ISBN 978-981-11-7861-0
Proceedings of 2018 the 8th International Workshop on Computer Science and Engineering (WCSE 2018)
Bangkok, 28-30 June, 2018, pp. 83-87
doi: 10.18178/wcse.2018.06.015

Research on Key Technologies of Comprehensive Information System for Auto Parts Used Dual-Band RFID

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Abstract. This paper briefly introduces the operation mode of comprehensive information system for auto parts used dual-band RFID, analyzes the basic characteristics of dual-band RFID label for auto parts,and focuses on the detailed coding technology of RFID label at ultra high frequency traceability code and high frequency traceability code.It can greatly improve the current operating conditions of the whole cycle and the whole industries of automobile, and crack down counterfeit manufacturers of auto parts,and standardize the circulation order of new and second-hand auto parts.

Keywords: dual-band, traceability, UHF coding, HF coding.

1. System Overview

Because of the low threshold of market access for auto parts distributing business,strengthening the management of the auto parts distribution industry will improve the after-sale quality and protect the rights and interests of consumers,and it is of great significance to reduce the hidden dangers of road traffic.The circulation of new auto parts and used auto plarts is related to the normative development of the whole automobile industry.If auto parts are equipped with "electronic identity cards" and applicable system,consumers will be more reassured to repair their cars,and government quality supervision is also more effective.

So we design dual-band RFID labels,that is,"electronic identity cards",that uniquely identify auto parts.The dual-band RFID labels contain all the information about auto parts with the unique number assigned to each auto part,meanwhile the information of auto parts are also recorded in the database in detail.In order to prevent the dual-band codes of auto parts from being copied and counterfeited by lawbreakers,we use multiple anti-counterfeiting techniques(discussed in detail in the other paper),so that every auto part has a unique electronic identity card to ensure the safety and reliability of labels and auto parts data.This ensures the buyer's rights and interests.

The comprehensive information system including two subsystems: anti-counterfeit read-write system for dual-band auto parts;EC traceability and trading system of auto parts with dual-band RFID(discussed in detail in another paper).Anti-counterfeit read-write system for dual-band auto parts realizes full cycle anti-counterfeit and tracing of auto parts,through which the circulation state and the detailed parameter of auto parts can be obtained immediately;EC traceability and trading system of auto parts with dual-band RFID can be used for the evaluation and online trading of spare parts. The comprehensive information system(Fig.1) can ultimately promote the healthy development of auto parts industry.

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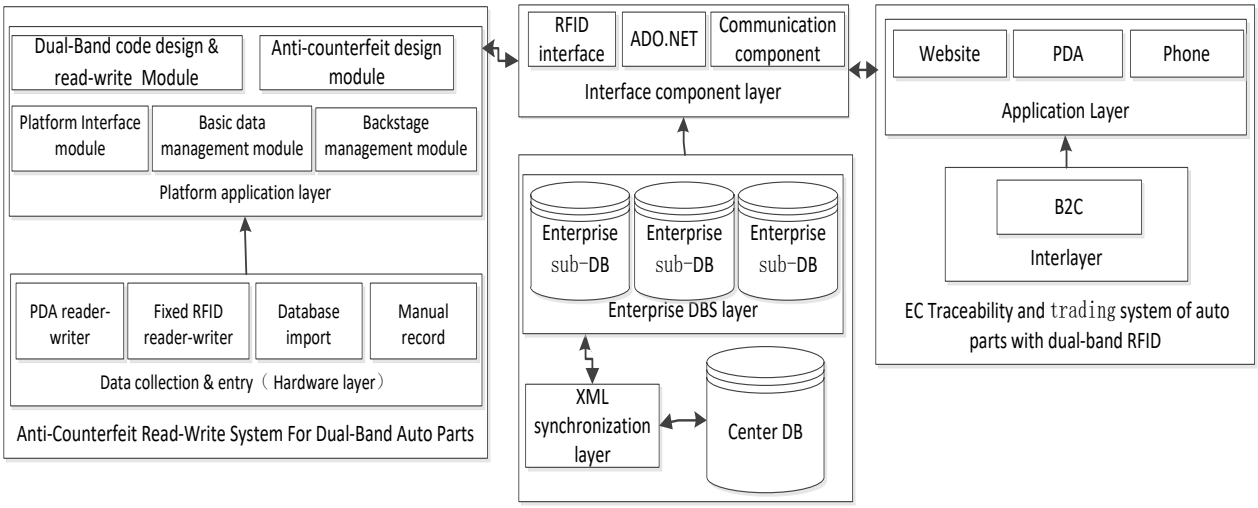

Fig. 1: Comprehensive information system structure

This comprehensive system innovates supply chain mode of auto parts, realizes the whole life cycle traceability and transaction management of all kinds of auto parts circulation processes from purchase, storage, sale, after sale, secondary sale. It connects automobile industries, automobile enterprises as a whole, through which the auto parts flow, and it can obtain the useful datas of vehicles, auto parts, car owners, so as to generate more values.

