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DESIGN AND FABRICATION OF SOLAR BOAT

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Abstract - *The aim of this project is to design a Solar-Electric Boat for tourists & 39 transport along the coast, in the rivers, in the lakes. In our project, the boat is powered by Lead Acid/Lithium Ion batteries that can be charged at any time by the photovoltaic modules placed on a flat top structure with the help of battery management system or charge controller. The project is designed for brief trip around rivers and lakes, where the public transport becomes very polluting during summer. Starting from the consideration that this boat is employed during sunny weather, it's possible to understand the boat & 39; energy demand and proceed with the planning of a electric boat and of the energy storage/management system.. With this management, we have optimized the use and prolonged the time of life of the batteries during the navigation and the control of the rea l autonomy of it. In addition, batteries, we are putting one Wind mill(demonstration) over the boat at the front side. The boat will be controlled over wireless communication.*

Key Words: (solar, Arduino uno, LM298, Nodemcu)

1. INTRODUCTION

The rapidly diminishing fossil fuel reserves are, today, one of the biggest challenges facing the planet. In order to secure the future for ourselves and generations to follow, it is widely accepted that we must act now to reduce energy consumption and substantially cut greenhouse gases, such as carbon dioxide. For many years, fuel has been the first source of energy. However, there's a limited supply of those fuels on Earth and that they are getting used far more rapidly than they're being created. Eventually, they will run out. In addition, due to safety concerns and waste disposal problems, renewable energy is certainly the answer since such technology is "clean" or "green" because they produce few if any, pollutants. The world trend nowadays is to seek out a clean source of energy. The most effective and harmless energy source is probably solar energy, which for many applications is so technically straight forward to use. In addition, due to safety concerns and waste disposal problems, renewable energy is certainly the answer . As the cheapest way of transportation , the maritime sector has great significance in the large scale implementation of renewable energy technologies. The paramount reduction of the pollutions caused by the fossil fuel powered vessels can be achieved by this. The spot of our consideration is Ashtami lake, from which endangered species like "syzygium travancocicum" is enlisted by IUCN. Thus the introduction of a solar powered boat gains more ecological importance. With annual average irradiation of 6kwh/m 2a so lar boat has great potential over this area.The development of a methodology of simple calculation, step by step, for solar boat is shown here, taking in account the use of clean energy. The major factors under consideration includes boat weight; sheet specification material utilized appropriate propulsion necessary quantity of solar panels; quantity of batteries; adequate engine until to the final commercial price.

Students from the engineering area, as an important part of their education and training, enroll during their senior year in a design course as required by ABET (American Board of Engineering and Technology) The main goals of the senior design project are for the student to develop skills and abilities such as engineering problem solving, creative reasoning, innovation, inventive design, team work, multidisciplinary work, and self-learning, also as using computer software to assist within the design of innovative prototypes. Tecnolo´gico de Monterrey is the largest private university system in Mexico, it is accredited by the Southern Association of Colleges and Schools (SACS), and the engineering programs at Campus Monterrey are accredited by the Engineering Accreditation Commission of ABET. In our School of Engineering, the senior design course has consisted recently in developing diverse projects that include the building of prototypes that help students develop skills valued by the automotive, aeronautic, and naval industry. Among these prototypes we can mention: an off-road vehicle for the BAJA SAE Me´xico competition; a RV-10 aircraft was assembled using Active Learning and Reverse Engineering techniques as well as numerical tools to perform structural and aerodynamics analysis of the aircraft; and a ship powered with solar power to compete within the Solar Splash Event. This article presents the experiences and the work of engineering students from Tecnolo´gico de Monterrey (ITESM) during the past two years in developing the concept

and following through the realization of the solar boat prototype model designed by different computational tools. Engineers seniors was asked to perform an assessment of the impact that Project Oriented Learning Aided by Computer Software had throughout the tactic . This qualitative observation by our students helps faculty in our department structure future curricula.

The conventional sources of energy are becoming exhausted thanks to their continuous use. There are numerous researches on alternatives available for conventional energy. It is concluded that the solar power should be preferred than the other alternatives thanks to their availability. We are concentrating on one fact that whatever the load is there on the boat is, it balanced on the water and whatever power required driving the boat is just a push force. In this project we are making alittle working model of solar boat. The boat that runs on solar power only. The conventional ship is runs on fossil fuels. The solar energy are often effectively and successfully utilized for Boat.

