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Contents

Editorial

Dear authors, dear readers,

This issue brings a variety of contributions related to applied information technologies. Most of them deals with database applications in range from daily business or hardware resources until medicine services and media content, to bring a tool for solving the daily complexity of information. Besides, there are two contributions related to interconnection and control. Human face recognition experiment is presented being a part of the web solution interface and some intelligent standalone/remote controlled technological plant is introduced. We would like to keep this manifold character of our journal, bearing a wide range of scientific and expert applications in the branch of information technologies. New papers and contributions are welcomed around the year. I would like to thank to all concerned people for collaborating, sending articles and correcting them.

Juraj Štefanovič
ITA Editor-in-Chief

DEVELOPMENT OF INFORMATION SYSTEM FOR MEDIA CONTENT MANAGEMENT

Andrey Preobrazhenskiy, Igor Lvovich, Ekaterina Choporova

Abstract:

Medium and large companies are increasingly faced with the need to maintain a single internal information background - a certain level of awareness of employees about the activities of the enterprise. The usual schemes - e-mail newsletters, corporate publications, wall newspapers, bulletin boards, etc. - often do not provide the expected efficiency. In this regard, the relevant processes need to be automated. In this paper the development of an automated information management system of media content of a visual nature is carried out. This system is focused on the use of a large number of people, potential buyers of goods or services. The main purpose of the developed information system is to provide a convenient way of operational management of advertising media content of a visual nature.

Keywords:

Information system, media content, managenent.

ACM Computing Classification System:

Software system structures, business process management, management of computing and information systems.

Introduction

Modern society is a consumer society. The life of most modern people can not be imagined without the Internet, television, radio, mobile phones, supermarkets. And everywhere we are surrounded by advertising. Advertising is everywhere - contextual advertising is placed on the websites, advertising spots are shown on television, advertising stands are installed on the streets of cities, and advertising is shown even in applications for smartphones. A special place is occupied by advertising in shopping centers. Every visitor to a shopping center is a potential buyer of a product or service, a person who is determined to purchase one or another product or service. That is why it is important to correctly and in time present to such a person a description of a product or service. This may be an audio recording, a promotion, a bright sign, or a video clip that plays on a large liquid crystal screen at the entrance to the point of sale.

In this paper, we are developing an automated information system for managing media content of a visual nature. This system is focused on the use in places where a large number of people, potential buyers of goods or services. The main purpose of the application of the developed information system is to provide a convenient way for the operational management of visual advertising media content.

To achieve this goal it is necessary to perform the following main tasks:

1. To review the leaders of the Russian and foreign markets of centralized media content management systems.
2. Compare the possible ways of delivering media content to the end nodes of the software package, and also select the most promising technology from them.
3. In accordance with the chosen method of content delivery, develop an automated information system architecture.
4. Analyze the available database management systems and select the most appropriate one.
5. In accordance with the chosen architecture, execute the software implementation of the information system modules.

1 Media Control Systems in Advertising

The word advertising comes from the Latin reclamare, which means "to approve, shout, protest."

Advertising is any information disseminated in any way, in any form and using any means, addressed to an indefinite circle of persons and aimed at drawing attention to the object of advertising, the formation or maintenance of interest in it and its promotion in the market.

Digital Signage is a technology for presenting information through electronic media installed in public places.

This technology is mainly used for advertising. Advertising messages distributed by digital signage, as a rule, aim to reach the target audience in the right place for contact and at the right time [1].

The advantage of advertising messages delivered by digital signage technology over traditional static forms of outdoor advertising in a more simple and fast replacement of content, dynamic content, adaptability of the message to the environment and the audience, including interactive. Among the disadvantages of the technology, it should be noted the technical complexity and, therefore, high initial costs.

The decline in prices for liquid crystal and plasma displays has led to a significant increase in the number of implementations of Digital Signage solutions. The determining factors in choosing a display are size and cost. The size of the display should provide a comfortable perception of information by the target audience [2].

Content is played on displays from at least one playback module. This can be either the software embedded in the display or an external device. Existing software and hardware solutions provide various ways to manage and play content, starting with simple media players, looping video, ending with national-scale distributed networks, managed from one center [3].

To date, among the software systems Digital Signage of the Russian development, designed for promotional activities, the obvious leader in the declared functionality and the number of implementations is the software company KINOMATIKA.

Software of the same name entered the market in 2007 after 5 years of development.

Currently, software systems based on KINOMATIKA are implemented in more than fifty cities of Russia and neighboring countries. According to official information posted on the manufacturer’s website, 670 software licenses have been sold.

Today, Scala is the most successful and popular among the foreign software manufacturers for Digital Signage.

The history of Scala dates back to 1987. Digital Vision AS was founded in Norway this year. The company specialized in product development for cable television stations. The software was intended for the first graphics-enabled computers, Commodore A.

The following modules are part of the automated information management system for media content:

1. Database server - database server of the program complex. Stores information about the quantitative and qualitative characteristics of the modules used. It stores information about the distribution of content, its playback time, content conversion profiles. The stored information provides for reading and editing the "Content Management Server".
2. Content Management Server - a module responsible for the interaction of "Content Distribution Services" with the database of the software package. Serves as a business logic module when working with new and existing content. Converts downloadable content in accordance with the specified profiles.
3. The content distribution service is a software module whose task is to launch the required number of "Players", distribute them to the displays and transfer information about what and when the "Player" should be displayed.
4. Player - a module that is directly responsible for displaying content. Receiving a command to download content from the "Content Distribution Service", connects to the "Content Server", downloads the specified content and displays it to the next "Content Distribution Service" command.
5. The content server serves as a file storage of content. Provides access to content by URL. Formation of the URL is produced by "Content Management Server".

The scheme of system we can see in Fig.1.

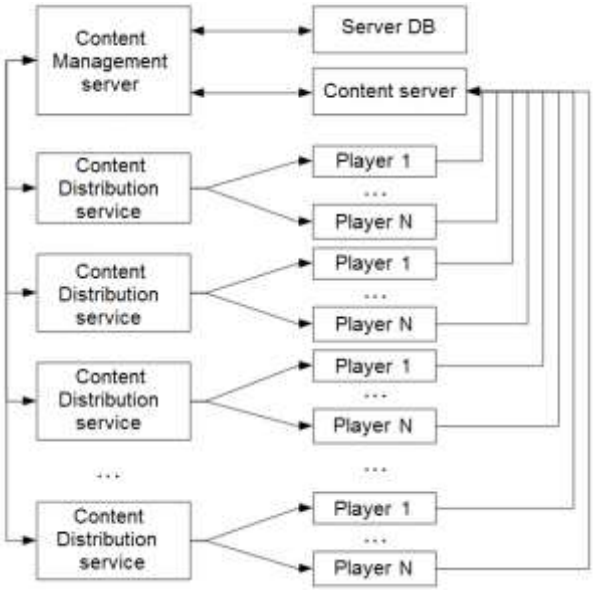

Fig.1. Scheme of the developed system.

Currently, there are a huge number of information transfer protocols. However, not all of them are suitable for the transfer of media content. For example, the XMPP protocol is great for sending text messages, but its use for streaming video is impractical because of the limitations of the protocol architecture.

The main object of HTTP manipulation is the resource pointed to by the URI in the client's request. Typically, these resources are files stored on the server, but they can be logical objects or something abstract. The peculiarity of the HTTP protocol is the ability to specify in the request and response the way of representing the same resource according to different parameters: format, encoding, language, etc. (In particular, the HTTP header is used for this.) It is thanks to the possibility of specifying the method of encoding the client message and the server can exchange binary data, although this protocol is textual.

Taking into account the fact that not only video information but also static images will act as content in the information system being developed, while further development it is planned to transmit HTML text, the choice was made in favor of the HTTP protocol [4].

The following requirements are imposed on the database management system of the application:

1. The number of failures, data loss should be minimal in the practice of using DBMS by other projects.
2. High request processing speed.
3. Minimum license cost of the most functional edition of the DBMS.
4. Maximum compliance with the standards of the structured query language SQL.
5. Low requirements for hardware.
6. Platform independence.
7. Transaction support.

Considering the above requirements for the database management system, the following DBMS are selected as candidates:

1. Firebird 2.5.2
2. MySQL 5.5.37
3. PostgreSQL 9.3.4
4. Oracle Database 12c Express Edition

Taking into account the fact that the developed warehouse accounting information system implies long-term use at the enterprise and the expected daily number of requests to the database server is about 10,000, it can be argued that the only database management system that fully meets the requirements is the PostgreSQL 9.3.4 DBMS.

The choice of programming language in the development of an information system must be compared with the tasks of the information system and the requirements for the speed of system development. You should also be guided by the experience of operating software written using this programming language.

Considering the requirements for the system, high-level programming languages such as Java and Qt, the C ++ language framework, are suitable for the implementation of the problem [5].

Java is a high-level, object-oriented, highly typed programming language developed by Sun Microsystems (later acquired by Oracle). Applications written in the Java language are translated into bytecode that runs inside a special virtual machine. Thanks to this approach, a Java application can be run on any platform for which there is an implementation of the Java Virtual Machine, without recompiling the application. The official release date of the Java language is May 23, 1995.

Over the past 19 years since the first release, Java technology has gained immense popularity and is widespread in any area of computer technology - browser applications embed [6]. In Fig.2 we can see he main application window.

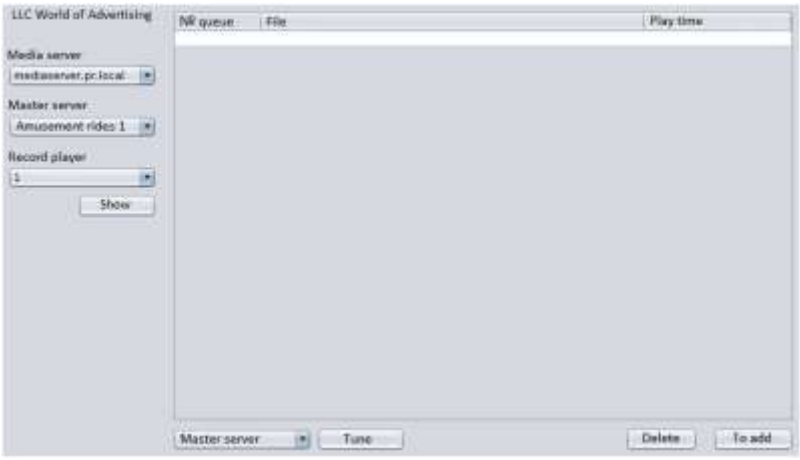

Fig.2. The main application window.

When you first start the information system is known only "Media Server". Therefore, it is necessary to add information about available content distribution services. To do this, in the drop-down list next to the "Configure" button, select the "Master Server" item and click the "Configure" button. A window will appear on which to enter information about known content distribution services. The view of this window is shown in Fig.3.

Fig.3. Form for adding information about distribution services.

After entering information about content distribution services, you must enter information about players. The player is tied to a specific content distribution service.

To enter information about the players in the drop-down list next to the "Configure" button, select "Player" and click the "Configure" button. The player information entry window will appear on the screen. The view of this window is shown in Fig.4. After entering all the necessary information, you can start working with the system.

To get information about the list of files played by a particular player, in the Master Server drop-down list, specify the content distribution service of interest we can see in Fig.5.

In the "Player" drop-down list, select the player in Fig.6.

In the right part of the main program window, a tabular view displays information about the list of playable files, the order and duration of playback. View of the information table is presented in Fig.7.

Fig.4. Player Add Form.

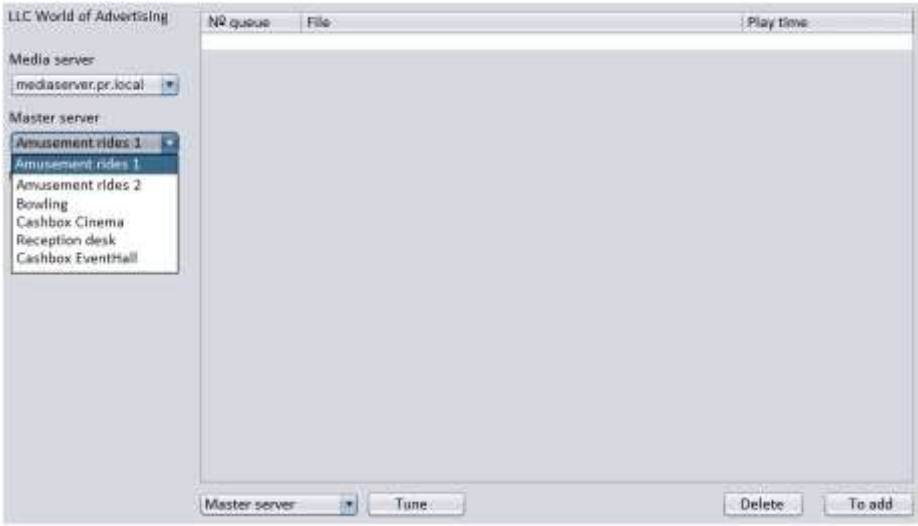

Fig.5. The choice of content distribution service.

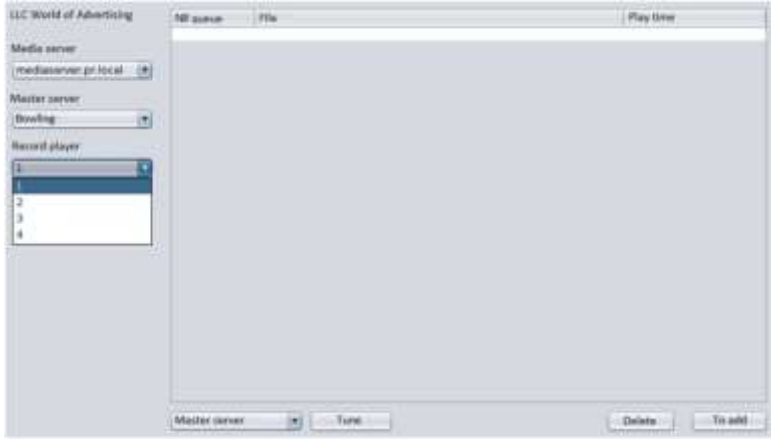

Fig.6. The choice of player.

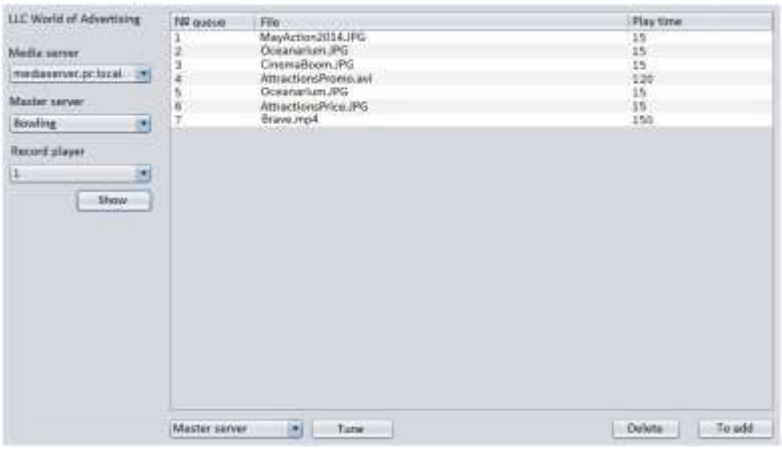

Fig.7. Information about the content being played.

Conclusion

In this paper, an analysis was made of the modern market for automated content management systems used in advertising activities. In the course of the work, the development of an automated information management system for visual media content was carried out.

The development of an automated information management system for media content is made in a high-level Java language using the PostgreSQL database management system as a data warehouse. The content playback module is made in high level C ++ language using the Qt framework. Nginx web server was used as a storage and distribution system for content.

The developed software meets the requirements - performs the assigned functions in full, is cross-platform, is not demanding on resources, has a low cost of implementation and operation.

