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SOLAR BASED CULTIVATOR

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Abstract: As the world continues to develop, the search for renewable energy continues. Not only is renewable energy popular with companies, but with advancements in technology, everyday people are beginning to utilize it. Nowadays, development should be in consideration with environmental factor. Rapid change in climate has forced us to switch our choices from traditional fuels to Renewable Energy. After the industrial revolution India underwent Green Revolution which boosted the production of agricultural products in India. Along with this Green Revolution the use of tools and the equipment used in Agricultural boosted. This equipment's used traditional fuels which emitted large amount of co2 which is harmful for nature and environment. This leads us to find alternative equipment's which runs on renewable fuels and are environment friendly.

Keywords: Efficiency, Output, Solar Panel, MMPT, Electric cultivator Agricultural business, House gardening

I. INTRODUCTION

Solar Energy is considered one of the most reliable forms of energy amongst all the forms of Renewable Energies Employing solar energy in agricultural works and equipment's will have higher impacts on environmental degradation. In country like India where sunlight is available in ample amount, we can easily we can easily use it in agricultural works. Amongst all the agricultural work that are carried out throughout the year cultivation is the work that is being carried out throughout the year which is really important in agricultural works. Cultivation in most of the fields is carried out by the equipment's which run either on manpower for traditional fuels. The rising cost of fuels make this out of reach for the small land owners. Making a cultivator run on renewable energy gives us has advantages in both factors such as environmental and economical.

In this paper we have presented the photovoltaic solar panel's operation. The foremost way to increase the efficiency of a solar panel is to use a Maximum Power point Tracker (MPPT), a power electronic device that significantly increases the system efficiency. By using it the system operates at the Maximum Power Point (MPP) and produces its maximum power output. Thus, an MPPT maximizes the array efficiency, thereby reducing the overall system cost. In addition, we attempt to design the MPPT by using the algorithm of a selected MPPT method which is "Perturb and Observe" and implement it by using a DC- DC Converter. We have found various types of DC-DC converter. Among them we have selected the most suitable converter which is "BUCK" converter, for our design.

II. LITERATURE REVIEW

1]This paper proposes an advanced perturbation and observation (P&O) algorithm for tracking the maximum power point (MPP) of a solar PV panel.[1]

2]The work deals with a PV battery charge regulator assigned for advanced CdTe modules of output voltage much higher than the popular values of the order 12 or 24 V nominally. As at the same time most of the nominal PV autonomous installation voltages generally remain on the 12 or 24 V level because of convenience, technical tradition and battery features- this high DC module's voltage has to be transformed to a proper lower value by means of DC/DC inverter of possibly high efficiency.[2]

3]This paper presents the development of a maximum power point tracking algorithm using an artificial neural network for a solar power system. By applying a three layers neural network and some simple activation functions, the maximum power point of a solar array can be efficiently tracked.[3]

III. PROPOSED WORK

Scope: The scope of the project is multidisciplinary it has advantages and scope in each and every factor such as economic, environmental and reduction in man power etc. The proposed system is to present a novel cost effective and efficient microcontroller based MPPT system for solar photovoltaic system to ensure the maximum power point operation at all changing Environmental condition. The P&O MPPT algorithm is used to control the maximum transfer power from

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a PV panel. This algorithm is executed by a pic microcontroller using the PV voltage and current data to control the duty cycle of a pulse width modulation signal applied to a DC/DC converter.