2. Operating Mode of the System

Enterprises,government and consumers obtain the corresponding authority to read and write dual-band labels through the anti-counterfeit read-write subsystem of auto parts,and change or obtain the circulation status of auto parts at any time.

The auto parts industry organization sets up the parts quality tracking and trading center, in which the central server is configured and the server is connected to the Internet.Auto parts datas of manufacturing, logistics, sales, maintenance, and resales for the corresponding automobile enterprise are recorded corresponding to the enterprise databases by RFID readers,and frequently updated to the center database.RFID readers,computers and regional database server are installed in each auto factory,auto maintenance enterprise,new and second-hand parts sales enterprise,auto recycling enterprise.Social users can check the information in the central server through multiple channels such as network and mobile phone(Fig.2) .

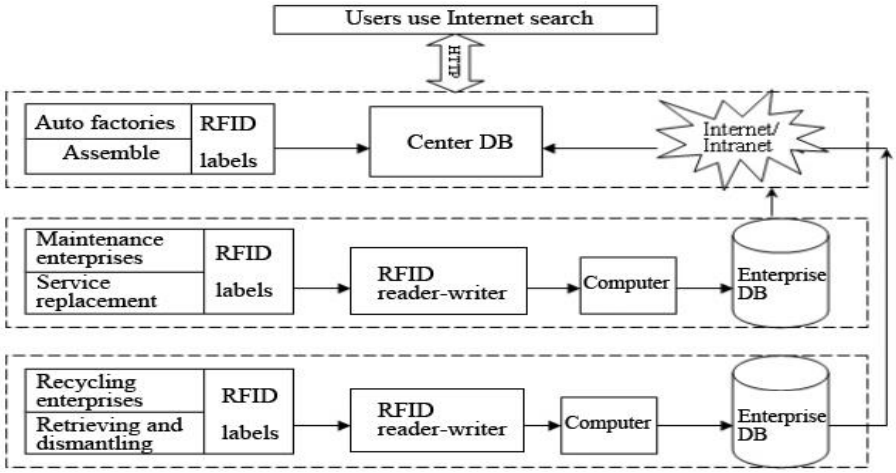

Fig.2: Auto parts datas acquisition for enterprises

The comprehensive system uses .Net architecture and C # language to establish the C/ S structure of anti-counterfeit read-write subsystem and B/S structure of EC traceability and trading subsystem ,use UML to

build model,use SQL server 2010 database.The hardware of the system is composed of RFID labels,readers and antennas. When there is a problem with the auto part,because the information of the auto part in the process of transportation,storage and sale is stored in the dual-band RFID label,the whole process can be traced back.When users need to purchase new or second-hand auto parts, they can search and distinguish the authenticity of auto parts through the electronic commerce subsystem, evaluate the price of auto parts online, and purchase and enjoy the after-sale service directly in the system.

3. Dual-Band Label for RFID

The designed RFID label contains UHF(ultra high frequency) code and HF(high frequency) code.It can mark and authenticate the circulation status of auto parts by writing two kind of codes to various enterprises in the automotive industry chain.

The purpose for using dual-band is mainly to facilitate the tracing and anti-counterfeiting function during the whole life cycle of auto parts.UHF is suitable for manufacturers,maintenance enterprises,and HF is suitable for auto part distributing enterprises and consumers.The integrated dual frequency has the function of fast and complete system application and whole process tracing.In addition,the dual frequency can provide multiple protection for the anti-counterfeiting of the system.

The key traceability information of RFID label is divided into UHF code (30 bits) and HF code (500 bits or more),collectively named dual-band traceablity codes.The two different codes need to be fused together through circuit design and material fusion to achieve UHF and HF functions in a label.

The system adopts dual-band passive label as electronic ID card.The label has good reading range and anti-collision design.UHF codes of label has advantage of long distance recognition(up to 15 meters distance) and fast data transmission,so it is suitable for identification of mobile vehicles and auto parts.Thus UHF area is used in auto parts manufacturing and logistics process.In the system,limited to the UHF small capacity,we encapsulate the part number and the VIN number of auto into the UHF area.While the HF area storage capacity of dual-band label is large.When datas exchange between label and reader,the label must be located in the near field area of the reader's antenna radiation,Generally the reading distance of the HF label less than 1 meter,and it is less disturbed by the environment.So HF area of label is mainly used in detection, sales, maintenance and resale of auto parts to implement quality tracking and anti-counterfeiting.The parameters are shown in table 1.

Table 1: Two frequency regions parameters

Frequency region	Frequency (Mhz)	Protocol	Recognition distance	Anti-interference	Main areas of use
HF	13.56	ISO15693	<1m	strong	Auto parts testing,sales,maintenance and resale
UHF	935	EPCC1-G2	4m-15m	weak	Auto parts manufacturing,logistics

All kinds of users obtain quality information from the comprehensive information system based on dual-band RFID,analyze the information,and feedback the results to the relevant departments to provide the basis for vehicle tracing,auto claim,recall,etc.