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DEVELOPMENT OF AN INFORMATION SYSTEM TO SUPPORT LOGISTICS PROCESSES IN THE ORGANIZATION

Oleg Choporov, Kseniya Lvovich, Eugen Ružický

Abstract:

Various information flows that circulate within and between the elements of the logistics system, between the logistics system and the external environment, form the logistics information system. It is in a certain way an organized set of interrelated computer equipment, various reference books and the necessary programming tools, while providing the solution of certain functional problems of material flow management. The logistics process in the warehouse is very difficult, as it requires full coordination of the functions of inventory supply, cargo processing and physical distribution of orders. Logistics in warehouses should cover almost all the main functional areas considered at the micro level, so the logistics process in the warehouse is much wider than the technological process.The purpose of this work is to develop a subsystem of logistics analysis of the warehouse of a commercial enterprise. Given the routing of goods in a warehouse, there is a Generalized scheme of the algorithm for product placement.

Keywords:

Information system, logistic, management.

ACM Computing Classification System:

Enterprise computing, operations research, planning and scheduling, software system structures.

Introduction

In the modern world, the role of logistics continues to grow. For the most part, this is due precisely to economic reasons, since increasing production volumes in industry and the deepening of intra-national and global economic relations need more and more attention from spending cuts. Therefore, the creation of a logistic analysis subsystem for a warehouse of a commercial enterprise is a relevant goal.

The purpose of this work is to develop a subsystem of logistic analysis of a warehouse of a commercial enterprise.

To achieve this goal it is necessary to solve the following main tasks:

- learning the basics of improving warehousing activities on a logistic basis;
- development of a scheme for the operation of a subsystem for logistic analysis of a warehouse of a commercial enterprise;
- software implementation of a subsystem for logistic analysis of a warehouse of a commercial enterprise.

1 Logistic Process in the Warehouse as the Basis of Warehousing

The logistic process in the warehouse is very difficult, since it requires full coherence between the functions of supplying stocks, cargo processing and physical distribution of orders. Logistics in warehouses should cover almost all major functional areas considered at the micro level, so the logistics process in the warehouse is much wider than the technological process. It includes the following types of work [1]:

- stocking,
- control over the supply of goods,
- unloading and acceptance of cargo,
- transportation and transshipment of goods within the warehouse,
- warehousing of cargo and its storage,
- formation (commissioning) of customer orders and shipment,
- transportation of orders and their forwarding,
- collection and delivery of empty commodity carriers,
- full control over the implementation of all orders,
- informing the warehouse of orders and the movement of goods,
- customer service and service provision.

The functioning of all components of the logistics process should be considered in interconnection and interdependence.

This approach provides not only a clear coordination of the activities of the warehouse services, but also it will be the basis of planning and will allow you to monitor the movement of goods in the warehouse with minimal cost [2]. Conventionally, the whole process is divided into three parts:

1) operations that coordinate the procurement service;
2) operations that are directly related to the processing of goods and the necessary documentation;
3) operations that coordinate the sales service.

Coordination of the procurement service is carried out in the course of operations on the supply of stocks, as well as through control over the management of supply. The main task of supplying stocks is to provide a warehouse with goods or materials, depending on the possibilities of processing it for a given period, with full satisfaction of customer orders.

Thus, we conclude that the determination of the need for the purchase of stocks must necessarily take place in complete consistency with the sales service, as well as with the available warehouse capacity.

In order to ensure the rhythmic handling of cargo traffic, the maximum and rational use of the existing warehouse volume and the creation of the necessary storage conditions, to reduce the storage times for stocks, which will increase the turnover of the warehouse, it is necessary to keep records and control over the flow of stocks and shipment.

When unloading and accepting goods, you must comply with the terms of delivery, which are specified in the concluded contract.

Accordingly, it is necessary to prepare in advance the places of unloading for the specified vehicle (for example, a trailer, wagon or container), and also it is necessary to agree on the schedule of operations of the loading and unloading equipment. In modern warehouses, unloading is carried out on special unloading road or railway ramps and container platforms.

Specially equipped places for unloading and the correct choice of loading and unloading equipment and equipment will allow unloading in the shortest possible time and with minimal loss of cargo, which, in turn, will reduce vehicle downtime, and therefore, the costs of handling will be lower. This stage includes the following operations [3]:

- unloading of vehicles,
- control of documentation and ensuring physical compliance of delivery orders,
- paperwork for the arrived cargo using the information system,
- formation of a warehouse cargo unit.

Transportation of cargo within the warehouse involves the movement of cargo between different areas of the warehouse.

For example, like this: from the unloading ramp to the reception area, from there to the storage area, picking and loading ramp. These operations are performed with the help of hoisting machines and mechanisms.

All intra-warehouse transportation of goods must be carried out taking into account the minimum length in time and space along the most "direct-flow" routes. With such rational transportation, it is possible to avoid inefficient execution of operations, moreover, to prevent the return to any of the storage areas. The number of movements of goods from one type of equipment to another should be minimal.

Warehousing and storage. The process of warehousing is the placement and placement of cargo for storage. The basic principle of efficient storage is the efficient use of storage space. The optimal choice of storage system and the efficient use of warehouse equipment are the main tasks in this process. Equipment for storage must comply with the specific characteristics of the goods, as well as ensure maximum use of the height and area of the warehouse.

At the same time, the space for working passages should be minimal, and should not create difficulties and inconvenience to normal operating conditions of hoisting-and-transport machines and mechanisms. For orderly storage of goods and its economical placement, an address storage system is used, based on the principle of solid (fixed) or free (the load is placed in any free space) of the choice of storage location.

The process of storage and storage involves the following steps [4]:

- laying the cargo for storage,
- storage of cargo and ensuring the required storage conditions,
- control of stocks in the warehouse, which is carried out using the information system,
- a complete set (commissioning) of orders and their shipment
  which are reduced to preparation of goods according to orders of consumers.

Package and shipping include:

- receiving an order from a client (selection list),
- selection of goods in accordance with the customer's order,
- complete set of selected goods for a specific client in accordance with the order,
- preparation of goods for shipment (packing in a container, on a commodity carrier),
- preparation and execution of documents for each order,
  as well as control over the readiness of the order,
- consolidation of customer orders in the consignment of sending
  and registration of bills of lading,
- shipment of goods by vehicles.

The commissioning of customer orders is carried out in the picking area, and the preparation and execution of documentation is carried out using an information system. Address storage system organizes the place of the selected goods in the selection list, thus, the selection time is significantly reduced, besides it allows you to track the release of goods from the warehouse.

When using an information system, the bundling of shipments and the performance of cargo consolidation into an economical consignment of shipment is greatly simplified, which makes it possible to use the vehicle as efficiently as possible. In this case, you can choose the most optimal route for delivery of orders. Shipment is made on the loading ramp.

Transportation and expedition of orders can be carried out both at the warehouse itself and directly by the customer. The last option will be rational only in the case when the order is carried out in batches equal to the capacity of the vehicle, thus, the consumer stocks will not increase. The most common and cost-effective centralized delivery of orders by the warehouse. In this case, a significant reduction in transportation costs is achieved due to cargo consolidation and optimization of delivery routes, and it also provides a real opportunity to make deliveries in smaller and frequent shipments, which, in turn, will lead to a reduction in unnecessary insurance stocks with the consumer.

Collection and delivery of empty commodity carriers are of great importance in the item of expenditure.

Commodity carriers, such as pallets, containers, tare-equipment, for transportation within the city can most often be used several times, so they will need to be returned to the sender. The effective exchange of commodity carriers can be carried out only in cases when it is possible to reliably determine their optimal quantity and subject to the schedule of exchanging them with consumers.

2 Optimization Criteria and Performance Indicators

Indicators of efficiency of storage systems can be divided into the following groups [5]:

1. Indicators characterizing the degree of customer satisfaction.
2. Indicators reflecting the quality of the warehouse.
3. Indicators of quantity and time.
4. Cost indicators.
5. Indicators of financial and economic results.

The first group includes the assessment of the level of order fulfillment by consumers, the return of goods by consumers due to incorrect picking, packaging failures, etc., the number of delays in shipment of goods, complaints from consumers, service level indicators, and others.

The second group of indicators partially complements the first, but mainly contains indicators that directly characterize the quality of the warehouse. These indicators are conventionally divided into indicators that reflect the accuracy of the order parameters (that is, meeting deadlines, volume, quality, assortment assortment, etc.), order fulfillment (stock level maintenance accuracy, stock availability, storage conditions, etc.). p.), compliance with the internal warehouse operation (cases of loss, damage, theft, etc.).

The third group of indicators characterizes the time of logistic cycles: the time of replenishment of stocks, processing of consumer orders, preparation, picking and delivery of orders, procurement of goods and others.

Indicators of the fourth group show the costs of inventory management, the cost of transportation in the territory of warehouses, cargo handling and storage, packaging and other logistics costs.

In the fifth group shows the financial and economic results, which are a set of derived indicators leading four groups. These include: inventory turnover (number and turnover period), number of warehouses loaded, warehouse volume used, warehouse capacity, number of daily turnover operations, logistic costs per unit of turnover for a certain amount of time, turnover of invested capital in fixed assets of the warehouse, time payback of fixed assets between inventories, costs of commissioning, packaging and other actions per unit of turnover, and others. In Table 1, these indicators are grouped by factors.

Table 1. indicators of efficiency and effectiveness of the logistics process in stock

Key factors	Performance and Performance Indicators
Warehouse service	- Ensuring the implementation of the order by the deadline; - Completeness of the order; - Accuracy of order parameters; - Accuracy of maintaining inventory levels; - The number of returns orders; - Errors in the execution of orders;
Warehouse service	- Cases of loss, theft, damage, etc .; - Return of goods by buyers; - Consumer claims; - Evaluation by consumers of the quality of service
Use of investment	- Speed and number of stock turns; - Use of working capital; - The average level of stocks in stock; - Return on investments in fixed assets; - Use of investments in technological (lifting and transport) equipment;
Logistic costs	- Inventory management costs; - Expenses for internal warehouse transportation; - Costs associated with the quality of products and services (damage from insufficient quality levels, loss of sales, return of goods, obsolescence of stocks, etc.); - Expenses for warehouse handling and storage; - Total logistic costs; - Total logistic costs per unit of warehouse turnover;
Logistic cycle time	- Customer order processing time; - Order delivery time; - Preparation time and order picking; - Load time;
Performance	- Number of orders processed per unit of time; - Freight shipments per unit of warehouse capacity; and cargo capacity of vehicles; - Use of storage space; - Number of cargo handling operations per hour;

3 Organization of Warehouse Processes With Elements of Logistics

Properly equipped technological process of the work of the warehouse enterprise should provide [6]:

- timely reception by quantity and quality of goods;
- rational explantation of mechanical means of loading and unloading and transport and warehouse operations;
- organized dispatch of goods with maximum use of the warehouse area when storing goods and other material values;
- organization of the trading halls, operations for the selection of commodity values, picking and preparing them for the release;
- regular dispatch work and the organization of timely delivery of goods to the halls of sale;
- consistent implementation of warehouse operations, which provide regular and systematic workload of warehouse workers, and provide favorable working conditions.

To optimize the timing and methods of execution of warehouse operations is applied the modeling using various methods. The modeling of processes in the warehouse is used to determine the routes of commodity flows, the choice of standards for workflow, the formation of the organizational structure and algorithms of functioning.

According to the results of the simulation, they identify the name of operations at each workplace, generate process flow charts, determine job descriptions, and select equipment to equip the warehouse.

Modeling logistics processes in a warehouse should begin with the standardization of warehouse processes. Standardization implies the development and use of standards for technological operations, including loading and unloading, acceptance of goods by quantity and quality, equipment, storage and many other warehousing operations.

High quality of the process is possible to ensure, provided that each participant clearly performs his or her role in it, as well as is trained in the actions that he must perform in various situations.

It follows that a great need arises for the formalization of processes with a clear description of the algorithms of actions in special documents. It is important to compile all the documents in a single structure, give them consistent and clear descriptions that are easy to read and do not allow for different interpretations.

Standardization of technological processes in warehouses can significantly reduce the time spent on training employees, helps in solving problems in the division and cooperation of labor.

Improving the quality of services provided by the warehouse and increasing productivity (that is, reducing downtime, cargo handling time) is the main goal of developing technological standards.

For a working warehouse, standardization must begin with a process analysis. A simple description of the existing procedures and control of their implementation can give a significant reduction in the time to perform operations (from 2 to 5%).

The analysis of the stages of technological operations at the warehouses of trade reveals the approximately identical nature of these operations and has the following steps:

- unloading of transport;
- acceptance of goods, carried out by quantity and quality of goods;
- packing of goods for preservation;

- direct storage of goods;
- sorting of goods;
- packaging of goods in containers for transportation;
- completing delivery lines;
- loading of complete sets of goods on transport for delivery to buyers.

The further path of the goods is determined by a number of factors, the main of which are: the type of the consignee and its location, the method of shipment of goods, the type of packaging of goods, the type and method of work, etc.

In order to clearly organize the work in the warehouse, it is recommended to make flow charts that are developed for specific warehouse conditions and in accordance with the process flow diagram [7].

Technological cards reveal the basic composition of operations and transitions, establish the order of their execution, determine technical conditions and requirements, and also form data on the composition of equipment, devices and mechanisms required in the process of performing the operations provided by the cards.

For example, routing cards for a warehouse of wholesalers should contain a lot of information about the initial conditions for the work; about the place of their performance; about the participants of the process; about the content of work with material and information flows; that is, all the information that is used or formed (which documents are prepared or used) in the course of the work; about the mechanisms and technologies used in the course of work.

Analysis of the enterprise activity allows building a qualitative model for acceptance of goods by quantitative and qualitative criteria. However, there is no perfectly formed model for the release of goods.

The developed technological map is presented in Fig.1.

Routings are designed for the entire process, or for its individual stages, it is advisable to use together with network schedules. As well as the network schedule, the technological map reflects the entire system of the warehouse process, but not in a temporary, but in a technical-technological context.

The description of the technological process presented in the map is supplemented with a detailed description of its individual procedures.

In addition to technological charts, daily work schedules should also be drawn up in the warehouse, which systematize the execution of warehouse operations by time (shift, day, etc.) [8]. For example, in order to efficiently use hoisting equipment, it is necessary to develop schedules that regulate the operation of loading and unloading mechanisms during the work shift.

To organize the rhythm of work in the warehouse, it is necessary to develop schedules for the arrival of customers at the warehouse on certain days, weeks and hours for the selection of goods. Such graphs allow the warehouse to work evenly during the working week, month, etc.

Technological schedules of the expedition are designed to ensure timely delivery of goods to consumers, acceptance of goods that may arrive during off-hours, planned loading of vehicles and timely preparation of goods and transport documents.

4 Algorithm Automated Placement of Goods in the Warehouse

In order for the algorithm of automated placement of goods in the warehouse to work correctly, you need to enter data into it, in particular, the logical structure of the warehouse. It is the logical structure of the warehouse that determines the further method of combined storage.

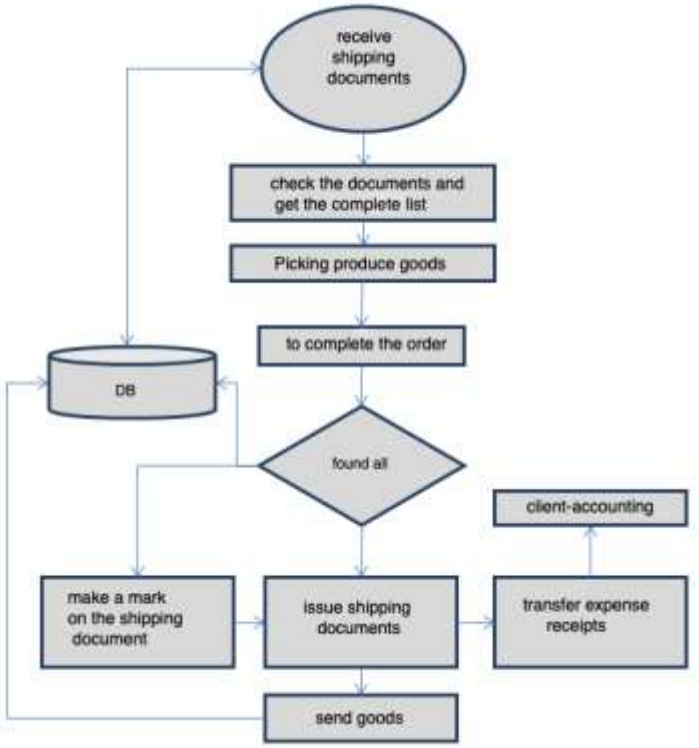

Fig.1. Technological map of the release of goods in stock.

