

# HYBRID – ANOTHER APPROACH TOWARDS ENVIRONMENT FRIENDLY BOAT

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**Abstract:** This paper gives the idea of a modified hybrid system for boats than the one used in cars. It mainly relates to the environment pollution caused by diesel engines on marine life and low income of fisherman due to ever raising fuel costs. It will benefit the local business and also promote the idea of green technology to the world. The idea is to make a boat run both on the conventional IC engine and the electrical motor for electrical drive. One modification is that the boat will run primary on the electric drive powered by the solar cell array at roof and the charging from plug point which is stored in battery. The purpose of using the motor for initial torque and engine for speed as in the conventional hybrid system fails in seadue to fuel leaks and noise pollution caused to marine life. So running primary on electric motor is a must and in case of undesirable weather conditions can switch to engine or on both as needed.

**Index Terms - Hybrid, Propulsion system, Environment friendly, Solar, Engine, boat.**

## 1. INTRODUCTION

Now-a-days the fisherman use local boats that are hand peddled or the boats that works with engine, but by doing this the cost of fuel is added to their expenditures and is deducted with their profit. So, for such cases they spend a lot in fuel, also the fuel prices are escalating day by day which again reduces the income of the fishermen. And the engine boat which is used causes harm to the marine life as well like creating noise pollution. Thus this paper gives a solution on the problem in the form of an advanced hybrid system technology which will help relieve at least some of the load and fuel consumption off the fisherman's boat. This make him/her to put less on petrol and hence more profit.

The paper introduces a hybrid model of the ship which consists of both the conventional IC (Internal combustion) engine and the electric system to power the boat. While fishing the boat usually stays in water for more than 10hrs so we have an electric system which takes power from solar give it to battery and drive the motor. This is for the normal cruising of the boat. As for situations where there is demand for speeds is critical we can switch to engine which we kept as secondary system on standby. Its importance lies in future where every vehicle or boat will run on electricity and not on petrol or diesels, will be more eco-friendly and green.

The standard Hybrid system uses the idea of getting a higher efficiency by using best features of the motor and engine. It is known that the motor gives a higher efficiency at lower speeds and engine at high speeds. Hence it uses motor for initial start and low speed and engine at high speeds. This is considered while driving on the road and not in sea. This fails to address the conditions of the sea as the boat needs high torque most of the time.

**Scope of project:** This project can then be extended to provide not only small scale transportation medium for small business but also for large ships using this mechanism. Also it can be equipped with GPS and RADAR facilities to navigate in the sea. This hybrid system can also be used for military for the electric drive for reconnaissance purpose as electric drive is much more silent with use of motor i.e. for spy purpose.

## 2. LITERATURE SURVEY

**Paper:** Development of Hybrid Propulsion System for Energy Management and Emission Reduction in the Maritime Transport System, September 30, 2016.

**Author:** Maryam Karimpour, Reza Karimpour

The above survey stresses on the issue of contamination of seas and noise pollution in maritime industry because of fuel and engine. So it proposes a solution of going green by using electric boats. For this,they have evaluated the model of a hybrid boat which is supposed to give a more dynamic performance than the normal boats working on the engine.so they modelled the power transmission system elements and evaluated boat function in real time by the movement of definite efficient strategic switching characteristics of the two power sources.

Type of boat	Normal	Hybrid	improvement percent
Fuel consumption (litr)	101	75	27%
(g/kW-hr) SO <sub>2</sub>	0.59	0.45	23%
(g/kW-hr) HC	0.25	0.19	20%
(g/kW-hr)PM	0.42	0.31	26%
(g/kW-hr) CO	1.8	1.4	14%

Fig: Table showing normal v/s hybrid system emissions

The results obtained by them are shown in the above figure. This is done by knowing the boat's dynamic performance and evaluating them by various simulation software and put them all together to get the emissions data. It is shown below.

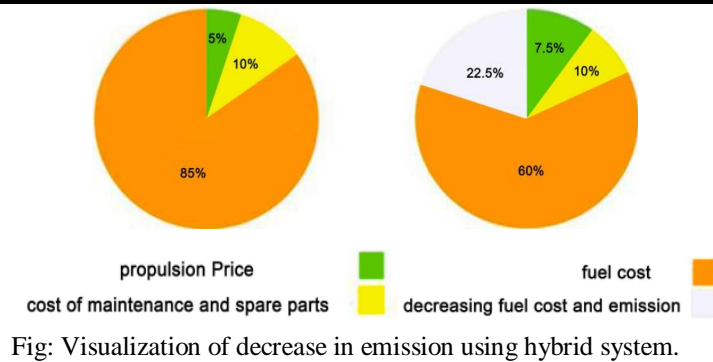


Fig: Visualization of decrease in emission using hybrid system.

