PRACTICAL RESEARCH IN FIELD OF AUTOMATIC IDENTIFICATION IN AUTOMOTIVE

KOLAROVSZKI Peter, TENGLER Jiří

University of Žilina, Žilina, Slovakia, EU, peter.kolarovszki@fpedas.uniza.sk; jiri.tengler@fpedas.uniza.sk

Abstract

Article deals with research in field of automatic identification by selected components through radio-frequency identification technology (RFID) in conjunction with automotive industry. The aim of our research was to identify all RFID identifiers placed on selected components and to localize position floodlights, which was stored on pallet. All results had been measured in laboratory and also real condition. A special section is dedicated to description of the real measurements at selected subcontractor.

Keywords: Identification, research, automotive, logistics, RFID

1. INTRODUCTION

Automotive industry is growing rapidly and the production of new cars are growing demands for the identification of parts, and sub-contracting the traceability of the entire supply chain. Slovakia has many of subcontractors who produce various components and used in transport various type of transport and handling units. Technology of automatic identification plays a significant role nowadays in all the fields of logistics and economics. Regarding the optimization of supply chains, the bar code technology is utilized for this purpose in a long term. Depending on the structure of goods and material of transport units, it is possible to simulate the implementation of RFID technology. Technology of radio frequency identification is getting more and more popular considering multitude of advantages and therefore it is highly expected, that its application will be extending further into all the fields of logistics chain, including automotive industry. The article focuses on research of RFID technology in the process of smart identification of selected floodlights trough RFID technology. It also talks about software support for RFID technology, mainly about creation and configuration of RFID middleware - specialized software tool allowing mutual communication between two or several applications; also known as connector between various application components. All results had been measured in laboratory and also real condition. A special section is dedicated to description of the real measurements at selected subcontractor.

2. RFID TECHNOLOGY OVERVIEW

RFID technology is complex, combining a number of different computing and communications technologies to achieve desired objectives. Every RFID system contains an RF subsystem, and most RFID systems also contain an enterprise subsystem. An RFID systems supporting a supply chain is a common example of an RFID system with an inter-enterprise. In a supply chain application, a tagged product is tracked throughout its life cycle, from manufacture to final purchase, and sometimes even afterwards (e.g., to support service agreements or specialized user applications). Radio frequency identification is a wireless data collection technology that uses electronic tags which store data, and tag readers which remotely retrieve data. It is a method of identifying objects and transferring information about the object's status via radio frequency waves to a host database. RFID represents a significant technological advancement in AIDC because it offers advantages that are not available in other AIDC systems such as barcodes. RFID offers these advantages because it relies on radio frequencies to transmit information rather than light, which is required for optical AIDC technologies. [1]

2.1. RFID components

There are three basic components of RFID system, RFID tags, RFID readers and middleware, which is responsible for all data transaction in the system. Each object which has to be identified has a small object called a RFID tag stuck to it. Each RFID tag has a unique identifier that enables additional information about each object to be stored. [2]

An RFID tag is a small device that can be attached to an item, case, roll cage, or pallet, so it can be identified and tracked. It is also called a transponder. The tag is composed of microchip and antenna. These elements are attached to a material called a substrate in order to create an inlay.

Tags are categorized into three types based on the power source for communication and other functionality:

- Active,
- Passive,
- Semi-passive.

Devices known as RFID readers wirelessly communicate with RFID tags (see Fig.1), with a view to identifying the attached RFID tags, as well as enabling information stored in the RFID label to be read and updated. Readers can have an integrated antenna, or the antenna can be separate. The antenna can be an integral part of the reader, or it can be a separate device. [3]

