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Solar Power Utilizing Motor Made in Low Cost

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ABSTRACT

The circuit acts as a control circuit to regulate the process of Photo-Voltaic Solar battery charging process. The circuit is cheap and can be easily constructed from the discrete electronic components. The circuit operation is based on matching the solar cell terminal load voltage to the approximate number of battery cell units to be charged depending on the solar light intensity condition. The charger circuit is simpleandthe usage of lead-acid battery charger is a good way to trap sun's energy. The usage of Voltage Regulator solves the problem by regulating the output voltage. A cumulative compound motor has characteristics intermediate between series and shunt motors.

Experimental results indicate that there is an increase of overall charging current using charging circuit is better than direct charging as shown in the solar cell characteristics. By increasing the charge collection, ten percent efficiency is experimentally established.

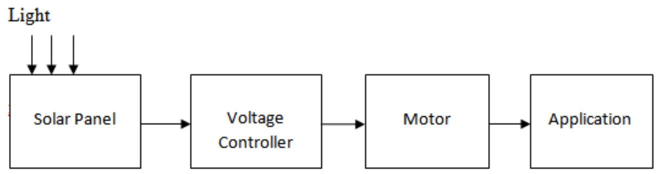
INTRODUCTION

Solar Project was initially fuelled by world apprehensions concerned with nuclear wastes and nuclear safety on one hand and green house gases and global warming on the other [1]. A part from some unsystematic results concerning cold electrolytic nuclear fusion [2], nuclear fusion energy proper, still seems a long way off. These considerations make solar energy the ultimate strategic choice as a source of world energy. As a result of current day satellite technology, designers now have a clear picture about solar energy intensity distribution worldwide [3].

Solar energy research emphases over the past three decades were concentrated on two main aspects of this subject. The first is concerned with solar energy direct heat production. The second is involved with solar energy electricity production. The later involves research into many aspects of solar to electric power production processes. Much effort has been put on attempting to increase solar panel conversion efficiencies. Encouraging results have been obtained. However, and after thirty five years, conversion efficiencies of about 60% are not up to the initial expectations on one hand and below economic considerations needed to make solar power an economically competitive source compared with conventional energy sources on the other hand [4].

Results from extensive researches in Storage batteries technology so far, fall short from producing new generations of practical electrical storage batteries which have a better charge, weight and cost than those of the good old lead acid battery or the nickel- cadmium battery. Working on the assumption that we have a particular solar cell with some fixed conversion efficiency, we are concerned with the optimum conditions for utilizing the maximum amount of electric charge from the panel that can be stored in the battery.

Some works have been sighted in literature concerning this matter [5, 6].



It is purpose of this work to introduce a relatively low cost electronic control circuit that can automatically distribute the electric current produced by a photovoltaic solar panel in an optimum way to utilize the maximum charging current at all times depending on the light intensity.

Solar Cell Characteristics:-

A solar cell, also called a photovoltaic cell is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect. It is a form of photoelectric cell with electrical characteristics likecurrent, voltage, or resistance which vary when light is incident upon it when exposed to light, can generate and support an electric current without being attached to any external voltage source.

Photovoltaic's is the field of technology and research related to the practical application of photovoltaic cells in producing electricity from light, though it is often used specifically to refer to the generation of electricity from sunlight. Cells can be described as *photovoltaic* even when the light source is not necessarily sunlight (lamplight, artificial light, etc.). In such cases the cell is sometimes used as a photo detector (for example infrared detectors), detecting light or other electromagnetic radiation near the visible range, or measuring light intensity.

The operation of a photovoltaic (PV) cell requires 3 basic attributes:

- The absorption of light, generating either electron-hole pairs or exactions.
- The separation of charge carriers of opposite types.
- The separate extraction of those carriers to an external circuit.

In contrast, a solar thermal collector collects heat by absorbing sunlight, for the purpose of either direct heating or indirect electrical power generation. "Photo electrolytic cell" (photo electrochemical), on the other hand, refers either a type of photovoltaic cell (like that developed by Becquerel and modern dye-sensitized solar cells) or a device that splits water directly into hydrogen and oxygen using only solar illumination.

