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Solar Operated Crop Cutter cum Sprayer with Active Solar Tracking System

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Abstract

These days we are facing the problems like pollution, power cut problems etc. In order to overcome these problems, we have thought about the device, which can be performing its functions without causing any of these problems. So we have thought of doing the project on cutting grass, this uses the renewable source of energy for its operation like solar energy. This project aims at developing a portable solar operated grass cutting device, as there is power shortage. So we have decided to make a solar energy operated device. Farmer is the heart of Indian Economy and our new invention gives support by making farmer friendly solar operated spray pump. Use of other pesticide pumps causes fatigues, pollution which is harmful for green society. Considering all energy crisis, solar energy would be one of the best solutions. Here we prepared low cost farmer friendly solar operated pesticide pump with devices such as emergency LED and dc mobile charger. This pesticide pump is remotely use at various places such as farm, garden also in municipality to kill mosquitoes. We hope our new invention make the farmers modern and smarter.

Keywords: Crop Cutter, Harvesting, Solar Panel, Rotary motion, Electricity, Photovoltaic cell, Solar Pump, Sprayer etc.

Introduction

Problem statement

Solar panels are always oriented in fixed south facing direction to gain the maximum amount of the surface heat available in the day time but in general we observed that the conversion of the solar energy to electric energy is most efficient to one particular angle of attack. So the focus of the project is to develop a new system which can target the specific angle of the incident all the time to operate solar panel at the maximum possible efficiency.

The wheat crop cutting is a very tedious process causing lot of human power and fatigue for workers also the regular crop cutter machines available in market consist gasoline powered equipment which causes pollution and also cause adverse effect because it contains gasoline and most of the wheat crops are dry so there is always possibility of fire which is really risky.

Objective

The objective of the project is to build highly efficient automated solar Tracking system and solar operated wheat crop cutting machine

The following are the main objectives of the project

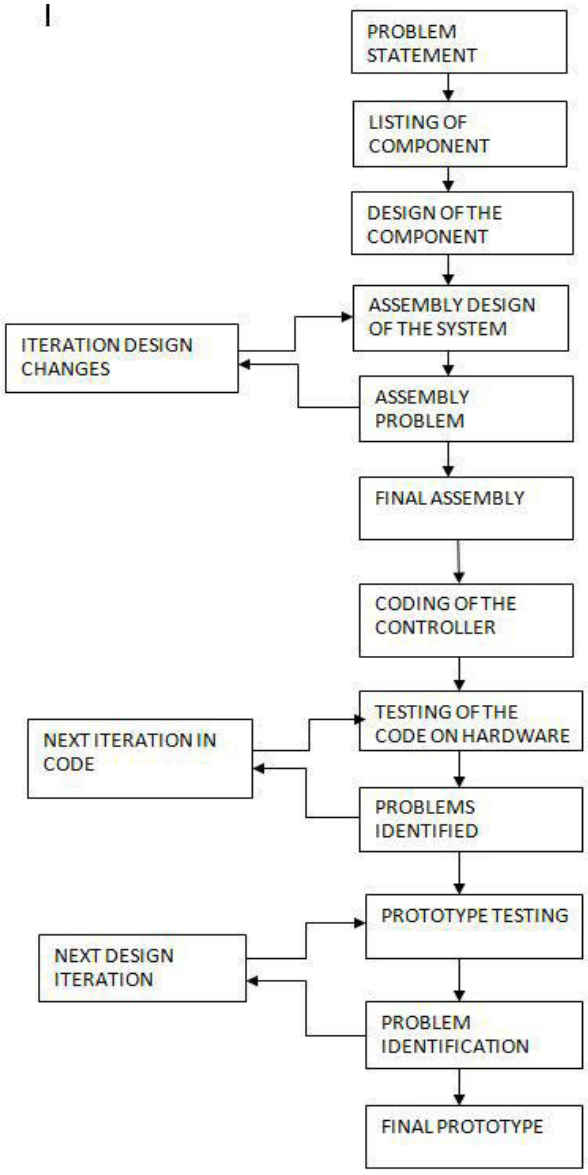
- To build a highly efficient and simple sun tracking solar system.
- System should be lightweight and less number of component.
- To build a solar operated wheat crop cutter.
- Human safety should be have highest priority.

