**Buletin Ilmiah Sarjana Teknik Elektro**
Vol. 5, No. 4, December 2023, pp. 438-447
ISSN: 2685-9572, DOI: 10.12928/biste.v5i4.9127 

# The Use of Alternative Energy as a Driver Fishing Boat

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**ARTICLE INFORMATION**

**Article History:**

Submitted 10 October 2023
Revised 09 November 2023
Accepted 19 November 2023

**Keywords:**

Boat;
River Transport;
Solar Cell;
Fishermen;
Environment

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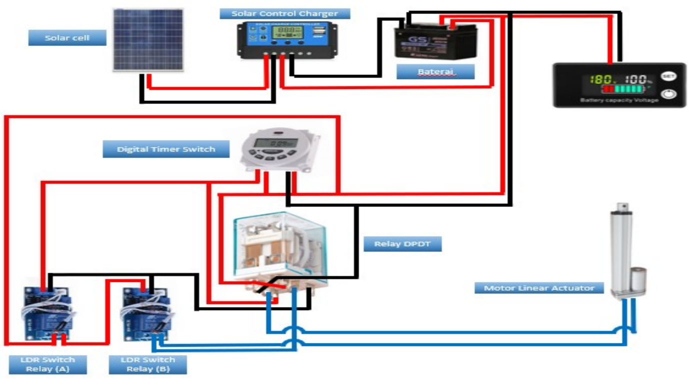
**ABSTRACT**




The use of outboard engines commonly used by fishing boats is considered no longer effective, considering the price of BBM (Fuel Oil) which always increases and the effects caused by the use of outboard engines are not environmentally friendly such as producing noise and air pollution caused. This research aims to overcome the problems of using outboard engines by utilizing solar panels to convert sunlight into electrical energy and DC 775 motors as boat propulsion. The use of solar panels with a tracker system to maximize solar panels in producing electrical energy which is then stored in a battery to drive a DC motor. The results of the calculation of a battery with a capacity of 20 Ah can drive the boat for 3.7 hours, where fishermen need 1 liter of fuel to run the outboard engine for 30 minutes. The maximum boat speed generated is 5.76 knots. The results of the analysis in terms of costs incurred for fuel operations are 0% because they utilize sunlight and there is no pollution and noise generated when the boat works. Future development can replace the battery with a larger capacity and add solar panels for faster battery charging. With this research, researchers hope to help fishermen in reducing operational costs and the success of catching more fish.

**Document Citation:**

N. P. IS and T. Ariyadi, "The Use of Alternative Energy as a Driver Fishing Boat," *Buletin Ilmiah Sarjana Teknik Elektro*, vol. 5, no. 4, pp. 438-447, 2023, DOI:10.12928/biste.v5i4.9127.

## 1. INTRODUCTION

In general, the size of small fishing boats ranges from 0 to 5 GT which is determined based on Gross Tonnage (GT) which is a standard measure of the volume of the ship in accommodating the results of fishing operations [1]. Boats are also the most important means for fishermen to find their livelihoods such as fish and shrimp. Fishing boats generally use outboard engines to drive their boats. Where, the use of outboard engines that are generally used by fishing boats is considered irrelevant, considering the price of BBM (Fuel Oil) is increasingly soaring, plus producing noise and air pollution around. In addition, the problem of fuel availability in riverside areas is very limited and the price is 15% more expensive than at gas stations (Public Fuel Stations) causing the operational costs required in fishing to be higher [2][3].

The cause of the irrelevance of the use of outboard engines on fishing boats is because they produce noise that causes the ecosystem in the sea to be disturbed, making it difficult to find fish and produce polluted surrounding air pollution which has a bad impact on the surrounding environment [4][5]. To overcome these problems, several studies have been conducted, one of which utilizes sunlight as an alternative energy and uses a DC dynamo for the boat drive system [6][7]. However, there are shortcomings because to achieve maximum energy from sunlight, solar panels must always be exposed to sunlight. So a tracker system is needed to direct solar panels towards sunlight in order to maximize charging on the battery. So that it is more efficient in maximizing solar energy obtained as an alternative energy source needed to drive fishing boats [8].

Based on this background, researchers are interested in conducting better development in the scope of optimizing solar panels in receiving sunlight, to maximize the electrical energy produced and efficiency in terms of storing electrical energy into batteries [9]. By adding a single axis solar tracker feature using 2 MDL-07 LDR sensors to detect the direction of the brightest sunlight, then instructing the actuator motor to move the solar panel in the direction of the sunlight. Thus making more efficient use of solar panels in receiving sunlight for battery charging [10].

