Application of the Automatic Identification System Transponder for Monitoring the Safety of Fishing Vessels

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Abstract: Bengkalis Island is located between the island of Sumatra and Malaysia and is surrounded by the Melaka Strait and the bengkalis Strait. The Melaka Strait and the bengkalis Strait are the traffic of ships such as import-export ships, company ships, passenger ships, freight ships, fishing boats, passenger ships, and illegal ships. According to news circulating in the official media, ship accidents such as fishing boats often occur. This happens because many fishing boats do not have or use AIS technology. This research proposes the application of Automatic Identification system (AIS) transponder for safety monitoring of fishing boats. This system can track the position of surrounding ships and can be tracked through the Polbeng AIS base station, so that it can be monitored directly through the Polbeng AIS application. The trial was conducted directly on the ship located in the bengkalis strait. From the results of the experiments carried out, it shows that the system can track ships around and can be tracked through AIS Polbeng, so that ship safety is more guaranteed and monitored.

Keywords: melaka-bengkalis strait; fishing boats; safety; automatic identification system; tracking; monitoring;

1. Introduction

Bengkalis Island is an island in Riau Province, also the main island of Bengkalis Regency. It is where the regional government center of Bengkalis district is located.

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The island is bordered by the Malacca Strait to the east, north and west, and the Bengkalis Strait to the south.

The Strait of Malacca is a strait located between Malaysia and the island of Sumatra (Indonesia). Economically and strategically, it is one of the most important shipping lanes in the world, as important as the Suez Canal or the Panama Canal. The Strait of Malacca forms a shipping channel between the Indian Ocean and the Pacific Ocean and connects three of the world's most populous countries: India, Indonesia and the People's Republic of China. As many as 50,000 ships pass through the Strait of Malacca each year, carrying between a fifth and a quarter of the world's maritime trade. As much as half of the oil transported by tankers passes through the strait; in 2003, that number was estimated at 11 million barrels of oil per day, a number that is sure to increase given the huge demand from China. Since the Malacca Strait is only 1.5 nautical miles wide at its narrowest point, Phillips Strait near Singapore, it is one of the most important traffic bottlenecks in the world. The existence of the Malacca Strait as one of the most important trade routes in the world cannot be separated from various interests. In terms of economic and military interests, the Malacca Strait is a very strategic choke points for the projection of naval fleets of countries that have interests in the Asia Pacific Region. In fact, the Malacca Strait can also be a "tool" in order to forward presence to all corners of the world [3] [4].

Politeknik Negeri Bengkalis has a Center of Excelent (CoE) on "Infrastructure Development of the Melaka Strait Coastal Area". This CoE has developed an AIS base station in collaboration with AIS ITS Surabaya. In addition, in 2022 through the Matching Fund program it has developed an AIS- Radar. Furthermore, this CoE strives to continue to develop research in the field of Ship Security and Safety in the waters of the Strait of Melaka.

Polbeng AIS base station functions as an AIS receiver that can track and record AIS data from surrounding ships that pass through the Melaka Strait and Berngkalis Strait. Polbeng AIS can track AIS with a radius of 80 kilometers [1] [2]. AIS data can be viewed on a website-based application with the address https://aispolbeng.id.

This research proposes the application of AIS transponder board for monitoring the security and safety of fishing boats in bengkalis. This system can track nearby ships that have AIS devices so as to avoid ship accidents at sea. In addition, this AIS can also be tracked through the AIS base station Polbeng to be monitored through the AIS monitor Polbeng application.

2. Study Literature

2.1. Automatic Identification System

Automatic Identification System (AIS) is a system for tracking and identifying vessel traffic automatically. Vessel Traffic Service (VTS) is used to identify, transmit and receive information. There are two types of data received: 1) Data exchange from one ship to another using the AIS Base Transceiver System (BTS) and satellites, 2) the

ship directly sends data without intermediaries. In the monitoring process using AIS, several data will be obtained including Maritime Mobil Service Identity (MMSI), ship speed (Speed Over Ground), ship position (longitude and latitude), navigation status, Course Over Ground (COG) and others. The data information recorded by AIS is real-time ship data with a delivery time of every 2 to 10 seconds depending on the speed of the ship while sailing [5].

Automatic Identification System (AIS) is a very vital system in sea transportation, because it helps to automatically track ships, ship positions. AIS with the vessel traffic service (VTS) can identify and locate ships and allow data exchange with other ships nearby. AIS is required by the International Maritime Organization (IMO) International Convention For The Safety Of Life At Sea (SOLAS) and became effective on December 31, 2004 for all cargo ships with a Gross Tonnage (GT) of more than equal to 300 GT on international voyages, all cargo ships above 500 GT and also for all passenger ships regardless of size [6].

