

Car Engine Storage and Spare Parts Management System Using RFID Technology

Evizal Abdul Kadir, Siti Mariyam Shamsuddin
UTM Big Data Centre, Faculty of Computing
Universiti Teknologi Malaysia, 81310 Johor Malaysia
evizal@gmail.com

Sri Listia Rosa
Fakultas Teknik, Universitas Karimun
Tanjung Balai Karimun, Kepulauan Riau, 29661 Indonesia
srilistia@gmail.com

Abstract - Increasing number of vehicles on the road very significant every year, demanding of spare parts for vehicle is increasing together to the number of cars, thus spare parts to replacing faulty component also high demand. Every workshop need to keep spare parts for replacing breakdown vehicle or some workshop request spare parts to store it. Base on that, a good spare parts management and storage system is required for effective and faster service to the customer. This paper discuss on the use of Radio Frequency Identification (RFID) for car engine storage and spare parts management system using RFID technology, because of its advantages compare to others technology which is no line of sight required and multiple reading. Every spare parts or engine tagging by an RFID tag which is programmed early with unique identity, then store to a central database for stock and inventory system. Testing have been conducted and shows reduce on reading performance because of most spare parts and engine made from metal material thus effected to RFID reading performance. A new technique used for RFID tag before tagging which is make some gap from the engine or spare parts to avoid RFID signal absorb by metal material. The other way is used high gain antenna and RFID reader for faster and powerfull reading. Results shows improvement on reading distance and performance compare to the previous tagging technique and tagging placement.

Keywords: Storage, Management System, RFID, Spare Parts

I. Introduction

The growing of automotive industry has been effected at a strong pace since recovery of world financial after economic crisis in 2008. Sales are started increasing and high demand of vehicles such as car, van, truck, and bus especially to the developing countries. Automobile vendor are busy with the order and some cases delay to delivery to the customer. That's mean, increasing number of vehicles on the road may effect to the demand of spare parts for the usage. Large number of vehicle running everyday may damage and made faulty on the automobile components, some of components may long life and changing only occasionally but many others components need to change regularly. Automobile vendor beside sales and supply vehicle to customer also have supply spare parts or components that regularly changing, suppling of components normally thru retails or dealers that customer easy to get its. Most of vendor

dealing with third party instead direct selling spare parts and components to customer to make convenience.

Additionally, the global automotive industry is estimate to make drastic expansion over the next seven years; research shows that automotive industry rapid growing especially in developing countries and China with huge number of people. Data shows, the global vehicles production will increase by 21 million units to 106 million units per year by 2021 as the automotive industry keep continues to recover from the impact of the global economic recession in previous year [1]. Increasing numbers in production of automobiles industry will trigger of vehicle sales in coming years to help and boost its revenues. Large number of vehicles sales shown strengthen of economic and good economic of the country. Meantime, requirement of spare parts is increasing together with number of sales, vendor are have to arrange automobile spare parts accordingly to avoid of shortage and no stock while request by customer, proper management system will assist vendor and retailer to manage they are stock and inventory. Good management system beside to assist retailer and vendor also to avoid to misplace or missing spare parts then will reduce time and efficiency in management.

This research proposes a new system for automobile management and inventory system, every vehicle engine or spare parts registered in advances before putting up into storage or store rack. Every parts and componenets registered into a central database that management allows checking the stock and balance for more order. RFID technology is use into this tagging and management system, because RFID system is more effective and rights to use compare to others technology. The challenging to use RFID technology into car engine storage and management system is because mostly of the environment is consist of metal such as engine block and other vehicle components thus made interference to the radio frequency. Some techniques are proposing to check reading performance of the RFID tag into the engine block and take some of location then choose the best location of tagging RFID chip. Selection of the RFID reader and antenna also important to make sure reading performance and time is reasonable to perform the task.

