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INTEGRATED MARITIME DOMAIN INFORMATION AWARENESS

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Abstract - The centralized maritime domain awareness information system is the most important and effective factor to the country covered by the sea. This paper presents detailed information on the implemented Automatic Identification System (AIS) network is used to collect the data using the central point as well as the selected 13 points in the whole over the country. Further, using this system collecting the ships and crafts plying the waters around the island can be viewed through a single interface. There are 14 outputs of the AIS system and can grab all details from 13 points to the central point. The implemented system is low cost and reduces the complexity of collecting information at a central point. The implemented system is more beneficial to the naval parties and the port authority.

Keywords - Automatic Identification System, Integrated Maritime Domain System (IMDS), Serial to Ethernet converter.

INTRODUCTION

Sri Lanka is called the pearl of the Indian ocean and it is covered by Indian seawater. Due to the geographical situation of the country, the centralized maritime information system is more important to the day to day life. Further, the maritime information system is useful to harbour needs, fisheries as well as security departments in Sri Lanka. The AIS provides the navigational data of the ships and seaboard. Also, location details, identification details were received from AIS [1].

Using a Wide Area Aerial Surveillance **(**WAAS) system facilitate awareness of the large area of the sea with high-resolution images [2]. The system of e-navigation contributes to the planning and implementation of integrated information to distribute the static and dynamic information to the vessels [3]. The traffic system was implemented to the aware traffic information for the sea travellers. Moreover, it gives the information of the whole journey of the travellers [4]. The human resource for maritime activities creates many difficulties in the day to day life. Therefore, introduced An integrated maritime reasoning and monitoring system for maritime shipping and port activities [5].

The Integrated Maritime System (IMS) is a chart plotting software, was designed by the new design cell for visualizing the vessels sailing around the island which was gathered by the 13 automatic identification system stations. All Ships and crafts must transmit their ship details through the AIS system and the receiving station can receive the ship details using their receiver. The 13 numbers receiving stations are established for the IMDS around Sri Lanka. The proposed system consists of 4 stages such as IMS, serial to Internet Protocol (IP) converter, network and integrated software interface.

The remainder of the paper is organized as follows: In section A, include the system model with AIS, serial to parallel converter, integrated software interface and the configurations. In section B, includes results and discussion. Finally, Section C concludes the whole paperwork.

A. System Model

The AIS system has been used the track the vessels and it is an automated system. Further, it is operating in the Very High Frequency (VHF) mobile maritime band. Moreover, it is connecting with the ships and able to identify using navigational marks.

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Figure 01-Proposed system model

Figure 01 shows the proposed overall system model of the integrated maritime awareness system.

1. AIS

The AIS system has two types of classes as class A and class B. Class A contains passenger ships and all vessels 300 GT on international voyages. There are limited functional in class B and non-SOLAS vessel are class B. The 161.975 MHz 161.975 MHz VHF frequency is used for simplex ship to ship communication and the 162.025 MHz frequency is used for duplex ship to shore communication. Also, it is used Self-organizing Time Division Multiple Access (STDMA) technology and it has 40 miles line of sight limitation. AIS is transmitting static information, dynamic information and voyage related information. Static details are MMSI number, IMO number, name and call sign, length and beam, type of ship, location of position fixing antenna. Dynamic details are ship's position with accuracy indication, position timestamp (in UTC), Course Over Ground (COG). Voyage related details are ship's draught, type of cargo, destination and ETA, route plan (waypoints).

Figure 02: Proposed AIS network locations.

Figure 02 shows the proposed locations of the AIS network in Sri Lanka.

1.1 AIS data format

Transmitter transmit the information in RS232 format in NMEA standard. The sample data format is as follows.

!AIVDM,2,1,3,B,55P5TL01VIaAL@7WKO@mBpl
U@<PDhh000000001S;AJ::4A80?4i@E53,0*3E

!AIVDM,2,2,3,B,1@0000000000000,2*55

Figure 03: AIS data in the software interface.

Figure 03 shows the AIS data in the software interface and it is in NMEA standard.

