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# Solar Sentry: Solar Power Module with Border Alert System for Fishing Vessel

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***Abstract***

*Fishermen are being caught and killed by the naval forces of the neighboring country, due to the lack of awareness about the ocean frontiers and advanced alert instruments in the boats. For this reason, maritime security has become a major concern of all coastal areas to protect the fishermen and provide assistance about sea frontiers via alerting, tracking, and monitoring of boat vessels. Thereby, a path-breaking technology of maritime border alert system using smart vessels is proposed; This technology fosters coast guard officials to effectively monitor fishermen and alert them if they sail inside the other country's border. Additionally, the implementation of lite loads powered by solar modules offers sustainability and cost-effectiveness for the fishermen in trawlers. The proposed border alert system and light loads powered by solar modules are a combination of technology innovation and renewable energy integration. This solution enhances the safety, efficiency, and sustainability of trawler fishing operations, benefiting both fishermen and the marine ecosystem. This technology integrates a border warning system with a renewable energy module to supply independent electricity for essential vessel operations and ensure compliance with maritime border laws. The solar power module reduces reliance on conventional fuel-powered generators and decreases emissions by utilizing solar energy to power navigation lights, communication devices, and other critical systems aboard the ship. When a vessel approaches prohibited areas or enters foreign waters, the border alert system uses GPS and geofencing devices to monitor its location relative to maritime boundaries and send real-time notifications.*

**Keywords:** GPS, GSM, pulse-width modulation (PWM), PV array, LCD

## INTRODUCTION

Our College (College of Engineering Muttathara) is located near the Arabian Sea shore. A large fishermen's community resides near (Valiyathura) our institution. Therefore, we decided to develop an idea that will solve some problems faced by the fishermen's community. We found that the community used a non-renewable source of energy in the fishing vessel for various purposes, including cooking inside the fishing vessel. Therefore, using a solar power module can help fishermen save money and fuel.

Fishing plays a fundamental role in the livelihoods of coastal communities worldwide by supporting food security, employment, and economic stability. However, fishing vessels that operate near maritime borders face a unique set of challenges. Unintentional boundary crossings, often a result of limited navigational tools and technology, can lead to severe legal consequences. These include fines, detention of the crew, seizure of the vessel, and strained international relations,

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particularly in regions with contested water. As maritime resources become increasingly valuable, there is a paramount need for effective tools to prevent border incursions and to enhance fishing vessel safety.

Simultaneously, the maritime industry is moving toward sustainable practices to reduce its environmental impact. Traditional fishing vessels rely heavily on fossil fuels, contributing to carbon emissions and limiting the operational range owing to fuel constraints. With global initiatives encouraging renewable energy adoption, the potential of solar power in marine applications is gaining attention. Solar power is a viable solution for small- and medium-sized fishing vessels as it provides a continuous, clean energy source in open waters, reducing both fuel dependency and operational costs.

The solar entry system addresses these dual challenges by integrating a solar power module with a border alert mechanism tailored specifically for fishing vessels. The system was designed to be cost-effective, sustainable, and user-friendly, combining solar energy with GPS-based geofencing to create a reliable alert mechanism when vessels approach or cross international maritime boundaries. Solar entry offers a proactive approach to minimizing the risks of boundary incursions while promoting energy independence and operational efficiency [1–3].

This study explores the development and implementation of the solar entry system and examines its technical components, field performance, economic impact, and environmental benefits. By leveraging renewable energy and advanced geofencing technology, solar entry has the potential to transform the operational landscape of fishing vessels, align with sustainability goals, and support the economic resilience of coastal fishing communities.

In the unpredictable expanse of the ocean, where trawler fishermen brave the elements to secure their livelihood, safety and security are fundamental concerns. Recognizing this, solar entry has emerged as a ground-breaking solution, merging the renewable energy capabilities of solar power with state-of-the-art border alert systems tailored specifically for the unique challenges faced by trawler fishermen.

## OBJECTIVES

The main objective of this study is to develop a cost-effective solar power module for fishing trawlers.

- By reducing the dependency on fossil fuels, we can reduce environmental pollution.
- To develop a border alert system for the fishing vessel.

## EXISTING WORK

There are many types of IC engine-based generators on some fishing trawlers. Some fishing vessels onboard alternators charge onboard batteries. Currently, a broader alert system is not available for small fishing vessels.

