

Integrated Port Traffic Management using Automatic Identification System and Radar

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ABSTRACT

In Vessel Traffic System (VTS), AIS can detect a larger number of targets without considering the shadow effect and can provide more voyage information for port center. For radar system can detect target actively even buoys or rock no matter ship size or fitted equipment. But even radar can detect all targets, it is cannot give full information as AIS. AIS can give full information such as types of ship, size, name, MMSI number and etc. AIS and radar system is very important in the VTS to control ship in and out at the port area. They have to use two different computers, which is one computer for AIS and another computer is for radar systems. By integrating AIS and radar, the officer can control port with more accurate and systematic. This paper will focus on integration of AIS and Radar for managing the movement of vessels in port for safety purpose by taking Port Tanjung Pelepas (PTP) as a case study.

KEY WORDS: *Port Traffic Management; Automatic Identification System, Radar, Integration.*

NOMENCLATURE

AIS	Automatic Identification System
PTP	Port Tanjung Palepas
VTS	Vessel Traffic System
IMO	International Maritime Organization

1.0 INTRODUCTION

In vessel traffic management (VTS), they are using AIS or known as an Automatic Identification System and radar systems to control ship in and out at the port area. The function of AIS is used to identify and locating the vessel by electronic exchange data either with nearby ships or VTS stations. Besides that, AIS also can detect a larger number of targets without considering the shadow effect and can provide more voyage information for Port traffic Management.

Even though AIS can give full information to VTS, but still the AIS cannot replace radar system. The radar is for vessel which is not fitted AIS in their vessel. The benefit of a radar system is can detect targets actively even buoys or rock no matter ship size or fitted to any equipment (Bin Lin, Chih Hao Huang, 2006). Even though the radar system can detect all targets, but radar system cannot give full information such as size of ship, name, MMSI and IMO number.

Therefore, the port traffic management required to use both of this system to prevent the ship from collision, including a ship colliding with a fishing boat. This is because fishing boats also are using a port area that obstructs ship moving and increases navigation risk. From AIS information, these kinds of situation cannot be found so that the port traffic management officer cannot sound collision warning to the related ships.

In effect of that, it is difficult for port traffic officers to look out AIS and radar system in two different computers at the same time. It is can be attributed to human error on navigational faults due to incorrect judgment of ship movement by the port officer (Bin Lin, Chih Hao Huang, 2006). By integrating of AIS and radar system, it is much easier for port officers to look out and control the situation in the port area.

The port area for this project is focused on Port Tanjung Pelepas (PTP), which is located in the Strait of Malacca and the most important channel in the world that connecting the Indian Ocean with South China Sea and the Pacific Ocean as shown in Figure 1. In PTP, they are still using Automatic Identification

System (AIS) and radar system with separate computer. Therefore, this study focuses on the combination of AIS and radar system for safety and improvement of vessel movement in and out of the port marine transportation system. In this project also was proposed the system and tested at PTP as a study case.

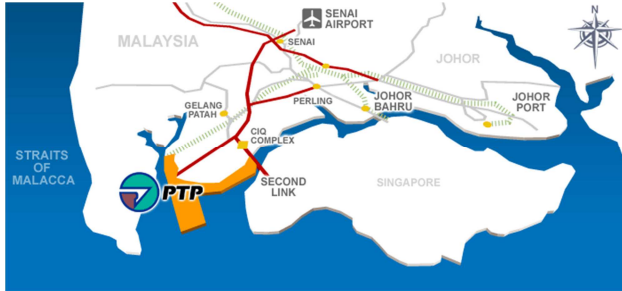


Figure 1: Port Tanjung Pelepas.

2.0 PRINCIPLE THEORY

2.1 Speed of Ship

Speed of ship can be determined by using basic rules of speed which is distance divided by time. The unit can be in m/s or in knot.

$$speed = \frac{distance(m)}{time(s)} \quad (1)$$

where,

Distance = Distance of ship move from one point to another point

Time = Time taken of ship move from one point to another point

1 knot = 0.5144 m/s

2.2 Actual Distance between Ships

For the actual distance between ships, it can be determined by using Haversine formulation. The Haversine formula expressed in terms of a two-argument inverse tangent function to calculate the actual distance between two points on the Earth as follows:

$$d = R . c \quad (2)$$

where,

R = radius of the earth (6373 km)