Methodology

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

1. Battery connection gets ON.
2. By human effort move the cutter in desired direction.
3. Through the power of battery cutter starts rotating.
4. Cutter cuts the crop and throws it aside.
5. Cutter cuts the crops and works desirably.
6. After discharging of the battery it is again charged with the help of charging adapter.
7. Battery can be also charged with the help of solar energy from solar panel.

The methodology of the work we have done in the 1st Stage is as shown in the following flow chart.



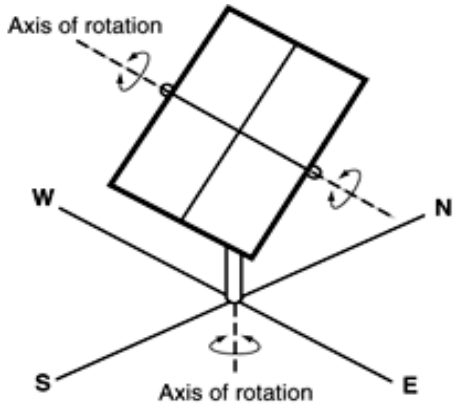
1. Stage 1 – Selection of the system.
2. Stage 2 – Modelling of the system components.
3. Stage 3 – Assembly of the system on sub-system level.
4. Stage 4- Selection of the hardware.
5. Stage 4 – Programming of the hardware.
6. Stage 5 – Manufacturing of the system.
7. Stage 6 – trial of the system.
8. Stage 7 – Testing and Iterative Changes
9. Stage 9 – Final Prototype.

Solar Tracking System

Dual Axis Solar Tracking System:

Dual axis trackers have two degrees of freedom that act as axes of rotation. These axes are typically normal to one another. The axis that is fixed with respect to the ground can be considered a primary axis. The axis that is referenced to the primary axis can be considered a secondary axis. There are several common implementations of dual axis trackers.

- The dual axis solar tracker is device which senses the light and positions towards the maximum intensity of light. It is made in such a way to track the light coming from any direction.
- To simulate the general scenario of the Sun's movement, the total coverage of the movement of the tracker is considered as 120˚ in both the directions.
- The initial position of both the servo motors are chosen at 90˚i.e, for east-west servo motor as well as for north-south servo motor.



Two Axis Tracking system

Observations

- In this Dual Axis Solar Tracker, when source light falls on the panel, the panel adjusts its position according to maximum intensity of light falling perpendicular to it.
- The objective of the project is completed. This was achieved through using light sensors that are able to detect the amount of sunlight that reaches the solar panel. The values obtained by the LDRs are compared and if there is any significant difference, there is actuation of the panel using a servo motor to the point where it is almost perpendicular to the rays of the sun.
- This was achieved using a system with three stages or subsystems. Each stage has its own role. The stages were; an input stage that was responsible for converting incident light to a voltage. A control stage that was responsible for controlling actuation and decision making. A driver stage with the servo motor. It was responsible for actual movement of the panel.
- The input stage is designed with a voltage divider circuit so that it gives desired range of illumination for bright illumination conditions or when there is dim lighting. The potentiometer was adjusted to cater for such changes. The LDRs were found to be most suitable for this project because their resistance varies with light. They are readily available and are cost effective. Temperature sensors for instance would be costly.
- The control stage has a microcontroller that receives voltages from the LDRs and determines the action to be performed. The microcontroller is programmed to ensure it sends a signal to the servo motor that moves in accordance with the generated error.

- The final stage was the driving circuitry that consisted mainly of the servo motor. The servo motor had enough torque to drive the panel. Servo motors are noise free and are affordable, making them the best choice for the project.

Literature Review

1. Robin Burgess-Limerick and et al; explored the design of sugarcane harvesting machines and identifies the design modifications undertaken by field maintenance staff to improve several issues of the equipment. [1].

2. Akshay Komawar and et al; developed and performance of human powered multi-crop cutter so that it can easy harvesting in minimum period of time. It has bevel gear mechanisms which results in transmission of this manual motion in rotary motion of cutter at the end of which the crops get cut easily without any hard effect.
[2].

