AUTOMATIC IDENTIFICATION OF ITEMS IN WAREHOUSE MANAGEMENT

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Abstract: Automatic identification of items saves time and is beneficial in various areas, including warehouse management. Identification can be done by many technologies, but RFID technology seems to be one of the smartest solutions. This article deals with testing and possible use of RFID technology in warehouse management. All results and measurement outcomes are documented in form of graphs followed by comprehensive analysis.

Keywords: RFID, UHF, testing, warehouse, management.

1. Introduction

RFID (Radio Frequency Identification) technology can be expressed in the most universal manner as wireless identification method, which doesn't need the line-of-sight to be read or written. It improves communication capabilities of electronic information to be associated with physical items. RFID technology can be basically used in all applications that previously used a bar code or label. The RFID tags are primordially used for identification purposes, such as for employee id/access badges to monitor everyone's whereabouts and credit card account identification or management of items in production. The advantage of RFID tags is that they are small in size, and can contain more information than a bar code, which is limited to a single sequence of numbers. On the other hand RFID and barcode technology complement each other because both of them are beneficial in different situations and can be used together in many applications.
RFID devices can be divided into two classes, active and passive. Active tags require a power source, usually a small battery. Passive RFID relies on RF energy transferred from the reader to the tag to generate its own quick response. A passive tag consists of three parts: an antenna, a semiconductor chip attached to the antenna, and some form of encapsulation. The main difference between bar code and RFID technologies as stated by Want [3.] is that RFID tags support a larger set of unique IDs than bar codes and can incorporate additional data such as manufacturer, product type, and even measure environmental factors such as temperature. Moreover, RFID systems are able to perceive many different tags located in the same area without human assistance.
This paper deals with setup, testing and deploying of portal solution for inbound and outbound automatic warehouse item identification under real industrial conditions.

2. Identification by use of RFID technology

RFID technology term represents wide area of hardware and software components. For the purposes of automatic identification of items in warehouse management, the following RFID equipment was selected as the most suitable for testing purposes:

- UHF Reader – Alien ALR-8800 (866 MHz)
- Alien ALL-9540-02 passive tag (called also world tag because it can operate from 860 MHz to 960 MHz)
- Alien RFID gateway application
- Custom software developed by Laboratory of identification technologies in manufacturing

Verification of suitable tag position was carried out in under real conditions in company producing plastic components. Based on the company's demands, the RFID implementation was intended to be involved in the modernization of their warehouse management and, especially with focus to real-time data collection to the warehouse information system. This meant to begin implementation process by mapping all information flows and specific material handling conditions in the warehouse.
Initial state of the warehouse organizing and management can be described as following. After receiving of raw material, which is mainly in the form of granulates, items are stored and manually registered into warehouse information system. Each type of granulate has its unique code, which is subsequently used for raw material (item) identification. Releasing of items into buffer stock is organized by FIFO. Overall, warehouse contains around 60 to 70 kinds of material items. Buffer stock is planned to be sufficient for 24 hours. The requirement to know actual warehouse state is related to optimization of warehouse stock in order to decrease financial sources lock-up.
As output items from production are labelled by barcode, company managers preferred solution based on this technology. Due to the fact of mentioned disadvantages of barcodes, we decided to verify for automation purpose UHF RFID technology.
The verification and testing was performed by use of portal solution. The layout of testing equipment is shown on the Figure 1. Possible surrounding sources of other electromagnetic fields have been checked by electromagnetic field meter and no sources that could interference the reader have been found. As it can be seen from the Figure 1. reader is in this case directly connected to the computer through telnet-command Alien RFID Gateway software and to the portal antennas by two wires. Both antennas were attached to the portal, one 0,7m above the floor, other 2m above the floor.

Figure 1. Layout of testing equipment (Alien ALR-8800)

The Alien RFID gateway application provided us information regarding tag unique identification number, its direction, velocity and distance from the reader.
RFID reader was set to read the tags every second and was connected wirelessly to the computer with RFID communication software. In order to verify interrogation zones, items on the pallet have been labelled and moved through all possible critical positions. This included both edges of the entrance, lower and upper side of the warehouse entrance. For carrying of the items, pallet truck instead of forklift was used (see Figure 2.). Information such as direction and velocity of the tags moving through the warehouse entrance has been recorded into the log file. Pallet truck was moved for six minutes into and out of the warehouse (as illustrated on the Figure 2.) to simulate material flow. During this period the reader recorded total 686 events. Another 2803 reads have been made in the lower edges of the entrance and 837 reads in the upper side of the warehouse entrance.

