

IoT-based Analysis on Optimizing Strategies for Transportation of Fresh Agricultural Products in China

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Abstract: With the improvement of people's living standard, requirements for the varieties, freshness and other aspects of agricultural products became more and more demanding. However, the low transportation efficiency usually makes the fresh agricultural products seriously damaged and unable to be fully utilized. Thus, it's closely concerned by relevant departments to guarantee the fundamental interests of the members at relevant nodes of the whole agricultural product supply chain, enhance the market competitiveness of fresh agricultural products, and cut down the operating costs. With its unique advantages, the technology of Internet of Things becomes the key to solve these kinds of problems. On the basis of analyzing the problems of fresh agricultural product transportation, this paper proposes that the technology of Internet of Things should be applied in the optimization of fresh agricultural product transportation, and emphasizes a series of pushing strategies and measures to enhance the application of the technology of Internet of Tings in fresh agricultural products transportation.

1. Introduction

Fresh agricultural products refer to the agricultural and animal products that are produced by peasant households or agricultural manufacturing enterprises, unprocessed or slightly processed, and storable in low temperature, such as red meat, birds, eggs, fruits, vegetables, aquatic products and so on. They are putrescible, damageable and squashy. With the rapid development of economy and improvement of people's living condition, people have increasing requirements on the varieties and quality of fresh agricultural products. However, traditional transportation of fresh agricultural products is unenlightened and the application of modern information technology is not popularized so far, which causes high costs long time of fresh agricultural product transportation, so the products become unmarketable and go bad and suffer great loss as a result. As it were, in our country, the unadvanced traditional transportation has become an obstacle for our painstaking efforts in developing fresh agricultural products, and has affected peasants' income and their enthusiasm. Therefore, how to improve the transportation of fresh agricultural products, how to guarantee the fundamental interests of the members at relevant nodes of the whole agricultural product supply chain, and how to enhance the market competitiveness of fresh agricultural products and cut down the operating costs have drawn close attention from relevant departments.

Learning the relevant experience from abroad, if we want to make up the disadvantages of the traditional logistics of fresh agricultural products and optimize it in our country, we have to start from information technology in that it supports the whole modern transportation system as its core part.

Nowadays, as a revolution of world information technology, the Internet of Things will become the main trend for the development of information technology. The establishment of logistics Internet of Tings for fresh agricultural products will meet the demands of the development of transport industry for modern modern agricultural products. And the application of IoT technology in the transportation of fresh agricultural products will form a new transportation system which integrates means of transport, fresh agricultural products, essential traffic factors and all the relevant departments. This way, a safe, rapid and individualized way of transportation can be achieved to

improve the modernization level of fresh agricultural product transportation, which supports the concept of comprehensive, intelligent, green and safe transportation proposed by the Ministry of Transport. Aiming the the problems existing in the traditional transportation of fresh agriculture products in our country, this paper will point out that the IoT technology is desperately needed by the development of fresh agricultural product transportation, and build the application model of the transportation IoT for fresh agricultural products, and give a series of suggestions for the next step of promoting the application of Internet of Tings in transportation industry.

2. IoT Technology is Desperately Needed by the Development of Fresh Agricultural Product Transportation in China

On the whole, in present China, the transportation of fresh agricultural products is still obsessed by long time consumption, tedious transport links, heavy losses, low efficiency, and low profits, which is lagging far behind the development of economy and society. To be specific, there are the following problems in the traditional transportation of fresh agricultural products, to which the Internet of Things is a good solution.

