Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 09, September-2019

Design of Solar Powered Water Boat for Water Quality and Quantity Measurement: A Review

Prof. Paval K. L*, Pandurang Sonne[1], Namdev Shinde[2], Sandip Sonawane[3]
*Assistant Professor,
[1,2,3]Student of
S. B. Patil College of Engineering, Indapur,
Pune-413106, Maharashtra, India

Abstract:- **Renewable energy and energy efficiency resulting in significant security energy, change in climate, mitigation and economic benefits. This research work presents autonomous system for solar powered water boat useful for water quality and quantity measurement. It is important to measure depth of water at predefined set points in water areas to calculate exact quantity of water. As we known, water quality plays an important role in controlling health and the state of disease. Therefore, it needs to be analysed a particular time span. Development of more economical, safe and accurate system for finding depth values and water quality index of water bodies with the help of solar powered water boat is reviewed in this research paper.**

Keywords-Solar boat, Average depth, water quality, stability analysis.

INTRODUCTION

Obviously, people have a great dependence on fossil fuels. Nowdays all vehicles used by human are powered by fossil fuels. In another field, electricity producer is dominated by fossil-fuelled generators, either oil or coal. Ironically, scientist classifies that fossil fuel is non-renewable energy resources therefore; traditional energy supplies shouldbe shifted to renewable sources of energy andnew technologies has to be developed .In all the renewable energy sources, solar power takes more attentions as a greatest promising option to be applied in system. Solar energy is available in large quantity, cost less and pure which does not make any noise or any kind of pollution to the environment [1].

Conventional ship propulsion system is using diesel engine while the common conventional electrical producer in the ship is also diesel generator. Those two instruments need a fair amount of diesel fuel. Therefore, marine engineer held the responsibility to develop renewable energy-based technology for ship electrical source and main propulsion system in order to preserve ship operation when fuel is no more available in the future. The use of renewable energy-based technology may also reduce the ship operation cost because of the uncertain price of oil. That's why we need research based on the renewable energy; and sun is best source of renewable energy [2].

The fresh water reservoirs are major power resources of India. These water reservoirs are in the form of dam, river, ponds, Lake Etc. To estimate the current power capability, the statistical information about the water reservoir is necessary. For the purpose of water management monthly or yearly survey of the reservoir is required. One of the important parameter is to find the water level and depth of reservoir, which can help us in finding the pressure and flow of water in it. The existing surveying systems have some problems, risks errors in measurement and sometimes expensive. The objective of the paper is to implement an Solar powered water boat which measure water Quality and Quantity which include average depth, silting ratio, average area ,and pH value, at predefined set points. It is more accurate, most economical, and robust /compact construction and safe way of surveying the water in the dams. This work can be used for multipurpose, whether to find the depth of water, distance from one point to the other in water, the overall capacity of the water bodied.

DESIGN OF SOLAR WATER BOAT.

Basically, there are two types of solar-powered boat. The first one is the combination of solar power with existing diesel generator while the second is the utilization of solar power as the only electrical supply to handle all electrical loads our aim to design second type (only solar powered) of boat[2]. The research uses computational aid tools such as CFD, CAM, FEM and CAD software. The hull design is created using CAD and CAM, then the stress and deformation analysis are performed with FEM program. The hydrodynamics analysis of the designed structure has also been performed by using CFD simulation [3].

STABILITY ANALYSIS OF BOAT

In it Simpson's 1/3 rd rule, this may be used to find the areas and volumes of irregular objects. When applied to ships they give a good approximation of areas and volumes.
This rule states that the curve is a parabola of the second order. A parabola of the second order is one whose equation, referred to co-ordinate axis, is of the form y = a0 + a1y + a2y2, where a0, a1 and a2 are constants [5]

International Journal of Engineering Research & Technology (IJERT)
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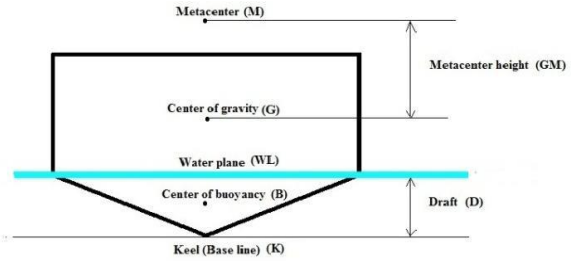

Fig2: Schematic diagram of boat stability [5]

Condition for Stability :-

1. If G is below M, the boat in stable equilibrium condition.
2. If G is above M, the boat in unstable equilibrium condition.
3. If G is coincide with M, the boat is in neutral[5]

