Title of Invention

Monitoring Hazardous Freight Container transportation - measure, record, display the Health Parameters including Air Quality, Temperature and Structural Impact.

Description

A kind of real-time monitoring and managing shipboard dangerous goods freight container based on the technology of the internet of things in the field of maritime transport.

Background

Freight Container transportation is characterized by high efficiency, convenience and has an important position and role in current logistics arrangements. In terms of value, global seaborne container trade is believed to account for approximately 60 percent of all world seaborne trade, which was valued at around 12 trillion U.S. dollars in 2017. Container-carrying capacity has increased by approximately 1,200% since 1968 and some of the world's biggest container ships are nearly about 400mtrs in length. The increased size has produced increased operating efficiency and improved international economy. Yet, there is little doubt that the real-time monitoring and managing dangerous goods in freight containers and support capabilities to mitigate containerized high-risk cargo-related incident at sea has progressed in proportion to increase in ship cargo carrying capacities. There have been several well-publicised ship-board explosion and fire incidents involving laden containers over the recent few years and as the size of container ships increases, so does the potential risk and consequence of maritime disasters.

As the name depicts, Dangerous Goods should be treated with the utmost significance. Since changes that are unfavourable to ensure safe carriage could occur during transportation, it is therefore important to pay more attention to the internal environment parameters of the container during sea passage. With the right knowledge and information, the on-duty personnel can make well-informed decisions when dealing with shipboard contingencies.

In many situations, to ensure unsafe conditions don’t develop and be able to take appropriate corrective and preventive measures during shipboard contingencies it is important to detect the hazards such as gas leakages or elevated cargo temperatures or loss of container structural integrity that can pose risk to the workforce, resulting in cargo damages or brings massive losses for the shipowners. Shipboard real-time monitoring system presses for a kind of technology to solves this difficult problem.

Summary of the invention

For solving an above-mentioned technical problem, the invention proposes a kind of real-time monitoring system and method based on the technology of the internet of things to monitor shipboard hazardous container during marine transportation.

One aspect of the invention is a method and system of monitoring hazardous container stowed onboard the ship, wherein providing safe access to containers due to the stowage location on-deck or under-deck cargo compartments for manual checking is not possible.

Another aspect of the invention is a method and system of real-time monitoring hazardous container internal environment condition, demonstration of history data according to set threshold value, whereby providing an information service and a decision-making consulting service.

Another aspect of the invention is a method and system of measuring impact forces on container pannel to if damage has occurred or if the physical conditions of the containers have been maintained within acceptable limits during transit.

Another aspect of the invention is a method and system providing an information service and a decision-making consulting service in the process of onboard contingency risk assessment during emergencies.

The monitoring system of the invention adopts following technical scheme:

The shipboard dangerous goods container real-time monitoring system based on the technology of internet of things, it is characterized in that, and comprise a plurality of detectors with a wireless sensing node, coordination station and monitoring centre. Every wireless sensing node installed in the container and within the range of the coordination station is connected to the monitoring centre. The connection between the monitoring centre and coordinator station is done over WiFi communication, Hypertext Transfer works as a request-response protocol between a client and server. The system is programmed to exchange data without the need to connect to the internet.

Said wireless sensing node comprises the gas sensor, temperature sensor and impact sensor mounted on printed circuit board powered by battery, and said sensor is used for monitoring containers internal Air Quality, Temperature of the container and sense crashes to container rooftop panel.

Said coordinator station is a portable routing station providing WiFi connectivity to wireless sensor nodes.

Said monitoring centre comprises information service and a decision-making consulting service.

Real-time monitoring based on Internet of Things of the above-mentioned monitoring system may further comprise the steps:

S1, wireless sensing node data acquisition system measures, records and transmits parameters for air quality, temperature and senses impact forces.

S2, multiparameter collected by wireless sensing node are sent to the monitoring centre through coordinator station.

S3, monitoring centre combines each wireless sensor node information, carried out multi-source information fusion, information pigeonhole, modelling and analysis to provide information service, determining, alerting and decision support.

Embodiment

According to the invention described herein, a Server-Client WiFi communication (via HTTP) is established for a wireless sensor network to connect a plurality of multi-parameter sensing equipment. The systems programmed to exchange data without the need to connect to the

internet. Coordinating station programmed as server operates as an Access point (AP) Server, works like a Wi-Fi router emitting its Wi-Fi signal and does machine to machine automatic recognition and information transfer through the Internet Protocol. The sensing node programmed as client installed inside the container to measures internal Air Quality, Temperature of the container and sense crashes to container rooftop panel. The sensing node saves the data in its internal storage in a CSV file and then uploads the data to the server via HTTP requests. The Server system listens, receives, records and display the data from Clients through the wireless network and presents the information on a DG container monitoring system in real-time. As shown in the figure-1, the system of the invention can be divided into 3 layers: perception layer, processing layer and application layer

One, perception layer.