BASIC PRINCIPLE:-

For any particular solar cell panel, the open circuit voltage increasesexponentially with the intensity of solar radiation, reaching a limiting value. Thecell voltage will assume the value of the battery terminal voltage which is an approximately fixed quantity except for the case of a highly drained battery. It is common practice to design photovoltaic solar systems for battery charging with solar panel open circuit saturation voltage being 1.5 times the nominal emf of the battery to be charged. Even with such design, a good deal of sun energy under morning, after noon hours and cloudy weather may not be exploited properly due to the fact that the operating point will slip back into the exponential regions. In order to gain more insight on the problem let us consider the simple equivalent circuit of the battery charging process shown in Fig. 1. The solar panel is represented by a voltage source *E*, an internal resistance *r*, and a diode D. When

the electromotive force *E* exceeds that of the battery to be charged *E*0, charging current *i* will flow. $ir = E - E_0$ *(1)*

The power stored in the battery will be $P iE_0$The solar panel internalresistance *r* is equal to the open circuit voltage *E* divided by the short circuitcurrent I_0. For a typical solar panel, this current will be proportional to theradiation fallout Φ . Thus $I_0 = K\Phi$, where *K* is a panel constant related to thecharge conversion efficiency.

$P = Ei - i^2 r$ (2)

For maximum power condition, we have

$i = \frac{E}{2} = \frac{I_0}{2} = \frac{K\Phi}{2}$ (3)

For a particular fallout condition, it would be beneficial to try to adjust the charging current value in accordance with equation (3). The only way do this, is through the adjustment of the electromotive force of the battery being charged.

Let us assume that we have a solar panel that has been designed to charge a battery consisting of *N* cells each has an electromotive *x* under full radiation fallout condition. It is not unusual to make the electromotive for such panel equal to $(3/2)Nx$. We further assume that this panel is being used to charge a smaller number of series cells $n < N$.The electromotive force solar fallout relation of a typical solar panel isusually of an exponential type. For such a case, equation (1) may be rewritten as

$\left(\frac{3}{2}\right) Nx(1 - e^{-K\Phi}) - nx = ir.$ (4)

Where K is the conversion efficiency factor.

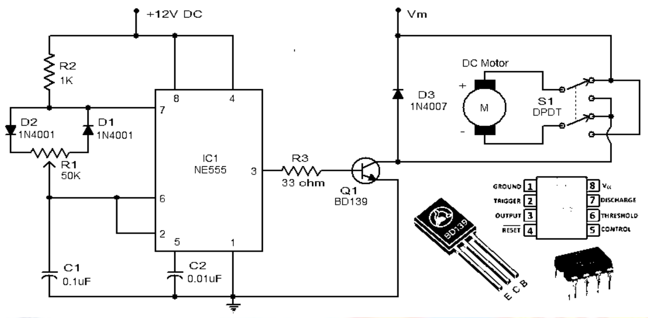
If one chooses to perform the charging process under maximum power condition, the current i will be that given by equation (3). If we further assume that the panel open circuit voltage is approximately equal to $\frac{3}{2} Nx(1 - e^{-k\Phi})$,

Equation (4) becomes

$\frac{3}{2} Nx(1 - e^{-k\Phi}) - nx = \frac{K\Phi}{2} \frac{\left(\frac{3}{2}\right) Nx(1-e^{-K\Phi})}{K\Phi}$ (5)

This gives $n = \frac{3N}{4}(1 - e^{-K\Phi})$ (6)