## PROPOSED WORK

The proposed system exhibits technological innovation and renewable energy integration using a solar power module and a border alert system. With solar energy as the energy source, the usage of fossil fuels and pollution can be reduced. Lithium-ion batteries have a longer life span and higher energy storage capacity, thereby increasing their efficiency. The GPS module can continuously track the trawler's location, providing real-time updates to the authorities or monitoring systems. GSM is used for data transfer and communication purposes [4].

### Solar Panel

The proposed system contains two 12 V and 250 W solar panels connected in series, which gives a panels system of 24 V and 500 W. The output current was 20.83 A. The solar panel is a crucial component of the solar entry system, providing renewable energy to power essential onboard equipment and ensuring the continuous functionality of the border alert system. For fishing vessels operating in open waters, solar panels offer a sustainable, efficient, and practical alternative to fossil fuel-powered energy sources, thereby significantly reducing fuel dependency and operational costs [5].

 

**Battery**

Two 12 V and 35Ah lead acid batteries are used in series, which gives a system of 24 V and 35 Ah system. With a 24 V and 500 W motor as load in the system with a peak current requirement of 20.83 A, the proposed battery system gives a minimum running time of at least 1.68 hr. at maximum load.

**PWM Charge Controller**

The pulse-width modulation (PWM) charge controller regulates the voltage and current from the solar panels to optimize the charging of batteries in the solar power module. It typically includes protection features, such as overcharge, overdischarge, reverse polarity, and short-circuit protection. The PWM charge controller is an essential component of the solar entry system, enabling efficient energy transfer from solar panels to the battery storage unit on fishing vessels. PWM charge controllers regulate the flow of solar energy, ensuring that batteries are charged safely and efficiently while preventing overcharging, which can damage battery health. This technology is ideal for small- and medium-sized systems, such as those on fishing vessels, providing a cost-effective and reliable solution for maintaining optimal battery performance.

**GPS Module**

The Neo 6M GPS module can continuously track the trawler's location, providing real-time updates to the authorities or monitoring systems. In the case of emergencies, such as distress calls or unexpected deviations from the designed route, the GPS module can transmit the precise location of the trawler, facilitating rapid response by authorities.

**GSM**

The Global System for Mobile Communication (GSM SIM 800 L) technology plays a vital role in enhancing communication and data transfer. A SIM must be fitted into the SIM card harborage in a modem and can operate using a mobile device, which can shoot and admit dispatches from the registered figures. In the solar entry system, GSM technology provides a communication link between fishing vessels and coastal monitoring authorities, offering a reliable method for transmitting alerts and data regarding vessel location and status. As a widely available and robust cellular technology, GSM is ideal for maritime applications near the coast, where signals can be used to support location-based alerts, emergency notifications, and real-time data sharing [6–8].

**Functionality in Solar Sentry System**

The GSM module in the solar entry system enhances the safety and connectivity of fishing vessels by providing the following functions.

- *Real-time location transmission:* When the vessel nears a pre-defined border, the GSM module enables the real-time transmission of GPS location data to coastal monitoring authorities. This feature helps both the crew and authorities to monitor the vessel's movement and ensure compliance with national boundaries.
- *Border alert communication:* If a vessel crosses a virtual boundary (geofence), the GSM system sends automatic alerts to coastal authorities, allowing quick intervention and avoiding potential legal issues or conflicts.
- *Emergency communication:* The GSM module enables the vessel to send distress signals or emergency notifications if the crew faces unexpected situations. This feature is crucial for fishing vessels operating in remote waters, where quick responses from authorities could be lifesaving.
- *Remote system monitoring:* The GSM link allows remote monitoring of the solar entry's operational status, including battery levels and solar power generation data. Coastal authorities can also use these data to assess the health of the vessel's system and provide technical support if needed.

**Arduino UNO**

The Arduino UNO can be used to manage and optimize power usage in solar power modules. It can control the charging and discharging of batteries in solar power modules. The Arduino UNO

 

microcontroller serves as the central processing unit for the solar entry system, managing data from various sensors, GPS, and GSM modules, and the PWM charge controller. As a versatile and user-friendly microcontroller, the Arduino UNO is ideal for small-scale embedded systems, such as solar entry, where it integrates power management, geofencing alerts, and communication modules to ensure smooth, coordinated operation [9].

