Journal of Theoretical and Applied Information Technology
31st May 2013. Vol. 51 No.3

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

CONSTRUCTING AND THE RELATED KEY TECHNIQUES FOR THE SMART LOGISTICS INFORMATION PLATFORM OF YIWU PORT

[1]XU JIAWANG, [2]JIAO YUPING, [1]YUAN YE

[1]Shenyang Aerospace University, School of Economics & Management, Shenyang, CHINA

[2]Chinese Academy of Sciences, Yiwu Branch of Shenyang Institute of Automation, Yiwu, CHINA

E-mail: [1]ccb867321@yahoo.com.cn, [2]1445462952@qq.com

ABSTRACT

Based on the introductions of the concept and the future development trends of Smart Logistics, the background of constructing Smart Logistics Information Platform at Yiwu Port were analyzed, and the details of the Smart Logistics Information Platform construction were put forwarded. Finally, some key technology problems associated with the information platform construction were pointed out.

Keywords: *Smart Logistics, Internet of Things, Information Platform, Key Technology, Yiwu Port*

1. INTRODUCTION

In Dec. 2009, the Information Center of China Logistics Technology Association, together with http://www.chniot.cn/ and the editorial department of Logistics & Material Handling, put forward the concept of Smart Logistics. In 2009, President Obama proposes to build a "smarter planet," believing the next target of IT industry is to deploy IT techniques in various trades and occupations. To be specific, they should embed sensors in different components of the society to connect them within one network, such as electrical networks, railroads, bridges, tunnels, highways, buildings, water supply systems, dams, oil-gas pipelines, and so on, forming a so-called Internet of Things. After that we will combine Internet of Things and existing Internet to realize the integration of the human society and the physical system [1,2]. In this integrated network, supercomputers can manage and control all personnel, machine, equipment, and infrastructures within the network in real-time. Then, humanity can manage the production process and our life in a refined and dynamic way, thus improving the resource utilization rate and productivity as well as the relationship between man and nature [3,4].

With the emerging of Internet of Things, the informatization of the logistics industry speeds up. The isolated application of IT technology are integrated into one system for achieving group effect, which motivates the logistics informatization and also promotes the intellectualization, networking, automation, visualization, controll-ability, and systematization of the industry. Then a Smart Logistics system can be created. With it, we can manage the logistics process visually and intelligently, making the building of intelligent logistics distribution center and intelligent port logistics become possible[5-8]. In this brand-new logistics system, we can connect the intelligent traceability network, intelligent and visualized delivery management network, and automatic logistics distribution center, thereby creating a smart information platform [9]. At the moment, the provinces already starting the construction of Internet of things begin to build the Smart Logistics Information Platform based on this network [10,11].

2. BACKGROUND OF CONSTRUCTING SMART LOGISTICS INFORMATION PLATFORM AT YIWU PORT

As the global procurement and distribution center for small commodities, Yiwu gradually becomes the logistics center for Zhejiang Province, even for the whole Yangtze River Delta. Now, Zhejiang provincial government selects Yiwu as one of the three pilot cities for Alternative Customs Clearance. Yiwu Logistics Center is one of the important four logistics centers supported by Zhejiang Province, and it is also the busiest one with the highest business volume. Among all the top-20 global sea shipping companies, 18 of them have branch offices in Yiwu. About 13,000

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

businessmen from more than 120 countries reside in Yiwu. In Hangzhou Customs, about 60% of goods for customs declaration and 90% of shipment quantity come from Yiwu; and about 1/7 of cargo throughput in Ningbo Port also comes from Yiwu. Yiwu now becomes an important inland port of Zhejiang Province. It has more than 2000 international freight forwarding companies & foreign trade companies and 56 customs brokers. The registered container truck number reaches 5,268. Yiwu commodity can be directly shipped to all major ports in the world [12].

In October 2009, Yiwu Logistics Park is officially enlisted as the logistics demonstration base by China Ministry of Transportation and Zhejiang Province, and it is also listed as one of the key transport projects of Zhejiang Province. After the entire Logistics Park is built, it will be equipped with functions of warehousing, logistics information service, bonded logistics, customs clearance, and transshipment. Then it can satisfy the domestic and international logistics demand and be prepared for building Yiwu as one global small commodities purchase and manufacture base.

