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ENHANCEMENT PLM PROCESSES BY RFID TECHNOLOGIES

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INTRODUCTION

The Internet is connecting world and uniting billions smart devices in the net. Gap between physical objects and real world is disappearing. This processes are sign the 4ht industrial revolution which was called Industry 4.0. Products and services become more and more complex. Therefore, more specialists from different fields should work as a single team in joint information environment for implementation best practices for innovation product engineering. Such framework for realizing innovations is provided by PLM (Product Lifecycle Management) systems. Moreover, we can observe trend of product customization and personalisation [1]. Due to polimorphism managing of product lifecycle become even more complicated task.

Monitoring states of different product instances is a key of overcoming the problems.

The aim of this paper is to research implementation of RFID technologies in PLM system for managing product lifecycle in Industry 4.0 perspective. As result, we propose different scenarios of using RFID and demonstrate example of product identification by industrial equipment.

RFID technologies description

RFID is a technology that uses the electromagnetic spectrum to identify an object. The industry are increasing the use of RFID sensor trying to replace the barcodes, because it does not require direct contact or line-of-sight scanning. The systems is composed of two main elements: an antenna and transponder. The antenna generates a radio frequency wave for activating the transponder, when the tag (transponder) feels the wave, it replies to the antenna back and this information is send by RS232 or another communication protocol to one device in order to make some action. The power required to activate the transponder is supplied through the coupling unit, as are the timing pulse and data. All the process is represented in the figure 1[2].

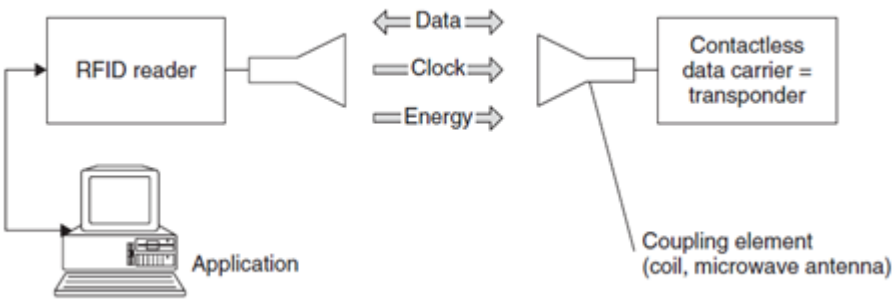

Figure 1. Architecture of a RFID system

There are two types of classification of the RFID sensors, the first is by frequency and the second is by power supplier. Depending of the frequency and the power supplier, the features and the applications are considerable different because radio waves behave differently in each frequency band.

Frequency classification refers to the size of the radio waves used to communicate between RFID components. These systems operate in low frequency (LF), high frequency (HF) and ultrahigh frequency (UHF) bands. LF operates between 30 KHz and 300 KHz, it has short transmission ranges of

generally less than six feet. HF Works between 3 MHz to 30 MHz and it offers more than 90 feet. Finally, UHF covers the range from 300 MHz to 3 GHz. In general, the higher the frequency, the more expensive the system. [3]

The RFID system also can be classified by using the power source. In this category, there are three classes: active, passive and BAP (Battery-Assisted Passive). In active RFID systems, tags have their own transmitter and power source that is usually a battery. The active RFID are making a constant broadcast with the information storage in the chip. In the passive RFID, the tags do not have their own power source; they take the energy from the reader when it is in the interrogation zone. A Battery-Assisted Passive RFID tag is a type of passive tag which incorporates battery for powering the chip and that allow that the tag uses all the energy of the antenna to reply.

The construction of the transponder has many options such as Glass Housing, Plastic Housing, Smart Cards, Coil-on-Chip and Smart labels. In our case, a smart label is used. The smart label is printed in a thin paper that contains the coil and the chip. The transponders are supplied in the form of self-adhesive stickers and are thin and flexible enough to be pasted to goods of all types.

Using RFID Technologies in PLM Systems

In this paper PLM is a system which unites processes of managing product-related design, production and maintenance information. Nowadays, PLM becomes more than central repository of product related data, business processes, manufacturing processes and CAD, CAM and PDM tools for banding together managers and engineers. PLM – strategic business approach of innovation, new product development and introduction. [4]

Innovative Industry 4.0 conception require customization of production for better customer satisfaction. Using RFID technologies can simplify processes of PLM of innovative product which conform with ideas of 4th industrial revolution.