2. COMPONENTS USED

i) Solar panel:

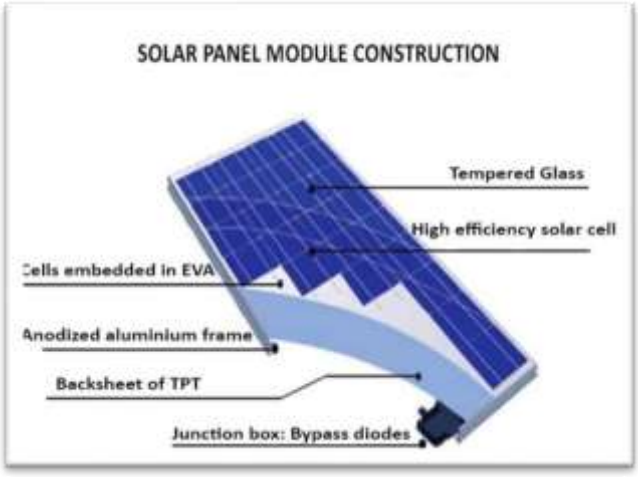

Fig. 1 solar panel

Solar panel is use to convert light energy into the electrical energy based on a phenomenon called photovoltaic effect. The joint between these two semiconductor is called the "P-N junction".[3]Sun light striking the photovoltaic cell is absorbed by the cell. The energy of absorbed light generates particles with positive or negative charge (wholes and electrons), which move about or shift freely in all directions within the cell.[1]

ii) Boost converter:

A boost converter can also be a DC-to-DC power converter that steps up voltage (while stepping down current) from its input power) to its output . It is a category of switched-mode power supply (SMPS) containing a minimum of two semiconductors (a diode and a transistor) and a minimum of one energy storage element: a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made up of capacitors (along side inductors) are normally added to such a converter's output and input.

A boost Converter is that the charge regulator or battery regulator limits the speed at which current is added to or drawn from electric batteries.[7] It prevents over charging and deep discharging which can reduce battery performance or lifespan, and may pose a safety risk. solar battery charge controller also provide automatic dusk to down operation of theload.[4]

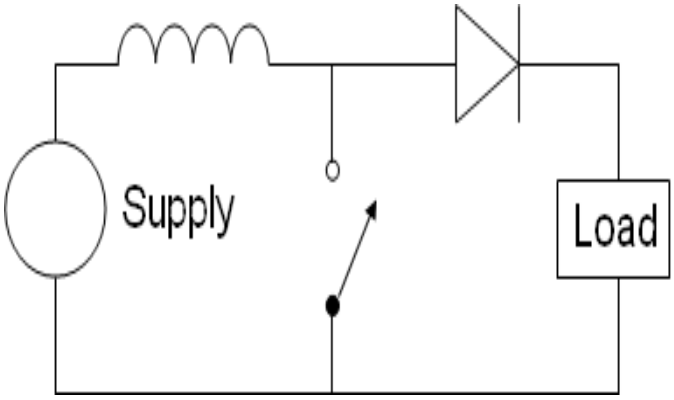

Fig. 2 boost converter

iii) Lead acid storage battery:

The battery which uses sponge lead and lead peroxide for the conversion of the energy into electric power , such sort of battery is named a lead acid battery. The lead acid battery is ordinarily used within the power stations and substations because it's higher cell voltage and lower cost.[4] The lead acid battery uses the constant current constant voltage (CC/CV) charge method. A regulated current raises the terminal voltage until the upper charge voltage limit is reached, at which point the present drops thanks to saturation. The charge time is 12–16 hours and up to 36–48 hours for giant stationary batteries. With higher charge currents and multi- stage charge methods, the charge time are often reduced to 8–10 hours; however, without full topping charge.

Fig. 3 lead acid battery

Discharge

A lead–acid cell with two lead sulfate plates. Fully discharged: two lead plates within the discharged state both the positive and negative plates become lead(II) sulfate (PbSO4), and thus the electrolyte loses much of its dissolved sulfuric acid and becomes primarily water. The discharge process is carried by the conduction of electrons from the negative plate

back into the cell at the positive plate within the external circuit. Negative plate reaction

Pb(s) + HSO− 4(aq) → PbSO 4(s) + H+ (aq) + 2e−

The hydrogen ions screen the charged electrode from the answer which limits further reactions unless charge is allowed to effuse of electrode.

