ABSTRACT: Recently, vehicle logistics transfer mode becomes more and more suitable for logistics’ requirements on transportation and storage as automobile output constantly grows. The operation of paper transfer receipts in combination with two-dimension code or bar code often leads to misleading and neglected loading. However, radio frequency identification devices (RFID) make up these defects. This study first discussed basic principle and systematic framework of RFID technology, then introduced characteristics and process of electronic transfer technology in vehicle logistics, analyzed logistics management data error that may exist from multiple aspects and discussed over the application of RFID technology in logistics management data error and vehicle logistics electronic transfer system.

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for people.

Figure 1 is the model structure of RFID system. Reader-writer and antenna all-in-one machine contains antenna that can make label produce electric energy by transmitting radio-frequency signal reader-writer capable of coding and decoding. Transmission of radio frequency signals between electronic tag and reader is fulfilled by coupling element in a non-contact way. In coupling channel, completing energy transmission and data conversion based on sequential relationship can reduce data loss and data transmission error [7], which improves transmission efficiency and ensure data safety.

Reader-writer is an equipment writing and reading data into RFID label by radio frequency coupling. It is an important component in the above system. Reader-writer can do long-distance data reading and writing once electronic label is read by reader-writer. Operating data with electronic tags has many advantages, such as long-distance operation, high speed, rewritable performance and large data carrying quantity [8]. These characteristics plays an important role in solving logistics management data error, as it can not only reduce data error rate, but also can improve working efficiency.

RFID middleware connecting hardware and upper layer application is mainly used to receive data transmitted by reader-writer and then uploading data to application software through filtering, proof and grouping. Its structure is shown in figure 2. RFID middleware, the core module in RFID system, not only lowers working difficulty and reduces working quantity but also improves working efficiency.
3. Analysis of Application of RFID Technology in Vehicle Logistics

3.1 Usage of Electronic Label and Reader-Writer
Electronic label refers to RFID label. We should choose proper installment position of RFID label and reader-writer when selecting information acquisition spot. To effectively identify different vehicles, it is necessary to make electronic label on every vehicle and reasonably confirm position of RFID label. Thus installment position of reader-writer should be confirmed by specific process of vehicle logistics. Detailed process of vehicle logistics is shown in figure 3.

![Figure 3. Detailed process of vehicle logistics](image)

VDC in figure 3 refers to vehicle distribution center and VSC is Vehicle Storage Center. Reader-writer can be installed in warehouse in places mentioned above.

In vehicle logistics, information collection consumes lots of time and energy as vehicle occupies a large area. Scanning information on electronic tag can acquire information of vehicle in a convenient way, thus we can write down detailed real-time information of every vehicle and then acquire related information by electronic tag.

3.2 Monitoring Vehicle Logistics Information by RFID Technology
Logistics information of all goods can be monitored in multiple aspects.

First is collection of warehouse-in information in central warehouse including information about vehicle unloading and information about vehicle entering warehouse [10].

Next is warehouse management including vehicle inventory and positioning. Vehicle inventory refers to warehouse keeper examining warehouse-in and warehouse-out records as well as checking vehicle quantity in warehouse. If parking information of vehicle does not conform to the information demonstrated on device, then reader-writer can be used to correct parking information in time.

Third is warehouse-out management including cache region information collection and warehouse-out information collection. The information can be collected by RFID reader-writer.

Besides the information mentioned above, collection of information concerning transit storage, third party logistics and automobile dealer.

4. Application of RFID technology in Logistics Management Data Error
RFID middleware is a core component in RFID system. RFID middleware subsystem is the set of application software of all read-writer in operation system. The system between reader-writer and RFID management subsystem provides standard unified interface upward and filters data flow and regulates events downward. Thus subsystem of RFID middleware includes content of three layers, i.e., reader-writer standard interface, data stream cleaning and real-time event scheduling. Content of these three parts determines accuracy of logistics management data. Following are the detailed statements in these aspects.

4.1 Reader-Writer Standard Interface
Reader-writer standard interface can be classified into four parts, i.e., translation and read of data flow, self-inspection, setting of reader-writer and active operation of reader-writer [9]. Translating and reading data stream is to translate data flow coming from all reader-writers into class instance set in same format based on the definition of Economic and Planning Council. Self-inspection is to confirm whether read-writer operates normally in real time. Active operation of reader-writer includes opening reader-writer, closing reader-writer, restarting reader-writer and actively reading and writing specified data with specified length in specified starting position in specified area.

4.2 Data Stream Cleaning
Data cleaning of RFID middleware is used to solve cross-read problem, i.e., judge real physical position of label belonging to which reader-writer when one label is identified by two or more reader-writer due to external environment, reflection and labeling. Cross read makes reality and effectiveness of system be uncertain. But RFID middleware design in that system just avoids cross read [6].

When a label is confirmed to be identified at the first time, RFID middleware would release the event that label has entered identification scope, but not release event when reading same label afterwards, as the label is thought to be remain in the identification scope of reader-writer and it us unnecessary to release events to upper layer application; similarly, when a label is no longer identified by reader-writer in read-write, the label is considered to leave identification scope of reader-writer, and at that moment, RFID middleware release an event that the label has left identification scope to upper layer application; then a complete RFID label identification process is fulfilled [11,12]. Label identification state is shown in figure 4.
Repeated read time and repeated non-read time mentioned in the above process should be strictly determined. Label identification would be sensitive if repeated read time is too low. Under such condition, a label will be thought to enter identification scope once it is read. But if the value is too large, then the event of entering identification scope will not release even if the label has entered practical identification scope for a long time [13]. Same problems also exist for leaving identification scope. Multiple tests confirm reader-writer should be set to identify once every 10ns, RFID middleware identification window as 0.5 s; moreover, setting two repeated values into 10 times can achieve the best effect.

Response mode of response events in RFID is different from other response events. In RFID application, events usually have different handling deadline and data read by different RFID reader-writers have different values. Sometimes, events with short deadline may not be important, thus those events can be stopped when more important events respond. An event priority list can be established based on handling deadline and importance degree of events (figure 5). It can be seen from the figure that, all events are ranked based on deadline; events with shorter deadline are ranked in higher position, and value of events are ranked inverted order, i.e., events with higher value are ranked in higher position. After position of events is confirmed, events are released one by one according to the arrows demonstrated in the figure. Events with shorter deadline are prior to be released if their value is same, and events with higher value are prior to be released if deadline is same.
A new event can be ranked based on priority confirmed by above rule or by the following formula.

\[ P = (i + j - 1) \times (i + j - 2) / 2 + i \]

Where \( i \) stands for the position of a event’s deadline in sequence, \( j \) stands for the position of a event’s value in sequence. Thus event dispatching system just needs to rank events in inverted order based on practical priority and then the event with highest priority is first to be released, which can ensure timely calling of events, reduce data error and improve commercial value.

5. Summary

As RFID technology gradually matures, it is applied more in electronic transfer system of vehicle logistics. Why RFID technology becomes more and more popular is that RFID technology characterized by rapid object identification, long-distance identification, large volume of information storage and erasable data greatly reduce data errors occurring in vehicle logistics information. Through summarizing characteristics of RFID technology, this study analyzed structure of FRID and emphatically explored the application of RFID technology in vehicle logistics electronic transfer system and errors of logistics management data.

Though RFID technology has many advantages, high cost of RFID label is not beneficial for its promotion. However, we believe that, RFID technology is bound to acquire rapid development and application in various industries as Chinese economy grows.

Conflict of Interest

The author(s) confirm that this article content has no Conflict of Interest

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