2. Serial to IP converter

The remote access, control and manage serial devices using serial to IP converter through IP network and internet. The asynchronous data transfer over an RS232, RS422, or RS485 port to TCP/IP or UDP packets. Further, it is connected with a direct cable connection or over Ethernet.

There are 3 types of Serial to IP converters that have been used for this system.

1. PortServer® TS by DIGI
2. USR-TCP232-302
3. Hi-Link USR-TCP232-30

2.1 Configuration of serial to IP converter

There is the same configuration procedure that will be followed for the above three types of converters.

1. First, the device must be powered with the help of a designated power supply.
2. The data output of the AIS unit has to be connected to the serial data input of the converter unit.
3. Ethernet cable has to be connected to the ethernet port of the converter and the PC.
4. Each device has its default IP address and it can be found by referring user manual of each device.
5. IP address, subnet mask and the gateway address of the PC must be changed according to the default IP range of the converter unit.
6. After configuration, log in to the web interface of the converter using a web browser by entering the user name and the password of the converter unit.
7. In the web interface, several sub-pages can be adjusted according to our device.
8. Most AIS transponder’s output their data at a 38400 bps baud rate. Therefore, the serial configuration has to be changed (baud rate, number of bits, start bits, stop bits, parity bits) according to the AIS unit.
9. The port settings have to be changed according to the cloud network. IP addresses of the converter have to be assigned according to the Network.
10. After finished configuration, the network cable can be plugged into the network switch.

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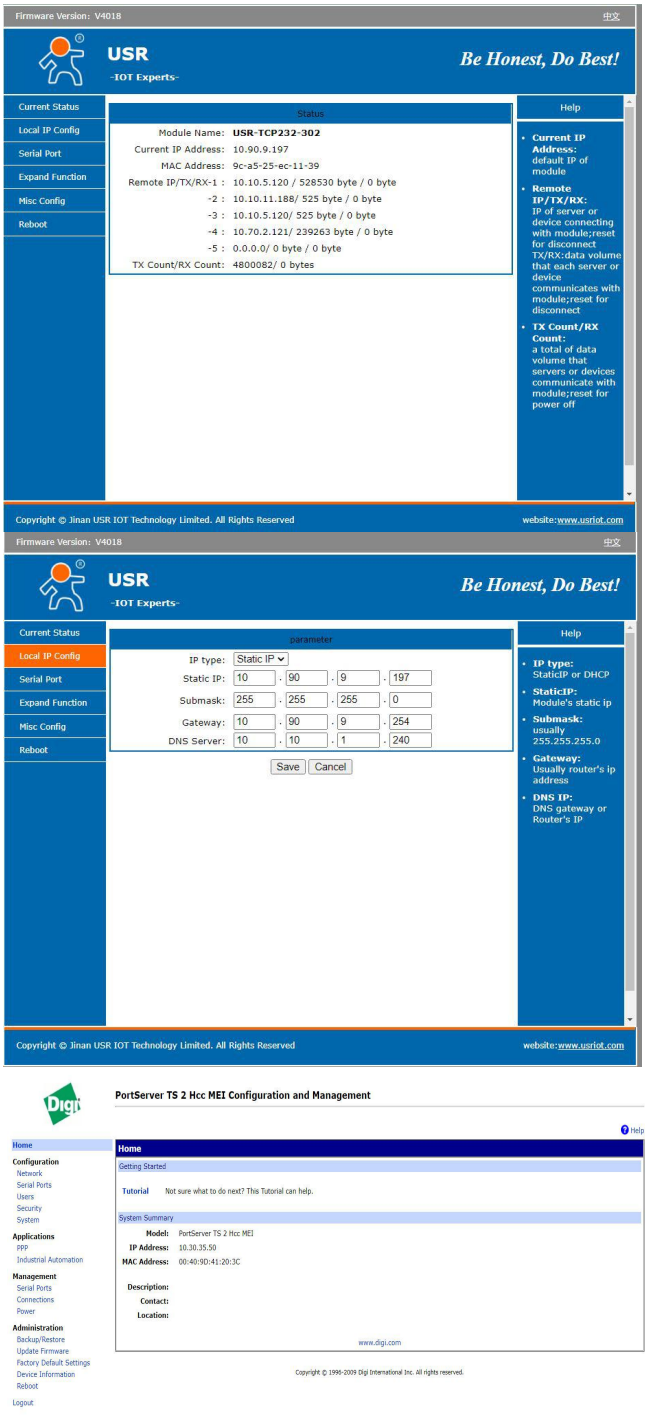

Figure 03-Details of computer interfaces.