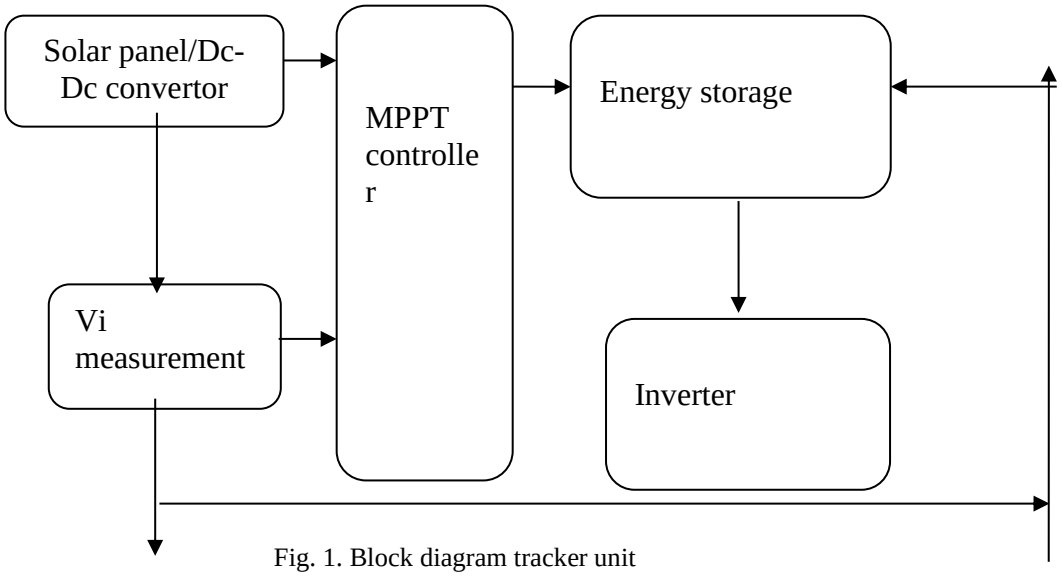

Fig. 1. Block diagram tracker unit

I]MCU:

The MPPT control circuit is implemented in a microcontroller, that has 8bits analog-to- digital (A/D) converters and two four PWM mode signals. The boost converter is controlled by the microcontroller. It read the voltage and current of the solar panels through the A/D port of controller and calculates the output power. It also calculates power by reading the voltage and current of battery side in same way and send corresponding control signal to the boost converter and control the duty cycle of the converter by PWM signal through controller to accordingly increase, decrease or turn off the DC-to-DC converter. The pic is a perfect combination of performance, features, and low power consumption for this application. The control circuit compares the PV output power before and after a change in the duty ratio of the DC/DC converter control signal. It is expected that the MPP presents a constant oscillation inherent to the algorithm.

II]Boost convertor:

There are several topologies available for DC-DC converter. Among them buck converter is in an increasingly popular topology, particularly in battery powered applications, as level of the output voltage can be changed with respect to input voltage. The commonly used a converter in PV systems is a DC/DC power converter. It ensures, through a control action, the transfer of the maximum of electrical power to the load. The structure of the converter is determined according to the load to be supplied. In this article we focus on the step-up DC/DC converter (Boost converter). MPPT uses the same converter for a different purpose, such as regulating the input voltage at the Maximum power point and providing load matching for the maximum power transfer.

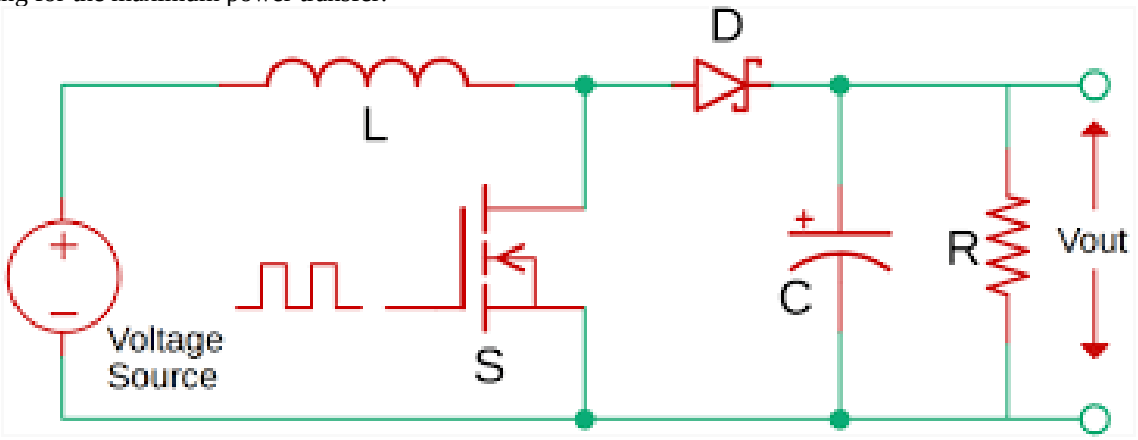

Fig. 1.Boost convertor

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III] MPPT:

