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Fishing Vessel Position Monitoring System Based on the Internet of Things (IoT)

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KEYWORDS
Monitoring
Microcontroller
Global position system (GPS)
Fishing vessel

ABSTRACT – The life of traditional fishermen in Indonesia is closely related to the sea. Coastal communities rely on marine products as a source of daily livelihood. However, in recent years, many traditional fishermen have disappeared at sea. Based on those problems, it is necessary to create a tool in an effort to develop security for fishermen in the form of a position monitoring system that is able to reduce the risk of fishermen disappearing in the middle of the sea by using a better and more practical system. This research developed a system for monitoring the position of fishing vessels using an Arduino microcontroller. Based on the results of testing and analysis in this research, it is known that the position monitoring system on fishing vessels uses a NodeMcu LoLin V3 type microcontroller as a data processor and GPS Ublox Neo-6M as a sensor which functions to send location points on a fishing vessel. The coordinates of the location of the fishing vessel are then displayed on the smartphone via the Blynk application. So when the tracking tool is connected to the internet, the average difference in distance precision between the Ublox Neo 6M GPS and Google Maps is 2.3 meters. For input speed from NodeMcu LoLin v3 and GPS Ublox Neo 6M to the Blynk application displayed on the smartphone. Monitoring for 40 seconds showed that the data speed displayed was one location data per second. From the results of the tests carried out, this tool can work well and can be used to monitor fishing vessels continuously.

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INTRODUCTION

The life of traditional fishermen in Indonesia is closely related to the sea. They rely on marine products as their daily source of livelihood. However, unfortunately, in recent years, many traditional fishermen have disappeared at sea. According to Destructive Fishing Watch (DFW), Indonesia recorded that 83 fishermen disappeared at sea in the archipelago during the six months from December 2020 to June 2021. The disappearance of fishermen was triggered by 42 accidents, the majority of which were experienced by fishing vessels under 10 GT. Of the 42 incidents, 142 victims were recorded, with details of 83 missing, 14 dead and 42 survivors. On average, in one month, fishermen experience seven incidents, and they inevitably result in casualties. In Barru district itself, almost every year there are fishermen who disappear in the middle of the sea [1]. Based on this, fishing boats should be equipped with tracking features. The use of a tracking system can certainly provide more security where the system can help track the position and location of fishing boats. This system works with a Global Positioning System (GPS) sensor which is free to obtain data from satellites. GPS makes it possible to continue to know the whereabouts and position of the fishermen. The use of GPS technology and the use of internet media can be one solution to fishermen's safety problems. Based on those problems, a tool was developed in an effort to enhance security for fishermen with a position monitoring system that is able to reduce the risk of fishermen disappearing in the middle of the sea by using a better and more practical system.

Internet of Things (IoT)

Internet of Things is a concept where the virtual world of information technology merges with real objects in the real world. This is possible by providing certain sensors to an object so that the object can capture events that occur in the real world as data which is then sent to the server system. These sensors can be RFID or other sensors that work like human senses such as light, sound, pressure sensors, etc. In some internet of things systems, objects that have sensors are also given the ability to carry out reactions ordered by the server via an embedded controller based on what is happening in the surrounding environment. This allows work to be done without human intervention. For example, a temperature sensor placed on a boiler will capture a certain temperature height and send data to the server. The server will order the boiler to stop working via the controller when the temperature reaches a certain degree. In a case example of applying the Internet of Things concept to the manufacturing industry, the flow of information that occurs is depicted in Figure 1. This figure explains that the source of the data flow comes directly from objects that are used to support work in the field. These objects are equipped with sensors that will capture certain data and send it to the server to be combined with data from other sources. This large amount of data is usually called Big Data. This server will then process this data into information needed by the related work units [2].

