

Research on Anomaly Detection of RFID Supply Chain Data Based on EPC

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Abstract. With the development of RFID technology has attracted more and more attention, the deployment of RFID systems is developing to the trend of large-scale, networked and distributed. So, it is important to analyze the reliability of RFID data. The paper aims to analyze and research the technology of RFID supply chain anomaly detection in-depth. According to the existing problems, such as delay in transiting and steal in supply chain, etc, the paper will put forward the anomaly detection system of RFID supply chain based on distance and rules. The system can provide some help for the enterprise management so as to help enterprises to effectively control the information of supply chain.

Keywords: RFID, anomaly detection, supply chain, EPC network

1 Introduction

RFID is called radio frequency identification technology, and it is an automatic identification technology. It can realize non-contact telecommunication in two-way by wireless radio frequency, to achieve the purpose of identification, and the process of recognition does not need manual intervention. Compared with the bar code, the advantages of RFID technology are more obvious, such as: long service life, big reading distance, encrypted tag data, large storage capacity, information easily to be changed etc [1]. In recent years, RFID technology has been widely used in many fields of industrial automation, business automation, and transportation control management. The deployment of the RFID system will have the trend of large-scale, networked, and distributed.

This is more and more demand on RFID data reliability. According to the survey of the "information overload" by international famous consulting company (Gartner), results show that more than 90% of the enterprises think the enterprise competitiveness is closely related to its information capacity. In order to obtain the useful information, enterprises must analyze the data and exclude "exception" data. So, it is very important to realize the detection of abnormal data.

Supply chain management is one of the important application fields based on the RFID system. The analysis of the abnormal data is important for the safety and effectiveness of supply chain.

This paper mainly studies the anomaly detection scheme of RFID supply

chain based on EPC network, in order to provide supply chain data analysis for enterprises, and to provide assistance for enterprise management decision.

2 Classification of Abnormity Based on RFID Supply Chain

In the supply chain system, the enterprise must grasp the relevant information of all items in the supply chain, which will produce a large amount of data [2]. But these data (including the time of goods and space information) can provide valuable information for the users of supply chain system by effective analysis, such as: the most reasonable path and best time for goods delivery.

Here, we will mainly divide the abnormal RFID supply chain into three types, as described below: (1) Delay of transport. In the supply chain, the delay of goods transport may occur in delivering goods, in transit and arrival link. Transport delay will lose its original value for some goods of strict requirement of time, for example, fresh goods need be sent to the destination in 2 days, while the transport delay caused the goods being sent to the destination for 4 days. The consequence can be imagined, therefore, in order to make the supply chain of goods circulation more efficient, it is necessary to monitor the transport of goods in the supply chain to avoid significant losses. (2) Theft. Every year, the phenomenons of commodity theft always happen in our country, and these mostly occur in the time period of goods-packing by suppliers, goods-unloading by retailers or drivers' rest. If we can achieve real-time tracking of goods in the supply chain system, which indicates the orientation of specified goods at any time, then we can largely reduce the loss rate. (3) Fake. The application of RFID in anti-counterfeit of the article has been respected in many countries, such as: access control management, food security and other aspects [3]. If the enterprise puts the RFID label on the goods, the goods can be monitored throughout the processes of production, circulation, sales and so on, which can avoid the fake.

3 Detection Method of Abnormity Based on RFID Supply Chain

Because the abnormal supply chain will bring great losses to enterprises, so it is necessary to find out the effective anomaly detection method in the RFID supply chain system. The RFID supply chain anomaly detection method can be divided into three categories: detection method based on the statistics, detection method based on distance and detection method based on rules.

(1) Detection method based on statistics

Anomaly detection method based on statistics detects anomalies by statistical thinking. Assume the set of data is in accordance with a distribution or probability model (such as the Gauss distribution), and then model is used to decide whether it is abnormal or not. The application of this method needs to know the probability distribution model and distribution parameters (such as the mean and variance) of data set [4].

(2) Detection method based on distance

Anomaly detection method based on distance judges the abnormal data which have not enough adjacent data. That “enough adjacent data” is determined based on the given object and the distance of the object. The method is mainly used in large data-base knowledge discovery.

(3) Detection method based on rules

Anomaly detection method based on rules has combined with characteristics of application itself and data [5]. The basic idea of analysis method based on rules is: making the classification model by general features, and produces feature database of normal behavior, then decides new data whether it is normal behavior or not.

4 Summary Design of Anomaly Detection System

(1) Ideas of Research

Anomaly detection method based on statistics mainly appeals to a single attribute, and need know the distribution model and parameter information of data set. The method is not suitable for anomaly detection of RFID data.

Anomaly detection method based on distance need calculate the distance between the calculation of normal data and the abnormal data. The method has wide range of application, but there are the problems of efficiency and error.

Analysis method based on rules is more effective, which can identify the abnormal data. But some supply chain system can not provide specific business rules, so the range of application is limited.