3. Sachin M Moghe and et al; produced a fly wheel motor with a concept of human powered mini paddy harvester is efficient as compared to modern harvesters. The battery charge due to peddling mechanism is also used for many electrical applications. [3]

4. Dr. U. V. Kongre and et al; introduced a new type of modified cutter which can reduce dependent to workers which give much effect in maximizing the profits to the farmers. The work was carried out with objective to design modification and evaluate the performance of manual operated reaper. [4].

5. Pedersen S. M. and et al; researched on autonomous system for grass cutting, crop scouting and autonomous weeding which reduce labor costs and restrictions on the number of daily working hours significantly.[5]

6. R. Joshua, V. Vasu and P. Vincent" in his paper titled \Solar Sprayer – An Agriculture Implement" has stated that, Energy - demand is one the major thread for our country and finding solutions, to meet the \Energy - demand" is the great challenge.[6]

7. Hemant Ingale, N.N.Kasat" in his paper titled \Automated Solar Based Agriculture Pumping" he stated that, Solar power is absolutely perfect for use with irrigation systems for gardens, allotments, greenhouses, and polytonal. When the sun is shining you need more water and so the solar power is there for the pump. By adding a suitable deep-cycle leisure/marine battery, power can be made available 24 hours per day enabling watering in the evening - the best time to water plants in the summer so that the water has a chance to soak into the ground.[7]

Components Used

Solar panel:

Power : 30 Watt

Voltage : 18 V

Current : 1.66 Amp

Max system valtage: DC 600V

Motor

1. 30 RPM; 12V DC Motor
2. 1800 RPM Base Motor
3. 32 kgcm torque

Battery

To run the motor and to store the energy powered by solar panel, battery is needed. We are using 12 V lead acid rechargable battery.

Pump

Type:Diaphragm

Usage Type: Agricultural

Power Supply:12 V

Power Rating:12 kW

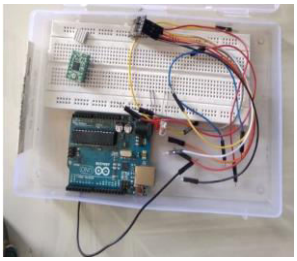
Motor Power:12 HP

Flow Rate:7.5 LPM

Cutter

Sprayer Nozzle

Arduino Uno Board



To control the sensors which senses the temperature radiation from sun. It helps to adjust the solar panel with dual axis tracker.

3D Model

Fig : 3D modeling of Project Model

Advantages:

1. A multipurpose handy equipment is available to farmers and need to buy separate equipment for farming process is not needed.
2. A low cost, cost effective tool is available to the farmers.
3. A compact equipment is available so easily usable in less area farm.
4. The flexibility of assembling and dissembling is provided with ease.
5. Whole machine is bolted with single size of nut bolt hence easy to dissemble.
6. All standard parts are used hence easily replaceable.

Disadvantages:

1. Crop collecting facility is not available after cutting.
2. Charge of battery will affect as per environmental condition.

Application:

1. To harvest the crops in agricultural field.
2. To cut the unwanted grass on filed and in lawns.
3. Used where shortage of labors occurs.
4. Also suitable in small farms.

Conclusion:

The top concentration of our design is the cost and operational ease in case of small farm units. This multipurpose ago equipment is thus designed to reduce the cost of harvesting, spraying . In the development of multipurpose ago equipment we utilize the past data and techniques. In this way the design of multipurpose agro equipment is safe. Such human powered machine systems will help to a great extent in improving the production per acre and increase profitability of small and middleclass farmers. A new type of multipurpose mechanism is fabricated which is different from other machines and will work on non-conventional energy source which is purely human operated. Such systems are of much importance in Asian countries, as almost all Asian countries are facing electricity and power scarcity which results in twelve to fourteen hours load shedding in rural areas especially in India. Therefore, there is the need to develop a locally, fabricated multiple multipurpose agro equipments.

Acknowledgement:

It gives us great pleasure in presenting the preliminary project report on "SOLAR OPERATED CROP CUTTER CUM SPRAYER WITH ACTIVE SOLAR TRACKING".

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