2.1 Losses in Transportation of Fresh Agriculture Products

The following links are necessary for fresh agricultural products from production to selling: producer-dealer-origin market-agency-market at sales area-retailer. The whole transportation chain with multiple links needs to be finished in one or two days, otherwise the products can not stay “fresh” and “green”. However, the problem of traffic jam is still quite an emergency, for example, in Aug. 2010, the G6 Jingzang expressway was blocked for over 20 days. Exactly for the reason of obstructed transportation, the damage rate of fresh agricultural products in China stays quite high all the time, which, according to statistics, is 25% on average, while in developed countries the average damage rate is 3% or even as low as 1%. Thus, as the land resources is in shorter supply but greater demand, we should utilize IoT technology to unearth the potential of existing transport means and devices. Specifically, with the IoT technology, we can speed up the informatization of transport facilities and the establishment of comprehensive transportation management and public information service platform, thus to improve the sharing of information resources, promote the information service industry and realize intelligentialize in communication and transportation field. This way, not only the phenomenons of unloaded returning can be reduced, but rapid conduct and coordination can be applied when block-ups occur, so as to ease the traffic pressure to a great degree.

2.2 Safety in Transportation of Fresh Agricultural Products

The traditional self-marketing circulation mode no longer fits today’s agricultural industrialization trend. Instead the off-site selling model carried out by wholesale markets and leading enterprises is springing up, such as the ShanDong Shouguang Wholesale Vegetable Market. They have become the main arteries for agricultural products penetrating through all the urban and rural areas of the country, and brought great benefits to agriculture industrialization. But this sales mode greatly expands the transportation radius of fresh agricultural products and adds the length of transport route, which inevitably increases the rate of traffic accident and brings about heavy losses both in economy and manpower. Faced with the severe security situation of agricultural product transportation, we should build a security monitoring and emergency management system based on sensor network with IoT technology for the transportation. Through this way, we will be able to comprehensively monitor the transport process of fresh agricultural products, best master the risk source of transportation, detecting and predicting the malfunctions of transport facilities and finally eliminate potential safety hazards.

2.3 It can provide the impetus for the innovation and development of land port logistics in Xi'an

Manufacturing and logistics industry interact with each other, if there is no manufacturing in the

logistics industry, logistics enterprises is a single. In the same way, the manufacturing logistics industry will lose its motive force of the innovation and development without the manufacturing industry. Therefore, to realize the rapid economic growth, we must develop both manufacturing and land-port logistics, both of which have a relationship between you and me.

To sum up, the linkage of manufacturing and land port logistics will promote the development of xi 'an manufacturing, and give impetus to the development of xi 'an economy, so the role of land port logistics can play out further more support for manufacturing. Therefore, the linkage development of manufacturing and logistics industry in Xi'an is the inevitable trend.

2.4 Energy Dissipation in Transportation of Fresh Agricultural Products

According to relevant documents, the unloaded rate of vehicle logistics is as high as 39% in china. On one hand, fresh agricultural products need to be transported by refrigerated vehicles which have particular structures, thus the stowage is rather difficult for the return trip, and unloaded vehicles are returned most of the time. On the other hand, most logistics enterprises don't have large-scale information system, so the insufficient information results in belated communication over the information of freight source and vehicles and finally the phenomena of out-of-step vehicle and freight sources. Hence, we should make use of the IoT technology to achieve dynamic collection, accurate analysis, unified management, timely release and sharing of data resource in this industry, thus meticulous management can be conducted for transportation process and green transportation can be realized.

In face of problems like blocked transport, frequent traffic accident and environment pollution in the transportation of fresh agricultural products, it's urgent for us to step up the application of IoT information technology in the transportation of fresh agricultural products to make it more informatized and intelligentized, thus the transportation system can be improved to provide better services and inspires the development of the whole industrial chain of fresh agricultural products.

3. Definition and Key Elements of Fresh Agricultural Products Transportation IoT

3.1 Definition of Fresh Agricultural Products Transportation IoT

Fresh Agricultural Products Transportation IoT means to use IoT technologies like sensor technology and RFID technology to put the key element of fresh agricultural product transportation into IoT, and enable all the key elements of transportation to be connected together. Thus we can timely master the operating and function condition of each key element in transportation, and through simulation and decision-making, apply interaction and coordination among the key elements. As a result, the whole transportation system can reach its optimal status.

