Drop and Pull Transport System Based on Whole Process Management

Juntao Li[1], Yingying Geng[1*], Liwei Zhang[1]

[1] Beijing wuzi university, Beijing, China

ljtletter@126.com, 731484186@qq.com, 285718575@qq.com

Abstract. As a kind of advanced organization mode, its flexible organization mode and the cost advantage are agreed by all walks of life. But the overall operation for Drop and Pull transport market in China presents the phenomenon of scattered and no specification, and lack of support of information technology, which causes that the information of the transport process is missing, and we unable to achieve precise control for the process. The key of the organization scheduling and production safety throughout Drop and Pull transport is to achieve the whole process monitoring and management of its business during the end of each node in the perspective of the whole management thinking. Therefore, guided by the idea of the whole management thinking, through the integration of the IOT technology, we can design the entire management system of Drop and Pull transport, and realize the real-time monitoring of human, cargo and vehicle during the process of Drop and Pull transport. In this way, we can improve the whole logistics service level in our country eventually.

Keywords：Drop and Pull Transport，the Whole Process Management Thinking，Monitoring

1. Introduction

Drop and Pull transport is a kind of transportation mode that tractor and trailer are flexible separated and combined, In each node of the transport link, tractor and trailer use a way of "separation - combination" to quickly finish unloading and loading process and greatly reduce the cargo handling time.

The development of Drop and Pull transport in our country began in the 1980s, which has also begun to take shape. While due to the lack of normative management and industry standards, its organization and management is disorder, and the trailer equipment is relatively backward. Without the support of information technology, it is difficult for Drop and Pull transport to realize the reasonable allocation of logistics resources. As a whole, domestic Drop and Pull transport development is very rapid, but for the impact of the social environment and the technical conditions, it lacks a comprehensive information-sharing mechanism, and its capacity cannot be allocated rationally, which results in a waste of social resources.

The process of Drop and Pull transport involves transport organization and management of multiple transport nodes. Therefore, to carry out Drop and Pull transport business, each link management of its entire business chain is particularly important. How to achieve pull transport control and management of each node through the integration of modern information technology is the key and difficulty to realize the efficient organization and operation of the transport.

2. The Analysis of Drop and Pull Transport Mode Based on the Whole Management Thinking

The core of Drop and Pull transport mode based on the whole management thinking lies in the acquisition and relation of the whole process real-time information in all aspects in Drop and Pull transport. And its core is perception and processing for basic information. Real-time information acquisition is the key to the entire carriage monitoring of Drop and Pull transport, thus the integration and processing scheme of the underlying data is the key link of monitoring and management of Drop and Pull transport.

Drop and Pull transport system based on IOT technology combines IOT technology and Drop and Pull transport mode, and uses the key technologies of IOT, such as RFID and GPS, to collect underlying data. It includes collection for warehouse data, tractor, trailer, the driver and vehicle location. A unified data storage server will store the data generated by each nodes of the entire process in Drop and Pull transport. Enterprises of Drop and Pull transport can schedule and configure tractor, trailer and other corporate transportation resources reasonably.

Drop and Pull transport operation pattern under the support of IOT begins from the warehousing link to all transportation process, including goods

collection, cargo and trailer information acquisition and binding, Tractor information, driver information acquisition and binding and collection and transmission of the vehicle position information, etc. The underlying collects data information, and stores information through a uniform data storage solution. And transport enterprises feedback the status information of the logistics resources, which is conducive to integration of logistics resources for enterprises.

Drop and Pull transport system based on the whole management thinking describes all the business processes from the transportation starting point to the transportation delivery and the flow of information. It realizes visualization monitoring for the whole process of Drop and Pull transport, and ensures the control and safety of the process during Drop and Pull transport, and provides more perfect services, including the vehicles in road monitoring, cargo tracking, and so on.

