A SYSTEM OF MONITORING THE PRODUCTS FROM A REFRIGERATING WAREHOUSE USING RFID TECHNOLOGIES

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***Abstract* – Radio Frequency Identification (RFID) represents an advanced wireless technology, which comprises an important new solution within intelligent chips area and of automation technologies. RFID means an implementation of 'intelligent objects' specific for tracking entities and making easy the way of information achieving. The data can provide any kind of information, such as: location or phase of an item within a manufacturing line or process, detecting entities or persons. The proposed system presents a scenario of monitoring products within a refrigerating warehouse, using RFID technologies. Creating a system composed of a RFID reader and a temperature sensor is presented, interconnected together with a management module, in the view of solving problems or carrying out specific processes.**

***Keywords*:** *RFID technology, tag, reader.*

1. INTRODUCTION

The RFID technology is a flexible, convenient, easy to use and adequate technology to automatic operations. It is used in the view of data transmission, with the help of mobile transponders, known as tags and for receiving data with the help of reading devices.
The RFID systems can be provided as read-only, read-write, do not need clear contact or line of visibility for processing and are able to function within a variety of environmental conditions, offering the integrity of data on high level. The data can provide any type of information, such as:

- location or stage of an entity within a manufacturing line;
- tracking of materials within the manufacturing processes;
- detecting the entities or the persons.

An RFID tag or transponder is a device that can store and transmit data to a reader in a contactless manner using radio waves. It represents a set formed of a microchip and an antenna. A typical passive tag can contain a few bits to hundreds of bits for data storage. The tags manufactured as adhesive labels can be attached to entities. The information of tags is written and read by the unit of a RFID reader's antenna. The communication between the RFID tag and RFID reader is wireless. The most important technical feature in designing a RFID system is represented by the frequency of operation. The frequency is established by the maximum reading distance, application type and the operating conditions.
An RFID implementation that assumes for the time being large expenses will become approachable in the future. In more applications, the great cost of tags is balanced out by the achievement of the best solution and results of problems.

2. PRESENTING THE SYSTEM

Within the proposed system, the refrigerating warehouse is equipped with a RFID reader (reading/writing equipment of data), in the view of automatic inventorying, placed at the warehouse input. The reader is placed so that each product that comes in or goes out from the warehouse is automatically read.
If a product is brought in the warehouse, the stored data within the attached tag of it will be read, transmitted towards the management module and automatically added within the database. Using an anti-collision algorithm, the RFID reader can automatically read within its reading range more tags, in a short period of time [2].
In case a product does not have attached the electronic label, a tag will be attached to it, in which the necessary information will be written, meaning: product name, producer, storage temperature, expiration date. The tags can be written through a module of writing tags, specific to the reader. The reader presents two functions: of reading and writing the tags.
After a product is equipped with the adequate tag, the information will be transmitted towards the management module. In case a product goes out from the warehouse, this will be read by the reader, the management module will identify that the product already exists within database and considers that the product shall be extracted from the warehouse and automatically deleted from database.
Simultaneously with the change of temperature from the warehouse, that is monitored through a temperature sensor connected to the system, the management module searches within database if

there are products having the critical expiration temperatures. In case these exist, the human operator, which is responsible of the warehouse is announced through the user interface, SMS warning, eventually e-mail.

2.1. The system's architecture

The architecture of the proposed system, intended to monitor the products temperature from the refrigerating warehouse is presented in fig. 1.

