

## Research Article

### A Novel Navigation Information Management System for Food Maritime Logistics Based on Internet of Things

<sup>1</sup>Wei He and <sup>2</sup>Xiumin Chu

<sup>1</sup>Transportation Engineering Institute, Minjiang University, Fuzhou 350108, China

<sup>2</sup>ITS Institute, Engineering Research Center of Transportation Safety (Ministry of Education), Wuhan University of Technology, 430063 Wuhan, China

**Abstract:** This study focuses on the construction of a new navigation information management system for food maritime logistics. With the vigorous development of Internet technology, the Internet of things technology has been introduced into the food maritime logistics to enhance the efficiency of food production transportation. However, the navigation information management system for food maritime logistics is still a big challenge and very limited work has been done to address safe and effective navigation information management for food maritime logistics. For this reason, a novel navigation information management system based on Internet of things for food maritime logistics is presented in this study to achieve a variety of network data exchange and integration and build a set of information collection and transmission modules to process and share the information involved with the beacons, hydrology and environment. The navigation information management system could provide important information and decision for food maritime logistics to ensure their safety.

**Keywords:** Food maritime logistics, internet of things, navigation information management system

## INTRODUCTION

The safety of food maritime logistics relies on the navigation information. As well known, with the rapid development of inland digital construction, the navigation mark information management which can be as an important component of the channel management has made some achievements in the informatization construction (Wu *et al.*, 2008; Hsiao *et al.*, 2010). But the navigation management is still on the starting stage, there are a lot of problems needed to be solved such as the basic data is still not complete, a unified data center has not formed, information foundation is weak, brand is numerous, informatization level is uneven, communication mode is single, Internet access and communication are difficulty, the existing information platform function is deficiency and there are short of information sharing and release means and so on.

As the third wave of informatization after the computer and Internet, the internet of things is the current strategic emerging industries with the vigorous development (Su *et al.*, 2004). Attaching the internet of things to the navigation information management system and solving the above problems will be of great significance. However, for food shipping, very limited work has been done in the field.

In order to establish a new navigation information management system for food maritime logistics, a novel navigation information management system based on

internet of things is proposed in this study. The new system for food shipping includes the wireless sensor networks, Accounting Information System (AIS) network, 3G networks and environmental information collection and transmission, processing, sharing release module and so on. Taking advantages of this new system, the shipping safety for food maritime logistics could be significantly improved.

## METHODOLOGY

**The novel food maritime logistics navigation system:** The navigation information management system based on Internet of things should give full consideration to the existing digital channel basement and development needs to build. For different type, location and uses, the all-round, diversified information acquisition, processing, storage and release should be done (Zhen, 2006). The navigation information management system based on Internet of things are including such as Telecontrol terminal (RTU), intelligent navigation marker sensor, navigation station, information management system platform, electronic navigation chart ship terminal. The architecture of navigation information management system is shown in Fig. 1.

As well known, a rich and valuable data is the basis of navigation mark information management system which can use various means to collect information such as navigation mark, hydrology and environmental

