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DESIGN AND DEMONSTRATION OF SOLAR COCO-ARECA TREE CLIMBER AND HARVESTER

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Abstract - *Designing and fabrication of areca nut and coconut tree climber and harvesting machine is a unique model which will be the machine-front of the areca nut industry and in turn will serve as a great help to the farmers. The design of the device is simple enough for villagers to operate and also it is safer as compared to other machines. This is the most suitable machine for harvesting areca nuts and coconut without man climbing on the tree and also reducing the time for harvest the nuts from tree. The machine consists of three mechanisms climbing, cutting, and spraying. And it's operated by solar energy.*

Key Words: Aurdino Uno Kit , Solar Energy ,DC motor, Control Unit.

1.INTRODUCTION

Researchers all around the world work on developing climbing machines, most of these climbing machines are capable of climbing regular structures like poles, walls etc. But a very few are capable of climbing trees, main reason being irregular surface and variation of diameter with length. Also the bark of some trees may not be strong enough to bear the weight of the climbing device, hence conventional climbing machine cannot be used for tree climbing applications. Many trees like coconut tree, arecanut tree, and palm trees are so tall that climbing them becomes risky. Hence harvesting fruits and nuts and maintaining them becomes difficult. So development of a unique tree climbing mechanism is necessary which may be used for maintaining and harvesting applications.

In recent years, labour scarcity has emerged as one of the foremost challenges in farming. One crop that has been most affected by this is the arecanut and coconut. Arecanut trees attain a height of about 60-70 feet and coconut trees attain a height of about 50-60feet. 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 arecanut. There are much equipment machines in the market to help the farmers in this regard. But they are not successful as the input for them is muscular power of the labour and it requires a person to physically climb the tree to cut the crop or harvest the nuts. It is the designing and fabricating areca nut and coconut tree climber which will be the machine-front of the areca nut industry and in turn will serve as a great help and boon to areca nut and coconut farmers.

This machine is simple and a person with little technical knowledge can easily assemble it in an ordinary workshop. It is very easy to move from one place to another. This is the most suitable machine for harvesting areca nuts and coconuts without man climbing on the tree. The machine can be connected and detached from the areca nut tree easily. Cutting of the areca nut and coconut bunch is also easy with a special type blade of this machine. The scope of this project is to climb areca nut and coconut trees having variable circumferences. Therefore, maintaining sufficient friction force capable of handling the self-weight, maintaining the stability of the structure while in motion, reducing the total weight, and achieving the precise gripping are the important parameters that have to be considered. The machine should be capable of adjusting to the varying cross-section of the tree during upward and downward movements. The machine should grab the tree firmly to maintain its positions during the operation. The geared motor should be powerful enough to carry the payloads and weight of the machine. The tension maintained by the spring must be good enough to maintain the gripping force between the wheel and the tree. In this study, considering all the above parameters, a safe, reliable and efficient climbing and spraying machine is designed and fabricated.

The design and fabrication of arecanut tree climbing and spraying machine is presented in this paper. The device consists of a triangular base frame which supports all the components to be built upon. It is fitted with three DC motors - nylon tyres with rubber grippers at 120 degrees

each other for ease of the operations. A specially designed remote controlled spraying unit is mounted on the frame. Power from the battery is supplied to the motors using flexible wires and DPDT (Double Pole Double Throw) switch is used to control the movement of climbing machine as well as spraying unit. DC geared motors having reduction gears which ensures self-locking of the tyres and thus maintains the height. To accommodate for change in the diameter of arecanut tree as the device moves up and down, a spring loaded mechanism is used for exerting sufficient tension required for gripping the tree. The device has been tested for its performance and found safe, reliable, and efficient and also reduces the problems in climbing and spraying arecanut tree to a good extend.