Positive plate reaction

PbO2(s) + HSO− 4(aq) + 3H+ (aq) + 2e− → PbSO 4(s) + 2H2O(l)

The total reaction can be written as

Pb(s) + PbO 2(s) + 2H2SO4(aq) → 2PbSO4(s) + 2H2O(l)

The sum of the molecular masses of the reactants is 642.6 g/mol, so theoretically a cell can produce two faradays of charge (192,971 coulombs) from 642.6 g of reactants, or 83.4 ampere- hours per kilogram. For a 2 v cell, there is 167 Wh/Kg of reactants, but a lead–acid cell in practice gives only 30–40 watt- hours per kilogram of battery, due to the mass of the water and other constituent parts.

Charging

Fully recharged: Lead anode, Lead oxide cathode and vitriol electrolyte. In the fully charged state, the negative plate consists of lead, and therefore the positive plate lead dioxide, with the electrolyte of concentrated vitriol .

At the time of overcharging the high charging voltages generates oxygen and hydrogen gas by electrolysis of water, which is lost to the cell. The design of some sorts of lead-acid accumulator allow the electrolyte level to be inspected and topped up with any water that has been lost. Due to the freezing-point depression of the electrolyte, because the battery discharges and therefore the concentration of vitriol decreases, the electrolyte is more likely to freeze during winter weather when discharged.

Iv) Arduino Uno:

The Arduino Uno may be a microcontroller board supported the ATmega328 (datasheet). It has 14 digital I/O pins (of which 6 are often used as PWM O/P), 6 analog I/P a 16 MHz ceramic resonator, a USB connection, an influence jack, an ICSP header, and a reset button. It contains everything which is to be needed to support the microcontroller; Just we have to connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to urge started.[7] The Uno differs from all preceding boards in that it does not use the FTDI USB- to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial.[1]

Fig. 4 Arduino uno

Specifications :-

Microcontroller

ATmega328 operating voltage 5V
Input voltage (recommended) 7v to12v
Input voltage limit 6v to 12v
Digital I/o pin 14 (of which 6 provide PWM output)
Input pin 6
DC current per I/O pin 40 mA DC
Current for 3.3V pin 50mA
Flash memory 32KB (ATmega328) of which 0.5 KB used by bootloader.
SRAM 2 KB (ATmega3280)
EPROM 1 KB
Clock speed 16 MHz

v) Dc Motor:

Brushless dc motor, also know as BLDC motor or PMDC motor(the permanent magnet dc motor). It can provide much more efficiency than the other traditional dc motor. At the best operation situation, our BLDC motor can up to 90%. At the market, 80% is the most have. About the size, we try to put the power into the smaller size so you can have more space to install. Use the IEC standard frame, easy for you to fit the machine or other parts.

Cooling system. To increase the contact area, there will be some grooves on the motor case. You can use the water cooling or the air cooling.

Fig. 5 Dc Motor

vi)L298 motor driver:

This dual bidirectional motor driver is predicated on the very fashionable L298 dual H-bridge motor driver. This motor (module) is to easily and independently control two motor of up to 2A each in both directions.[4] It is switch for the microcontroller requiring just a couple of control lines per motor. The L298 driver is a high voltage, high current dual full bridge driver chip and driver inductive load such relay, solenoid, dc and stepping motor.[9]

