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Artificial Solar Oxygen Tree

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ABSTRACT

In this, we proposed, to convert solar energy from solar tree for generation of Hydrogen, Oxygen and light. Very small space requires for solar tree than conventional solar panel system. The solar panels on solar tree convert solar radiation into electricity, which is used for decomposition of water into oxygen and hydrogen. Oxygen is released in the air to breathe and hydrogen is stored as fuel. Light Emitting Diode (LED) lights, driven from the generated electricity are used to radiate light during night. Solar Tree can be implemented to meet oxygen and Hydrogen fuel requirements and lighting demands of the cities in an eco-friendly manner. We have developed a solar tracking system using a combination of Arduino, servo motor and light dependent resistors (LDR's) with the primary aim of improving the power efficiency of the solar panels. The main component of this tracker is Arduino AT mega 328 which is programmed to detect the sunlight with the help of LDRs and then actuate the servo motor to position the solar panel in such a way so that it gets the maximum sunlight.

Key words: Solar, Electrolysis, Oxygen, Hydrogen etc

I.INTRODUCTION

There can be no denying in the fact that solar energy is an effective source of power, one that is going to serve us for long. Despite the need to harness this energy, very little re-search has been conducted to make photovoltaic cells cost effective and thereby available for utilization by masses for their various devices. Photovoltaic cells use sunlight and convert it directly to electricity without leaving any residual elements that can pollute the environment, and is therefore believed to be energy source that could be available to mankind. This project can generate and releasing pure oxygen in the atmosphere using renewable resources. In addition to it, hydrogen gas is produced which is stored and has potential to be used as fuel later. We believe that such a design will not only aid in supplying pure oxygen to urban environment but also meet lighting demands of developing and developed cities. All the waste water from the buildings is gushed out into the sea thereby ruining the sea life and collection of unnecessary waste in the sea. This would prove harmful to all of us. The waste water from the complexes when filtered and electrolyzed would not only help in generating oxygen and hydrogen but also reduce the sea pollution to a great extent.

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The reduction in oxygen levels is being felt all over the world. Oxygen deficiency leads to mental and physical disorders not only in humans but also in sea creatures. Planting trees in urban areas is almost impossible with so many skyscrapers and industries already being there. The artificial solar oxygen tree would compensate for this loss to some extent at least. Tracker systems follow the sun throughout the day to maximize energy output. The Solar Tracker is a proven single-axis tracking technology that has been custom designed to integrate with solar modules and reduce system costs. The Solar Tracker generates up to 25% more energy than fixed mounting systems and provides a bankable energy production profile preferred by utilities.

II.LITERATURE SURVEY

Kalhan Kampasi et al The solar panels convert daylight into electricity, which is used for decomposition of waste water into oxygen and hydrogen. Oxygen is released in the air to breathe and hydrogen is stored as fuel. Light Emitting Diode (LED) lights, driven from the generated electricity are used to radiate light during night. The automation and control for the processes is provided by an integrated Peripheral Interface Controller (PIC)**.** [1]

Krishanu Das et al This project aims at the development of process to track the sun and attain maximum efficiency using Arduino Uno for real time monitoring. The project is divided into two stages, which are hardware and software development. In hardware development, two light dependent resistor (LDR) has been used for capturing maximum light source. Servo motor has been used to move the solar panel at maximum light source location sensing by LDR. [2]

Sujitpatil et al Solar tree requires very small space than conventional solar panel system. The solar panels on solar tree convert solar radiation into electricity, which is used for decomposition of water into oxygen and hydrogen. Oxygen is released in the air to breathe and hydrogen is stored as fuel. [3]

S.N. Maity et al Solar, as believed, is the only major alternative in comparison to other sources of available renewable energies. For absorbing the sun solid silicon-crystalline photo-voltaic (SPV) method is the best. SPV panels are laid on structures at tilt angle. SPV is a land consuming system. Scarcity of land is the greatest crisis of the earth. [4]

