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Arecanut Tree Climbing and Cutting Machine

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***Abstract*—Here we are designing and fabricating areca nut tree climber. This is a unique model which will be the machine-front of the arecanut industry and intern will serve as a great help to the farmers. The design of the device has to be simple enough for villagers to operate and also it is safer as compared to other tree climbing machines. This is the most suitable machine for harvesting arecanuts without man climbing on the tree and also, we can reduce the time for harvest the nuts from tree. The control is wireless here we are using IR remote to control the motors.**

In recent years, labors car city has emerged as one of the fore most challenges in farming. One of the crops that has been most affected by this is the arecanut. It is mandatory to climb the tree a minimum of five times a year for a successful harvest i.e., twice for the preventive spray against fungal disease, and thrice to harvest the arecanut. Only skilled laborer' scan carry out this task.

I. INTRODUCTION

Arecanut is an important commercial crop in India. An arecanut is the seed of the areca nut palm. It plays a prominent role in the social, cultural, religious, and economic life of the people in India. The produced income comes from the fruit called "betel nut," which is used mainly for masticatory purposes. These areca nuts have uses in Ayurveda and veterinary medicines. Furthermore, it is estimated that nearly ten million people depend on the arecanut industry for their livelihood in India.

The quality, variety, and types of areca nuts vary from one place to another. Areca nut palms grow under a variety of climatic and soil conditions. This areca nut palm grows well from sea level up to an altitude of 1,000 meters in areas of abundant and well-distributed rainfall, or under irrigated conditions. While fresh, the husk is green and the nut inside is so soft that it can easily be cut with an average knife. During the ripening of the fruit, the husk becomes yellow or orange, and as it dries, the fruit inside hardens to a wood-like consistency.

Betel nut is an important commercial crop in India. Betel nut is the seed of the betel nut palm. It plays a prominent role in the social, cultural, religious, and economic life of the people in India. This betel nut has uses in Ayurveda and veterinary medicines. There are two varieties of betel nut, called White Supari and Red Supari. The white variety of supari is prepared by harvesting fully ripe betel nuts and sun-drying them for 40 to 50 days. The red variety of supari is prepared by harvesting the tender (green) betel nut, boiling it, and peeling off the husk.

The nuts derived by peeling the tender nuts are processed according to the variety required (i.e., whole nut, two pieces, eight pieces, etc.), boiled in water, and then sun-dried. Dried fruit is fruit from which the majority of the original water content has been removed naturally or through the use of specialized dryers and dehydrators. Dried fruit has a long tradition of use dating back to the fourth millennium BC in Mesopotamia, and it is prized because of its sweetness, nutritional value, and long shelf life. There are different types of dry fruits available in India, such as almonds, apricots, cardamom, cashews, dates, and so on. They are rich in carbohydrates and low in fat. They are also a source of fiber, vitamins, and minerals. The fragility of vitamin C means that there is virtually none left in dry fruit.

II. PROBLEM DEFINITION

In recent years, the non-availability of labor has emerged as one of the biggest challenges in farming. One crop that has been most affected by this is the arecanut. Arecanut trees attain a height of about 60 to 70 feet. It is mandatory to climb the trees a minimum of five times a year for a successful harvest twice for the preventive spray against fungal disease, and thrice to harvest the areca nut. The currently available areca tree climber is not user-friendly, efficient, and requires a power supply to operate.

To improve upon an existing system, a new design for a simplified, economical climbing unit should meet the following goals:

1. To climb areca trees to maximum height.
2. To ensure safety by providing proper gripping.
3. To develop the product at minimum affordable cost.
4. To develop a product without compromising aesthetic & safety of the climbing mechanism.
5. Repairs and maintenance problems are less.

Koleroga is another such disease prevalent in high-rainfall regions. This disease assumes intensity during south-west monsoon causing heavy damage to the crop. Bud-rot, foot-rot, stem-breaking, inflorescence die-back, and stem bleeding are other diseases which affect areca yield and cause damage in varying degrees. Yellow leaf disease has been causing much damage to arecanut. This disease is categorized by the yellowing of leaves. As a result, there is reduction in the size of leaves and nuts, tapering of the stem and mature nut fall occurs.