## LITERATURE REVIEW

*Electric Generator with Solar Power on a Fishing Boat (Corvis L. Rantererung, Agus Salim Yulianus Songli [1])*

This project aimed to integrate a solar power system into a fishing boat's energy generation setup, reducing dependence on conventional fuel-powered generators. By utilizing solar energy, the fishing boat could operate more sustainably and cost-effectively while reducing its carbon footprint.

*A Systematic Review of Solar and Wind Power Plants for 14-Meter Fishing Boats (Nanang Setiyobudi, Agoes Santoso, Eddy S. Koenhardono, Achmad Baidowi, Dian Purnamasari, Teguh Muttaqie, Muryadin, Fariz M. Noor, Ari B. Setiawan, Ari Kuncoro, Zarochman [2])*

This study focused on the integration of solar and wind power systems for 14-meter fishing boats. The goal of their review was to evaluate the feasibility, efficiency, and potential benefits of using renewable energy sources—specifically solar and wind power—to replace or supplement traditional fuel-powered systems on fishing vessels.

## BLOCK DIAGRAM

The solar panel connects to the charge controller. The charge controller links to the battery and power management unit. The power management unit powers the microcontroller, GPS module, communication module, alarm system, and display unit (Figure 1).

A Border Alert System is a safety and security mechanism designed to alert fishermen when their vessels approach or cross maritime boundaries (Figure 2). These systems aim to prevent unintentional trespassing into foreign waters, which could lead to legal issues, conflicts, or threats to fishermen's safety. Figure 3 shows a three-dimensional (3D) model of the border alert system.

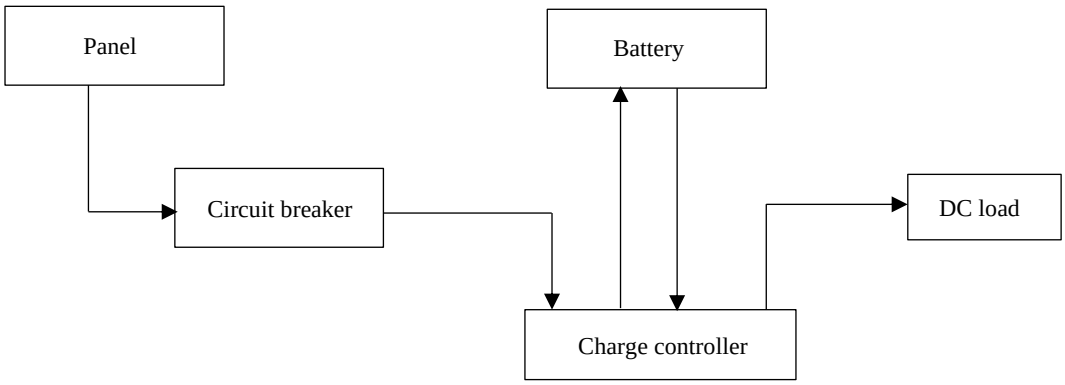


**Figure 1.** Power module.

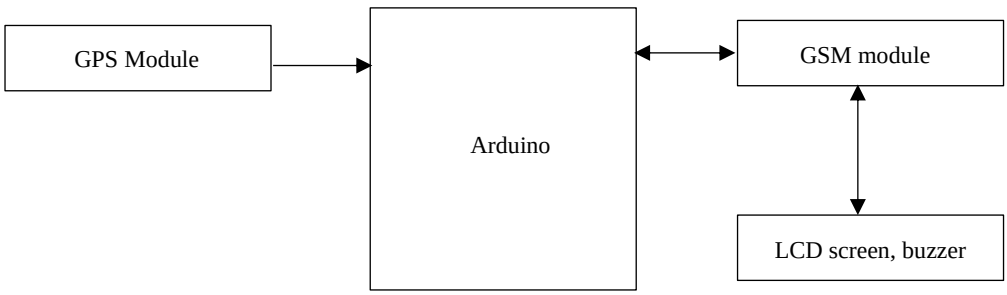


**Figure 2.** Border alert system.

 