II. Literature Review

Several literatures have been reviewed for the previous paper that related to this research, there are authors discussed on this topic such as wrote in [2], a warehouse management system using RFID based on fuzzy. The inventory provides a buffer for the production plants, warehouse management systems (WMS) can assist the warehouse operators in managing the warehouse. As human beings are involved in the operation, mistakes and inconsistency cannot be avoided, a new RFID-based fuzzy storage assignment system (R-FSAS) developed to maximize the efficiency and effectiveness of the put-away process by means of formulating feasible and tailor-made storage plans for products coming into a warehouse. Through using R-FSAS, real-time warehouse operations are monitored by Radio Frequency Identification (RFID) technology, and a hybrid fuzzy association rule engine is adopted to formulate different storage plans. By applying R-FSAS in a manufacturing company, the overall results illustrate that R-FSAS enhances the efficiency of the put-away process in a warehouse.

The purpose of automotive supply chain for a demand driven environment as discussed on [3], this article is to demonstrate the development of a supply chain model for the automotive industry that would respond to changing consumer demand. The principles of lean manufacturing and just-intime (JIT) inventory control that were renowned for helping companies to rise to the top of their respective industries are no longer adequate. The article is only based on theoretical reviews; there is no implementation of an automotive supply chain model for a demand-driven environment. Empirical applications of RFID in the manufacturing environment as elaborated author examines these empirical applications and presents an analysis of the benefits that have been observed in the field. This encompassing collection of six empirical applications of RFID in the manufacturing environment discusses how RFID technology is presently being utilised and its potential for use, by manufacturers to control internal operations and for supply chain management [4]. In the [5] discussed on the supply chain using RFID technology for help employment to manage operation and inventory also identification of product.

Engineering management solutions based on Radio Frequency Identification (RFID) model in comparison to the well known and widely used UPC bar codes, which offer generic object-level visibility, RFID tags, also referred to as the Electronic Product Codes (EPCs). Because of UPC codes are typically product and manufacturer specific, whereas RFID codes are generic, truly unique IDs. This RFID technologies with the appropriate information systems and information technology (IS/IT) infrastructure help both major distributors and manufacturers, as well as other logistics operations, such as the electronic manufacturing industries, defense industries, automotive, pharmaceutical industries, and others, dealing with complex, global supply chains in which products and product manufacture, assembly and shipments must be traced and

identified in a non-contact, wireless fashion [6]. The optimization and application of process model for spare parts management information system as elaborated in [7], the increasing financial pressure, the inadequate resources as well as the inefficient maintenance all become long-term problems which reduce the development of current industry. As an emerging field, process of spare parts management lacks in standardization and rational design. A process model of spare parts management proposed based on the analysis of status quo of domestic and foreign research. Then the preliminary model will be further optimized based on the role-driven concept.

The above articles and papers as prented by previous author is freat usefull to accommodate RFID technology in warehouse, supply chian, and inventory and logistics management system. RFID technology is applicable to overcome of some issues in logistic operation but never paper discuseed to the engine and vehicle spare parts management system, because of vehicle components is mostly made from metal material thus a challenging to the RFID technology especially in reading performance, in this propose paper elaborated more the issues and results to the testing have done into warehouse management system for the vehicle spare parts.

III. RFID Technology in Storage Management System

Warehouse storage management system conventionaly is used manual record by log book or manual tagging on the items, this system leak of technology then effected to the efficiency and productivity to the user or customer. Thus, a technology is adopted in the warehouse management system in efficiency to the management, technology used is RFID with electronic tag that enable store some information electronically to the computer. The use of Electronic Product Code promises to become the standard for global RFID usage, EPC global is now leading the development of industry driven standards for the Electronic Product Code (EPC) network to support the use of Radio Frequency Identification (RFID) in today's fast moving, information rich trading networks. EPC global is a member driven organization comprised of leading firms and industries focused on creating global standards for the EPC global Network. The EPC global Network is a set of technologies that enable immediate, automatic identification and sharing of information on items in the supply chain. In that way, the EPC global Network will make organizations more effective by enabling true visibility of information about items in the supply chain [8]. Figure 1 shows an example of engine storage system and labeled by yellow tag for the identification.