This research aims to solve the problems faced by fishermen by making electric fishing boats with the main source of power using sunlight as an alternative energy to fuel. That way, it is expected that this fishing boat can operate more efficiently, environmentally friendly and reduce operational costs in terms of fuel [11].

## 2. METHODS

In the research conducted, there are three stages of design which include software design, hardware design and design of boats and mechanical systems. Software design includes a flowchart of each system, both the solar tracker system and the boat drive system. Hardware design includes wiring of each system as well as ship design and mechanical systems including ship specifications and fishing boat propulsion systems.

### 2.1. Software Design

The software design in this study consists of a solar tracker system flowchart and a boat drive system flowchart. Making the flowchart is to make it easier to design the program so that the system works as desired. All systems on fishing boats use the Arduino Uno microcontroller to control all actuators and sensors. Figure 1 is a flowchart for the solar tracker system on a fishing boat.

In Figure 1, the system is active from 07:00 - 17:00 WIB, when outside these hours the system is automatically disabled. Activating the system at that time is to maximize the use of sunlight as the main energy to move the fishing boat and charge the battery. When the system is active, the LDR sensor will receive sunlight and then proceed to command the actuator motor to move towards brighter sunlight to maximize the capture of energy from solar panels. The use of LDR sensors uses the MDL-07 LDR sensor module. The energy received by the solar panel will be stored in the battery [12].

Furthermore, Figure 2 is a flowchart of the fishing boat drive system. In this system, the voltage generated from the solar panel stored in the battery serves to supply voltage to the DC 775 motor. When the DC 775 motor is working, the infrared sensor will detect the motor speed in units of RPM (Revolutions Per Minute). Then, the ACS712 sensor will read the current used when the DC 775 motor is working and display the parameters of both the current used and the RPM read on the infrared sensor into a 16x2 LCD which serves to facilitate the driver in monitoring the current and RPM when the boat is working.