Krishanu Das et al Solar energy plays an important role as a primary source of energy, especially for rural area. This project aims at the development of process to track the sun and attain maximum efficiency using Arduino Uno for real time monitoring. [5]

Sushma Gupta et al This paper presents Solar Tree implementation as alternate source of energy in urban cities. A new idea of a solar tree design us in Nano wire solar cell is presented. Nano wires possess high physical light absorption properties which can be improved tremendously Hence we can say that it is a revolutionary urban lighting concept and these technologies lead to the development of high efficiency solar energy. [6]

Jeng-Nan Juang et al In this paper, a solar tracking system for renewable energy is designed and built to collect free energy from the sun, store it in the battery, and convert this energy to alternating current (AC). This

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makes the energy usable in standard-sized homes as a supplemental source of power or as an independent power source. [7]

III.PROBLEM STATEMENT

A] Increasing population:

In today's world, our environment is facing a lot of stress because of increasing population and development. The problem is more severe in developing nations like India. The need of the hour is to implement eco-friendlier projects or plants that can provide advanced technology solutions, preferably by means of renewable energy and have least or no negative impact on environment. The biggest challenge is to implement this technology in Indian cities as we know the population is a lot more in this country and hence the environment is more polluted.

B] Cutting of trees:

Trees are very important part of life on earth as they provide oxygen by consuming carbon dioxide, which is essential for survival of almost all living organisms on Earth. However, currently, humans are cutting down billions of trees for paper, furniture, building supplies, and other purposes. The number of trees is decreasing while the population of humans is growing rapidly. Thus, the oxygen levels are falling while the concentration of carbon dioxide in air is increasing.

C] Air Pollution:

Air pollution is a major issue for almost all countries across the world. Air pollutants can lead to respiratory illness in humans and animals, create acid rains and deplete the ozone layer.

D] Sea pollution:

All the waste water from the buildings is gushed out into the sea thereby ruining the sea life and collection of unnecessary waste in the sea. This would prove harmful to all of us. The waste water from the complexes when filtered and electrolyzed would not only help in generating oxygen and hydrogen but also reduce the sea pollution to a great extent.

E] Lack of Land:

Flat or roof top mountings of PV systems require large area or land. Scarcity of land is greatest problem in cities and even in villages in India. Planting trees in urban areas is almost impossible with so many skyscrapers and industries already being there. The artificial solar oxygen tree would compensate for this loss to some extent at least.

IV.METHODOLOGY

1. The solar panels were placed on 5 Ft tall solar tree which has 6 branches. Each branch carries one solar module. The arrangement of solar tree Spiralling Phyllataxy technique is used in designing of Solar Tree. For tracking maximum power from sun this Technique helps the lower panels from the shadow of upper ones. The efficiency of the plant can also be improved by this technology.
2. The solar energy was converted into electrical energy by PV modules. This energy was used to charge the rechargeable batteries. We used one battery of 12v. The diodes were connected in circuit in such a way that they prevented the reverse flow of energy, i.e., flow of electricity from batteries to solar modules.
3. The main impulsion is to design a high quality solar tracker. It consists of three main constituents which are the inputs, controller and the output. Photo resistor or Light-dependent resistor (LDR) or photocell is a light-controlled variable resistor. LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000000 ohms, but when they are illuminated with light resistance drops dramatically. LDR’s have low cost and simple structure. The Servo motor can turn either clockwise or anticlockwise direction depending upon the sequence of the logic signals. The sequence of the logic signals depends on the difference of light intensity of the LDR sensors. The principle of the solar tracking system is done by Light Dependant Resistor (LDR). Two LDR’s are connected to Arduino analog pin AO to A1 that acts as the input for the system. The built-in Analog-to-Digital Converter will convert the analog value of LDR and convert it into digital. The inputs are from analog value of LDR, Arduino as the controller and the Servo motor will be the output. LDR1 and LDR2 are taken as pair. If one of the LDR gets more light intensity than the other, a difference will occur on node voltages sent to the respective Arduino channel to take necessary action. The Servo motor will move the solar panel to the position of the high intensity LDR that was in the programming.
4. An Electrolysis kit was placed next to the solar tree. The kit contained two steel electrodes to carry out electrolysis. We used waste water for electrolysis by mixing it with small amounts of sodium hydroxide because electrolysis of pure water occurred very slow or not at all. The NaOH acted as a catalyst in separation of oxygen and hydrogen from water.
5. The identification of gases produced by decomposition was done by collecting these gases in two different test tubes and lighting each with a matchstick. One test tube made a pop sound. It was confirmed that this test tube contained hydrogen gas because hydrogen gas is highly flammable. The other test tube contained oxygen. Oxygen supported combustion but did not produce a pop sound.
6. The Arduino Atmega328 microcontroller performed all the controls in the system. It was programmed with help of Arduino 1.8.5, an application which provides integrated simulator, compiler and debugger.
7. In this project, the Su-Kam 12V/10A PWM Solar charge controller is used. Moreover, the Su-Kam 12V/10Aalso performs overcharge, over discharge, battery reverse current, overloading, short circuit, and reverses polarity connection protections.
8. An LDR was used to control the activity of LED lights. LDR gave us the value of intensity of light (lux). When the reading of the measured value fell below the set point value, the LED lights glowed. However,