RFID is a technology used in this storage management system because of the advantages, once components or spare parts tagged by RFID electronic tag then monitoring and identification can be done and also parts inventory very possible doing in minimum of time. The process of the storage management system start by tagging components or spare parts,

normally tagging is done when components arriving from vendor. Keeping in specific rack and sheft of location for easy to find, every location of sheft and rack identify by using RFID tag that labeled in front of rack. Person in charge of staff when keeping the components will scan the product location and items tagging for updating stock in the system, as well as when withdraw the items have to scan and update to system either location and items tagging. Scanning system used mobile handheld RFID reader then updates via wireless network to the system.

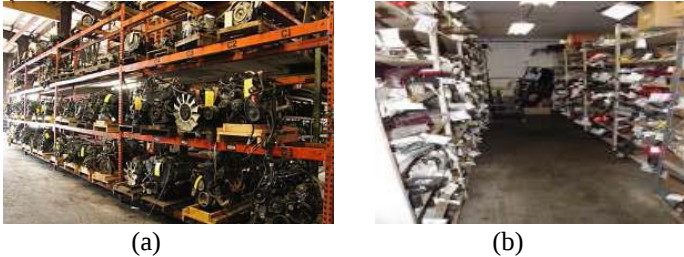


Figure 1. An example of warehouse storage (a) engine block (b) spare parts

3.1 Spare Parts Tagging and Registration

Every components and spare parts received from vendor must be label using RFID tag that programmed with identity and components description. Arrangement in the rack is according to the sheft that labeling in advance, location tagging used especial tag that has some gap to avoid effect of matelic material apply in this system. On the physical of tag as labeling also available manual identification wire on the tag packing, this info can be use manual serial number as backup beside electronics embedeed inside the chip. Label shows information such as parts name / type that can be write and company name or information. Beside tah manual identification is backup plan, if sometime system is has problem that can not be read, then manual record still available while waiting electronic system is available, Any components and spare parts is updated into database for incase of others users is request for buying or loan. Registration process of components start by key in part number and model for new components that not in database list, if the components has been registered in database then the process updating stock is required to keep balance of company inventory. Figure 2 shows a block diagram how an RFID tag registering on desktop reader then by computer system to update the number of stock and update to the last process keeping in a central database.



Figure 2. Registration process of components/spare parts

3.2 Spare Parts Identification

Witdrawing of components or spare parts happen when cumtomer or buyer requesting and the process is start by checking the stock as in database thru personal computer then if request number in the stock, person in-charge taking the items and update the stock by scan RFID tag label. Handheld RFID reader were used for update the stock for more convenience while high mobility in such big storage area, the other way updating also can be done infront of counter using desktop reader but some case because of many number of customer requested with the same items then updating process quite slow cause stock update is not in real-time, this case maybe the next customer is getting wrong number of stock in the warehouse because of updating process not in real-time. The challenging in items or components identidication is for the big size of items especially engine block because of the material mostly made from metallic then reading performance of RFID is affected and reduced. The other issue is because of power RFID handheld reader normally lower and limited reading distance in normal environment. Some techniques is proposed to overcome this issues such as placement of RFID tag on engine block in right position and location, used good RFID tag for labeling and packing of tag with the material / enclosed does not effected to much to the reading performance. Figure 3 shows how a testing conducted by placement of RFID tag at several locations and positions then checks the best reading performance by using handheld mobile reader.

