Research Paper

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A Survey of the Various Techniques Used in the Warehouse Tracking and Management

Engineering

KEYWORDS : Autonomous Mobile Robots, Reader, RFID, Barcode and Path Planning

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ABSTRACT

Navigation and Tracking of packages / bundles in a complex warehouse environment is a complicated issue and a big challenge. Number of efficient techniques and algorithms were developed by researchers for warehouse management and tracking. This paper presents an overview of the path planning and tracking techniques developed for warehouse of different industries. The main aim of this paper is to review the available warehouse management techniques aimed at generating the shortest path and to conclude with describing the most optimal technique satisfying all necessary criteria.

I. INTRODUCTION

Warehouse is key section of any industry and it involves timely delivery and business planning. Most of the Industries are struggling to deliver goods in time due to improper warehouse management systems. Sometimes the same item which is already manufactured is repeated due to misplacement and untraceable situation. Here we are aiming to survey issues and possible solutions in the warehouse industry. Most of the industries use internet and automated systems to solve the warehouse issues. Previously Manual warehouses were used with huge manpower then it was replaced by Barcodes enabled automated system. In the manual warehouse, trained manpower is needed to maintain the records. But it is very tough to identify misplaced items.

Barcodes are next generation automated systems and here barcodes are attached to the goods and parcels to identify but it is also causes severe issues due to line of sight visibility and wear and tear problems. Here also we need skilled manpower to trace parcels. RFID technology is the latest and giving optimum solution to these issues with durability. Handling of goods and transporting form production units to particular spots in a warehouse is an important task of warehouse management. For such operations conveyors, cranes, truck forklifts etc are used. In most cases forklifts are preferred to transport items since it is more flexible. But here the problem is navigating the vehicle, in manual navigation driver may decide an alternate route and it may lead to misplacement errors. So, automated navigation system is mandatory in warehouse management systems. Various types of warehouse automated systems are discussed here.

2. Warehouse

Warehouse management systems often utilize automatic identification and data capture technology, such as barcode scanners, mobile computers, wireless LANs to efficiently monitor the flow of products. Once Data has been collected; there is either batch synchronization, or a real-time wireless transmission to a central database. The database can then provide useful reports about the status of goods in the warehouse. Warehouse design and process design within the warehouse is also part of warehouse management. Warehouse management is an aspect of logistics and supply chain management. Here the existing system is a barcode system which is used for identifying the products and optimizing the stock movements inside the warehouse. It is a method to consolidate repairs coming back into larger shipments. It handles returns and avoids margin erosion due to the cost of return. It is designed specifically to help manage returns. A business analyst can evaluate your internal processes to make sure that the return process is mapped out and addressed in any technology implementation.

3. Barcode in Warehouse System

Barcode is a mature automatic identification (auto-ID) technology that has been used in supply chain management (SCM) for several decades. It is shown in figure1 below. Such has been the domination of the auto-ID technique that it has pervaded all facets of SCM, from item-level identification to transportation applications. It has enjoyed free reign especially in the retail sector. The primary method of data collection involved document analysis. Given that barcode is a well-established technology there were many company case studies from differing vertical sectors available online. It continues by giving evidence as to the maturation of barcode from proprietary to open standards, i.e. its institutionalization into the marketplace. Thereafter a discussion on its organizational advantages and disadvantages is provided, ending with its economic factors which have made the technology affordable by even the smallest of merchants (1).

Two semi-structured interviews were also used to supplement and further validate the findings of the document analysis. Participant 1 is an employee of a leading barcode supplier, and Participant 2 is an end-user of barcode in one of the world's largest oil refineries. This paper is both descriptive and interpretive. As barcodes require line of sight technology, products must have barcode labels that are clearly visible to make scanning easy. This leads to an inherent hindrance as barcodes are susceptible to damage. To prevent damage, barcodes must be relatively clean, be handled gently in abrasion free environments, and not be exposed to extreme temperatures and harsh surroundings.

This can pose a significant problem throughout the supply chain, where goods are often handled roughly and exposed to damaging environments. Barcode readers must also have clean and clear optics to achieve effective scan rates. Harsh environmental conditions such as fog, dirt and rain are considered to be the *downfall* of traditional barcodes (1, 12). Participant 1 outlined a common environment consideration when they stated that many manufacturers and distribution centers run continuously. As barcodes rely on reflective light for reading, sunshine can often tamper barcode scanner read rates and reliability when it is directed at barcode labels.

Hau Lee, a professor at Stanford's business school thinks that when it comes to barcodes and inventory management, —Wal-Mart is certainly the champion. Enhanced inventory management practices throughout their supply chain has allowed Wal-Mart to keep both costs and prices down by using barcode systems, which benefits both the company and the consumer.

Wal-Mart stores use wireless scanners, allowing staff to make price changes, place orders and view sales histories of products. This in turn means that stores can be flexible, adjusting prices on a popular item which is a crucial capability for a worldwide supply chain. This ensures that companies do not run out of stock for a particular item, as systems can alert staff when spe-

cific product quantities are running low. Australian retailer, David Jones, uses a similar system that allows staff to use wireless barcode scanners.

Zebra Technologies note that for companies with millions of parts to identify locate and move in and out of inventory, barcoding is essential. Warehouse management systems (WMS) linked with barcode systems can help route workers directly to optimize put-away locations depending on a good's shelf-life, size and predicted consumption schedule. This system has many issues such as direct line of contact, less security, labor intensive and easily forged. To overcome these issues, we go for RFID system (13).