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when the reading of measured value exceeded the set point value, the lights stayed off. The set point value was kept as 100lux. The set point value was fixed or adjusted by programming the Arduino Atmega328 microcontroller. A magnetized relay was used for on-off purpose of LED lights.

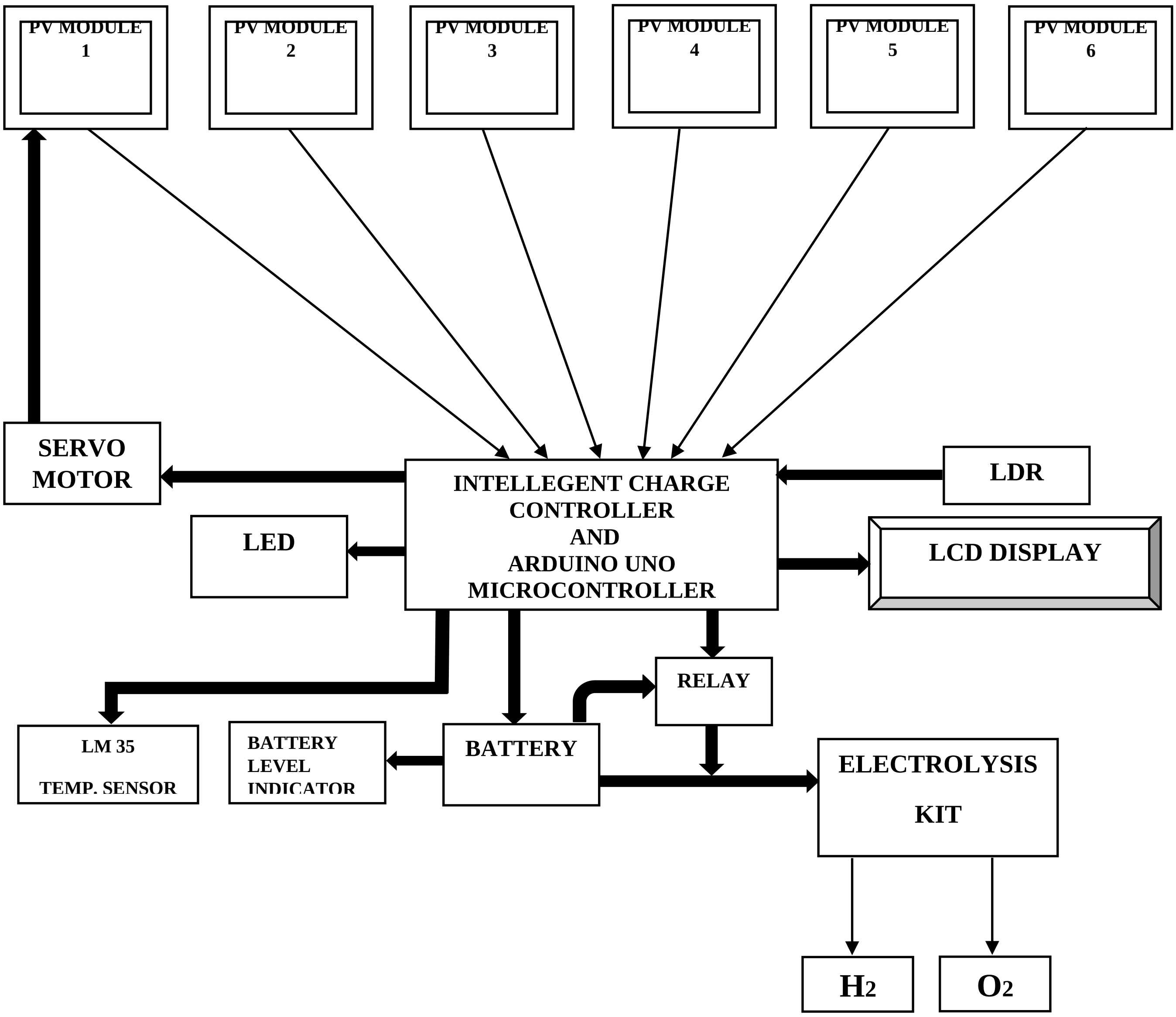

Figure1: block diagram

9. A thermistor was used to sense the temperature of the surroundings. It was necessary to keep the temperature in check because high temperatures could be fatal as electrolysis involves production of hydrogen gas. As soon as the measured thermistor reading exceeded the set point value, the electrolysis would shut down. The set point value was set at 40 thermistor reading. Theon-off control was again achieved with the help of relay (NO) and Arduino Atmega328 microcontroller.

10. A third relay (NC) was used to start or stop charging of battery. Whenever the voltage coming from the solar panels fell below minimum set point value (10V) or exceeded maximum set point value (14V), the NC relay opened and the charging stopped.
11. The 16*2 LCD screen was connected to the Arduino Atmega328 controller. A 16*2 LCD screen has 2 rows with capacity of 16 characters each. We used this LCD screen to display battery voltage (volts), temperature (thermistor reading), light intensity (lux) and timer (seconds). The Arduino Atmega328 controller was programmed in such a way that it displayed these parameters simultaneously for five seconds. As the timer counted five seconds, the first advertisement was displayed fora period of five seconds. Now, after ten seconds from the start, the second advertisement was displayed. After fifteen seconds, the third advertisement. And after 20 seconds, the cycle repeated.
12. Arduino USB cable was also connected to the Arduino Atmega328 microcontroller. It acted as an interface between the computer and the Arduino Atmega328 microcontroller. It could be used to display messages on LCD screen during emergency at any instant of time.

V.RESULTS

A. Power Output of Solar Panels:

It was observed that the solar panels absorb enough energy to charge the batteries. The total power output of solar modules was calculated to be 18 watts. The explanation is given below.

1. Voltage and current output of single solar panel =12V/250mA.
2. Voltage and current output of six solar panels connected in parallel = 12V/1.5A.

Power (W) = Current (A) × Voltage (V) ………… (1)

From equation 1, we get total power output of solar modules as 18 watts.

