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INTEGRATED MARITIME DOMAIN INFORMATIONS AWARENESS

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Abstract - The centralized, integrated maritime domain informations awareness system (IMDIAS) is one of the most important and required information systems for a country covered by the sea. This paper presents detailed information on the implemented integrated maritime domain informations awareness system (IMDIAS) which is based on the most related informations for sea operations and Automatic Identification System (AIS), is used to collect the data to a central point from the selected 13 points to cover the complete sea area around the country. Using this system data of the ships and crafts which are plying the waters around the island can be viewed through a single interface. Detailed transmitted by the AIS system is received and collected from 13 points to the central point. The implemented system is low cost and reduces the complexity of collecting information at the central point. Also, it is more beneficial to maritime operations and especially for the port authorities.

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

INTRODUCTION

Since ancient times, Sri Lanka is called the pearl of the Indian ocean and it is surrounded by the Indian Ocean. Due to the geographical situation of the country and East to West and West to East maritime shipping lane is fallen south of Sri Lanka, strategically it is very important to have a centralized maritime information system. Further, the maritime information system is very useful for purposes such as for ports operations, collision avoidance fisheries activity & fleet monitoring, accident investigations and most importantly for regional Navies and Coast Guards to ensure maritime safety and security of all units plying around the Sri Lankan waters up to Extended Economic Zone as well in International waters. The AIS provides the navigational data such as location, speed, heading…etc of the ships. Also, it transmits the static details, identification details and received from others 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 IMDIAS centralized system that was developed to visualize the vessels sailing around the island as gathered by the 13 automatic identification system stations. All Ships and crafts transmit their ship details through the AIS system and the receiving station can receive the details using their receiver. The 13 numbers receiving stations are established for the IMDIAS around Sri Lanka to get the best coverage. The proposed system is a combination of 4 stages such as AIS, serial to Ethernet converter, IMS and local area network.

The remainder of the paper is organized as follows: In section A, include the system model with AIS serial to Ethernet converter, IMS and Local Area Network (LAN). In section B, includes results and discussion. Finally, Section C concludes the whole paperwork.

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A. System Model

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

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. As per the 2002 IMO SOLAS agreement, it is mandated to have Class A type on board passenger ships and all vessels above 300 GT on international voyages. There are limited functional in class B and non-SOLAS vessels 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 information includes the MMSI number, the IMO number, the ship's name, and call sign, the length and beam, the type of ship, and the location. 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).

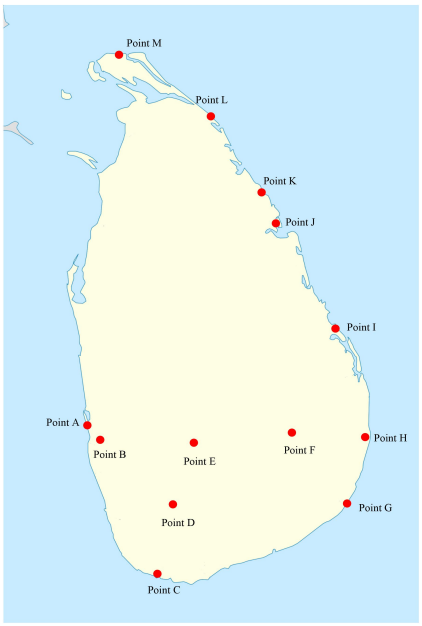

Figure 02: Proposed AIS network locations.

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

1.1 AIS data format

The AIS transmitter transmits messages in RS232 format in accordance with the National Marine Electronics Association (NMEA) standard. The following is the typical data format of an AIS.

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

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

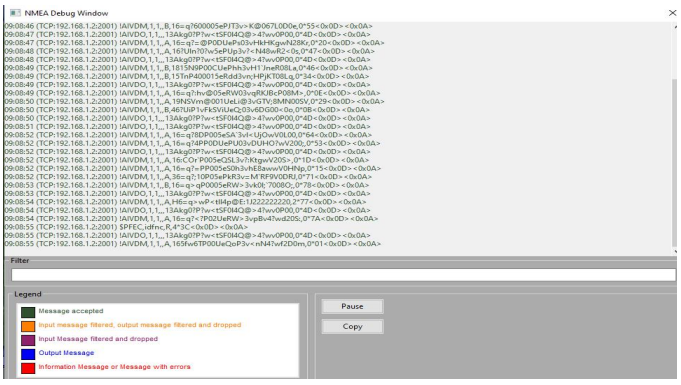

Figure 03: AIS data in the software interface.