Figure 2. Testing of direction identification (illustration)

As it can be seen from the fragment of recorded data shown on the graphs (Figures 3. and 4.), tags, even if positioned not far from each other, have different measured velocity, which was depended on the distance of the tags from the reader's antenna. Anti-collision algorithm also played its role in these results, because tags are not read at once, but one by one. But after all, the direction of tag movement was recognized correctly ((+) represents inbound items and (–) outbound items). Accordingly, information about the tag movement direction can be beneficially used for real-time automatic data entry, which reflects real material flow into and out of the warehouse.

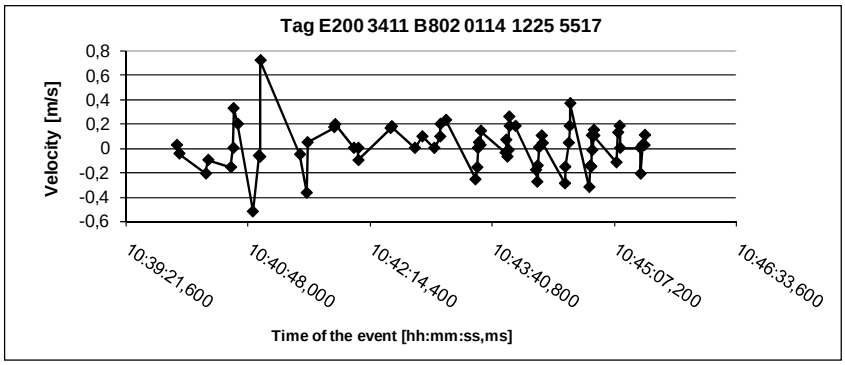

Figure 3. Graph of E200 3411 B802 0114 1225 5517 tag readings and velocity

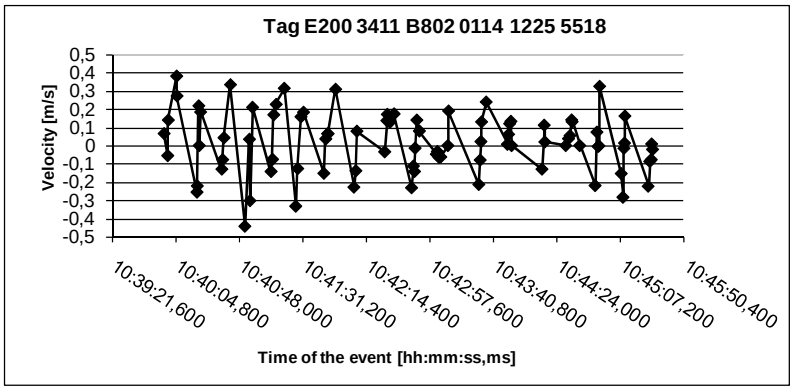

Figure 4. Graph of E200 3411 B802 0114 1225 5517 tag readings and velocity

If we take closer look to the graph on the Figure 4., we can see that the density of readings is much higher in compare with the tag displayed on the Figure 3. The probable reason of this effect is caused by characteristic of the antenna interrogation zone and overall anti-collision reading procedure of the reader.

3. Conclusion

In generally, an adoption of RFID technology in warehouse management is due to many specifics rather long-term problem. This paper describes testing and preparation stages of the pilot project, in which only passive RFID technology components were applied. According to above mentioned practical experiences it is possible to say that selected RFID principle and components are suitable for effective use in the given conditions. Moreover, it was successfully verified that tag movement parameters can be effectively used for recording of altered amount of goods in the warehouse. Materials and items stored in the warehouse didn't cause considerable signal loss and tags were responding timely even at higher distances. Evenly, tags were responding timely if they were placed in the edge of the warehouse and surrounded by other pallets with raw material. In a further investigation, cost effective analysis of proposed solution could be carried out to convince managers and stakeholders to make investment to this advanced technology.

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