

Design and Implementation of Safety Monitoring System for Dangerous Chemical Tanker Transportation Based on Net

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Abstract

In recent years, with the improvement of the level of national economic development, China's industrialization is also developing. At the same time, people's demand for dangerous chemicals is also gradually increasing. Firstly, this paper introduces the background and significance of analyzing and studying the safety monitoring system of dangerous chemical tanker transportation, and briefly introduces the development status of domestic dangerous chemical transportation; Then it analyzes the characteristics of the current transportation of dangerous chemicals and the realization idea and significance of the safety monitoring system for the transportation of dangerous chemicals tank cars; Finally, according to the challenges faced by the safety monitoring system of dangerous chemical tanker transportation, its future development prospect and prospect are analyzed.

Keywords

Transportation; Dangerous chemicals; Monitoring system; Implementation ideas; Development prospects.

1. Introduction

The rapid development of chemical industry has led to the gradual increase of accidents in the production, transportation, storage and use of hazardous chemicals, including transportation 30%~40%. The transportation of dangerous chemicals is a complex and difficult process to control. Because hazardous chemicals are flammable, explosive, corrosive and toxic, they may cause various malignant traffic accidents, such as leakage, corrosion, combustion and explosion, poisoning, etc. after being subjected to external effects such as vibration, extrusion, impact or open fire during transportation. In addition, the rescue of dangerous chemical tanker accidents can not only refer to other ordinary traffic accidents, but need to use relevant professional knowledge and provide targeted rescue action plans.

Therefore, it is particularly important to monitor the transportation safety of dangerous chemicals. At present, with the rapid development of Internet of things, sensors, communication and other related technologies, it also provides stable technical support for the real-time monitoring of the transportation safety of dangerous chemical tanker.

2. Domestic Status

The development of the country is inseparable from the support of basic industries with the improvement of the level of national economic development, China's industrialization is also developing. At the same time, people's demand for dangerous chemicals is also gradually increasing. In 2020, the number of dangerous chemical transport vehicles in China reached 18000, an increase of 7.3% over the previous year. The market scale of dangerous chemicals increased to 1521 billion yuan, a year-on-year increase of 13.4%.

However, in sharp contrast to the rapid development of the chemical industry, the accidents of hazardous chemicals in the production, transportation, storage, use and other links are also gradually increasing. According to incomplete statistics, more than 1300 domestic chemical accidents occurred in 2020. Among them, 184 accidents killed more than one person, resulting in a total of 313 deaths; There were 597 fire and explosion accidents, accounting for 45% of the total accidents, resulting in 184 deaths; There were 180 poisoning and suffocation accidents, accounting for 13% of the total accidents, resulting in 112 deaths.

In China's 13th five-year plan, in terms of safety production, relevant departments and enterprises are more strictly required to pay attention to the safety of dangerous chemical tanker transportation. At the same time, with the state's attention to the operation safety of "two passengers and one danger" key operating vehicles, relevant laws and regulations have been issued one after another, which provides a solid policy foundation for the real-time monitoring of the transportation safety of dangerous chemical tank vehicles. In addition, with the rapid development of Internet of things, sensors, communication and other related technologies, it provides stable technical support for the real-time monitoring of the transportation safety of dangerous chemical tanker.

3. Hazardous Chemicals Transportation Monitoring

3.1. Project Purpose

Therefore, according to the existing policies and regulations, it is particularly important to develop a set of dangerous chemical tanker transportation safety monitoring system by using various advanced technical means. It not only needs to realize the real-time monitoring of the operation process of dangerous chemical tanker and record the operation conditions of the vehicle, but also needs to help relevant technical experts analyze and summarize the causes of the accident through massive operation data. Finally, greatly improve the operation safety of dangerous chemical tanker.

3.2. Project Implementation Process

The monitoring terminal is responsible for collecting the operating conditions of dangerous chemical tank cars, uploading the real-time conditions to the cloud black box, judging the dangerous situation and receiving relevant instructions from the remote monitoring center, so as to timely warn the driver. The cloud black box is responsible for receiving, processing and storing the operating conditions of all vehicles, and providing an interface to enable the remote monitoring center to access and download data. The remote monitoring center displays the operating conditions of all vehicles on the screen humanized and intelligently, so as to facilitate the staff to understand the operating conditions of each vehicle and deal with various emergencies in time at critical times.

