

Smart longline: a tool to help fishermen detect fish and location with smartphone integration

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ABSTRACT

Longline is widely used by fishermen in Indonesia. The use of longlines, which require fishermen to go back and forth periodically to check the catch, creates problems of time and fuel. The goal of this research is the development of a fishing tool for fishermen that will be more efficient in terms of time and fuel. The method used in this research is a literature study related to the components to be used, design electrical, mechanical, interfaces and microcontractorel programs, as well as the assembly of components and test tools. The research was conducted from March to July 2022 at the Batam State Polytechnic with the test site at Nongsa Beach, Batam City. The result of this research is an smart longline prototype that can detect fish pulls using accelerometers as vibration detectors on each hook, and locate using GPS features processed by the Mappi 32 microcontroller using LoRa communication. The information is displayed on the fishermen's smartphones. This allows the fishermen to monitor their catch without having to regularly check the longline. This tool is also equipped with a solar panel as a power source. This allows it to operate for 25 hours above sea level. Future proposals for this research include making smart longline capable of detecting the species of fish caught. This would help fishermen analyze the species of fish in these waters.

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1. Introduction

Indonesian marine resources are rich in demersal fish. Therefore, fishing gear is important to support the sustainability of demersal fisheries. Bottom longlines are the most effective demersal fishing gear [1].

In terms of construction, the basic longline consists of a main rope, which is attached to the branch ropes in a row at a certain distance from each other, with a hook at each end, and then a float and sinker at certain points from the tip to the base [4]. The operation of the longline is carried out using a vessel equipped with mechanical equipment that functions to lower and raise the longline to the ship. The waiting phase is carried out after the longline gear has been lowered. The duration of this drift phase is 3 to 4 hours [2], [8].

This system is quite simple and the fisherman is not sure when all the baits on the line are consumed by the fish, so the line which is raised to the top of the boat is oftentimes less than the target catch, causing the fisherman to go back to the sea and wait again.

This research will result in a system that will allow fishermen to monitor how much bait has been associated with fish via smatphone, making it easier for fishermen to determine the right time to pull the longline onto the boat.



This system uses an accelerometer sensor as a fish-pull detector on each hook [7]. The data from the sensor is processed on the Mappi 32 microcontroller, which is able to differentiate the sensor reading when exposed to waves and fish pull [6]. There is also a GPS to mark the position of the longline in the middle of the sea. All this information is sent by LoRa communication from Mappi 32 on the longline to Mappi 32 in the fisherman's house, which is connected to the Internet network.

The data is stored in the firebase cloud database. It is then displayed in the application on the fisherman's smartphone. This system also uses a solar panel as an energy source with a capacity of 10 WP with a battery voltage of 12 volts, the two components above are connected using a solar charger so that the microcontroller can be powered by the solar charger [3].

2. Method

The method and stages of research implementation for making smart longline can be depicted in Fig. 1

