RFID Network and Its Application in Management of Aviation Maintenance

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Abstract. According to the existing status of civil aviation enterprises' office network, this paper brings up a project to combined RFID and the VPN network which have been provided by the original system, by adding a RFID server. It bases on VPN technology to form a RFID intelligent aviation material management information system, without affecting the function of the original office network. The system is able to locate the material position in the warehouse and improve the level of the management on civil aviation material information.

Introduction

Situations of civil aviation informationization. With the rapid development of Chinese civil aviation industry and the aviation maintenance management, new higher requirements need to be put forward. The increasing airplane Models making the maintenance more complicated, the increasing demand for passenger service and the increasing competition with other companies on airlines exert a higher demand in aircraft maintenance and management. Therefore, it is a fundamental requirement for Chinese civil aviation informationization that airlines use new information technology to improve its management of aircraft maintenance to match itself development.

The development of RFID and Internet of Things. RFID is the advance of the new smart sensor technology and one of the core technologies of Internet of Things whose based framework include of EPC coding standards and information networks. The problems in RFID technology, limit the development of Internet of Things. Firstly, due to the high price of RFID labels, complex logistics species, and the very low single-product value of product, single-product terminal in the logistics applications of RFID technology cannot be solved successfully, limiting the popularity of a wide range of RFID applications to a certain extent. Secondly, having not been applied in large-scale, standardized uniformity, RFID is prevented from further reducing the cost also. Thus, in the logistics field, there has not been large-scale application of RFID as expected. Especially when the worldwide economic crisis broke out, The increasing applications of Internet of Things which takes the RFID as the core technology are becoming slow, but RFID technology, especially ISO18000B / C series using of passive label, having a big reading distance and good prospects, in some realms which are insensitive to label price such as bulk cargo transportation, high-priced goods monitoring, food safety management and other aspects of the application research keeps active. People on the one hand expect that these applications, for RFID technology in all sectors to promote the accumulation of engineering experience, on the other hand hopes to expand the realms of their application to increase the scale of the label market, to reduce labeling costs.

The civil aviation is not sensitive to the label's price since the aviation material is expensive, and aviation safety requires a high standard in Aviation Material management and in maintenance management. Currently, the civil aviation material management and maintenance management become the most dynamic areas of applied research for RFID technology, besides ocean container transportation, ETC (Electronic Toll Collection) and large livestock tracking. This paper will

combine the existing office-based VPN technology information network with the RFID technology, to design a flexible and valuable project of RFID technology.

The range of applications in civil aviation

The aviation maintenance management basically includes the management of the aircraft maintenance tools, materials and maintenance staff.

Aviation materiel management that maintains the continued airworthiness of aviation materials includes sending aviation materials to be repaired and making an inventory of them. In order to achieve the above targets, aviation material management information system usually needs to support inquiring the state of aviation material online and corresponding stock inventory. Usually, the previous system can work automatically, and the follow-up work must to be operated by man. With RFID technology, the system can achieve the automatic inventory of aircraft materials, by scanning and positioning RFID readers which read the label attached to the aviation materials. The ISO18000 series of passive RFID tags has the effective working distance of 6 ~ 7m to meet the needs of stocktaking.

Management of Maintenance tool not only strengthens the asset management, but also ensures the standardization of maintenance work quality of maintenance, since tools' being left in aircraft is also considered a kind of serious accident affecting the flight.

The management of maintenance staff consists of two aspects, one is personnel qualification management, and the other is the security control. Airlines and aviation maintenance department is usually not only one airplane type, and the maintenance of the same airplane type also require more than one task, As consequence, the repairing needs a perfect training and strict certification and licensing. So there must be strict airplane type management and maintenance engineering management systems to ensure the maintenance adheres to the regulations laid down by the producers. The information system on maintenance personnel management, should include personnel information, personnel maintenance qualification information, and can administer the personnel qualification by comparing the information in database with the information of maintenance environment qualifications read by RFID in a non-contact way. In order to ensure the safety of aircraft flying up, aircraft-repairing process needs a strict control of check-in maintenance personnel, which can be realized with the access control system basing on the RFID technology.