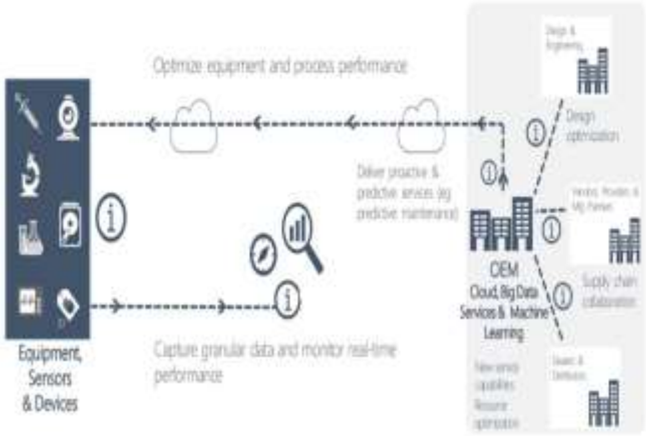


Figure 1. Information flow in industry with the Internet of Things concept [2]

Katinting Boat

Katinting is a traditional boat that is still widely found in South Sulawesi Province. Katinting boats can be categorized as traditional boats because these boats are made and used traditionally by the community like fishing boats that are commonly found in Indonesia [3,4]. In contrast to the modern ship design process, the construction of traditional ships such as the Katinting ignores the line plan technology in its construction, the ship's skin is made first and then the frame (wooden beams) is installed inside [5,6]. This is in line with the statement of [7] explaining that the term traditional refers more to the methods or methods used by fishing boat craftsmen in constructing their boats, where the methods or methods used are inherited from their predecessors. The name of the katinting boat in South Sulawesi Province was originally caused by the engine used to move this type of boat being the katinting engine, so that the name katinting has become attached to the community and calls boats that use this type of engine "katinting boats" As time goes by, katinting boats not only is it based on the use of a katinting engine as the main driver, but another thing that determines whether a boat can be categorized as a katinting boat by fishermen is the presence of outriggers (South Sulawesi Province people call it 'Sema-Sema") on both sides of the boat lengthwise. The existence of outriggers also makes a significant contribution to the cultivation of katinting boats by the community.

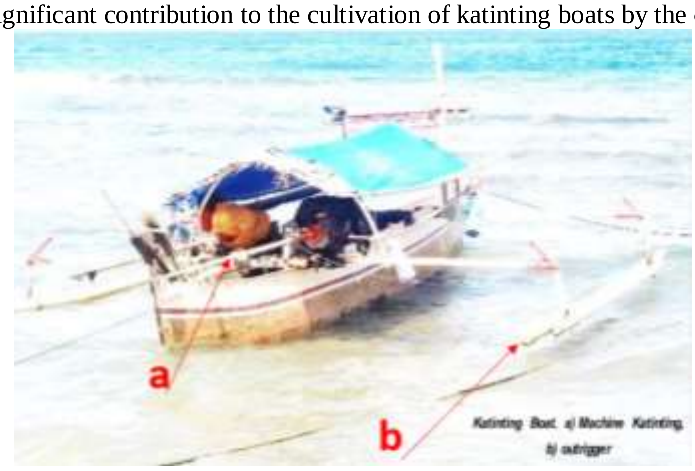


Figure 2. Katinting Boat

Microcontroller

A microcontroller is a chip that functions as an electronic circuit controller and can store programs in it. The use of a microcontroller is more profitable than the use of a microprocessor. This is because with a microcontroller there is no need to add external memory and I/O as long as the internal memory and I/O are still sufficient. Apart from that, the production process is mass, so the price is cheaper than microprocessors. A microcontroller chip generally has the following features:

1. Central processing units ranging from simple 4-bit processors to high performance 64-bit processors.
2. Input/output network interface such as serial port (UART).
3. Other serial communication interfaces such as IC, serial peripheral interface and controller area network for system connection.
4. Peripherals such as timers and watchdogs.
5. RAM to store data.
6. ROM, EPROM, EEPROM or flash memory to store programs on the computer.
7. The clock generator is usually an RC circuit resonator.
8. Analog to digital converter [8].

Apart from that, the microcontroller is also a small computer that can be programmed using the C programming language so that it produces commands in the form of coding and can send data to sensors. To be able to access data from sensors remotely, you can use the NodeMCU module so that data obtained from sensors can be sent via the internet. This NodeMCU is a microcontroller that is equipped with an ESP8266 Wifi module which has been integrated with the internet in it [9].

