International Journal of Control and Automation
Vol. 9, No. 9 (2016), pp.63-68
http//dx.doi.org/10.14257/ijca.2016.9.9.07

Design of Marine Transportation Facilities Alarm System and Integrated Protocol

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Abstract

Electronic Chart Display & Information System(ECDIS) is has a limitation in expressing various navigational route data and falls short of productivity as it had been frozen to prevent from being changed for a long time. Also, it cannot satisfy requirements for high tech such as lattice structure data and time series information.

The current sea route sign system based on an electronic marine chart only has a data manufacture specification for uses at ECDIS. Therefore, it has a limitation in expressing various sea route data and falls short of productivity as it is frozen to prevent being changed for a long time. Also, it cannot satisfy requirements from high tech such as lattice structure data and time series information. Currently, although it builds each independent operation system based S-57, it has been found that it is the most important requirement from consumers that the entire monitoring system can mutually interwork by standardizing and uniting formats of all protocols.

In addition, current status information and alarm system is using Automatic Identification System(AIS), Trunked Radio Service(TRS), Wideband Code Division Multiple Access(WCDMA) telecommunication and processing all the data after saving it into each different server.

In this thesis, we will realize the status information and alarm system of Marine transportation facilities which is a sea route sign system based on S-63 electronic marine chart, S/W, after uniting each different protocol and making combined system.

Keywords*: electronic marine chart, AIS, TRS, WCDMA*

1. Introduction

While industrial modernization has been repeated in Korea for approximately 100 years, aids to navigation including numerous lighthouses and (light) buoys have been installed and operated. According to the 2012 statistical material provided by the Ministry of Maritime Affairs and Fisheries, approximately 4,366 aids have been operated. (Light) buoys have also varied in type, and 18 types have been designated and managed as standard. Moreover, there are various purposes for installing such buoys. Accordingly, Large Automatic Navigation BuoY (LANBY), spar buoys, *etc*. have been installed and operated at in major ports [1].

The facilities of Aids to Navigations (AtoN) are moving to a concept of e-Navigation with state-of-the-art technology of radio navigation equipment such as AIS, Differential Global Positioning System(DGPS) and enhanced Long range navigation(e-Loran) from the traditional visual facilities (optics, shape), Although the autonomous maritime traffic system is a new trend, yet the traditional and conventional AtoN like lighthouses and beacons are still imperative for vessel's safe navigation [2].

ISSN: 2005-4297 IJCA

A large amount of sea freight is dramatically increased due to rapid economic growth. According to this situation, marine accidents is getting frequent. It leads to severe pollution of the marine environment and safety concerns. Especially, coastal waters in Korea has a very long shoreline and a lot of large and small islands. Furthermore, There are many narrow channels and serious the sea level change of the area. Therefore, occurrence factors of marine accidents are scattered. Besides, frequent see fog results in obstacle causes for secure vessel navigation. In order to manage systematically marine traffic environment, overall examination and search about marine traffic system in coastal waterway should be conducted. Above all, it is acutely essential to establish management system of high-tech marine traffic facilities which takes on a role as a guide for ship sailing safety [3].

Accordingly, when colliding with a vessel, they cause damages to the vessel and when losing their functions or sinking, they also incur economic losses [4]. Above all, occurrence of such problems will lead to waste of national taxes and further loss of national treasury. However, if there are no prominent targets or if sailing at night, it is difficult to identify the location of the vessel only with the natural targets. As such, the navigational routes with heavy vessel traffic, ports, narrow channels, and other places where many rocks exist require artificial facilities to assist a vessel's navigation. They are installed, operated, and managed by the respective district port authorities under the Ministry of Maritime Affairs and Fisheries and private management companies. For each district port authority, the Ministry of Maritime Affairs and Fisheries (the former Ministry of Land, Transport and Maritime Affairs) has conducted remotely monitoring and unmanned management of the AtoN by way of installing an integrated management system for aids to navigation based on various wireless communication methods including AIS, CDMA, and TRS since 1999 [5].