**Figure 3.** Concept model.

**Table 1.** List of components used.

| S.N. | Components | Values |
|---|---|---|
| 1 | Solar panel | 10 W, 12 V |
| 2 | Battery (lithium-ion) | 12 V, 5 Ah |
| 3 | Charge controller | 20 A, 12 V |
| 4 | LED | |
| 5 | Arduino UNO | |
| 6 | GPS Module Neo 6 | |
| 7 | GSM Module SIM 800L | |
| 8 | LCD Screen | 7 segments |
| 9 | Buzzer | |

## WORKING

The system includes solar panels installed on the vessel to harness solar energy and power various components of the system. The board alert system is equipped with sensors and communication devices. These sensors monitor the vessel's position and detect its proximity to pre-defined borders or boundaries. When the vessel approaches or crosses a designated location, the system triggers, and alerts. This alert can be in the form of audible alarms, visual indicators, or communication signals sent to designated authorities or the crew of the vessel. The system may include a monitoring and control interface for the vessel's crew or authorities to track the vessel's movement in real-time, set pre-defined boundaries, and adjust alert parameters, as needed. Solar sentry may integrate with the vessel's navigation system to provide seamless monitoring and ensure compliance with maritime regulations and boundaries. Overall, Solar Sentry aims to enhance the security and compliance of fishing vessels by providing real-time alerts and monitoring capabilities to prevent unauthorized border crossing [10].

### Components

Components for the prototype are given in Table 1.

## CONCLUSIONS

Fishermen face many livelihood challenges, and the major problems they encounter are addressed in this paper. The concept of automatically acquiring the exact location, using environmentally friendly and sustainable electrical energy, as well as eliminating fuel costs on boats, can improve the welfare of

 

fishermen. Additionally, the border alert system on trawlers helps protect innocent fishermen from being easily caught or imprisoned by the sea or foreign navies.

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**REFERENCES**

1. Rantererung CL, Salim A, Songli Y. Electric generator with solar power on fishing boat. Int J Mech Eng Technol. 2021 Dec;12(12):49–53. DOI: https://doi.org/10.17605/OSF.IO/AHR35.
2. Setiyobudi N, Santoso A, Koenhardono ES, Baidowi A, Purnamasari D, Muttaqie T, et al. Systematic review of solar and wind power plants for 14-meter fishing boats. Int J Mar Eng Innov Res. 2023 Jun;8(2):167-78. DOI: https://doi.org/10.12962/j25481479.v8i2.16703.
3. Arunvijay D, Yuvaraj E. Design of border alert system for fishermen using GPS. Int J Stud Res Technol Manag. 2014 Mar-Apr;2(2):67-70.
4. Chakraborty S. Design and implementation of solar power system in fishing trawler. Design and implementation of solar power systems in fishing trawlers. The 2nd Annual Gobeshona Conference 2016, 8th - 11th January 2016, Dhaka, Bangladesh. January 2016.
5. Rajalakshmi NR, Saravanan K. Fisherman communication at deep sea using border alert system. In: Solanki V, Hoang M, Lu Z, Pattnaik P, editors. Intelligent Computing in Engineering. Advances in Intelligent Systems and Computing, vol 1125. Singapore: Springer; 2020. pp. 283-95. DOI: https://doi.org/10.1007/978-981-15-2780-7_33.
6. Radhakrishnan A, Gandhi AH, Nandhini GS, Sowmiya S. Smart tracking and nautical border alert system. Int Res J Eng Technol. 2018 Feb;5(2):1804–7.
7. Kumar KS, Sharath Kumar K. Design of low-cost maritime boundary identification device using GPS system. Int J Eng Sci Technol. 2010;2:4665–72.
8. Sivaramaganesh M, Ramya M, Gowtham V, Bharathi T, Jeevitha G. Implementation of maritime border alert system. Int J Innov Res Electr Electron Instrum Control Eng. 2014;2:1254–7.
9. Satyanarayana P, Aruna VBKL, Kumar PNVVS. International boundary scanning and ship surveillance system. 2017 International Conference on Electrical, Electronics, Communication, Computer, and Optimization Techniques (ICEECCOT), Mysuru, India. 2017. pp. 212–5. doi: 10.1109/ICEECCOT.2017.8284669.
10. Rahman MM, Hasanuzzaman M, Rahim NA. Effects of various parameters on PV-module power and efficiency. Energy Convers Manag. 2015;103:348–58. DOI: 10.1016/j.enconman.2015.06.067.

 