3.2 Key Elements of Fresh Agricultural Products Transportation IoT

To establish the fresh agricultural products transportation IoT, the paramount and core task is to build RFID(radio frequency identification) taking identity characteristics as its core information (the RFID should be one-one corresponding). Then RFID technology and sensor technology should be applied to dynamically map the information on RFID comprehensive transportation information processing platform. Then through intelligent analysis and processing on the obtained information, the unified monitoring and management over the transportation process of fresh agricultural products can be achieved at last.

3.2.1 Agricultural Identification System

In the Internet of things(IoT), all the things related to transport environment should have a unique identification to be sensed and traced by the system. So the identification of "Things" is the basis of IoT in its application in fresh agricultural products transportation. In the fresh agricultural product IoT, every product, transport facility and transport infrastructure should be labeled with globally unique identity, namely addressing code, which will be recorded in the identity authentication system.

This way, all the key elements involved in the transportation of fresh agricultural products become a part of identification system.

3.2.2 Information Collection Data

The data acquisition system of fresh agricultural transportation IoT includes data input and output interfaces and information collection system based on identification and sensor technology. The information collection system carries out basic works of collecting information for the fresh agricultural product transportation IoT, which is large scale and in time. As for the process of the aforementioned data collection, firstly, collect relative information of fresh agricultural products and the operating status of transport facilities and infrastructures, then send the collected data to information processing center by means of communication and transmission, and finally make decisions according to these data.

3.2.3 Overall Processing Center of IoT

The collected information are finally transmitted to the overall processing center of IoT. As the mainstay of intelligent management of agricultural product transportation IoT, the overall processing center is composed of data processing center and overall management platform which implement the function of real-time monitoring over information collection, functional interaction among transportation elements and service needs. By the storage of enormous transportation data, data processing center provides backstage technical support for the automation and intelligent data processing of the overall management platform.

Through the overall processing center of IoT, we are able to master the real-time information collection, function interaction and service needs of all the transportation elements. In addition, by connecting all the transportation elements with the IoT, information can be updated timely and the operating status of transport system can be recovered. What's more, technologies like cloud computing are capable of unified integration and centralized management for the stored data, making data analysis and mining, resource sharing and data integrated utilization possible.