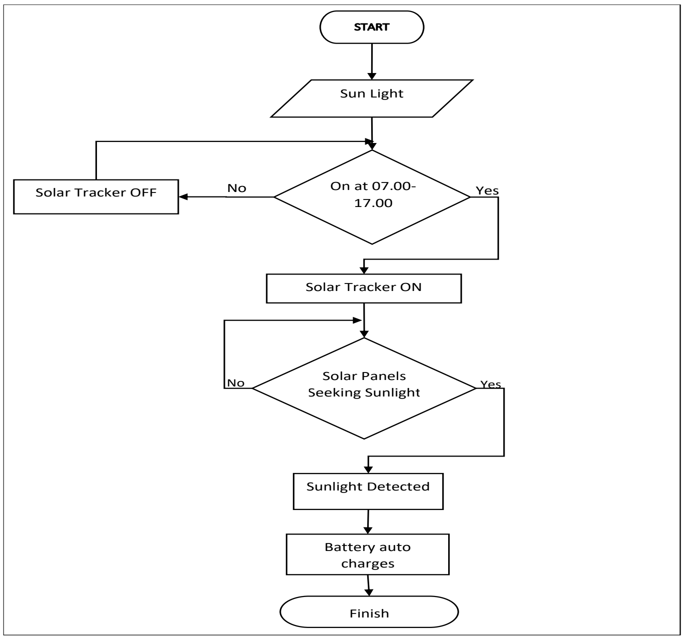



**Figure 1**. Flowchart of solar tracker system

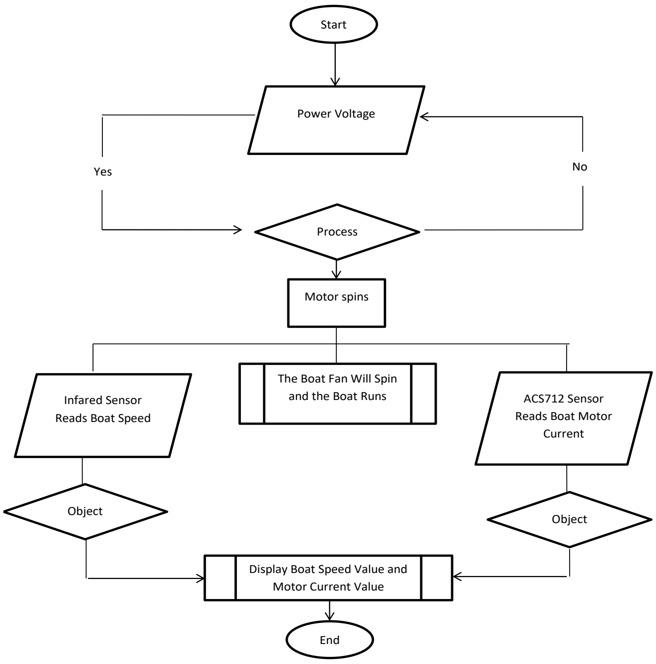



**Figure 2**. Flowchart the boat drive system

### 2.2. Hardware Design

The hardware design in this study consists of hardware design for solar trackers and hardware design of ship propeller drive systems. The solar tracker design uses a single axis system using 2 LDR sensor modules [13]. Wiring diagram of the solar tracker system can be seen in Figure 3. The type of solar panel used is Polycrystalline with 20Wp specifications using 1 piece. The solar charger controller component is used to regulate the energy from solar panels that will be stored in the battery. The digital timer switch is used to ON/OFF the system on the actuator motor. The use of a digital timer switch to activate the system automatically, so that when the boat is not used, the system will deactivate automatically to save power usage on the battery. Two MDL-07 LDR sensor modules are used as cloudy detection sensors and as sunlight direction detectors. The solar tracker system uses 1 linear motor actuator. Electric energy storage uses 2 12VDC batteries each with a capacity of 20Ah, then assembled in series so that the voltage on the battery becomes 24VDC [14].

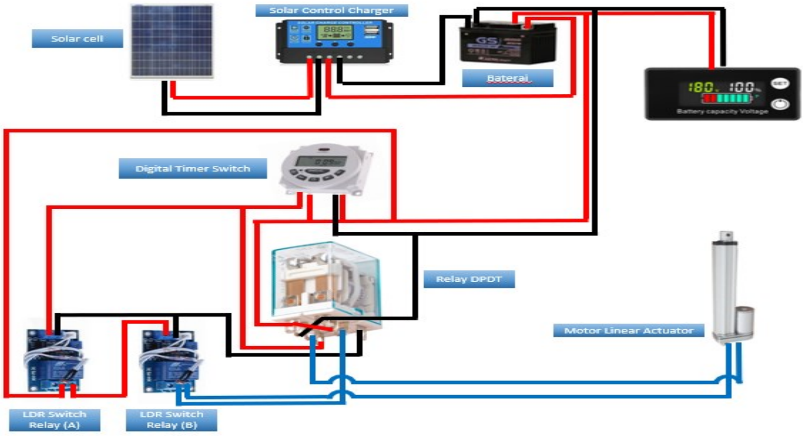



**Figure 3**. Wiring solar tracker system

The wiring design of the propeller drive system can be seen in Figure 4. The voltage from the battery is reduced using a stepdown to supply the voltage of two Arduino Uno. Arduino Uno 1 serves to regulate the speed of 4 DC 775 motors that are assembled in parallel using the BTS7960 driver with rpm setting input from the potentiometer. Arduino Uno 2 is used to monitor the rpm of the DC 775 motor using an infrared sensor and the current generated when the DC motor works using an ACS712 sensor displayed on the 16x2 I2C LCD.