Usually, warehouses are divided in several different ways. One example of such a method is the ABC analysis method - this is a method developed based on the nomenclature turnover rules [5]. A similar warehouse partitioning is performed using the functionality of the storage areas. A warehouse is divided into storage areas - warehouse locations that have similar parameters (for example, how close to the loading and unloading areas, the same temperature, security mode, etc.). Each storage cell is assigned a storage area, and the cell must simultaneously belong exclusively to one storage area. In turn, storage areas can be combined into storage areas. Storage areas are a specially ordered list of storage areas so that the priority of the area within the zone is preserved. A zone can include only one area. At the same time one storage area can consist simultaneously in several storage areas. You need to set several attributes for each area to get to the storage area. You can set the following attributes:

- priority: priority of the area within the zone;
- class ABC: the class can take the values A, B, C, which determines which class of goods (in accordance with ABC analysis) is preferably stored in this area.

The location of the item is set through the storage area. Each commodity-nomenclature group is assigned a zone, which allows the algorithm for determining storage cells to maximize the use of storage space for incoming goods. In the case when the storage area contains several areas, when the algorithm tries to store the cargo in the first area, the system will find that there are no places, then it will attempt to arrange this cargo in the next area. When searching takes into account priorities.

The scheme of the algorithm for automated placement of cargo in the warehouse is shown in Fig.2. The essence of the algorithm is the following: for the cargo arriving at the warehouse, the commodity-nomenclature group is included, into which it belongs [5]. According to the article of the commodity-nomenclature group, the storage area is determined. After that, in order to determine the area in which the load can be placed, one of these steps will be performed:

a) Placement of cargo in free cells

To place the cargo in free cells, you must specify the priority of the area within the zone. The cells are sorted in order of priority in each suitable area and a free cell is searched. The first free cell found is the load.

b) Placement of cargo using the ABC-classification (compatibility is controlled when placing)

To prevent selection errors, you can prohibit finding goods with different batches, expiration dates, or batch numbers in the same cell, if required.

The control of the residuals and the employment of cells is carried out by dividing the N nomenclature into three own inequivalent subsets A, B and C (N = A∩B∩C), or the equivalence class based on some formal algorithm of all consumed material resources, realized values and others.

In a specific case, the division algorithm looks like this: first, the total number of applications that came in over a certain time is highlighted, then the result is divided by the total number of positions in item N, and as a result of these calculations, the average number of applications P is displayed for one position of item N.

In turn, the subsets A, B and C can be considered as ordered sets

$$(A =< a_1, a_2, \dots, a_k >, \quad B =< b_1, b_2, \dots, b_k >, \quad C =< c_1, c_2, \dots, c_k >)$$

All elements are included in the subset A, if they are six or more times greater than P. The subset C includes all the elements that are two or more times smaller than P. All other elements are included in the subset B.

The likelihood of demand for material resources from the subsets A, B and C is subject to various distribution laws. It has been established that in most industrial and trading firms approximately 75% of the value of stocks covers about 10% of item names (subset A), 20% of cost — respectively, 25% of items (subset B), 5% of cost — 65% of items (subset C).

In order for this method to work correctly, you need to set the priority of the area within the zone and the class of ABC for each zone. Area A includes the most easily accessible cells (as a rule, these are lower shelves and closest to the loading / unloading zone), since the goods with the highest turnover (class A goods) will be placed in them. The area of class B will include cells that are less accessible (the second tier of shelving); the goods with average turnover (class B) will be stored in this area. The most difficult-to-reach shelves (upper shelves) will belong to a class C area, the class C goods with the lowest turnover will be stored in this area.

The following actions after the distribution of ABC classes for regions and goods, when accepting goods, determine its class. Based on this information, in the zone are selected the areas most suitable to its class. Then there is a check on the availability of space for placing this cargo in areas of a similar class, in the order that is determined by the priority of areas within the zone. And only after that there is a check of places in areas of other classes. The search order depends on the nomenclature class and is given in Table 2.

There are cases when the placement of goods with different series, expiration dates or batch numbers in one cell.

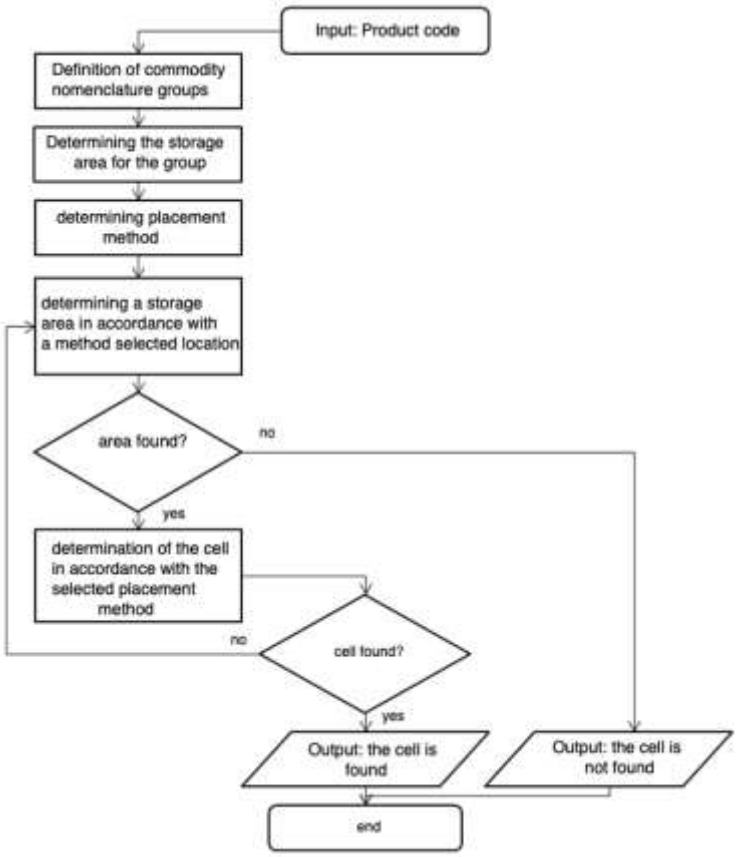

Fig.2. The generalized layout of the product placement algorithm.

This condition is also verified. The load is also placed in the first suitable cell. The classification of the nomenclature when placing in accordance with the ABC classification can be carried out at intervals of a week or a month to account for changes in demand for the goods.

Table 2. Search procedure for a free cell

Nomenclature class	Search order
A	A > B > C
B	B > C > A
C	C > B > A

c) Placement of cargo in occupied cells to an identical or similar cargo (if possible)

When placing to a similar cargo is a compatibility check. To exclude the possibility of selection errors, it is necessary to follow the prohibition of finding a cargo with different batches, expiration dates or batch numbers in one cell, if necessary.

When placing loads in already occupied cells to an identical or similar load, it is necessary that the priority of the area within the zone be determined. In order of priority, in each area, a cell is searched with a load from the same commodity-nomenclature group as the load being placed. If the placement of cargo with different series, expiration dates or batch numbers in one cell is prohibited, this condition is checked and the cargo is placed in the first suitable cell.

d) Placement of cargo in occupied cells to any cargo.

This step can be used when you need to save space in the storage room. In order of priority, in each area, a cell with a load is searched for, all the conditions for placing the load in the given cell are checked, and the load is placed in the first suitable cell.

5 Software Implementation of the Subsystem of Logistic Analysis of a Warehouse of a Trading Enterprise

The program has a separate window for each type of work, between which the user can switch. The program has functions that do not require separate windows and can be performed in the current window. Figure 3 shows the visual structure of the program.

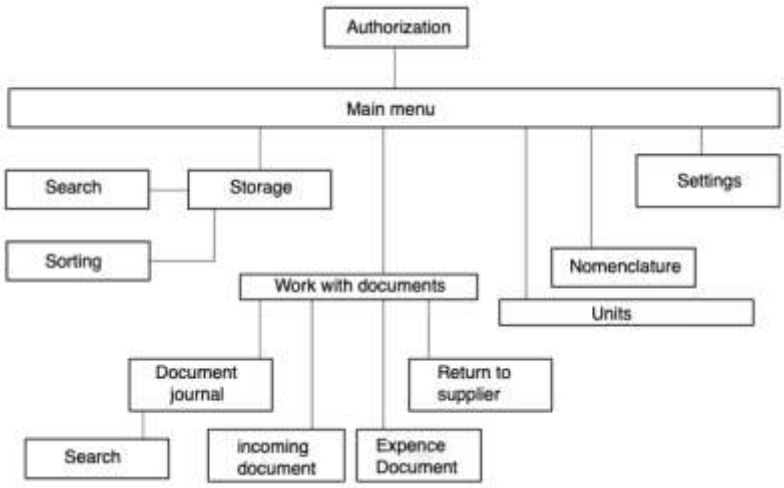

Fig.3. The generalized layout of the product placement algorithm.

Conclusion

During the performance of the paper, the basics of improving warehousing activities on a logistic basis were studied, which allowed us to identify criteria for evaluating the effectiveness of the organization of the warehouse. A scheme was developed for an information system that uses logistics as a tool for organizing efficient warehouse operations.

The developed scheme was successfully implemented in accordance with the technical specifications and tested in the enterprise. This made it possible to simplify the work of ordinary workers, thereby increasing labor productivity and reducing the time for training new warehouse workers without losing the possibility of centralized control and data management. The development does not stop at this stage, the management of the company encourages the further development of the program improvements.

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THE MODERN AND INNOVATIVE WASTE WATER TREATMENT PLANT

Ján Cigánek

Abstract:

The modern and innovative waste-water treatment plant (WWTP) was developed in cooperation of two partners - Slovak University of Technology in Bratislava and private industrial company Tercial, a member of BOST Group. WWTP achieves exceptionally high and stable treatment values over a long period. The treatment plants are suitable wherever it is too expensive to build a multi-kilometre long connection to existing sewage networks, in areas with increased environmental protection and where the construction time and the size of the built-up area play an important role. WWTP is mobile container with individual construction parts - modular system which can be modified according to the customer's requirements and location properties. The main innovation is in usage of membrane bioreactors (MBR) and nanotechnologies with unprecedented 99% efficiency which is achieved by modern control, scanning and communication technologies. The innovative waste water treatment plant is managed and controlled by SCADA system what will allow its optimal performance, fast information on failures, fast and effective service and prolonged lifespan. Intelligent SW control (PLC with HMI) will allow remote centralized management and fast service interventions with the minimisation of personal and service costs.

Keywords:

Environmental protection, membrane bioreactor,
mobile container, modern control system,
SCADA system, waste water treatment.

ACM Computing Classification System:

Hardware, emerging technologies,
analysis and design of emerging devices and systems,
emerging tools and methodologies.

Introduction

Environmental protection is one of the key values of Tercial, a member of BOST group. In cooperation with Slovak universities, it has developed a modern and innovative system of wastewater treatment using membrane bioreactors. Water Beast 700 is a modern container wastewater treatment plant with a treatment capacity of 100 m^3 per one day, which is sufficient for approx. 700 PE (population equivalents).

Water Beast treatment plants achieve exceptionally high and stable treatment values over a long period. The treatment plants are suitable wherever it is too expensive to build a multi-kilometer long connection to existing sewage networks, in areas with increased environmental protection and where the construction time and the size of the built-up area play an important role.

The usage of innovative waste-water treatment plant is suitable for:

- municipalities,
- industrial objects,
- commercial objects,
- crisis areas,
- areas with an increased level of environmental protection.

1 Treatment Process

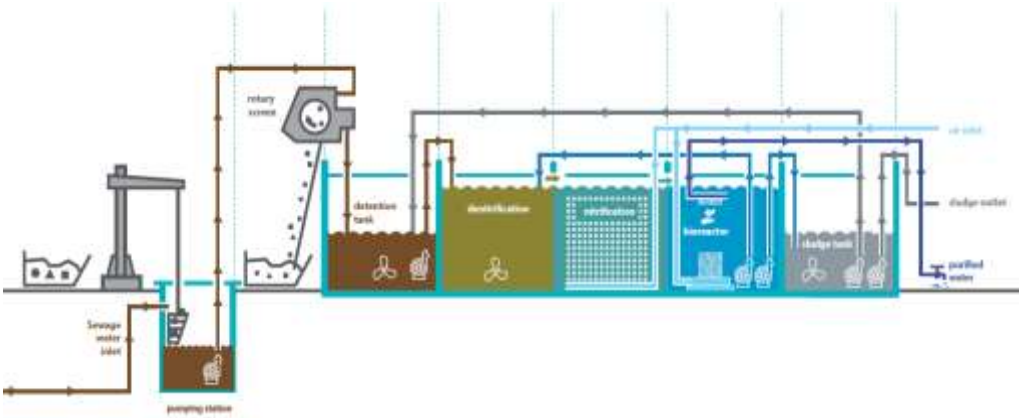

Fig.1. The basic scheme of the treatment process.

1.1 Input pumping station

The input pumping station is used to pump wastewater from the inflow sewerage level to the accumulation section of the process tank.

The pumping station (PS) consists of a shaft with a diameter of 2-2.5 m. Its depth depends on the depth of the input sewerage, inflow unevenness and is fully adapted to the local conditions.

The PS includes a bar screen basket for retaining solids with gaps between individual bar screens of 20 – 25 mm. When the basket is full, it is emptied into a collecting container using a bracket jib crane. Pumps in the pumping station will be designed for a maximum calculation inflow. One pump constitutes a 100 % backup for the other one.

1.2 Mechanical pre-treatment

The mechanical pre-treatment is provided by the bar screen basket in the input PS and subsequently by a rotary screen with openings with a diameter of 0.5 mm. Here, insoluble substances of sizes larger than 0.5 mm are separated from the inflow wastewater. Rotation of the drum pushes impurities into a chute and into an adjacent container. The rotary screen is located above the accumulation section of the process tank.

1.3 Biological treatment in the process container

The process container is divided into sections in which the biological treatment process takes place gradually using activated sludge (specific mixture of micro-organisms), which removes individual components of pollution during the biological treatment process. The tank consists of the following sections:

- accumulation section,
- denitrification section,
- nitrification section,
- MBR section,
- sludge tank.

1.4 Accumulation section

The accumulation tank is used to balance the inflow unevenness during the day, thus ensuring a continuous and uniform treatment process in the following sections. This section contains submersible pumps, which pump water into the next denitrification section. The pump is switched on and off depending on the setting of the level sensor and the level drop in further sections. The tank also contains a submersible propeller stirrer ensuring homogenization of water intended for treatment. The accumulation section also receives back water returning from the sludge dewatering section.

1.5 Denitrification section

The denitrification section follows the accumulation tank and is used to remove nitrogen pollution from the wastewater, namely by converting nitrate and nitrite forms of nitrogen into gaseous nitrogen. At the same time, partial degradation of carbon pollution stemming from the organic substrate takes place here. Correct functioning of the denitrification reactor requires continuous homogenization of its content by the installed submersible propeller stirrer. The inlet of the recirculation, which ensures the return of activated sludge from the membrane bioreactor, also discharges into this section.

1.6 Nitrification section

It follows the denitrification section, into which a mixture of polluted water and activated sludge flows gravitationally over an overflow edge. The nitrification section enables biological removal of carbon pollution, which reduces COD and BOD5, and, at the same time, oxidation of nitrogen pollution in the form of ammoniacal nitrogen up to nitrates takes place here. This process requires oxidation of treated water. For this purpose, fine-bubble membranes ensuring uniform airflow across the whole area of the section are located on the tank bottom. Necessary amount and pressure of air are ensured by a set of blowers located in the blowing plant.