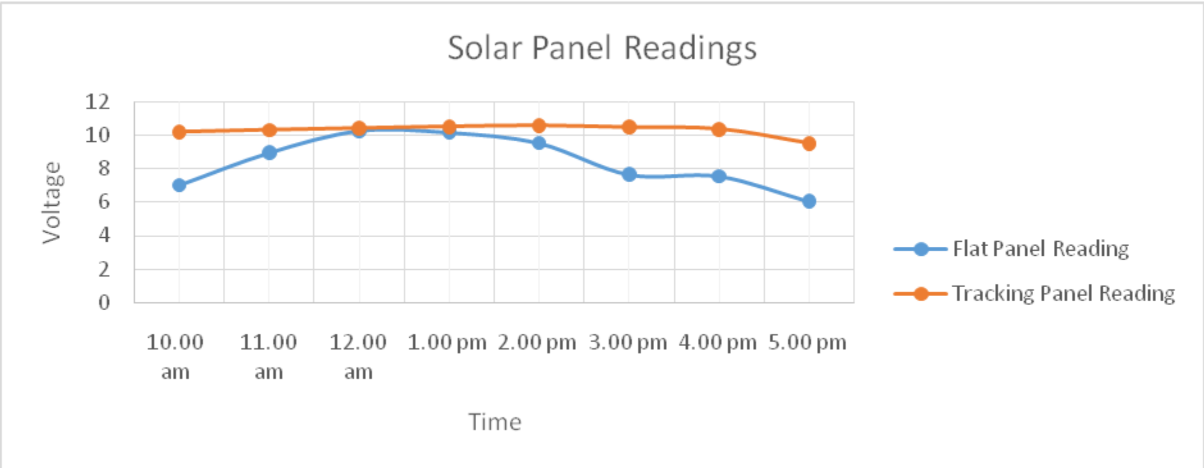

Figure 2: graph of solar panel voltage with different time slot

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B. Charge Capacity of Solar Panels and Batteries:

The total energy supply of solar modules and batteries was calculated in terms of electric charge (Ampere-hour).

1. Battery rating of

Time	Flat panel Open circuit voltage	Tracking panel Open circuit voltage	Closed circuit voltage	Current (Amperes)
10.00 am	7.03	10.18	11.18	0.32
11.00 am	8.95	10.30	11.46	0.38
12.00 am	10.25	10.40	11.42	0.34
1.00 pm	10.15	10.50	11.47	0.32

2. single battery = 12V/7.5Ah.

3. Total energy output of solar modules (one hour) = 1.5 Ah.

From above calculations, it was concluded that it would take solar modules 5 hours at full working (maximum output) to fully charge a dead battery. But in reality, the lead-acid battery does not charge linearly with time and hence it would take more than 5 hours. However, the case of batteries becoming fully discharged is highly unlikely during normal functioning and was never observed in our experiments. Once the batteries were sufficiently charged, the electrolysis took place smoothly for an entire day. Even when it was a cloudy day, the battery worked properly. The battery had enough charge to carry on for a couple of days without input from solar panels. Under normal circumstances, the batteries were charged enough during daytime to carry on function throughout the night.

2.00 pm	9.51	10.56	11.45	0.33
3.00 pm	7.65	10.45	11.40	0.31
4.00 pm	7.55	10.35	11.42	0.29
5.00 pm	6.05	9.50	11.40	0.28

Table(1):voltage and current readings of solar panel at different time slots.

C. Rate of Electrolysis:

The rate of electrolysis was observed to be same throughout the day whether it was day or night, sunny or overcast. The rate does not depend on percentage of charge unless the battery is fully discharged. In our model, the electrolysis would stop only at full discharge of battery or if the battery voltage fell below 10V or exceeded 14V, which was improbable under normal circumstances.

D. Amount of Hydrogen and Oxygen Produced:

During electrolysis, it was noted that the production of hydrogen gas was more than that of oxygen. This was confirmed by equation 2 (decomposition of water). Remember that the use of sulphuric acid is essential for electrolysis. The pure water decomposes very slowly or does not decompose at all.

