SAFETY ON NAVIGATION IN THE STRAITS OF MALACCA USING AUTOMATIC IDENTIFICATION SYSTEM (AIS) DATA

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Special dedication to my beloved family

My parents Mr. Yaacob & Mrs. Jamaliah, My wife Mrs. Siti Norfatihah, My siblings, Mrs. Norrita, Ms. Norhanizah, Ms. Noridah, Ms Norizan, Ms Noraini and the last one Ms Noraishah …...

Thanks for your valuable sacrifice

Love you all…

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ABSTRACT

Safety on navigation has become one of the important issues to the entire world shipping community. The result from the ship collisions has been contributing to the issues of security, the loss of lives and property also the environmental may occur. This study focuses on the Strait of Malacca area because it is one of the world's most congested straits used for international shipping which is located on the border among the three countries of Indonesia, Malaysia and Singapore. The study is to extract and record the data of ships which is passing through The Strait of Malacca using Automatic Identification System (AIS) in Marine Technology Center, Universiti Teknologi Malaysia, Skudai, Johor. The main scope is to develop the program that can reduce the numbers of collision between the vessels during the navigation in the Straits of Malacca. The data from Automatic Identification System (AIS) will be analyzed using the program that will be developed. The effectiveness of the developing program will be determined by using the data analyses and determination of the particular vessel which is in danger condition which is using safety distance calculation.

ABSTRAK

Keselamatan pelayaran telah menjadi salah satu isu penting kepada masyarakat dunia keseluruhan. Hasil daripada perlanggaran kapal itu telah menyumbang kepada isu-isu keselamatan , kehilangan nyawa dan harta benda juga alam sekitar boleh berlaku. Kajian ini memberi tumpuan kepada kawasan Selat Melaka kerana ia adalah salah satu selat yang paling sesak di dunia yang digunakan untuk penghantaran antarabangsa yang terletak di sempadan antara tiga negara Indonesia, Malaysia dan Singapura. Kajian ini adalah untuk mengeluarkan dan merekodkan data kapal yang melalui Selat Melaka menggunakan Automatik Identifikasi Sistem (AIS) di Pusat Marin Teknologi, Universiti Teknologi Malaysia, Skudai, Johor. Skop utama adalah untuk membangunkan program yang boleh mengurangkan bilangan perlanggaran antara kapal semasa pelayaran di Selat Melaka. Kemudian data dari Sistem Pengenalan Automatik (AIS) yang diperolehi dianalisis menggunakan program yang akan dibangunkan. Keberkesanan program yang dibangunkan akan ditentukan dengan menggunakan data analisis kepada kapal tertentu yang berada dalam keadaan bahaya dengan menggunakan kaedah jarak selamat.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

AIS	-	Automatic Identification System
IMO	-	International Maritime Organization
SOLAS	-	Safety of Life at Sea
MMSI		Maritime Mobile Service Identity
VTS		Vessel Traffic System
TSS		Traffic Separation Scheme
ALAM		Akademi Laut Malaysia
STCW		Standards of Training, Certification and Watchkeeping
MSC		Merchant Shipping Committee
ETA		Estimated Time Arrive
NOAA		National Oceanic and Atmospheric Administration
UTM		Universiti Teknologi Malaysia
MTC		Marine Technology Center
COG		Course over Ground
SOG		Speed over Ground
ROT		Rate of Turn
HDG		True Heading
AlVTlS		AIS-based Vessel Traffic Information System
NTOU		National Taiwan Ocean University
ALE		Arbitrary Lagrangian Eulerian

LIST OF SYMBOL

%	-	Percent
N_m	-	Number of ship using channel
D_c	-	Length of the channel
W_c	-	Width of the channel
N_A	-	number of vessel encounter in a time period
P_c	-	the probability of failing to avoid a collision
N_{coll}	-	Number of Collision
P_s	-	Traffic Density
L	-	Length of the subject (Vessel)
B	-	Beam of the subject (Vessel)
T	-	Period of passage
S	-	Speed of Vessel
P_i	-	Probability of Collision
N_a	-	Collision per year
D	-	Stopping Distance
Lon	-	Longitude
Lat	-	Latitude
R	-	*Radius of the Earth*

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Safety on navigation between the vessel have become one of the important issues to the entire world community. About 80% of the international trade and movement of goods carried by ship through the sea (UNCTAD, 2010). It is not suprising that in a recent survey, more than 80% of captains of Very Large Cargo Carriers (VLCC) responded that they are worried when transiting the strait. This number can show the possibility of the accident that can occur between the vessels are very high. For centuries, concern over safety on navigation have focused on issues of security and the loss of lives and property. Currently of growing significance is concern over environment protection. From this result, the International Maritime Organisation (IMO) objectives in term of the implementation of an Automatic Identification System (AIS) are to enhance safety and efficiency of navigation, safety of life at sea and also maritime environmental protection (IMO, 2001).