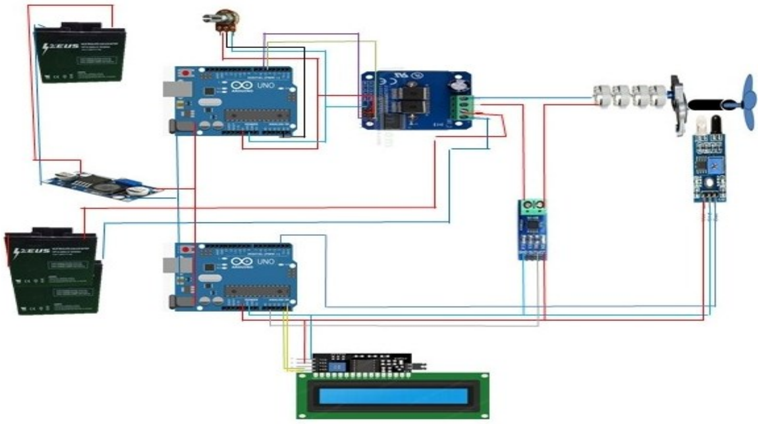


**Figure 4**. Wiring the boat drive system

### 2.3. Boat Design

The boat designed has a diameter of 300 cm long and 90 cm wide, with this size the ship can be boarded by 2 people and the maximum load is 150kg. The boat design made leads to a mini boat type, because it has a U-shaped boat hull so that it does not produce high waves to maintain the aquatic ecosystem [15]. The boat is also equipped with a water drain system to anticipate when the hull of the boat experiences seepage from the propeller, so that the boat remains dry. The basic material for making boats uses Styrofoam. The selection of Styrofoam as the basic material for making boats, because it has a light weight and has high buoyancy so that the boat can run optimally and the boat is also coated with fiberglass to make it stronger so as to reduce the risk of leakage to the hull [16][17]. The use of materials used in making boats can be seen in Table 1. The results of the boat made can be seen in Figure 5.

**Table 1**. Details of materials used

| Material Type | Quantity |
|---|---|
| Resin | 15 liters |
| Catalyst | 200 milliliters |
| Mat fiber | 3 kilogram |
| Masking Tape | 7 rol |
| Styrofoam glue | 1 kilogram |
| Styrofoam 3m x 1m | 3 pcs |

**Figure 5**. The final result of the boat made

### 2.4. Mechanical Design

The mechanical design in this study includes the design of the boat drive and the components used in the boat drive system. The boat drive design can be seen in Figure 6. The mechanical design in this study includes the design of the boat drive and the components used in the boat drive system. The boat drive design can be seen in Figure 6.

**Figure 6**. Boat drive design

In Figure 6, the boat drive uses 4 DC dynamos type 775 assembled in parallel with a working voltage of 24V to maximize torque in running the boat. The minimum speed generated from the DC motor is 6000 RPM and the maximum speed is 12000 RPM. From the dynamo rotation is transmitted to the gearbox with a ratio of 1: 6, which means that 6 turns in the dynamo gear will produce 1 turn in the gear on the propeller. The use of the gearbox ratio is to increase the torque on the propeller rotation [18].

## 3. RESULT AND DISCUSSION

Tests on fishing boats were carried out at the Palembang Polytechnic's River, Lake and Crossing (SDP) training pool. The tests carried out consisted of testing ship leaks, testing ship safety, testing ship stability and buoyancy, testing solar trackers and testing the length of battery usage when used and testing the speed generated when transporting loads in the boat.

### 3.1. Boat Testing

The tests carried out consisted of hull leakage testing, boat stability testing and boat buoyancy when fully loaded. In Figure 7 the test was carried out with a load of 2 people with a total weight of about 150kg, the test results obtained were no leakage on the ship's wall and the point of immersion of the ship into the water was about 20% of the height of the ship's wall, meaning that the boat was safe when fully loaded. The boat is also in a stable state when there is a shock so as to minimize the risk of the boat capsizing very small. The use of Styrofoam material also affects the buoyancy of the ship, because the material is lightweight so that the ship can float perfectly. The use of resin on the ship's wall layer to strengthen both the ship's walls and hull, thus avoiding the risk of leakage due to sharp objects when sailing for fish.

**Figure 7**. Buoyancy and leakage testing of boats

### 3.2. Solar Panel Testing

Tests carried out using solar panels with a maximum power specification of 20 Watts. This test is to determine the comparison of the power generated by solar panels when in sunny weather and cloudy weather. The data collection is taken per hour, starting from 07:00 WIB to 17:00 WIB. The test results are displayed in trend form in Figure 8.