4. Design of Dual-Band Traceability Codes

4.1. UHF traceability code （30 bits)

UHF traceability code=Automobile VIN code （17 bits）+ auto parts number（13 bits）.

The dual-band label in UHF area records the most critical information with only 30 bits just like "ID card number",it is read-only for most users,only a few government users,high-grade users and administrators can modify.

4.2. HF traceability code（500 bits)

The dual-band label in HF area records all attributes of auto parts with high storage capacity,it is widely writable under appropriate authority.HF code is more than 500 bits,including ten parts:status bit,parts category,initial circulation time,qualified bit,certificate number,manufacturer number,repair times,area code,quality inspection table,check code.

The meanings of the HF code are as follows:

- Status bit(1 bit).It includes the availability or invalidation of auto part(Table 2),and so on.The automobile enterprise fixes its status by writing to the RFID label after detection evaluation.

Table 2: Status of auto parts

Code segment	Status of parts	Enterprise with modify authority
0	Out of operation	Automobile maintenance Enterprise,auto parts Recycling Enterprise
1	New parts	Automobile manufacturing enterprise
2	New parts	Auto parts sales enterprise
3	Reuse parts	Automobile maintenance Enterprise,auto parts Recycling Enterprise

- Part category (1 bit).The definition is shown in Table 3.

Table 3: Parts category

Code segment	Auto parts category
0	Engine auto parts
1	Chassis auto parts
2	Car body parts and components
3	Electrical auto parts

- Initial circulation time(8 bit).It is expressed as the year,month and day.According to the service life of the auto part and this parameter,the remaining service life of the auto part can be estimated in advance during the later maintenance.
- Qualified bit(1 bit).It marks whether the auto parts are qualified or no.If not qualified,it marks whether to reuse or can not work anymore after detection.As defined in the Table 4:

Table 4: Qualified state

Code segment	Qualified state
0	Qualified
1	Not qualified and need repaired
2	Unqualified and reinstated to be inspected
3	Not qualified to use

- Certificate number(10 bit).It marks the factory certificate number of auto parts.The auto parts manufacturer adopts the national uniform certificate code format.
- Manufacturer number(9 bit). Auto parts manufacturers use unified organization code issued by the state.
- Repair times(2 bit).It marks the total repairs times of auto parts,up to 99 times.It can evaluate the reuse value and transaction value of auto parts.
- Area code(6 bit).It marks the location where the auto parts are recently traded or made.Defined as table:

Table 5: Area code

G1G2	G3G4	G4G5
Province	City	District town

- Quality inspection table (500 bit).It includes all the status information and backup of auto parts in circulation, which can be traced easily,stores up to 500 digits.

1) Technological process traceability:Including the parts batch number, basic information, station number, installation position, model, part name, installation staff, installation time, installation status, etc.

2) Quality inspection traceability:Including certificate number,warehouse position,inspection point,defect description,rework confirmer,recheck confirmer,final audit confirmer,confirmation time,etc.

3) Logistics traceability:Including car VIN,location,time,etc.

4) Maintenance traceability:Including maintenance stream number,warehouse position,automobile basic information,driving kilometers,damaged parts,failure cause analysis,repair type(repair/replacement),reporting time,reporting department,etc.

5) Sales/secondary sales traceability:Including sales stream number,sales enterprise name,sales customer name,sales times,trade time,sales location,sales staff,whether to resell,etc.

- Check code (1 bit).It is used to check whether the preceding HF code is correct or not and to prevent decoding errors.

5. Summary

Through the key technology of dual-band coding of the comprehensive system,the whole period identification traceability and anti-counterfeiting function of auto parts are designed and solved.Dual-band RFID labels and comprehensive system can greatly improve the current operating conditions of auto part enterprises,eliminate counterfeit auto parts suppliers,and facilitate industry integration.Therefore,it has a good market prospect.It can meet the needs of the government,suppliers of auto parts buyers,distributors of auto parts,and consumers.

By the dual-band label,the system can be used in automobile manufacturing enterprises,auto parts manufacturing enterprises,automobile sales and maintenance enterprises.Anti-counterfeit read-write subsystem and EC traceability & trading subsystem can improve the operation efficiency of auto parts industry.For second-hand auto parts users,this comprehensive system can greatly improve the transparency of auto parts circulation,effectively ensure the quality of auto parts,and effectively protect the rights and interests of consumers.

The further work is to integrate all kinds of offline enterprises of auto parts in circulation channel and strengthen the anti-counterfeiting identification ability of system.

6. Acknowledgments

This work is supported by the funding from the excellent young teachers（Peng Peng）of guangdong university cultivation programme under grant YQ2015213.

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