Automatic Identification System (AIS) is an automatic tracking system used on ships and by vessel traffic services (VTS) to identify and locate ships by electronic data exchange with other nearby ships, AIS base stations, and satellites [7]. When satellites are used to detect AIS signatures the term Satellite-AIS (S-AIS) is used. AIS information complements marine radar, which continues to be the primary method of collision avoidance for water transportation. Information provided by AIS equipment, such as unique identification, position, course and speed, can be displayed on a display or ECDIS. AIS is intended to assist ship watchstanders and allow maritime authorities to track and monitor vessel movements.

AIS integrates a standard VHF transceiver with a positioning system such as GPS or LORAN-C receiver, with other electronic navigation sensors, such as a gyrocompass or turn indicator level. Vessels equipped with AIS transmitter- receivers and transponders can be tracked by AIS base stations located along the coastline or, when out of range of terrestrial networks, via a growing number of satellites equipped with specialized AIS receivers capable of deconflicting a large number of signatures [8].

2.2. AIS Base Station

AIS Base Station is a technology developed to provide a complete facility that can monitor the traffic situation of ships in their observation area. Not all vessels can be monitored by the Base Station, only vessels with AIS transceiver devices installed can be monitored. AIS Transceiver technology works using VHF radio communication at maritime frequencies 161.975 and 162.025. Ships with AIS Transceiver technology installed at these frequencies will automatically send AIS messages in all directions. AIS messages are sent in the form of Mobile Matirime System Identification (MMSI) / Ship ID information, ship coordinate position, ship steering direction, ship speed, Ship Name, and so on so that other ships in the vicinity that are also equipped with AIS Transceiver devices can find out the traffic conditions around them through the Electronic Chart Display Information System (ECDIS) monitor display screen [2] [9] [10].

3. Methodology

The application of AIS for ship safety monitoring has 2 parts, namely the AIS transponder installed on the ship and the AIS base station installed on the Polbeng campus. The proposed system design can be shown in Figure 1.

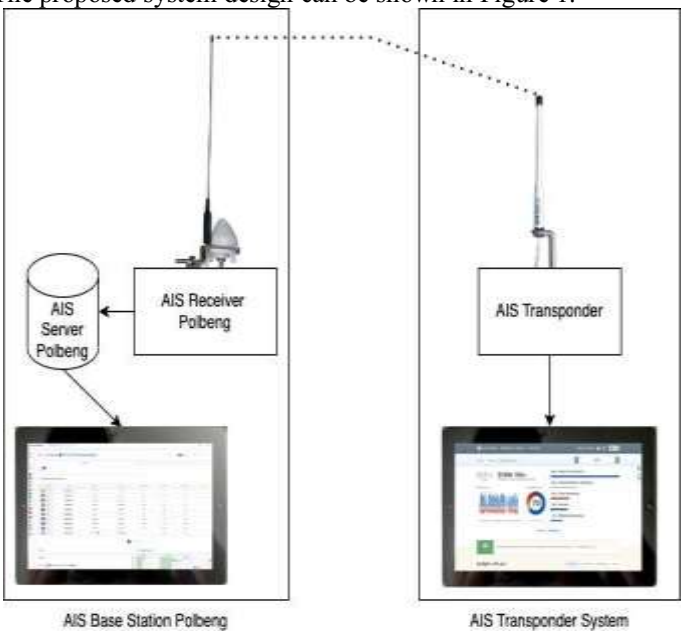

Fig. 1 AIS implementation design for ship safety monitoring

3.1. AIS Transponder System

The proposed AIS transponder system has several main parts: power supply, AIS transponder system, data processing, and data display. The main diagram of the proposed system can be shown in Figure 2.