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

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2. Serial to Ethernet converter

The remote access, control and manage serial devices using serial to Ethernet 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 Ethernet converters that have been used for this system.

1. PortServer® TS by DIGI
2. USR-TCP232-302
3. Hi-Link HLK RM -04

2.1 Configuration of serial to IP converter

The configuration methodology for the three types of converters listed above is the same.

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 the device.
8. The majority of AIS transponders transmit data at a baud rate of 38400 bits per second. As a result, the serial configuration (baud rate, number of bits, start bits, stop bits, parity bits) must be updated according to the AIS unit.
9. After configuration is complete, connect the network cable to the network switch.

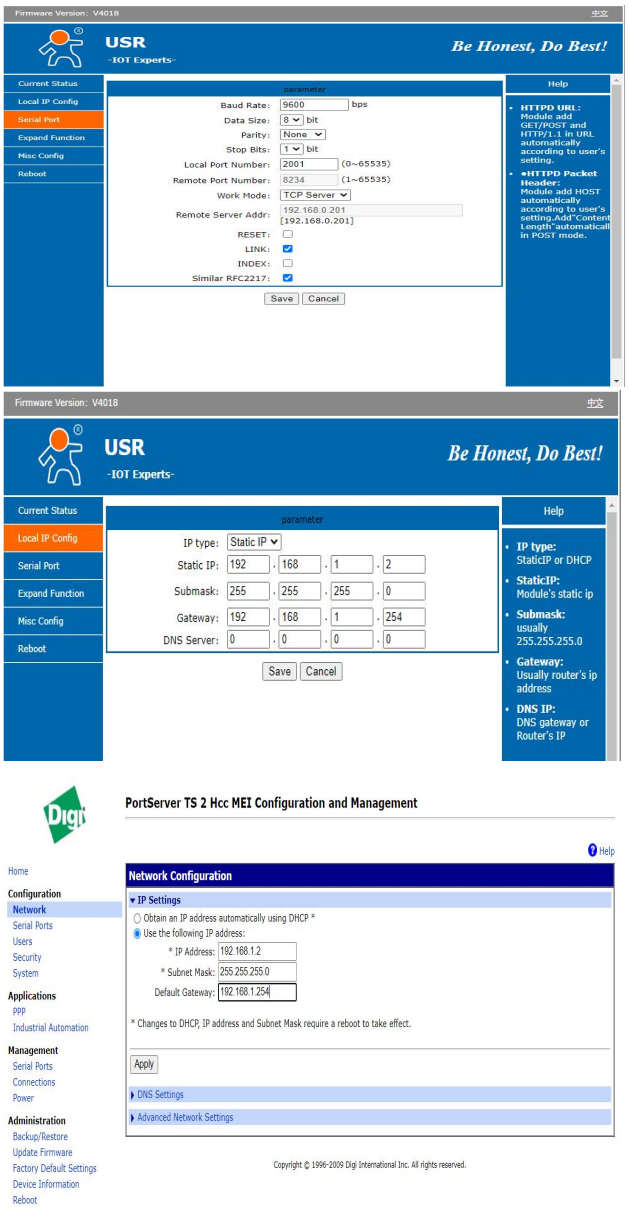

Figure 03-Details of computer interfaces.

3. Integrated software interface

A concise chart plotter software called “Integrated Maritime 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”. This software was written by C/C++ programming languages.

3.1 Software configuration

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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.

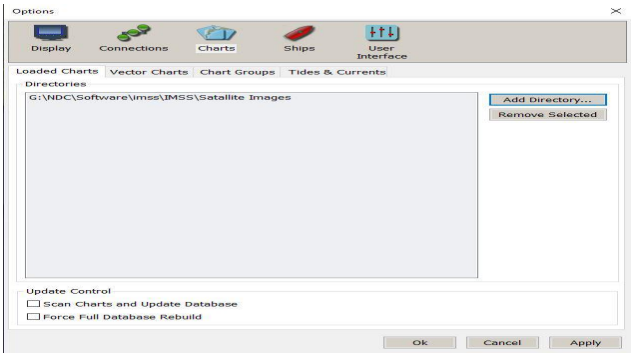


Figure 04- Adding the chart.