Yiwu city wants to build Yiwu Port as a departure and destination port with functions of collection, storage, transport, packing, tally, and distribution. To reach this goal, it will build a convenient and highly-effective logistics platform and promote the construction of the following projects: inland port terminal, logistics center in the west of Yiwu city, and Qingkou supervision center. Meanwhile, with the convenience brought by Alternative Customs Clearance, Yiwu will build the E-Port informatization platform, promote the development of third-party logistics, play the role as a port, and accelerate the seamless connection with the harbor and border port, so as to achieve the goal that the goods will pass the customs only after one application and one assessment. And Yiwu also will innovate the convenient customs clearance mechanism for imported goods, speed up the construction of the bonded logistics center (type B) and the comprehensive bonded zone, so that Yiwu can finally become the center for international transshipment, distribution, purchase, transit trade, and export processing. Yiwu will also emphasize the functions of Yiwu Airport so that it can be included in the national Twelfth Five-Year development plan and can be officially opened.

3. THE CONSTRUCTION CONTENTS OF THE SMART LOGISTICS INFORMATION PLATFORM AT YIWU PORT

With the application of the Internet of things in Yiwu logistics system, Yiwu will use the related common and key techniques to develop the following information platforms, including the visualized logistics public service platform(VLPSP), smart & comprehensive logistics terminal management system (SCLTMS), smart & visualized logistics management system (SVLMS), and intelligent container drop & pull transport management system (ICDPTMS). These four modules will be seamless integrated in one system, so that we can build a coherent logistics system with refined management to effectively monitor the key indicators. The data and coding in each module are in unified format. If the data are needed in several modules, we only have to input it once. The data entry times is reduced and the data consistency and accuracy are ensured. The functions of each module are as follows.

3.1 The Visualized Logistics Public Service Platform

The resources of all information systems in the center will be integrated in this platform, so that the data can be shared among different systems, providing basic logistics information for the freight forwarding companies, foreign trade companies, ship transport companies, customs brokers, stores, factories, and related government departments, such as customs and commodity inspection departments. Then the information systems of all these companies or departments can run more efficiently. With information sharing, the cooperation between the upstream and downstream businesses can be strengthened, helping to form an optimized supply chain and industry chain. It has several submodules: information management module for logistics-related professions, logistics data exchanging center, public logistics data release and inquiry center, and customer service call center. The structure of this function module is shown as Figure 1.

3.2 Smart & Comprehensive Logistics Terminal Management System (SCLTMS)

The construction of this system can begin with the following four submodules, container yard management system (CYMS), vehicle approaching management system (VAMS), traffic flow monitoring & dispatching system (TFMDS), and

Journal of Theoretical and Applied Information Technology
31st May 2013. Vol. 51 No.3

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

machine-vision-based terminal traffic & parking lot monitoring system (MVTTPLMS). The structure of this function module is shown as Figure 2.