The existing integrated management system for aids to navigation has separate servers. For instance, the system structure of the Vessel Traffic Service (VTS) center in Jindo is inconvenient to check the data needed since it has separate servicers including a data collection server, a database server, an integrated management server, *etc*. In its design, this thesis integrates the separate servers since there are requirement for use of many materials and difficulties for use [6].

2. System Model and Methods

Figure 1 is the previous way is having each server. All of separated servers send data to main PC through the collecting server. It leads to a high cost due to excessive use of the servers.

According to this paper, it is possible to cut the cost because of direct transmission from each server to main PC.

Former function is that the data is gathered by parsing every protocol. However, our program parses all collected data. It is effective to reduce the process. Due to separation of the servers, the data should be integrated. It results in additional costs.

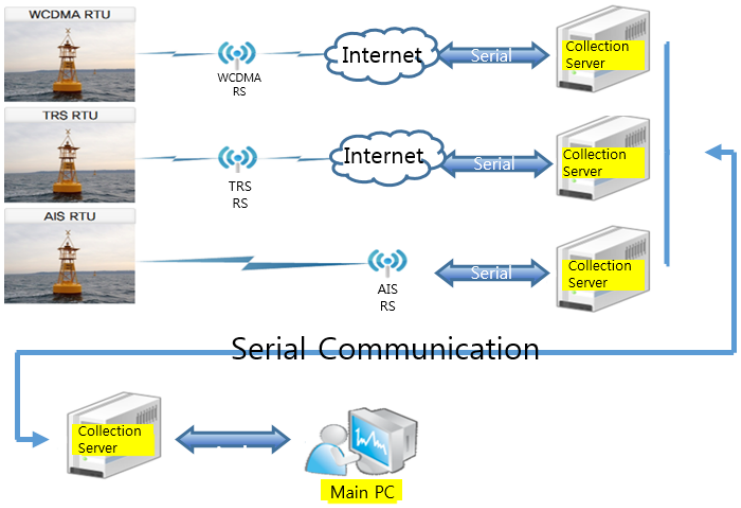

Figure 1. Conventional Methods

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!AIVDO,1,1,,B,6>lEMBh13:r4KS?e5GDe7ojb=i0P:m`roU801w@b1001p0000B0000,4*4D

 (CU->MU) $CUOK*12
0
 (msg que) Prior4Que[0].state=1, cnt_tx=1 by msg.6 tx done

 (MU->CU,2) $MUDID,0,00994401611*56,r5 gmA m21=08:27:01@A mtf0
 (CU->MU) $CUOK*12
 (msg7 contents) MMSI=004403105, SeqNo=0
03:22:30  p0 s0o S
 (using flag) UsingFlagPrior4Que : 0x0 by ack received

03:22:
 (rx msg contents) Messsage ID=7N m21=08:27:01@A mtf0
 (rx msg contents) Source ID=004403105
 (CU->MU) $LISTS,00.0,00.0,
 (rx msg contents) Destination ID=9944016110*FF