Table 01 shows the 13 AIS locations of the network with the IP address and port details.

3. Integrated software interface

A concise chart plotter software called “Integrated Maritime Surveillance System” is used to decode the AIS data and visualize it on a single interface. This software was designed using free open-source software called “OPEN CPN”.

S.No.	Station	IP Address	Port
01	Station A	192.168.1.1	2001
02	Station B	192.168.1.2	2001
03	Station C	192.168.1.3	2001
04	Station D	192.168.1.4	2002
05	Station E	192.168.1.5	2002
06	Station F	192.168.1.6	2002
07	Station G	192.168.1.7	10001
08	Station H	192.168.1.8	10001
09	Station I	192.168.1.9	10003
10	Station J	192.168.1.10	8080
11	Station K	192.168.1.11	8080
12	Station L	192.168.1.12	2001
13	Station M	192.168.1.13	2002

Table 01- Network details of the AIS locations.

This software was written by C/C++ programming languages.

3.1 Software configuration

The software has to be configured before use,

1. A suitable chart has to be added to the software interface using add chart menu.
2. Network settings (IP address and Port) has to be entered using add connection menu.
3. Display settings have to be changed according to the user requirements.
4. After configuration vessels begin to appear on the display.
5. Clicking on the vessel icon will allow viewing the vessel data.

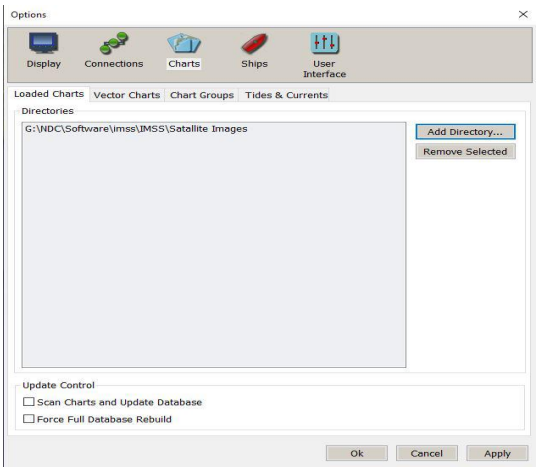

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Figure 04-Adding the interface.

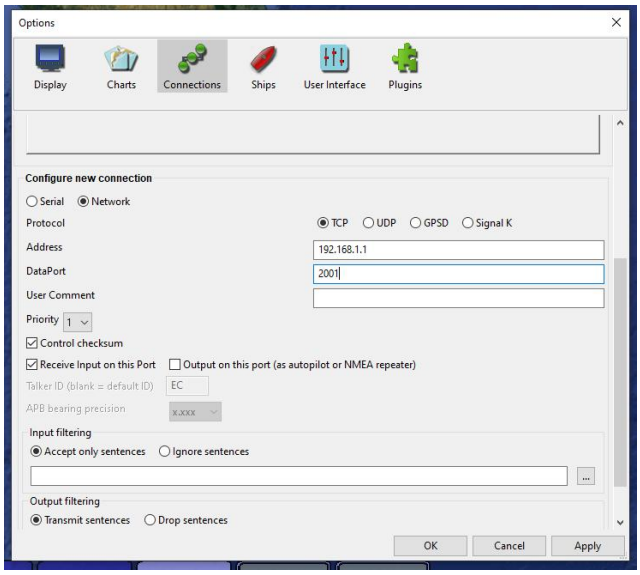

Figure 05-Adding new connection.