Design and Estimating the output power of PV solar panel

Construction and PV placement design is an important issue in order to realize a solar-powered boat. The main problem is the limited space to mount PV modules in the ship. The place to mount the PV modules must be exposed to sunlight in order to get higher power from PV[6]. The higher the intensity of light received by PV module, the higher the power generated by PV module. The addition of PV system on the ship may also arise stability problem because the total weight of PV modules, battery, and another equipment increases the burden of the ship.[2]

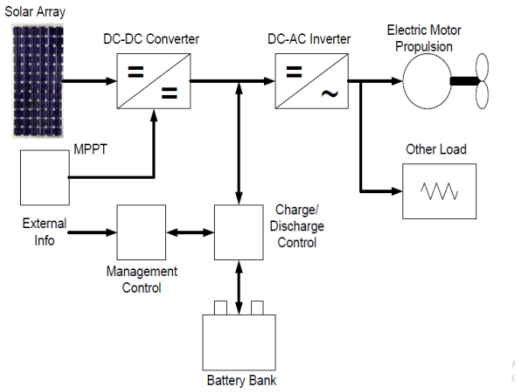

Fig6: Schematic diagram of solar power generation for water boat[2]

In PV boat first we need to calculate how much driving power required to drive the boat that we can calculate from the propeller shaft.by using following way.[4]

The boat characteristics determine the power need to propel the boat, see equation 1.

$P=c.v^3$…….(1)

with:

P = power [W]

C = constant describing the hull's resistance

V= speed [m/s]

The drive train consists out of a motor controller unit, an electrical motor, stern drive and a propeller.

The power (or thrust) of a propeller is dependent on the angular velocity and torque.

P=T.w……..…….(2)

with:

w = angular velocity [rad/s]

T = torque [Nm]

From that equation (1) & (2) we can found the power required to drive boat by considering the resistance on it (C) and also weight on it.

Calculate the annual solar energy output of a photovoltaic system that is important to calculate input energy from solar plate. The global formula to estimate the electricity generated in output of a photovoltaic system is[15]

Energy = (A * H * r * PR)

Where,

E =Energy(kWh)

A =Total solar panel Area (m2)

r =is the yield of the solar

H is the annual average solar radiation on inclined panels.

PR : PR (Performance Ratio) is a very important value to evaluate the quality of a photovoltaic installation of inclination panel. It includes all lossesPerformance ratio, coefficient for losses (range between 0.5 and 0.9, default value = 0.75)[15].

From that relation can calculate the solar output power required to drive the water boat.

WATER QUALITY MEASUREMENT

The determination of pH is one of the most common process in water quality measurements pH is a measure of the relative amount of hydrogen and hydroxide ions in an aqueous solution At 25°C fewer than 2 x 10^{-7} % of the water molecules have dissociated. In terms of molar concentrations, water at 25°C contains 1 x10^{-7} moles per liter of hydrogen ions and the same concentration of hydroxide ions[7].

In any aqueous solution, the concentration of hydrogen ions multiplied by the concentration of hydroxide ions is constant. Stated in equation form:

$$K_w = [H^+]\,[OH^-] .$$

The value of K_w depends on temperature.

Acids improve the hydrogen ion concentration, and, because the product $[H^+]$ $[OH^-]$ must remain constant, acids decrease the hydroxide ion concentration. Bases have the opposite effect. They increase hydroxide ion concentration and decrease hydrogen ion concentration.pH is another way of expressing the hydrogen ion concentration. pH is defined as follows:

$$pH = -\log [H^+]$$

pH measurement cell

The cell consists of an indicating electrode whose potential is directly proportional to pH, a reference electrode whose potential is independent of pH, and the liquid to be measured. The overall voltage of the cell based on the pH of the sample. where different indicating electrodes have slightly different responses to pH, the measuring system must be calibrated before use. The next step in the operational definition of pH is calibration. The system is calibrated by placing the electrodes in solutions of known pH and measuring the voltage of the cell[8]. Cell voltage is a linear variation of pH, so only two calibration points are needed. The final step in the operational

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definition is to place the electrodes in the sample, measure the voltage, and determine the pH from the calibration data.Setup for pH measuring cell-

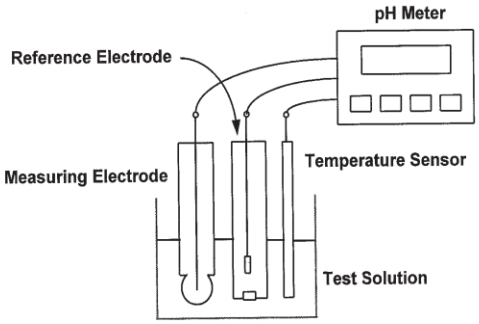


Fig. pH measurement cell.