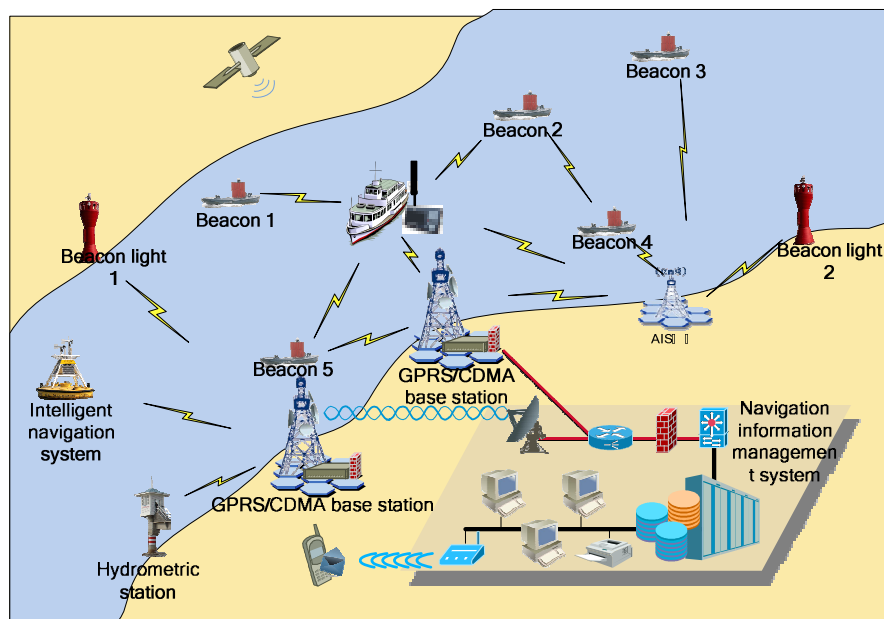


Fig. 1: The architecture of the proposed navigation information management system for food maritime logistics

information (Wei and Li, 2003). The telecontrol terminal of the navigation mark can use GPS or Beidou module to location and using various sensor chips to percept the working state, at the same time a variety of intelligent navigation sensor equipment are installed to collect hydrological and meteorological environment information. In the navigation information management system, the telecontrol terminal transmit information to management system platform through Zigbee and 3G network which can realize communication between the network and the seamless connection between different networks. In addition the navigation mark information management system platform also can realize the integration of multiple heterogeneous data and storage of redundant data compression, which can display friendly and be graphical interface. The system also can release navigation mark and environmental information through the AIS base station radio and electronic navigation chart platform.

**Key technology for food maritime logistics navigation system:**

**Telecontrol terminal of beacon telemetry:** Telecontrol terminal of beacon telemetry is the integration of low power consumption systems, including the high precision Beidou/GPS positioning, GPRS/GSM/CDMA compatible communication, AIS extensions, etc. Based on this telecontrol terminal, the beacon can provide the real-time acquisition and monitoring on the beacon operation parameters and position, respond to the remote control command and perform automatic alarm and so forth.

Figure 2 shows the structure diagram of the beacon telecontrol terminal system, which consists of the telemetry and telecontrol terminal, embedded beacon controller and power supply system, etc. Among them,

Table 1: The specific function of modules in the telemetry and telecontrol terminal

| Modules                        | Functions   |
|--------------------------------|---|
| Central control module         | Data processing and control of other modules            |
| Memory module                  | Save the system configuration data, history data, etc., |
| Measurement and control module | Acquire GPS and other information of the beacon         |
| Communication module           | Provide remote communication services                   |
| Extension module               | Provide interfaces for AIS and sensors                  |
| Power supply module            | Supply power for each module                            |
| RS485 module                   | Provide RS-485 communication interface                  |

the telemetry and telecontrol terminal is composed of the central control module, memory module, measurement and control module (Beidou/GPS, working state acquisition), communication module (GSM/GPRS/CDMA), extension module (AIS) /sensors, power supply module. Table 1 lists the specific function of each module.

**Intelligent sensor acquisition subsystem based on ZigBee technology:**

Zigbee technology, one of the typical representations of wireless sensor network, is a kind of two-way wireless communication technology and wireless network technology (Xu, 2009). Zigbee technology uses the Direct Sequence Spread Spectrum (DSSS) technology, working on 2.4 GHz frequency band, with the highest 250 kbit/sec transmission rate. The transmission distance is within 10 m~1 km. As a kind of wireless technology, Zigbee has advantages of close distance, low complexity and low power consumption, low cost, low bitrate, etc. Zigbee is constructed based on the IEEE 802.15.4 wireless standards and has been widely used in the application areas including industrial monitoring and control,