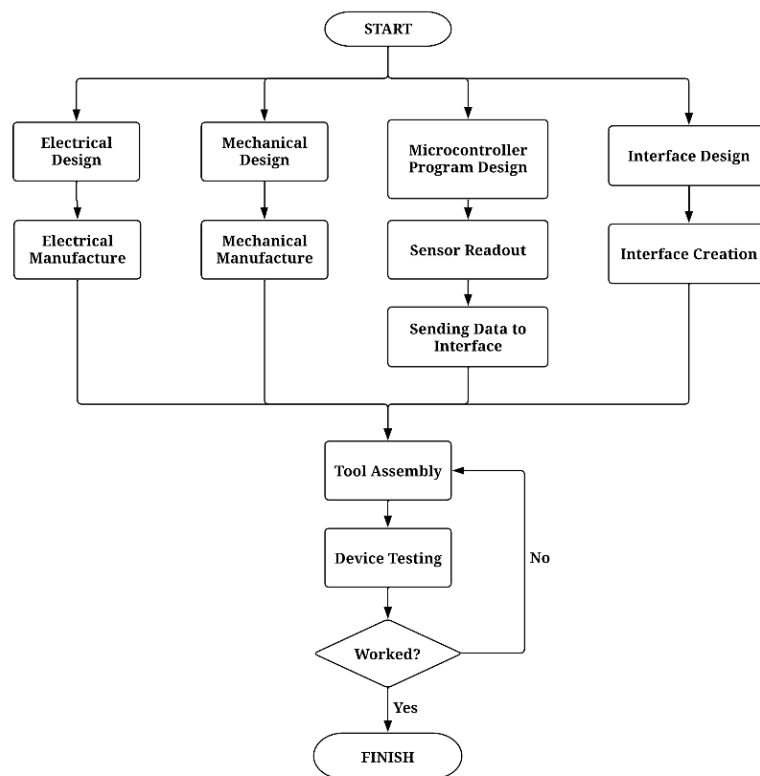


Fig. 1. Flowchart of implementation method

The implementation flow begins with a literature study of the system to be used, how the longline works, determination of the sensors needed, and how to display the sensor readings on a smartphone. Then the research phase continues with the design process, which consists of 4 points, to the process of making, assembling and testing the results.

2.1. Electrical Design and Manufacture

In the electrical design, there are a number of components that are used in the system. First is the power supply module, where there are solar panels as the power source and batteries as the energy

storage from the solar panels, as well as solar chargers as the link between the two components that will provide power to the microcontroller through the power USB connector. In the control module, there are 4 accelerometer sensors attached to each branch rope of the longline as a vibration detector when the fish eat the bait, and the GPS module as a marker of the location of the longline in the middle of the sea. Each sensor is connected to the microcontroller on specific pins so that the microcontroller can read the data from each sensor and the value of the GPS module.

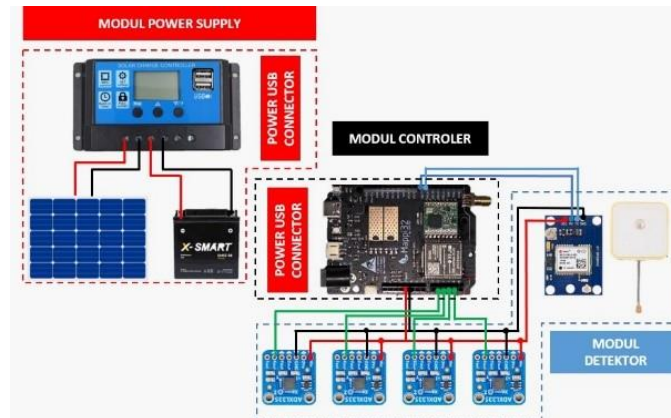


Fig. 2. Electrical design

2.2. Mechanical Design and Manufacture

The mechanical design uses a circular buoy with a diameter of 50 cm and a height of 20 cm. Inside the buoy are components such as the Mappi32 microcontroller, battery, DC-DC buck converter, step-down module and GPS, as well as solar panels and acrylic for the top cover. The main cable of the smart longline is 4 m long, and every 1m a branch cable is installed to attach the hook and the accelerometer sensor.

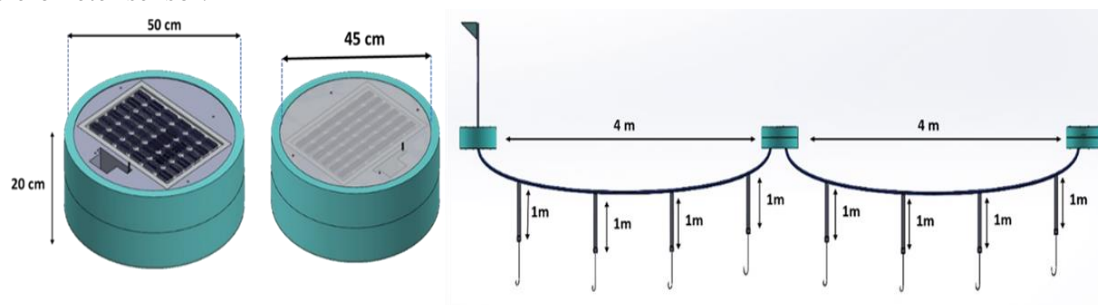


Fig. 3. Mechanical design

2.3. Perancangan Program Mikrokontroler

Design and build microcontroller programs using Arduino IDE to calibrate and read sensors. The data is sent from the Mappi transmitter to the Mappi receiver using LoRa communication to overcome the problem of network failures at sea, then the Mappi receiver connected to the Internet

network sends the data to the firebase cloud database, which is then displayed on the smartphone application.