A typical solar panel converts only 30 to 40 percent of the incident solar irradiation into electrical energy. Maximum power point tracking technique is used to improve the efficiency of the solar panel. According to Maximum Power Transfer technique, the output power of a circuit is maximum when the source impedance matches with the load impedance. In the source side a buck converter is connected to a solar panel in order to enhance the output voltage. By changing the duty cycle of the buck converter appropriately by PWM signal the source impedance is matched with that of the load impedance. There are various MPPT techniques are proposed. Among those methods, the perturb and observe (P&O) and incremental conductance (INC) methods are widely used although they have some problems such as the oscillation around MPP and confusion by rapidly changing atmospheric conditions.

IV]Storage:

Storage device is 12v lead acid dry battery. Storage capacity of each battery is 9Ah .We have utilised two batteries .Both the batteries are connected Parallel.

Cycle use :14.4-15.0V
Standby use :13.6-13.8V
Initial current :2.1A

Fig. 2. Storage

V] Objectives of proposed work:

The primary objective of this thesis is to build efficient solar charger that will recharge the battery properly with minimum loss with overcoming the voltage variation in solar panel.

Perturb and Observe

The main objective of maximum power point tracking is to read the voltage and current from the solar panel, perform the calculation for power and then display the power at its maximum. There are many algorithms available to execute this process. Some examples include Perturb and Observe (P&O), Incremental Conductance, Parasitic Capacitance and Constant Voltage Method. Of all the available algorithms, P&O is the most widely used algorithm because of its easy implementation. As for the Incremental Conductance method, it is more complex. However, a pro with this method is that it can be more accurate than the P&O method. As for the Parasitic Capacitance, it is much more complicated since the effect of the solar cells' parasitic junction capacitance matters.

I]Motor

These are traditionally built and used for car wipers, but they can also be run as a highly efficient worm drive motor.
This particular unit has extremely tight tolerances (zero backlash) and an ultra-smooth motor and gearbox.
While it is operating you can barely hear it, that's how quiet the motor and gearbox are.
These are a good choice if you are on a budget simply for the fact you can overdrive them with little more than some extra current. The worm will actually stall at 29Nm but it will only hold torque to about 80% of its rated load (so between 4-5nM).

Technical Parameters:

Rating Voltage: 12V
Rating Power: 50W
No Load Current: 2.0/2.5A
No Load Speed: 45/65 +/- 5 RPM
Load Current: 6.5/7.5A 3.5/5A
Load Speed: 40/60 +/- 5 RPM
Stall Current: 31A (max)
Stall Torque: 29NM (min)

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Fig. 3. Motor

II] PV Panel

Fig 4 shows the current source and diode which are connected in parallel. PV array is designed by connecting number of solar cells in series and parallel. The specification of PV panel is decided as per the following.

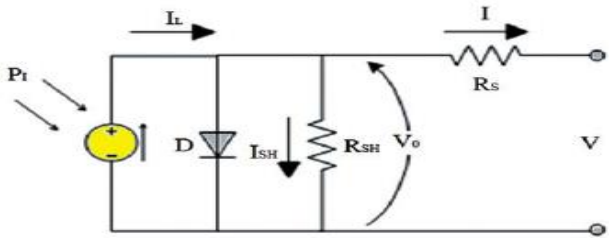

Fig. 4. PV Panel

Specification of PV panel:
Maximum Power (Pmax) = 20W
Open Circuit Voltage (Voc) = 22.57V
Short Circuit Current (Isc) =1.23A
Voltage At Maximum Power (Vmp) =19.48V
Current at Maximum Power (Imp) =1.09V

III] Maximum Power point Tracking:

The use of MPPT is the extracting the concentrated power at any environmental condition. Using the MPPT technique, definitely improve the efficiency of PV panel. Here we are using perturbation and observation MPPT technique.

