Application of RFID Technology for Enhancing an Inventory Management System

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ABSTRACT

The objective of this study is to produce enhanced inventory management system rather than traditional inventory management systems for an enterprise. The RFID technology may be used for enhancing the traditional inventory management system for this RFID technology will be mapped to the identified inventory management functionalities. The study will look at the architecture of a system that fully integrates the technical advantages of Radio Frequency Identification (RFID), for identifying stock levels on shelves, loss prevention and as an enabler for locating misplaced stock, anti-counterfeiting of stock, achieve JIT inventory etc.

Keywords:RFID Technology, Inventory Management

INTRODUCTION

Inventory management is an importantactivity in almost all the business firm in the modern industrial world. Inventory management is responsible for the successful growth and survival of any business. Sales reduction and loss of revenue may be generated due topoor inventory management which may be one of the cause of failure of a business. In the real world, most of the company seems to have improper inventory management. Some problems likeproduct misplacement, spurious products and the replenishment of stock on shelves are faced by most of the business firm. It is estimated that 30% of the stock will affect 5% to 18% of retail sales(Xin 2009). The application of RFID has proven to be the most advanced technology to improve inventory management for most businesses, such as Wal-Mart stores.RFID technology can help to read products in real time eliminate counterfeiting, inventory replenishment and product dislocation, without manual intervention. Information is immediately sent directly to the backend system for immediate or later retrieval in order to make appropriate decisions on the Inventory manager (Chen et.al 2009). The use of radio wave technology has developed into a relatively new application called radio frequency recognition (RFID). RFID technology consists of two basic hardware components, a reader and a tag. The tag transmissions are carried out over RF waves that are activated when placed in the transmission field of a reader. The data embedded in a tag can provide a wealth of information about an item and its current status. Two common uses of RFID technology are to show about a product or good location (manufacturing, inventory, in-transit, etc.) and product identification (price, serial number, store ID, antitheft protection).

II. THEORETICAL BACKGROUND

RFID promote the communication among different objects without any human intervention. Traditionally, operations in warehouse management are processed manually, with information gathered by manually and captured through keyboards, voice entry or barcodes and integration through human-machine-interface. The introduction RFID involving sensors & actuators changed the laborious processing of warehouse operations. Data entry is now automated, which results in accurate information gathering and thus informed decisions can be made by inventory managers. RFID consist of tags which are attached to an object, with each tag can contain product information such as the expiry date; object pressure, temperature, prices etc. Sensors may optionally also be embedded within the tagged object Readers access data from the tags in a code form (de Saint- Exupery, 2009). The RFID technology was developed during World War II as a method to assist

aircraft to identify fellow aircraft and commanders on the ground. RFID tags are divided into two general types, active and passive, depending on their supply of electrical power. Active RFID tags contain of their own power source, normally an on-board battery. Passive RFID tags get power from the signal of an external reader. RFID readers also come in active and passive varieties; depending on the kind of tag they read (Intermec Technologies, 2007). Active tags contain their own power source. They send out a stronger signal, and readers can access them from further away. The on-board power source makes them big and costly, and thus active RFID systems normally work well on big objects tracked over lengthy distances. Low-power active tags are generally a little larger than a deck of playing cards. Active tags can stay inactive until they come in range of a receiver or can continuously transmit a signal. As a result of their on-board power source, they can function at higher frequencies, normally 455 MHz, 2.45 GHz, or 5.8 GHz, relying on the application's read reach and memory needs. Readers can converse with active RFID tags across 20 to 100 meters (Intermec Technologies, 2007). Passive tags are very economical and new technologies are continuously manufacturing them on a low-price for integration into general materials and products. At present, passive RFID tags contain about 2 Kbits of memory which is quite small to hold much more complex information than identification and history information. RFID technology is continuously improving. Consequently, the amount of information and capabilities of RFID tags will increase over time, thereby allowing RFID tags to ultimately hold and transmit enough information (Weinstein, 2005). Passive-tag readers can continuously transmit its signal or transmit it when required. Once a tag moves across the reader's range, it accepts an electromagnetic signal from the reader through the tag's antenna. The tag then keeps the energy from the signal in an on-board capacitor. This process is called inductive coupling. Once the capacitor has made sufficient charge, it can be able to power the RFID tag's circuitry, which transmits a modulated signal to the reader. The return signal consists of information stored in the tag. Low frequency tags, less than 100 MHz, send information by releasing energy from the capacitor to the tag coils in altering strengths over time, which affects the radio frequency produced by the tag. The reader perceives these varying waves and can use these variances to demodulate the code (Weinstein, 2005). Higher frequency tags, greater than 100 MHz, the tag transmits the signal by means of backscatter, in which the tag's circuit adjust the resistance of the tag's antenna. This change in resistance makes a transmission of Radio Frequency waves, which the reader can accept and demodulate. Passive tags usually work at frequencies of 128 KHz, 13.6 MHz, 915 MHz, or 2.45 GHz, and have read ranges of only few inches to 30 feet. Frequency selection depends on the system's environment, kind of material the signal have to pass through , and the system's essential read range. RFID tags can be enclosed in numerous materials. Plastics are the most familiar material for RFID, making identification cards for building entrance, credit cards, or bus fares (Weinstein, 2005 and Intermec Technologies, 2007).