RFID is needed to achieve all the function which a management information system should support, so how to implement RFID-based unique technical advantages in a management information system is the key to the design. This article focuses on how to construct an information network and how to realize the maintenance management information system to administer the airplane components and maintenance tools based on the network. Maintenance personnel management system works as this.

The combination between RFID and VPN network

Airlines VPN network is usually shown as Fig1.

With the INTERENET，office network's firewalls and network servers should be set up in every knot between each branch network and public network interface, the communication of the company in various regions through the network is needed the security review of the server proxy and firewall. This process can be achieved through the following functions:

Ensure INTERNET access security between the company headquarters and all branch companies.

Ensure that the company headquarters and overseas business department achieve confidentiality, integrity and availability of the INTERNET data transmission.

Ensure network connectivity and VPN channel stability, high efficiency, convenient maintenance and management.

Ensure the company headquarters and various overseas business department data safe, and the network not being attacked.
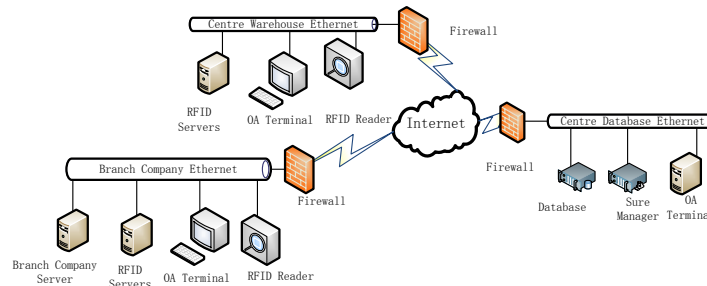
Fig.1.The Airlines RFID servers basing on VPN network structure

Suitable server and firewall settings can ensure the security of data and information, high-speed, stable and real-time transmission. Through the VPN network, aviation company and its divisions achieve real-time information transmission on the ticket information, financial information, personnel information and maintenance.

In order to reduce the expenses of system improvements, the structure of the company's network and the office automation software don't need to be changed, when the RFID equipments are added to. The RFID servers are set up behind the VPN servers to improve aviation Material Management Information System, which as shown in figure2.In this structure, not only the former office automation system still run on it, but also all of the RFID servers can access the central database through the VPN servers.

The principle of RFID servers and RFID information system

In network application, it's important to reduce system complexity and dependencies between the various systems, and the RFID sensors' functions should be supplied and their construct detail should be shielded in order to avoid the locations and type of the sensor or other changes on a small area disturbing the whole system. The RFID servers are set up, which can achieve two functions, one is storing a RFID's map, and the other is supporting the RFID readers' work strategy.

The main function of RFID Map is to map the requirements of access to the RFID devices for the specific RFID terminal. The terminal clients who ask for the access need not to concern which and how RFID sensors provide services for him, and the RFID terminal reader upload the information to the central database and terminal display equipment via RFID servers ,without transmitting their own information to them through the map. The RFID terminal readers' changes won't affect the system, which can keep the stability of the system; and at the same time the readers' changes in the information chain which are independent of the whole information system, it enhance the flexibility of system.

According to the EPC global (Global Centre for Electronic Product Code) and EPC (Electronic Product code) standard requirements, different labels have different EPC codes distributed by EPC global to ensure uniqueness. More than 256 coded bits provide so enormous information capacity and each aircraft materials can be assigned to different codes.