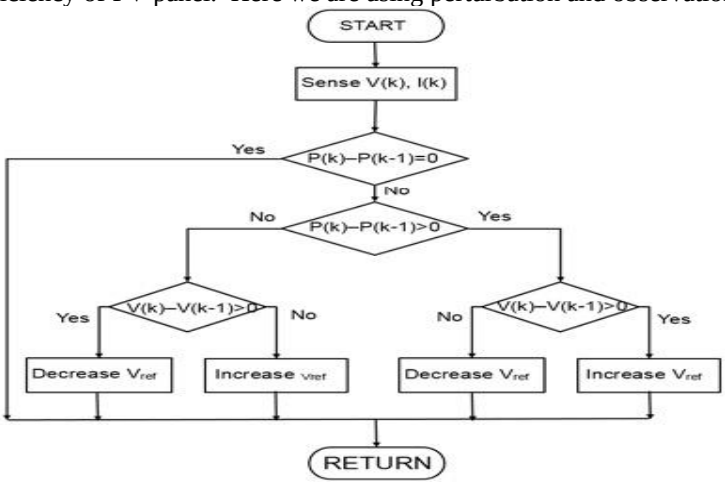

Fig. 5. Flow chart of P&O MPPT

In this technique, first of all the current and voltage of PV is sensed. The power is given by the reproduction of voltage and current of solar panel. The output power is increasing due to the PV current increases. So, the reference current is also increased otherwise the reference current is decreased. If the output power reduced with increasing solar panel current, the reference current is decreased by one step; otherwise, the reference current is increased by one step. If the power is increasing, the perturbation will be in the forward direction otherwise direction will be inverted. Due to this continuous process PV panel is able to extract maximum power in any environmental condition.

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IV] MPPT Boost Converter:

Following figure shows the simulation model of the DC-DC converter. The input capacitor is compulsory to steady the input voltage due to the peak current must of exchanging power supply. Specification of inductor is very important which decided through the following equation.

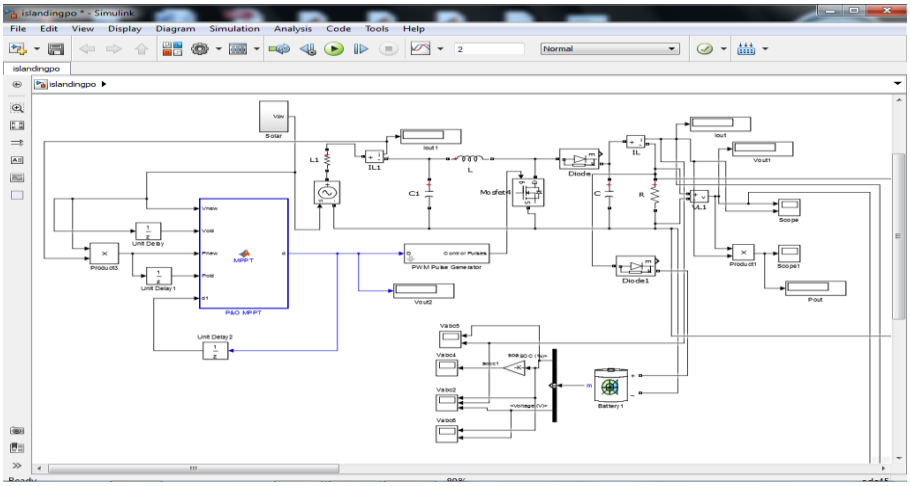

Fig. 6. MPPT Boost Convertor

Since the type of DC/DC converter chosen for this project is the buck/boost converter, it will step the input voltage down based on the duty cycle. The preset duty cycle for the simulation is 50%, so the voltage from the input of the buck converter will be reduced by half when measure the output of the converter.