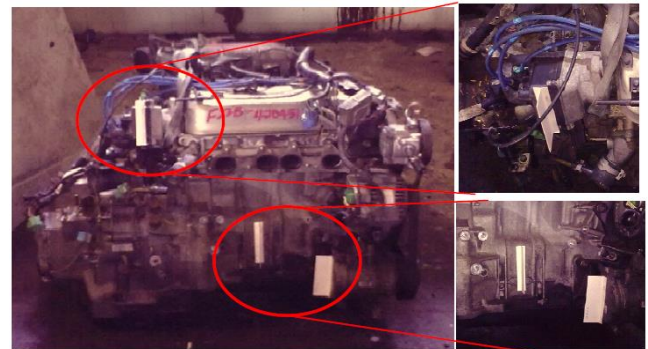


Figure 3. RFID tagging on the engine block

3.3 Inventory System

Normally every company or retailer store is doing inventory of spare parts or items in the house to know how many assets are keeping for auditing or next order. Inventory done in regular time sush as monthly, quarterly or yearly depending on company regulation and management system. Because of so many numbers of company components and items, in conventional way may take time to do it thus by using RFID management system that every items was tagged by RFID tag then inventory can be done in short of time. Figure 4 shows example of inventory at warehouse is done using handheld RFID reader.



Figure 4. How inventory of stock in warehouse is done using handheld reader

Beside inventory of components or items in the store for company stock, company asset also can be done used this system as long every asset is tagging by RFID tag application [9]. Using mobile RFID handheld is very easy and saving time to do an inventory instead of cheking for record at every item manually, by using handheld just scanning to the items then current stock is updated to the system.

IV. Conclusion

A system for car engine storage and spare parts management system using RFID technology has been proposed and discussed. This system will assist management to improve efficiency and productivity of manpower instead using manual record to check stock and doing an inventory. RFID technology is used in this system but during testing some issues is facing cause of the environment is mostly metal that effected to RFID reading performance. Some techniques are proposed on the tagging location and placement for better reading while RFID reader scan or capture the information. Selection of RFID tag and packaging material also take attention in this system because effected to the performance in overall, although major issues is on the tag placement and reader performance but any minor issues is take concern to achieve good performance of system. Proposed system will hepful management and staff in company operation especially for spare parts retailed to check stock, inventory and withdrawing process including company asset inventory. In a central database all items and asset recorded then management able to check in the spot by access application software.

REFERENCES

- [1] Benhadj, M., The global automotive market. Economic Outlook, Economic Research Euler Hermes Group, September 2014(1210): p. 1-24.
- [2] Ho, G.T.S., K.L. Choy, and T.C. Poon. Providing decision support functionality in warehouse management using the RFID-based fuzzy association rule mining approach. in Supply Chain Management and Information Systems (SCMIS), 2010 8th International Conference on. 2010.

- [3] Intaher M. Ambe, J.A.B.W., An Automotive Supply Chain Model for A Demand-Driven Environment. Journal of Transport and Supply Chain Management, November 2011.
- [4] John K. Visich, J.T.P., and Christopher J. Roethlein, Empirical Applications of RFID in The Manufacturing Environment. Int. J. Radio Frequency Identification Technology and Applications, 2009: p. 115-132.
- [5] Evizal Abdul Kadir, S.M.S., Eko Supriyanto, Wahyudi Sutopo, Sri Listia Rosa, Food Traceability in Supply Chain Based on EPCIS Standard and RFID Technology. TELKOMNIKA Indonesian Journal of Electrical Engineering, January 2015. vol.13(1): p. 187-194.
- [6] RANKY, P.G., Engineering Management-Focused Radio Frequency Identification (RFID) Model Solutions. IEEE Engineering Management Review, 2007. vol.35(2).
- [7] Gong, P. and F. Liu. The Optimization and Application of Process Model for Spare Parts Management Information System. in Information Management, Innovation Management and Industrial Engineering, 2009 International Conference on. 2009.
- [8] Evizal Evizal, T.A.R., Sharul Kamal Abdul Rahim, Sri Listia Rosa, Development of RFID EPC Gen2 Tag for Multi Access Control System. International Journal of Electrical and Computer Engineering (IJECE) December 2013. vol.3(6): p. 724-731.
- [9] Evizal, T.A.R., Sharul Kamal Abdul Rahim, Active RFID Technology for Asset Tracking and Management System. TELKOMNIKA, March, 2013. Vol. 11(No.1): p. 137-146.