**Paper:** Type selection and design of hybrid propulsion system of ship, October 2016.

**Author:** Xichen Lin, Riping Zhou, Nengqi Xiao

They introduced many different a new type of system with a dynamic form which has the characteristic structural complexity and the diversity of operating conditions which depends on the two primary fuel sources and their operating conditions. This the paper has illustrated idea of hybrid propulsion and its various functions and variables or parameters which is selected and monitored by the fuzzy comprehensive evaluation method which works on the modular approach and give a better accurate result. They produced the following results as below.

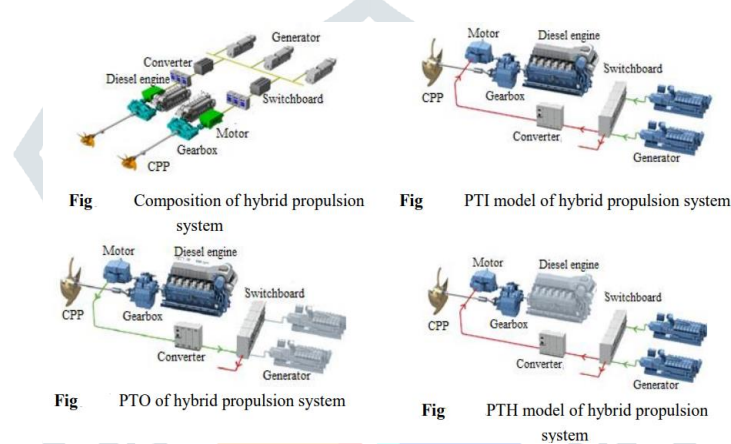


Fig: Various hybrid models approaches.

Fuzzy wide-ranging evaluation method is incorporated for measuring various aspects such as mobility, economy, applicability, maintainability and reliability in the system, so that the results of hybrid propulsion system type spectrum determination is more scientific and precise

**Gaps found**

1. Many of the previous systems designed were in favour of electric systems only.
2. Also hybridization was solely meant for purpose of increasing efficiency.
3. No backup mechanism for electric system and vice versa.
4. Current hybrid boat uses the idea of only efficiency using both engine and motor.
5. High cost. (Lakhs to crores).

**3. Proposed Work:**

**3.1 Problem definition**

We all know that the prices of fuel is increasing day by day. So is true for all the modes of transportation but this more of a problem to those people who get their income using these. Especially the fisherman who earns by means of boat during fishing. Half of his income is gone due to fuel (diesel) expenses. Also the use of diesel engines causes harm to the marine life. So we need some kind of system which uses non-conventional sources of energy like the sun and works primarily on it. There is abundant of solar power during the day and even more at the seas.so some kind of system which will make us of all these factors for solving this problem is needed.

So the problem for above can be summarized into following points:

- 1 Boats use an engine which produces noise and also is the fuel leaks that it cause severe problem in marine life.
- 2 So this cause contamination in waters and also harm the nature

So the objective of this project is as follows:

- 1 To design a boat which is green (no emissions), no noise (ideally), has nicer design and can use renewable sources of energy for power generation.
- 2 Develop and approach to make the boats with eco-friendly technology and more efficiency with considerable reliability.

### 3.2 proposed system

Our idea is to build a hybrid boat to help the fisherman by reducing the cost of their fuel and make the boat run on electric as a primary source and engine at critical situations (bad weather). Hybrid boat will work on both electricity and fuel engine but the first priority will be given to electric and then fuel engine can be used as a backup part.