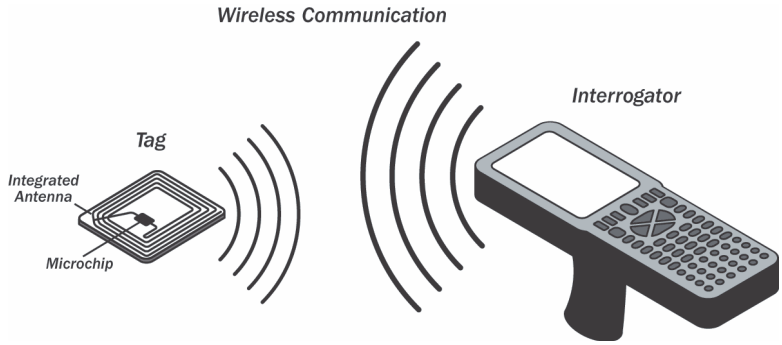

Fig. 1 Tag to reader communication

There is also Middleware, software that controls the reader and the data coming from the tags and moves them to other database systems. It carries out basic functions, such as filtering, integration and control of the reader. RFID systems work, if the reader antenna transmits radio signals. These signals are captured tag, which corresponds to the corresponding radio signal. [4, 5, 6]

3. IDENTIFICATION OF SELECTED AUTOMOTIVE COMPONENT

3.1. Description of measurements

Our tests focused on identifying the product - the left and right front floodlights for Kia Sportage. After completion and quality control, the front signal light are stored in a carrying case, thus forming also the handling and transport unit.

Front floodlights for Kia Sportage are packed and stored on plastic pallet KIA Grey (1200x800x145mm), in six plastic boxes, in three layers of two lights. The lights are embedded in plastic boxes with pocket. Each box consist two pieces of lights (see **Fig. 2**), total 12 pieces front lights on a pallet. Transport unit is without ESD protection.

Fig. 2 Location of front lights inside the box

After the individual components of RFID system was installed and well configured, we have set up the construction on which we placed as readers, as well as the corresponding antennas. When the pallets have been running of, both upper and side antennas had been connected to reader.

3.2. Result of measurement

The whole process was divided into several phases, respectively test types:

1. Pre - test - in this test, it was necessary to properly configure and tweak our application. Than was necessary to deploy RFID antennas and set the necessary signal strength, which emit the appropriate antenna. Due to the fact that in the area was located several tags at locations outside of the front lights, we had to very carefully perform the appropriate pre-tests. These configuration changes was necessary to undertake, depending on the environment in which measurements were taken.

2. Real test - implemented without interference from the application, which was decomposed into two measurements:

- Measurements of three pallets in a row that were drawn by transport truck - measurements 2, 3.
- Measurement of individual pallets, which was pushed by Hand pallet truck - measurements 4, 5.

The figure 3 clearly processed the results of measurements that were described above.