The first field of using RFID is manufacturing. In product design process we can attach to product RFID chip which will contains individual technical process data according to customer order. Additionally, the chips can be used for tool recognition of mechatronics systems on flexible manufacture. Moreover, thanks to read/write feature of the chips PLM system get access to

direct feedback about product state on each stage of production. So, transparency of processes increased, that is extremely important for implementing PLM strategy.

The second field of using RFID is logistic. After the product is made it must be delivered to a specific customer. Distribution of goods can take a lot of time and resources, because we need to take each product and identify address to deliver of each individual product. Inasmuch as RFID reader do not require direct contact with the chips, we can automize distributing. RFID read head can scan all goods with the chips on pallet or in wagon and send data to distribution system without special manipulations. Additionally, we can track each package to customer till he takes it from the shop shelf.

At last, RFID can be implemented in support and maintenance. Since whole data of product lifecycle stored in RFID chip, information about where and how the product was done, how it was delivered, when it was bought will be very helpful for customer care departments.

RFID technology is rapidly developing and find application in this and others field without doubt.

Example of Implementation RFID in flexible manufacturing

A manufacturing system where some amount of flexibility allow the system to react in the case of changes, whether predicted or unpredicted is called flexible manufacturing systems. A modern flexible manufacturing system (FMS) usually contains the many distribution control systems, such as machine stations, assembling stations, material handling and storage systems. Implementation of the new technologies and new approaches on a FMS show the result regarding more flexibility, agility and re-configurability. In the manufacturing systems, the application of Radio Frequency Identification (RFID) gives the source for completing more flexible and agile systems in which real-time information of the components can be utilized. Currently, RFID technology has been widely applied in the field of logistics, supply chain, warehousing, retailing and transportation. [5]

The primary focus in this section is to show the description of the configuration regarding hardware configuration, list of equipment that will use in the implementation process of RFID in manufacturing systems. The

software that will use in the process of hardware configuration is SIMATIC MANAGER (Figure 2).

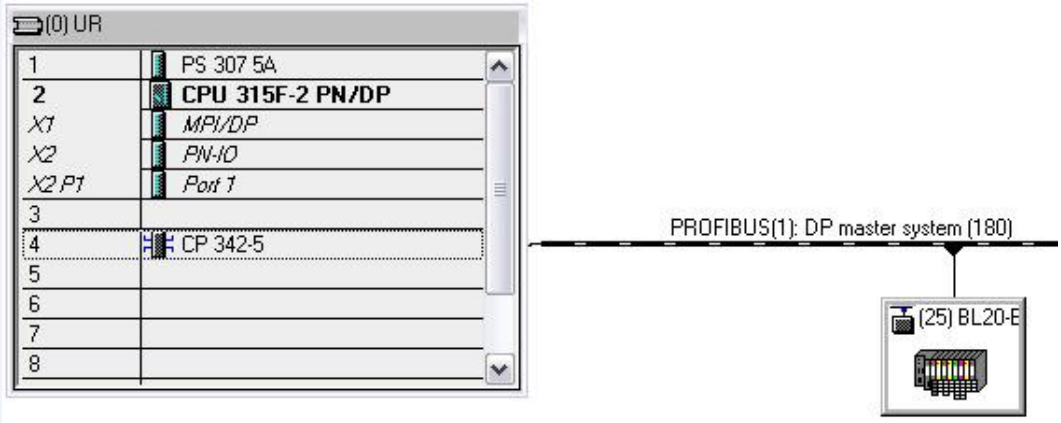

Figure 2. Hardware configuration of RFID system

The system consist of:

Functioning of developed system represented in specific variable table (Figure 3).

1. Programmable Logic Controller (PLC) (Siemens PLC 300 Station)
2. Industrial Ethernet Cable (Industrial Ethernet M12 Connector)-
3. BL-20 Gateway (BL-20-E-GW-DP Gateway)
4. RFID (TW-L18-18-F-B128)
5. Read/Write Head (TN-CK40-H1147)

Functioning of developed system represented in specific variable table (Figure 3).

Input_data -- @BL_20\SIMATIC 300(1)\CPU 315F-2 PN...