It is estimated that about 35-40% of areca plantation in Kerala has been affected by this disease. In addition to the diseases mentioned above, arecanut are also affected by many pests and insects. Therefore, in order to prevent the above-mentioned problems a machine to climb the tree is needed.

III. OBJECTIVES

The objective of this project is to design and develop a robot which can climb the Arecanut tree thereby reducing time and labor required for the same job.

- The primary objective of the study is to fabricate a coconut and arecanut harvesting device for farmers and residents without climbing the tree.
- Our goal is to harvest the coconut tree efficiently through a remote control with maximum work volume covered.
- The arm with a rotating blade will cut the coconut in a more precise manner than any other machine.
- The machine can be manually controlled under any required circumstances as per the necessity.
- The machine does not require human labor to accompany the device, but only to control it from the ground using a remote control.
- Specially fabricated to harvest coconut and arecanut quickly, safely, and efficiently.

IV. MATERIALS AND FABRICATION

To produce a quality product, a cutting tool must have three characteristics:

- Hardness: Hardness and strength at high temperatures.
- Toughness: So that tools do not chip or fracture.
- Wear resistance: Having acceptable tool life before needing to be replaced.

Cutting tool materials can be divided into two main categories: stable and unstable.
Unstable materials (usually steels) are substances that start at a relatively low hardness point and are then heat-treated to promote the growth of hard particles (usually carbides) inside the original matrix, which increases the overall hardness of the material at the expense of some of its original toughness. Since heat is the mechanism to alter the structure of the substance, and at the same time the cutting action produces a lot of heat, such substances are inherently unstable under machining conditions.

Stable materials (usually tungsten carbide) are substances that remain relatively stable.under the heat produced by most machining conditions, as they don't attain their hardness through heat. They wear down due to abrasion, but generally don't change their properties much during use.

Most stable materials are hard enough to break before flexing, which makes them very fragile. To avoid chipping at the cutting edge, some tools made of such materials are finished with a slightly blunted edge, which results in higher cutting forces due to an increased shear area. However, tungsten carbide has the ability to attain a significantly sharper cutting edge than tooling steel for uses such as ultrasonic machining of composites. Fragility combined with high cutting forces results in most stable materials being unsuitable for use in anything but large, heavy and rigid machinery and fixtures.

Unstable materials, being generally softer and thus tougher, generally can stand a bit of flexing without breaking, which makes them much more suitable for unfavorable machining conditions, such as those encountered in hand tools and light machinery.

V. COMPONENTS SPECIFICATIONS

DC GEARED MOTOR - JOHNSON MOTOR

- DC MOTOR

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

A coil of wire with a current running through it generates an electromagnetic field aligned with the center of the coil. The direction and magnitude of the magnetic field produced by the coil can be changed with the direction and magnitude of the current flowing through it.

A simple DC motor has a stationary set of magnets in the stator and an armature with one or more windings of insulated wire wrapped around a soft iron core that concentrates the magnetic field. The windings usually have multiple turns around the core, and in large motors there can be several parallel current paths. The ends of the wire winding are connected to a commutator. The commutator allows each armature coil to be energized in turn and connects the rotating coils with the external power supply through brushes. (Brushless DC motors have electronics that switch the DC current to each coil on and off and have no brushes.)

The total amount of current sent to the coil, the coil's size and what it's wrapped around dictate the strength of the electromagnetic field created.

The sequence of turning a particular coil on or off dictates what direction the effective electromagnetic fields are pointed. By turning on and off coils in sequence a rotating magnetic field can be created. These rotating magnetic fields interact with the magnetic fields of the magnets (permanent or electromagnets) in the stationary part of the motor (stator) to create a torque on the armature which causes it to rotate. In some DC motor designs, the stator fields use electromagnets to create their magnetic fields which allow greater control over the motor. At high power levels, DC motors are almost always cooled using forced air.

Different number of stator and armature fields as well as how they are connected provide different inherent speed/torque regulation characteristics. The speed of a DC motor can be controlled by changing the voltage applied to the armature. The introduction of variable resistance in the armature circuit or field circuit allowed speed control Modern DC motors are often controlled by power electronics systems which adjust the voltage by "chopping" the DC current into on and off cycles which have an effective lower voltage.