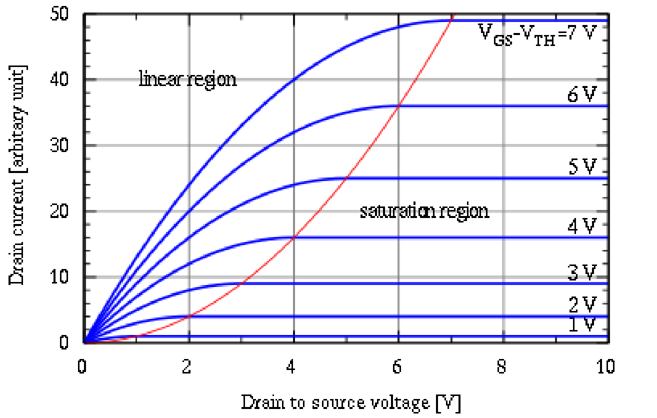
Equation (6) gives the number of unit cells that can be charged under maximum power condition as a function of the solar radiation fallout. Fig. 2 shows the optimum values of n plotted against Φ for a typical solar panel of 10% conversion efficiency



Result and Discussion of Solar :-current–voltage characteristic or **I–V curve** (current–voltage curve) is a relationship, typically represented as a chart or graph, between the electric current through a circuit, device, or material, and the corresponding voltage, or potential difference across it.

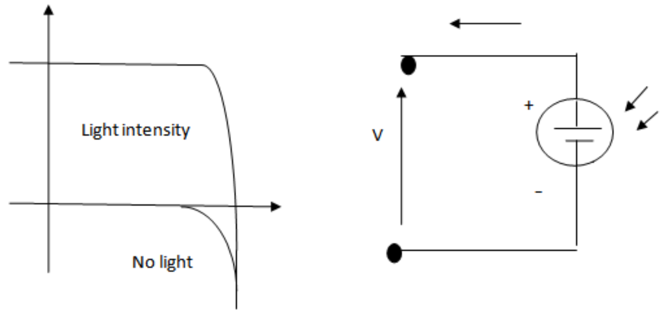
MOSFET drain current vs. drain-to-source voltage for several values of the *overdrive voltage*, $V_{GS} - V_{th}$; the boundary between **linear** (**Ohmic**) and **saturation** (**active**) modes is indicated by the upward curving parabola.

In electronics, the relationship between the direct current (DC) through an electronic device and the DC voltage across its terminals is called a current–voltage characteristic of the device. Electronic engineers use these charts to determine basic parameters of a device and to model its behaviour in an electrical circuit. These characteristics are also known as VI curves, referring to the standard symbols for current and voltage. A more general form of current–voltage characteristic is one that describes the dependence of a terminal current on more than one terminal voltage difference; electronic devices such as vacuum tubes and transistors are described by such characteristics. The figure to the right shows a family of VI curves for a MOSFET as a function of drain voltage with overvoltage ($V_{GS} - V_{th}$) as a parameter.



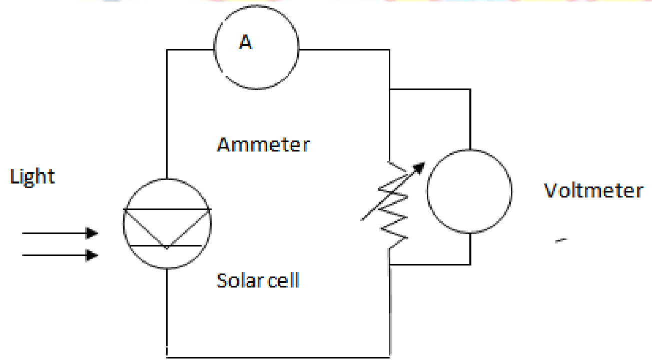
The simplest VI characteristic involves a resistor, which according to Ohm's Law exhibits a linear relationship between the applied voltage and the resulting electric current. However, even in this case environmental factors such as temperature or material characteristics of the resistor can produce a non-linear curve.The trans-conductance and Early voltage of a transistor are examples of parameters traditionally measured with the assistance of an I–V chart, or laboratory equipment that traces the charts in real time on an oscilloscope.