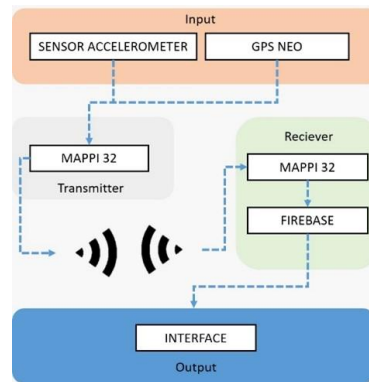


Fig. 4. Microcontroller program design

2.4. Interface Design and Creation

There are several menus such as register, login, longline position and today's catch in the interface design. All the menus have an attractive appearance and make it easier for fishermen to use the application. The creation of interfaces using the Android Studio application with the API: 18 using the Java programming language as a base. In the picture below you can see the database design in this system:

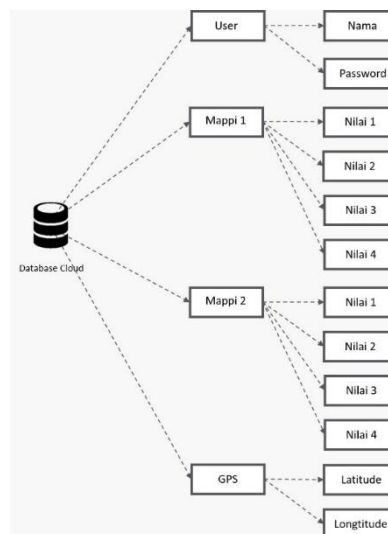


Fig. 5. Android studio database design

2.5. Device Test

The test was the installation of the smart longline prototype in the middle of the sea at Payung Beach, Nongsa, Batam City. In this test, data was collected from 8 sensors to measure the difference in value between the current vibration in the sea and the vibration when the bait is caught by fish. From the data, it is determined the maximum limit of the sensor reading value when it is in the sea without any fish pulling. It also calculates the efficiency of the tool in terms of fuel consumption, testing time and the data transmission distance that can be covered between the Mappi32 transmitter and the Mappi32 receiver.

3. Result and Discussion

3.1. Functional Products



Fig. 6. Functional products smart longline

The functional product of the smart longline consists of a round dummy with a diameter of 50 cm and a thickness of 20 cm, with a solar panel at the top as an energy source connected to a battery at the bottom of the solar panel, as well as a battery charger and Mappi32 as a microcontroller to send sensor readings to the Mappi32 receiver at the fisherman's house.

The surroundings of the dummy are covered with stickers and the upper and lower sides are covered with acrylic in the shape of a circle, which is connected with a 52 cm long thread iron. The two dummies are connected with a 4 m long hose, in which there is a rope as a place to hook the fishing line, as well as cables to connect the microcontroller to the sensors. The purpose of the hose is to prevent the cable from short-circuiting when exposed to seawater. Every 1 meter of the hose is connected to a branch cable wrapped in heat shrink tubing, with a kebel and sensor on the inside and a fishing line connected to the hook at the end.

This smart longline is designed to withstand the marine environment, which is prone to short circuits caused by water, and the use of dummies aims to keep all components stable on the rough sea surface.

The process of sending sensor data uses the same node address, so 2 Mappi32 transmitters will send 4 data values each, which are then parsed programmatically on the Mappi32 receiver. After parsing, the data is sent back to the Firebase cloud database in the format of 2 main nodes of the rawai with each node having a branch in the form of 4 sensor data which are then displayed in the application so that the sensor reading process can be monitored by the fishermen. This tool is also installed with GPS as a marker of the position of the longline, which produces output in the form of latitude and longitude of the position of the longline. The process of sending GPS data is also the same as the previous 8 sensors.

The operation of the Smart Longline begins with the deployment of the longline in the sea. When the fish eat the bait, the application displays the catch status along with the position of the longline on the map.

3.2. Interface Display

There are several menus in the Smart Longline application. These include Register, Login, Today's Catch and Longline Position. The Register menu prompts the fisherman to enter a username and password that will be used to access the login page. In the login menu, fishermen are asked to enter the username and password data that has been registered. Fishermen can press the Register button below the Login button if they do not have an account.