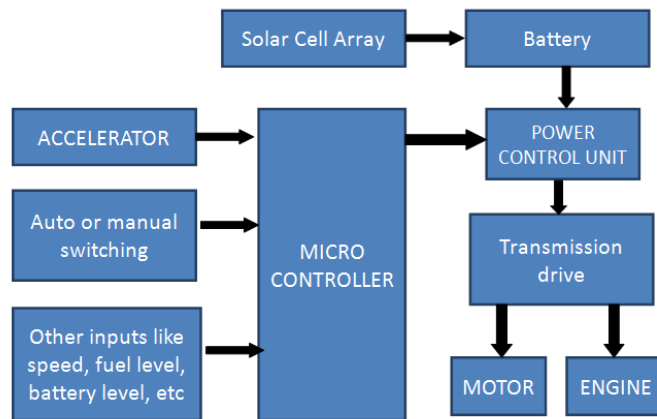


Fig 3.2.1: Block diagram of hybrid boat.

- 1 Solar panel: It consists of the solar cells array to charge the battery.
- 2 Battery: It is a 12V high ampere hour rated battery for super performance to provide necessary rpm and torque capacity at a constant rate to the motor. It is charged by the solar panel.
- 3 Power control unit: It has a microcontroller based system and a solar charge Maximum Power Point Tracking (MPPT) circuitry. For the best performance and life of the battery, it ensures efficient charging and optimal lifetime for battery.
- 4 Motor: It is a high rpm and high torque motor equipped for maximum power generation on the water surface.
- 5 Engine: we are planning to put on engine with 43cc engine with maximum speed of 45 km/hr.
- 6 Microcontroller: We are going to use Atmega 328p Microcontroller to do the switching part between the motor and engine. Our electric part which is solar panel with battery charging and inputs from various sensors are also controlled by it.

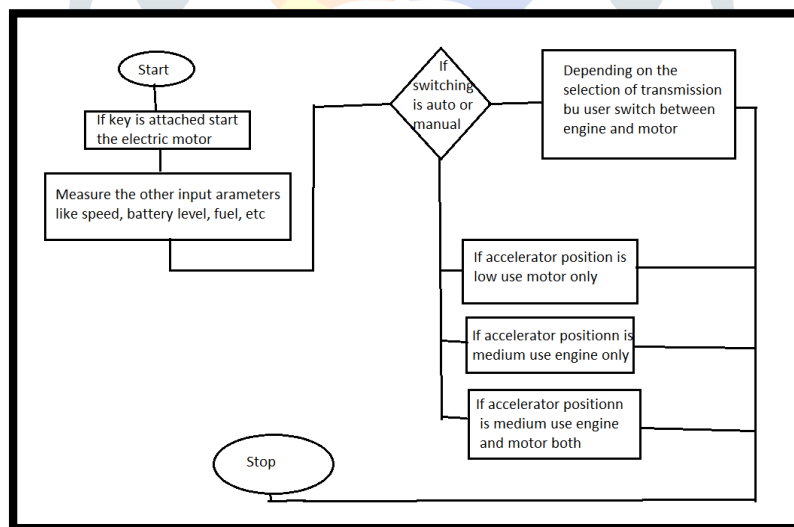


Fig 3.2.2: Algorithm of hybrid boat.

The above algorithm states the working of the system. Like initially when the key is placed the electric motor will start and various inputs from the sensors will be evaluated. Next depending on the user or automatically switching is going to take place between engine and motor. Automatic switching is most the traditional hybrid system but we are going to mostly run on electric motor so manual switching is needed. Automatic switching will mainly depend on the accelerator i.e. the power requirement of the user if it demands more power we can just use both the engine and the motor simultaneously for maximum speed and power attainment.

IV. Implementation and Design

4.1 Implementation of solar charge circuitry

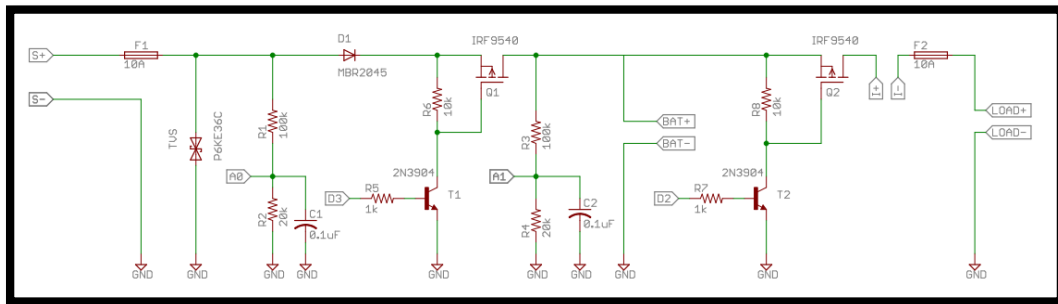


Fig 4.1.1: MPPT solar charge controller circuit.