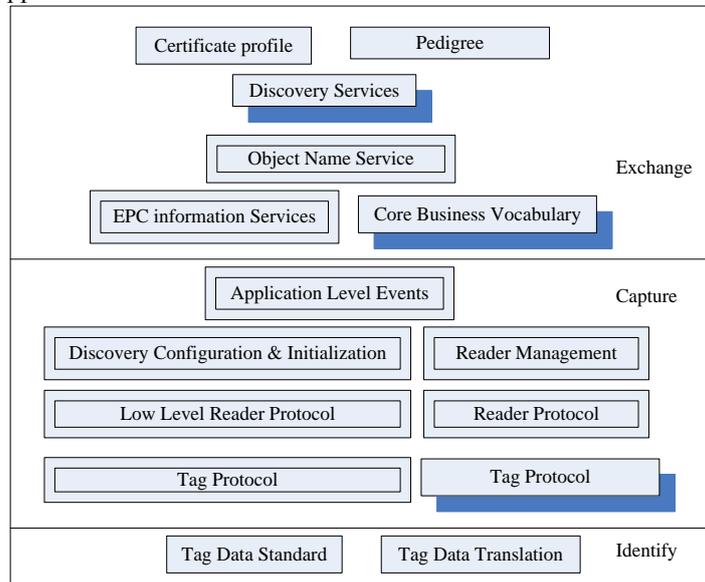


Fig.1. Architecture of EPCglobal

To sum up, based on the summary of the existing abnormal data discrimination method and considering the characteristics of RFID data itself, the paper has con-

structured the anomaly detection system of RFID supply chain data based on EPC [6]. The system can be combined with the detection method based on distance and detection method based on rules to play their respective advantages and provide the graphical display, so managers can easily browse exception information of the supply chain.

(2) Architecture of EPCglobal

EPCglobal is a neutral, non-profit organization for standardization. It is made up of two standardization organization (EAN and UCC) [7]. Its major responsibility is to establish and maintain the EPC network in the global scope of each industry, and to ensure the automatic, real-time recognition technology. The architecture of EPCglobal is shown in Fig.1 above.

5 Architecture of Anomaly Detection System

The architecture of the system is shown in Fig. 2:

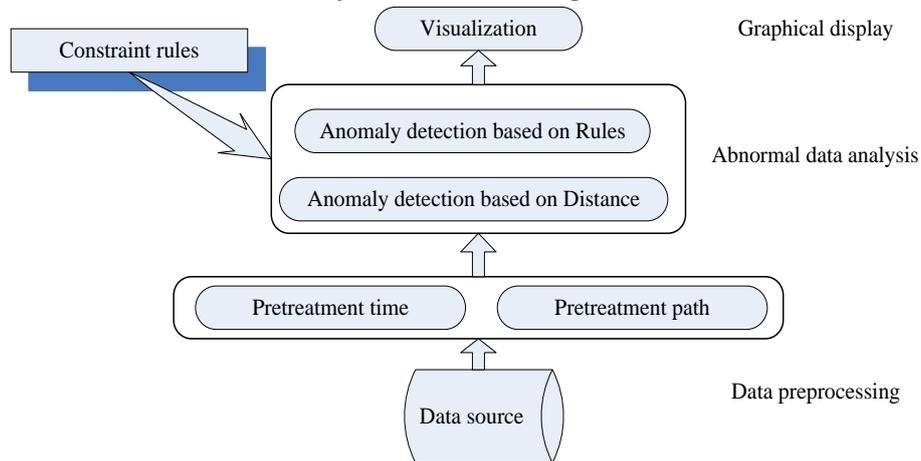


Fig.2. Architecture of the system

This paper has designed three layers of anomaly detection system, such as: data preprocessing layer, anomaly analysis layer and graphical display layer.

(1) Data preprocessing layer

This layer is mainly to pretreatment the event data of collecting from EPCIS based on two aspects of time and route. By the appropriate transformation of time data, this layer is convenient for the analysis of subsequent anomaly detection, and is more direct to analyzing the abnormal data without further processing.

(2) Abnormal Analysis layer

The layer by detection method can realize the anomaly detection from the global and local aspects by detection method based on distance and detection method based on rules. Detection method based on distance method transforms the temporal information to frequency domain information, and uses the path similarity of frequency space to exclude abnormal. Detection method based on

rules can exclude those data which does not meet the rules, using some predefined rules, such as the flow, speed, residence time. This layer can analyze the large amounts of data for analysis for the purpose of finding abnormal phenomenon.

(3) Graphical display layer

This layer displays the data flow by anomaly detection based on approach, and can provide a visual interface, convenient managers to view the information of supply chain circulation and exceptions.

6 Conclusions

Supply chain management is the important application fields of RFID system. Analysis of the abnormal data is important to the supply chain security and reliability. Through the analysis of RFID supply chain business needs, summary of the existing literature, the paper has presented an anomaly detection scheme for RFID data supply chain based on EPC network.

On one hand, the system can be combined with the detection method based on distance and detection method based on rules to play their respective advantages. On the other hand, the system can provide effective supply chain data analysis for the enterprises, and it is convenient for the management to check the data.

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