1.7 Membrane bioreactor – MBR

Treated water flows into the section by overflowing from the nitrification section. The section contains a membrane bioreactor (Fig.2) embedded with membrane units with a total surface area of 420 m^2. Cleaned water rid of activated sludge and bacteria is extracted through pores in the membrane walls with a size of 0.04 μm from the inside of hollow fibers into a collecting tank for cleaned water. Water thus cleaned does not contain almost any insoluble substances and most of the bacteria [1], which is why it can be used as service water for irrigation and for the restoration of natural water areas and wetlands.

Fig.2. The membrane bioreactor MBR.

Cleaned water can be used for:

- Cyclical back-flushing of membranes.
- Spraying the rotary screen of mechanical pre-treatment.
- As service pressurized water for secondary use in the treatment plant.
- In the WWTP (Waste Water Treatment Plant) sanitary facility for flushing.

The flow of the mixture of treated water with sludge around the outer walls of the membranes is solved by an aeration system located at the bottom of the bioreactor. The membraneless filtration process follows the following regime:

- 20-25 min. extraction of cleaned water from the membrane walls into the collecting tank.
- 5-7 min. a back-flushing of the membranes with the cleaned water from the collecting tank.
- 1 min. in the last phase of the flushing a chemical is dosed by injecting a sodium hypochlorite or citric acid solution.

The whole process of cleaned water extraction and membrane module back-flushing cycles are programmatically controlled using the PLC system.

Extraction of cleaned water from the bioreactor tank causes sludge densification in the section. Submersible pumps with a backup are located in the section together with the bioreactor. These provide the following functions: the pumps provide the pumping of the returned sludge back to the treatment process in the denitrification section. The recirculation coefficient is adjustable within the range of 2–5 times the WWTP output.

An airlift pump is switched on automatically after the sludge density in the bioreactor section reaches 12-15 g/l and pumps superfluous sludge into the sludge tank (sludge collector).

1.8 Sludge management

The last section in the process tank is the sludge tank, which is divided into two parts with a different volume by a dividing barrier. Superfluous sludge from the MBR (Membrane BioReactor) section is pumped into the first part, whose volume takes up ¾ of the sludge collector, and not only gravitational densification of the sludge and the offsetting of sludge water, but also the completion of sludge stabilization takes place here as it is provided with both a stirrer and aeration.

The offset sludge water falls into the other tank part over the barrier and when it is full, it is pumped with the submersible pump into the accumulation tank. Homogenized sludge with dry matter of approx. 20-30g/l, which is monitored with a sludge probe, can be pumped out using a faecal suction truck or pumped into a sludge dewatering line.

2 Constructions and Options

The proposed treatment process is offered in two basic construction forms:

- Water Beast 700 - Container treatment plants with a membrane bioreactor designed for 700 – 2100 inhabitants (100 – 400 m^3 of waste water per one day),
- Water Beast 5000 - Wastewater treatment plants with a membrane bioreactor designed for 5 000 – 15 000 inhabitants (800 – 3000 m^3/day).

2.1 Water Beast 700

Container WWTPs are delivered pre-assembled. A very short time of delivery and putting the facility into operation is needed (from 3 to 6 months).

They consist of two basic modules, each with dimensions of a transport container for simple transport and assembly. They are equipped with the state-of-the-art treatment technology using membrane bioreactors.

Fig.3. Water Beast 700.

The container tanks are covered. The covers are also used as service platforms for the maintenance and repairs of technological equipment. All the equipment inside the tanks (pumps, stirrers etc.) is adapted to allow its easy and quick replacement. The container tanks may be located on the surface, as half-embedded or fully embedded.

Depending on climatic conditions, the will be provided with suitable thermal insulation. Submersible equipment is already installed in the lower part. A service platform with laid segments of distribution pipelines is located in the upper part. Both parts will be joined together and sealed at the place of assembly. The inner surfaces of the tank and covers are provided with a special zinc-containing coating resistant to the water being treated.

In addition to the basic container modules, we also supply service containers containing supplementary technologies, a control center, and a blowing plant. The treatment plant is pre-assembled and during the on-site assembly it is only necessary to interconnect pipelines, electric distribution lines, process tanks and make a connection to the WW (Waste Water) pumping station.

2.2 Water Beast 5000

Water Beast 5000 offers a solution to minimize construction works and quickly deliver the treatment plant and put it into operation.

Process tanks are circular with inner division of individual tanks. They are made up of metal sheets enameled on both sides, mutually screwed together and sealed. They are placed on a water-resistant reinforced concrete plate.

6m high tanks may be supplied as open or roofed, equipped with thermal insulation or without it. Auxiliary operating facilities consisting of a control room with a sanitary facility, a bioreactor and sludge dewatering control are also delivered fully assembled, at the construction site they just have to be mutually interconnected and connected to the process tanks.

Fig.4. Water Beast 5000.

The technological equipment is supplemented with a sand separator and adapted to the designed output. The operation of this type of treatment plants is fully automatic with the possibility of remote control via mobile devices or PC. We give a WWTP with an output of 1000 m^3/day as an example. It consists of three circular tanks with the following parameters:

- The accumulation tank is located in the circular tank itself with a diameter of 8.57 m and height of 5.8 m with a volume of 330 m^3. It contains a sand trap, a stirrer and pumps for pumping the treated water into biological treatment tanks. The mechanical pre-treatment and thereafter also the interception of fats and oils of plant and animal origin (if the character of mainly industrial WW requires it) takes place separately before entry into the accumulation tank.
- The treatment process tanks - they include 2 concentric circular tanks, the outer tank has a diameter of 11.14 m and a height of 5.8 m, the inner one 6.86 m. The inner tank with a volume of 211 m^3 is used as a denitrification tank. The space in the annular area is divided into 3 parts with dividing walls: the anaerobic section with a volume of 71 m^3, the nitrification section 177 m^3 and the bioreactor section 106 m^3.

2.3 Supplementary technological equipment

Separation of ballast water from wastewater is necessary in a place with a single-pipe system. The equipment – an overflow (OF) – is located in the preliminary shaft ahead of the inflow of the WW into the pumping station.

The OF is a certified finished product allowing a WW volume of Q_{max} to be conveyed into the WWTP and the WW volume to be relieved into the by-pass, thinned in a proportion required by legislation, which will flow to the recipient either through the rain tank or directly.

The filling of the rain tank is enabled by a motor-operated slide, which opens and closes the entry into the rain tank from the by-pass. In the case of torrential rain, the slide opens from the by-pass into the rainwater retention tank. In normal operation, the slide is in the open position into the WWTP, closed into the by-pass. In the case of torrential rain, the inflow into the treatment plant is closed and the inflow into the by-pass or the rainwater retention tank opens simultaneously. The control may be remote or automatic via a rain sensor.

The basic version envisages the transport of aerobically stabilized sludge, gravitationally densified to 20-25 g/l using a faecal suction truck to the nearest big treatment plant for further processing. If it is not possible, we offer to add equipment for sludge dewatering by pressing using a screw press or a screen belt press. The pressed sludge cake contains 20 % of dry matter and its further use must be in accordance with legislation on the handling of sewage sludge. It can be used as a garden or field fertilizer.

Water from the press – the filtrate – flows into the collecting tank and returns to the accumulation section of the process tank via a pump. The equipment is located in a separate container together with a device for inserting and dosing the flocculants into the sludge before the pressing process. Composted sludge can be used as a quality garden or field fertilizer.

The quality of the cleaned WW and its wholesomeness allow its reuse for flushing the technological equipment for WW pre-treatment, sludge dewatering equipment, in sanitary facilities for flushing the toilet, the maintenance of green areas in the WWTP area etc. Further usage of the cleaned WW is possible while using it as service water for agriculture, e.g. for irrigation during the growing season and other purposes. The equipment consists of a pressure water station connected to a distribution pipeline to places of its direct consumption. Cleaned WW not used for the above purposes flows into the recipient, to wetlands etc.

Removal of phosphates is suitable for higher outputs and high pollution of wastewater by phosphate compounds and wherever required by environmental authorities. The treatment is done using the simultaneous coagulation technology. Phosphor is normally coagulated using ferric or ferric-aluminium coagulants, dosed into the denitrification section. The equipment consists of a separate solution reservoir and a dosing pump, which doses the chemical into the denitrification tank in a set ratio.

It is possible to use solar energy on the WWTP by installing photovoltaic cells. Energy gained from them is used for lighting, as a backup power supply for the control system, or to drive part of the technological equipment. The solar system contributes to the reduction of electricity running costs.

2.4 Operating facilities

Operating facilities are used to provide utilities, operating media and the overall operation of the treatment process in the basic configuration. These operating facilities are designed to be located in transport 20’ containers with dimensions 6 x 2.4 x 2.52 m and are delivered with the following equipment:

1. Blower operation facility – The equipment in the container provides compressed air necessary for the aeration in the nitrification section, for the bioreactor and airlift pump modules. Three pieces of Roots blowers are located here: for nitrification, for the bioreactor module and one backup blower with an automatic start for one or the other branch. The operation is controlled from a central control room. The blower output is controlled using frequency converters and in the nitrification also based on oxide probe data.

2. Bioreactor automatic control operation facility – The container contains a cleaned water balancing tank, reversing pumps for sucking off water from the bioreactor into the balancing tank. They also provide the flushing of membranes during reverse operation. The output of the pumps is controlled using frequency converters based on pressure and flow sensors. If the set membrane resistance is exceeded, they automatically switch the reverse operation to the back-flushing. An automatic water station is also connected to the balancing tank. This automatic water station provides pressurized water for the rotary screen, a sludge dewatering line and other use of cleaned water for utility purposes. Furthermore, chemical tanks can be found here, which are placed in safety tubs, as well as dosing pumps of chemicals, which inject a dose of a chemical (a sodium hypochlorite or citric acid solution) right at the entry of the back-flushing water into the bioreactor module at selected cycles during the membrane back-flushing.

3. Control room and sanitary facility – Here is the room of the central electric switchgear and control system for the automatic control of the technological process of the WW treatment, the control of external lighting, heating, security cameras etc., with a direct connection to the internet network. Another part houses a sanitary facility with a toilet, shower and a changing room for occasional operators, also a laboratory with basic equipment for taking samples and performing necessary analyses of the WW and sludge.

2.5 Remote control

The latest generation of PLC, a database and visualization system, works under both the Android and iOS systems. After it is connected via the internet, it is any time capable of monitoring the state, correcting the automatic WWTP control or switching the operation to the manual mode. The visualization system provides timely alerts to changes of process values beyond required ranges, which helps prevent emergency situations of the WWTP. For service purposes, it is possible to retrospectively monitor all states, alarms and messages. Remote diagnostics and preventive maintenance thus help you substantially reduce service costs and predict potential emergency situations. We offer the possibility to connect to the manufacturer‘s dispatching.

Statistical evaluation of selected process parameters representing the amount of cleaned water and energy consumption at selected time intervals goes without saying.

Conclusion

The proposed treatment process with membrane bioreactors offeres several advantages in comparison with conventional types of wastewater treatment plants:

- 1/3 built-up area compared to conventional WWTPs;
- low construction costs;
- a very short manufacture, installation and commissioning time (3-6 months);
- usage of cleaned water as service water;
- the possibility of discharge into low-flow watercourses;
- an application for remote control and for checking the condition from a PC, smartphone or tablet;
- saving of costs related to the construction of a system of concrete tanks;
- high treatment efficiency, for some indicators up to 99 %;
- fully automatic and almost unattended operation.

A typical site for embedding a container WWTP with a MBR is an agglomeration of minor municipalities and settlements in mountain areas with recreational facilities or sports facilities, hotels and hostels. This is an opportunity to reuse well cleaned water and also a possibility to retain it in the area. The dewatered stabilized sludge produced from the WWTP is suitable for use in local compost plants and for agricultural purposes in plant production. Due to its high efficiency the treated water can be (re)used also in little watery watercourses even with very high environmental protection level.

Acknowledgement

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DEVELOPMENT OF AN AUTOMATED WORKPLACE OF THE EXPERT IN ROOFING MATERIALS

Igor Lvovich, Alexander Plotnikov

Abstract:

Currently, a variety of software tools are widely used when working with a computer. Among them are automated information systems. Information system (IS) - a system of processing, storage and transmission of any information that is presented in a certain form. In modern computing IS is a software package that allows you to securely store data in memory, perform data conversion and perform calculations using a convenient and easy-to-use interface. The purpose of this work is to develop an automated workplace specialist roofing materials, performing the calculation of the flow and the presence of material residues, as well as the calculation of the cost and timing of work.

Keywords:

Automation, information system, workplace.

ACM Computing Classification System:

Enterprise computing, operations research, planning and scheduling, software system structures.

Introduction

In the modern world, in an age of flourishing computer technologies, there is a growing desire and desire to share manual and hard human work with powerful multi-core computers to increase productivity, thereby facilitating problem solving for workers, scientists, engineers, designers various fields of activity and management personnel. Accordingly, the problems of all kinds of process control automation are becoming very relevant today. To speed up the work of the staff and to work quickly, a huge amount of data is perfectly handled by computers installed directly in the workplaces of specialists [1]. An increase in automated workplaces may follow from this. Computers have penetrated into all sectors of the national economy and the need has arisen to develop an automated workplace for a roofing materials specialist, as there is a need for instant calculation and proper distribution of material and financial resources together with the proper organization and distribution of human resources. Roofing materials specialist needs a quick calculation of upcoming work, information about the material in stock and instant calculations of the cost of the order.

The purpose of this paper is to develop an automated workplace specialist for roofing materials, performing the calculation of the flow and the presence of material residues, as well as the calculation of the cost and timing of the work. With features to add, remove materials, orders and suppliers.

To achieve this goal it is necessary to solve the following main tasks:

1. Understand what is an automated workplace.
2. Separate the main types and classifications of APM.
3. Create an information model of the automated workplace of a specialist in roofing materials.
4. Describe the information support of APM.
5. To implement a software for the automated workplace of a specialist in roofing materials.

1 Information model of the APM of the specialist

To create our information model of an automated workplace, it is necessary to answer the questions: “What do we want to see at the end?”, “What information will we store and will we keep information at all?”, “What data operations will we perform?” And “With which software just we want to work? ". Answering these questions, we collect a set of information characterizing the essential properties and states of the automated workplace object and on the basis of this information an information model will be built [2].

At the output, we want to see a software product running on most modern computers that uses a minimal set of peripheral devices, that has cross-platform, accelerates the work of the operator and naturally performs the necessary calculations [3].

In order to answer the question about stored information, you need to figure out what information will have to work. A computer cannot make all physical work for the person, but what a person can calculate in a few hours a computer can decide in an instant. The roof workman can cover the roof, but the computer does not. The workman can make calculations on a piece of paper, spending a lot of time, while this work can be entrusted to a computer. Calculations involving the name and quantity of the material, the required number of people, the number of days to close the object, as well as the name and coordinates of the customer’s company and the total cost of the work are more expediently stored in a computer for quick access [4].

The program interface should be intuitive, even for a beginner, in order for new employees to quickly get into the work process and not waste time on extra training. More useful information and data will appear in the automated workplace about the work required by the customer or the company. For customers, we will make a separate table, where the data will be located, as shown in table 1.

Table 1. Example of a customer table

Company name	Address	Directors	Phone	Email
OOO «SamStroy»	Lipetsk, Pervomayskaya st., д.1	Ivanov I.I.	212-34-56	Samstroy@mail.ru
OOO «Teleset»	Lipetsk, Bolshevikov st., д.2	Prtrov I.I.	265-43-21	Teleset@mail.ru
OOO «SamStroy»	Voronezh, Sadovaya st., д.3	Sidorov S.P.	231-25-52	ServStroy@gmail.ru

It would be absolutely correct and reasonable to add buttons direct to the table on screen, with the help of which the data in the table at any time can be deleted or added new, as well as to make the transition to other screens.

Speaking about the stored data, you should take into account the data of the materials themselves, such as the name, cost, rate of output for the worker, the daily salary of the worker. Such data are presented in table 2.

Table 2 - Table of information about the materials

Name	Unit price	Working rate for worker	Daily Salary
Metal tile	10000	5	1000
Tiling	7500	10	1100
Slate	1000	13	1200
Ondulin	6700	3	1300
Ruberoid	5400	10	1400

Accordingly, in the development process and for this form it is necessary to save data, as well as add the ability to add data, change and delete. For ease of navigation, place the button with the transition to the next form [5].