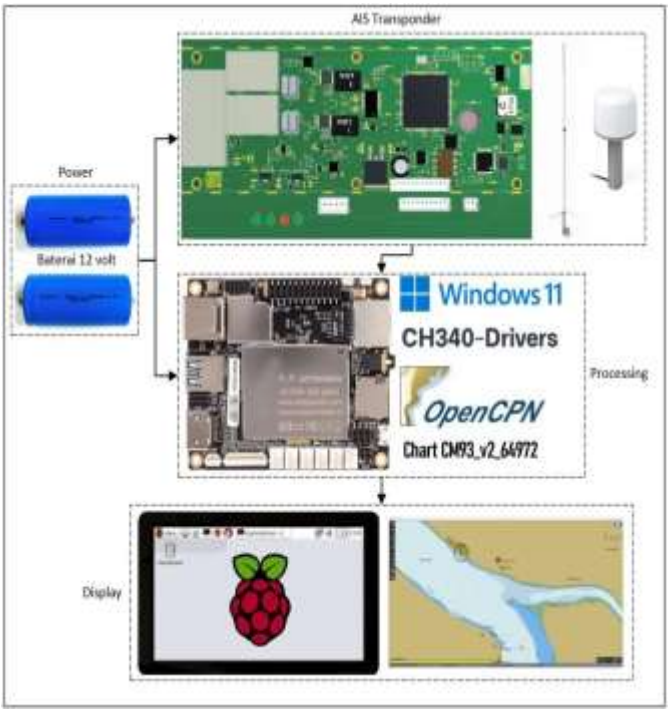

Fig. 2 AIS transponder system

The power supply uses a 12-volt battery. This power is used to supply power to the AIS transponder and mini PC. Meanwhile, the power for the display monitor will be supplied from the mini PC power. Power Supply is an electrical component that functions as a converter of AC voltage into DC. To supply power to electronic components sourced from DC Voltage.

AIS transponder board class B is used to receive information transmitted by other ships and transmit AIS information to other ships and base stations. The information exchanged is in the form of MMSI code, ship name, call sign, ship type, GPS antenna position, ship position, SOG (speed over ground), COG (direction over ground), UTC date and time, GPS antenna type, and PA (position accuracy).

A. The mini PC is used to process the AIS data. This research uses a 4/64 GB latte panda mini PC. AIS data is transferred from the AIS transponder to the mini PC through the NMEA data interface to DB9 which is converted to RS232 and then enters the PC through the Port. AIS data is tested using Hyperterminal to determine the AIS data connection. AIS data is then displayed to maps in the form of ship objects using OpenCPN. To update maps to be more accurate by adding Chart maps. Mini displays are used to display data or maps to the layer. The mini display used is a 7 inch HDMI LCD for Raspberry Pi and Windows

Capacitive Touchscreen.

3.2. AIS Base Station Polbeng

AIS base station is used to monitor ships around the waters of the bengkalis and melaka straits. The ships being monitored are ships that have AIS transponder devices on board. AIS base station polbeng can track with a radius of about 100 km. This system has a local server to store AIS data that is tracked, so that the history of AIS data will always be stored and can be seen at any time [2]. Polbeng AIS system architecture can be shown in Figure 3.

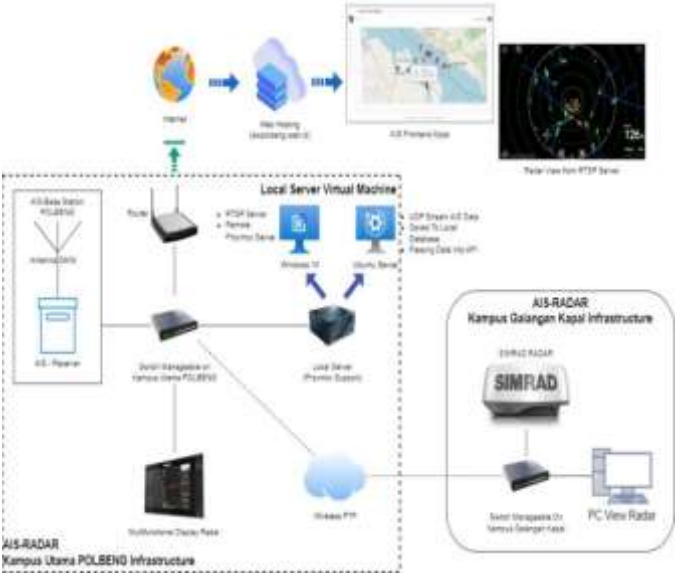

Fig. 3 AIS base station Polbeng

3.3. Implementation and Result

The implementation results in the form of an AIS transponder system installed on fishing boats. This system is used to track nearby ships so as to avoid ship accidents. The results of the AIS transponder system implementation can be shown in Figure 4.

Fig. 4 AIS transponder design result

AIS transponders were tested for tracking nearby ships that have AIS devices. The experiment was conducted with a ship distance of 3 km. AIS data is displayed on a map using OpenCPN software. The results of the experiment showed that there were 3 ships detected with a distance of 3 km. The tracking results of the AIS Transponder can be seen in Figure 5.