4.2 Implementation of the boat and the engine

It was done using the propeller on the outside part of the rod of grass cutter engine i.e. at the fan blade side the blade was removed and the rod was made straight which was initially slanted at 40 degrees.



Fig 4.2.1: Shaft redesigned to meet drive requirements

Again engine was placed with the rod for direction and whole setup was mounted on the wooden platform as shown below.



Fig 4.2.2: Whole mechanical setup of engine and boat

4.3 MPPT Solar charger controller

In this charge controller we have implemented the load and battery control by continuously sensing the voltages of both.

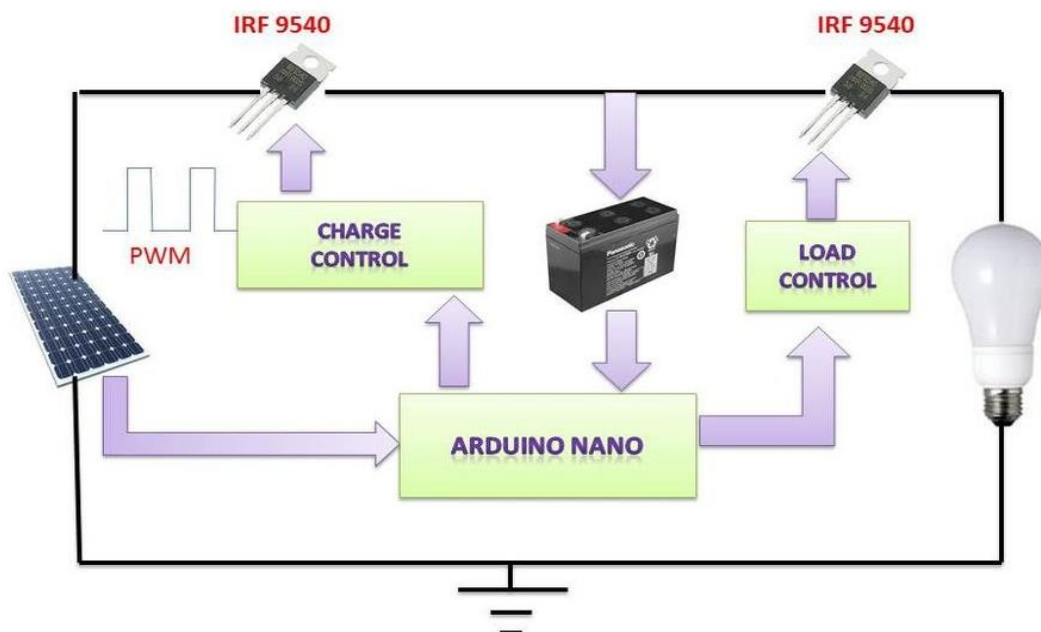


Fig 4.3.1: Block diagram of solar charger



The Main Functions of Solar Charge Controller are:

The charge controller is planned & scheduled by taking care of the following points.

1. **Prevent Battery From Overcharging:** To limit the energy brought to the battery by the solar panel when the battery becomes fully charged. This is realized in charge cycle () of my code.
2. **Prevent Battery From Over discharging:** To disengage the battery from electrical loads when the battery reaches low state of charge. This is executed in load control () of my code.
3. **Provide Load Control Functions:** To automatically connect and disconnect an electrical load at an indicated time. The load will ON when sunset and OFF when sunrise. This is realized in load control () of my code.
4. **Monitoring Power and Energy:** To monitor the load power and energy and display it on screen.
5. **Protect from abnormal Condition:** To protect the circuit from different irregular situation like lightening, over voltage, over current and short circuit etc.
6. **Indicating and Displaying:** To specify and display the various parameters
7. **Serial Communication:** To print various constraints in serial monitor

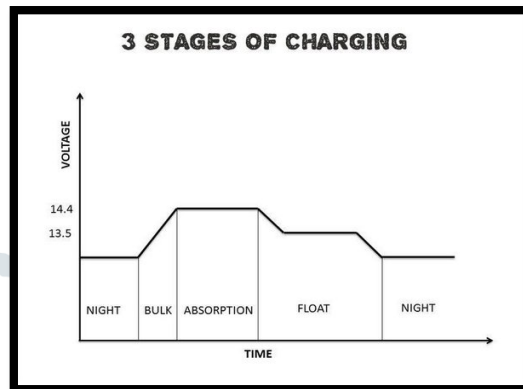


Fig 4.3.2: 3 stages of charging.