V] Pulse Width Modulation:

Pulse width modulation, or PWM, has become an accepted method for generating unique signals, due to the advancement of microcontrollers and its power efficiency. To create a sinusoidal signal, PWM uses high frequency square waves with varying duty cycles. Duty cycle is the percentage of time the signal is on relative to the period. This means as the duty cycle increases, more power is transmitted. PWM requires rapid on and off signals, which can be achieved using high power MOSFETs MOSFET are ideal switches due to the low power loss when the device is activated. It should be noted, however, that when a MOSFET is in transition between on and off, the power loss can be significant. For this reason, the transition times and frequency should be engineered to be as short as possible.

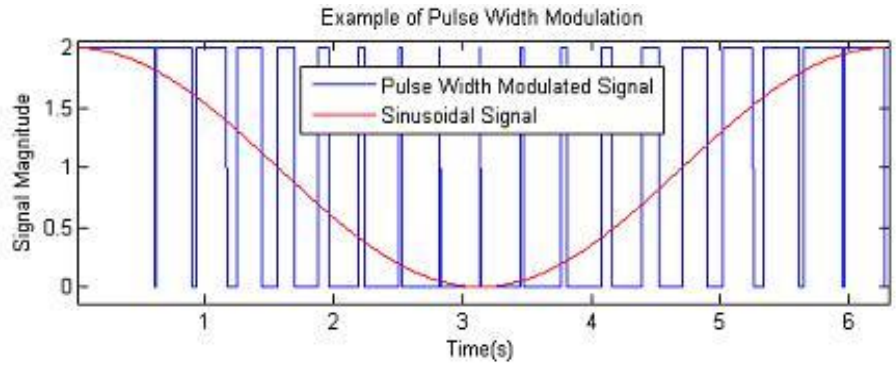

Fig. 7.PWM

VI] IC 7805:

All voltage source cannot able to give fixed output due to fluctuations in the circuit. For getting constant and steady output, the voltage regulations are implemented. The integrated circuit which are used for the regulation of voltage are termed as voltage regulator ICs. Here, we can discuss the IC 7805.

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ATMega328P Microcontroller

ATMEGA328P is high performance, low power controller from Microchip. ATMEGA328P is an 8-bit microcontroller based on AVR RISC architecture. It is the most popular of all AVR controllers as it is use.