Global Positioning System (GPS)

The Global Positioning System (GPS) is a satellite-based radio navigation system developed by the United States Department of Defense. The GPS system consists of an array of 24 satellites orbiting the earth in 6 circular orbits. The satellites are arranged so that at any one time there are 6 satellites within range of the GPS receiver. GPS consists of three parts, namely space segment (outer space), ground segment (earth) and user segment (user). The space segment (outer space) is a satellite, there are 24 active satellites, 6 orbital planes with an inclination (angle between the plane that is the reference and the plane whose inclination is measured) of 55°, with a 12 hour orbital period, a height of 20,000 km, with The satellite's approximate speed is 4 km/sec.

RESEARCH METHOD

The first step in designing is to create a block diagram to use as reference in building tools. Figure 3 shows block diagram of suitcase tracking using GPS. This matter allows writers to easily compose a series that will later be put in the boat.

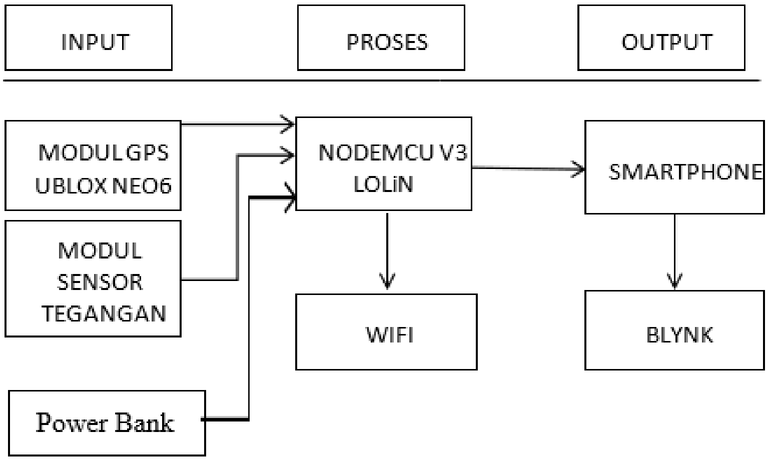


Figure 3. Block Diagram of Hardware (Hardware)

The block diagram in Figure 3 is the work flow of the overall fishing vessel tracking system. NodeMCU is used as a processing center. NodeMCU can translate data from analog signals to digital or vice versa. NodeMCU can also receive data issued by the Ublox NEO-6M GPS Module which functions to send the coordinates of the location of the fishing vessel in real time and a voltage sensor which functions to reduce the voltage provided by the battery or power bank. After the NodeMCU receives data from the Ublox NEO-6M GPS module and voltage sensor, the NodeMCU will provide information on the coordinates of the fishing boat's location and voltage to the smartphone and can be accessed via the Blynk application [10].