- TYPES

BRUSHED DC MOTOR

The brushed DC electric motor generates torque directly from DC power supplied to the motor by using internal commutation, stationary magnets (permanent or electromagnets), and rotating electromagnets. Advantages of a brushed DC motor include low initial cost, high reliability, and simple control of motor speed. Disadvantages are high maintenance and low life-span for high intensity uses. Maintenance involves regularly replacing the carbon brushes and springs which carry the electric current, as well as cleaning or replacing the commutator. These components are necessary for transferring electrical power from outside the motor to the spinning wire windings of the rotor inside the motor.

Brushes are usually made of graphite or carbon, sometimes with added dispersed copper to improve conductivity. In use, the soft brush material wears to fit the diameter of the commutator, and continues to wear. A brush holder has a spring to maintain pressure on the brush as it shortens. For brushes intended to carry more than an ampere or two, a flying lead will be molded into the brush and connected to the motor terminals. Very small brushes may rely on sliding contact with a metal brush holder to carry current into the brush, or may rely on a contact spring pressing on the end of the brush. The brushes in very small, short-lived motors, such as are used in toys, may be made of a folded strip of metal that contacts the commutator.

BRUSHLESS DC MOTOR

Typical brushless DC motors use one or more permanent magnets in the rotor and electromagnets on the motor housing for the stator. A motor controller converts DC to AC. This design is mechanically simpler than that of brushed motors because it eliminates the complication of transferring power from outside the motor to the spinning rotor.

The motor controller can sense the rotor's position via Hall effect sensors or similar devices and can precisely control the timing, phase, etc., of the current in the rotor coils to optimize torque, conserve power, regulate speed, and even apply some braking. Advantages of brushless motors include long life-span, little or no maintenance, and high efficiency. Disadvantages include high initial cost, and more complicated motor speed controllers. Some such brushless motors are sometimes referred to as "synchronous motors" although they have no external power supply to be synchronized with, as would be the case with normal AC synchronous motors.

UNCOMMUTATED

Other types of DC motors require no commutation.

- Homopolar motor

A homopolar motor has a magnetic field along the axis of rotation and an electric current that at some point is not parallel to the magnetic field. The name homopolar refers to the absence of polarity change. Homopolar motors necessarily have a single-turn coil, which limits them to very low voltages. This has restricted the practical application of this type of motor.

- Ball-bearing motor

A ball-bearing motor is an unusual electric motor that consists of two ball bearing-type bearings, with the inner races mounted on a common conductive shaft, and the outer races connected to a high-current, low-voltage power supply.

An alternative construction fits the outer races inside a metal tube, while the inner races are mounted on a shaft with a non-conductive section (e.g., two sleeves on an insulating rod).

- PERMAGNETMAGNETSTATORS

A PM motor does not have a field winding on the stator frame, instead relying on PMs to provide the magnetic field against which the rotor field interacts to produce torque. Compensating windings in series with the armature may be used on large motors to improve commutation under load. Because this field is fixed, it cannot be adjusted for speed control. PM fields (stators) are convenient in miniature motors to eliminate the power consumption of the field winding. Most larger DC motors are of the "dynamo" type, which have stator windings. Historically, PMs could not be made to retain high flux if they were disassembled; field windings were more practical to obtain the needed amount of flux. However, large PMs are costly, as well as dangerous and difficult to assemble; this favors wound fields for large machines. To minimize overall weight and size, miniature PM motors may use high energy magnets made with neodymium or other strategic elements; most such are neodymium-iron-boron alloy.

With their higher flux density, electric machines with high-energy PMs are at least competitive with all optimally designed singly-fed synchronous and induction electric machines. Miniature motors resemble the structure in the illustration, except that they have at least three rotor poles (to ensure starting, regardless of rotor position) and their outer housing is a steel tube that magnetically links the exteriors of the curved field magnets.

High performance DC geared Johnson motor with metal gear box used for high torque application and other automation purposes. The motor comes with 6mm off-centred shaft (side shaft) and M3 holes for mounting. It is different from the regular Johnson for its very high reliability (mainly of its gears) and the shaft length of 29mm (comes with a hole on the shaft).