As shown in Figure 1, sensors and components and the schematic diagram of a wireless sensor node according to the invention is shown. The device includes sensors and components including WiFi capability, memory for storage, power source typically constructed to be compact as possible, allowing it to be mounted inside every container carrying dangerous goods stowed on board the ship on deck and underdeck cargo spaces. Fig. 1 is the Sensors and components include, Gas Sensor for monitoring air quality, wide detecting scope and measures the level of Ammonia, nitrogen oxide, alcohols, aromatic compounds, sulfide and smoke; Temperature sensor for monitoring temperature, operating temperature range from -55°C to +125°C with ±0.5°C accuracy from -10°C to +85°C; Impact sensor for sensing container structural impact/crashes, a non-directional sensor measuring structural impact when an external force is applied to the container; Real-Time Clock providing clock information, chip communicates with the microprocessor via a serial interface, module is based on 'integrated inside which there is a real-time clock/calendar and static RAM. Battery included; Digital memory card module provides an SD card slot for use with the microcontroller, programmed to create a file in an SD card to write and save data using the SD library; microprocessor with an open-source IoT platform, Integrated 802.11b/g/n HT40 Wi-Fi

transceiver for connecting to a WiFi network to interact with the Internet and also used to set up a network of its own, allowing other devices to connect directly, a voltage regulator to convert from 5v to 3.3v and 16MB of Flash memory (for program and data storage) enabling to cope with the large strings required for the web pages, JSON/XML data, and everything required for this IoT dev to work as a smart monitoring device for Dangerous good freight container; Nicad battery capacity to provide energy to the wireless sensing node, extreme temperature tolerance, deep discharge capabilities and very robust. The sensing node programmed as client installed inside the container to measures internal Air Quality,

the temperature of the container and sense crashes to container rooftop panel. The sensing node saves the data in its internal storage in a CSV file and then uploads the data to the monitoring centre server via HTTP requests.

Two processing layer.

Data received by the monitoring centre is processed to display the container locations in the bay plan and internal environment parameters for each of the container. Figure-1 shows the

information flowing into the Server recording the corresponding results from each client with time stamps. To performing additional analysis, the Raw data from *.csv file could be extracted to the monitoring system in ships office. Alerting function in the system is programmed to highlight the container having high internal temperature and or the presence of hazardous gas. The officer on the watch takes appropriate action in case of tackling shipboard emergencies as per Fire and Spillage schedules in the IMDG Code.

Three Application layer.

Application layer uses the process data from the previous layer. This layer constitutes the front end of the monitoring and managing system. It is based on a software platform and the webserver is mobile responsive to be able to access with any device that is connected in server local WiFi network. The basic level service interface of the program provides each wireless sensing node running, the status information of checking containers in range. Dashboard (Figure-3) comprises container Bayplan indicating the onboard stowage location for the various Dangerous Goods Freight Container loaded on the container ship. And detailed information about the cargo routing, container internal environment parameters, cargo data and its Emergency Schedule in the respective containers. Alerting the duty personnel to inspect the container to ascertain appropriate management process and provide information regarding relevant Emergency Schedule requirements as per the International Maritime Dangerous Goods Code. The Management level, accessed through the login of monitoring centre, can manage the system information, append the cargo particulars, routing information and container details. Manage the status information, automatic alerts, decision support and schedule functions such as maintenance, system interlink, data mining and diagnosis. Accomplish effective monitoring and managing dangerous goods freight containers in the marine transportation process. Comprise measuring, analysing and realizing basic action in the cargo care process, be i.e. the process of intelligent marine transportation, intelligent shipboard storage, intelligent loading and unloading at the port and intelligent information for a decision support system.

Description of drawings

Pass through the detailed description of hereinafter in conjunction with accompanying drawing, the present invention will be easier to understand and master, wherein:

Fig. 1 shows a shipboard dangerous goods container monitoring system IoT architecture.

Fig. 2 shows a dangerous goods container wireless communication system.

Fig. 3 shows a shipboard dangerous goods container monitoring system display stowage plan and wireless network coverage.

Fig. 4 shows a shipboard dangerous goods container monitoring system dashboard.

Claims (8)

1. A shipboard dangerous goods monitoring system and management method based on the technology of internet of things, wherein, include: ① plurality of wireless sensing nodes, ② wireless coordinator station and ③shipboard monitoring centre, the three modules collaborate enabling real-time monitoring and managing maritime transport process, wherein:

2. The monitoring system according to claim 1 is characterized in that, a piece of intrinsically safe equipment, wireless sensing node comprises the air quality sensor, atmospheric temperature sensor and crash detection sensor arranged on circuit board powered by a lithium battery.

3. The monitoring system according to claim 1 is characterized in that, said wireless coordinator station is a portable routing station providing WiFi connectivity to wireless sensor systems.

4. Monitoring management methods according to claim 1 are characterized in that, said shipboard monitoring centre comprises information service and a decision-making consulting service.

5. The method of claim 1, wherein the method further comprises, receiving, via machine to machine automatic recognition Wifi interface, information detecting air quality and temperature and rooftop panel impact by a plurality of sensors installed in the dangerous goods freight container;

6. The method of claim 1, wherein the method further comprises, generating, by the processor, a report for the containers in range, displaying multi-parameters by sensing nodes and onboard stow plan position for the containers.

8. The method of claim 1, wherein the method further comprises, analyzing, by the processor, information identifying internal environment conditions and rooftop panel impact history of the plurality of containers;

7. The method of claim 1, wherein the method further comprises, determining and alerting, by the processor, whether the sensors values is above a threshold associated with each of the wireless sensing nodes;