3. The Whole Technical Architecture of the System

The system designing process divide the entire Drop and Pull transport business process into four nodes, including cargo loading stage, docking identification and gathering driver information stage, vehicles in transit stage and goods up. On data acquisition technology, the system marks the objects by RFID, on the position monitoring, it is GPS positioning terminal that gets vehicle positioning coordinates data to complete the acquisition of the underlying data. In order to effectively improve maintainability and scalability of the overall system, the system uses SOA-based service architecture, separate data acquisition and processing, by means of processing the underlying data to a uniform format, through a URL accessing corresponding services to complete the system background data manipulation. Similarly, the upper application uses the corresponding URL to access the specific function service to obtain the required data. The overall architecture of the system is shown in Figure 1:
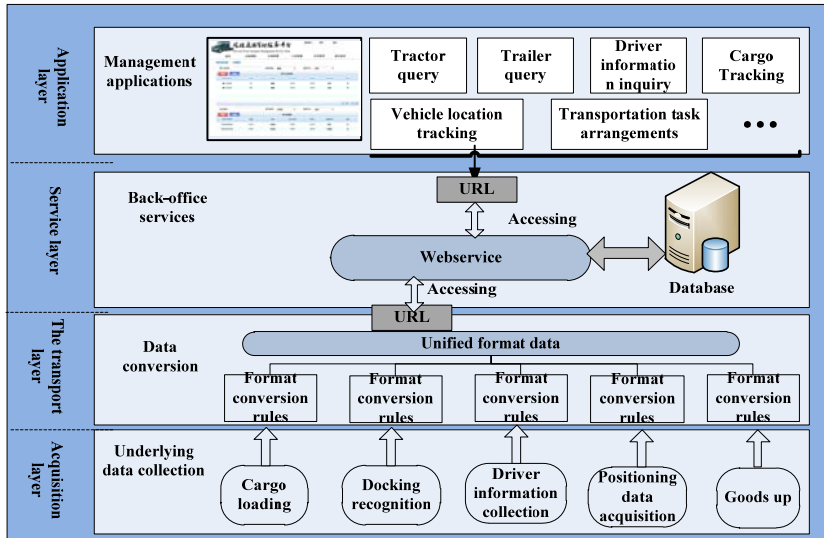
Fig. 1.   The overall architecture diagram of the system.

The system is designed based on the basic architecture of IOT, which includes basic three floor architecture. In data processing and transmission layer, in accordance with certain conversion agreement, unified underlying data is converted to a uniform format and converted data is transferred to the specified backend server through wireless transmission technology, and accesses to the service to complete the database operation.

Corresponding data processing services are deployed in the service layer. Data storage services are provided for data acquisition layer, and for the upper application, there provides the appropriate data query, modify, and delete services. The business logic of background services access is shown in Figure 2:
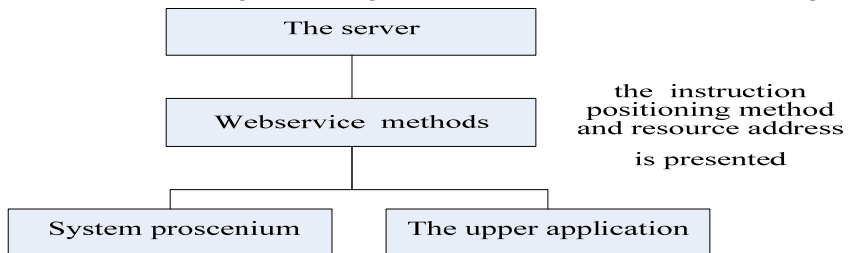

Fig. 2.   Web service working relationship diagram.

In the application layer of the system, the whole process management services platform of Drop and Pull transport are designed, including the resource management of the transportation enterprise, scheduling supporting of Drop and Pull transport organization, and monitoring and management services in transit of Drop and Pull transport. As is shown in Figure 3:
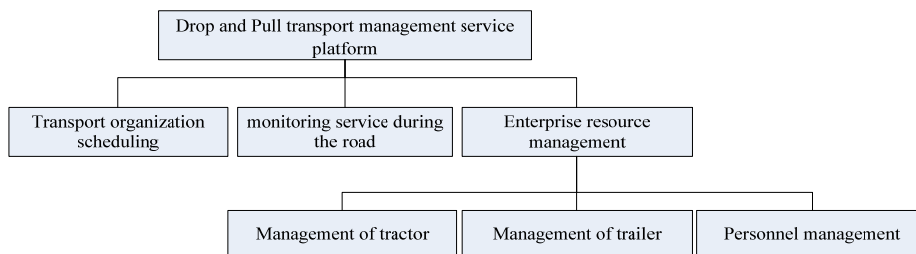
Fig. 3.   The structure diagram of Drop and Pull transport management service platform.

Supported by the underlying data acquisition technology, the system realizes transportation condition monitoring of each node during the whole flow. And it ensures that the continuity of the data stream from the upstream activities of transport business including warehousing, loading and docking, to the downstream transportation arriving. Through visual management means of the platform, it realizes visual management for the transport enterprise resources, and the reasonable allocation of logistics resources, and improves the utilization rate of resources. At the same time, by providing the visual monitoring system of Drop and Pull transport, it provides a safe guarantee for Drop and Pull transport logistics, as well as provides vehicle tracking and tracing functions for goods for the customers, which improves customer satisfaction effectively, and improves service level of Drop and Pull transport logistics.