	Address	Symbol	Display format	Status value	Modify value
1	I 0.1	"TRF"	BOOL	false	
2	I 0.2	"TP"	BOOL	false	
3	I 0.3	"XCVR_ON"	BOOL	true	
4	I 0.4	"XCVR_CON"	BOOL	true	
5	I 0.5	"ERROR"	BOOL	false	
6	I 0.6	"BUSY"	BOOL	false	
7	I 0.7	"DONE"	BOOL	false	
8	IB 1	"ERR_LSB"	HEX	B#16#00	
9	IB 2	"ERR_MSB"	HEX	B#16#00	
10	IB 4	"READ_DATA_1"	HEX	B#16#01	
11	IB 5	"READ_DATA_2"	HEX	B#16#02	
12	IB 6	"READ_DATA_3"	HEX	B#16#03	
13	IB 7	"READ_DATA_4"	HEX	B#16#04	
14	IB 8	"READ_DATA_5"	HEX	B#16#05	
15	IB 9	"READ_DATA_6"	HEX	B#16#06	
16	IB 10	"READ_DATA_7"	HEX	B#16#07	
17	IB 11	"READ_DATA_8"	HEX	B#16#00	
18					

Output_data -- @BL_20\SIMATIC 300(1)\CPU 315F-2 PN/DP...

	Address	Symbol	Display format	Status value	Modify value
1	Q 0.0	"RESET"	BOOL	false	
2	Q 0.1	"XCVR_INFO"	BOOL	false	
3	Q 0.2	"TAG_INFO"	BOOL	false	
4	Q 0.3	"WRITE"	BOOL	false	false
5	Q 0.4	"READ"	BOOL	true	true
6	Q 0.5	"TAG_ID"	BOOL	false	false
7	Q 0.6	"NEXT"	BOOL	false	
8	Q 0.7	"XCVR"	BOOL	true	true
9	Q 1.0	"ByteCount0"	BOOL	true	true
10	Q 1.1	"ByteCount1"	BOOL	true	true
11	Q 1.2	"BtteCount2"	BOOL	true	true
12	QB 2	"AddrHi"	HEX	B#16#00	
13	QB 3	"AddrLo"	HEX	B#16#00	
14	QB 4	"WRITE_DATA_1"	HEX	B#16#01	B#16#01
15	QB 5	"WRITE_DATA_2"	HEX	B#16#02	B#16#02
16	QB 6	"WRITE_DATA_3"	HEX	B#16#03	B#16#03
17	QB 7	"WRITE_DATA_4"	HEX	B#16#04	B#16#04
18	QB 8	"WRITE_DATA_5"	HEX	B#16#05	B#16#05
19	QB 9	"WRITE_DATA_6"	HEX	B#16#06	B#16#06
20	QB 10	"WRITE_DATA_7"	HEX	B#16#07	B#16#07
21	QB 11	"WRITE_DATA_8"	HEX	B#16#08	B#16#08

Figure 3 – Demonstration of functioning RFID system

To activate the read/write head open the variable table “Output Data”. An Electromagnetic field created by activating the read/write head and the signal can be transferred with 13.56 MHz. For reading the status value and to download the control values we need to active the online connection to your control (PLC > Connect> Direct CPU). The Mode “RUN” will be displayed with a green mark. XCVR value relate to the activation of read/write head and signal activation. NEXT command bit shows the execution process with the same data carrier. In the following Figure 7 the XCVR_ON is true which is showing by “Green mark “means the value is 1 showing the read/write head is active and ready to transfer the signal. On the other hand, “XCVR_CON” is also shown by “Green mark” that is representing the read/write head is correctly connected with the BL-20 2RFID S module. In the input table from the Input Byte (IB) 1 to 11 the input Hexadecimal Data is stored in the RFID chips that is showing in the right side of the Figure 3. After touching the read/write head sensor to RFID chips we are able to write the data which is stored in the RFID chips to Output side as shown in the Figure 7. Hence it is proved that we have successfully accessed the stored information or data in the RFID chips.

Conclusion and outlook

Internet opens countless possibilities in connectivity that reflected on manufacturing as Industry 4.0. Companies needs innovations for creating smart, individual and competitive products and services or suffer from consequences. PLM is a key for new product designing and introduction. In this paper, we propose to use RFID technologies for enhancing and making more transparent PLM approach. As result of our research we define three perspective fields where RFID can be successfully implemented: manufacturing, logistics and maintenance. In practical part we demonstrate functioning of RFID system on industrial equipment example.

Our future research shall focus on testing of the inferential scenarios based on flexible assembling line FESTO MPS500 type.

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