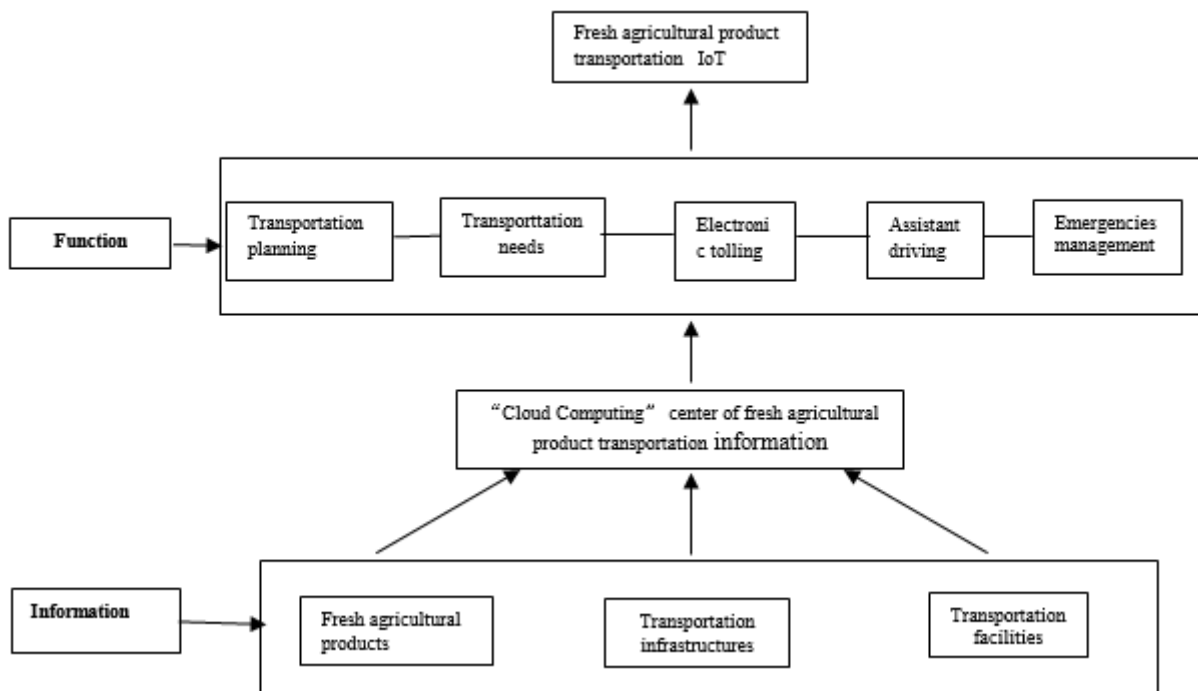


Fig.1 Application model of fresh agricultural product transportation IoT

4. Application Model of Fresh Agricultural Product Transportation IoT

4.1 Model Building

Taking the whole transportation system as a entirety composed of fresh agricultural products, transport facilities and infrastructures, the aforementioned three elements realized things connection in the fresh agriculture product transportation field, and built a functional group for the function interactions in the whole transportation system, so as to establish a down-to-top application model of information resource development on the basis of cloud computing, which is specified as fig.1

4.2 Application Model

The specific application model of fresh agricultural product transportation IoT which involves down-to-top information, functions and services is as follows:

Firstly, by building unique identity labels for fresh agricultural products, transport facilities and infrastructures, the fresh agricultural product transportation IoT achieves IoT object visualization, and then collects precise data of the operating status via transportation sensors and forms the “cloud computing” center for the information of fresh agricultural product transportation.

Secondly, by “cloud computing”, the fresh agricultural product transportation IoT can coordinately process the collected object data of transportation system, then make the real operating status of transportation system reappear in form of visual “mirror image”, and next, carry out intelligent analysis, decision making and the functional interaction among transportation elements, thus to form six patterns of transport planing, transport needs, electronic tolling, assistant driving and emergencies management.

Thirdly, through data analysis, the transportation IoT overall management platform shows the real-time operating status of the whole transportation system, and meanwhile enables the reappearing and intelligent processing of the overall information of transportation system. It provides support for the decision making in the intelligentization of fresh agricultural products, transport facilities and infrastructures, and optimizes the automation and operation of the functions of fresh agriculture product transportation IoT.

The whole application process adopts the means of unified collection, unified storage and sharing application to gather information, and comprehensively integrates the transportation information using “cloud computing” technology, ubiquitous network communication technology, wireless communication technology and other IoT technologies. And finally, the “trinity model” which is leded by government, concentrated on enterprises and orientated by market is realized to intelligentize the transportation of fresh agricultural products.

5. Promoting Strategies for Fresh Agricultural Product Transportation IoT

One of the key factors for the application popularity and sustainable development of fresh agricultural product transportation IoT lies in a series of promoting strategies, which mainly aim at virtuous circle of the industry chain and the all-win result with concentration on information service. this way, these strategies will be able to support the sustainable construction and service of the application of fresh agricultural product transportation IoT and generate more economical and social benefits.

As mentioned before, the promotion of fresh agricultural product transportation IoT is realized via the “trinity model” which is leded by government, concentrated on enterprises and orientated by market. So the specific promotion will be conducted in the three aspects of government, enterprises and market, thus the problems of low security, high costs, heavy energy consumption and high wastage rate can be solved at root.