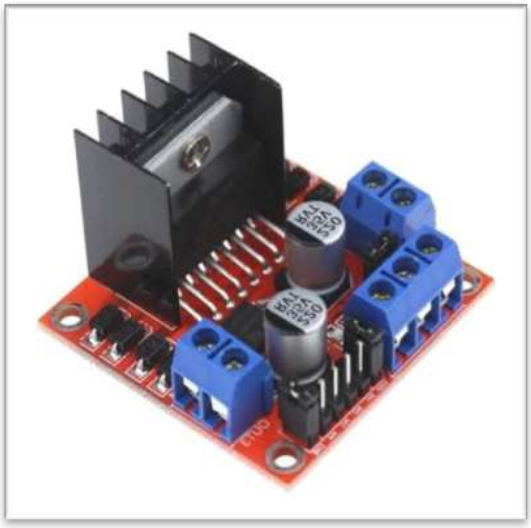

Fig. 6 L298 motor driver

3. BLOCK DIAGRAM AND DESIGNED CIRCUIT

I) BLOCK DIAGRAM

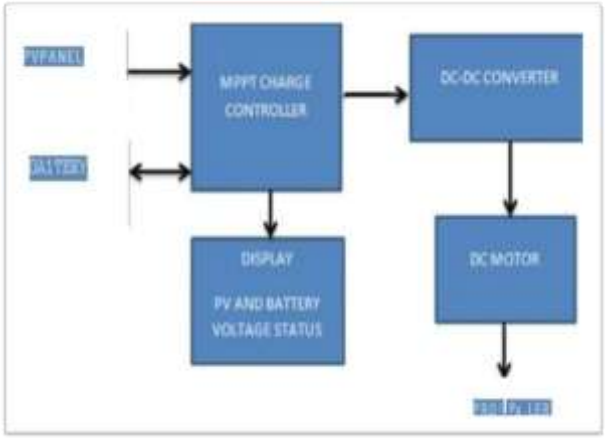

Fig. 7 block diagram

II) DESIGNED CIRCUIT

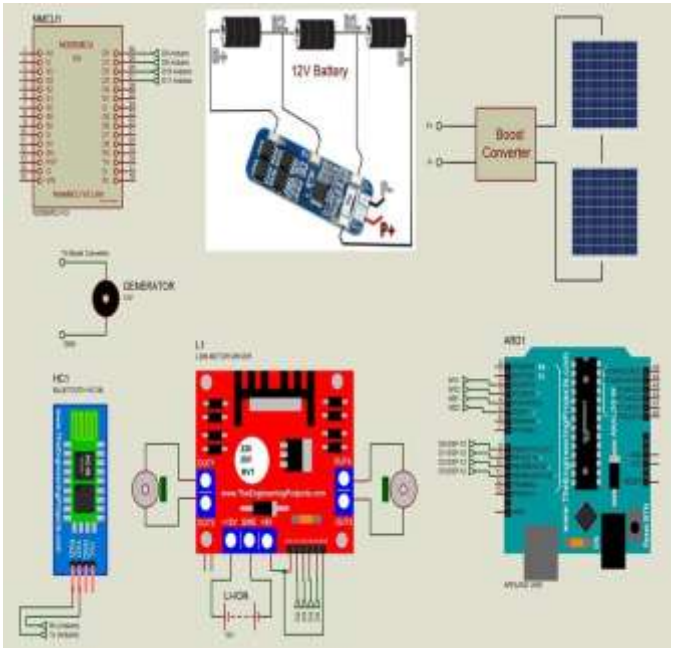

Fig. 8 designed circuit

4. METHODOLOGY AND WORKING

onsidering the Solar regulations through the whole process from conception to realization, Project Oriented Learning (POL) is the guided pedagogic approach, with the help of computational programs of CAD, CAM, CFD and FEM. In the POL technique, a project is assigned with a selected goal, in our students' case, to enter a solar powered boat to the Solar Splash competition. The purpose of POL is that students learn as they develop and style the prototype, with the trainer as a facilitator. It is a student-centered learning technique that involves interdisciplinary and team work. The

POL is implemented in the senior design course that is conducted in 15 weeks of one semester with two hours of faculty/student meetings per week. The senior course is totally project oriented where the first three weeks are devoted to plan the activities of the semester and to review fundamentals concepts of mechanical design and solar energy conversion. Also, there is a training period where the students learn how to use specialized software. The strategy and the advances of the project are reviewed by the professor. During the last twelve weeks of the semester, students work completing the boat with the implementation of the propulsion system and of the electrical diagram to store and distribute the electrical energy. Every design idea is evaluated analytically and computationally using engineering software for CAD, CAM, CFD and FEM. To integrate of these computational tools within the creation and style of this prototype the subsequent methodology was employed. The next section explains each step of this methodology.

DESIGN OF PROTOTYPE CREATION CONCEPT DEVELOPMENT

The students were organized by teams of 4 to 5 students and they were assigned to present proposals of different preliminary designs. The engineering requirements for the planning of the boat were selected with the help of QFD (Quality Function Deployment). The QFD results and sketches of the boat were presented to a committee of advisors consisting of engineering faculty and other experts so as to debate the pros and cons of the designs. After this feedback process, the preliminary designs were modified and three prototypes were selected. The Delft Ship software was employed to create a preliminary design of the hull boat and a CAD program was employed to generate the drawings of the prototypes. shows in below fig. preliminary design of the hull and therefore the CAD drawing.