Specification:

- RPM: 60 rpm @12V
- Voltage:4Vto 12V
- StallTorque:10kg/cm
- Gear: Metal(spur)
- Shaftsize:6mmdia
- Shaft length: 29mm (comes with a hole on the shaft for mounting wheels)
- Motorweight:180gms

Fig No2: Johnson Motor

- MILDSTEEL

In this project we have used half-inch x 3mm thickness mild steel flat for the frame for arecanut climber machine. Carbon steel is a steel with carbon content up to 2.1% by weight. The definition of carbon steel from the American Iron and Steel Institute (AISI) states:

Steel is considered to be carbon steel when:

- The specified minimum for copper does not exceed 0.40 percent;
- Or the maximum content specified for any of the following elements does not exceed the percentages noted: manganese 1.65, silicon 0.60, copper 0.60.

The term "carbon steel" may also be used in reference to steel which is not stainless steel; in this use carbon steel may include alloy steels.
As the carbon percentage content rises, steel has the ability to become harder and stronger through heat treating; however, it becomes less ductile. Regardless of the heat treatment, a higher carbon content reduces weldability. In carbon steels, the higher carbon content lowers the melting point.

TYPES

- Mild or low-carbon steel

Mild steel (iron containing a small percentage of carbon, strong and tough but not readily tempered), also known as plain-carbon steel and low-carbon steel, is now the most common form of steel because its price is relatively low while it provides material properties that are acceptable for many applications.
Mild steel contains approximately 0.05–0.25% carbon making it malleable and ductile. Mild steel has a relatively low tensile strength, but it is cheap and easy to form; surface hardness can be increased through carburizing.
In applications where large cross-sections are used to minimize deflection, failure by yield is not a risk so low-carbon steels are the best choice, for example as structural steel. The density of mild steel is approximately 7.85 g/cm^3 (\ (7850\text{kg/m} ^3\) or \ (0.284\text{lb/in} ^3\)) and the Young's modulus is 200 GPa (29,000 ksi).
Low-carbon steels suffer from yield-point runout where the material has two yield points. The first yield point (or upper yield point) is higher than the second and the yield drops dramatically after the upper yield point. If a low-carbon steel is only stressed to some point between the upper and lower yield point then the surface develop Lüders bands. Low-carbon steels contain less carbon than other steels and are easier to cold-form, making them easier to handle.

- High-tensile steel

High-tensile steels are low-carbon, or steels at the lower end of the medium-carbon range, which have additional alloying ingredients in order to increase their strength, wear properties or specifically tensile strength. These alloying ingredients include chromium, molybdenum, silicon, manganese, nickel and vanadium. Impurities such as phosphorus or sulphur have their maximum allowable content restricted.

- 41xx steels
- 4140 steels
- 4145 steels
- 4340 steels
- 300M steel.
- EN25 2½% nickel-chromium-molybdenum steel.
- EN26 steel.

- Higher-carbon steels

Carbon steels which can successfully undergo heat-treatment have a carbon content in the range of 0.30–1.70% by weight. Trace impurities of various other elements can have a significant effect on the quality of the resulting steel. Trace amounts of sulfur in particular make the steel red-short, that is, brittle and crumbly at working temperatures. Low-alloy carbon steel, such as A36 grade, contains about 0.05% sulfur and melts around 1,426–1,538°C (2,599–2,800°F). Manganese is often added to improve the hardenability of low-carbon steels. These additions turn the material into low-alloy steel by some definitions, but AISI's definition of carbon steel allows up to 1.65% manganese by weight.

AISI CLASSIFICATION

Carbon steel is broken down into four classes based on carbon content:

- Low-carbon steel

0.05 to 0.30% carbon content

- Medium-carbon steel

Approximately 0.3–0.8% carbon content. Balances ductility and strength and has good wear resistance; used for large parts, forging and automotive components.

- High-carbon steel

Approximately 0.8–2.0% carbon content. Very strong, used for springs, edged tools, and high-strength wires.

- Ultra-high-carbon steel

Approximately 3.25–4.0% carbon content. Steels that can be tempered to great hardness. Used for special purposes like (non-industrial-purpose) knives, axles or punches. Most steels with more than 2.5% carbon content are made using powder metallurgy.

BATTERY

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smartphones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode.

The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work.[3] Historically the term "battery" specifically referred to a device composed of multiple cells; however, the usage has evolved additionally to include devices composed of a single cell.

The battery that we have used is lead acid battery which has specifications as 12V 1.3Ah of current.