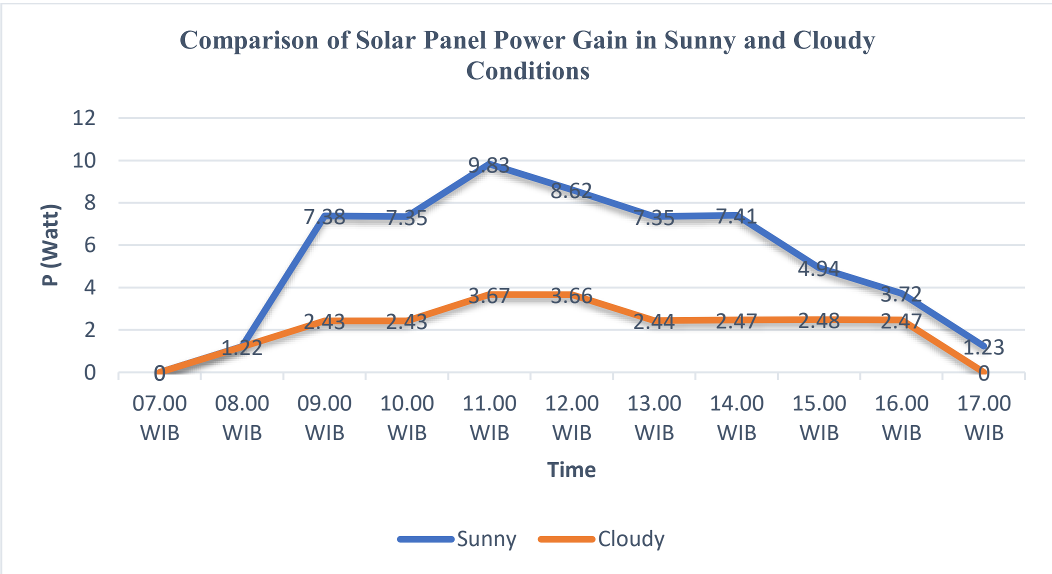



**Figure 8**. Comparison chart of power obtained by solar panels in sunny and cloudy conditions

Based on the datasheet, the maximum Solar Panel power that can be obtained is 20 Watts. In Figure 8, the power graph in sunny conditions starting at 08.00 amounting to 1.21 Watt, peaked at 11.00 am amounting to 9.83 Watt and began to decline until 16.00 amounting to 2.47 Watt. Effective power acquisition during sunny conditions, namely 09.00 to 15.00 WIB with power above 7.5 Watts or around 30-50% of the maximum power of the Solar Panel. While in cloudy conditions, the graph shows the power peaked at 11:00 am at 3.67 Watt and decreased at 12:00 and rose again at 15:00, this states that when cloudy conditions the heat from the sun cannot be optimally absorbed by the Solar Panel because the sun's heat rays are covered by clouds.

### 3.3. Solar Tracker Testing

Testing is done to find out whether the solar tracker system is running well and whether the solar tracker can move following the maximum direction of sunlight. The solar tracker used is a single axis type, which only moves towards the front and moves towards the back [19]. The test results are in the form of solar tracker tilt angles using the online degree website, www.ginifab.com. The testing process is carried out starting from 07:00 WIB until 17:00 WIB, but test observations are made at 08:00 WIB, 12:00 WIB and 17:00 WIB. The testing process can see some of the Figure 9, Figure 10, and Figure 11.

Figure 9 shows the tilt angle of the solar panel tracker at 07.00 a.m. (GMT) with a tilt angle of 50 degrees in the morning. Figure 10 shows the tilt angle of the solar panel tracker at 12.00 p.m. (GMT) with a tilt angle of 90 degrees during the day, following the direction of sunlight which is directly above and perpendicular to the solar panel. Figure 11 shows the tilt angle of the solar panel tracker at 17.00 p.m. (GMT) with a tilt angle of 122 degrees in the afternoon. The overall test results on the solar tracker show that the solar tracker system works well, namely the solar tracker can move the solar panel following the maximum sunlight direction.

**Figure 9**. Solar tracker tilt angle at 08:00 a.m. (GMT)

**Figure 10**. Solar tracker tilt angle at 12:00 a.m. (GMT)

**Figure 11**. Solar tracker tilt angel at 17:00 p.m. (GMT)

### 3.4. Battery Usage Test

Battery usage testing is done to find out how long the boat can operate when the battery is full until the energy in the battery runs out. By knowing the limit of battery capability can be used as an evaluation in further development. As for knowing the length of battery usage time can use the calculation equation (1).

$$T = \frac{Ah}{A} \tag{1}$$

From the results of the calculation of battery energy capacity of 20 ah can drive an electric fishing boat with varying speeds can last approximately 3.7 hours with a minimum current of 5.4 amperes. However, battery energy cannot be used in full because if it is used in full, the battery will be easily damaged and result in reduced battery life can be seen in Table 2. In Figure 12, is a graph of current consumption when the boat is working. The resulting current consumption increases when the load in the boat gets heavier. For a maximum load of 2 people with an accumulated weight of 150 kg, the maximum current used is 32.5 A. In a sense, the heavier the load carried by the boat, the greater the current used, causing the duration of battery use to be shorter [20].