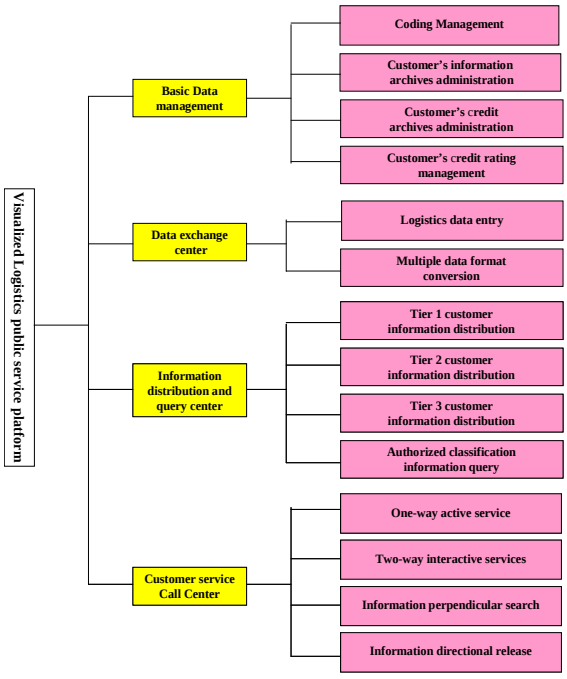

Figure 1. The Structure of Visualized Logistics Public Service Platform

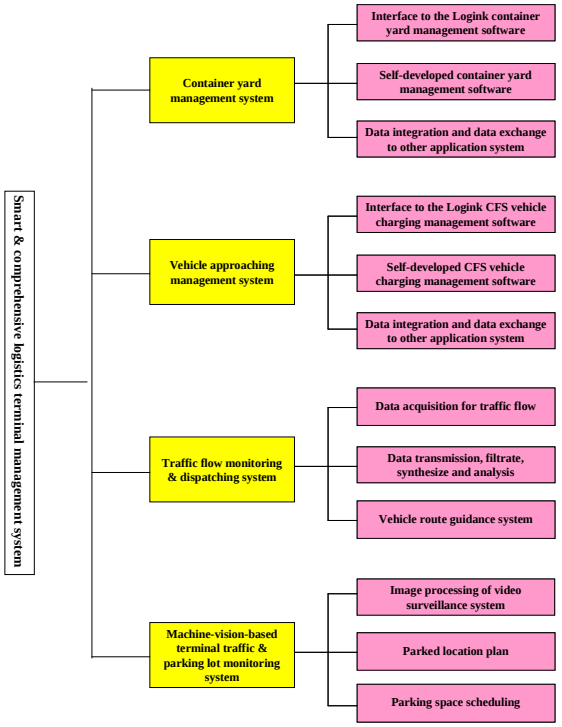

Figure 2. The Structure of Smart & Comprehensive Logistics Terminal Management System

In CYMS and VAMS, two functions are embedded, which are container yard management and charge management for vehicles in the terminal. Actually two ways can realize these functions: The first is that the users install the Logink software of Zhejiang E-port, and these two systems provide a data exchange interface for collecting data from Logink software. The second is that these two systems directly provide the related management function for the users.

As to TFMDS, we can install traffic flow sensors in the key transport nodes in Yiwu Port to collect the real-time traffic data. Then TFMDS can use the date fusion technology to transmit, filter, combine, and analyze the collected data, providing necessary information for decision-making.

For MVTTPLMS, we can use the current video surveillance system of Yiwu Port. MVTTPLMS can acquire the real-time terminal status through the video surveillance system: It will first use the image processing technique to get the information of vehicles parked in the port, analyze the data to get the status of each parking lot (occupied or idle), and upload the acquired information to the Internet for query. In this way, the administrative personnel of the port entrance can learn whether there are idle parking lots for trucks heading for certain consignment station, and they will no longer need the parking card, greatly improving the management efficiency.

3.3 Smart & Visualized Logistics Management System (SVLMS)

In SVLMS, we will first build an encoding management system for two dimensional barcode and promote it in local Yiwu factories. All products in the warehouse will be attached with a two dimensional barcode. For the agent commodities produced outside of Yiwu, the agency should be responsible for the two dimensional barcode attachment, gradually these agencies can require the original manufacturer to supply the two dimensional barcode. Based on two dimensional barcode mechanism, we can develop the warehousing logistics management system and machine-vision-based logistics monitoring system. The structure of this function module is shown as Figure 3.

3.4 Intelligent Container Drop & Pull Transport Management System (ICDPTMS)

This system integrates GPS, GIS, and RFID, so it can help us to speedily get the geographical position of vehicles, providing technical supports

Journal of Theoretical and Applied Information Technology
31st May 2013. Vol. 51 No.3

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

for reasonable scheduling of drop & pull transport (DPT). The trailer companies, cargo owners, forwarder, and traffic administrative departments can visit ICDPTMS from the public network, realizing dynamic monitoring of containers' drop & pull process. The system contains five submodules, including basic data management for DPT, short and long distance connecting transport, intelligent matching and dispatching of boxcar, and real-time tracking of the vehicle and commodity status. The structure of this function module is shown as Figure 4.