1. Hardware Design

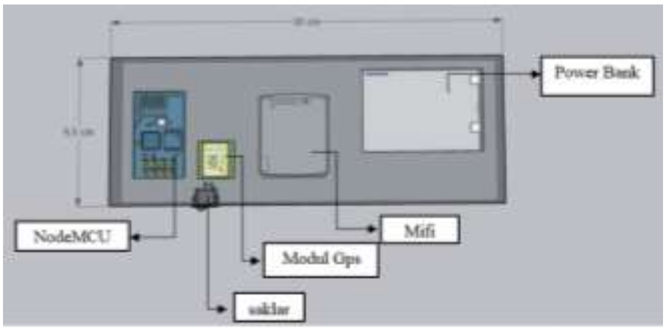


Figure 4. Top view of tool design

Figure 5. Side view of tool design

2. Tool Prototype

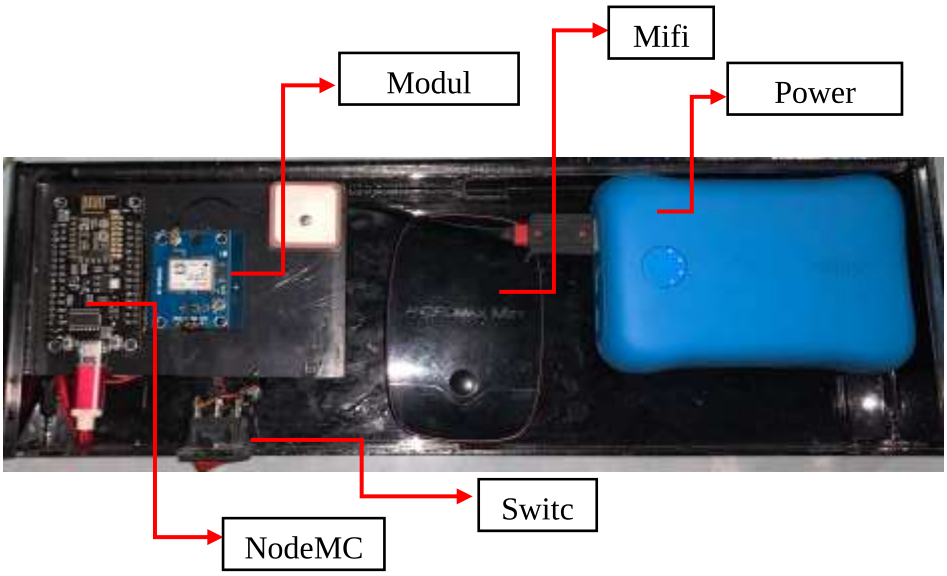


Figure 6. Set of tools

Test Equipment

1. NodeMCU V3 LoLin

The block diagram above is the work flow of the overall fishing vessel tracking system. NodeMCU is used as a processing center. NodeMCU can translate data from analog signals to digital or vice versa. NodeMCU can also receive data issued by the Ublox NEO-6M GPS Module which functions to send the coordinates of the location of the fishing vessel in real time and a voltage sensor which functions to reduce the voltage provided by the battery or power bank. After the NodeMCU receives data from the Ublox NEO-6M GPS module and voltage sensor, the NodeMCU will provide information on the coordinates of the fishing boat's location and voltage to the smartphone and can be accessed via the Blynk application [10].

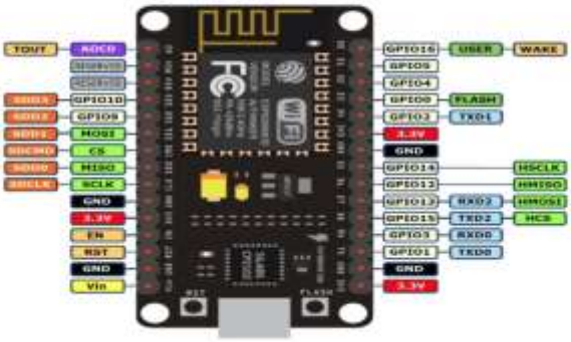


Figure 7. NodeMCU LoLin V3 Board Schematic

Table 1. Specifications of NodeMCU LoLiN V3

Microcontroller	Tensilica 32-bit RISC CPU Xtensa LX106
OperatingVoltage	3.3 V
Input Voltage	7-12 V
Digital I/O Pins (DIO)	16
Analog Input Pins (ADC)	1
UARTs	1
SPIs	1
I2Cs	1
Flash Memory	4 MB
SRAM	64 KB
Clock Speed	80 Hz

2. Ublox NEO-6M GPS Module

The APM2.5 NEO-6M GPS (Global Positioning System) module measures 25x35mm for the module, 25x25mm for the antenna. The APM2.5 NEO-6M GPS module functions as a GPS receiver (Global Positioning System Receiver) which can detect location by capturing and processing signals from navigation satellites. Applications of this module include navigation systems, security systems against theft on vehicles/mobile devices, data acquisition on terrain mapping systems, location tracking, and others. This module is APM2 and APM2.5 compatible with integrated EEPROM (Electrically Erasable Programmable Read Only Memory) that can be used to store configuration data. Interface communication uses serial TTL (Transistor Transistor Logic) (RX/TX) which can be accessed from a microcontroller that has a UART (Universal Asynchronous Receiver Transmitter) function or TTL serial emulation (on Arduino you can use the serial communication library which is already available in Arduino IDE package). Baud rate is set by default at 9600 bps. The GPS Processor of this module uses the u-blox NEO-6 GPS Module. This module can process up to 50 signal channels quickly with a Cold TTFF (Cold-Start Time-To-First-Fix, the time required to determine the position from a total dead condition) of less than 27 seconds [12].

3. Power Bank

A power bank or power bank is a device used to input electrical energy into a battery that can be recharged without having to connect the device to an electrical outlet. This battery charger is classified as portable because it is different from battery chargers which must be connected to an electrical outlet. Power banks have the capacity to tamp electrical energy so that when the power has been used up, the electrical energy must be refilled by connecting the cable to an electrical outlet [13].

