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Logistics Management System Design Based on GIS

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Abstract

In order to solve such problems as large workload and poor safe reliability of manual piecework during short-distance logistics transportation, GIS information acquisition technology, wireless communication data transmission technology and two-dimension code technology are adopted to design STM32 based Logistics Management & distribution data teletransmission management system in order to acquire real-time cargo data during the logistics distribution process; meanwhile, these data are transmitted to Logistics Management System through GPRS wireless network, thus to realize the centralized management of real-time cargo transportation information.

Keywords: *Logistics Management System; GPRS wireless communication; GIS*

1. Introduction

In recent years, along with the prosperous development of logistics industry, the quantity of logistically transported cargos is gradually increased and the economic losses caused by improper Logistics Management are also increased year by year [1]. In order to reduce losses, various large companies at home and abroad have respectively designed their own logistics inquiry systems, but manual mode is stilled adopted in the logistics industry for Logistics Management and accordingly economic losses are frequently caused by human factors. Such modes as manual sorting and manual piecework adopted for traditional Logistics Management have such obvious defects as many subjective factors, information delay, real-time cargo transportation state monitoring failure [2]. At present, with the features of permanent online performance, cheap charge, easy networking, high transmission rate, *etc.*, GPS has been widely applied for vehicle monitoring and is especially applicable to sudden and frequent flow data transmission [3], and the theoretical peak value of data transmission rate supported thereby can reach 171.2kb/s, so GPRS network is adopted as the information transmission tool for this system. Meanwhile, in order to more visually monitor the logistics information of the cargos and record the cargo distribution routes during the logistics transportation process, GIS (Geographic Information System or Geo-Information system) is also adopted for this system. Specifically, GIS also called "Geographic Information System" or "Resource and Environment Information System" is a particularly important spatial information system, namely a technical system able to collect, store, manage, calculate, analyze, display and describe relevant spatial geographic distribution data under the support of computer software and hardware system[4-9]. In this article, GIS technology and two-dimension code automatic identification technology are applied to the Logistics Management System, wherein the handheld terminal equipment is adopted to monitor cargo loading, handover and delivery, and the two-dimension code identification technology is adopted to uniquely identify cargo information and accordingly realize the digital management during the logistics process.

The features of Logistics Management have determined the large quantity of vehicle terminals, the dispersed locations and the great data acquisition difficulty. In this article,

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STM32 based SCM location information acquisition, data teletransmission and GIS based Logistics Management platform are combined to design system software and hardware and analyze system architecture, and such combination is a beneficial try for current logistics real-time inquiry and management technologies.

2. General Design of System

Logistics teletransmission management system is composed of vehicle-mounted GSM module, database service module and Logistics Management platform, wherein the vehicle-mounted GSM module is mainly responsible for basic cargo unit management, real-time distribution data communication, response to control instructions of Logistics Management platform, *etc.*; the database service module is mainly responsible for storing logistics information and cargo information; the Logistics Management platform is mainly responsible for monitoring, displaying and analyzing logistics process management information and real-time cargo information. The general design of the system is as shown in Figure 1.

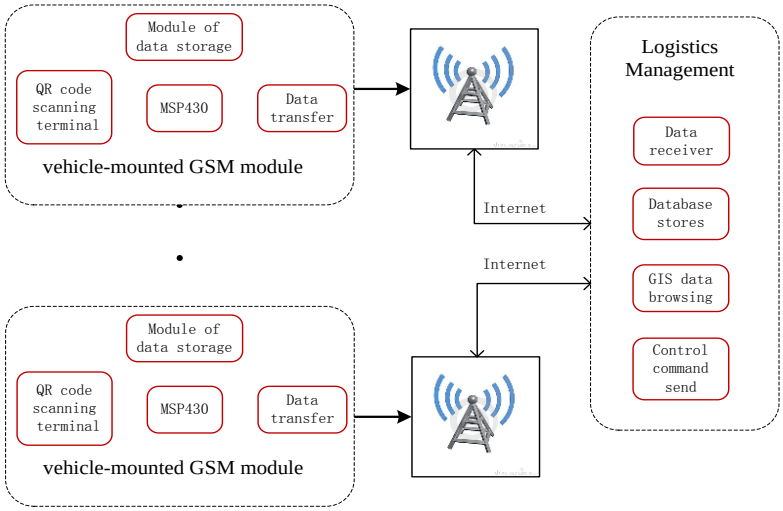

Figure 1. General Design Drawing of GIS Logistics Management System

As one part of the vehicle-mounted system, the basic Logistics Management unit aims at managing cargo data and transmitting cargo information during cargo transportation process through the combination of embedded GIS technology and two-dimension code automatic identification technology, and is mainly composed of following four modules: data acquisition module (namely two-dimension code scanning circuit), data storage module, communication module and power supply.