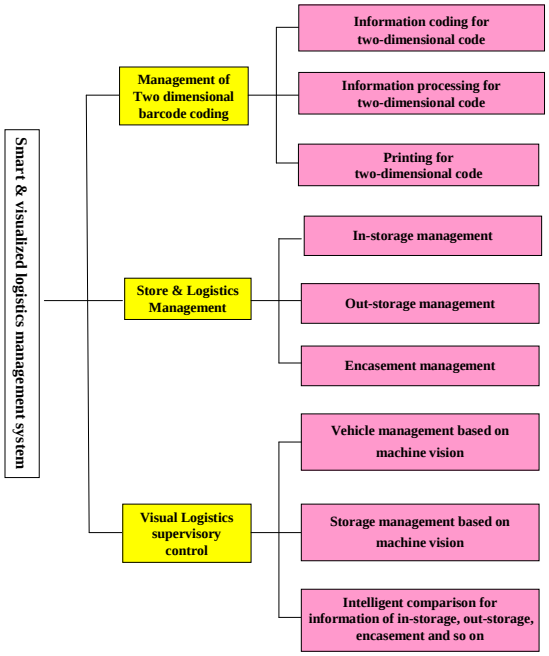

Figure 3. The Structure of Smart & Visualized Logistics Management System

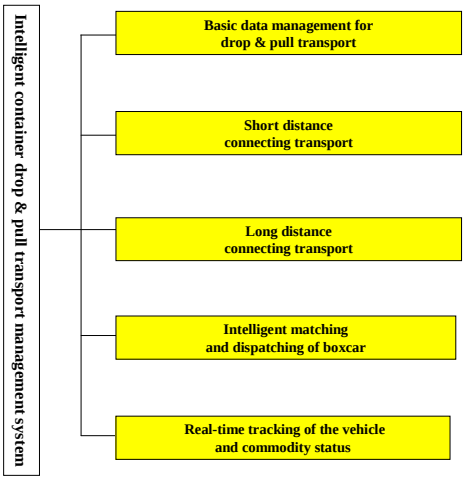

Figure 4. The Structure of Container Left Hanging Intelligent Management System

Summing up the above, the relationship among each module and that among each submodules within each module in Yiwu Port Smart Logistics Information Platform is shown as Figure 5.

4. KEY TECHNIQUES FOR CONSTRUCTING SMART LOGISTICS INFORMATION PLATFORM AT YIWU PORT

The key techniques required for the construction of Yiwu Port Smart Logistics Information Platform are the common and key techniques used in Internet of things. For example, wireless sensor networks for monitoring traffic flow, dynamic tracking of vehicles through the vehicle-mounted GPS terminal and RFID on the vehicle, using QC code to monitor of the whole production and circulation process of the export goods, and smartphone application software for users to check and submit the related information from their handsets.

4.1 Adopting Date Fusion Technology for Processing Data Acquired by the Flow Sensor Network

Install the traffic flow sensor in the key transport nodes to collect the real-time traffic data. Then use the date fusion technology to transmit, filter, combine, and analyze the collected data, providing necessary information for decision-making.

4.2 Building Self-learning Mathematical Model for Traffic Dispersion

When traffic jams causing by vehicle breakdown appear, the system can speedily and automatically ease the traffic, for example, guide the vehicles to move in a specified traffic route, limit traffic flow, or change the drive direction of the traffic lane. To realize this goal, we need to build the traffic dispersion mathematical model. After we introduce a self-learning module into this mathematical model, the self-learning module will report the traffic guidance decisions back to the knowledge base and also will modify the related confidence index to upgrade the knowledge base. Meanwhile, the self-learning module can perform reasoning with the knowledge base and the inquiries of the users. In this way, new knowledge and new experience will be added to the knowledge, which will be expanded continuously. Then we achieve the self-learning function of the system.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