4. Blynk App

Blynk is an open data platform and application programming interface (API) for IoT that allows users to collect, store, analyze, visualize and actuator. Blynk also has apps for iOS, OS, and Android to control Arduino, NODEMCU, Raspberry Pi and the like over the Internet. This application can be used to control hardware devices, display sensor data, store data, visualize, and so on. The Blynk application has 3 main components, namely applications, servers and libraries. Blynk server functions to handle all communications between smartphones and hardware. Widgets available on Blynk include Button, Value Display, History Graph, Twitter, and Email. Blynk is not tied to several types of microcontroller but must be supported by the selected hardware. NODEMCU is controlled with the internet via WIFI, ESP8266 chip, Blynk will be made online and ready for the Internet of Things [14].

RESULTS AND DISCUSSION

After going through several stages of design and refinement, the design of the fishing vessel position monitoring system can function in accordance with the controller program provided. The results of the design along with testing and analysis of the fishing vessel position monitoring system will be explained in this chapter.

This test uses the Blynk application on a smartphone to display GPS location points. This test was carried out at several locations to get the right data, then the data obtained from the GPS location points in the Blynk application will be compared with the location coordinates on Google Map. The results obtained can be seen in Figure 8.

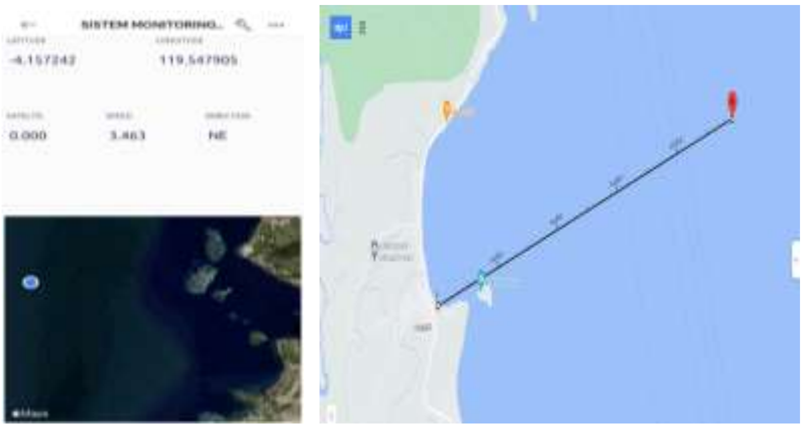
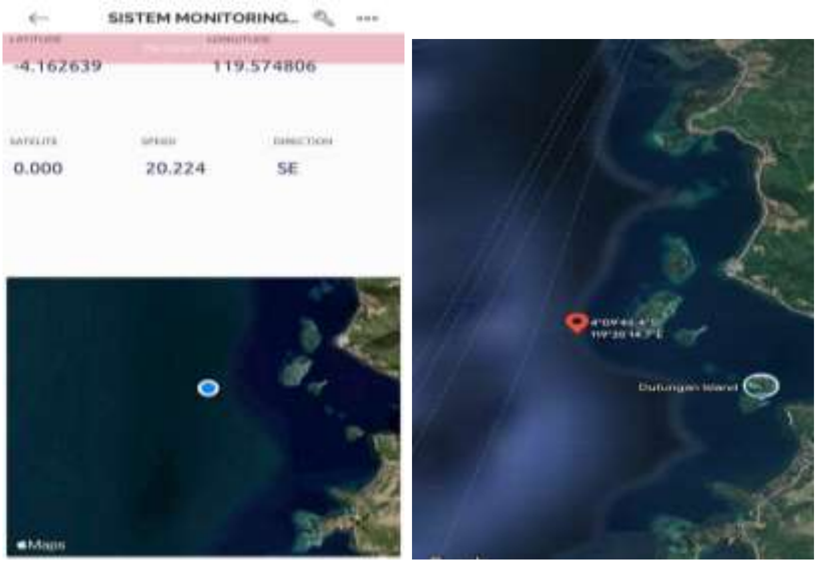


Figure 8. Location Points of 1 Fishing Boat on the Blynk Application and Google Maps



. **Figure 9.** Location Points of 2 Fishing Boats on the Blynk Application and Google Maps