1. **Bulk:** At this method, a present maximum constant amount of current (amps) is fed into the battery-operated as no PWM is present. As the battery is being charged up, the voltage of the battery increases progressively
2. **Absorption:** When the battery reaches the bulk charge set voltage, the PWM begins to grasp the voltage constant. This is to avoid over-heating and over-gassing the battery. The current will fall down to safe levels as the battery becomes more completely charged.
3. **Float:** When the battery is completely recharged, the charging voltage is reduced to prevent additional heating or gassing of the battery

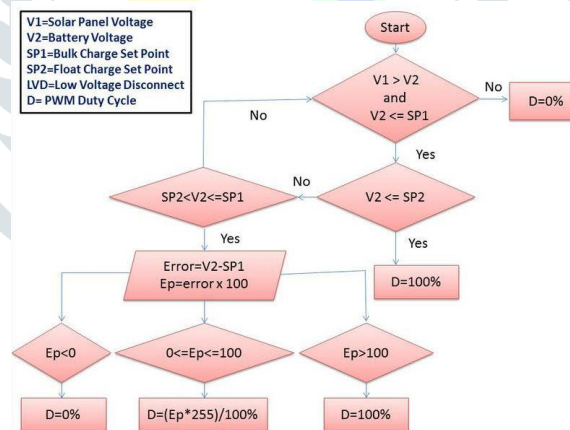


Fig 4.3.3: Algorithm for implementing 3 Stage charging

## V. Results

### 5.1 Output of Mechanical System

So in this project we are trying to achieve hybrid propulsion system for boat. Up till now we have done all the analysis and design needed for the project. In this this semester end we are going to run the boat using engine only and after that in next semester we will incorporate motor as second drive.



Fig 5.1: Testing of the engine with boat on gorai beach

We have made the boat and tested it right away after completing the necessary modifications and joining the various components. We also attached the light weight engine to boat and drive it out for testing on beach. The propeller and shaft was manually modified to produce thrust and handling control for steering purpose. Below is the pic of our testing the boat.

### 5.2 Output of the solar charge controller

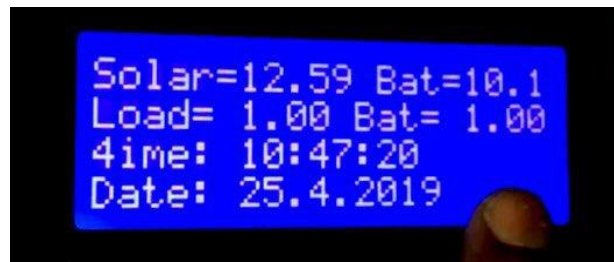


Fig 5.2: Solar charge controller output

### 5.3 Output of auto start setup of engine



Fig 5.3: Testing auto start for manual engine.

## VI References

- 1] "Solar-Electric Boat" by Giuseppe Schirripa Spagnolo, Donato Papalillo, Andrea Martocchia, Giuseppe Makary Department of Electronic Engineering, University "Roma Tre", Roma, Italy, March 15, 2012.
- 2] "Type selection and design of hybrid propulsion system of ship" by Nengqi Xiao, Riping Zhou, Xichen Lin School of Energy and Power Engineering, Wuhan University of Technology, Wuhan 430063, China, 2016.
- 3] "Design and Implementation of Solar Electric Boats for Cleaner U.S. Waters" by Recayi Pecan Michael E. Hay Electrical and Information Engineering Technology Program Department of Industrial Technology, University of Northern Iowa Cedar Falls, Iowa .
- 4] "The Science of Hybrid Propulsion: Part 2" an article written by the author Nigel Calder June 18, 2014.
- 5] Books on "Hybrid Dynamical Systems: Modeling, Stability, and Robustness" by Andrew R. Teel and Ricardo G. Sanfelice
- 6] Books on "Hybrid Systems, Optimal Control and Hybrid Vehicles: Theory, Methods" by Benjamin Frank and Thomas J. Böhme
- 7] ORL database, <https://www.instructables.com/id/ARDUINO-SOLAR-CHARGE-CONTROLLER-Version-20/>