3. Hardware Circuit Design of Vehicle-Mounted GSM Module

The hardware circuit of vehicle-mounted GSM module is mainly divided into following six modules: master controller system module, two-dimension code data acquisition module, RAM data storage, display module, GIS communication module and power supply module. The general design block diagram of the system is as shown in Figure 2.

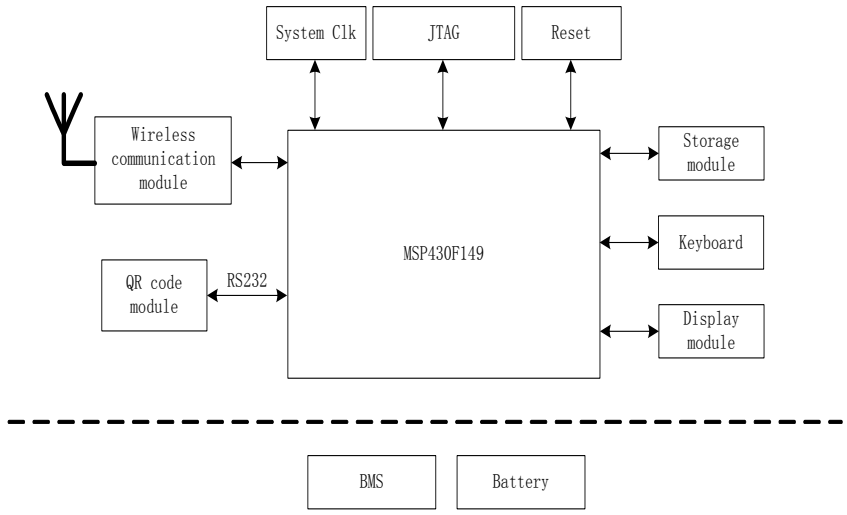

Figure 2. Hardware Circuit Design Drawing of Vehicle-Mounted GSM Module

3.1. Minimum System Design of Master Controller

MSP430F149 ultra-low power consumption chip manufactured by TI Corporation is selected as the main control chip in this article. In order to realize cargo information acquisition function, the portable design and 18650 type secondary battery as the power supply are adopted. Specifically, MSP430F149 is started from built-in SRAM, I2C bus operates EEPROM, and the operating voltage is 3.3V; meanwhile, RS232 and the two-dimension code scanning circuit are adopted to display such information as time, date, longitude, latitude and speed on LCD. Therein, EEPROM 24C512 chip compatible with I^2C interface is adopted for geographic information storage. The data received and extracted at each time is compressed and then stored, and the data at most for one day can be stored. Additionally, due to extremely large compression ratio, only 6.5bytes are equivalently used for the geographic information. The specific circuit design is as shown in Figure 3.

