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Abnormal Event Detection of Workshop Logistics Production Management Based on RFID Technology

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Abstract. RFID, as one of the most important key technologies in the next generation of advanced manufacturing system, has increasingly significant advantages in the application of data collection in the manufacturing workshop, real-time tracking of the manufacturing process and product quality backtracking, etc., and is considered to be the most potential and play a huge role in the technological innovation of manufacturing informatization. In order to better study the abnormal event detection technology of workshop logistics production management based on RFID technology, this paper firstly studies the abnormal event detection method of workshop production based on RFID technology based on the analysis of RFID technology principle, data characteristics and workshop production process. Then, a formalized complex event representation method is constructed to meet the complex and changeable business logic requirements in the actual workshop production application. Then, the solution idea of extracting complex RFID events from massive RFID data using Rete algorithm based on MapReduce framework is discussed. The results show that the accuracy of detecting abnormal events increases by 18.21%, which proves the validity of the model.

Keywords: RFID Technology, Workshop Logistics, Abnormal Events, Production Management.

1. Introduction

When the production environment is complicated and changeable and the management mode is backward, information in workshop production is difficult to be collected and processed in a timely manner, resulting in low enterprise management and operation efficiency [1-2]. A large amount of production data information will constantly be generated in the production site, which cannot be collected and processed in real time, so that the production process cannot be monitored in a timely and effective manner. Once abnormal problems occur, the production line will be shut down due to the inability to deal with them in a timely manner, resulting in serious losses [3-4].

Chen Chih-Chen proposes rfid technology to improve and enhance the effectiveness of upper limb rehabilitation. The traditional rehabilitation pulley is equipped with RFID reader, RFID tag panel and servo host to record the training process. In the Brunnstrom stage of clinical evidence, time to reach full mark, counting of missing specified points, and assisted recovery, the proximal upper limb showed that rFID-based upper limb training significantly reduced the negative impact of disability in daily life and activities [5]. Oliveira Rodrigo R came up with SafeTrack, a logistics management model based on geofcontinuos algorithm and rf technology. In this approach, the focus is on dealing with delivery management. The main scientific contribution of SafeTrack is automated delivery management. In addition to handling deliveries without user interaction, we provide a mechanism for detecting inconsistencies in real time [6]. After extensive literature retrieval, Mohammad Alamgir Hossain conducted qualitative and quantitative research, developed and validated the multidimensional hierarchical model of external responsiveness, and studied its impact on adoption intention. The research results show that: in the background of radio frequency identification (RFID) technology, the external response is a third-order external pressure reflected by the reflection structure [7].

This paper studies the abnormal event detection technology and related theories of workshop logistics production management based on RFID technology, analyzes the requirements of workshop abnormal event detection system, and constructs a detection framework combining RFID technology [8-9]. Then, this paper designs the functional structure of the workshop detection system, establishes

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relevant models, summarizes the problems found in the experiment, and puts forward appropriate technical Suggestions [10].

2. RFID technology and workshop production management

2.1 The RFID Technology

Radio frequency identification (RFID) technology is a kind of non-contact automatic identification technology based on radio frequency principle. It can automatically identify intelligent objects with tags through radio frequency signals, and obtain static or dynamic information in a timely and effective manner. In recent years, RFID, as an important supporting technology of the Internet of Things, has been widely concerned at home and abroad. With the rapid development of RFID technology and its industrialization as the core, promoting its application in the fields of manufacturing, logistics and supply chain, transportation, medical and health is an inevitable way to build the ubiquitous Internet of things.

Based on the constant value of the distance between the point on the hyperbola and the two focal points, the time difference is converted into the distance based on the time difference of the signal arriving at the detection device, and then the hyperbola equation is substituted into the position coordinate of the target object according to the trigonometric method. This kind of positioning system has relatively high precision and is suitable for high-precision target positioning:

$$d_{ij} = \left| r_i - r_j \right| = \left| \sqrt{(x - x_i)^2 - (y - y_i)^2} \right| \tag{1}$$

Based on the back scattering principle of passive RFID tag, the tag will transmit back a part of the carrier signal whose transmitting frequency is F of the reader. Therefore, if the transmitted carrier is coherently demodulated with the signal carrier reflected back from the tag at the reader end, the amplitude of the reflected signal and the phase reflecting the distance information of the two can be obtained:

$$\theta = 2\beta L = \frac{4\pi L}{\lambda} = \frac{4\pi L f}{c} \tag{2}$$

2.2 Workshop Production Management

In the production preparation stage, after the workshop management receives the production task, the production plan of the key process shall be prepared, and the production materials before production shall be checked, and the required materials such as spare parts and tooling shall be checked to ensure the completeness of production materials, technical documents, equipment and appliances, etc. At last, according to the result of matching test and the production plan of key process, the workshop production plan will be sent to each production team in the workshop. The monitoring and management realized by using RFID technology includes the binding of RFID tags on the work order such as the prepared production plan and production technology documents to realize the tracking management of the production task execution.

