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OF RAPID CHANGES**

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## INFORMATION AND WEB TECHNOLOGIES

### Software development for small details production warehouse automated system

**Nevliudov Ihor<sup>1</sup>, Maksymova Svitlana<sup>2</sup>, Nevliudova Viktoriia<sup>3</sup>,  
Vzhesniewski Maksym<sup>4</sup>, Klymenko Oleksandr<sup>5</sup>**

<sup>1</sup> Doctor of Engineering Science, Professor, Department of Computer-Integrated Technologies, Automation and Mechatronics;  
*Kharkiv National University of Radio Electronics; Ukraine*

<sup>2</sup> Candidate of Engineering Science, Associate Professor, Department of Computer-Integrated Technologies, Automation and Mechatronics;  
*Kharkiv National University of Radio Electronics; Ukraine*

<sup>3</sup> Candidate of Engineering Science, Associate Professor, Department of Computer-Integrated Technologies, Automation and Mechatronics;  
*Kharkiv National University of Radio Electronics; Ukraine*

<sup>4</sup> Postgraduate student, Department of Computer-Integrated Technologies, Automation and Mechatronics;  
*Kharkiv National University of Radio Electronics; Ukraine*

<sup>5</sup> Postgraduate student, Department of Computer-Integrated Technologies, Automation and Mechatronics;  
*Kharkiv National University of Radio Electronics; Ukraine*

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The development of science and technology constantly sets new requirements for modern production. It should become more flexible and quickly adapt to new types of products. This leads to the need for a structured, easily understandable and convenient organization of storage of goods.

Modern software will allow you to expand the supply chain, establish inventory management, processing and fulfillment of orders in accordance with modern procurement methods, will ensure the availability of all stocks in real time - with the help of personal computers, or even mobile devices.

Also, order management using server databases gives supply chain participants the opportunity to control stocks and operations in real time, regardless of which technological solutions their customers use for purchases. Software allows, due to its implementation, to manage cost optimization, since enterprises will no longer have to pay for expensive maintenance and modernization.

The customized software should be used on an automated warehouse system, which is a complex solution to simplify the process of storing and removing large volumes of cargo in

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warehouses. The systems include a number of controlled software devices capable of placing and extracting cargo. Automatic systems allow you to operate various types and sizes of standard and non-standard cargo.

To solve the problem, the following software was chosen:

- multi-platform development framework Qt;
- MySQL Workbench;
- C# Windows Forms Applications;
- Zxing and Zbar libraries

After, analyzing the purpose and functions of the developed software product, the following entities can be identified:

- characteristics - stores previous information about the product that arrived at the warehouse;

- codes - stores the unique (non-final) bar code of the product and its detailed description;

- warehouse - stores information about the position of the product in the warehouse (its tier, floor, row and place).

On the basis of these entities a relational implementation model was built. The description of the relational database and their attributes are given in Table 1.

Table 1

**Database description**

Table name	Attribute name	Attribute type	Dimension	NULL / NOT NULL	Key
characteristics	ID	INT	-	NOT NULL	PK
	country	VARCHAR	40	DEFAULT NULL	-
	manufacturer	VARCHAR	40	DEFAULT NULL	-
	title_with_description	VARCHAR	150	DEFAULT NULL	-
	strength class	DOUBLE	-	DEFAULT NULL	-
	material	VARCHAR	40	DEFAULT NULL	-
	coating	VARCHAR	40	DEFAULT NULL	-
	product list	VARCHAR	2000	NOT NULL	-
	code_id	INT	-	DEFAULT NULL	-
codes	ID	INT	-	AUTO INCREMENT	PK
	Code type	VARCHAR	25	DEFAULT NULL	-
	Code	VARCHAR	25	DEFAULT NULL	-
	legal code type	VARCHAR	25	DEFAULT NULL	-
	description	VARCHAR	500	DEFAULT NULL	-
warehouse	ID	INT	-	AUTO INCREMENT	PK
	legal code type	INT	-	DEFAULT NULL	-
	tier number	INT	-	DEFAULT NULL	-
	lift number	INT	-	DEFAULT NULL	-
	row number	INT	-	DEFAULT NULL	-
	place number	INT	-	DEFAULT NULL	-

An automatic product storage system was created. It allows you to add goods to the warehouse system according to

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the characteristics of the warehouse, i.e., logic occurs for the situation when you need to load the goods not in the serial number from 1 to infinity, but according to the distribution relative to the compartments. That is, the first product is loaded into the first tier, 1st floor, 1st row, 1st place.

With the help of a set of rules that are based on the conditions and characteristics of the warehouse system, that is, its capacity in width, length and height, it is possible to program the storage system (an example of logic for one tier) (Fig. 1).

```
if (@current_place_number >=4 and @current_row_number <14 and @current_lift_number <=3) then
    set @current_row_number = @current_row_number + 1;
    set @current_place_number = 1;
elseif (@current_place_number >=4 and @current_row_number >= 14 and @current_lift_number < 3) then
    set @current_lift_number = @current_lift_number +1;
    set @current_place_number = 1;
    set @current_row_number = 1;
elseif (@current_place_number < 4) then
    set @current_place_number = @current_place_number +1;
elseif(@current_place_number >= 4 and @current_row_number >= 14 and @current_lift_number >=3) then
    set @current_lift_number = null;
    set @current_place_number = null;
    set @current_row_number = null;
end if;
```

Figure 1

### Part of the CODE with the Rules of Product Storage

The procedure is responsible for making it possible to view the product on the warehouse system, namely when the system is filled, the table will have the following entry: "unique barcode" "1" "1" "12" "4" - which corresponds to: tier 1, floor 1, row 12, location 4. In Figure 2, you can see how the logic of the program works, relative to the specified characteristics of the warehouse system, loading works at all locations of the warehouse, which allows the operator to control the occupancy of certain goods in the warehouse.

But in the case of full occupancy of the warehouse, the initial condition is used in which the extreme characteristics in terms of length, width and height are set, if it exceeds them - the goods will not be stored, which allows the operator not to break the logic of the storage system in the event of an error.

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	ID	legal_code	tier_number	lift_number	row_number	place_number
	44	3830004573645	1	1	11	4
	45	3830004573645	1	1	12	1
	46	3830004573645	1	1	12	2
	47	3830004573645	1	1	12	3
	48	3830004573645	1	1	12	4
	49	3830004573645	1	1	13	1
	50	3830004573645	1	1	13	2
	51	3830004573645	1	1	13	3
	52	3830004573645	1	1	13	4

Figure 2

**Database View with Goods in the Warehouse Relative to their Locations**

So, in this paper small parts warehouse management automation software development was described. It can organize automated work for different warehouse departments, such as stocking/unloading goods in the warehouse system and generating product ID using barcode. In future, this solution will allow us to decrease time for searching and choosing required products.

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