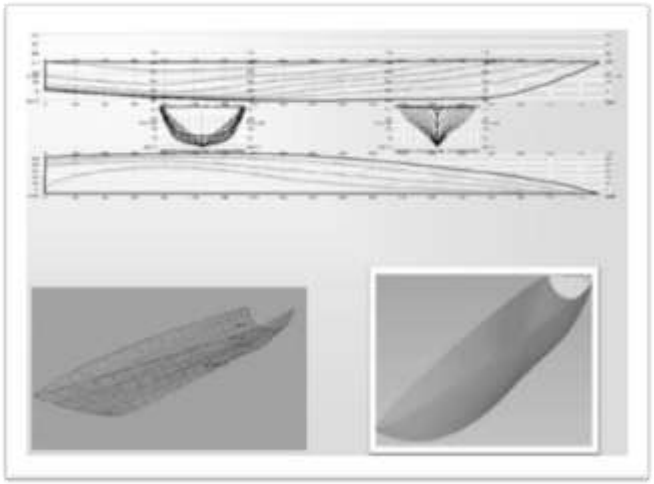

Fig. 9 Preliminary drawing of the hull of the prototype

A stress and deformation analysis with a FEM program was performed to work out that the structure of the boat can withstand the stresses produced by the forces thanks to the water pressure and the outboard motor. The results of the strain and deformation analysis were important within the selection of the fabric and therefore the design of the hull skeleton. The CAD/CAE/CAM development is shown Below in fig. CFD Simulations helped the students evaluate the hydrodynamic performance of the three prototypes. The drawings of the prototypes generated within the CAD program were imported into the CFD program. The geometry of the prototype was subtracted from a large parallelepiped to create the domain that represents the flow of water around a boat. The domain was divided in a finite number of small control volumes using a grid generator program. CFD software based in the finite volume method was used to solve the governing equations (Naiver-Stokes, continuity, etc.) for the problem of flow of water about the boat. Pressure distributions, drag force and the velocity field were obtained from the numerical simulations for different boat velocities. Experiments were performed during a hydraulic channel with a scale prototype to validate the CFD results. Particle Image Velocimetry (PIV) allowed visualization of the flow around a scale boat prototype. PIV consists of adding small tracer particles to the fluid that moves with the flow in a region selected for the analysis. This region is then illuminated with a laser beam and a digital camera captures pictures at shown

5. APPLICATION

1] Solar Panel Development in Transportation
Solar power dependency is rapidly increasing, as more people and industries believe different solar technologies for power, like solar panels. In the present, solar panels are ready to supply an outsized amount of energy for a household's necessities, allowing self-sustainability after a brief period of your time after being installed. Moreover, solar energy has been recently implemented into transportation, with the event of solar powered automobiles, and expanding to public transportation, air transport and marine transportation.

2] Solar Panels for Boats
Solar power for boats has several advantages, among a few, are that it reduces carbon emissions, diesel costs and drastically reduces noise levels. The industry has grown offering several different solar options for boat owners, consistent with panel type and a charge controller system.

6. CONCLUSIONS

In light of recently revised accreditation criteria and the call from industry on what they need from engineering graduates, it would appear that these demands are unlikely to be satisfied by a standard engineering curriculum and

"chalk and talk" pedagogy. In this work, we present results of our experience in teaching the senior design project with a technique of Project Oriented Learning with the evaluation of engineering design through the application of simulation software. A group of scholars were exposed to an engineering challenge to innovate and make prototypes for engineering. The methodology proposed in this work achieved several goals. First, the scholars were challenged with a stimulating project, where their goal was to enter and compete within the Solar Splash event, following its rules. Second, the students were exposed to modern computer based engineering tools and the effect of these tools on their creativity was carefully observed. We can conclude that computer software becomes an advantage in promoting and enhancing student creativity as he/she works on the capstone project. For the solar-powered boat project, the utilization of this software has increased year after year given its positive impact on students' output and performance. In this work, a rubric and a survey are presented as a first attempt to assess the effect of computers and engineering software in the innovation and creativity of the students. However, more information is required to assess and quantify the impact of those tools in developing creativity within the students when designing prototypes. This is ongoing research that's administered in our Department.

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