4. The Key Realization of the Whole Management System of Drop and Pull Transport Based on IOT Technology

The system is divided into two parts, front and back, the main function of the front part of the program is data collection and packaging, and the back is the data accessing and processing. Such system architecture can effectively improve system scalability and operational efficiency. In the development of the system, the front part selects the C # to develop, whose advantage lies in the rapid prototype development, and the development process is relatively simple, at the same time, it is possible to design a system prototype quickly; while the back part development use the PHP language, which builds a lightweight server, with a better development efficiency and scalability.

4.1   The Underlying Data Acquisition System

The underlying data acquisition system includes the four stages of information collection that from the cargo loading, drivers docking recognition, vehicles in

transit to goods arriving. From the loading of the goods to the process of Drop and Pull docking and the driver information acquisition, it uses the PDA to read the card information to complete collection of such data; in transit stage of Drop and Pull transport, collect space coordinate information by use of car GPS terminal and extract coordinate information; in the final reached stage, transport task card information are shipped by PDA directly to complete the task status changing. Accordingly, in the underlying data collection, it involves the resolution of the RFID tag information and extraction of space coordinates data gotten by GPS positioning terminal.

4.2　The System Data Processing Program

This system uses the service-based technology architecture on the overall designing. For the underlying data transmission, it develops appropriate data interface standards for each data acquisition subsystem and ruling data collected by acquisition subsystem into a unified data format through a unified data format conversion, finally accessing to the appropriate back-end services through the specified URL, and to complete the data operation. The system uses the JSON string as a unified format for data transmission between systems, thus, in order to transfer data, the data collected by the underlying data acquisition system has to be formatted to JSON format.

The underlying data acquisition system uses language C # for development. Under the guidance of object-oriented programming ideas, data is collected and temporarily stored in an unified form of class. In other words, Data field properties from various acquisition subsystems are packaged into appropriate classes, and corresponding value are stored in the form of class.

The following is corresponding fields properties manifestations of data acquisition subsystem:

1) The chain of Data acquisition of the goods loading:

Class< Cargo_id , Trailer_EPC, Order_code , Time >;

2) The trailer identification and the driver information acquisition:

Class< Task_id , Tractor_id ,Trailer_id , Driver_id , Time >;

3) Location acquisition during road:

Class< Task_id , Longitude , Latitude , Time >;

4) The arriving goods information acquisition:

Class< Task_id , Time >.

After each underlying data acquisition system collects the corresponding data information through the bottom perception device, the foreground system stores the collected data through the class of the corresponding data storage. Then, the

data is converted into specified JSON data types by some data conversion rules. In .NET development platform, you can install the appropriate components of JSON conversion agreement, whose corresponding class libraries method could be called to achieve the conversion and resolution of JSON format.

After converted by JSON format, the data collected by the various subsystems will be converted to a unified JSON string to conduct the data transmission. The following is JSON string generated by data acquisition subsystem.

1) The chain of Data acquisition of the goods loading:

[{"Cargo_EPC":"value1","Trailer_id":"value2","Order_code":"value3","Time":"value4"}];

2) The trailer identification and the driver information acquisition:

[{"Task_id":"value1","Tractor_id":"value2","Trailer_id":"value3","Driver_id":"value4"," Time":"value4"}];

3) Location acquisition during road:

[{"Task_id":"value1","Longitude":"value2","Latitude":"value3","Time":"value4"}];

4) The arriving goods information acquisition:

[{"Task_id":"value1","Time":"value2"}].

4.3   The Key Realization of Background Services

System background services development is based on lightweight servers build by ThinkPHP framework structures. And it deploys many services with different function including parsing JSON data and the corresponding database operations. For application and transmission of the foreground data, we need access to specific services by the only address, so as to realize data acquisition and operating functions, and realize the operation of the underlying data and the support from the upper application.

The system includes a variety of services to achieve the appropriate data storage, data query, status modifying, and data deleting. Correspond services of the entire processes in Drop and Pull transport, includes data storage collected by the underlying data acquisition system, and services corresponded by Drop and Pull transport platform including the query to enterprise resource, the vehicle position monitoring query and the corresponding state modifying. In writing language of service, using the PHP programming language to develop the appropriate service, and deploy it into the ThinkPHP framework, and the system can complete the required data manipulation by accessing to corresponding service through a URL.

1) Data storage operation services

Data storage operations are mainly used in the storage of the data collected by the underlying data acquisition devices. After treated through a data transformation rule, the underlying data is passed to the system background in JSON format. So in the writing of service, we need to parse the JSON format data, extract the corresponding data information, and store the data into the specified table through the SQL statements. Therefore, there involves the JSON parsing and the SQL statement on the preparation of service.