III. ADVANTAGES OF RFID TECHNOLOGY

Incorporation of RFID in the supply chain can reduce the labor required to monitor goodsmovement and inventory flow. RFID used in conjunction with a bar-code system or a standalone inventory tracking application can allow manufacturers and retailers to complement existing systems while gathering more information from the supply chain. Systems with the power to update individual product information can provide complete supply chain visibility without the prohibitive labor costs and error rates of a more traditional manual system. RFID can help an enterprise to achieve the JIT inventory; RFID can serve as a security guard at a gate or entrance way. As the shipment moves from the dock to truck for storage, RFID can conduct automatic inventories and compare the goods with manifests. The flow of goods becomes more efficient, stock-outs are reduced, overages are curtailed and accounting discrepancies are removed.

IV. PROBLEM STATEMENT

It is vital that inventory management systems allow managers to receive real time information on inventory. The traditional inventory technology provides the resolution on inventory concerning the products available on shelves, when some products are misplaced, expired, damaged etc. But the traditional technology alone is

not complete since it does not have the feature that will update the inventory managers on what is happening on their inventories using advanced technologies like RFID. Supply chain activities involve processes where goods must be tracked from docks and warehouses to trucks and retail centers. Incorporating RFID technology into logistics and supply chain operations promises to reduce labor costs and improve the overall efficiency of inventory management. This type of RFID usage provides managers with the ability to monitor inventory levels in real- time. As goods move through the supply chain, RFID readers can automatically monitor and record this information. As a result, movement of inventory quickens and shortages and accounting errors are reduced. RFID will assist management to accurately make informed decisions, anywhere anytime and save time and cost used for labor and thus working on inventory management properly, business enterprises can make accurate analysis on which product are top sellers and which are slow movers. As a result this study proposes to take advantage of the RFID tools in the management of inventory. The collaboration of RFID to the existing inventory technology can bridge the digital divide between inventory managers and inventory processes in the enterprise and improve inventory management.

V. IMPROVED SOLUTION APPROACHES FOR INVENTORY MANAGEMENT:

In this section an improved solution approach is discussedfor inventory management. Integration of RFID to the traditional inventory management will help in loss prevention and as an enabler for locating misplaced stock, ant counterfeiting of stock, and availability of stock on shelves. In this architecture, RFID serves as a replacement for the bar code scanners which are normally used to track products and shipments in similar ways (Smith 2000). This architecture fully integrates the technical advantages of RFID to provide feedback on the process to the inventory manager. RFID system consists of three fundamental components. Initially, the RFID tag is attached to a product in the inventory. The tag contains information about the particular inventory or product and also may include sensors. The next component is the RFID reader, which communicates with the RFID tags. The last component is the backend system, which links the RFID readers to a centralized database or server. The centralized database will store all the information of the products, such as price, for each RFID tagged item. In this proposed architecture for inventory management, the passive tags will be used due to their low cost. Among the functionalities expected to be performed by this system includes:

- Checking the availability of stock on shelves:
- Identifying misplaced stock on shelves.
- Identifying expired stock.
- Identifying counterfeit products.
- Sending updates to the inventory manager.
- Support JIT Inventory
- Visibility of inventory throughout the supply Chain
- Perform the inventory functions with less manual intervention

The Electronic Product Code (EPC) is a unique global identifier of each product in RFID technologies which is used to track and trace products (Yan 2008). The EPC RFID readers will be placed among the shelves and the products will be programmed with EPC RFID enabled tags. EPC RFID tags will send out the signal which will be received by the EPC RFID readers in the radio frequency field. The readers will receive the signal through their antennas and transmit the stored information, i.e. Validation, tracking, counts, and error messages to the EPC middleware. The EPC middleware will filter out the repeating and irrelevant information. Thereafter, information will be sent to the local server. The local server computer system will pass on the information to the inventory manager i.e. reports on inventory, aggregate counts, errors occurred, misplaced stock etc. The end user or owner will receive the notification on inventory through his/her desktop. This system gives effective technical reference for enterprise managers to monitor whole process of inventory without them being physically involved in the process. The consumers of the products will benefit also in this proposed architecture. They can query information about the product on the remote server using the EPC

(Electronic Product Code); the ONS (Object Naming Service) is network system which works similar to the DNS (Domain Name Service).It spots out servers storing information in the internet.

VI. CONCLUDING REMARKS

RFID technology is very much helpful for and enterprise owners in better management ofthe inventory in any business firm. By using RFID technology in inventory management will help them in monitoring the stock validity, stock on shelves, misplaced stock etc. RFID could play a major role in keeping enterprise owners posted about what is happening on the inventory without them being physically there and helping them to make informed decisions, and to know urgent matters which may need their attention immediately. RFID tools bridge that divide of objects and humans. As a result, this study encourages inventory managers to actively promote the development procedures of the RFID technology to improve the inventory management in their enterprises. Today the RFID technology is applied to many fields and it outperforms traditional technologies such as barcodes in several aspects; nevertheless, its implementation cost still daunts most of participants in a supply chain. In the transition stage, we need to bridge the gap between the new technology and the existent ones. By doing so, the substitution for existing technologies can thus go more smoothly. The momentum behind RFID technology is growing rapidly. As businesses begin to fully understand the benefits and efficiencies created by RFID, and as standards are solidified, it seems that the technology will become increasingly ubiquitous within numerous industries. By integrating RFID with the existing systems, businesses will have more abilities to access real-time product and location data and to leverage the value created within their supply chains.

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