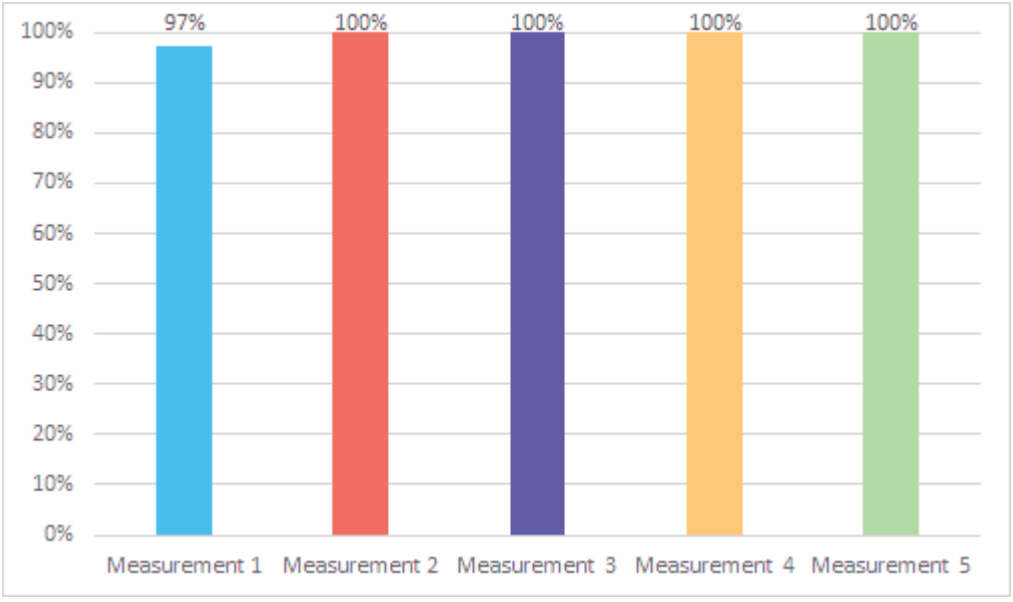

Fig. 3 Result of measurements

Our tests we have realized at the selected subcontractor Hella Signal Lighting Slovakia. In the measurements 2 and 3, we tested a real transition of three pallets filled front lights KIA Sportage. As can be seen from the graph, we have achieved 100 % readability, which provides a prerequisite for the use of RFID technology for these purposes. Subsequently, we tested the passages of individual pallets, but the readability was unchanged and we obtained 100 %.

4. LOCALIZATION OF SELECTED AUTOMOTIVE COMPONENT

Currently, there are several techniques through which scientists are trying to revive this supplementary feature of UHF RFID reader. They are especially experiments in conjunction with RSSI value with a knock-out performance of RFID antennas, phase experiment, the specific locations of the antennas and so one. [7, 8, 9]

In our research, we worked with the technique used RSSI value. Let's try to specify what an acronym RSSI is. From the English "Received Signal Strength Indicator" can be loosely translated as received signal strength indicator. Therefore the RSSI values represent the strength of the signal received via the RFID reader antenna from RFID identifier antenna.

4.1. Description of measurement

The subject of our research became front floodlights equipped with RFID tag and stored in transport boxes and then on the variety, together forming a transport unit. Within each box were four lights in four positions. The number of boxes on the pallet was three. Overall it was on a pallet in the framework of the boxes and their positions 12 front floodlights. The main idea of our research was then clearly determine the position in which the particular floodlight is located. For practical purposes, therefore, this solution is used to determine whether someone tampered with the positions of the floodlights during the transportation.

Measurements were carried out by two independent readers. The reason for choosing these two readers lies in varying formats and precision RSSI values that are demonstrated on the **Table 1**. Readers used for measurements:

- Motorola FX7400 reader with a single antenna transmitter and receiver representing,
- Alien ALR-8800 with two antennas, the first transmitter and the second featured receiver.

Table 1 Readers RSSI values

	Motorola FX7400	Alien ALR-8800
Best measured RSSI	49	3089,8
Poor measured RSSI	32	228,9
Differences	17	2860,9

4.2. Result of measurement

We made five tests with different configuration depending on used RFID readers, position and number of RFID antennas, reading position, placement of floodlights and so one.

On the figure 4 and figure 5 we can see configuration and result for the test with the best value that we have realized.

Description of the test:

- Reader - Alien ALR-8800.
- Antenna - AN480-CL66100WR.
- Number of antennas - 2.
- On side reading.
- Linear placement of all floodlights.
- Recorded RSSI values.