5.1 For Government

5.1.1 Conduct unified planning and coordination for the development of IoT industry

The information competitiveness can be improved through the development of IoT industry. However, the IoT industry in China is still at its primary stage, so it's necessary for the government to specify the technical roadmap of IoT industry from a national perspective, and comprehensively allocate the resources in related fields referring to its application and application, which, as a result, will lay a solid foundation for the development and application of fresh agricultural product transportation IoT.

5.1.2 Pay close attention to and complete relevant standards of fresh agricultural product transportation IoT.

Standardization is quite an important technical base for fresh agricultural product transportation IoT because of the wide referring range, high integrity and conformity of transportation system. It's a common phenomenon in developed countries to obtain high paybacks through mastered international standards and multiple technical monopolies. So the Chinese government should persist in completing the standard system of IoT to promote the cooperation of infrastructures and connection of systems. The standard system mainly includes the core draft standards such as the standard system of fresh agricultural product transportation IoT, cloud platform technical specification, data source format and so on. On the basis of unified standards, the government should make great efforts to improve its quality, strengthen its credibility, establish thorough execution mechanism, and provide reconditions and guarantee for the development of the industry, thus to lead and drive the fresh agricultural product transportation IoT system to develop in a healthy way.

5.1.3 Further improve the data security system of fresh agricultural product transportation IoT

The data security system of fresh agricultural product transportation IoT follows the guiding ideology of unified planning, unified arrangement and throughout management to comprehensively manage the application, data, integration and integrated facilities of all the information systems inside the transportation IoT. The security system tightly combines technologies, strategies, organizations and operation systems. It covers the Ministry of Transport of China, all the departments of transport and the local transport managerial departments at each level, for the unified management of information security. The data security system of transportation IoT mainly includes strategy system, organization system, operation system and technology system.

5.2 For enterprises

5.2.1 Carry out fresh agricultural product transportation IoT demo projects

The fresh agricultural product transportation IoT project needs the Ministry of Transport to take the lead, local governments and transport management departments to cooperate, science institutions to provide technical support, and the core enterprises in fresh agricultural product supply chain to implement. And only when all parties interact and coordinate together can the project be implemented successfully. Thus we must choose proper areas and the leading enterprises in the supply chain which are aware and capable of the application of fresh agricultural product transportation IoT to carry out the demo project. And an application organization plan which is in favor of the industrial promotion must be made to stimulate the development of fresh agricultural product transportation IoT.

5.2.2 Make full use of the vehicle-road coordination technology

To improve transportation security is an important purpose of the development of fresh agricultural product transportation IoT. And the application of goods-vehicle-road coordination technology can improve the transportation security to a significant degree. Therefore, if we want to optimize the application of fresh agricultural product transportation IoT, we have to use advanced

information and communication technology to exchange and share vehicle-vehicle, vehicle-road and goods-vehicle information, to boost the deep processing of information and its exchange among all parties and to effectively assess potential transportation risks.

5.3 For markets

5.3.1 Build industrial alliances quickly

To solve the standardization and technology problems existing in fresh agricultural product transportation IoT in China, the government not only needs to provide powerful support for policy-making, capital investment and other aspects, but also should carry out positive guidance and plan for relevant enterprises with the orientation of market, thus to make industrial integration to be deemed as economically indispensable inside the transportation industry and between the transportation industry and fresh agricultural enterprises. Therefore, the enterprises inside the industry and across industries will build industrial alliances in a short time, which can promote the fresh agricultural product transportation IoT in China.

5.3.2 Establish complete and independent investment and financing system

The transportation information construction in China has been relied on the construction fund of roads, harbors and others all the time. But the establishment of fresh agricultural product transportation IoT demands for an enormous sum of money, which can not be satisfied by the relied funds. So we should set up a special fund for the technologies, industrialization and demonstration of fresh agricultural product transportation IoT, and we also should build independent investment and financing system to support the research and development of key technologies; the establishment of public service platform, project technology center and laboratory; and the construction of the infrastructures of fresh agricultural product transportation IoT for key demo projects and the strategical arrangement.

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