$c = 2 . a . \tan 2 (\sqrt{a} , \sqrt{1-a})$

$a = (\sin (\frac{\Delta_{lat}}{2}))^2 + \cos (lat_1) . \cos (lat_2) . (\sin (\frac{\Delta_{long}}{2}))^2$

$\Delta_{lat} = lat_2 - lat_1$

$\Delta_{long} = long_2 - long_1$

3.0 AUTOMATIC IDENTIFICATION SYSTEM

In this research, data was extracted from the AIS station of Joint International Research Center on Safety Navigation. They have seven locations of AIS as showed in Figure 2 which is station A (P23, UTM), station B (Belakang Padang), station C (Batu

Ampar), station D (Politek Batam), station E (Karimun), station F (Bintan) and station G (Bengkalis). This paper, the AIS is focused at station A, P23, Faculty Mechanical Engineering, Universiti Teknologi Malaysia.

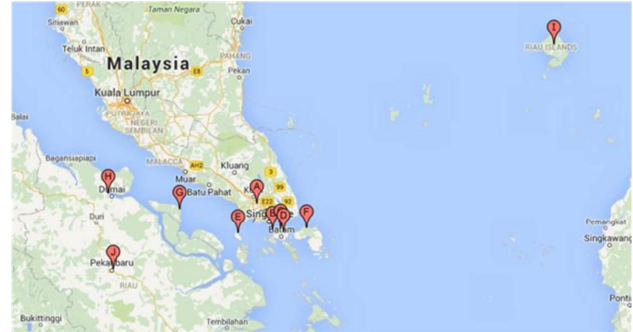


Figure 2: Location of AIS receiver

2.1 Station A (P23, UTM)

Location of Station A is located in P23, UTM, Malaysia as shown in Figure.3. The position of this station is at 1.56335° N 103.64239° E, elevation: 38.6m. Distribution of ships were received shown in Figure.4



Figure 3: AIS antenna installed in P23, Faculty Mechanical Engineering, Universiti Teknologi Malaysia

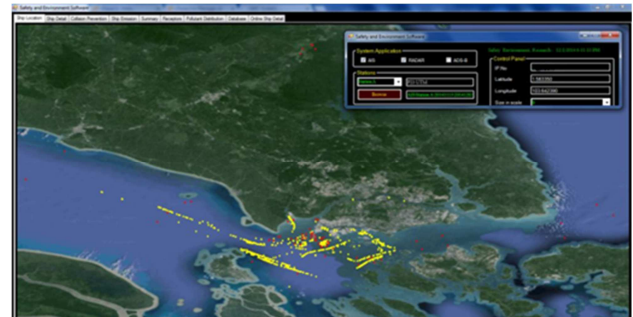


Figure 4: Ship distribution collected at P23-UTM Station, Malaysia

The AIS system consists of an antenna, AIS receiver CYPHO-150, TP-Link and Personal Computer (PC) computer as shown in Figure 5.



Figure 5: AIS System in Station A, P23, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia.

This AIS Marine Safety and Environment simulation was developed using Microsoft Visual Basic 2010 as showed in Figure 6. The primary data of ships which is obtained from AIS receiver consists of date, time, MMSI number, IMO number and position of the ship (longitude and latitude). The data collected from AIS receiver is simultaneously stored and update in a hard disk on the PC. Ships details such as names of ships, types of vessel, and other data was extracted from free ship database such as Marine Traffic and Vessel Tracker. The raw data was recorded in every one minute which depends on setting up.

Firstly in this safety and environment system is choosing the location of AIS. For this paper the AIS was focusing on station A. Then, the file is uploaded from AIS to the server and required to select port serial and period with connect to server. The period is the data was save depend on setting up either one minutes, five minutes, ten minutes or one hours. In control panel, it is required to select the location and types of map. It has several types of mapping such as roadmap, satellite, terrain and hybrid. For this paper, the location is used Strait of Batam-Singapore because of the location of PTP near with this strait and mapping is using satellite map.

