Network of Things Based Logistics Vehicle Management System

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Abstract

the city express in China faces many problems, such as more and more complex city road networks, all kinds of traffic control, traffic jams, changing customer sites and so on. These make vehicle management becoming difficult. The article aims to create a vehicle management system based on technology of Internet of Things. It also uses wireless communication technology and geographic information technology. It can guide drivers to drive on the optimal route which can save costs signally.

Keywords

Express, vehicle management system, Internet of Things, optimal route.

1. Introduction

Express mail was introduced to Chinese as a new service in 70s of 20th century. From then on, it has mostly promoted economic development and improved state of employment. Express service is one of the most fast developing trades in China. Especially with the fast developing of electronic commerce in China, more and more owners of online store express their goods to consumers[1]. Since 2007 financial crisis, the business of the traditional express has declined, while the online express business has developed rapidly. In 2008, business from electronic commerce has been reached 0.5 billion packages. It is almost 1/3 of the full. In the day of June 30th 2009, there are 4 million packages delivered from taobao ltd (one electronic commerce enterprise), 75 percent used express[2].

At the same time we should see delivering express in city in China faces many problems. such as more and more complex city road networks, all kinds of traffic control, traffic jams, changing customer sites and so on. These make vehicle management becoming difficult, the utilization rate of vehicles becoming low, costs increasing and profits declining.

The article aims to create a vehicle management system based on technology of Internet of Things and use Particle Swarm Optimization (PSO) as optimal path algorithm[3]. It also uses wireless communication technology and geographic information technology. It can guide drivers drive on the optimal route. This can significantly save costs.

2. Levels of Application System Using the Internet of Things Technology

Application systems based on Internet of Things technology usually consists of three layers. They are physical layer, network layer and application layer[4], as shown in the figure 1.

Physical layer's main role is to obtain information. It uses RFID, sensors and such other facilities to get information of goods. RFID technology[5,6], sensor networks technology[7,8], electronic product code are the main parts in the layer. The present research includes the invention of chips, communication protocol studying and research on product coding.

Physical objects connect to Internet for sharing information about themselves and their surroundings. It is necessary to use wireless network or wired network to connect them to users. The main function of network layer is to transport information and command in two ways. The information got from

physical layer can transfer to application system in time from wireless network or Internet. Also, command from application layer can arrive on time through the network.

Application layer mainly uses the data what has been transported from physical layer to provide kinds of service for users. The application mainly includes Intelligent transportation, Intelligent buildings, smart grid, logistics management, digital home, medical surveillance, food inspection, Digital library and so on[9,10].

Up till the present moment, the research of the Internet of things focus more on physical layer, such as sensor networks technology, radio frequency identification technology, electronic product code etc. As the case stands, how to use the information efficiently, how to integrate various service and provide different application to users are very important.

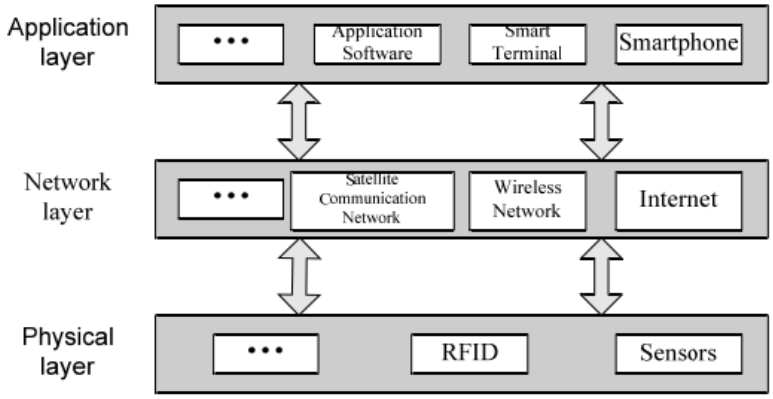

Figure 1. Layers of Internet of Things technology

3. Express Vehicle Management System

The express vehicle management system in this paper has the architecture as shown in figure 2.

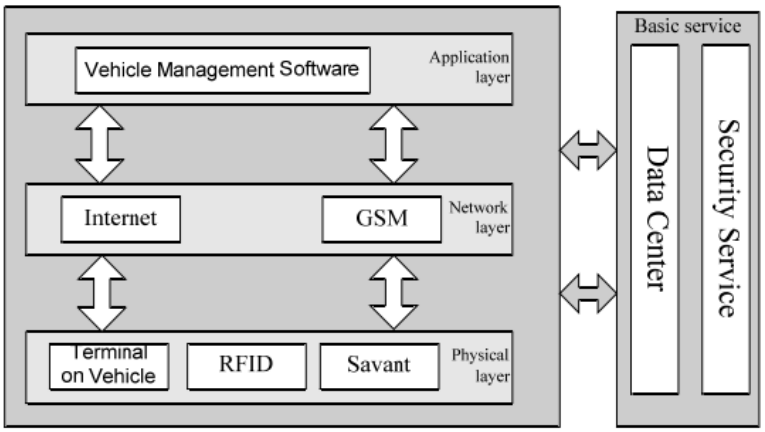

Figure 2. Architecture of the express vehicle management system

3.1 RFID Module

RFID readers and writers are used to read information from RFID tags or write information to RFID tags.