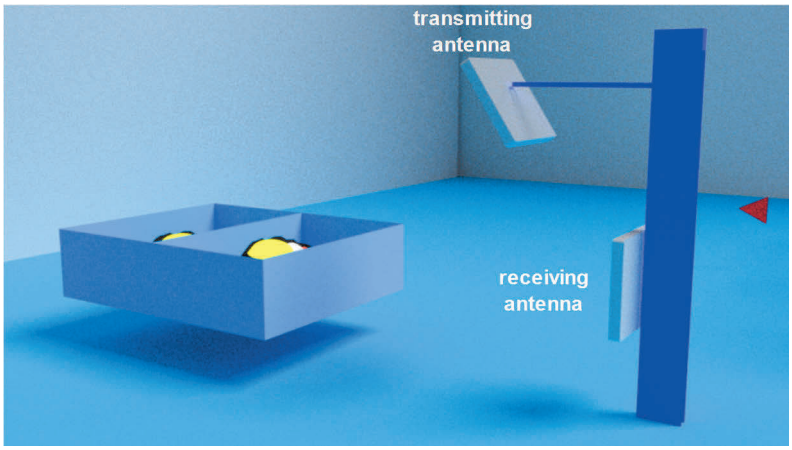

Fig. 4 Test configuration

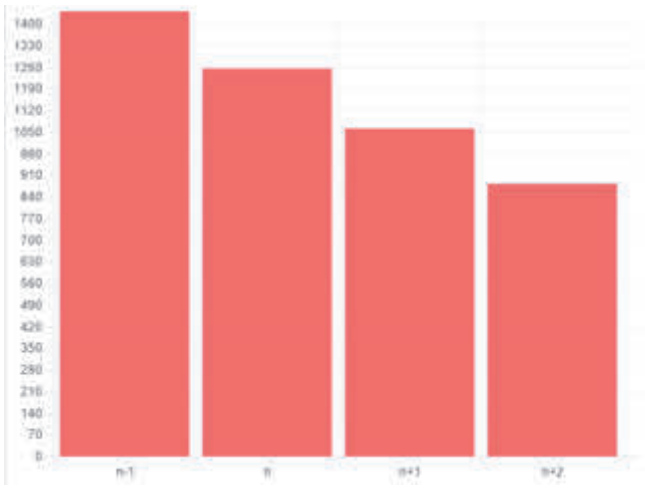

Fig. 5 Results of test

From these measurements we can say, that through large-scale RSSI values for Alien reader is strongly apparent order of floodlights.

5. CONCLUSION

Looking at the test results and satisfaction by the company with realized measurements we can be stated that the aim with which we went to testing, we managed to fulfill. We has reached 100 % readability of RFID tags placed on front lights KIA Sportage, which gives us an appropriate basis for application of this technology in the identification in the automotive industry. Our tests we have realized at the selected subcontractor Hella

Signal Lighting Slovakia. Through real subcontractor and the possibility of testing RFID technology in its operation, we found that the implementation of RFID technology is technically and economically possible. Hella Signal Lighting Slovakia representatives were satisfied with the results of the tests, which showed us a mirror of our work. Regarding the location of lights, it is still necessary to carry out many research projects on this so that we can claim the 100 % that the headlamp is the location. Our research has been a springboard for further research in this area.

ACKNOWLEDGEMENTS

This article was created to support project named as:

IV - Institutional research - 7/KS/2015 - Implementation research via the "Intelligent package" at selected postal operator.

E!7592 AUTOEPCIS - RFID Technology in Logistic Networks of Automotive Industry

REFERENCES

[1] HUNT V., PUGLIA A., PUGLIA M. RFID: A Guide to Radio Frequency Identification. New Jersey: John Wiley & Sons, 2007.

[2] THORNTON F., LANTHEM, CH. RFID Security. Rockland: Syngres Publishing, 2006.

[3] FINKENZELLER K. RFID Handbook: Fundamentals and Applications in Contactless Smart Cards, Radio Frequency Identification and Near-Field Communication. London: John Wiley & Sons, 2010.

[4] KUBASAKOVA I., KAMPF R., STOPKA O. Logistics information and communication technology, Communications, Scientific Letters of the University of Žilina, Vol. 16, No. 2, 2014, pp. 9-13.

[5] KENDRA M., LALINSKÁ J., ČAMAJ J. Optimalization of transport and logistics processes by simulation. In ISTEC: 3rd International Science, Technology and Engineering Conference, Dubai, United Arab Emirates (UAE), 2012, pp. 886-892.

[6] KOLAROVSZKI P., VACULÍK J. Middleware - software support in items identification by using the UHF RFID technology, STOJMENOVIC I. et al. (Eds.): MOBIQUITOUS 2013, LNICST Vol. 131, 2014, pp. 358-369

[7] KEBO V., STAŠA P., BENEŠ F., ŠVUB J. RFID Technology in Logistics Processes. In SGEM 2013: 13th International Multidisciplinary Scientific GeoConference, Albena, Bulgaria, 2013, pp. 219-226.

[8] BUKOVÁ B., BRUMERČÍKOVÁ E., KOLAROVSZKI P. Zasielateľstvo a logistika. Zodpovedný redaktor: Mária Bali-Jenčíková. Bratislava: Wolters Kluwer, 2014.

[9] MADLEŇÁK R., MADLEŇÁKOVÁ L., ŠTEFUNKO J. The variant approach to the optimization of the postal transportation network in the conditions of the Slovak Republic. Transport and telecommunication, Vol. 16, No. 3, 2015, pp. 237-245.