Journal of Engineering and Applied Sciences 13 (Special Issue 12): 9357-9360, 2018
ISSN: 1816-949X
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Analysis of Marine Accidents and Design an Enhanced Method of Collision Avoidance Using AIS

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Abstract: Accidents in the marine were results in the serious loss valuable goods or products which in turn affect the economy of the country and even a loss of lives. The statistics report on accidents of vessels over the waterways shows that the rate of increase in accidents every day. In future, expected density of vessels over the waterways will be increased high. This study mainly focuses on the collision type of accidents in the waterways. In any case, vessel collision results a loss of several life and also polluting the marine environment. For this problem Automatic Identification System (AIS) based system is designed to provide the alert to the concerned authority's about the information of the vessels to be collide one another. The status of collision alerts are also given to the pilots through loud speakers.

Key words: Accident analysis, collision avoidance, AIS, voice warning, loud, pilots

INTRODUCTION

From the ancient days, marine transportation plays a prominent role in the trading with the countries all over the world (Chauvin and Lardjane, 2008; Kao *et al*., 2007). Over 80% of the world trade happens through marine transportation. So, this is one of the main sources which employed for deciding the economic growth of the country (Chauvin *et al*. 2013).

The density of the vessels in the waterways increases with the developments in the several technologies in the marine for improving the trade with other countries. So, this will also increases the accident risks of the vessels (Mou *et al*., 2010). Figure 1 shows the Statistics of overall analysis in marine accidents with its cause.

Casualty of the vessels is a term which represents the accident of vessels results in valuable property or the vessels (Goerlandt *et al*., 2012). Causalities can be occurred in several ways, they are sinking, collision or contact, foundering, fire or explosion, stranding, vessel breakdown, grounding or horrific weather conditions (Baldauf *et al*., 2011). Statistics of the various types vessels involving collision accidents are shown in Fig. 2. An enhanced system is designed for collision avoidance in the waterways using the AIS. If the vessels are about to be collide with one another an alert will be given to the pilot of the vessel and also other peoples through loud speakers. This process can be monitored from the control room using IoT.

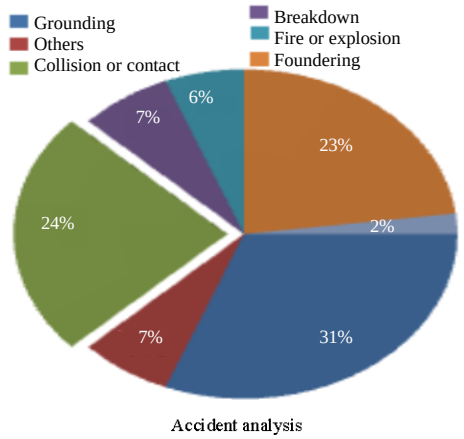

Fig. 1: Statistics of overall analysis in marine accidents with its cause

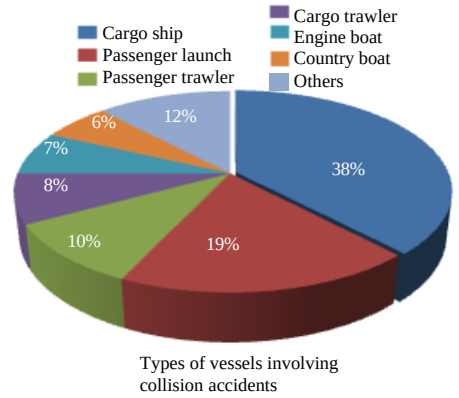

Fig. 2: Statistics of the various types vessels involving collision accidents

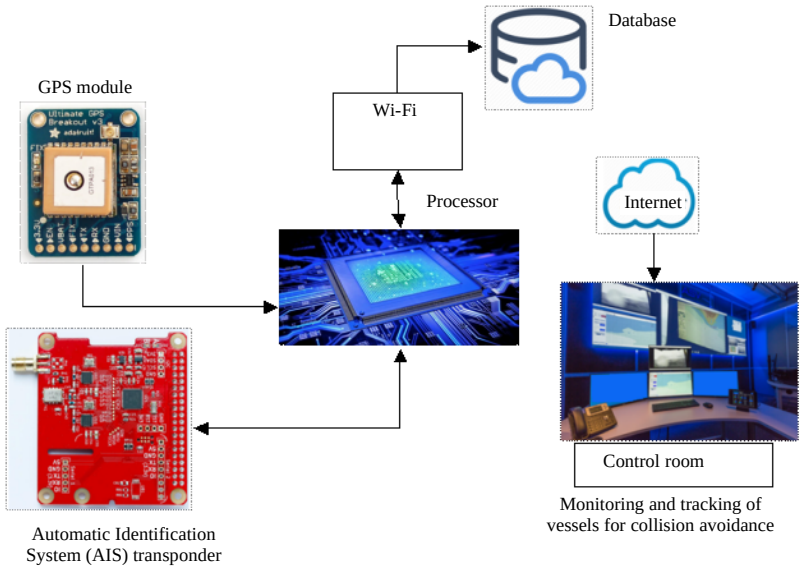

Fig. 3: System architecture for the collision avoidance of vessels by using Automatic Identification System (AIS) through Internet of Things (IoT)