Of course, the above data would not be logical to leave in vain, they are involved in the preparation of an order for work and cost. Information about orders rationally should be placed in the following table with the name "Information about orders", visually can be seen below in table 3.

Table 3 - Table of information about the materials

Ordering number	Start date	Number of work days	Material	Amount of material	Material costs	Number of workers	Worker Payment	Total to pay	Work company
1	2012-07-22	1	Metal tile	500	500000	10	10000	510000	OOO «Sam-Stroy»
2	2014-02-03	3	Ruberoid	6700	3780000	20	84000	3864000	OOO «Tele-set»

This table is the main one and in this table the timing and economy will be calculated. The user adds orders, the computer calculates the parameters and displays the corrected data on the screen. In case of a filling in or canceling an order, you can delete the entire fully formed order in the line [6].

As for the timing - this is the dependence of the number of days to work on the number of workers. The rest of the economic calculations such as material costs, worker's wages, total payments are calculated according to data from the table “Information about materials”.

Composition of information support:

1. Information support of the automated workplace is very necessary for presenting a more accurate picture of the project. Information support will cover information on issues such as organizing information support, organizing the collection and transmission of information.
2. For proper development of an automated workplace of a roofing materials specialist, it is necessary to choose the type of database with which the specialist will work. First, let's remember what a database is, what database models exist, and choose the most suitable for our tasks.
3. Database - a simple language, a certain set of interrelated data that can be easily used for a large number of applications, to quickly obtain and modify the necessary information.

Database models are based primarily on the modern approach to the processing of stored information. The structure of the database information allows you to create logical records of their elements and their relationships, which is very convenient.

Relationships are of three kinds: one to one, one to many, and many to many. The choice of one or another type of relationship is determined by three database models: hierarchical, network, relational.

The hierarchical model in its form is represented as a tree graph. Of the main advantages can be noted that this model allows you to describe the structure of the data, as well as at the logical and physical level. It may be noted the disadvantage of a tight relationship between the elements. Therefore, any change in the relationship requires a change in its structure. In addition, access speed was achieved due to one more minus - the loss of information flexibility, i.e. for one pass through the tree it is impossible to obtain information located on another branch of communication. This model implements only one type of one-to-many communication [7].

The network database model is presented in the form of a diagram of links. In the network model, any kinds of connections between records are allowed, restrictions are imposed only on the number of feedbacks. The principle of many to many is used. The advantage of this model is greater information flexibility compared to the hierarchical model, but the disadvantage remains - the rigidity of the structure [8].

The relational database is used in the case of frequent reorganization of the information base. This model is the most perfect, compared to the network and hierarchical. In this model, there are no differences between objects and relationships. The type of connection of such a model is one to one. In this model, relationships between objects are presented in the form of two-dimensional tables - relations. Since any data structure can be transformed into a simple two-dimensional table, and this view is most convenient both for the user and the machine, the vast majority of modern information systems work with such tables, i.e. with relational databases.

Relationships have the following properties:

- each item is one item of data;
- there are no repeated groups;
- the elements of the column have the same nature;
- the table does not repeat the line;
- rows and columns can be viewed in any order.

The advantage of this model:

- the simplicity of the logical model;
- system flexibility;
- data independence;

Therefore, in this project it is more appropriate to use the relational model of the database. The database in the project will have the name “krovelsik” and contain four tables: “customers”, “materials”, “orders” and “users”, with which the operator will work through the user interface of the application.

Organization of information support:

Since the automated workplace does not require instant or automatic backup to a separate or remote data storage, it would be more logical for the data storage to use the HDD of the personal computer directly to the one the roofing materials specialist works for.

Organization of the collection of information:

Information collection should be carried out directly by a roofing materials specialist (operator), who has relevant personal computer skills and has been instructed to work with this software. The operator uses the method of dialogue with the customer to make an order with entering the relevant information in the tables defined by him.

The operator can enter the software only by authenticating with the login and password issued by the database administrator.

2 User Interface Development

To create a program, create a project. The name can be any, but I called the project final. Remember that the name of the project must match the name of our main class.

When developing an APM GUI, you need to create a connection to our database. To do this, download the jdbc driver called mysql-connector-java-5.1.23-bin.jar. We will deal with the structure of the project. Consider the class tree Fig.1.

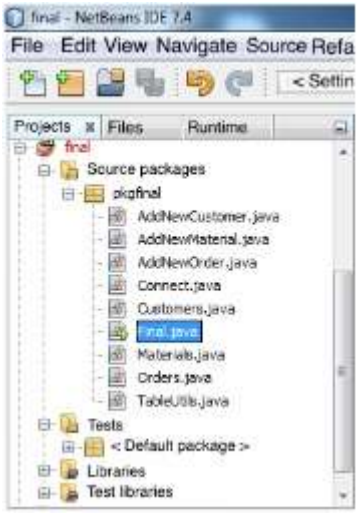

Fig.1. Class tree.

We create 9 classes for the program to work: “Final.java”, “Connect.java”, “Customers.java”, “AddNewCustomer.java”, “Materials.java”, “AddNewMaterials.java”, “Orders.java”, “ AddNewOrder.java ”and“ TableUtils.java ”.

When you enter your login and password and click on the "Login" button, a connection to the database is created with the username "root" and the password "root".

```
try
{
Class.forName ("com.mysql.jdbc.Driver");
con = DriverManager.getConnection ("jdbc: mysql: // localhost: 3306 /
                                    krovelsik", "root", "root");
} catch (ClassNotFoundException ex)
{
System.err.println ("KFDB.Cannot find this db driver classes.");
ex.printStackTrace ();
} catch (SQLException e)
{
System.err.println ("KFDB.Cannot connect to this db.");
e.printStackTrace ();
}
```

To connect to the database, the class “Connect.java” responds.

The “Customers.java” class is responsible for the “Enterprise Details” table. On this form, you can add a new enterprise to the database (button to add an enterprise) Fig.3 or remove the old one from the database (delete company button) Fig.2. When adding a new enterprise, the table increases line by line and does not display a huge number of empty fields, which gives the advantage of comfortable work with a small number of enterprises. With a significant increase in the number of new enterprises, a “scrolbar” appears on the right, which, when scrolling, in turn makes it possible to work comfortably with a large amount of data.

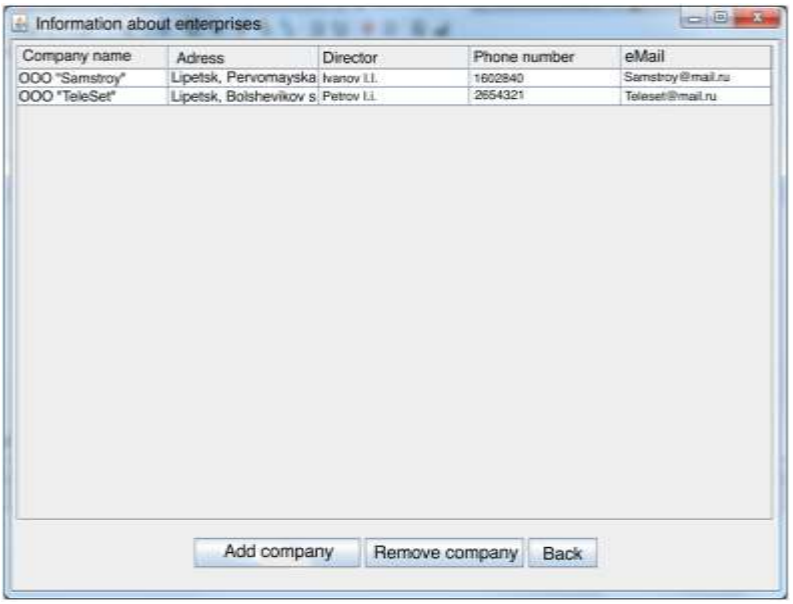

Fig.2. Information about enterprises.

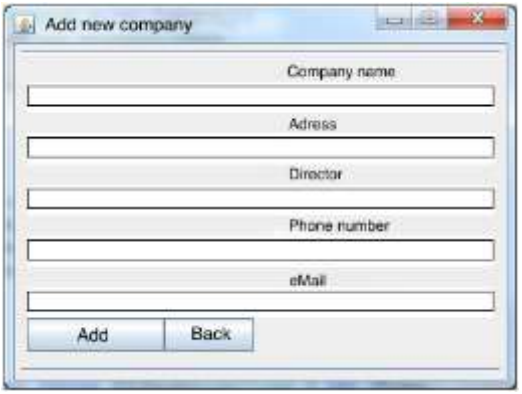

Fig.3. Adding a company to the database.

The class “AddNewCustomer.java” is responsible for adding a “new enterprise” to the database and deleting the “old” one.

Before updating the table, the program checks for the presence of empty fields; if all data is entered correctly, the following code is executed:

```
int rs=stmt.executeUpdate("INSERT INTO custom-
ers(NAME_OF_COMPANY,ADRESS,DIRECTOR_NAME,TELEFON_NUMBER, EMAIL_ADRESS)"+ " VALUES
('" + name.getText() + "','"+adres.getText()+"','"+director.getText()+"',"+ tele-
fon.getText()+",'"+ email.getText()+"')");
```

If you enter error data, an error message is displayed. Form "Information about materials" Fig.4 works with the help of the “Materials.java” class, where you can add new material to the database with the parameters “Price per unit”, “Production rate for the worker”, “Daily worker salary”, the class “AddNewMaterials is responsible for this. java ” Fig.5 or delete an existing material with all its parameters.

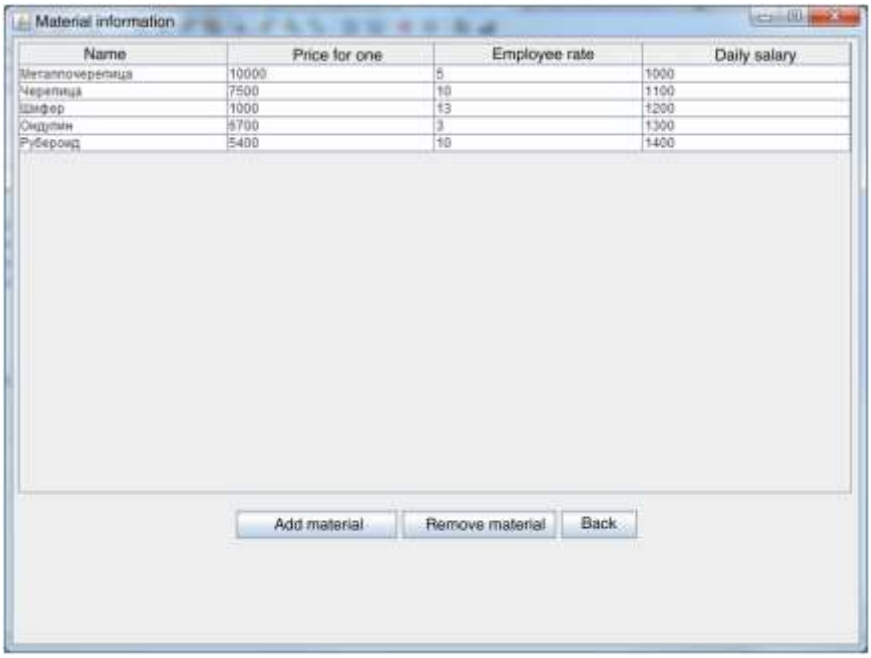

Fig.4. Material Information.

Fig.5. Adding a new material.

The following table is “Order Details” Fig.6. This table is formed by the class “Orders.java”. In this table, you can add the order in Fig.7, delete the order, go to the forms "Go to the list of enterprises", "Go to materials" and calculate the dates and economic parameters. The presence of material in the warehouse, the calculation of the cost of deadlines.

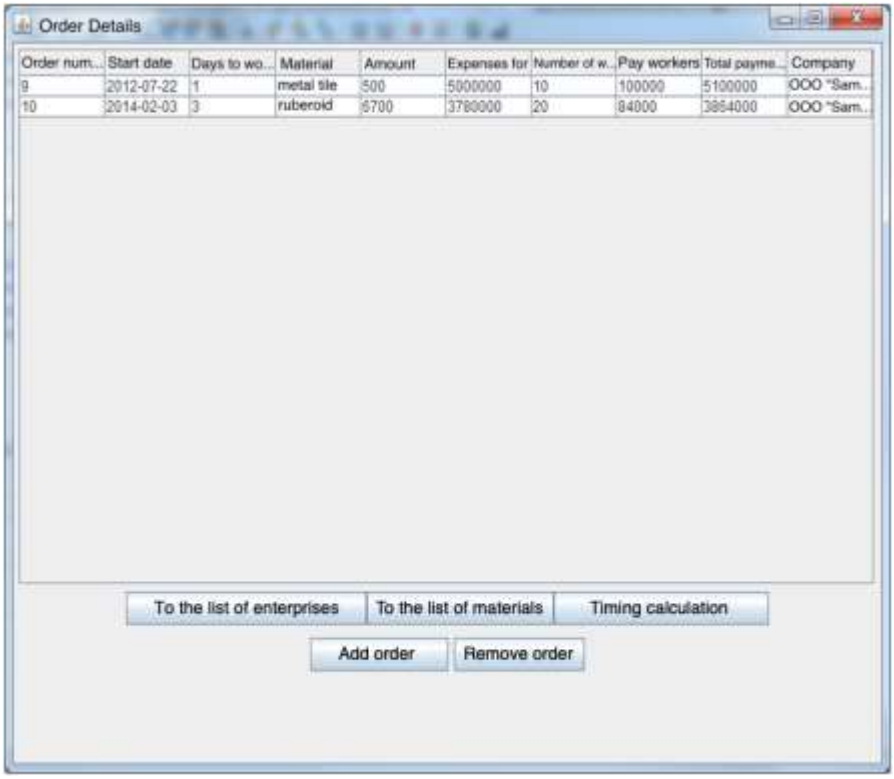

Fig.6. Order Details.

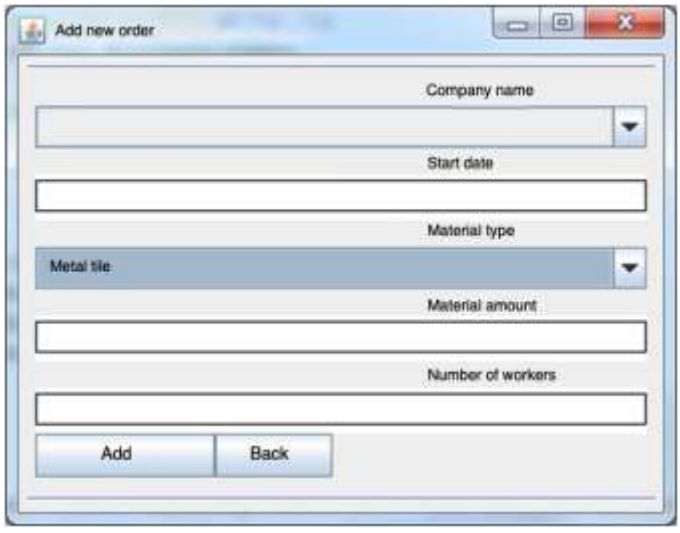

Fig.7. Adding a new order.

On the form "Add a new order" using the JComboBox component, you can choose from already existing enterprises already registered in the database. It is very convenient if there are many cooperating firms and there is no need to memorize them all in order to enter the name of the customer's company manually. And you can also choose the name of the material from the base, and if there are a lot of varieties of material in stock, you can thereby further speed up the work of the operator, saving him valuable time.

The last class working in the program is called "TableUtils.java", its implementation is presented below.

```
package pkgfinal;
import java.sql.ResultSet;
import java.sql.SQLException;
import java.util.Vector;
public class TableUtils {
public Vector data;
public Vector tableData(ResultSet rs, int numColumns) throws SQLException{
data = new Vector();
while (rs.next()) {
Vector row = new Vector();
for (int i = 1; i <= numColumns; i++) {
row.add(rs.getString(i));
}
data.add(row);
}
return data;
}}
```

This class responds by accepting as parameters a variable with sample values from the ResultSet rs table and accepts the number of columns with the table, then iterates through all the values that came from the table and fills them with an object of the Vector class, and then sends it to the calling class for display in a specific table.