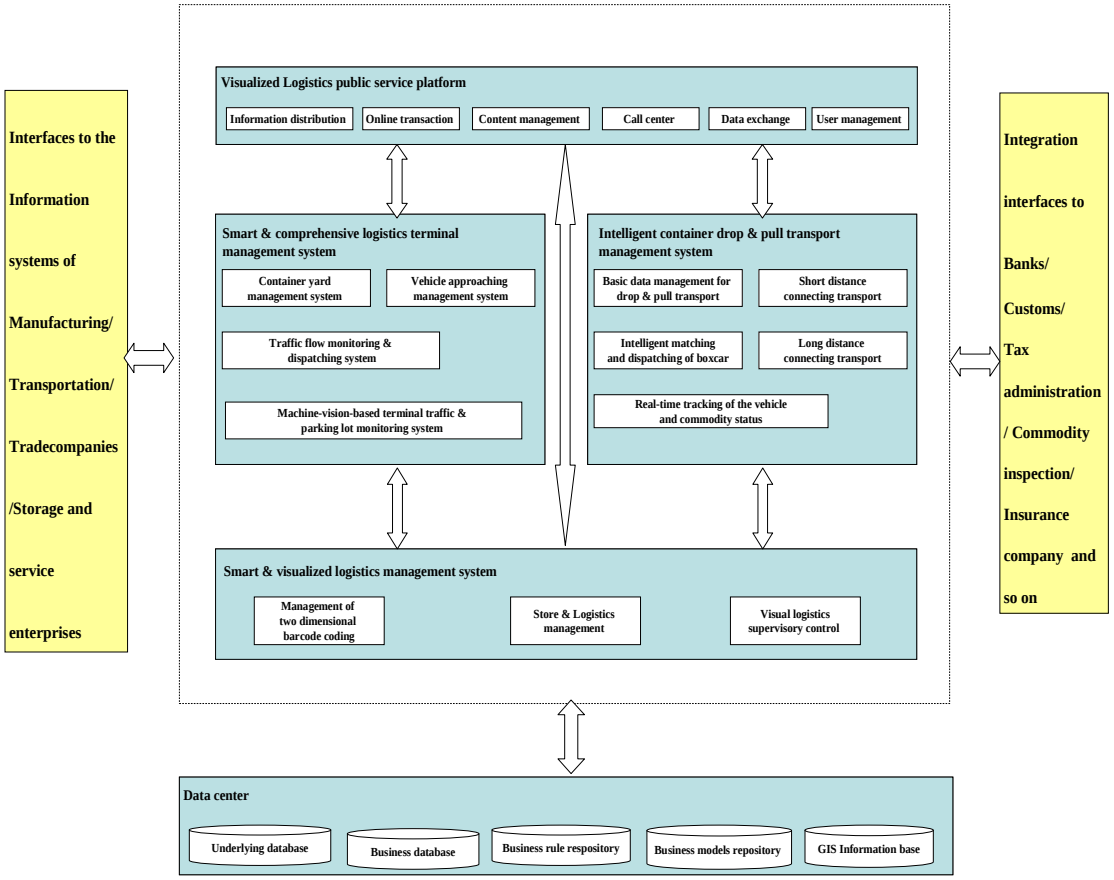

Figure 5. The Structure of Smart Logistics Information Platform of Yiwu Port

4.3 Machine-vision-based Logistics Monitoring System

With the value-added service of the existing video surveillance system, this monitoring system can use the machine-vision-based image processing technique to acquire and analyze images of the vehicles and warehouses. With the image processing technique, the system can perform an intelligent analysis of the commodity quantity in the warehouse and get the warehousing, ex-warehouse, and commodity relocation information. Meanwhile, it can analyze the freight vehicles arriving time, unloading time, loading time, and sealing time, get information about commodity quantity, and then compare the information acquired from image processing with that submitted by the users through the Internet to check the accuracy of these information, achieving a dual monitoring for the warehouse.

4.4 Machine-vision-based Terminal Traffic and Parking Lot Monitoring System

Use the current video surveillance system to acquire the real-time status of the terminal. And then use the image processing technique to get the information of vehicles parked in the port, analyze the data to get the status of each parking lot (occupied or idle), and upload the parking lot information to the Internet for query. In this way, the administrative personnel in the entrance of port can learn whether there are idle parking lots for trucks heading for certain consignment station, and they will no longer need the parking card, thus greatly improving the management flow.

4.5 Real-time Tracking of Vehicles and Commodities

Track the vehicles dynamically with vehicle-mounted GPS terminals and RFIDs on the vehicle, automatically record the vehicle departure time, site, and trailers status, and use the vehicle-mounted GPS terminal to monitor the whole passage in real-time. When the vehicles reach the destination, the information platform automatic records the arrival time and parking position. The transport management unit can check the geographical position, condition, and availability of the vehicles on this platform in real-time.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Develop the function to forecast vehicles' arrival. Then the loading and unloading spot can be prepared in advance, and cargo handling can be started once the vehicle arrives, helping to cut down the standby period of the tractor and improve the efficiency.

Bond the vehicle and the loaded commodity, so that we can track the entire journey of the vehicle and the commodity dynamically.