 (rx msg contents) Sequence No=0
 (lantern status) Voltage=0.
03:28:20  p2 s2o SPI:m0,d7 sr00 ir00 rn00 st1 ca1 by0 ch0 mb00 rd00 I2C:w0,r0
gmate=0(day), Lantern=0(off), Ligh
03:28:40  p4 s2o SPI:m0,d0 I2C:w0,r0 gmX m21=03:31:14@B mtf0
```

Figure 2. Data Log

Figure 2 shows entering data log. Protocol exchange system is data transfer, WCDMA, AIS and TRS. Protocol parsing the data is transmitted as a single coded command. Received data should be decoded and parsed. There are 3 data (WCDMA, AIS, TRS) transmitting methods which are WCDMA, AIS and TRS as a protocol transceiver. It is essential to parse those logs. The data is transmitted and received with a single coded command. The received data must be parsing by decoding in order to gain expected information.

2.1. System Design and Major Functions

The system designed by this thesis is software which processes data collected by use of serial communications. We have developed a program which receives the integrated data transmitted from RTUs attached to aids to navigation (light houses, light beacons and light buoys) and saves the data onto database. The protocols for TRS, WCDMA, and AIS communications are used by parsing the protocols applicable to the standard specifications of the integrated management system for marine transportation facilities by the Ministry of Oceans and Fisheries (MOF).

1) Structure of Status Information and Alarm System for Marine Transportation Facilities

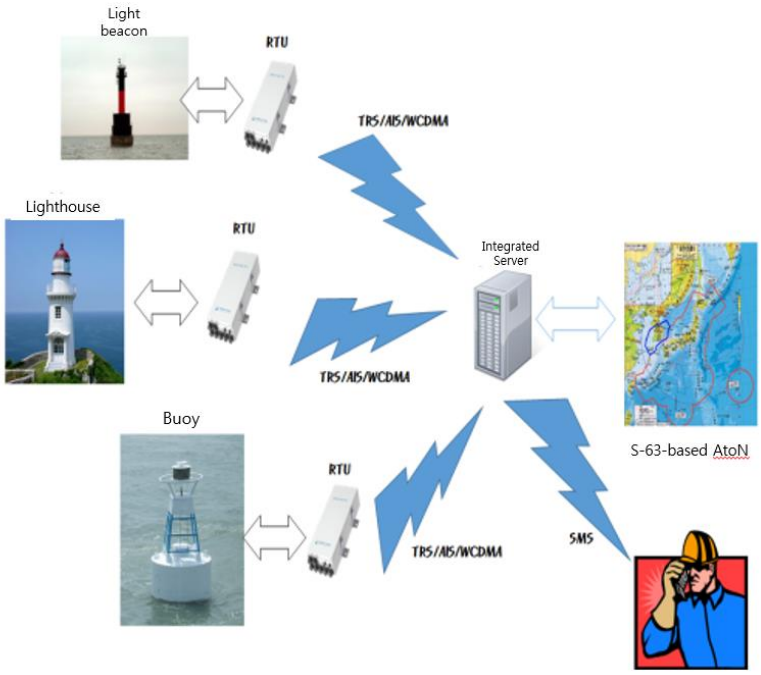

Figure 3. Schematic Diagram of Status Information and Alarm System for Marine Transportation Facilities

Figure 3 is the structure of the system where data transmitted from the Remote Terminal Unit (RTU) attached to a (light) buoy are received and saved onto database. The system that the data from RTU attached to light buoys is stored in a reception and database. Each RTU and servers sends the data through respective servers in the old way, this system structure is designed to communicate by an integration server.

The existing method has each server between RTU and servers so as to transmit and receive data, but this research integrates servers into one to make communications possible. The reason therefor is that there was no better communication method in the past and a communication method for a (light) buoy has been developed in the order of AIS, TRS, and WCDMA. Since high budges are required to install those at all the existing (light) buoys, (light) buoys which have recently been installed use the WCDMA method.

The system that the data from RTU attached to light buoys is stored in a reception and database.

Each RTU and servers sends the data through respective servers in the old way, this system structure is designed to communicate by an integration server.

2) Structure of Communication System

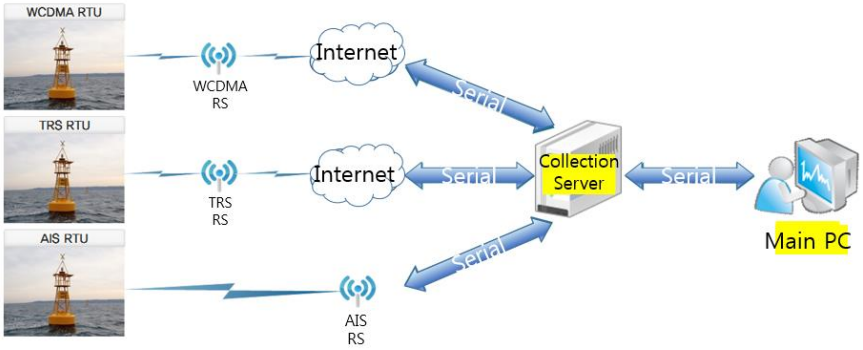

Figure 4. Integrated Communication System