I-V characterization:-PV cells can be modelled as a current source in parallel with a diode. When there is no light present to generate any current, the PV cell behaves like a diode. As the intensity of incident light increases, current is generated by the PV cell, as illustrated in fig:



I-V curve for p v cell and associated electrical diagram

Output characteristics of solar cells:-The output characteristic of solar cells is expressed in the form of an I-V curve. An I-V curve test circuit & typ: V I-V curve produced by the circuit are shown bel... The I-V curve is produced by varying RL from 0 to infinity & and measuring the current & voltage along the way. The point at which the I-V curve & resistance (RL) intersect in the operating point of solar cell the current and voltage at this point or IP&VP, Respectively. The largest operating point in the square area is the maximum output of solar cell



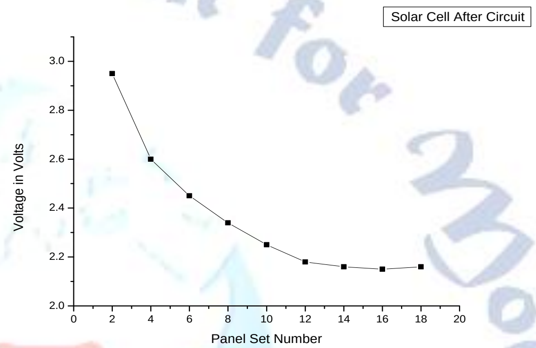
From the below Graphs 1, 2,3,4,5 and 6, we can obtain the characteristic curves for Voltage and current. The above sets of readings obtained from the table are different for different panels. Depending upon the motor the voltage and current varies.

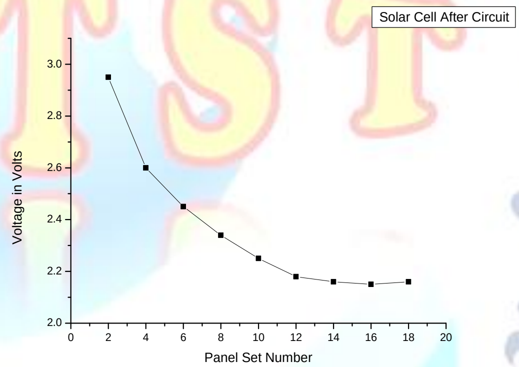
SOLAR PANEL CELL CHARCTRISTICS

Set 1: Panel Input Voltage = 3.3 V Time: 12:20pm

Panel Set Number	Before motor	After motor
2	5.6	2.95
4	5.6	2.60
6	4.62	2.45
8	4.39	2.34
10	4.21	2.25
12	4.09	2.18
14	4.04	2.16
16	4.03	2.15
18	4.00	2.16
20	4.00	2.16
22	3.98	2.14
24	3.95	2.11
26	3.86	2.07
28	3.80	2.06
30	3.77	2.03
32	3.66	1.98
34	3.65	1.96
36	3.55	1.8

Graph 1and 2

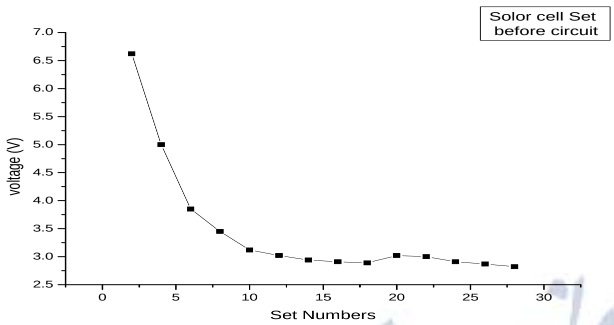


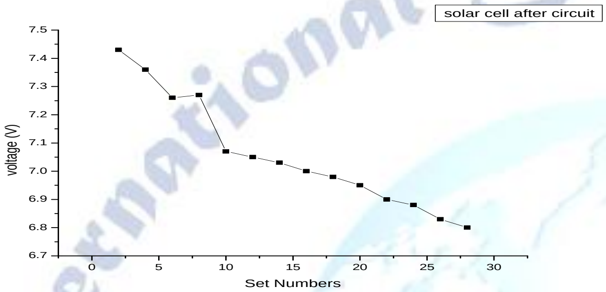


Set 2: Panel Input Voltage = 8.87 Volts Time: 12:50pm

Panel Set number	Before motor	After motor
2	6.62	7.43
4	5.00	7.36
6	3.85	7.26
8	3.45	7.27
10	3.12	7.07
12	3.02	7.05
14	2.94	7.03
16	2.91	7.00
18	2.89	6.98
20	3.02	6.95
22	3.00	6.90
24	2.91	6.88
26	2.87	6.83
28	2.82	6.80
30	2.78	6.79
32	2.75	6.76
34	2.71	6.74
36	2.64	6.72