3. Design of the experiment

3.1 Experimental Background

Due to the natural advantages of RFID technology in automatic identification, it is especially suitable for the manufacturing process with high requirements of real-time and visualization, which provides new ideas and solutions for manufacturing enterprises to deal with multiple challenges. Through automatic identification and visual tracking of manufacturing resources, enterprise managers can grasp the workshop production schedule in real time, discover production bottlenecks and waste phenomena, identify machine failures, production sequence adjustment and other production disturbances and emergencies, and improve the production process. Therefore, how to use

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RFID technology to collect real-time data, what kind of data to collect, how to process the data and timely feed back to the management to assist the production decision, and realize the closed-loop production planning and control are the most meaningful and challenging problems in the application of RFID in the manufacturing process.

3.2 Experimental Design

The discovery of abnormal events in the workshop based on MapReduce means that the MapReduce programming model of Hadoop is used to realize the parallel processing of massive RFID data in the workshop production process, Map function and Reduce function are compiled according to the actual business requirements, and real-time processing of RFID data flow is carried out to extract the required complex event information. ReduceWorker obtains the data location information from the Master and reads the intermediate data set from the corresponding storage area, and categorize the data with the same key value, i.e., the same <e-r> value, into the same Reduce task in a -ordered order to get the data set to be processed.</e-r> Some experimental results are shown in Table 1.

Table 1. Experimental results

The area	Device name	The part	Check the status	Case description
1	For the pump	The shell	Normal	Without leaking
2	Exhaust equipment	Pressure gauge	Normal	The normal operation
3	Platform screen door	Switch	Is not normal	Badly worn
4	Refrigerator	Exhaust fan	Normal	Switch to normal
5	Fire alarm	As a whole	Normal	No damage

4. Workshop logistics production management abnormal event detection

4.1 Detection and Analysis of Abnormal Events in Workshop Logistics Production Management Based on RFID Technology

As shown in Figure 1, the value of N from 1 to 4, two algorithms of positioning error curve showed a sharp decline, reflecting the two algorithms is within the scope of positioning error decreasing speed is very fast, N by 4 to 10, two algorithms of positioning error curve tends to be stable gradually, and the positioning precision of the improved algorithm is always higher than the traditional algorithm. When the threshold value is around 1, the error of the two algorithms does not change much, while the error of the other values is large. However, the accuracy of the improved algorithm is significantly higher than that of the VIRE algorithm, and when the threshold value is 1, the accuracy is the highest. Any intelligent object can be detected when entering the RFID signal detection space, and its electronic tag information will be read repeatedly. In this case, the key to reduce the complexity of data storage and processing is how to eliminate the redundant label data repeatedly read.

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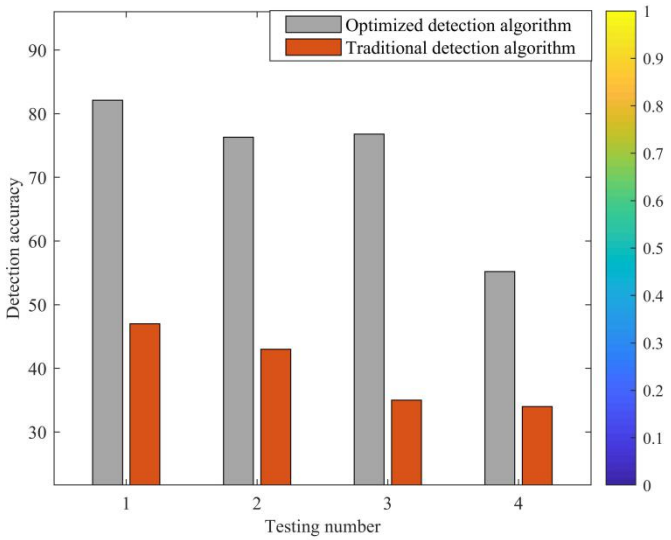

Figure 1. Comparison between traditional detection algorithms and RFID detection algorithms

Figure 2 shows the frequency of three common abnormalities detected in workshop production management. Abnormal monitoring using advanced RFID technology for machining process monitoring anomaly and reasonable visual monitoring operation, will inevitably have unusual: artifacts not carry on the processing according to the regulations of the processing craft route, the work procedure out-of-order leakage processing, or authorized to enter without the operator visual process and abnormal; Illegal workpiece tags unrelated to the process (other illegal workpiece) may "break into" the RFID signal detection space corresponding to the process, thus generating illegal data and causing confusion in the RFID database; The state quality of the workpiece after processing in a certain process has not fully met the requirements of the designed processing quality, and it cannot continue to flow to the next process. To effectively resolve the first two types of exceptions, you need to predefined paths for the normal flow of artifacts. According to the process route and production plan of the workpiece, its processing path is determined. According to this, the various event sets, state sets, location sets, path sets, etc. that the pre-defined workpiece production process needs to experience can be predefined in order. Data matching When valid data is automatically collected and detected by an RFID reader, the system automatically matches the data with the predefined data sets. Once the match is unsuccessful, it means that the workpiece does not flow according to the specified path, and an exception occurs. The type of the exception is judged and the alarm device is automatically triggered, and the operator is prompted to make reasonable operation according to the exception type to correct the exception. The system will also automatically record the abnormal time, place, state, operator and other information, so as to trace the machining process of the workpiece in the future.