4.6 Intelligent Matching and Dispatching for Boxcars

The control center can learn the current position and running status of the tractor truck in real-time, thus realizing the Omni-directional management and dispatch. Meanwhile the center is also connected with the transport systems of the dock, ships, and railroads. With the data exchange software, the data can be shared among all the related departments.

Develop the intelligent matching and dispatching software for boxcars, which can track the status of the tractors and trailers (containers) to get their current status. Then the system can use the intelligent matching model to generate the boxcar matching data to assist the decision-making of the dispatchers.

5. CONCLUSION

In the future, Smart Logistics will be intelligent, integrative, hierarchical, flexible, and socialized. As to the further development, the logistics enterprises can use Smart Logistics to optimize the dispatching and logistics configuration, so as to reduce the cost; meanwhile, the Smart Logistics also can help to improve the logistics management mode and efficiency, improving the logistics QoS. With the development of the logistics industry, the logistics process becomes more complicated, so does logistics resource deployment, logistics management, as well as joint dispatch and logistics management in all circulation process of goods and materials.

Zhejiang Province determines to build a smart urban system with "one center and three junctions." Yiwu is listed as one of the three junctions and is now promoting the comprehensive reform for international trade and construction of "Two Districts and Six Urban Characteristics," so as to accelerate the transition of the economy and society. To build Yiwu as a smart city, the informatization of Yiwu port is the most important, and logistics intellectualization bears the brunt of the work. After studying the logistics status in Yiwu port, this article proposes the tentative idea for constructing the Smart Logistics Information Platform and points out the key techniques involved in the construction, so as to provide the reference for the future Yiwu Port informatization.

ACKNOWLEDGEMENTS

This work was supported in part by Special Major Science and Technology Projects of Zhejiang Province under Grant #2011C03004, MOE (Ministry of Education in China) Project of Humanities and Social Sciences under Grant #11YJA630165 & #12YJC630312.

REFRENCES:

[1] ZHU Haibo, “A framework to enable communication in heterogeneous environment for the internet of things”, *Journal of Computational Information Systems*, Vol. 8, No. 18, 2012, pp. 7791-~ 798.

[2] NING Huansheng, HU Sha, “Technology classification, industry, and education for Future Internet of Things”, *International Journal of Communication Systems*, Vol. 25, No. 9, 2012, pp. 1230~ 1241.

[3] WEI Xiaoxiao, “Application research of internet of things technology in China post modern logistics warehouse management based on RFID”, *Advanced Materials Research*, Vol. 403-408, 2012, pp. 5225~ 5229.

[4] YAN Tao, WEN Qiaoyan, “A trust-third-party based key management protocol for secure mobile RFID service based on the internet of things”, *Advances in Intelligent and Soft Computing*, Vol. 135, 2012, pp. 201~ 208.

[5] CAI Liyan, “Intelligent Logistics in the Era of the Internet of Things”, *Logistics Sci-Tech*, No.12, 2010, pp. 95~97.

[6] HU Xiangdong, WEI Qinfang, TANG Hui, “Model and simulation of creditability-based data aggregation for the internet of things”, *Chinese Journal of Scientific Instrument*, Vol. 31, No. 11, 2010, pp. 2636~ 2640.

[7] SHI Yaping, “Intelligent logistics build on the basis of the internet of things”, *Logistics Technology*, Vol. 30, No. 9, 2011, pp. 44~45.

[8] U. Dieter, “A definition approach to smart logistics”, *Lecture Notes in Computer Science*, Vol. 51, 2008, pp. 273~ 284, 2008.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

[9] LIU Wei, D. Gu, WANG Hao, "A study on construction of the integrated information platform of smart transportation logistics system", *Advanced Materials Research*, Vol. 524~ 527, 2012, pp. 2757~ 2761.

[10] ZHANG Yi, ZHAO Xiao, ZHU Jiaoli, et al., "Some thoughts on wisdom logistics information platform construction for Yiwu Port", *Internet of Things Technology*, No. 8, 2012, pp. 71~ 73.

[11] WEI Caiqiao, WANG Xiaoguang, GUO Hui, "Design and realization of intelligent logistics transportation equipment", *Proceedings of International Conference on Consumer Electronics, Communications and Networks*, 2011, pp. 205~ 208.

[12] Digital Yiwu—The national economic and social development situation of Yiwu 2010 (Report), *Information Office of Yiwu Government*, 2011.