System architecture: Figure 3 shows the system architecture of enhanced method for vessels collision avoidance by using Automatic Identification System (AIS) through Internet of Things (IoT).

MATERIALS AND METHODS

Proposed method aims for developing the enhanced method of collision avoidance in the transportation through the waterways. The proposed system employs the AIS transceiver and GPS module interfaced with the central processor to find the exact location and monitor the vessels in colliding with other vessels. If the range of the vessels gets close then the alert will be conveyed to both vessels through loud speaker by using audio management unit. Figure 4 shows the block diagram for collision avoidance of vessels by using Automatic Identification System (AIS) through Internet of Things (IoT).

This monitoring data are directly sent and saved to the cloud database by using the inbuilt Wi-Fi in the central processor. Then this information can be viewed from the control room using IoT.

Hardware components

GPS module: Our system uses Global Positioning System (GPS) for ensuring the exact position of the vessels over the coastal area. The position co-ordinates of the vessels can be viewed in display and also through the IoT.

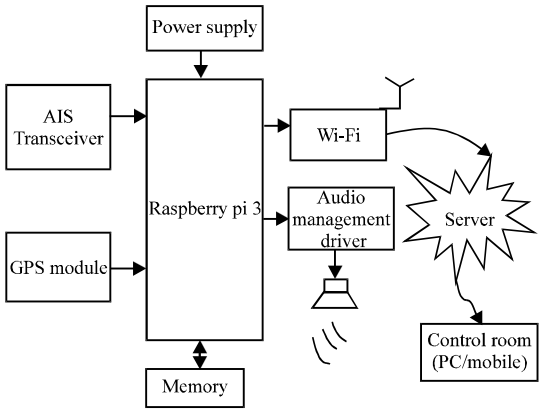

Fig. 4: Block diagram for collision avoidance of vessels by using Automatic Identification System (AIS) through Internet of Things (IoT)

AIS transponder: The main aim of the AIS in our system is to identify and monitor the vessel-traffic in their area and also find the nearby vessels in order to avoid the collision with them. AIS transceiver allows the authorities port or other facility members to view the status in the map through the computer or smartphone. A database is created, the information about the vessels traffic, position and others are stored in the database. It can be accessed from anywhere in the world using IOT. AIS transceiver is used because of the following advantages they are easy installation, implementation cost is low, suitable with the small ports, easily upgradable.