Conclusion

In the process of performing this thesis, the concept of an automated workplace and characteristics, the main types of AWS structure and their classification were considered.

Based on the analysis, a software product was developed for an automated workplace for a roofing materials specialist, in a high-level Java language, using the MySQL Server DBMS, which performs the tasks of automating economic calculations. The calculation of the consumption and the presence of remnants of material in the warehouse, the calculation of the cost and timing of the work is carried out on the basis of orders for roofing work. At the expense of what is an effective distribution of human resources and focus on obtaining more profit.

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AN EFFECTIVE FACE DETECTION ALGORITHM FOR CLIENT-SIDE WEB-BASED SOLUTIONS

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Abstract:

This paper studies a real-time face detection problem for online web applications and its solution. The main aim of this paper is to describe functionality of effective face detection algorithm and analyze existing solution in order to improve current situation. To obtain satisfying results Viola-Jones object detection framework is chosen, which uses feature selection in combination with Integral images, AdaBoost training and Cascading classifiers. This algorithm is highly popular among existing javaScript frameworks for face or another objects detection for its extreme speed of image processing while achieving high detection rates and multiple objects detection. As analyzed answer for solving stated problem a javaScript tracking.js is chosen.

Keywords:

Computer vision, face detection, Viola-Jones framework, AdaBoost training, cascading classifiers, tracking.js.

ACM Computing Classification System:

Computer vision, machine learning algorithms, web applications.

Introduction

In this era, a computer vision, a field that covers high level understanding of digital images and videos, that seeks automatization of human visual system tasks from the engineering perspective [1], is on its rise. Since more and more refinements and simplifications of every day human lives are relying on computer technology, computer vision has its place in this field too. Face detection or, also more generally said, object detection is one of fundamental blocks for computer vision.

Face detection is a computer-based technique to distinguish human faces in digital images, still like photographs or moving as a video, in order to extract or caption the human face. This technology is used in variety of applications, i.e. biometrics. Face detection, object detection and gesture detection itself is getting into a larger awareness nowadays, since its wide range of use. Not only biometrics, but also interactive games, intelligent gadgets or part of face recognition for security are in the center of interest.

In this paper we will focus on face detection mainly. A face detection is considered as a specific part of object-class detection. In object-class detection the task is to find the locations and sizes of all certain class related objects. Eye regions, eyebrows, iris, nostrils and mouth corners combined in explicit mutual proportions are creating a human face.

These algorithms are focused mainly on frontal human faces, but also a small rotation can be considered. In this case, each pixel of a photography or a video record is compared to a processed database of human faces.

Any facial changes in the database, such as tone of skin, light in the room, different proportions of the face, smile, grin and many more are considered and processed before and during training algorithm run. There are different approaches of normalizing images such as each face candidate is normalized to reduce both the lightning effect and head rotation or skipping normalizing and continue with defining with preprocessed similar features.

1 Problem formulation

The main problem to be solved in this paper is finding and describing an effective algorithm to find face on a visual input, image or video, that is quick and lightweight enough that it can be used in online web applications. What looks as an easy task for a human, is not an easy task for a computer since computer has to be programmed to take exact orders and define mathematically how a face looks like. Every person differs and also there are many factors, that change the exact model, i.e. face proportions, deformations, expressions, captured angle etc. At this point, however, it is reachable to apply an algorithm that is bounded by certain rules.

Fig. 1. A typical input image [2].

In Fig. 1., we can see a typical input image to a face detection algorithm. This image consists of group of people of different races, sexes, angles of faces (frontal to approximately 20 degrees) and contrast composition of face itself and its surroundings like hair and hair color and background.

Another challenge is to develop a lightweight algorithm, that would be enough robust to provide very high detection rate, also known as true-positive rate, and very low false-positive rates and provide a real-time detection for online solutions not to halt CPU of a basic user.

We seek an algorithm, that need not be used only on faces itself, but also on their segments, as eyes or mouth for closer lookups, what basically means, that algorithm can be trained not only to detect faces, but objects themselves.

2 Viola-Jones method

Viola-Jones method is a framework firstly proposed by Paul Viola and Michael J. Jones in 2001. This framework has its vision to provide a solution to process images extremely rapidly while achieving high detection rates. The main idea behind this is image representation called Integral Image which provides detector a high computation. [3]

Converting image to an integral image is done by expressing each pixel by a sum of all pixels above and to the left of the concerned pixel. Such a conversion is presented in Fig.2. [4]

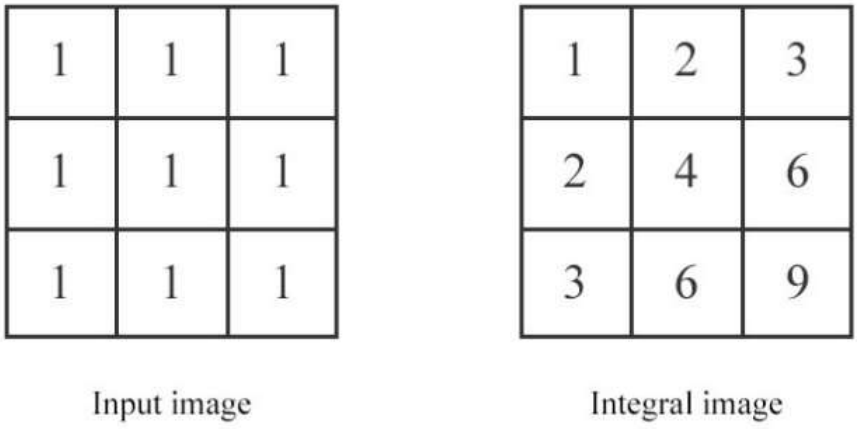

Fig. 2. Image conversion to summed-area table, also known as Integral image.

As the second step, when image is represented as summed-are table, AdaBoost learning algorithm is used to build an efficient classifier to select a small amount of visual features that are crucial for detecting an object using feature selection.

The third and final step is combination of classifiers into a cascade. This technique promises fast discard of background of the image and focus more on face promising features, [3].

A Features

In the above discussed face detection process, images are classified based on the value of simple features, which are encouraged more than using individual pixels directly. Such a technique is used mainly because it is faster way than a pixel-oriented system.

Originally, there were three kinds of features used to select, two-rectangle feature, three-rectangle and finally a four-rectangle feature.

Two-rectangle feature consists of two regions and it is a difference between the sum of the pixels within the two of them. When it comes to three-rectangle feature, than it computes the sum within two outside rectangles subtracted from the sum of central rectangle. Four-rectangle feature computes the difference between diagonal rectangle pairs. All those three kinds of HAAR like features are visible in Fig.3. These types are base types, but can be also vertically or horizontally rotated, what makes more feature types.

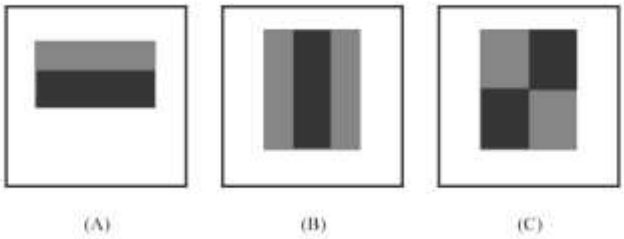

Fig. 3. Three types of rectangle features. The sum of pixels from the grey area is subtracted from the sum of pixels in the black area. Two-rectangle features are visible in (A), three-rectangle features in (B) and four-rectangle features are shown in (C).

The base resolution of a detector is 24 x 24, what offers total of approximately 160 000 different features to be constructed, what basically outnumbers total 576 pixels contained in the detector. [3]

Each feature is computed by subtracting the sum of light rectangles from the sum of dark rectangles. These features are simple in their true nature for an advanced object detection, but on the other hand they provide sufficient computational speed, that is wanted and a key feature for real-time online face detection. [3]

Later on, another type of rectangle features was introduced, since based on experiments, only three types were not efficient enough to detect non-upright faces and non-frontal faces with high accuracy. This was a time, when diagonal features were presented. These diagonal features are represented as four overlapping rectangles, that create a new shape. They are calculated in the same way as previous features, [5].

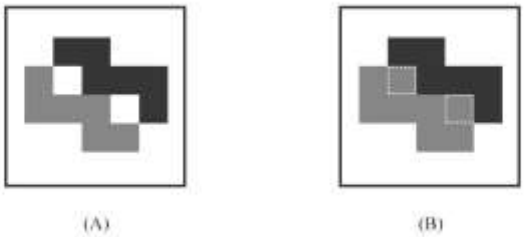

Fig. 4. Example of diagonal features related to the enclosed detection window. Basic type of diagonal feature is shown in (A) and filter constructed from 4 rectangles is visible on (B).

1.) Integral image

Rectangle features used for selection can be calculated quite quickly by using an interpretation of integral image, or also called summed-area table. The integral image at position x, y contains the sum of all pixels above and to the left of the given location:

$$II = \sum_{x' \leq x, y' \leq y} I(x', y') \quad (1)$$

where II(x, y) is the integral image and I(x, y) is a representation of the original image. The integral image can be computed in one pass over the original image by using the following pair of recurrences:

$$s(x, y) = s(x, y - 1) + I(x, y) \tag{2}$$

$$I(x, y) = II(x - 1, y) + s(x, y) \tag{3}$$

where *s(x, y)* is a cumulative row sum, *s(x. -1) = 0* and *II(-1, y) = 0*.

Using the integral image any rectangular sum can be calculated in four array references like those showed in Fig.5.

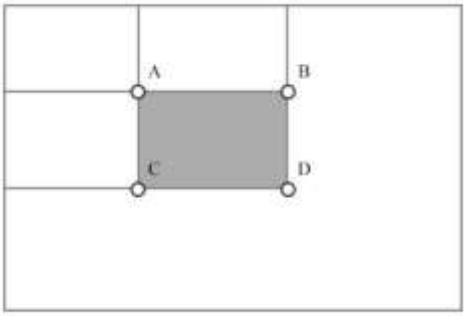

Fig. 5. The sum of Grey rectangle can be calculated as D – (B + C) + A

2.) Feature selection

Regarding to faces, every face consists of isolated structures as eyes, nose and lips which vary from person to person. Face detection algorithm is based on those features that measures face directly and robustly and is capable of distinguish those differences between personal variation.

Each feature mentioned before describes a concrete property at a certain position, scale and aspect ratio and therefore is assigned a weight. Filters are there for choosing which variation is still considered as a part of a face and which is not. This problem covers the learning algorithm to determine which features are effective enough to distinguish a face from other objects i.e. ratio of eyes, nose and mouth should be considered as an effective feature, while on the other hand hair itself shouldn't since its variability in haircuts.

B Learning algorithm

In order to effectively find features, that differentiate characteristics of a face from other pieces of images, the challenge was to find an efficient learning algorithm. As mentioned before, there are approximately 160 000 rectangle features associated with each sub-window, a number, that is much larger than the number of pixels. While there is a great number of possible features, only a small number of them combined can compose a beneficial classifier. Therefore Viola-Jones framework is based on modified AdaBoost learning algorithm developed by Freud and Schapire in 1996 [6]. It's used to find the right features and also to construct a classifier.

In original form, AdaBoost is a learning algorithm for boosting the classification performance of a simple learning algorithm by creating a strong classifier by combining of a collection of weak, simple, classifying functions. A weak learn function is called weak for its simplicity and mathematically described as follows:

$$h(x, f, p, \theta) = \begin{cases} 1 & \text{if } pf(x) > p\theta \\ 0 & \text{otherwise} \end{cases} \tag{4}$$

where x is a 24x24 pixel sub-window, *f* is applied feature, *p* is the polarity and Θ is a threshold responsible for classifying x as positive or negative.

The best classification function to classify the training data is not expected in this case. Rather than that, a weak learner is boosted by solving a sequence of learning problems. Round after round of learning, the examples are re-weighted in order to improve ones, that were classified by previous weak classifier incorrectly. The final form of a strong classifier is a perceptron, a weighted combination of simple classifiers in combination with threshold. [3]

It is proved by Freund and Schapire, that the training error of a strong classifier goes to zero exponentially with the number of rounds. Since AdaBoost is round based, the algorithm assigns to each example x_i a weight w_i which is initialized to 1⁄N where N is a number of all samples. After every round, one weak classifier is chosen, while the requirement for selecting one is, that its error rate is less than 0.5. In this case, input vectors are image pairs:

$$x_i = (I_1^i, I_2^i) \tag{5}$$

and a weak classifier is composed of one feature with rectangle filter on each input image in the pair. Therefore let the algorithm is modified as follows: If

$$h_j(I_1, I_2) = \left|\phi_j\left(I_1^i\right) - \phi_j\left(I_2^i\right)\right| \tag{6}$$

where ϕ_j is a scalar function of an image called "filter" then:

$$f_j(x_i) = f_j\left(I_1^i, I_2^i\right) = \begin{cases} \alpha & \text{if } h_j(I_1^i, I_2^i) > t_j \\ \beta & \text{otherwise} \end{cases} \tag{7}$$

where α and β are weights and t_j is a threshold that combined with rectangle filters create classifier that separates the positive examples from the negative ones.

On every round of AdaBoost is chosen a weak classifier ϕ_j and t_j for which:

$$\epsilon_j = \sum_{\substack{i:\, y_i = +1 \\ h(x_i) \le t}} D_i + \sum_{\substack{i:\, y_i = -1 \\ h(x_i) > t}} D_i \tag{8}$$

is minimized. The first sum specifies sum of weights of the examples that are false negatives and the second one is the sum of weights for examples that are false positives. Therefore minimizing the summing of false negatives and false positives minimizes also the weighted error.

After successful finding of optimal threshold and filter by minimizing the weighted error, adequate values for α and β are calculated. Minimizing is considered as good criteria for selection of weak hypotheses, which can be used to calculate efficient values α and β as follows:

At first, sum should be split into a sum of negative and sum of positive examples:

$$Z = \sum_{i:\, y_i = +1} D_i e^{-f(x_i)} + \sum_{i:\, y_i = -1} D_i e^{f(x_i)} \tag{9}$$

$$Z = \sum_{\substack{i:\, y_i=+1 \\ h(x_i)>t}} D_i e^{-\alpha} + \sum_{\substack{i:\, y_i=+1 \\ h(x_i)\le t}} D_i e^{-\beta} + \sum_{\substack{i:\, y_i=-1 \\ h(x_i)>t}} D_i e^{\alpha} + \sum_{\substack{i:\, y_i=-1 \\ h(x_i)\le t}} D_i e^{\beta} \tag{10}$$

By simplifying the formula, we get:

$$Z = W_+^+ e^{-\alpha} + W_+^- e^{\beta} + W_-^+ e^{\alpha} + W_-^- e^{\beta} \tag{11}$$

where W_+^+ are true positives, W_+^- are false negatives, W_-^+ are false positives and W_-^- are true negatives.

Z respectively to α can be minimized by:

$$\frac{\partial Z}{\partial \alpha} = W_-^+ e^{\alpha} - W_+^+ e^{-\alpha} = 0 \Rightarrow \alpha = \frac{1}{2} \log\left(\frac{W_+^+}{W_-^+}\right) \tag{12}$$

and also similarly for β:

$$\frac{\partial Z}{\partial \beta} = W_-^- e^{\beta} - W_+^- e^{-\beta} = 0 \Rightarrow \beta = \frac{1}{2} \log\left(\frac{W_+^-}{W_-^-}\right) \tag{13}$$

These equations are used to set α and β every round of AdaBoost.