Fig No03: Battery

WHEELS

Totally 6 wheels are used in this project 3 wheels are connected to the dc geared motor and other 3 wheels are dummy wheels which are not powered by the motor these wheels help in providing support for the movement of the arecanut climber machine The wheels that we have used is of 2-inch diameter these wheels are made up of plastic material and the top black layer is of rubber material.

Fig No04: Wheel

LEAD SCREW

A lead screw (or lead screw), also known as a power screw [1] or translation screw,[2] is a screw used as a linkage in a machine, to translate turning motion into linear motion. Because of the large area of sliding contact between their male and female members, screw threads have larger frictional energy losses compared to other linkages. They are not typically used to carry high power, but more for intermittent use in low power actuator and positioner mechanisms. Common applications are linear actuators, machine slides (such as in machine tools), vises, presses, and jacks. We have used 8mm screw rod in order to move the wheels front and back and have dampering effect through the spring.

FigNo05: Lead Screw

SOFT SPRING

A spring is an elastic object that stores mechanical energy. Springs are typically made of spring steel. There are many spring designs. In everyday use, the term often refers to coil springs.

When a conventional spring, without stiffness variability features, is compressed or stretched from its resting position, it exerts an opposing force approximately proportional to its change in length (this approximation breaks down for larger deflections). The rate or spring constant of a spring is the change in the force it exerts, divided by the change in deflection of the spring.

The spring that we have used is a soft spring that is wore on the lead screw which is in turn connected to the wheels these springs provide variable load dampering effect and helps in movement of the arecanut climbing machine.

Fig No06: Soft Spring

VI. DETAILED ASSEMBLY AND MANUFACTURING

The concept of DFM (Design for Manufacture) is not new; it dates back as early as 1788 when LeBlanc, a Frenchman, devised the concept of interchangeable parts in the manufacture of muskets which previously were individually handmade. DFM is the practice of designing products keeping manufacturing in mind. "Design for manufacture" means the design for ease of manufacture for the collection of parts that will form the product after assembly. Similarly, DFA is called Design for Assembly. DFA is the practice of designing products with assembly in mind. "Design for assembly" means the design of the product for ease of assembly.

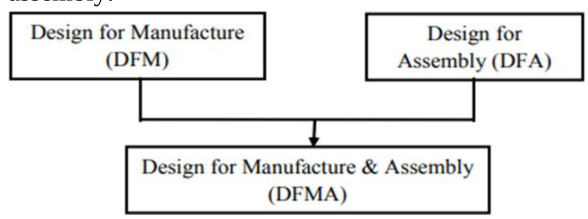


Fig No 16: Design for assembly

History of DFMA: 1. Eli Whitney is an inventor from America who used some DFM techniques in earlier times before the term DFM came into existence. Whitney incorporated the concept of interchangeable parts for manufacturing muskets for the U.S. government. Prior to this innovation, each craftsman was responsible to manufacture the complete product by using saws and files to shape each part and fit them together. 2. Henry Ford, an American industrialist, was renowned for his advanced and extensive use of assembly lines. The manual assembly operation was broken down into small chunks of repetitive work that could be carried out at high efficiency. Ford in his book "My Life and Work" described the successful Model T car that includes simplicity in operation, absolute reliability, and high quality in materials used in that model. The concept used at that time by Ford is now referred to as DFM. 3. General Electric used value analysis techniques in the late 1940s. With the help of value analysis techniques, it is possible to find the cost of a product and obtain the design alternatives for the product at the lowest cost. The philosophical approach of value analysis is through questioning and comparing the value and cost of each feature and each element of a product design.

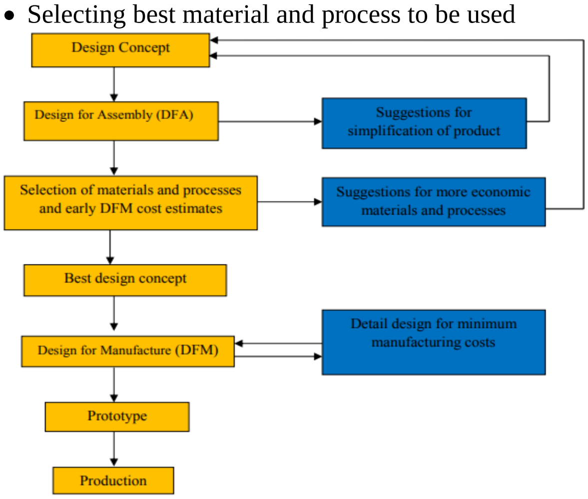
The book "Metal Engineering Processes" edited by Roger W. Boltz is one of the books from a series of handbooks published by ASME in 1941. This book provides a series of guidelines to designers in enhancing the manufacturability of metal components made with a number of manufacturing processes such as casting, forging, extrusion, machining, joining, finishing etc. Though Boltz used the word DFM, he is the first person to arrange and plan DFM methodology. 5.