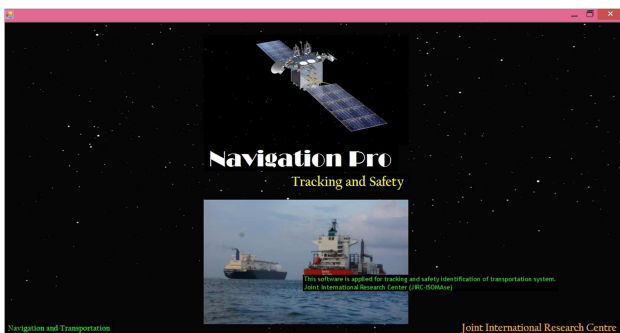


Figure 6: The AIS Marine Safety and Environment Simulation

This system can be used for navigation tracking and collision prevention using GPS and AIS. The marine navigation tracking system will show the position of a ship on the map which is linked to a Google map and denoted with yellow color as show in figure 7. The full detail of ship can be identified in the ship database.

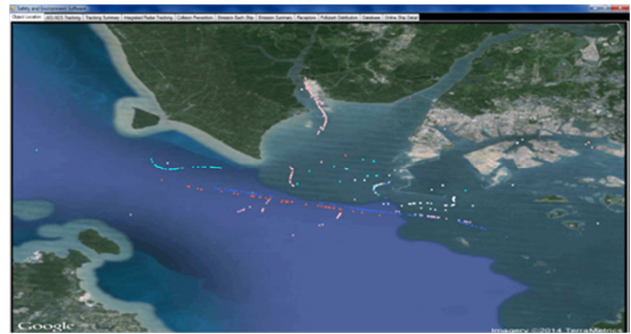


Figure 7: AIS data linked to a satellite map

4.0 RADAR

RADAR stands for Radio Detecting and Ranging, which is using a radio wave to detect an object. It can be used in air, water and land. Radar is very important in marine for navigation. Radar system also is used in port management. It is to detect all moving or stationary targets in the area of the port. In the port area, any target should be acquired and maintain tracking in at least 5 out of every 10 scans average over a period of 2 minutes [1].

Radar for this project is located at Tanjung Piai, Johor as shown in Figure 8. The radar data was getting from the Tanjung Piai marine operation. In this radar system they are using Linux system which is one of the operating system. This radar system also same like AIS system, it is can detect and scan target in that area but just showed in symbol. By using this symbol, the longitude and latitude is showed. In this project, the data are given from Tanjung Piai in the raw data and only consist of longitude and latitude.

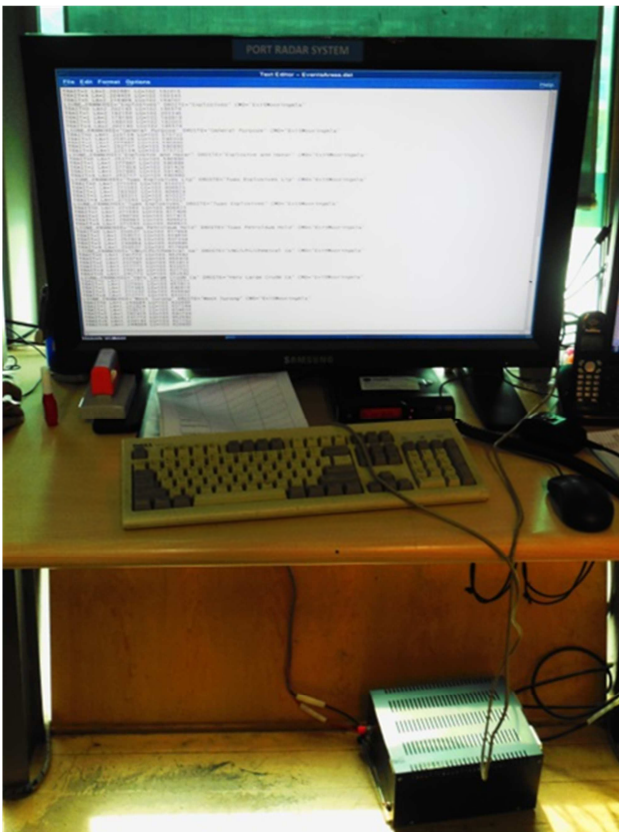


Figure 8: Port Radar System

In Figure 9 showed radar data in the Marine Safety and Environment system. The denoted with red color represent the target at the Strait of Batam-Singapore.