4. Main Contents of Hazardous Chemicals Transportation Safety Monitoring System

4.1. Design of On-board Monitoring Terminal

The on-board monitoring terminal is responsible for the omni-directional and non-delayed dynamic acquisition and monitoring of various conditions of "person vehicle cargo environment" during tank car transportation, and connects the personal hotspot of the smartphone through the WiFi module to access the 4G network to upload various working conditions in real time. When the data exceeds the preset value, it will warn the driver by receiving the command of the monitoring center remotely, Achieve scientific management and

safe transportation. The overall framework of on-board detection terminal is shown in Figure 1

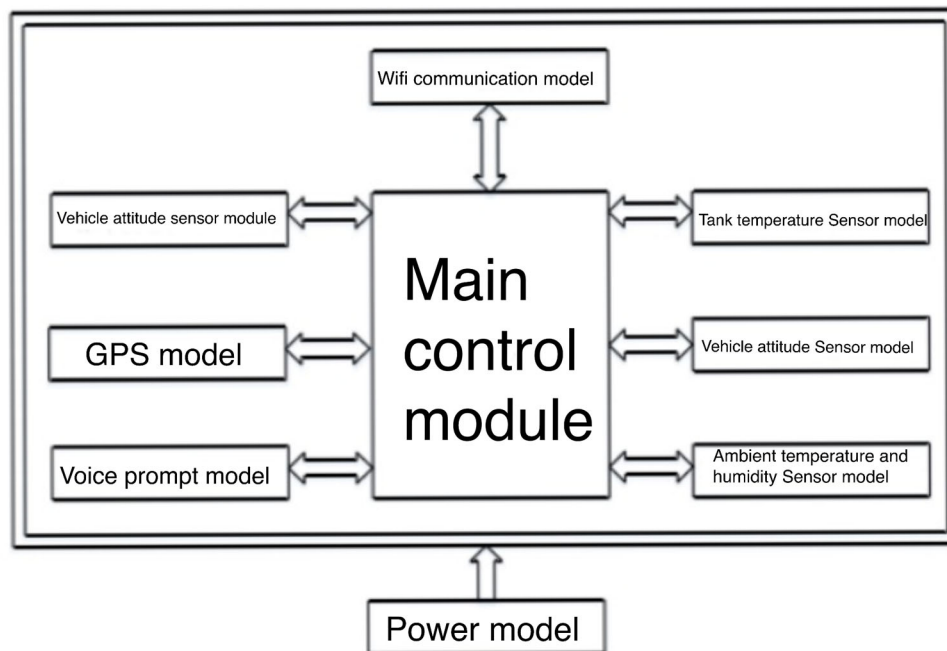


Figure 1. Overall framework of on-board detection terminal

4.2. Cloud Black Box Design

The cloud black box consists of a SQL Server database and a TCP server, and is deployed on Ali cloud ECs. As the data operation core of the whole system, the cloud black box is responsible for receiving the operating conditions uploaded by all tank cars. At the same time, it can analyze the data by itself and list the dangerous and abnormal alarm data for access and download by the remote monitoring center. After an accident, once the site is seriously damaged and the cause of the accident cannot be accurately analyzed, you can download the operating conditions of the tank car before the accident by accessing the cloud black box. The database E-R model is shown in Figure 2