In the year 1960, people started to use the terms producibility and manufacturability and about 1985, design for manufacturability and its short form DFM were widely used. 6. Geoffrey Boothroyd and A.H. Redford studied automatic assembly and provided various design guidelines to make the assembly process easier. 7.

In the recent years various trade associations and vendors of parts are issuing booklets to the product designers providing a series of guidelines and tolerances and materials recommendations for parts. These kinds of publications have provided valuable and authoritative assistance to product designers.

Steps for applying DFMA during product design. The following steps are followed when DFMA used in the design process.

- DFA analysis lading to simplification of the product structure
- Early cost estimation of parts for both original design and modified design
- Selecting best material and process to be used



FigNo17: Design of Manufacturing

VII. DESIGN CONSIDERATIONS

MOTOR (DRIVER) SELECTION

The most suitable type of motor for this application was found to be a DC high torque motor. Its compact size, simplicity of design, relatively low cost, light weight and widespread availability of motor and spare parts makes it ideal for use in this project. The high torque dc motors are a well-established technology and consequently their performance is well understood. The motor affinity laws give the relationship between input power, rotational speed and torque for dc motor.

- DIAGRAM

TOPVIEW

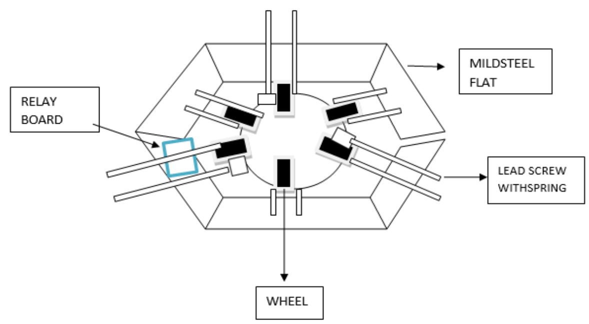


Fig No 1: Top View OF Design

SIDEVIEW

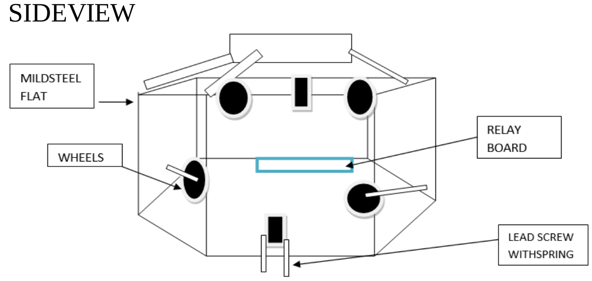


Fig No 2: Side View Design

PREPAREDMODEL

Fig No 3: Prepared Model

VIII. WORKING PRINCIPLE

This design of arecanut cutting machine worked on the basis of Remote-controlled device and uses the electric energy as the energy source. The power supply is provided by using battery to all the momentary parts. By fixing robot to the tree trunk and controlled it by using the remote, the climbing of the robot takes place with Johnson DC-motors connected to the rollers. By providing a motor on the top of hexagonal frame and motion of the arm1 takes place. Then by using suitable mechanisms arm2 and arm3 rotates and horizontal movement takes place respectively. By rotation of cutter which pivoted at the end of arm3 we can harvest the arecanut.

CHAPTER DEDICATED TO FIELD OF WORK

We have experienced in a healthy way during project work the jobs performed during development of the project showed us the skills that need to be learnt that may be in a material procurement or even mechanical design consideration. We have made a Gantt chart in which the processes and duration that was consumed for the particular process is shown. This chapter includes design fabrication and methodologies that are included. The design fabrication is the most interesting part during the season. The methodology of the project consists of both mechanical and embedded systems. The mechanical system includes the following which is shown in block diagram.