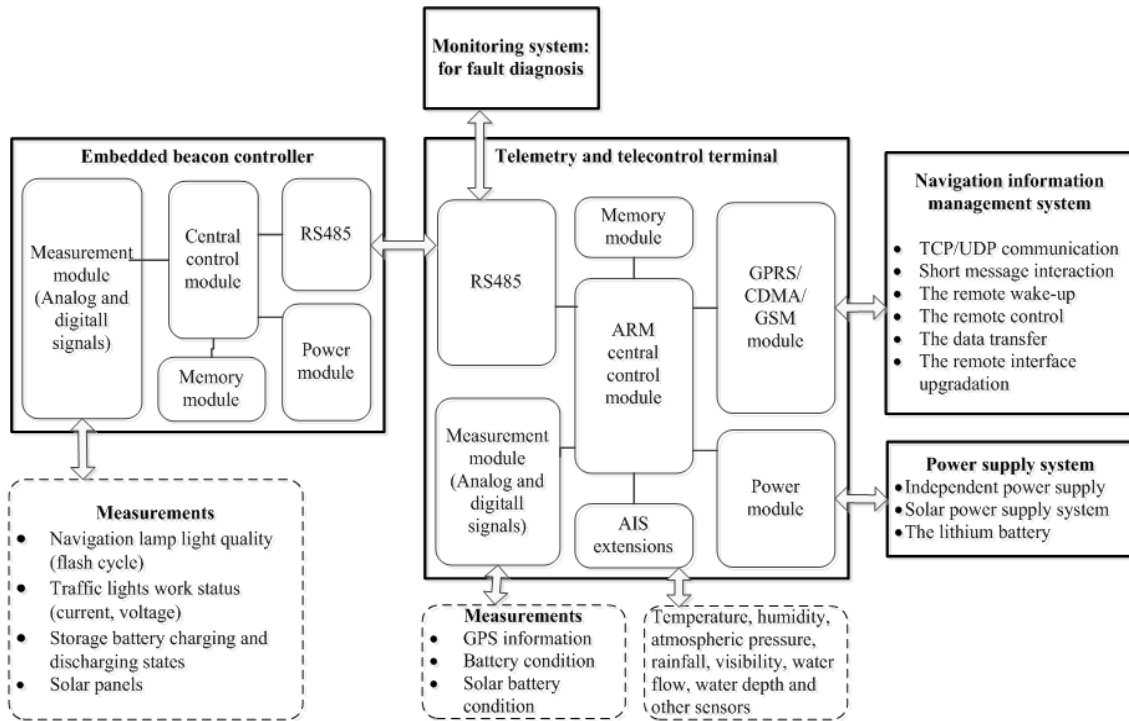


Fig. 2: The structure diagram of the beacon telecontrol terminal system

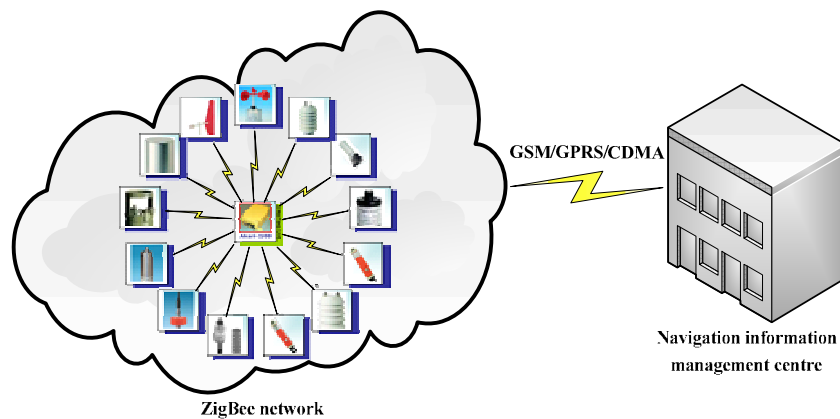


Fig. 3: Zigbee network based intelligent navigation mark system

sensors, electronic equipment, ship automation, port logistics, digital channel and so on. Fig. 3 shows the ZigBee network based intelligent navigation mark system.