- Given example images $(x_1, y_1) \ldots (x_n, y_n)$ where y_i = 0 for negative and 1 for positive examples.
- Initialize weights $w_{1,i} = \frac{1}{2m}, \frac{1}{2l}$ for y_i = 0, 1 respectively, where *m* and *l* are the number of negatives and positives respectively.
- For *t* = 1,..., *T* :
  - Normalize the weights, $w_{t,i} \leftarrow \frac{w_{t,i}}{\sum_{j=1}^{n} w_{t,j}}$
  - Select the best weak classifier with respect to the weighted error

$$\epsilon_t = \min_{f,p,\theta} \sum_i w_i \left| h(x_i, f, p, \theta) - y_i \right|$$

  - Define $h_t(x) = h(x, f_t, p_t, \theta_t)$ where f_t, p_t, and θ_t are the minimizers of ϵ_t.
  - Update the weights:

$$w_{t+1,i} = w_{t,i} \beta_t^{1-e_i}$$

where e_i = 0 if example x_i is classified correctly,
e_i = 1 otherwise, and $\beta_t = \frac{\epsilon_t}{1-\epsilon_t}$

- The final strong classifier is:

$$C(x) = \begin{cases} 1 & \sum_{t=1}^{T} \alpha_t h_t(x) \ge \frac{1}{2} \sum_{t=1}^{T} \alpha_t \\ 0 & \text{otherwise} \end{cases}$$

where $\alpha_t = \log \frac{1}{\beta_t}$

Fig. 6. Pseudocode of the modified AdaBoost algorithm [3].

C Cascading classifier

The key principle of Viola-Jones object detection framework is to go through the same image many times, while the spotted window is enlarging. In most of the cases of input images there will be more of sub-windows that don't hold any face related information. Therefore, a different approach to solve this problem is considered. Instead of finding face related sub-windows, algorithm should be focused more on discarding non-face sub-windows. This should be a better conclusion, since it's faster to discard a face non-related sub-windows than evaluating sub-windows containing a face related information. In this case a single strong classifier wouldn't be much efficient, because no matter the input, the computational time remains constant. This problem offers a question how to boost the computational time and its solution is presented as cascade classifier.

The final form of the classifier after AdaBoost training is a perceptron, a thresholded linear combination of features. Viola-Jones framework uses a sequence of more and more complex classifiers formed into the cascade in order to reduce false positive rate and also to significantly improve computational efficiency. Simple classifiers are called to reject most of sub-windows, that holds background and any other unimportant sections of an image, and after that increasingly stronger classifiers are used to achieve low false positive rates. The input window is passed from classifier to the next stronger classifier in the cascade until every one of them returns true. Otherwise an input window is considered as non-face and is discarded.

The single stage classifiers allow higher false negatives rates in order to reduce false positive rate, but in this case it's not much of a problem to pass more false positives, since sub-windows are reassessed by stronger classifiers. Because most parts of an image don't look like a face itself, they are very quickly thrown away. Such a process is depicted in Fig.7.

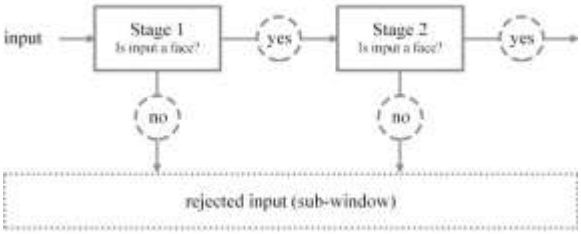

Fig. 7. Cascaded classifier functioning showcase

Conclusion

Considered face detection algorithm is popular for real-time online face detection using video-input from a camera or also for detection from a still image thanks to its low computational load.

One of solution like that is a javaScript project called tracking.js that is capable of recognizing faces, mouths and eyes on the input. The main idea of this solution is to take precomputed patterns for all mentioned objects to be detected and compare it with the input. It can be modified to detect also other objects by providing a representation as a Float64Array variable filled with HAAR like features and a bit of customization of the detector class.

A medium image, approximately maximum of a size 800x800 pixels has to be provided, depending on the computational resources of the user's computer, in order to not halt the CPU and not enforce the site to crash. Therefore, this script is a useful presentation of a real-time online face detection, but needs further improvement for scaling the input image to smaller size in case of high-quality image input.

For video input a different approach should be considered, since for now the estimated face area differs radically by every small change of position of the scanned object. Examples of a face detection results used by tracking.js solution are showed in Fig.8, Fig.9 and Fig.10.

Fig. 8. successful processed and evaluated image with face detected and highlighted [2].

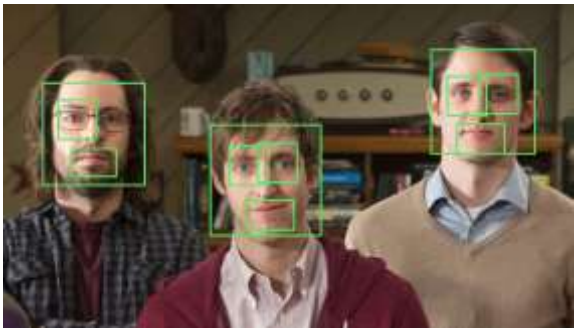

Fig. 9. face, mouth and eyes detection using tracking.js [8]

Results for Fig.8 and Fig.9 are satisfying. Every face on the photo was detected successfully, while on Fig.9 the right eye of the first face wasn't recognized, most probably glasses created noise, while shadow as a noise source should be discarded, because other two faces are similarly contrasted.

After changing the input image to another frontal face results are not that satisfying as before. Image itself has low contrast, but as smaller input as better results are provided. Another problem that this framework generates is multiple detection of objects in a very close area. In the end, there are three types of problems created by tracking.js: buggy object detection in video input, inadequate input image size and multiple detection in a close area.

Problems found it this framework could be get rid of by calibrating code. The essence of buggy face recognition in video is in false negative frames while the frame changed only slightly. The main idea is compute the total weight of difference and evaluate its value.

When it comes to the size of the photo, the main idea is changing the size to acceptable size around 500x500 pixels to not halt CPU by computation right after its upload. By changing the size it doesn't only improve the calculation speed, but also it improves the true positive rate.

Solution of a problem of multiple object detection in very close overlapping objects borders could be storing the size and location of those areas and their comparison.

The main aim in this case is to calibrate the ratio of found features by putting a weight for every found feature in their positions, i.e. overlapping regions of the eyes and mouth in comparison to the face and to the other recognized features like eyes should be placed on the upper face while mouth on the bottom face. Therefore, another set of rules should be considered.

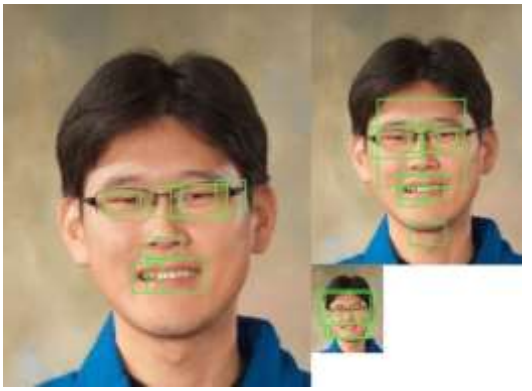

Fig. 10. A difference of recognized face and its features varies significantly by the size of an input image.

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DEVELOPMENT OF INFORMATION SYSTEM OF STORAGE ACCOUNTING RADIO ELECTRONIC COMPONENTS

Yakov Lvovich, Yuriy Preobrazhenskiy, Juraj Štefanovič

Abstract:

In warehouse facilities, material flows are converted from dynamic to static and Vice versa. In addition, the storage and processing material flows are included with some parameters, and go with others. The parameters should be understood as the intensity, power, rhythm, structure of material flows, as well as the type and method of packaging products, arrival and departure time of transport batches, etc. The General concept of the warehouse system solution in the first place should be economical. Economic success is ensured if the planning and implementation of the warehouse system are considered from the point of view of the interests of the whole company, being only part of the overall concept of the warehouse. And the profitability of the warehouse will be, in the end, the main criterion for the chosen General concept. The aim of this paper is to develop an information system of warehouse accounting of electronic components.

Keywords:

Storage, information system, electronic components.

ACM Computing Classification System:

Enterprise computing, operations research, planning and scheduling, software system structures.

Introduction

Currently, no production, trading company, service enterprise can not be imagined without a warehouse. A warehouse is one of the "strategic objects" of any enterprise. On how much actual and reliable information is about the quantity and quality of products, raw materials stored in the warehouse of the enterprise, directly depends on production planning. Proper production planning is the key to the success of any enterprise, one of the methods to reduce the costs of an enterprise.

A modern warehouse is not only a storage room, shelves and staff, but also specialized software. The task of this software is the continuous collection of data on the presence and movement of material values, the fastest possible provision of the collected data for analysis [1].

On the market of modern automated warehouse accounting systems, companies such as Oracle, EME, 1C-ASTOR, Business Systems Engineering, BUKhta, KOMPAS, SOFT RETAIL, AXELOT and other well-known developers represent their software.

Given the significant cost of such systems, many companies decide to develop their own automated warehouse accounting system.

All warehouse accounting programs, without exception, use certain databases in their work. This is a convenient way of structured storage of information and access to it.

The functionality of most modern warehouse accounting systems is already close to the capabilities of modern ERP-systems. However, there are cases when these systems are redundant and their use in certain areas of production is inappropriate because of the significant costs of acquiring a ready-made solution and refining it for the needs of the enterprise [1].

The purpose of this work is the development of an information system for inventory accounting of electronic components. To achieve this goal it is necessary to solve the following main tasks:

1. Review of the market leaders in modern warehouse accounting systems, comparison of the cost of their acquisition, refinement and operation.
2. The choice of architecture of the developed system.
3. The choice of storage system and data management system.
4. Software implementation of data entry and processing by users of the system.

1 The Concept of the Warehouse Management System

Warehouse management system - a management system that provides automation and optimization of warehouse processes. The architecture of an automated information warehouse management system is built, as a rule, on a three-level principle:

- the client application, through which the user enters, modifies and deletes data, gives requests for operations and queries for selecting data,
- database server that stores data,
- business logic - a module that performs user-initiated data processing and returns the processed data to the database, informing the user via the client application screen about the completion of the requested operation.

The main objectives of the implementation of automated warehouse management systems are:

- warehouse management,
- increase the speed of processing orders,
- obtaining accurate information about the location of the goods in the warehouse,
- effective management of goods with a limited shelf life,
- optimization of the use of storage space.

For efficient use of storage space and for automation, the warehouse area is divided into zones according to the types of operations for receiving, placing, storing, processing and shipping goods. This allows you to optimize the work of staff in different areas and effectively distribute areas of responsibility [3].

At the stage of introducing an automated warehouse accounting system, the system records the physical characteristics of the warehouse, loading equipment, the parameters of all the equipment used and the rules for working with it [4].

In modern warehouses, all incoming goods are marked with bar codes. The technological warehouse operations under the control of the system are carried out on the basis of the data of bar codes, the location of the place where the goods are stored and the location of the loading equipment. Loading equipment and warehouse workers are equipped with a data collection terminal, which is a portable computer with special software installed. The data collection terminal constantly sends and receives information from the server system.

During the inventory, specialists use data collection terminals to read barcodes that are automatically entered into the instrument databases.

The automated warehouse accounting information system takes into account all the requirements for storage conditions when distributing storage locations for goods entering the warehouse. For example, humidity, temperature, product shelf life, manufacturer, sales date, supplier, compatibility rules, and any other parameters may be considered. The automated system automatically selects storage locations for received cargo and generates tasks for warehouse workers. Tasks come to the terminal screen in the form of elementary step-by-step teams individually for each employee.

When forming teams, the system develops optimal routes for moving vehicles around the warehouse, which reduces the total idle mileage of the loaders. The system assigns the loading equipment to the operations, the use of which most fully meets the set task and it is closer, free or free in the near future. The execution of tasks is confirmed by scanning a bar code. Thus, the system controls all actions of the employee and makes it possible to almost completely eliminate the possibility of erroneous placement of cargo or incorrect picking of the order. When reading a bar code, the system instantly updates all information about the location of goods, the availability of goods in stock, the actions of employees and the operations performed. For convenience, as a rule, it is possible to monitor the warehouse in the two-dimensional graphical display mode [5].

Tasks that are solved by modern automated warehouse accounting systems:

- acceptance of goods and materials,
- warehousing - automatic or under the control of staff,
- maximize storage space utilization and/or performance of warehouse operations,
- comprehensive criteria for the construction of storage cells,
- custom creation of warehousing tasks,
- preparation of bulk goods from various suppliers for storage,
- automation of one-time acceptance and shipment of goods,
- overload of the received goods to be sent to customers,
- transit shipment of products through the warehouse,
- comprehensive grouping of orders,
- processing and issuing orders by groups with optimization of processes and resources,
- consolidation and separation of lots of goods,
- customizable parameters need replenishment,
- automatic generation and sending of replenishment tasks,
- customized replenishment strategies,
- automatic generation and sending of tasks to employees for order picking,
- a complete set directly in the pallet taking into account requirements of ergonomics and also the sizes, weight and other parameters of goods,
- complete set on a conveyor belt,
- completion in lots of goods,
- packaging,
- personalization of orders during assembly,
- generation of identification numbers of shipped containers and their tracking, scheduling shipment of goods, taking into account priorities,
- ordering and combining goods during loading, depending on the sequence of delivery,
- check and close the send operation,
- creation of accompanying documents,
- container tracking,

- flexibility in moving and adjusting stocks,
- intermediate partial inventory,
- complete physical inventory with weight fix on entry and exit,
- monitoring the status and obtaining information on warehouse stocks in real time,
- localization of stocks and configuration of areas and warehouse zoning,
- record dates and track the timing of the sale of goods,
- scheduling tasks with their rearrangement in accordance with the priorities,
- dispatching and alternating tasks,
- bookmark in the container several different products,
- identification of goods by packaging for shipment and return,
- definition of restrictions on joint storage of goods,
- inspection of warehouse equipment and refueling planning.

Despite the huge functionality for automating warehouse processes, no warehouse can be done without people. Warehouse workers are the key to the effective functioning of the enterprise.

There are several classes of automated information systems for warehouse accounting:

- entry level systems, designed for warehouses of small companies, shops with a small nomenclature,
- boxed warehouse management systems, where the target consumer is a warehouse with an area of 1000 - 10 000 m² with a large range, but a low turnover,
- adaptable systems, they are implemented by large logistics companies, distribution centers, warehouses over 5000 m²,
- configurable systems which are designed for warehouses over 5000 m² with a large range and high turnover.

2 Designing the System of Storage Accounting of Radio Electronic Components

2.1 Formation of Requirements for the Developed System

Let´s consider a model problem. At the time of collecting and analyzing data on the processes of warehouse accounting and control of the movement of material resources, the information flows of the company related to the work of warehouses have the following scheme (Fig.1). This diagram shows the interaction of the warehouses with each other and the controlling authority - the accounting department.

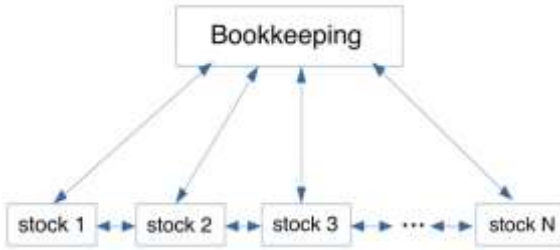

Fig.1. Diagram of information flows of the warehouse before the introduction of IP.

The total number of links in the presented scheme is $(N^2 - N) / 2$, where N is the number of nodes in the scheme. Due to the low computerization of the enterprise and the lack of an electronic document management system, the exchange of data between elements of the scheme runs as a transfer of paper invoices, requirements and acts of inventory. In a modern market economy, this scheme of work is unacceptable and requires optimization.

The following requirements were formed for the developed information system:

1. The information system should increase the speed of interaction of the warehouse with counterparties. Counterparties are storerooms of assembly shops and assembly lines.
2. Due to the implementation of the information system, the time for obtaining information on the quantity and availability of electronic components of one or another counterparty should be reduced.
3. In the information system should be implemented a system of double accounting between counterparties.
4. The information system must be implemented using transactions.
5. It is necessary to provide for the possibility of supporting and updating the software with the involvement of third-party developers. The code should be as readable as possible.
6. Minimum software requirements for the hardware resources of the operator's workstation.
7. Software should not be tied to any platform. Requires the ability to run and work in operating system environments other than Microsoft OS.

On the basis of the requirements for the developed information system, a general scheme of information flows of the developed information system is drawn up (Fig.2).