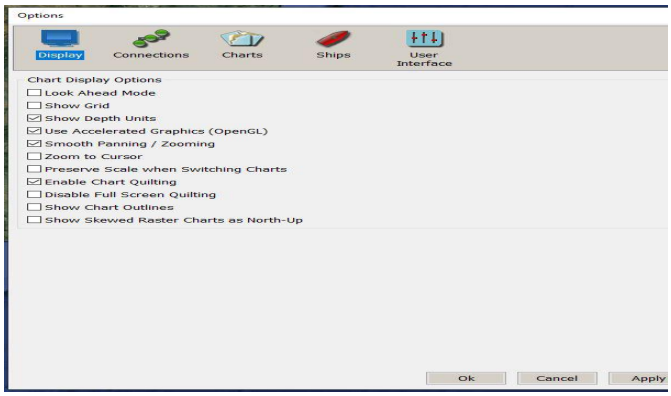

Figure 06- Display options.

B. Results and Discussion

There are 3 inputs for the software interfaces such as chart, IP addresses of the converters and ports of the converters. Also, there are 14 outputs such as MMSI number, Call Sign, IMO number, class, navigational status, type of the vessel, size, destination, estimate time to arrive, course, speed, heading, rate of turn, range and bearing to receiving station and position data.

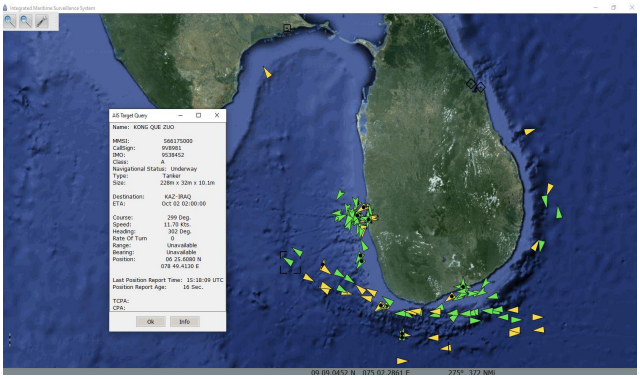

Figure 07: Vessel details

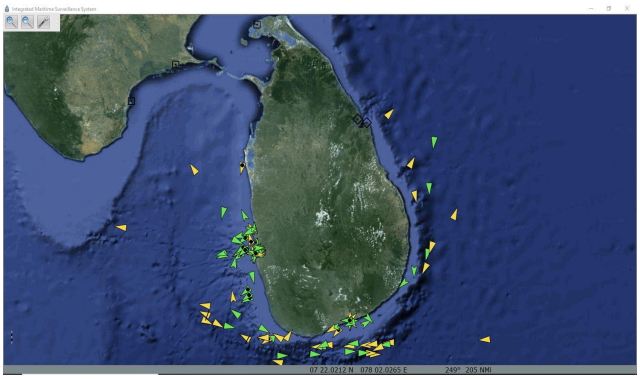

Figure 08: Software interface after adding all AIS stations

C. Conclusion

The integrated maritime domain information awareness system is more advantages in many ways. All the AIS stations around the island are networked so that the details of all ships and crafts plying the waters around the island can be viewed through a single interface. Ability to view a wide range of data as all systems are networked. Ability to easily trace the location of the vessel as it maps the current location. Ability to easily analyze the data of the vessel by viewing the data of the vessel on a screen at the same time. Vessels that are capable of being captured by the AIS system are divided into different categories, with the ability to easily observe vessels belonging to these categories by representing those vessels in different colours and icons. One system failure

is covered by another nearby system so that the failure of one AIS doesn't affect the entire system.

Serial to IP Converters can now be purchased at a relatively low price in the market, making it possible to make new connections at a very low cost. Increase the ability to expand the network as the number of systems that can be included is unlimited. There are a few limitations of the system such as Since the system performance depends on the performance and the speed of the network, a system failure can occur during a network crash. Problems with data storage due to unavailability of centralized sever system. Inability to analyze past data due to inability to record. Due to the shortage of serial to IP converters in the local market, it takes a long time to repair a breakdown. Some Serial to IP converters has limited access to the number of users that can be accessed, reducing the ability to monitor from a large number of monitoring stations.

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