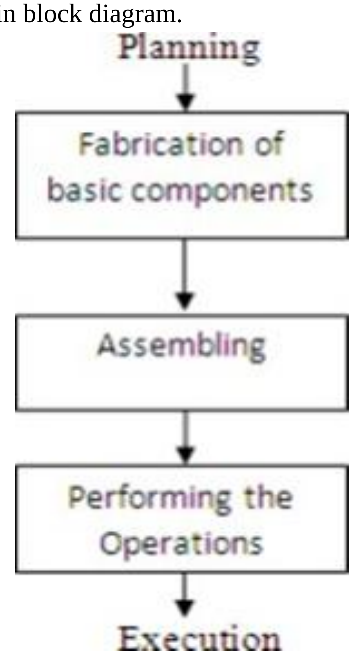


Fig No 21: Methodology of working principle

IX. RESULTS

FORCE CALCULATION

Weight of the machine, W = 7 kgs

W = 7 × 9.81, W = 68.67 N

Assuming Co-efficient of friction between tree and rubber grip, $\mu = 0.3$

Actual Force to be lifted, $F = W / \mu$

F = 68.67 / 0.3, F = 228.9 N

- TORQUE CALCULATION

Calculating motor torque:

Torque [Nm] = Mass [Kg] × g × Radius [m]

Torque = 7 × 9.81 × 0.045 = 3.09015 Nm

(3.09015 × 100) / 9.81 = 32 kg·cm

- POWER CALCULATION

Power = (F × v)

where v = (π × D × N) / 60

= (π × 0.09 × 75) / 60

= 0.353 m/s

= 228.9 × 0.353

= 85.1475 W

Climbing per minute:

= 2πr × rpm

= 0.2199 × 60

= 13.19 meter / minute

= 43.27 feet / minute

Conclusion: The robot machine climbs 43 feet per minute and its working performance is better than the labors.

X. CONCLUSION

In the present day, arecanut trees people have to climb and risk their lives. It is also difficult to find workmen to do this job. We are successful in putting together a prototype that can replace the manforce involved in doing this job.

The use of this prototype makes it economical and reduces workmen.

After testing the prototype on an areca tree, we found that:

- The design is efficient in climbing the tree very smoothly without damaging the tree.
- Human will not climb the tree so safety is increased.

- The design is simple and appealing to the majority. An unskilled labor can operate the machine safely and efficiently.
- By installing properly designed sprayers or cutting device many numbers of trees can be harvested in a single climb thus increasing the efficiency. So, we conclude that the multitalented robot machine is a safe, reliable, efficient and automatic tree climber which reduces the problems in climbing the arecanut tree and also it solves all arecanut harvesting problem and it avoids the arecanut wastes to a good extent.

XI. SCOPE FOR THE FUTURE WORK

Further research into the mechanical design of the wheel alignment or body would allow for the final project to be more effective in completing our list of requirements. The design of the wheel alignment is something that could be explored in great detail by future projects. The shape and strength of the base could be redesigned to make them smaller and lighter, possibly allowing for the robot to climb around the tree. Research on this could also look into designs that would allow for more force to be applied to the wheel, allowing for heavier payloads to be carried. Our design can be improved by installing a camera on the tip of the movable arm so as the operator can easily identify the target area of the sprayer.

Weight of the product can be reduced by manufacturing the base using strong lightweight material. Wheels can be used for easy movement of the climber on the tree. Automatic mechanism at affordable cost can be achieved.

- To observe the crop for spraying pesticide web camera can be attached to the end of robot arm which helps in avidness of spraying on healthy crops.
- Wireless technology can be adopted.
- Use of microprocessor can automate the climbing of robot and spraying of pesticide.

Stepper motors can be used for better performance of robot.

We feel the project that we have done has a good future scope in AGRICULTURAL SECTORS. The main constraint of this device is the high initial cost but has low operating costs. Savings resulting from the use of this device will make it pay for itself within short period of time & it can be a great companion in any field dealing with rusted and unused metals. The device affords plenty of scope for modifications, further improvements & operational efficiency, which should make it commercially available & attractive. If taken up for commercial production and marketed properly, we are sure it will be accepted in the industry.

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