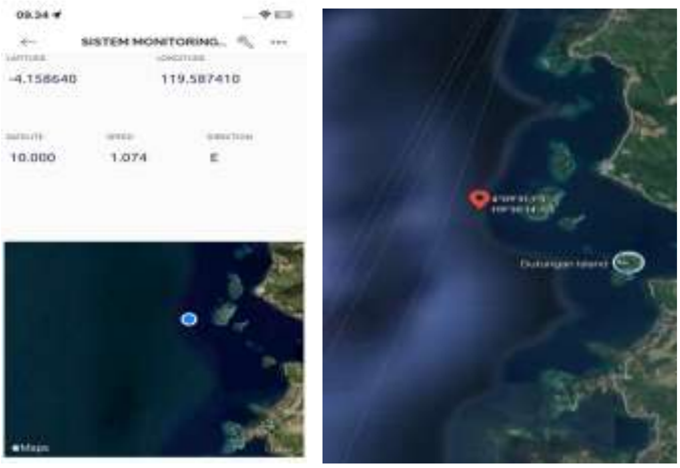


Figure 10. Location Points of 3 Fishing Boats on the Blynk Application and Google Maps

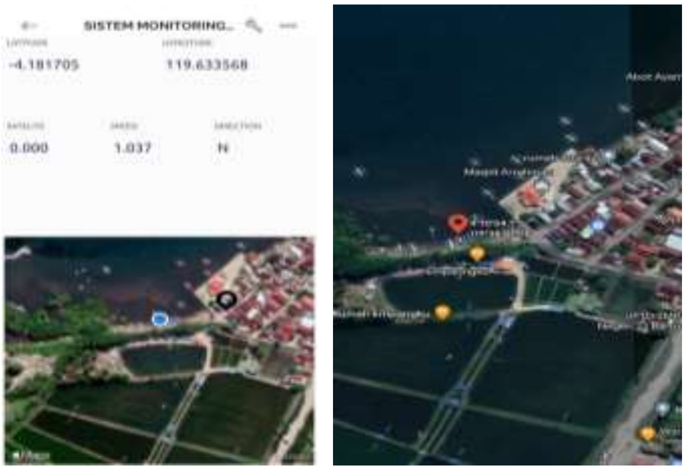


Figure 11. Location Points of 4 Fishing Boats on the Blynk Application and Google Maps

Next, look for the difference in distance between the Blynk application and Google Maps

Asked: The level of precision between a fishing boat's GPS and its actual location on Google Map?
Answer :

Distance = $\sqrt{(\text{Latitude}_1 - \text{Latitude}_2)^2 + (\text{Longitude}_1 - \text{Longitude}_2)^2}$

Distance = $\sqrt{(-4.157242 - (-4.1572857))^2 + (119.547905 - 119.5479538)^2}$

Distance = 0.058019063523 x 111319 meters (1 earth degrees = 111.319 km)

Distance = 6.45 meters

Table 2. Test Data on the Level of Precision of Tracking Systems on Fishing Vessels

No	Location	GPS coordinates blynk	Google map coordinates	Difference result (meters)
1	Point 1	LAT: -4.157242 LONG: 119.547905	LAT: -4.1572857 LONG: 119.5479538	6.45
2	Point 2	LAT: -4.162639 LONG: 119.574806	LAT: -4.162620 LONG: 119.574811	1.69
3	Point 3	LAT: -4.158640 LONG: 119.587410	LAT: -4.158648 LONG: 119.587405	1.11

4	Point 4	LAT: -4.181705 LONG: 119.633568	LAT: -4.181701 LONG: 119.63365	0.083
Average Distance Difference				2.33

Table 2 shows the precision of the results from the test. The data collection was conducted in 4 (four) locations. The exact position location was taken from blynk and google map coordinates for comparison. From Table 2, it is found that the average difference in distance between the position of the fishing boat in the Blynk application and the position of the fishing boat on Google Maps is 2.33 meters. This difference can be considered quite accurate.

Testing Data Input Speed on Blynk

This test was carried out to review the input speed of ESP 8266 data and the GPS module to the Blynk application with the smartphone used for monitoring. The results obtained can be seen in Table 3. The data displayed spans 37 seconds of sending data to the Blynk application.