**Table 2**. Full battery power consumption

| **Full battery power consumption without person load** | | |
|---|---|---|
| **Battery Capacity (Ah)** | **Current (A)** | **Time (Hour)** |
| **20 ah** | 1.8 | 11.11 |
| | 3.0 | 6.66 |
| | 3.9 | 5.12 |
| | 4.2 | 4.76 |
| | 5.9 | 3.38 |
| | 7.0 | 2.85 |
| **Full battrey power usage with 1 person load** | | |
| **Battery Capacity (Ah)** | **Current (A)** | **Time (Hour)** |
| **20 ah** | 5.8 | 3.70 |
| | 10.4 | 1.92 |
| | 14.9 | 1.34 |
| | 21.3 | 0.93 |
| | 24.6 | 0.81 |
| | 29.5 | 0.67 |
| **Full battrey power usage with 2 person load** | | |
| **Battery Capacity (Ah)** | **Current (A)** | **Time (Hour)** |
| **20 ah** | 5.4 | 3.44 |
| | 12.6 | 1.58 |
| | 15.9 | 1.25 |
| | 21.6 | 0.92 |
| | 25.7 | 0.77 |
| | 32.5 | 0.61 |

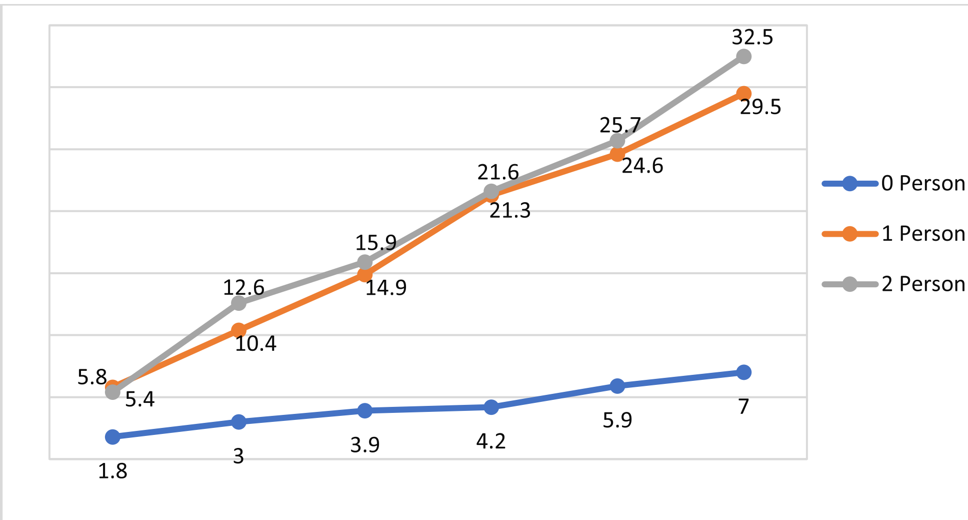



**Figure 12**. Comparison graph of electric current (A) with load

## 4. CONCLUSIONS

The results of the overall conclusion from making the boat to testing the boat are that the boat has good buoyancy and there are no leaks on the boat wall. The use of resin on the boat wall can increase the durability of the hull and the boat wall is stronger. The solar tracker system and boat drive system run according to the desired goal, namely the solar tracker system can follow the movement of sunlight well and the boat drive system made can run the boat smoothly. Resistance to battery life with a capacity of 20 ah can run the boat without load for 11.11 hours, with a load of 1 person obtained time 3.44 hours and with a load of 2 people or a maximum load of 150 kg can run the boat with a long time 3.70 hours. The operation of the boat uses a potentiometer as a speed regulator on the propeller with the condition that it is rotated to the left to move backwards and rotated to the right to move the boat forward. The drive system designed using a 1:6 ratio gearbox can provide boat thrust with a maximum speed of 5.7592 knots. With this boat, it can prove that the use of alternative energy from sunlight can be relied upon because it can reduce operational costs in terms of fuel and has a relatively small noise and even no sound produced and is environmentally friendly because it does not produce pollution that can pollute the surrounding air. The limitations of this research, namely fishermen can only fish from 07:00 to 17:00 WIB, because of dependence on sunlight and the ability of the battery to drive the boat at full load can only last 3 hours. So for future development, you can add battery capacity with a larger current and add solar panels with larger wattage specifications and upgrade the solar tracker from single axis to two axis so that it can direct solar panels in all directions to optimize faster battery charging. Then for future boat design development, you can use a boat hull with a V or W shape model. The use of the hull shape model can split the waves better, thereby reducing the drag that causes the boat to move better.

## ACKNOWLEDGEMENT

Many thanks to the editor and reviewer team for all their suggestions, input, and assistance in the process of publishing this manuscript. We would also like to thank all those who have been involved and helped in this research, both morally and materially.

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