2. Block diagram

In this dissertation work electrical energy is produced using solar panel which converts the light energy to electrical energy. The power generated in the above method is stored in the battery. The power stored in the battery is supplied to DC motor and it will drive for various mechanisms. The power stored in the battery is utilized for climbing, cutting and spraying mechanism

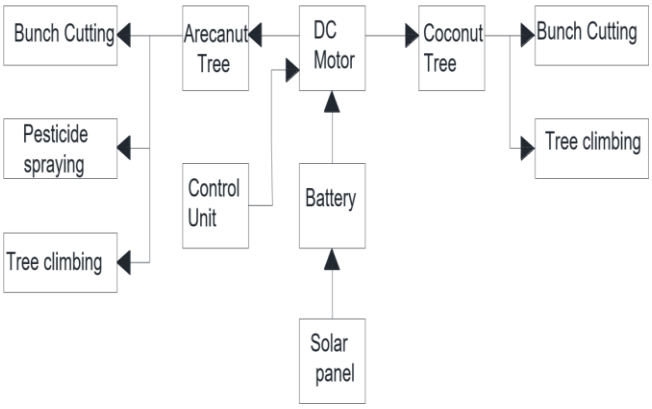


Figure 1: Block diagram

Solar Panel:

Photovoltaic solar panels absorb sunlight as a source of energy to generate direct current electricity. A photovoltaic (PV) module is a packaged, connected assembly of photovoltaic solar cells available in different voltages and wattages. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications.

Geared Motor:

A gear motor is a specific type of electrical motor that is designed to produce high torque while maintaining a low horsepower, or low speed, motor output. Gear motors can be found in many different applications, and are probably used in many devices in your home. Gear motor" refers to a combination of a motor plus a reduction geartrain. These are often conveniently packaged together in one unit. ... For large N, often the maximum output torque is limited by the strength of the final gears, rather than by N times the motor's torque.

Fig 2: Geared Motor

Nozzle Motor And Pump:

A spray nozzle is a precision device that facilitates dispersion of liquid into a spray. Nozzles are used for three purposes: to distribute a liquid over an area, to increase liquid surface area, and create impact force on a solid surface. A wide variety of spray nozzle applications use a number of spray characteristics to describe the spray. Spray nozzles can be categorized based on the energy input used to cause atomization, the breakup of the fluid into drops. Spray nozzles can have one or more outlets; a multiple outlet nozzle is known as a compound nozzle. Spray nozzles range from heavy duty industrial uses to light duty spray cans or spray bottles.

Fig 3: Nozzle Motor And Pump

Control Unit :

The remote consists of switches in which each switch is used to control the different devices such as for controlling the DC motor and its speed, water pump and nozzle motors. The controlling action which is achieved by operating the control unit from the bottom of the tree with the sufficient length of wire which is connected between the control unit and machine.

Camera:

A camera is a device that takes pictures (photographs). It uses film or electronics to make a picture of something. It is a tool of photography. A lens makes the image that the film or electronics "sees".A camera that takes one picture at a time is sometimes called a still camera. A camera that can take pictures that seem to move is called a movie camera. If it can take videos it is called a video camera or a camcorder. A camera is an optical instrument used to record images. At their most basic, cameras are sealed boxes with small holes that let light in to capture an image on a light-sensitive surface. Cameras have various mechanisms to control how the light falls onto the light-sensitive surface. Lenses focus the light entering the camera, the size of the aperture can be widened or narrowed to let more or less light into the camera, and a shutter mechanism determines the amount of time the photo-sensitive surface is exposed to the light.

Fig 4: Camera

Voltage Regulator:

A voltage regulator is a system designed to automatically maintain a constant voltage level. A voltage regulator may use a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages. Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

Solar Charge Controller

An A solar charge controller manages the power going into the battery bank from the solar array. It ensures that the deep cycle batteries are not overcharged during the day and that the power doesn't run backwards to the solar panels overnight and drains the batteries. Some charge controllers are available with additional capabilities, like lighting and load control, but managing the power is its primary job.

A solar charge controller is fundamentally a voltage or current controller to charge the battery and keep electric cells from overcharging. It directs the voltage and current hailing from the solar panels setting off to the electric cell. Generally, 12V boards/panels put out in the ballpark of 16 to 20V, so if there is no regulation the electric cells will damaged from overcharging. Generally, electric storage devices require around 14 to 14.5V to get completely charged. The solar charge controllers are available in all features, costs and sizes. The range of charge controllers are from 4.5A and up to 60 to 80A.