Each RFID server will save a material information map, through which the exclusive serial number of the aircraft material in the database can be related to the unique EPC code stored in the tags, and the EPC tags can be stuck on aircraft materials, and by the correspondences between two unique codes, the material whose EPC code read by the RFID sensors connected to the material data information stored in the database. The uniqueness and the huge capacity of the EPC code ensure ambiguity will not appear in the conversion in the map. The maps are separately maintained by the workers in central database and the local departments. In actual operation, the operation instructions on aviation materiel's procurement, transfer , discard and repairing are usually directly executed by the managers in aviation material department who are issued by the central material department via the office automatic system, and the tasks are performed by the staff of the storage department since all them are in relation with the aircraft material management .Together, in the airline the aviation materiel's updates to central database such as adding, deleting and modifying are usually performed by the staff of aviation material management department ,the operations on the aviation material are

done by the staff of aviation material storage management responsible for the material's being transferred . The changes on the central database will activate the database triggers which automatically update the information to the maps stored in the RFID servers of subsidiary company material .The staff of the storage management department sign for the material, and stick the tags on the material, and then upload the material's information including location, EPC code in the tags and so on to the map which has been automatically updated by database triggers. The data up to the maps need be carefully checked before uploaded to the maps.

The RFID server can be use to execute RFID's information reading strategies. The RFID technology's advantage excelling the traditional bar code technology is that it can relate the RFID tag which sticks to the product to the aviation equipments data map in the database, it make the information of aviation equipments corresponding to their position in the warehouse and RFID's unique non-contact distance reading make it possible to locate the aviation equipments position. It is available to achieve this function if take full advantages of RFID readers combined with some reading strategies . The directive flow diagram of the RFID network is shown as figure2.

RFID reader's location function is easy to achieve because of the shooting at right angles of the RFID communication medium. With the circularly polarized micro strip patch antenna, the RFID devices accord with ISO18000B / C protocol which works in 825-945MHZ has 6m effective identification distance identify within range of 90 ° cone angle area. One dimension of the aviation equipments can be determined by the reader's Scanning. Orientation in space usually requires three dimensions value. In practice, because of the constraints of real space, two cone intersection position determined by the range can reach the desired accuracy, so combining the antenna position, using two RFID reading antenna to scan the warehouse can determine the material position.
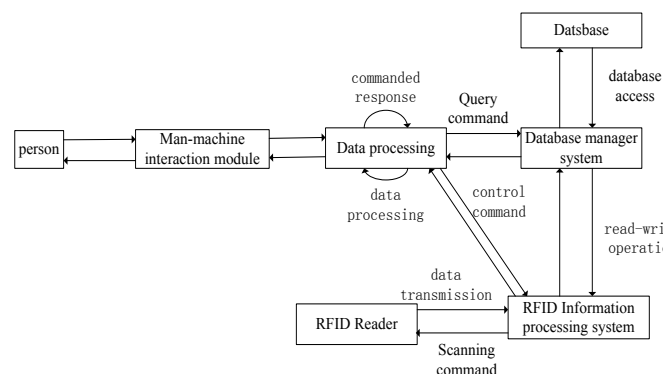

Fig.2 The directive flow diagram of the RFID network

Airlines typically have multiple warehouses located in different locations, and each warehouse environment is differ from the other, so it is difficult for the central server to unified planning inquiry strategy in such an inventory system by the usual technology. In practice, the environment change of warehouses and layout will inevitably lead to the location change of the aviation equipments storage position and a reader antenna, the query strategy requires a corresponding amendment. If the query strategy is stored in the central server, the server's frequent updates inevitably severely affect on the entire company's office automation system. If the query strategy is distributed down to the RFID servers which locate in different filiale, with any changes in storage layout the corresponding query strategy can be amended by the local engineers in charge of the local servers, it not only can reduce the pressure on the main server, but also can provide the flexibility of the RFID information systems.

Conclusion

As a new member of intelligent sensor family, in the future, RFID play an important role in the Internet of Things. Taking full its advantages and combining with the characteristics of the airline VPN network, the new network provides remote inquiry functions without affecting the existing network and the original foundation functions of office information system, and improve the material management and the security maintenance of the civil aviation enterprise information.

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