$2\ H_2O\ (l) \rightarrow 2\ H_2\ (g) + O_2\ (g)$……………... (2)

The amount of gas produced depends on the pressure and concentrations. It also depends upon the amount of current supplied to the electrolysis jar. Assuming standard conditions, we calculated the amounts of oxygen and hydrogen produced in one hour on decomposition of water by a battery when no other component was connected to the battery. Electric charge in 12V battery = 7.5Ah. We know that,

Charge (C) = Current (A) × Time (s)………………………. (3)

Therefore, from equation 3, it is clear that if we run 7.5A current for 1 hour, we get 27,000C of electrical charge. Now, a mole of electrons has a charge of 96,500C, so that means 27,000/96,500 = 0.28 moles of electrons will flow. Now, two electrons have to flow for each water molecule to be divided so 0.28 moles of electrons split 0.14 moles of hydrogen and 0.07 moles of oxygen. But, 1 mol gas = 22.4L of gas. Therefore, 12V x 7.5A = 90-watt hour of electricity can split 2.7 gram of water into 3.36L of hydrogen and 1.18L of oxygen. Note that the above calculations were done under ideal conditions in which the electrodes draw all the current from battery at 12V. Suppose, electrodes (electrolysis process) draw 1A of current from the batteries, it would mean that the batteries have the capacity to run for duration of 7.5 hours.

Table 1 represents amount of hydrogen and oxygen gas produced for different levels of battery charge. The quantities of hydrogen and oxygen produced were calculated in Litres. The amount of water decomposed was calculated in grams. The Battery Charge column shows the percentage of battery charge when the electrolysis started. Fig. 1 represents 'Gas production (Litres) v Battery Charge Capacity (%)' graph. It was confirmed that the rate of production of hydrogen gas is double to that of oxygen gas for any battery and does not depend on the electrical charge of the battery. It was clear from the calculations that a higher Ampere-hour battery would produce higher amounts of oxygen and hydrogen.

Battery Charge (%)	Water Decomposed(g)	Hydrogen gas(L)	Oxygen gas(L)
100	2.7	3.36	1.68
75	1.9	2.46	1.23
50	1.3	1.68	0.84
25	0.63	0.78	0.39
0	0	0	0

Table 2: Amount of oxygen and hydrogen gas produced on decomposition of water by 7.5Ah battery

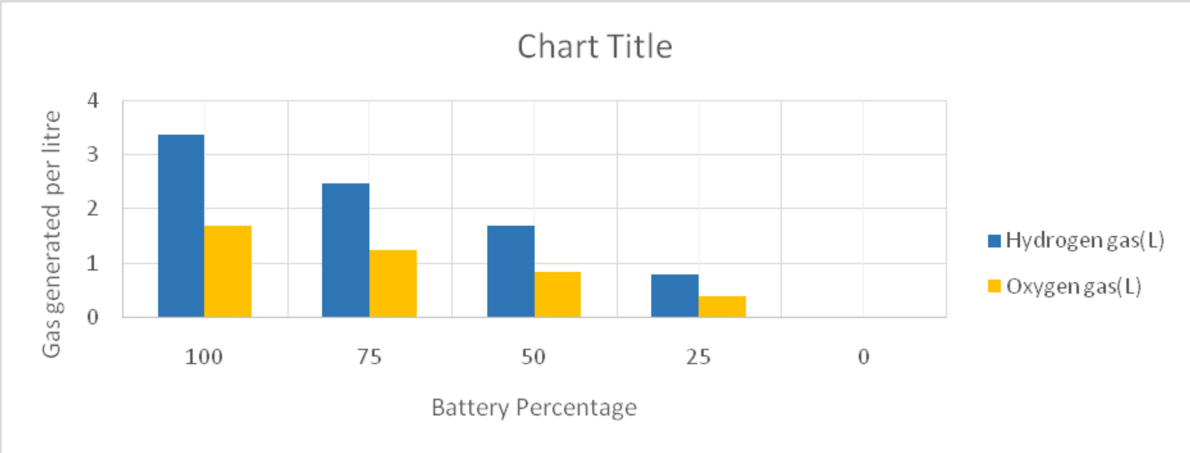

Figure 3: Gas Production (L) v Battery Charge (%). Y-axis shows amount in litres and x axis shows battery charge percentage

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