Table 3. Data Input Speed Testing to the Bylnk Application

No	Input time to the Blynk (hours, minutes, seconds)	Coordinate point
1.	08:47:00	LAT: -4.154738, LONG: 119.548042
	08:47:01	LAT: -4.154745, LONG: 119.548065
2.	08:47:02	LAT: -4.154751, LONG: 119.548080
3.	08:47:03	LAT: -4.154758, LONG: 119.548103
4.	08:47:04	LAT: -4.154778, LONG: 119.548141
5.	08:47:05	LAT: -4.154788, LONG: 119.548157
6.	08:47:06	LAT: -4.154798, LONG: 119.548172
7.	08:47:07	LAT: -4.154808, LONG: 119.548195
8.	08:47:08	LAT: -4.154819, LONG: 119.548210
9.	08:47:09	LAT: -4.154829, LONG: 119.548233
10.	08:47:10	LAT: -4.154839, LONG: 119.548248
11.	08:47:11	LAT: -4.154849, LONG: 119.548271
12.	08:47:12	LAT: -4.154859, LONG: 119.548286
13.	08:47:13	LAT: -4.154868, LONG: 119.548309
14.	08:47:14	LAT: -4.154880, LONG: 119.548332
15.	08:47:15	LAT: -4.154891, LONG: 119.548347
16.	08:47:16	LAT: -4.154901, LONG: 119.548363
17.	08:47:17	LAT: -4.154911, LONG: 119.548386
18.	08:47:18	LAT: -4.154920, LONG: 119.548409
19.	08:47:19	LAT: -4.154930, LONG: 119.548431
20.	08:47:20	LAT: -4.154941, LONG: 119.548454
21.	08:47:21	LAT: -4.154951, LONG: 119.548470
22.	08:47:22	LAT: -4.154962, LONG: 119.548492
23.	08:47:23	LAT: -4.154974, LONG: 119.548508
24.	08:47:24	LAT: -4.154986, LONG: 119.548531
25.	08:47:25	LAT: -4.154997, LONG: 119.548546
26.	08:47:26	LAT: -4.155008, LONG: 119.548569
27.	08:47:27	LAT: -4.155019, LONG: 119.548592
28.	08:47:28	LAT: -4.155027, LONG: 119.548607
29.	08:47:29	LAT: -4.155041, LONG: 119.548622
30.	08:47:30	LAT: -4.155057, LONG: 119.548630
31.	08:47:31	LAT: -4.155072, LONG: 119.548645
32.	08:47:32	LAT: -4.155087, LONG: 119.548668
33.	08:47:33	LAT: -4.155100, LONG: 119.548691
34.	08:47:34	LAT: -4.155108, LONG: 119.548714

35.	08:47:35	LAT: -4.155117, LONG: 119.548737
36.	08:47:36	LAT: -4.155127, LONG: 119.548759

Table 3 shows the coordinate points or location of the vessel produced by the system. From the results of the data collection in Table 3, the input speed from the NodeMcu LoLin v3 and GPS Ublox Neo 6M to the Blynk application displayed on the smartphone is obtained. From the results of monitoring for 37 seconds, it was found that the data speed displayed was one location data per second.

CONCLUSION

Based on the results of tool design through testing and discussion, the following conclusions were obtained: Design of a position monitoring system on a fishing boat using a NodeMcu LoLin V3 type microcontroller as a data processor and GPS Ublox Neo-6M as a sensor whose function is to send location points on a fishing boat which then displays the coordinates of the location of the fishing boat on a smartphone via the Blynk application .The working principle of the position monitoring system on this fishing boat is that the Ublox Neo 6M GPS will read the location of the fishing boat which will then be sent to the NodeMcu LoLin V3 for processing and will be displayed on the Blynk application which is available on smartphones in the form of displaying points on maps. . From the results of tests carried out, GPS can work well and continuous monitoring can be carried out if the tracking device is connected to the internet and the average difference in distance precision between the Ublox Neo 6M GPS and Google Maps is 2.3 meters. For input speed from NodeMcu LoLin v3 and GPS Ublox Neo 6M to the Blynk application displayed on the smartphone. From the results of monitoring for 37 seconds, it was found that the data speed displayed was one location data per second. Please note that the speed of inputting position data can also be influenced by other factors in the field, such as weather and environmental conditions, network coverage, and the reliability of the hardware used. Careful planning and selecting the right technology will be the key to achieving optimal speed and accuracy of IoT-based fishing vessel position data input.

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