In the Internet of things based navigation information management system using ZigBee technology, with a buoy or beacon as the carrier platform, the ZigBee network can integrate a variety of intelligent navigation sensor equipments to acquire the hydrological and weather information, including the channel temperature, humidity, atmospheric pressure, wind speed, wind direction, rainfall, visibility, water flow, water depth, etc. This collection information would provide important technical support for waterway maintenance and maritime management.

**Navigation mark technology based on automatic identification system:** Ship Automatic Identification System (AIS) is a new kind of digital navigation systems that integrates the network technology, modern communication technology, computer technology and electronic information display technology (Fang *et al.*, 2009). The purpose of AIS is to identify ships, help shore stations and ships track targeted ships with auxiliary information to avoid collision and simplify information exchanges. Figure 4 shows the ship automatic identification system.

In the navigation information management system based on Internet of things, AIS are installed in the telemetry and telecontrol terminal module and can regularly send AIS navigation radio to provide the ship

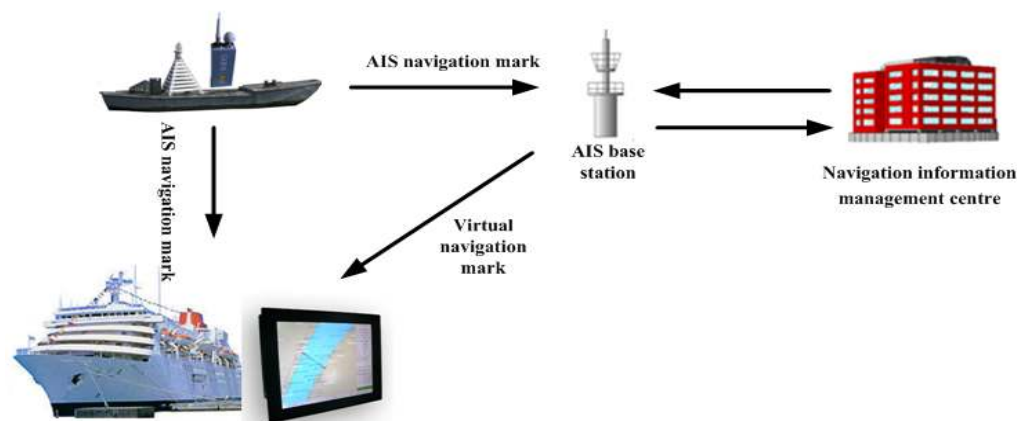


Fig. 4: The AIS for food ship logistics chain

navigation information. The AIS navigation radio includes navigation beacon name, type, location, working status and other information. In addition, the navigation information management system broadcasts virtual beacon information through AIS base stations to realize the virtual beacon function. The AIS navigation information will be real-time displayed on the ship electronic equipments to provide effective navigation service for the ships.

**Navigation information technology based on electronic navigation chart:** Electronic navigation chart is the basic platform of digital waterway to supply important basic geographic information data. Based on the electronic navigation chart, the daily shipping management and safety supervision management can be implemented in inland waterway channel is also one of combined with the satellite positioning system, ship location and navigation trajectory can be displayed on the electronic navigation chart to ensure the safe navigation of the ships.

The telemetry and telecontrol system server will share the latest beacon information to the electronic navigation chart system by a specific interface. Then the electronic navigation chart system updates itself according to the latest navigation information so as to realize the timely release and sharing of latest navigation information.

## CONCLUSION

This study has introduced the Internet of things technology into the navigation mark information management system for food maritime logistics. The latest Internet related technologies based on the existing technology have been employed. The new system has adopted the navigation mark, modulator and channel in inland to provide navigation information for food transport. The navigation mark information management system based on Internet of things will enhance the level of channel information service and grasp the real-time dynamic information capacity

timely to ensure the safety of food transport. The new system can also realize the information resource integration and comprehensive utilization to improve the quality of food maritime logistics, which can save energy, reduce the management cost and realize intelligent management of food maritime logistics.

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