The Strait of Malacca and Singapore is one of the most important shipping channels in the world connecting the Indian Ocean with the South China Sea and the Pacific Ocean. The Strait remains as one of the world's most congested straits used for international shipping. Approximately over 60,000 vessels pass through The

Strait annually (Mihmanli, 2011). The Strait of Malacca is a narrow stretch of water lying between the east coast of Sumatra Island in Indonesia and the west coast of Peninsular Malaysia and is linked to the Strait of Singapore at its southeast end. Approximately 990 kilometers long and 2.7 kilometers wide, the Strait of Malacca connects to the Indian and Pacific Ocean and it is recognized as one of the most economically, strategically and the busiest shipping lanes in the world. This study focuses on the Strait of Malacca and Singapore area because it is one of the world's most congested strait used for international shipping where located on the border among three countries of Indonesia, Malaysia and Singapore. The Strait of Malacca is a narrow strait where major hub is to be found and it is one of the heavy marine traffic.

Automatic Identification System (AIS) carriage requirements for the Convention On the Safety of Life at Sea (SOLAS) vessels have been adopted by International Maritime Organization (IMO) and entered into forces starting on 1st July 2002. The ships of 300 gross tonnage and upwards, engaged on international voyages are required to be fitted with AIS system no later than the first safety equipment survey after 1st July 2004 or by 31st December 2004 (IMO, 2002). Based on IMO resolution MSC.74 (69), the recommendation on performance standards for a universal shipborne Automatic Indentifcation System (AIS), the AIS system should satisfying the following functional requirement:

1) In a ship-to-ship mode for collision avoidance
2) As a means for port authorities or maritime safety bodies to obtain information about a ship and its cargo
3) As a Vessel Traffic System (VTS) tools for traffic management

Automatic Identification System (AIS) is based on VHF radio transmission and it is designed to transmit and receive information about a vessels such as ships' identity, position, speed and also heading with other relevant information (Eriksen, 2010). Vessels within AIS range can receive information on a dedicated AIS display, a chartplotter or a PC using navigation software. Combined with a shore station such as Marine Technology Center in Universiti Teknologi Malaysia (UTM), this system

can offer port authorities and maritime safety bodies the ability to manage maritime traffics and reduce the hazards of vessel navigation (Adi Maimun, 2010).

The objective of this study is to develop the program that can be used to identify the ship that in high risk condition in term of collison in the Strait of Malacca and Singapore areas using Automatic Identification System (AIS) data. AIS is used as an initial data, it is can identify Maritime Mobil Service Identity (MMSI) of ship, ship speed, initial position and type of ship. This data is used to evaluate the traffic density of the Strait of Malacca and Singapore area. The initial data will combine with ship database and will be use to determine which ship in The Strait of Malacca that can contribute to the collision during navigation.

1.2 PROBLEM STATEMENT

The Strait of Malacca is one of the world's most congested straits used for international shipping, a narrow Strait where major hub to be found and it is one of the heavy marine traffic and in addition, the Strait of Malacca is located on the border among three countries of Indonesia, Malaysia and Singapore.The problem that can be found because of the congested and geographically factor is the collision and fatality of the vessels during navigations. From the result of collision, the issues of security, the loss of lives and property also the environmental may occur.

To reduce this problem, a program will be develop using the data from Automatic Identification System (AIS). The information regarding the ships' identity, position, speed and also heading is tracking. From AIS, all the information will be extract and identifying the ship in risk condition using calculation. The program will analyse which vessels are in the dangerous mode of navigation. So, that particular vessel will be advice or warn in term of reducing the speed, change the course and other related in term of collision avoidance.

1.3 OBJECTIVE

The objectives of this study are:

i. To extract the data of ships which is passing through the Strait of Malacca and Singapore using Automatic Identification System (AIS) in Marine Technology Center, Universiti Teknologi Malaysia, Skudai, Johor.

ii. To create the database of ships which is passing through the Strait of Malacca and Singapore using Automatic Identification System (AIS) data in Marine Technology Center, Universiti Teknologi Malaysia, Skudai, Johor

iii. To develop the program that can identify the vessels which is in danger condition during the navigation in the Straits of Malacca.

iv. To identify the vessel in high risk condition during navigation using the stopping distance calculation.

v. To ensure the safety distance program are effective by using the stopping distance calculation by using the reference data of the particular vessel which is in danger condition.

1.4 SCOPE OF STUDY

The scopes of this thesis are:

i. An analysis of the numbers of ships and its information using AIS data will focuses on the Strait of Malacca area because it is one of the world's most congested straits used for shipping.

ii. An analysis of actual vessel data will focus only data which are detected by AIS receiver installed in Marine Technology Center, Universiti Teknologi Malaysia (UTM) Skudai, Johor.

iii. An analysis of the number of the vessel will focuses on one certain day which is occurred the highest traffic in 2013.

iv. An analysis of the range of the most congested shipping hour of choosing a day that occurs highest traffic in 2013.

v. An analysis of the safety distance between the ship by using stopping distance calculation for the most congested shipping hour of choosing a day that occurs highest traffic in 2013

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