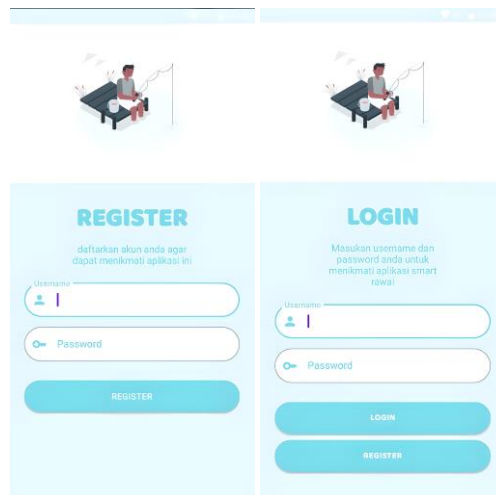


Fig. 7. Register and login page views

In the "Today's catch" menu, there are 8 fields with indicators in the form of YES or NO. The YES indicator means that the bait was eaten by the fish and the NO indicator means that the bait was not eaten by the fish. Creating 8 boxes divided in two on the application screen represents 2 dummies on the longline, each dummy having 4 hooks and sensors. In the Longline Location menu, the interface displays the location of the longline using GPS latitude and longitude.

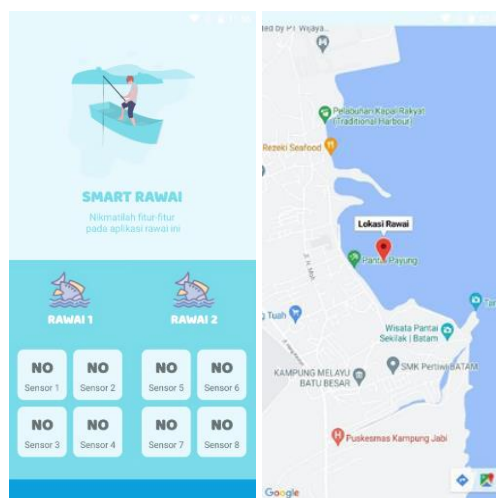


Fig. 8. Today's catch and location page view

3.3. Sensor Reading Result

The accelerometer sensor test is carried out by placing the sensor on each branch rope. The results of the sensor tests are plotted on a graph as shown below.

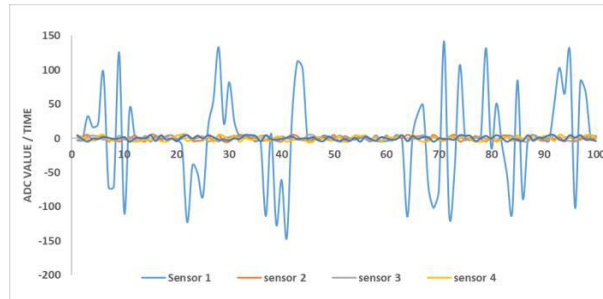


Fig. 9. Graph of sensor readings when lure is pulled by fish

In the graph above it can be seen that when the bait is eaten by fish (fish on) there is a very contrasting fluctuation in the accelerometer sensor graph. As for the results of the sensor readings on Mappi 1 and Mappi 2 when not eaten by fish, the results are as shown in Fig. 10 and 11.

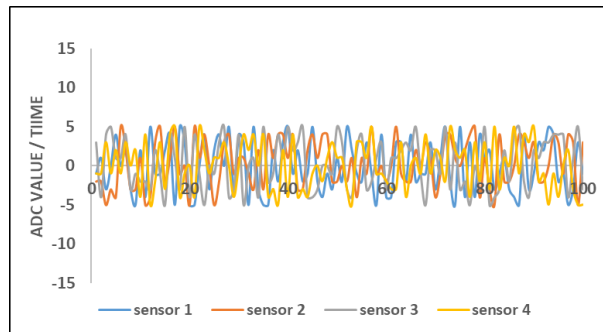


Fig. 10. Graph of sensor readings on mappi 1 when bait is not eaten by fish

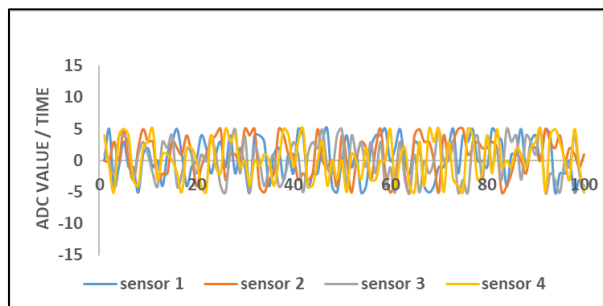


Fig. 11. Graph of sensor readings on mappi 2 when bait is not eaten by fish

For sensor readings that are only exposed to ocean waves without the pull of fish, the average maximum value of the sensor readings will be obtained. This value is the maximum detection limit for a sensor in an unfished condition. If the sensor reads the vibration value above the maximum limit of the sea wave value, Mappi will read the data as fish on data or the hook has been eaten by fish.