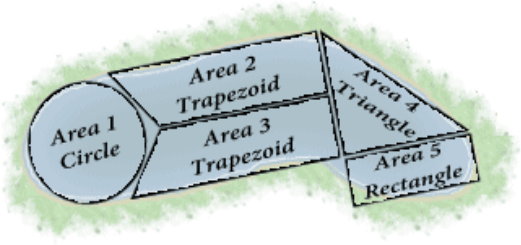
The cell setup contain of a measuring electrode, a reference electrode, a temperature sensing element, and the liquid being measured. The voltage of the cell is proportional to the pH of the liquid. The pH meter measures voltage and uses a temperature-dependent factor to convert the voltage to pH. Because the high internal resistance, the pH meter must have a very high input impedance. In most process sensors, the combination of electrodes and the temperature element are into a single body. Such sensors are often called combination electrodes[9].

WATER QUANTITY MEASUREMENT

Irrigation water management starts with measuring the quantity of water available. Sometimes one will want to know only the volume of water used; while, at other times one will want to know the rate of flow [11].

Surface area

The surface of most ponds can be measured as several different shapes. From these measurements you can work out the surface area of each shape and add them together for a total surface area for your pond.

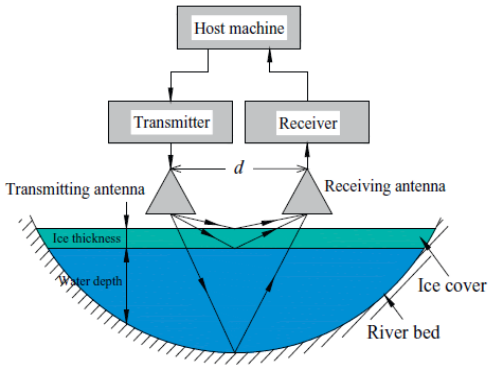


Schematic diagram shows average area of water bodies[17]

Depth Measuring Sensor

While testing various water quality parameters it is be necessary to take measurements at various depths.. The depth sensor within the Aqua probe can also be used to monitor small changes in the water level. By making the zero depth reading once the probe is fixed in place. The sensor will then detect small changes in the water level and record them as a positive or negative change. Measuring depth by using the various sensor such as sonar sensor, ground penetrating radar (GPR) and micro-hydrometer from that most economical and effective sensor is sonar GPR[13].

The non-contact measurement methods include sonar; remote sensing by satellite, airborne and ground-based radar; and GPR. The equipment used for water depth condition measurementThe system functions by transmitting and receiving ultrasonic pulse signals. It has the advantage of the ability to measure the water depth. There has been continuous improvement of the GPR measurement method in recent years, with the technology offering the advantages of compactness, low cost, and high efficiency[12].



Principle of depth detection [14][13]

The basic operating principle of a GPR system is illustrated in Fig.High-frequency short-pulse electromagnetic waves are transmitted into the ice from the transmitting antenna of the radar system placed on theground. The waves encounter underground formations or targets of differing electrical properties and are reflected back to the ground surface where they are received by the receiving antenna of the radar system. Two-way travel time (t) in the measured medium can be calculated as follows

$$t = \frac{\sqrt{d^2 + 4H^2}}{v}$$

where H is the water depth, v is the propagation velocity of the electromagnetic waves in the measured medium, and d isthe distance between the transmitting and receiving antennas of theradar system.

$$v = \frac{c}{\sqrt{\varepsilon}}$$

where c=30 cm/ns, is the propagation velocity of the electromagneticwaves in a vacuum, and ε is the dielectric constant.Then, the thickness of the measured medium, H, can be obtained as follows:

$$H = \sqrt{\frac{c^2t^2 - \varepsilon d^2}{4\varepsilon}}$$

The differences among the dielectric properties of air, ice, water, and sandstone were given above, and this enables detection of layersbetween two materials with different dielectric permittivity's using a GPR. A double-frequency

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radar system was developed, thus enabling the measurement of water depth [12].

CONCLUSION

Applications, developments and forecasts of solar energy used in water boat were presented in this paper It was discussed how the solar energy utilization can improve the quality and quantity of products while reducing the greenhouse gas emissions. It has been found that both solar thermal and PV systems are suitable for various applications. However, the all efficiency of the system relies on appropriate integration of systems and correct design of the solar collectors. Solar energy of systems can be hold as the power supply or applied directly to a process. An unmanned Autonomous Surveying Boat is designed and developed which will be used for finding the depth of water (in dams & ponds) and other similar applications. The Boat is made to work automatically according to predefined program. The boat is an example application of renewable energy, surveillance, safest and economical method to find water depth.

Using this methodology it is possible to manufacture cost effective solar powered robust boat Sampling & testing of water quality on regular basic will give real time water quality index which will be useful to take further action

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