots thus maintaining a clearance between them.

The power transmission from the engine to the main rotor shaft as well as the wheel has certain intermediate mechanisms; the power produced by the engine is transmitted to the gear box through a belt drive which is connected to the pulleys of the engine and gear box respectively. The gear box is used to attain the coveted speed of engine. The output of thegear box has two sprockets, major and minor. The major sprocket is connected to the counter shaft through chain and the minor sprocket is connected to the wheel. All the latter power transmissions taking place are due to the chain sprocket mechanism. The size of the sprockets are

arranged in such a way so as to the desired speed is attained .The rotation of the counter shaft causes the rotation of the chain sprocket arrangement of the main rotor shaft to move which causes the blade to rotate thereby initiating the cutting action. The speed is hereafter adjusted with the help of an accelerator and the power based on load conditions is controlled by the clutch arrangement. The elevation of the blade from the ground level is adjusted with trial wheel adjuster depending on the depth of cut or the utilization of blade. However after cutting action the machine can be easily moved from one plant to another by declamping the arm and adjusting the trial wheel adjuster and once the cutting operation is complete the machine is turned off by a switch given on the engine.

V. DESIGNCALCULATIONS

1. *Design for PowerTransmission*

a. *FirstStage*

Belt and pulley forms first stage of transmission between engine output shaft and gearbox input shaft. Pulleys are made of Cast Iron material which is of 8 Inches and 2 Inches respectively. Input speed is the speed of engine which is 3000 rpm.

From above statement we can write as follows: Input speed (N1): 3000 rpm;

Diameter of larger pulley (D1): 4 Inches; Diameter of smaller pulley (D2): 2 Inches; We know that,

$$i = \frac{N1}{N2} = \frac{Z2}{Z1} = \frac{D1}{D2}$$

$$\frac{3000}{N2} = \frac{4}{2}$$

$$\mathrm{N2} = 1500\ \mathrm{rpm}$$

∴ Input speed for gear box = 1500 rpm

b. *SecondStage*

Gearbox reduction is used for second stage transmission which is directly taken from market with reduction ratio of 15. Input to gear box is output from first stage which is 1500 rpm. Output speed of first stage (N2): 1500 rpm

Reduction ratio of Gearbox (θ): 15 We know that,

$$\theta \propto N$$

$$\theta = \frac{N2}{N3} \ldots\ldots\ldots\ldots$$

$$15 = \frac{1500}{N3}$$

$$\mathrm{N3} = 100\ \mathrm{rpm}$$

∴ Output speed of second stage = 100 rpm

c. *Third Stage*

Third stage is gear box to counter shaft which is connected by chain arrangement, where counter shaft speed is increased. Output speed of second stage N3 = 100 rpm Number of teeth on larger sprocket (Z1) =30 Number of teeth on smaller sprocket (Z2) = 16 We know that,

$$\frac{N3}{N4} = \frac{Z2}{Z1}$$

$$\frac{100}{N4} = \frac{16}{30}$$

$$\mathrm{N4} = 188\ \mathrm{rpm}$$

∴ Speed of counter shaft = 188 rpm

d. Fourth Stage

Fourth stage is an important stage as it is connected to cutting element by the help of chain. This stage requires transmission without slip hence Chain transmission is used.

Output speed of Third stage N4 = 188 rpm Number of teeth on larger sprocket (Z3) = 13 Number of teeth on smaller sprocket (Z4) = 10 We know that,

$$\frac{N4}{N5} = \frac{Z4}{Z3}$$

$$\frac{188}{N5} = \frac{10}{13} \quad \therefore \text{ N5} = 245 \text{ rpm}$$

∴ Speed of rotor shaft = 245 rpm

e. FifthStage

Transmission is taking place between gear box and wheel by the help of chain arrangement, where wheel speed is decreased. Output speed of second stage N3 = 100 rpm Number of teeth on larger sprocket (Z6) = 33 Number of teeth on smaller sprocket (Z5) = 16 We know that,

$$\frac{N3}{N6} = \frac{Z6}{Z5}$$

$$\frac{100}{N6} = \frac{33}{16}$$

∴ Speed of Wheel = 49 rpm

2. Torque of theEngine

The torque transmitted to engine shaft,

$$\text{T} = \frac{9.74\times10^5\times P}{N}$$

$$= \frac{9.74\times10^5\times1.342}{3000}$$

T = 436 N-m

VI. CONCLUSION AND FUTUREENHANCEMENT

In current scenario, time and efficient work matters more than money which is attained by adopting modern mechanical equipment. The proposed framework being semi-automatic plucks those weeds and unwanted small plants along with the uplifting of different layers of soil. As the machine progresses the soil and the weeds are mixed which leads to formation of manure thus providing a way for good yielding of the plant with the increased nutrient content in it. The use of machine diminishes the labour time, labour cost and also increases the efficiency with which the operation is carried out.

The machine although being beneficial has some more modifications. For better cutting operation the blade design and material can be changed such that the operation goes simple and without chugging much of power. The machine can be microcontroller driven along with sensors that can be installed which would then carry on the whole process of the entire plantation on its own, there would be no need of human intervention to help it switch between thetrees.

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