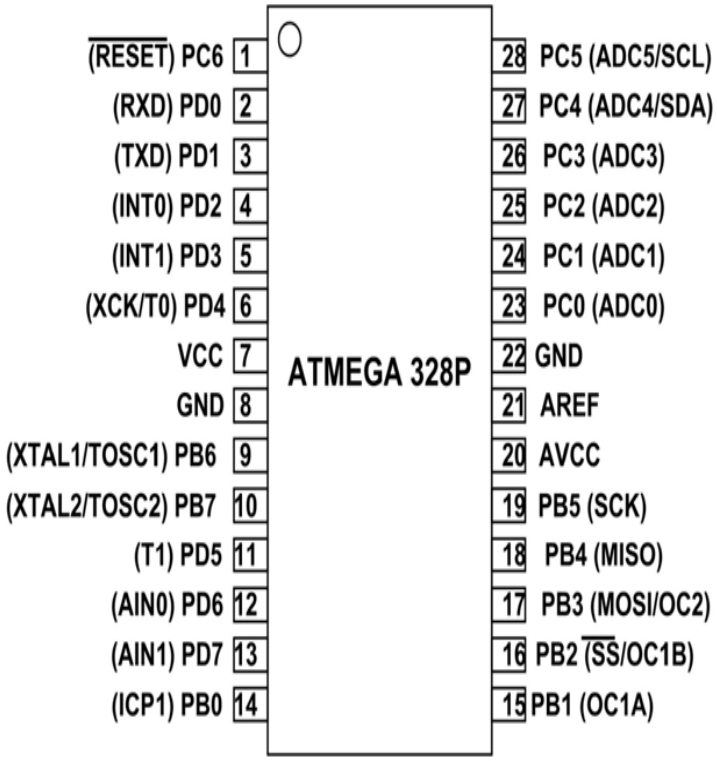

Fig. 8. ATMega328P Microcontroller

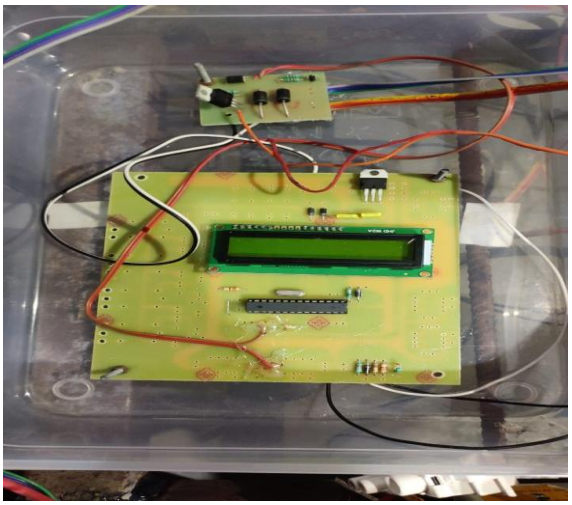

Fig. 9. LED Display

VII] Display:

An electronic device that is used to display data and the message is known as LCD 16×2. As the name suggests, it includes 16 Columns & 2 Rows so it can display 32 characters (16×2=32) in total & every character will be made with 5×8 (40) Pixel Dots. So, the total pixels within this LCD can be calculated as 32 x 40 otherwise 1280 pixels

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Fig. 10. Actual Image of Project

Fig. 11. Actual Image of Project

IV. RESULT AND DISCUSSION

This study focuses on the design and production of a cultivator for agricultural and domestic gardening. The key problem is the ecological and ageing society's future consideration of agricultural business, especially in local places like India, where agriculture is the primary industry. Although the design and manufacturing in this study seems to have practical utility, there are still difficulties. The battery life is one of them. The charging experiment was carried out in two different methods. The first is a charging experiment with a constant current and voltage unit. The other is a solar cell and capacitor combo.

V. FUTRUE EXPLANSION

Though the machine has some innovative concepts, there is still a lot of scope for development like
• Weight of the machine could be made lighter and this could be achieved by removing excess of material from the machine.

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• A continuous supply of liquid pesticide/ fertilizer in sprayer tank could be generated.
• Soil testing equipment may be added to this project.

VI.APLLICATIONS

1. Used in small scale cultivation land for operation like weeding, spraying.
2. When soil shifting cultivator is detached from the machine. Sprayer alone can be used for sanitizing public areas, roads, house boundaries etc.
3. Blades of the cultivator are so designed that when machine moves forward soft loamy soil can be shifted towards the vicinity of the plants and bridge(mend) like patterns is formed which is important in cultivating crops like sweet potato.
4. It is used to prepare an uncultivated area for ploughing.

VII.CONCLUSION

Concluding this study, it is important to comment all important points that stemmed out. The first is that this project is proved feasible. Although many assumptions occurred, the results can be judged as rational and realistic. From a technical aspect, this project is parted from matured and relatively simple technologies such, as PV panels, batteries and electric motors. Hence major problems of compatibility between technologies do not occur. This is very important when it comes to applicability in real conditions. Financially the project is feasible and under certain conditions it can be very profitable. Last but not least the project, as an idea, seems to comply with the EU environmental standards and goals, while offering solution to the matter of the environmental degradation from farming activities. As mentioed in the previous paragraph, this study proves that the project has a lot of potentials regarding its application. All technologies that were combined have proven their reliability and of course their drawbacks (battery unreliable technology) through last decades.

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