As the ThinkPHP framework encapsulates analytical method of the JSON format, in order to parse JSON format, we need only to call for the packaged analytical method json_decode () to parse the incoming JSON string, and then to complete the data storage operations through the SQL statement. The following is an example for the storage service of vehicle location data:

```
public function add_Location_info() // Add vehicle coordinate information
    {
        $jsonInput = file_get_contents("php://input");
        $jsonInput = $this->checkUTF8($jsonInput);
        $decodedTags = json_decode($jsonInput);
        $Task_id = $decodedTags->Task_id;
        $Longitude = $decodedTags->Longitude;
        $Latidute = $decodedTags->Latidute;
        $Time = $decodedTags->Time;
        $sqlExecute = "insert into Location_info
(Task_id,Longitude,Latidute,Time)
        values('$Task_id','$Longitude','$Latidute','$Time')";
        $M = new Model();
        $r = $M->execute($sqlExecute);
        if ($r) { echo "ok";}
        else { echo "fail";}
    }
```

As is shown above, to parse the incoming vehicle coordinate data JOSN string and store the parsed data in the specified database Location_info and return to the operating state.

2) Data query service

There provides corresponding query services in Drop and Pull transport management service platform, including query service of tractor, trailer, transport tasks, and vehicle position information. Through querying service, the background queries the data according to the query conditions from the

specified database, and transfers qualified data into JSON format, and then sent it to the front of the management services platform. Finally, the data parsed and displayed on the page by corresponding analytical tools.

3) State modifying service

The whole process management of Drop and Pull transport involves multiple link state changes. Therefore, there should involve the corresponding status update service in the different stages of all aspects.

4) Deleting service

There involves management of enterprise resource in the management service platform of Drop and Pull transport, which involves some information deleted service correspondingly. For writing service, instead of physically removing, we update the data status in the database that needs to delete, and mark this data, so that management platform cannot read it.

4.4 The Management Service Platform Prototype of Drop and Pull Transport

The management services platform prototype of Drop and Pull transport mainly includes enterprise resource management, such as vehicle personnel management module, organization scheduling module and transportation monitoring module.

The Figure 4 shows its prototype interface for trailer and tractor management:

Fig. 4.   Trailer and tractor resource management interface.

The Figure 5 shows its scheduling module prototype interface:

Fig. 5.　Scheduling module prototype interface.

Through query, the transport organization and scheduling module can display the image of tractor and trailer real-time status on the interface. And the module assigns transportation tasks to the idle state of the tractor and trailer to complete capacity configuration, at the same time, it generates the corresponding transportation task, which is given to the driver to carry out transportation task.

5. Conclusion

This article divides business processes of Drop and Pull transport into four stages in the view of the whole management idea of Drop and Pull transport. In the whole process management, aiming at a four-stage process monitoring, we achieve real-time access to the underlying data by use of the IOT sensing technology, and achieve visualization and control for the whole business process of Drop and Pull transport.

We build a service-based whole management system of Drop and Pull transport based on SOA system architecture, to improve controllability and maneuverability of the overall business of Drop and Pull transport in the perspective of the whole process, and provide a visual management and control mechanisms of the whole process of Drop and Pull transport pull transport.

For Drop and Pull transport, especially those based on the whole management, the core is perception, acquisition and transmission for the underlying data. The acquisition of real-time dynamic information is the key to the entire carriage

monitoring for Drop and Pull transport, and using modern information technology to achieve each link of information perception and selection in Drop and Pull transport business process is particularly important. Therefore, the integration of the underlying data processing scheme is a key implemented link in the process of transportation monitoring and management to Drop and Pull transport. At home, to truly achieve Drop and Pull transport, we also need to overcome many problems, such as policy, information technology, standardization problems, etc. It will be a long process to complete it, and needs cooperation from the government, transport enterprises, as well as industry leading enterprises.

Acknowledgments.

References

Gao Hongtao, Li Hongqi. (2010). Theory and Practice of road drop and pull transport organization. *The People press for transportatio*n, the first edition, 12-36.

Li Juntao, Liu Bing Wu, Zhu Jie, Liu Jun, Huo Lingyu. (2008). Development of logistics and transport monitoring experimental system based on GIS/GPS/GPRS technology. *The Logistics Technology*, 27, 118-119.

Ma Guoqiang. (2009). The programs for information platform of drop and pull transport. *the containerized*, 20(7), 31-32.

Qu Yanguo, Zhang Zhenhua, Zhang Quanzhong. (2008). Explore of carrying out drop and pull transport for logistics enterprises on road transportation. *The Logistics Technology*, 27(10), 15-18.

Tang Zhizhong. (2012). Research of the automatic monitoring system for transportation vehicles based on RFID. *Railway Purchase and Logistics*, 7,59-61.

Yuexia Gu, Qingqi Liu. (2013). Research on the application of the internet of things in reverse logistics information management. *Journal of Industrial Engineering and Management.* 6(4), 963-973.