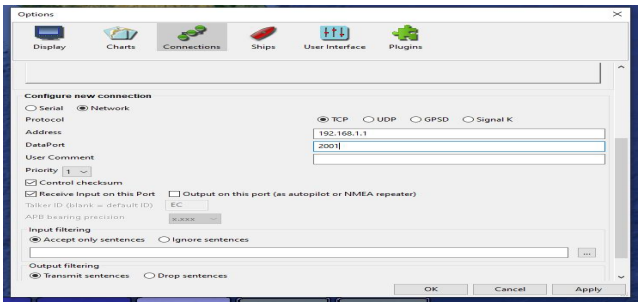


Figure 05-Adding new connection.

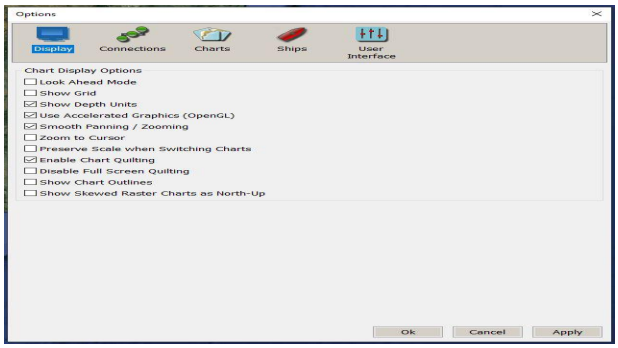


Figure 06- Display options.

Figure 04, figure 05 and figure 06 show the web interfaces of the converter, adding new connection and display options of the proposed system respectively.

4 The Local Area Network

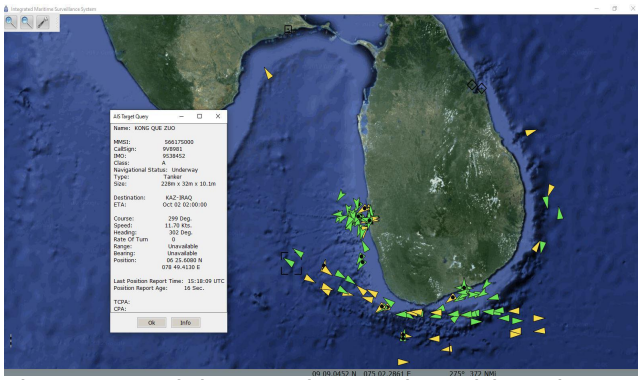
S.No.	Station	IP Address	Port
01	Station A	192.168.1.1	2001
02	Station B	192.168.1.2	2001
03	Station C	192.168.1.3	2001
04	Station D	192.168.1.4	2002
05	Station E	192.168.1.5	2002
06	Station F	192.168.1.6	2002
07	Station G	192.168.1.7	10001
08	Station H	192.168.1.8	10001
09	Station I	192.168.1.9	10003
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.

Table 01 shows the 1- 13 AIS locations of the local network with the IP addresses and port details of the proposed system.

B. Results and Discussion

There are 3 inputs for the software interfaces as a chart, IP addresses of the converters and ports of the converters. Also, there are several 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 shows the received detailed results of the proposed system.

Figure 07: Received details from the proposed system.

C. Conclusion

The integrated maritime domain informations awareness system has more advantages in many ways. All the AIS stations around the island are networked so that the details of all ships and crafts which are equipped with AIS plying the waters around the island can be viewed through a single interface. The system can view a wide range of data as all systems are networked. It could be easily traced to the location of the vessel as it maps the current location. It analyzes the data of the vessel by viewing the data of the vessel on a screen at the same time. Vessels that are being captured by the AIS system are divided into different categories These categories are represented by different colours and icons hence they can be easily identified. AIS receivers in the system are located in the land is situated to overlapped hence if one system fails it is covered by another nearby system so that the failure of one AIS doesn't affect the entire system.

Serial to IP Converters is available at a relatively low price in the open market, making it possible to make additional connections as required at a very low cost if needed to further expand the system. The number of systems that can be integrated into the original system is unlimited. There are a few limitations of the implemented integrated maritime domain information awareness system. The system performance is depended on the performance and the speed of the network which the system is running. System unavailability may occur during a network failure. Data storage is restricted due to the unavailability of separate, centralized high-end server systems. Since the recording facility is not yet introduced, it is unable to use past data for purposes. Some Serial to IP converters has limited access and hence to the number of users that can be accessed is limited reducing the ability to monitor from a large number of monitoring stations.

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