Each warehouse of the express enterprise classifies the goods from custom by destination, and then it encloses goods in container. Employees use RFID readers and writers write information to RFID tags and paste the tags on container. After that, the employees register the information in database server by use internet and application system. On the other hand, when the goods arrived, the employees get rid of the RFID tags and change information of goods through application system.

Savant is a middleware between RFID readers (or sensor network) and internet (or wireless network). It is used to process data got from RFID readers (or sensor network). It can capture data, filter data,

collect and integrate data, inspect data, transport data and manage task. It is mostly used to process data before it has been transport to application system (or data server). It also can interoperate with supporting software of RFID.

3.2 Terminals on Vehicle

Terminal on single vehicle consists of RFID reader and writer, GSM communication terminal, GPS terminal and Geographic Information Service module.

RFID reader and writer read information of goods in single vehicle, and then link the application system using GSM network to transport data. All the data has been processed by savant.

One function of the GSM communication terminal is taking data from RFID reader, then encodes the data by specific protocol and transports it to the application system. The other function is taking message from the server, decoding it to command and giving the command to geographic information service module. The Geographic Information Service module will produce the optimal route to the vehicle.

The central part of the GPS terminal is GPS receiver. A GPS receiver calculates its position by precisely timing the signals sent by GPS satellites high above the Earth. Each satellite continually transmits messages that include the time the message was transmitted, precise orbital information (the ephemeris) and the general system health and rough orbits of all GPS satellites (the almanac). The receiver computes the transit time of each message and the distance to each satellite. These distances along with the satellites' locations are used with the possible aid of trilateration, depending on which algorithm is used, to compute the position of the receiver. This position is then displayed, perhaps with a moving map display or latitude and longitude; elevation information may be included. Many GPS units show derived information such as direction and speed, calculated from position changes [3]. In the application, GPS terminal sends the position message of the vehicle to server by GSM network when the goods have been loaded or unloaded. When the traffic is moving, GPS terminal sends the position message to geographic information service module.

The function of the geographic information service module is producing the optimal route and showing on the screen of the terminal. To do that, the geographic information service module should use the command from application system, the position message from GPS terminal and the map data stored in the module.

3.3 Communication Network

Global System for Mobile Communications (GSM) is the world's most popular standard for mobile telephone systems. GSM is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. In the application, the information from RFID reader to application system and the command from application system to GPS terminal are transported by GSM network.

The Internet is a global system of interconnected computer networks that use the standard Internet Protocol Suite (TCP/IP) to serve billions of users worldwide. In the application, internet is used to deliver information between warehouse and application server. The information is all about the goods.

3.4 Vehicle Management Software

After the information of goods arrived the application system, the vehicle management software begins to look for the appropriate vehicle. During the course, the vehicle management software must take the information such as station, destination, weight and volume of the goods into account. When it has found the right vehicle, vehicle management software sends command to it to change the exist route in the terminal on vehicle.

After goods had been loaded on the vehicle, the vehicle management software produces the optimal route for it. Then it would send the optimal route to the terminal on vehicle as commands. The

geographic information service module shows the route on the screen of the terminal. The need of express enterprise is to manage vehicles perfectly to accomplish the shortest distance of the vehicle, with the lowest costs and the highest efficiency.

Of course, the premise is that it can ensure the service quality. The core algorithm of the vehicle management software mainly considers the optimal path. What it should do is to produce route for the traffic according to the position of the warehouse, the position of the vehicles, the destination of the goods, and the maximum load of each vehicle and so on.

The vehicle management software takes PSO as core algorithm. Particle swarm optimization (PSO) is a computational method that optimizes a problem by iteratively trying to improve a candidate solution with regard to a given measure of quality. PSO optimizes a problem by having a population of candidate solutions, here dubbed particles, and moving these particles around in the search-space according to simple mathematical formulae over the particle's position and velocity. Each particle's movement is influenced by its local best known position and it's also guided toward the best known positions in the search-space, which are updated as better positions are found by other particles. This is expected to move the swarm toward the best solutions.

3.5 Basic services

The data center is used to house computer systems and associated components. The information of goods must be stored in it and be kept in security. Security service is the service to ensure adequate security of the systems, of the dada and of the data transport.

4. Conclusion

The article shows a new vehicles management system In order to solve vehicles dispatch and driving route problems of express enterprises. This system is base on Internet of Things technology, combining communication technology and GPS technology. It adopts effective particle swarm optimization algorithm as optimal path algorithm. The system design suitable routes for vehicles according to the car quantity load and destination of goods. Then it sends commands to the vehicle through wireless communication network, which can improve the vehicle efficiency and save the cost.

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