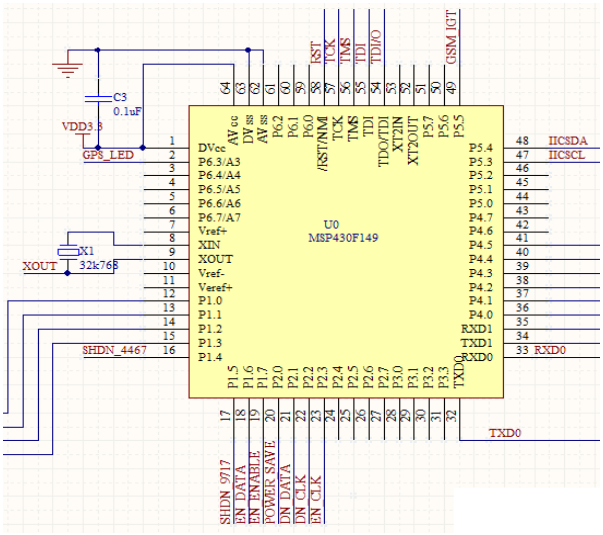

Figure 3. MCU Minimum System Diagram

3.2. Communication Module Design

The communication module is composed of two parts: SIM cassette circuit, standard module interface and module power supply control circuit designed on terminal main board; standard DTU module (GPRS module or CDMA module). In this article, SIM900A provided by SIMCOM Company is adopted to realize GPRS communication. The specific circuit design is as shown in Figure 4 and Figure 5. Specifically, MSP430F149 receives the geographic information data transmitted from GIS communication module, then extracts and compresses the useful information of the data, then displays such information as longitude, latitude, time and speed, and finally stores the geographic information. The specific communication functions are as follows:

(1)GPRS data teletransmission: the transmitted information includes: longitude, latitude, time and speed. The compressed data are transmitted every second to realize strong timeliness.

(2) GPS positioning: the data are updated every second and output by asynchronous serial port and the extracted information includes longitude, latitude, time, data, speed, *etc*.

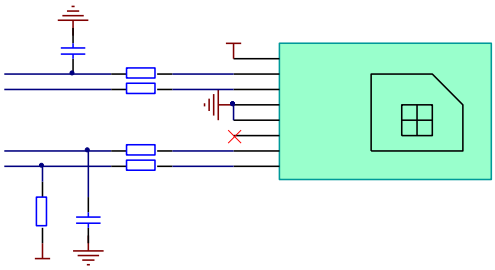

Figure 4. SIM Card Circuit Diagram

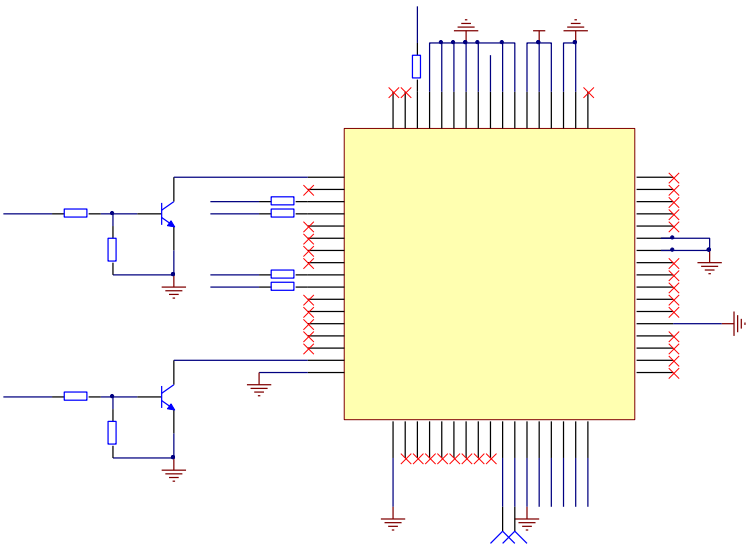

Figure 5. SIM900A Module Circuit Diagram

3.3. Two-Dimension Scanning Module

In the design, the minimum unit for logistics transportation, namely individual vehicle, is taken as the basic unit. Two-dimension code management is adopted for the cargos in each basic unit, and the commercial two-dimension code long-distance scanner of Argox AS-8250 is adopted in this article to scan the cargos, wherein this scanner communicates with MSP430 SCM through RS232 serial communication, and the specific circuit diagram is as shown in Figure 1. Specifically, pins TXD0 and TXD1 communicate with Argox AS-8250 serial port to acquire cargo data information, and the acquired information is stored in the memorizer of the vehicle-mounted system.

3.4. Power Supply Module

Due to the requirements of the large quantity of power supply modules and the high precision of power voltage and current for the system, multiple power supplies are adopted in this article. Specifically, VBAT power supply scope is 3.2～4.8V and the voltage is 4.0V in normal condition. Under some circumstances, the peak current for the radio frequency data to transmit time slot pulse can reach 2A, which will inevitably cause voltage drop, so the power supply with the current above 2A is needed. Additionally, voltage stabilization module AAT3221 can provide 3.3V voltage to MSP430F149.