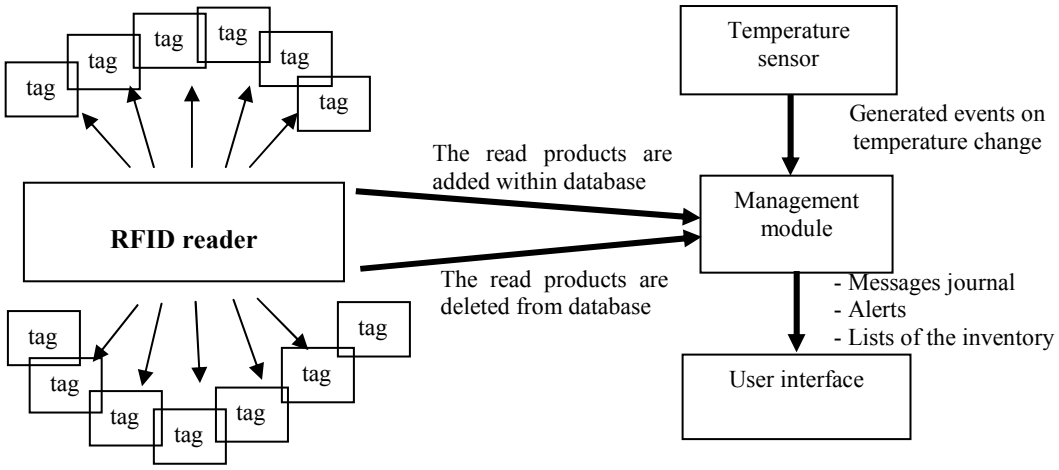

Figure 1: The architecture of the monitoring system

Within the application, using an EzScan reader made by Kenetics is proposed, which has an external gate antenna attached and functions on 13,56MHz frequency, the standard ISO 15693, having the reading range of 150cm, the communication with the computer being made through the serial interface and the communication rate is set from 9,6Kbps to 115,2Kbps.

2.2. The management module

The data from sensor are compared with the management rules concerning the critical temperature [1]. The situation in which the temperature at a certain moment of time is within the established interval is analyzed, after which the user is alerted in case of not respecting those rules.
The application is performed in Visual Basic and presents options of reader configuration (communication port, rate, reader testing). On running mode, when an event is received from the temperature sensor, this is sent towards the management module and after that, interpreted.
The option of alerting by SMS or e-mails is implemented, when the warehouse temperature comes closer to the critical one. At the temperature changing with a degree, the management module processes the information and sends it to user interface, in the right side display (see fig. 2).
If the temperature is situated within an allowed range, an update of the displaying list shall be send, the last event becoming the first from the list. When this limit is overstepped, the management module notifies this, changing moreover the message of warning. Reaching the critical temperature and inventorying the products that present alteration danger may be thus observed. The refrigerating warehouse can be directly managed by the management module. In this way, if there are temperature variations that can lead to products alteration (for instance, as a result of opening the door of the warehouse for a long time or of increasing the outdoor temperature), then the

refrigerating device will automatically run on the capacity imposed by the established conditions.
Using the management module, the strategies of managing the products can be established, such as: the first product arrived – the first product to be left; interrogations of the database as regards the products from the warehouse will be performed (for instance, the products being within the critical interval of expiration, the products having the insufficient stock or the products arrived on batches and their data of arrival in the warehouse) [6].

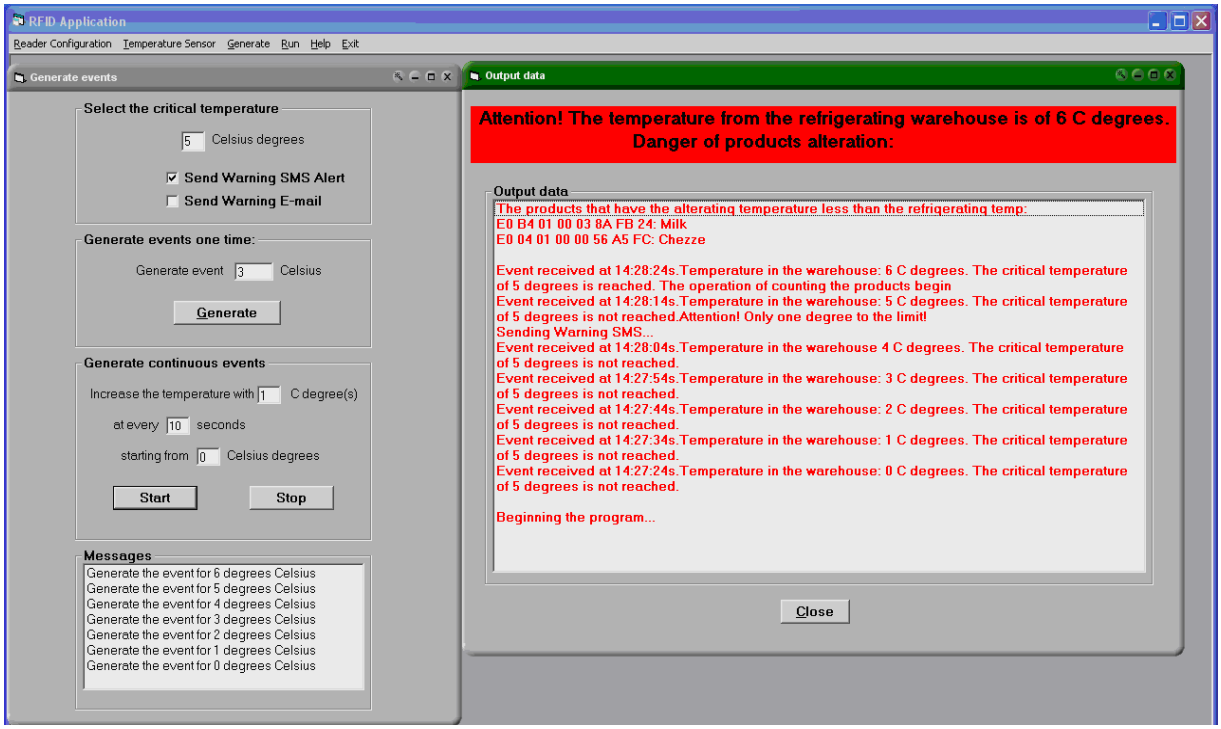

Figure 2: Displaying the output journal for events generating the temperature at each 10 seconds