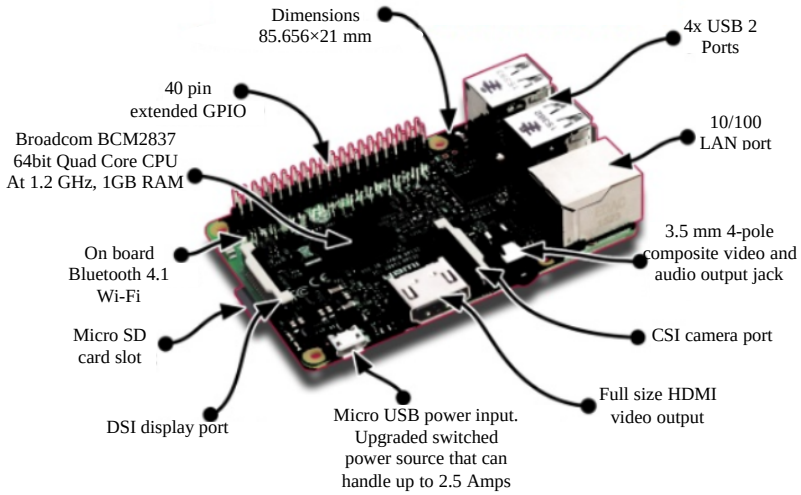

Fig. 5: Raspberry Pi features

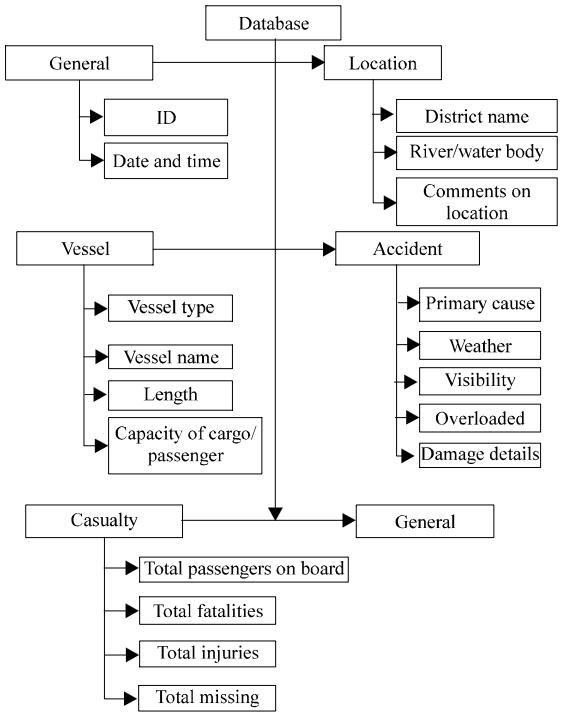

Fig. 6: Structure of the database

Raspberry Pi 3: Raspberry Pi3 is a mini computer. It is powered and driven with Broadcom system on chip processor (BCM2837) which is included with processing the several signals like analog, digital and sometimes mixed signals. It is a small and very competent to operate in Pi platform. Pi3 has a pair of USB can be used for interface of keyboard and mouse. For external memory we can connect memory card to the SD card port (Fig. 5 and 6).

USB cable is enough for powering the board. This Pi can be operated for a long time and power consumption less. Figure 5 shows the features of the raspberry Pi3. The system will connect to the cloud server through the built in Wi-Fi chip. As it acts as a central processor, the data obtained by the processor can be viewed anywhere in the world by accessing the secured server.

Architecture of database: The server offers the capability of accessing it everywhere to the concerned authorities. The server contains a storage subsystem developed with MySQL database. Once the data is gathered by the server then it transfers the obtained data to the database through various protocols like HTTP protocol and MQTT protocol. The HTTP server is based on the request-response mechanism, the HTTP server accepts the user's request and responds quickly and enables the data to access the server and helps in storing the data in MySQL. Figure 6 shows the structure of the database.

RESULTS AND DISCUSSION

A system is developed with according to the analysis of collision accidents on the narrow waterways. Developed system aims at offering the assured collision avoidance in all conditions with the help of combines GPS and AIS transceiver.

Figure 7 shows the collision analysis model. The AIS transceiver and GPS module interfaced with the raspberry Pi processor which is used to found the precise location and monitor the vessels in colliding with other vessels. If the range of the vessels gets close then the alert will be conveyed to both vessels through loud speaker by using audio management unit. Figure 8 shows the overall density of vessels which are travelling in the narrow waterways.

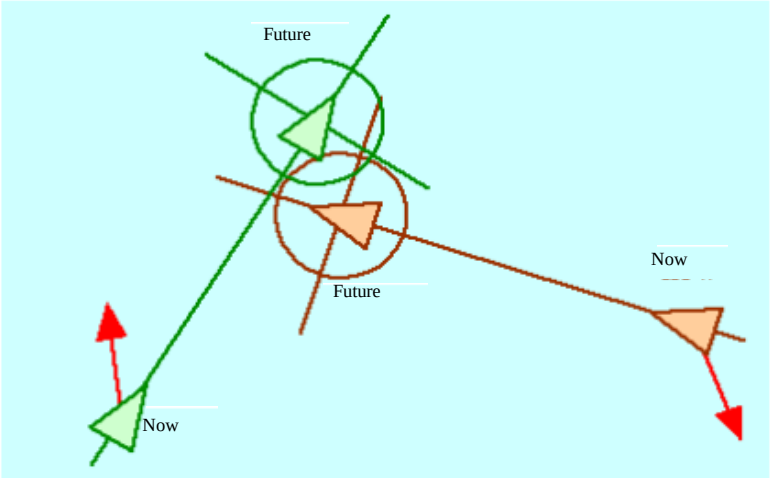

Fig. 7: Collision analysis model

Fig. 8: Overall density of vessels in the water channel

CONCLUSION

The system proposed explores an efficient method for the avoidance of vessels collision over the narrow waterways. The tracking system in our system which is implemented by using GPS is accurate. It can be stable over a long period of time. This enhanced position tracking and monitoring by AIS is very adequate. So, this system can be implemented as an avoidance system for the collision. But the proposed method not yet implemented. For that several securities and safety needs have to be proved.

RECOMMENDATIONS

In future research, several developments in the marine IoT along with the enhanced cost-effective system will be implemented for enhanced system performance.

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