4. Design of GIS Logistics System Management Platform

4.1. Design of Management Platform Framework

The modeling theory of 2D-GIS technology is taken as the basis to acquire such real-time information as the longitude and latitude information and the cargo management information from the vehicle-mounted GSM module so as to establish the logistics system management platform, as shown in Figure 1.

2D-GIS logistics system management platform is composed of three mutually independent subsystems: SQL Server based logistics information database, ArcSDE server system and Web application system.

SQL Server based logistics information database is mainly used to store and manage mass logistics information data and cargo distribution data. Therefore, high-performance commercial server is adopted to establish SQL Server database system in order to separate data and business logics and accordingly improve system stability and maintainability.

ArcSDE application server system is mainly responsible for responding to the data storage and inquiry requirements from the client, searching, accessing and forwarding mass data in the database. Meanwhile, this system is directly connected to the background SQL database so as to automatically allocate and calculate tasks according to CPU utilization and network occupation of present client and server, thus to significantly reduce the dependence of the whole system on the data server and effectively improve the performance of the whole system as well as provide more effective technical support to the client application system.

Client application system employs C# and ASP.net technologies to complete the coordinated management and interaction between the Logistics Management personnel and the cargo transportation personnel and respond to inquiry and analysis requests.

4.2. GIS Technology Based Logistics Management Process

Vehicle-mounted GSM module and Logistics Management platform are combined to realize the digital and real-time logistics process management. The software subsystem of the whole management system is as shown in Figure 6.

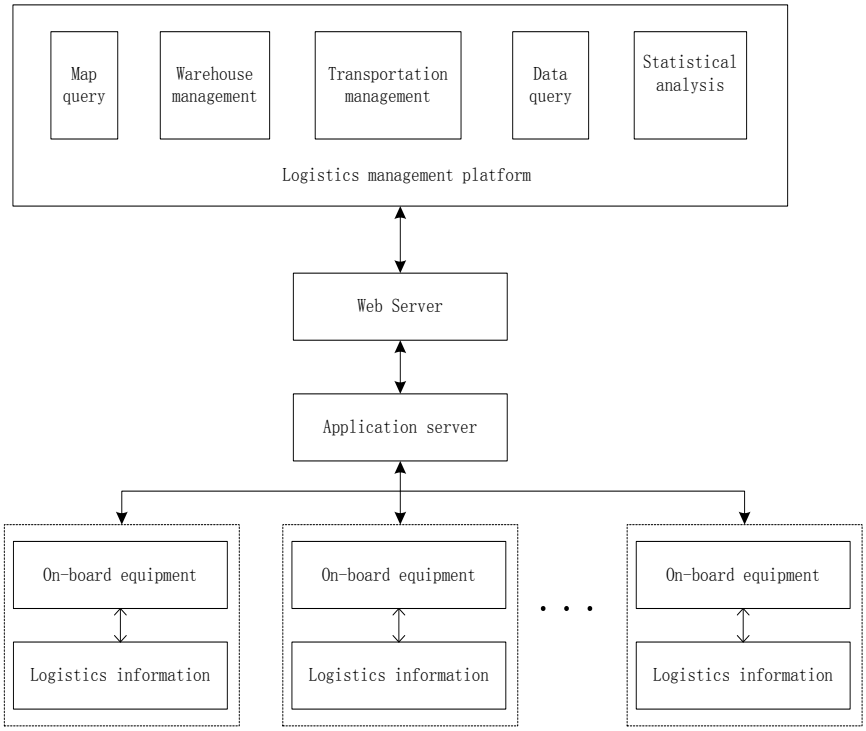

Figure 6. Software Block Diagram of Management System

In the whole Logistics Management System, Web based client can design the operable and browsable interactive interface for each operator according to different authorities of the clients and the management personnel. Except the functional module, the interactive module is the most important submodule of the management system.

5. Conclusion

A GIS technology based Logistics Management platform mainly composed of vehicle-mounted GSM module and Logistics Management System platform is designed in this article. Specifically, this system is used to digitally manage cargo logistics process according to the handheld terminal modules, inquire and mange cargo information in a real-time manner during the transportation process. During the whole logistics transportation process, two-dimension code is regarded as the unique cargo identification. Relevant test has proven that such system has good effect and can realize the dual-identification of freight note number and cargo number, thus to reduce Logistics Management error and improve Logistics Management efficiency.

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