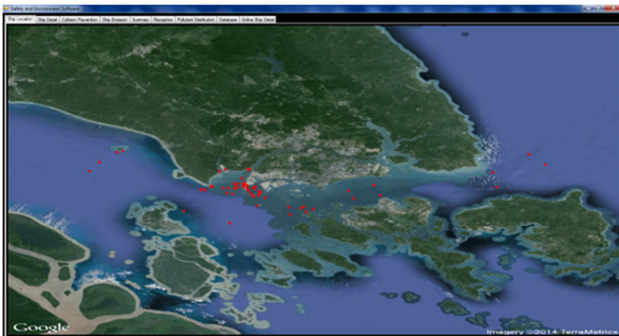


Figure 9: Radar data

5.0 INTEGRATION OF AIS AND RADAR

This integrated system was used to integrate AIS and radar system by using AIS Marine Safety and Environment simulation which was developed using Microsoft Visual Basic 2010. The study framework is started from collecting of AIS raw data such as name of ship, types, MMSI number, position of the ship,

received date and received time and speed of ground. This AIS data is simultaneously updated and stored in the hard disk on the Personal Computer (PC). Besides that, the data is always updated into the database system on the server. These ship data bases were extracted from free ship data based such as Marine Traffic and Vessel tracker.

After collecting AIS data, next step is collecting radar data. This radar data were collected at PTP in the raw data which consists of longitude, latitude, speed and course. After collecting AIS and radar data, then integrating this AIS and radar data in the system. Figure 16 show the flow of integration AIS and radar system.

This integration of AIS and radar is using the position (longitude and latitude) of the ship. If the longitude of radar and AIS are same and the latitude of radar and AIS also are same, so it is a same ship. In this system, the denoted with yellow color represent the AIS data and red color represent the radar data. Radar can detect all targets compared with AIS which is only can detect the vessel that has AIS only. So, when on the map the denoted only appear red color means that maybe it is the buoys, rocks or small boat such as fishing boat which is does not require AIS. The integrated AIS and radar result will appear with the red and yellow color.

Figure 10 shows an example data of integration system. Based on this result, the ship that have AIS and target detected by radar can see clearly. This integrated system was recorded on 15th December 2014.

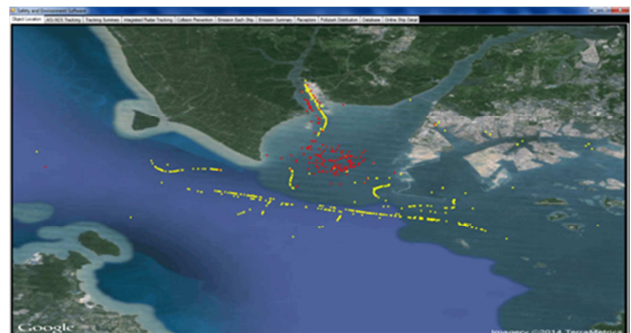


Figure 10: The integration of AIS and radar data.

In figure 11 shows the integrated radar tracking from the integrated system. In this track, it will show the longitude, latitude, course, speed and MMSI number of ship. When there is no MMSI number, it is means small boat, rocks or buoys. It is also can be ship that does not send their signal to the VTS station. In this integrated system, the vessel detected from AIS can know the detail in ship details. It will show the name of the ship, MMSI number, IMO number, length, beam, draft and flag. So, VTS officer can see clearly the position of the vessel or any target in this integrated system.

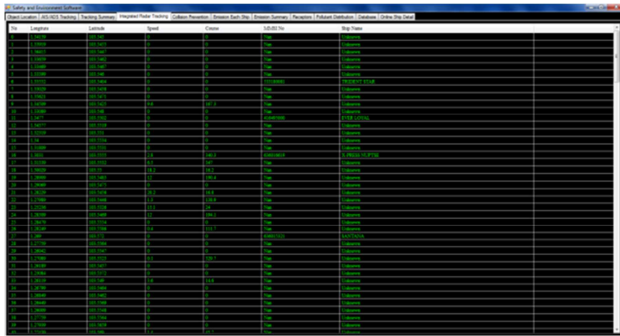


Figure 11: The integrated Radar tracking

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6.0 CONCLUSION

The AIS and radar is very important in the port traffic management. It is because both of this AIS and radar can give accurate position detected target ships. By integrating AIS and radar, it can reduce the ship collision and prevent from the human error on navigational faults. It is because one of the major purposes of VTS is to prevent from collision occurring at the port area.

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