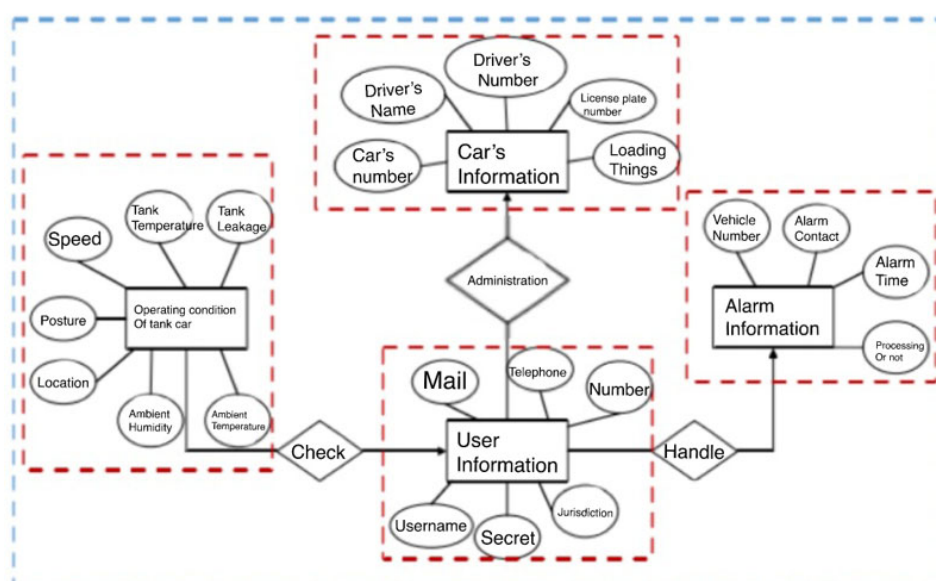


Figure 2. E-R model of database

4.3. Realization of TCP Server

The TCP server is responsible for opening the TCP multi connection, which can effectively receive the operating conditions sent by all tank cars and store them in the corresponding database table. The working flow chart of TCP server is shown in Figure 3.

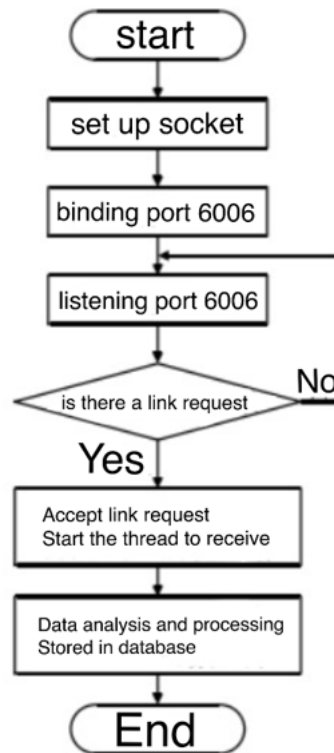


Figure 3. Working flow chart of TCP server

4.4. Design of Remote Monitoring Center

The main function of the remote monitoring center is to monitor and manage all tank cars. In order to achieve fast and efficient monitoring and management, its UI design makes the whole software operation simple and easy to understand. The software design process is shown in the figure. The specific UI design code is in monitoring_ System_ Under the UI file directory, it is written in XAML markup language. It is mainly composed of grid panel and stack panel, supplemented by button, text box, image and other controls. At the same time, it provides customization of some contents for some users.

5. Future Development

In 2020, the State Council, the Ministry of communications, the Ministry of emergency management, the Ministry of ecological environment, the Ministry of public security and other competent departments frequently issued new policies, and a number of road transportation and vehicle safety technical standards were officially implemented. It is required to strengthen the supervision of all links of consignment from the source, improve the management of dangerous cargo tank cars on a large scale, implement the waybill management system, supervise the safety of ships carrying dangerous goods, and systematically improve the training management Establish a dangerous goods exemption system. In response to the national call and promote the implementation of policies, local governments have stricter control over the new transport capacity of dangerous chemicals logistics, and the industry access threshold has been further improved. In recent years, with the rapid development of the chemical industry, it has entered a high-speed growth stage. At present, the competition among enterprises is

increasingly becoming the competition among supply chains. At present, most production enterprises and trading enterprises in the domestic chemical industry rely on the third-party logistics enterprises to realize the transfer and transportation of products, while the third-party logistics enterprises generally have small scale and low management level, Large employee turnover and weak profitability. Therefore, the gradual establishment of a fourth party logistics platform with shared transportation capacity, unified management and control and excellent service standards will become the next development direction of the industry.

A set of safety monitoring system for the transportation of hazardous chemicals tanker is designed and applied to practice to realize the real-time monitoring of the operation process of hazardous chemicals tanker, record the operation conditions of the vehicle, help relevant technical experts analyze and summarize the causes of the accident through massive operation data, greatly improve the operation safety of hazardous chemicals tanker and create a good social environment.

Acknowledgments

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