As can be seen in Figure 4, transmission from RTUs to the server is based on three communication methods such as TRS, WCDMA and AIS. Firstly, the TRS and WCDMA methods transmit data to the server through the RS-232 internet communication by use of TRS and WCDMA modules attached to RTUs. Secondly, the AIS method receives data by use of an equipment converting RS-232 into USB through the AIS receiver since the method cannot directly make the AIS communication possible through the server. To identify such RTU data received, the respective RTUs give message IDs and classification is made accordingly.

3) Structure of Communication

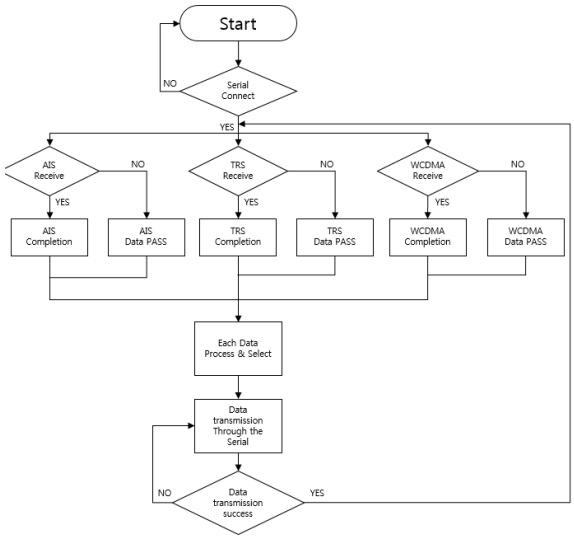

Figure 5. Program Flow Chart

Figure 5 is Program flow chart.

After serial communication, it is possible to get AIS, TRS and WCDMA data. And then, among them could be useless. Other useful data can be applied or changed to take desired values. Finally, applied data will be parsed by a program to show the information needed.

After serial communication, the data of AIS, TRS and WCDMA becomes available.

One of them could sometimes stop sending the data. The data gained can be processed except the other data failed to transmit. The data which is processed by parsing shows useful information.

3. Conclusion

State information guide and alarm system on the market are the methods to collect and process the data by saving the data and using other servers with AIS, TRS and WCDMA communication. State information guidance and alarm system were plane to integrate other protocols using RTU equipment, TRS, WCDMA and AIS. Workers can easily use the system with the integrated server.

Currently, each independent operational system has been established based on S-57, but it has been revealed as the biggest requirement from consumers that the entire monitoring system can mutually interwork by standardizing all protocols and uniting formats thereof Moreover, the status information and alarm system circulated in the market makes communications of AIS, TRS, and WCDMA to save data onto each different server and then, uses another server to collect and process data. This thesis has implemented a status information and alarm system for marine transportation facilities which is an aid to navigation system based on the electronic charts in S-63 format, by integrating different protocols through TRS, WCDMA, and AIS. In addition, users may use the system more easily since the existing various servers have been integrated into one server. In the future, we will apply and implement the system designed by this thesis by programming so that the status information and alarm system will be established. Moreover, we will research and add the services needed by users to make the status information and alarm system more perfect.

Acknowledgments

This thesis is the result of C0249807 research subject to the 2015 Industry-Academic Cooperation Technology Development Project supported by the 2015 BB21 and the Small and Medium Business Administration.

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