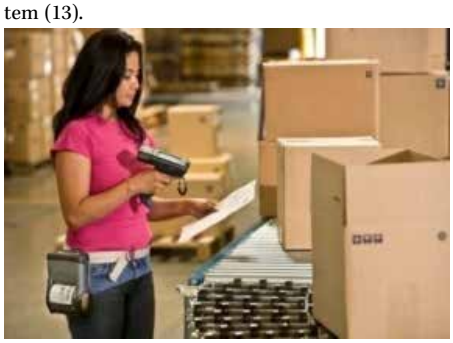

Figure.1

4. RFID in Warehouse

However, recently radiofrequency identification (RFID) has been considered a rival technology, more superior in terms of its power to store and update information instantaneously, and non-line of sight ability to be read. Yet RFID is more costly and for the present barcode is still the most widely used and accepted standard worldwide. It is shown in figure2 below. This paper makes use of document analysis and reviews as sources to support the premise that while RFID may be looming, the need for barcode in the supply chain will never really disappear. It is being observed rather is a pattern of convergence, suggesting a need for both technologies to be integrated into the supply chain, each serving toward a common goal (1,19). RFID technology is an emerging technology that has been widely adopted in different environments, such as manufacturing, warehousing, retailing, etc., for object identification. RFID uses a small tag containing an integrated circuit chip and an antenna, which has the ability to respond to radio waves transmitted from the RFID reader. It is able to send, process, and store information (1,2,3).

This technology has been widely adopted in different business operations to identify, locate and track people, animals or assets (4,5). Although it is much more expensive than bar-code technology, enterprises are willing to adopt such techniques so as to improve the accuracy of data capture (6,7,8). By using the RFID technology, the feature of automated data capture is established. Two identical passive low frequency RFID tags are used in warehouse management wirelessly. In particular one identical tag is placed in the parcel and the other patched on the floor in the destination place. When the RFID reader reads the tag information the address of the destination tag is displayed. Now the parcel moved to the destination address and if it is placed in the correct position, it displays correctly placed. However, the mechanism that coordinates the resource management process of analyzing information, decision support, and knowledge sharing is still neglected. This highlights the need to adopt artificial intelligence (AI) techniques integrated with RFID technology to support the management of warehouse processes. In this research, the case based reasoning (CBR) technique is adopted as this is one of the well-known AI techniques for the development of decision support systems.

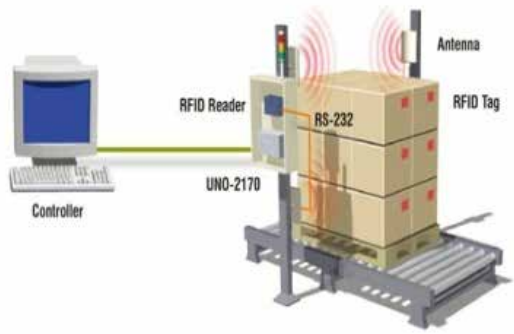

Figure.2

4.1. RFID Case Based Logistics Resource Management System

In the supply chain, a warehouse is an essential component for linking the partners, dealers and distributors. It is necessary to allocate warehouse resources efficiently and effectively to enhance the productivity and reduce the operation costs of the warehouse. Therefore, warehouse management systems (WMSs) have been developed for handling warehouse resources and monitoring warehouse operations. However, it is difficult to update daily operations of inventory level, locations of forklifts (10) and stock keeping units (SKUs) in real-time by using the barcode-based or manual-based warehouse management systems. In this paper, RFID technology is adopted to facilitate the collection and sharing of data in a warehouse. Tests are performed for evaluating the reading performance of both the active and passive RFID apparatus. With the help of the testing results, the efficient radio frequency cover ranges of the readers are examined for formulating a radio frequency identification case-based logistics resource management system (10).

4.2. RFID based WMS with 3D Modeling

The RFID technology is complex, combining a number of different computing and communications technologies to achieve desired objectives in an Industry. Peter Kolarovszki and Vladimír Dúbravka proposed a model with the simulation of production line and warehouse management based on RFID technology, through 3D modeling and animation (11). It describes the various components of a RFID lab (a laboratory for the automatic identification of goods and services), which consist of a production line and a warehouse management system based on RFID technology. Here they characterized and described the processes which are take place in the laboratory as well as the technologies which are used. It sets up and describes 3D models and animations created to capture the whole process in the laboratory.

4.3. RFID –FSAS (Fuzzy storage assignment system)

Warehouse management plays an important role in every manufacturing company. The inventory provides a buffer for the production plants. The Put-away process is one of the key activities in warehouse operations and has a significant impact on the overall performance of the warehouse. The put-away operation, if done effectively by the warehouse operators, helps the production plant to run smoothly. Warehouse management systems (WMS) can assist the warehouse operators in managing the warehouse. However, the current WMS cannot fulfill the individual warehouse objectives. Due to this drawback, warehouse operators have to rely solely on their knowledge and experience when doing the put-away process. As human beings are involved in the operation, mistakes and inconsistency cannot be avoided. Hence, as described in this paper, a RFID-based fuzzy storage assignment system (R-FSAS) has been developed to maximize

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the efficiency (12) 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 (12).

4.4. RFID based WMS for TPL (Ihird-party logistics)

Using the value chain model and a longitudinal real-world case study of a third-party logistics (13) supply chain, this study provides support for the enabling role of RFID technology in effecting warehouse process optimization. Furthermore, the findings of our study reveal the RFID technology implementation costs as the key inhibitors factor of RFID widespread adoption and usage among suppliers.

5. Conclusion

In warehouse environments manual systems, Barcode and RFID systems were used to automate process. The manual process is conventional method and time delay is very high in this method. Barcode and RFID are alternative solution to this issue. Barcode systems are cheaper but it is still having problems in tracking of items due to misplacing. The reviews of various systems were done and RFID gives comparatively good solution in warehouse management.

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