Graph 3and 4



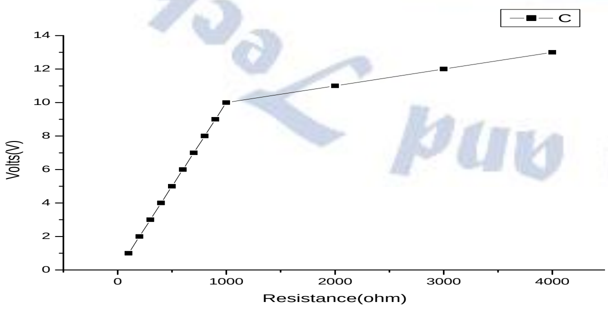


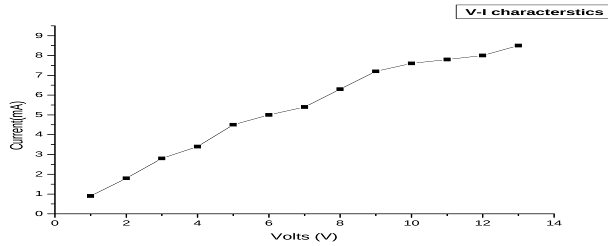
Set 3:

Output characteristics: Time: 1:15pm

Load Resistance	Voltage In Volts	Current in Ampere
100	1	0.9
200	2	1.8
300	3	2.8
400	4	3.4
500	5	4.5
600	6	5.0
700	7	5.4
800	8	6.3
900	9	7.2
1000	10	7.6
2000	11	7. 8
3000	12	8.0
4000	13	8.5

Graph 4and 5

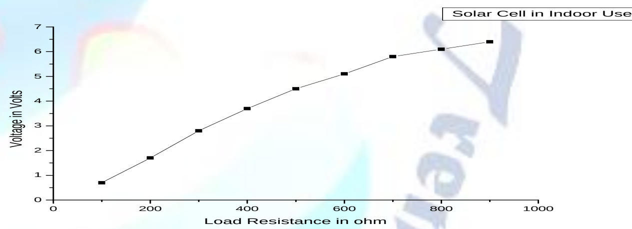


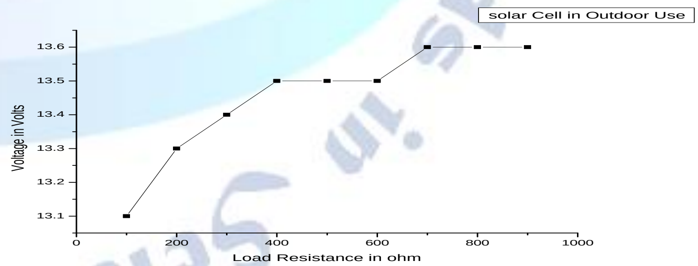


Set 4:

LOAD RESISTANCE In ohms	INDOOR VOLTAGE in volts	OUTDOOR VOLTAGE in volts
100	0.7	13.1
200	1.7	13.3
300	2.8	13.4
400	3.7	13.5
500	4.5	13.5
600	5.1	13.5
700	5.8	13.6
800	6.1	13.6
900	6.4	13.6
1000	6.5	13.6
2000	7.4	13.6
3000	7.8	13.6
4000	7.9	13.6

Graph 5and 6





CONCLUSION

An electronic Solar circuit is designed and studied. The circuit acts as a control circuit to regulate the process of photovoltaic solar panel battery charging process. The circuit is cheap and can be easily constructed from discrete electronic components. The circuit operation is based on matching the solar cell terminal load voltage to the appropriate number of battery cell units to be charged depending on the solar light intensity condition. Experimental results indicate that there is an increase of the overall charging current using the circuit over that using direct charging as shown in solar cell characteristics. Increase in the charge collection efficiency of the about of 10% is experimentally established.

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