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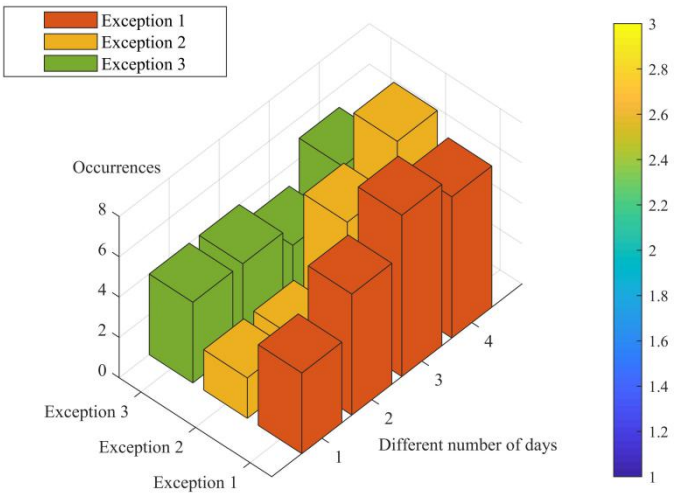

Figure 2. Frequency detection of abnormal conditions

The Rete network built according to the rules and conditions is divided into a network and B network. From the root node to the storage node of A, the A network is mainly responsible for testing the conditional attributes of facts. The rest of the B network is mainly responsible for testing the association between the facts that meet the conditions. A network includes three types of nodes as shown in the figure, namely Root Node. TestNode and Alpha Memory are respectively. The Root Node is the entrance of fact into the Rete network, which is at the beginning of the network. Nodes is also called a test store conditional constraints, and constant value of property, to be responsible for the fact that a type with the const attribute test, located in the lower root node, a node with an input and an output terminal, receive comes from the fact that the root node and after the test, by the fact that the test will be output to a storage node, these facts are known as storage element. After the Map calculation node receives the passed simple event set, it will test all the simple events according to the Predefined A network composed of conditional attribute constraints, and filter out the events that match the requirements. Only when an event matches the constraint condition successfully, a key-value pair <key, value=""> will be generated; otherwise, the output intermediate data will not be generated, where the value value is the event attribute and the key value corresponds to the subsequent Reduce process that needs to use the event, and the output will be arranged in chronological order.</key,> For example, if an event <e- occurs,ts=""> passes the match test and will be used as a rule;</e-> For the complex event component corresponding to association rules, the Map process outputs <ruler,{e,t}> intermediate data and waits for the Reduce function call to perform rule1 related tests.</ruler,{e,t}>

4.2 Suggestions on Abnormal Event Detection of Workshop Logistics Production Management Based on RFID Technology

RFID middleware for vehicle manufacturing production line needs to provide effective data information to computer applications. In this process, the processing speed and accuracy of data information will affect the performance of the whole RFID data acquisition system. At the same time, the electronic tags on the workshop site send a large amount of redundant or missing data information to the reader. When the information is sent to the background computer system without processing and analysis, it will cause excessive application load. Middleware layer is connected MES and equipment is an important part of the bottom, according to data information, the middleware layer needs to be done to information distribution, information coding and decoding, and the electronic label send packet filtering and integrated operation, reduce redundancy and missing data information, be sure to provide accurate and effective data information background computer system.

In the whole vehicle manufacturing line, multiple readers may be deployed at some key stations to improve the accuracy of e-tag data collection. Around these monitoring points, once the workpiece

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or car body attached to the e-tag enters the reader's work area, the e-tag receives the command and sends a packet, and the reader continuously collects data information. In this case, two phenomena occur: first, multiple readers repeatedly read the data of the same electronic tag; Second, the same workpiece or car body stays near the monitoring point for too long, which exceeds the scanning cycle of the reader and causes the reader to read the electronic tag repeatedly. Although it ensures that the reader can read the data information on the electronic tag, it results in a large number of duplicate data being collected.

Artifacts or vehicle to the reader the work area, the corresponding electronic label information will be identified, in this process can know the time of the electronic tags are read and read the serial number of the reader, and according to the information of time and number judgment in this time period, whether the same reader reads the electronic tag data and information, using this feature can effectively filter the repeated read electronic tag data information.

5. Conclusions

Firstly, this paper introduces the research background and the problems to be discussed, and analyzes the research status of RFID technology. Secondly, this paper analyzes the composition and working principle of RFID system, and points out the application requirements of RFID technology in the workshop manufacturing production line. Finally, according to the requirements of current workshop production management, this paper designs a workshop production management abnormal event detection system combining RFID technology. Compared with the traditional algorithm, this system further improves the detection accuracy and is effectively applied in workshop production.

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