In testing the Neo 6M GPS tracking sensor, the Neo 6M GPS tracking device is placed on the dummy and its accuracy is compared with the GPS on the smartphone in the form of reading the latitude and longitude. From the results of the experiments carried out, we obtained the results shown in Table 1 below.

Table 1. Tests the accuracy of GPS NEO readings

GPS NEO 6M		GPS Smartphone		Distance Difference (m)
Latitude	Longitude	Latitude	Longitude	
1,100464	104,0554	1,100529	104,05545	8
1,119176	104,0578	1,119299	104,09997	5,5
1,104920	104,0533	1,199299	104,08897	11
1,154827	103,9978	1,145299	104,06057	7
1,098991	104,0534	1,199088	104,07057	11

3.4. LoRa Communication Test

The LoRa communication test is performed outdoors, with data being sent from the 4 sensors, which are combined into one packet and sent to the LoRa receiver. The test results show that the farthest LoRa data was sent at a distance of 2.2 km.

Table 2. LoRa communication distance test

Distance (m)	Data Transmit					Data Receiver	RSSI
	Data 1	Data 2	Data 3	Data 4	Packet Transmit		
200	10	15	30	35	#10#15#30#35&	#10#15#30#35&	-96
400	15	20	35	40	#15#20#35#40&	#15#20#35#40&	-92
600	20	25	40	45	#20#25#40#45&	#20#25#40#45&	-97
800	25	30	45	50	#25#30#45#50&	#25#30#45#50&	-92
1000	30	35	50	55	#30#35#50#55&	#30#35#50#55&	-93
1200	35	40	55	60	#35#40#55#60&	#35#40#55#60&	-93
1400	40	45	60	65	#40#45#60#65&	#40#45#60#65&	-82
1600	45	50	65	70	#45#50#65#70&	#45#50#65#70&	-94
1800	50	55	70	75	#50#55#70#75&	#50#55#70#75&	-102
2000	55	60	75	80	#55#60#75#80&	#55#60#75#80&	-118
2200	10	65	80	85	#60#65#80#85&	#60#65#80#85&	-115
2400	15	70	85	90	#65#70#85#90&	#@#\$%\$#@#8&	-143

3.5. Battery Power Capability

With a 12V 10Ah battery and a voltage of 3.6V, the Rawai Pintar can operate for 25 hours when not powered by the solar panel. This is calculated as follows.

Table 3. Smart longline power calculation

Component	Unit	Current (A)	Total Arus (A)	Total Current (w)
ADXL 335	4	0.00035	0.0014	0.00504
GPS NEO	1	0.01	0.01	0.36
Mappi 32	1	1.2	1.2	4.32
Total Beban				4.69

Battery Power 12v 10 Ah = 120 wh

$$Usage\ time = \frac{Battery\ Power}{Total\ Load} = \frac{120\ wh}{4.69\ wh} = 25.58\ h$$

The operating time of the "Smart Longline" with the use of a 12 V 10 Ah battery is 25 hours and 58 minutes.

3.6. Product Advantages

The advantages of smart longline over conventional longline are shown in Table 4.

Table 4. Smart longline advantages

Features	Conventional Loongline	Smart Longline
Know the coordinates of the location of longline	✗	✓
Detect catches in real time	✗	✓
Monitor the longline remotely	✗	✓

4. Conclusion

From all the research and testing activities, we have succeeded in making a Smart Rawai prototype that can function properly. The tool can work in the middle of the sea and can send sensor information with LoRa communication. The fishermen can use the smart longline application on a smartphone to find out the catch and the position of the longline, allowing the fishermen to monitor their catch without having to check it directly. It is hoped that this system can help fishermen to increase the efficiency of time and fuel use, which will have a good effect on the fishermen's catch.

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