Fig 5: Solar Charge Controller

Types of Solar Charger Controller:

There are three different types of solar charge controllers, they are:

1. Simple 1 or 2 stage controls
2. PWM (pulse width modulated)
3. Maximum power point tracking (MPPT)

Features of Solar Charge Controller:

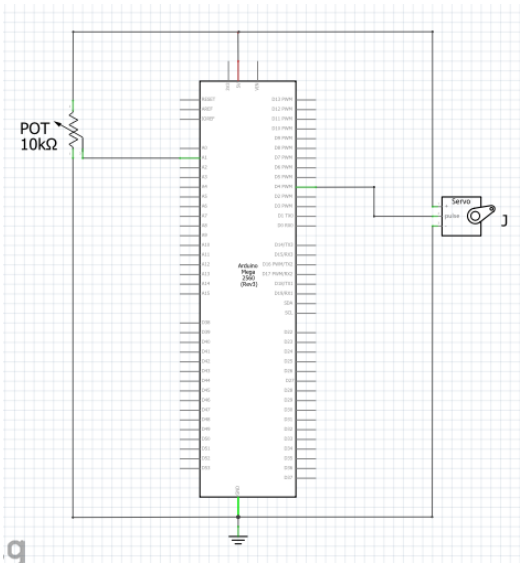
- Protects the battery (12V) from over charging
- Reduces system maintenance and increases battery lifetime
- Auto charged indication
- Reliability is high
- 10amp to 40amp of charging current
- Monitors the reverse current flow

3. CIRCUIT DIAGRAM

Motor Driver Circuit For Arecanut And Coconut Tree Climbing :

Fig 6 : Motor Driver Circuit For Arecanut And Coconut Tree Climbing

Motor Driver Circuit For Spraying Mechanism :



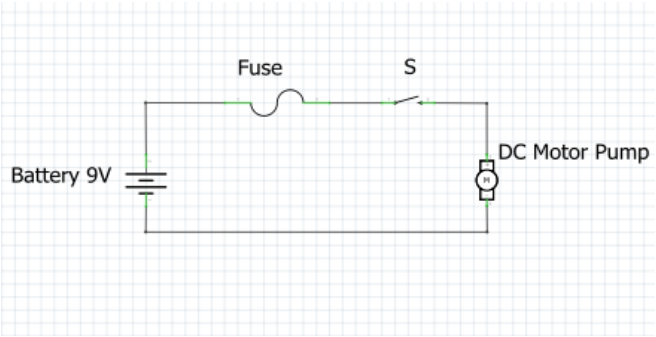
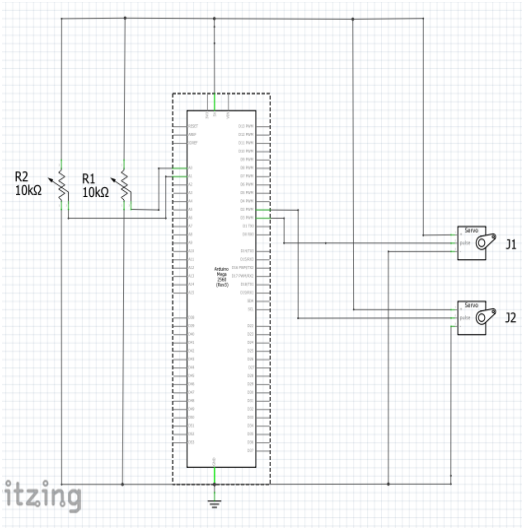


Fig 7 : Motor Driver Circuit For Spraying Mechanism

Robotic Arm For Cutting Coconut Tree :



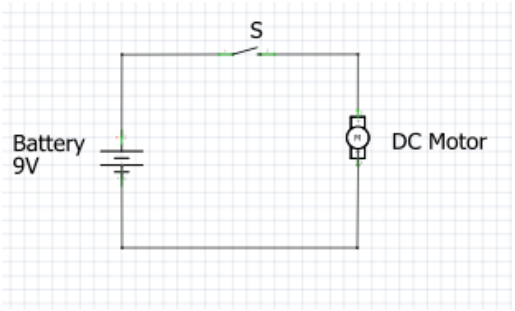


Fig 8 : Robotic Arm For Cutting Coconut Tree

3. WORKING PRINCIPLE

In this dissertation work electrical energy is produced using solar panel which converts the light energy to electrical energy. The power generated in the above method is stored in the battery. Priority device is used to select the supply from the battery depending on load and supplied to the following applications.