2.3. The anti-collision algorithm

An anti-collision algorithm will assure multiple tag reading, thus becoming a great advantage of the RFID technology. Using such an algorithm, a RFID reader is able to read several tags in its reading range in an automatically manner, for a short period of time. An anti-collision algorithm can be explained as follows: if more than one tag tries to communicate to the reader at the same time, a collision will take place.
A RFID reader will have to solve this collision, with a view to correctly identify all the tags in its reading range. A RFID reader has to establish rules on communication, so that only one tag can communicate to the reader at a certain moment, during which period all the other tags should remain silent.

Generally, using this algorithm, a RFID reader will uniquely identify a few to more tags in short time, in accordance to the tag's type and the applications performed. This advantage allows the data from a group of objects having attached the tags on them to be read by a RFID reader, no matter if they are stationary or in motion; in this manner, necessities of reading one tag at a certain moment of time will be removed. The situation of reading the data from a certain tag as response to an anti-collision interrogation (only some data bits are read) becomes different towards the case of reading the data from a specified tag in a complete manner (all data bits are read). As in most of applications, there have to be imposed theoretical and practical limitations as concerns the number of tags tracked and read by a reader within an interval of time. It is assumed that future research have to improve the number of tags

that can be identified per second (respecting the theoretical and practical limits).

3. FUNCTIONS CARRIED OUT BY THE RFID TECHNOLOGY AS CONCERNS THE PROPOSED SYSTEM

The proposed system reflects the fact that RFID technology and the information management offer safety, efficiency, as well as saving related to time and costs. The advantages specific to system's implementation within a refrigerating warehouse can be mentioned:

- improving the capacity of accurate determining of inventory on real time and reducing the processing time through automation;
- growing the rate of updating the database with products and the efficiency and minimal errors during performing with database;
- eliminating the possibilities of products alteration;
- reducing the human intervention and of work costs and
- the accurate control of the warehouse temperature;
- immediate identification of products on alteration danger within unforeseen situations of sudden change of temperature;
- Improving the management of the existent merchandise.

These benefits are either available in some form for the time being or will be available as improved features in the future as the technology develops.

4. CONCLUSIONS

Through the proposed system within this paper, the way in which RFID technology and a temperature sensor can lead to a series of definite advantages can be analyzed, on a harsh competition market.

Adopting this managing solution is addressed to any type of companies that own warehouses, in the presented case a refrigerating one, only few changes being necessary, which will take into account each company requirements. The companies which accept immediate using of RFID technology will have a significant advantage toward the concurrency, which adopts the idea of waiting and belief and after that, the acceptance.

The first thing that has to be taken into consideration when implementing a RFID system consists on evaluating the operating manner of the new technology towards the bar codes technology. The bar codes are well understood in the present, have low price in comparison to RFID, are largely used and are based on opened standards, but they need a clear visibility. The RFID tags do not need that, they allow large reading ranges, allow modifying the stored data, providing more information than the bar codes over the items or the content of packages and greatly overrun the bar codes performances, as concerns the unfavorable physical conditions. The RFID technology can fundamentally influence the work strategies of the business. Thus, it can accelerate and rationalize the access and consistence of data within the business. By using the strategies imposed by the RFID technology, this will become a constitutive part of the business management solutions. The promises of RFID represent an enormous feature, by taking into consideration the real world challenges. As any other new technology, understanding the provocations for RFID becomes critical, with a view to avoid the use of a RFID project unable to accomplish the complex goals that simple technologies do not carry out. For the near future, the dual managing of bar codes – RFID systems will continue. Until RFID will reach the maximum matureness, a critical requirement will be represented by the capacity of companies on taking good decisions towards applying the RFID projects. Their experience on learning the parameters can finally allow for organizations to rapidly and efficiently develop.

The RFID technology isn't just a simple accomplishment of some research, but an efficient solution for companies, which will determine visibility on developing the business processes in a correct manner and of complete transparency.

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