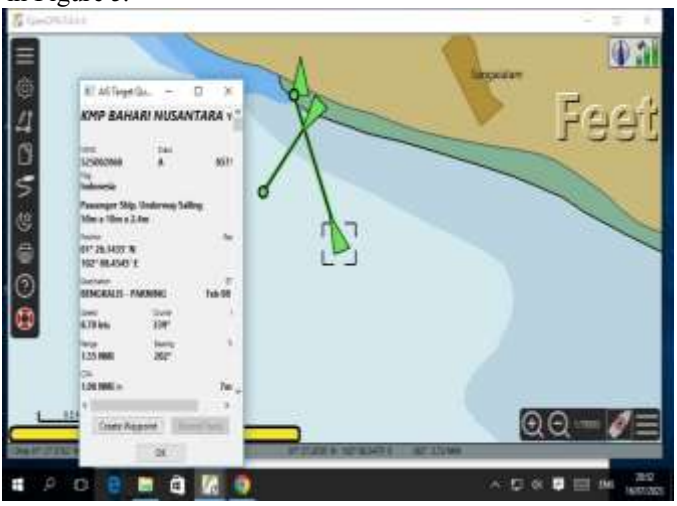

Fig. 5 Ship tracking results via AIS transponder

AIS base station polbeng can track ships with AIS devices connected to AIS base station polbeng. Monitoring is done using a website-based application. The monitoring results can be seen in Figure 6.

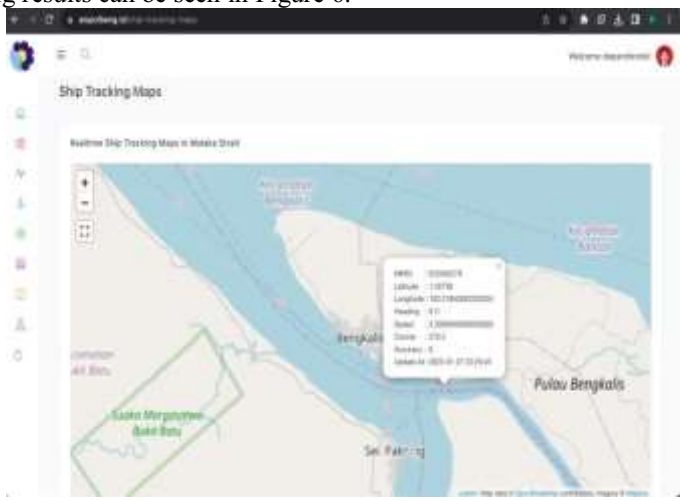

Fig. 6 Monitoring results through AIS base station Polbeng

To measure the success of the system, experiments were carried out on the system. Tests were carried out using 2 scenarios, namely testing the functionality of each component used and testing the system as a whole.

Functionality trials were conducted to measure the success of each component used. The components used are 12 volt battery, AIS transponder board, AIS Antenna, GPS and GPS Antenna, NMEA to RS232, mini PC, OpenCPN, 7 inch display. The results of the functionality test can be shown in Table 1.

TABLE 1. FUNCTIONALITY EXPERIMENT RESULTS

Component	**Experiment results**	
	Test results	***Description***
Baterai 12 volt	Successful	The battery can provide power to the AIS transponder and Mini PC
AIS transponder board	Successful	AIS devices can send and receive AIS data.
Antenna AIS	Successful	AIS devices can connect with Polbeng base station AIS devices and AIS of surrounding vessels

GPS dan Antenna GPS	Successful	The device can determine the coordinate position on the map.
NMEA to RS 232	Successful	The device can send data from the AIS transponder board to the mini PC
Mini PC	Successful	The device can process AIS data.
OpenCPN	Successful	Can record AIS data and display it as a ship object on a map.
Display 7 inch	Successful	The device can display data from the mini PC.

Table 1 shows that each component used in the system can run according to its functionality. This shows that the proposed system can send AIS data to the AIS base station polbeng and other AIS devices installed on ships in the AIS coverage radius. In addition, it can receive AIS data so as to be able to track nearby ships that have AIS devices.

CONCLUSION

The proposed system is an AIS transponder system that can be used to track ships that have AIS devices. By tracking ships, it can avoid ship accidents. AIS transponders can also be monitored through the Polbeng AIS base station, so that ship security and safety are well controlled. The trial was conducted by tracking ships that have AIS devices. The test results show that the AIS transponder can track ships with a distance of 3 km.

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