3.1 CLIMBING MECHANISM :

The arecanut and coconut tree climbing and spraying machine works on the basic principle of friction that is the relative lateral motion of two solid surfaces in contact. The machine developed consists of a base frame with wheels driven by high torque geared motor. A spring is used to provide sufficient grip to the wheel on the tree according to the change in the size of the tree. The frame of the arecanut and coconut tree climber can be opened up and held across the tree. The setup is connected across the tree with the help of a brake cable. In this tree climbing machine power is obtained from battery through the solar panel through which motors are energized. The control unit is

used to control the motors. When the drive motor is switched on, the motor rotates the shaft which in turn rotates the wheels. Due to the friction between drive wheel and the bark of the tree machine rises up along the length of the tree. The contact friction between the wheel and tree is maintained with the help of tension springs and grippers on the wheels. The only component which is in contact with the tree is the wheels which are made up of rubber. Hence it doesn't cause any damage to the bark of the tree.

3.2 CUTTING MECHANISM :

When the setup reaches on top of the tree the cutting mechanism which is mounted over the structure cuts the bunch of arecanut and coconuts using blades. The cutting operation is carried out by the cutting tool during the unwinding operation carried out by the motor. This operation gives enough power for the cutting tool to produce a cutting action. The collector present along with the cutting tool collects the areca nut and prevent it from falling to the ground and thus helps in reducing the overall time by eliminating the time required to collect the areca nut from ground. The blade used for cutting the coconut bunch is different from that of arecanut bunch cutting blade. The cutting mechanism of coconut bunch which includes several motors for the movement of arms and a separate motor which is used for cutting the coconut bunch with the rotating blade which is fixed to the motor.

3.3 SPRAYING MECHANISM :

For the spraying mechanism the motors for controlling the nozzle attachment is switched ON with the help of control unit, then these motors start to rotate. The motor unit is capable of rotating in all direction. The nozzle is rotated to the required position in order to spray pesticide to the crop using motor. The nozzle is positioned near the arecanut with the help of drive motor and then the drive motor is switched OFF. Then the wiper pump motor is switched ON. Then the pesticide is being sprayed. After which the pump is stopped, the whole setup is being brought back by changing the polarity of the switch, so that the drive motor rotates in opposite direction there by making the wheels rotate in opposite direction. After reaching the ground the setup is removed from the tree and attached to the

4. RESULTS

The machine was successfully designed and fabricated. The machine was able to grip to the tree and climb up and down. The harvesting mechanism was successfully operated and it was able to cut down the areca nut bunch and coconut bunch, able to spray pesticides to areca nuts, and for proper vision the machine is allotted with an camera while cutting coconut bunch. It has the following advantages like can climb large heights, do not require skilled labour, no risk involved, ease of handling, low maintenance cost, and the overall system is operated by using solar power.

5. CONCLUSION & SCOPE OF FUTURE WORK

After testing the machine on the arecanut tree, it has been found that, The design is efficient in climbing the tree very smoothly without damaging the tree. The climbing mechanism and spraying unit was working according to the requirement. The design is simple and appealing to the majority. An unskilled labour can also operate the machine safely and efficiently.

SCOPE OF FUTURE WORK

The mechanism for harvesting areca nut will surely bring about a revolution in the traditionally labour intensive areca nut collection industry. Since the machine has to work for hours, it is made less power consuming. The maintenance requirement of the device is very less making it very convenient to use. In future the device can be fully automated. Instead of controlling the switches, microcontrollers can be used and can be made wireless. Use of camera will make the device easier to use. The project can be made more efficient by inclusion of pesticide sprayer.

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BIOGRAPHIES

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I am having four and a half years of industry experience and five years of teaching experience. Currently, I am working as Asst. Prof. in EEE Dept., Yenepoya Institute of Technology. My specialization is Computer Application in Industrial Drives. And interested areas are solar, power system and drives.

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