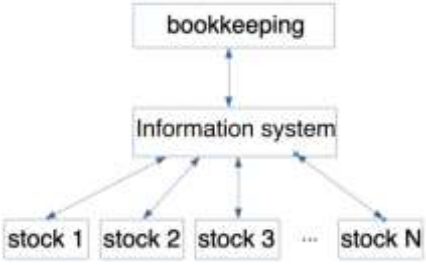

Fig.2. Scheme of information flow after the introduction of IP

By adding information flows to the scheme, an additional link, the Information System, eliminates the exchange of information directly between warehouses. In addition, the load on the accounting element is reduced by reducing the number of links from N, equal to the number of warehouses, to 1. The total number of links in the information system will be N, where N is the total number of nodes. By reducing the number of information flows from $(N^2 - N) / 2$ to N, paragraph 1 of the requirements for the developed information system is achieved.

Additionally, due to a single point of collection and storage of information, paragraph 2 of the requirements is fulfilled - reducing the time to access information.

2.2 Selection of the Architecture of the Developed System

During the analysis of the enterprise's information infrastructure, the study of the computer park and the structured cable network (SCS) of the enterprise, the following were revealed:

1. Outdated computer hardware and software.
2. Multiple user violations of computer security rules. As a result, infection with various computer viruses in the park of user workstations is more than 80%.
3. Low qualification and computer literacy of users. The average age of future users of the information system is 49 years.
4. Due to the work of the enterprise with government orders of the Ministry of Defense of the Russian Federation, access to the Internet is strictly limited. The bandwidth of the external channel is 5 megabits/s. No reservations.
5. The SCS is in a satisfactory condition but does not have sufficient reliability to ensure uninterrupted access to the network elements.
6. The management of the company requires maximum results with minimal investment and in a short time.

Based on the above, it was concluded that it is impossible to use web-based information systems. It was decided to develop a classic desktop client-server architecture application using a two-tier scheme. The implementation of the three-tier information system will require additional time and financial costs for the implementation of the application server API. Let a client be an application running on the workstations of operators. A server is a relational database management system (RDBMS). The business logic of the information system is implemented in the client application. The server serves as a data warehouse.

2.3 Development of the User Interface of the Application

Main requirements for the user interface should be divided in two main topics.

1. The user interface of the developed information system should provide quick access to the functions used.
2. The interface should not be overloaded with elements, as this will slow down the user experience with the application.

In accordance with the requirements above, a multi-window graphic interface was developed based on the Swing graphic elements library.

Swing is a library for creating a graphical interface for Java programs. Swing was developed by Sun Microsystems. It contains a number of graphic components (English Swing widgets), such as buttons, input fields, tables, etc. Swing refers to the JFC class library, which is a set of libraries for developing graphical skins. Related to these libraries there are Java 2D, Accessibility-API, Drag & Drop-API и AWT [6].

When the application is launched, the main application window is created (Fig.3). Using the application involves working with material values, which is why the application has a login and password authentication mechanism that is issued to the system user by the administrator. Until the user passes the authorization, the work with the program will be blocked.

After launching the application, the existence of the file for setting up the connection to the database server is checked [7].

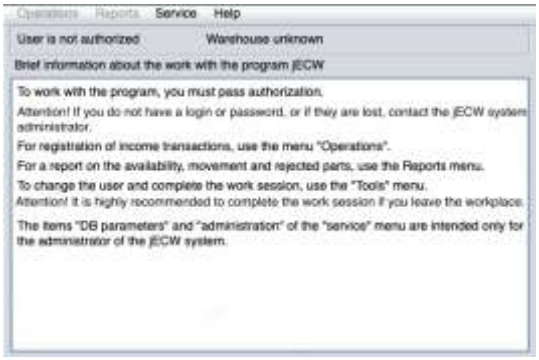

Fig.3. The main application window.

The connection configuration file must be located in the application launch directory. If a configuration file is found, the program will prompt the user to log in (Fig.4).

Fig.4. Authorization form.

If the configuration file is not found, the program will offer to configure a new connection to the database server (Fig.5).

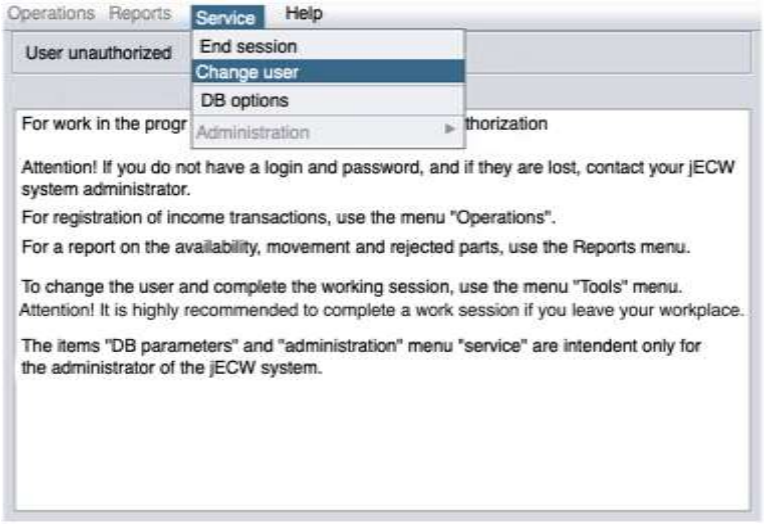

Fig.5. Form for setting up connection to the database server.

In the form fields, you must enter the appropriate information - the server address (the address is supported in the form of a domain name), the connection port, the name of the database being used, and the username and password of the database server. Clicking on the "Save" button will write a new file with connection parameters to the database server.

If the authorization window was closed by the user, select the Tools - Change user menu item (Fig.6). The authorization window (Fig.5) will become available again.

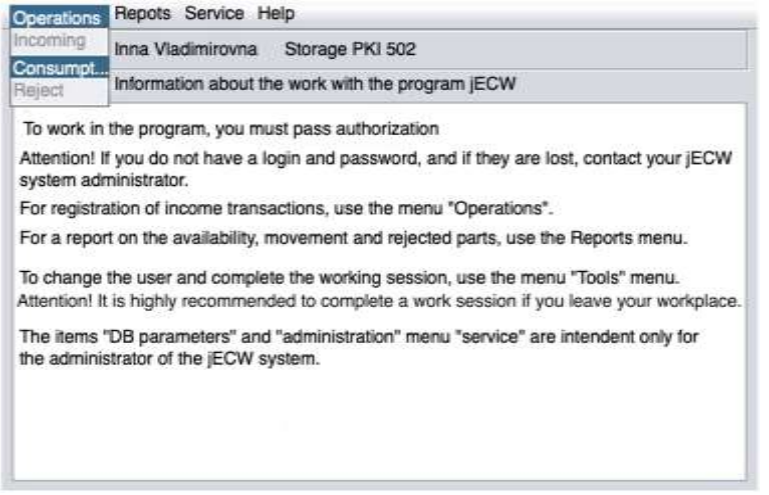

Fig.6. Call the authorization window.

After successful authorization, the program checks the role of the registered user. In the case of authorization of a user who is not a part of the administrator group, the program locks menu items related to entering new instances of the “details” into the system and taking out defective instances from circulation (Fig.7). Additionally, the program administration menu is blocked (Fig.6). If a user is a member of the Administrators group, all program menu items become available to him (Fig.8, Fig.9).

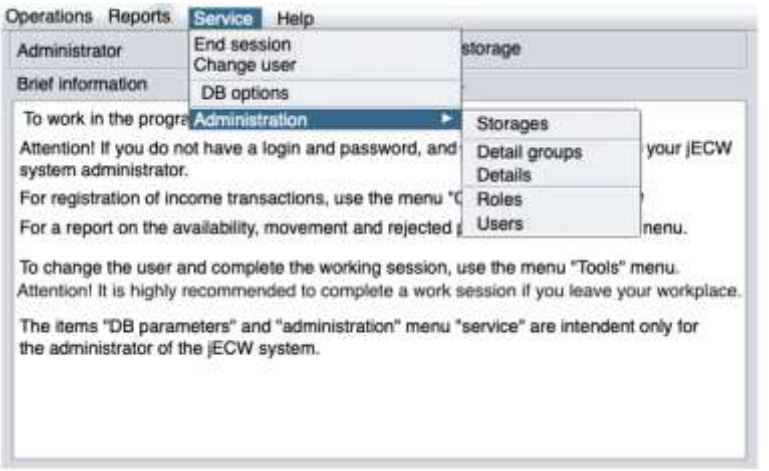

Fig.7. Operations menu after login is not administrator.

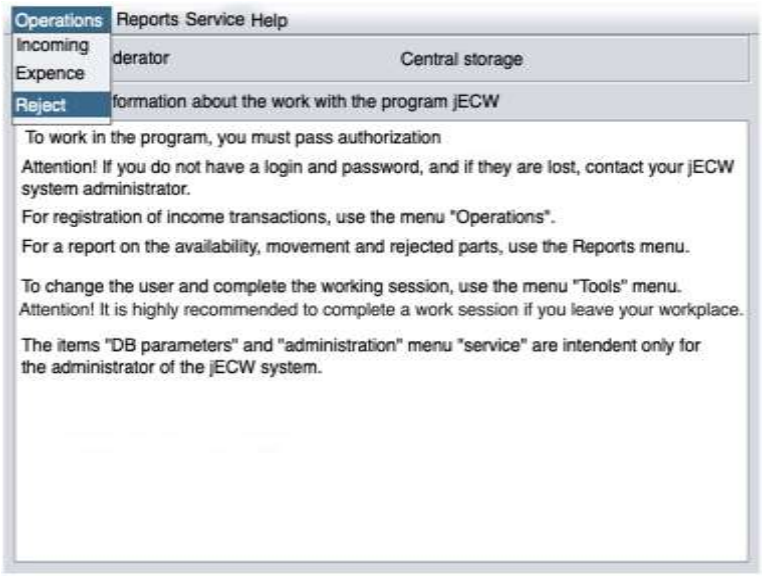

Fig.8. Administrative menu.

Fig.9. Operations menu unlocked.

In the case of the initial setup of the information system, you must perform the following sequence of actions:

1. Add warehouses to the system. Administration menu - Warehouses. Using the form, you must register in the system all the warehouses of the enterprise.
2. Add user groups to the system using the Administration - Roles menu item (Fig.10).
3. Add users to the system, distributing them into roles and warehouses. The user operation form is invoked by selecting the Administrative Tools - Users menu item.
4. Create new groups of "parts" in the system. The forms for handling groups of "details" (Fig.11) are available in the Administration - Details Groups menu.
5. After creating the groups of "details" you need to create the "details" themselves. This operation is performed by filling in the required fields of the form with "details" (Fig.12).
6. All newly created “parts” go to the “Central Warehouse” and their number is zero. To move parts between warehouses, the number of instances of a “detail” must be greater than zero. To replenish the stock of copies of a particular “part”, use the form called from the Operations - Income menu.

When working with this form, the system moves the specified number of copies of the "part" from the internal warehouse "Purchasing" to the "Central warehouse".

7. After replenishing the stock of a "part" in the "Central warehouse", it becomes possible to transfer a certain number of copies of this "part" between the warehouses of the enterprise. This operation is performed in the form called by selecting the menu item Operations - Flow. Also the main work of users occurs in this window.

Fig.10. Managing user roles.

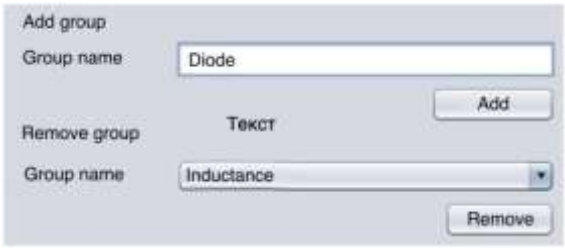

Fig.11. Handling groups of "details".

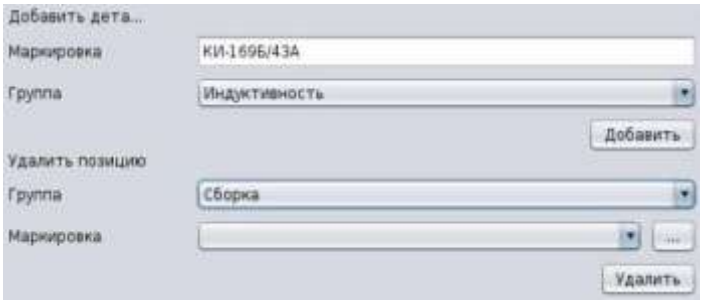

Fig.12. The form of operating "details": insert part (code, group) / delete part.

3. Installing an Application on a System Operator Workstation

The client application of the developed information system is supplied as a single file in the form of a zip archive.

To install the application, you need to unpack the archive into the user's home directory. The software comes with java - application launchers.

The scope of delivery includes the oracle-jre-1.8.0 execution environment. Additional installation of the java application runtime is also not required.

The application is launched using command line scripts - start.bat for Windows operating systems, start.sh - for UNIX-like operating systems.

Conclusion

In the course of this work, an analysis was made of information flows between the warehouses of the existing enterprise. Inefficient working methods were identified in the existing architecture of interaction between participants in the warehouse accounting process and the movement of tangible assets within the enterprise. Based on the data obtained for enterprise management a new algorithm can be offered for the interaction of participants in the warehouse accounting process.

Within the framework of the proposed information flow scheme, highly specialized warehouse accounting software was developed in a high-level Java language using the PostgreSQL database management system as a data warehouse.

The developed software meets the requirements - performs the assigned functions in full, it is a cross-platform, not demanding on resources and it has a low cost of implementation and operation.

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DEVELOPMENT OF THE "ELECTRONIC REGISTRY SYSTEM"

Andrey Preobrazhenskiy, Yakov Lvovich, Oleg Choporov

Abstract:

One of the problems of modern medicine organization is that there is no unity in it. Now patients can be registered in various medical institutions, each of them has its own paper history of the disease, while doctors who have only one of them, do not have complete information about the patient, because it is stored distributed. The introduction of a common knowledge base of people who seek help from professionals is required. There is also a problem of territorial distribution of laboratories in which tests are carried out, and medical institutions. This leads to delays in obtaining the required information. And such problems are not enough.

Keywords:

Web site, medical information system.

ACM Computing Classification System:

Enterprise computing, operations research, planning and scheduling, software system structures.

Introduction

Nowadays, computer technologies are increasingly used everywhere in all spheres of human activity. The most leading areas for the introduction of computer technology are accounting and warehouse-accounting programs.

Medicine is very lagging behind in the implementation of even the simplest innovations, for example, all accounting information is kept on paper. The reasons are that almost all medicine is funded by the state and in most cases, hospitals do not have enough funds to introduce computer systems for accounting and analysis, almost all medical equipment and software for it comes from abroad as humanitarian aid.

Private hospitals and clinics, if they acquire any software, then acquire it abroad, which is much more expensive than the development would cost from domestic producers, but faster than the development from domestic producers. But, nevertheless, medicine will soon affect computer progress, because in many medical studies one cannot do without a computer and special software for it, as well as special websites.

A lot of technologies are used to build websites, such as HTML, CSS, Flash, JavaScript, jQuery, PHP and others. No one of the sites is complete without HTML markup language and CCS stylesheets; they create the framework for the site being created [1].

Website development is needed for the timely submission of information to interested people in the hospital services [2].

The aim of this paper is to develop a dynamic website using modern web technologies designed for electronic registration in a medical facility. For this, the solution of the following main tasks is necessary:

1. Review of technologies for creating web sites.
   Description of technologies used in the development.
2. Selection of technologies for building a project,
   analysis of the main criteria and parameters for selection
3. Creating a design for the future project, site structure.
4. Software implementation.

1 Integrated Automation System of Medical Institutions

The organizational structure should effectively provide medical services, regardless of the use of new medical technologies. The management system must be competitive and profitable, even with the highest quality of treatment.

For such an organization without an information system, it is impossible to make operational decisions in the field of medicine and economics.

Information systems should be complex and include interconnected automated systems of medical institutions that solve problems in the following areas: administrative, medical, financial, economic and scientific [3].

This approach allows you to quickly analyze the financial condition of the company while improving the quality of medical care, through the acquisition of new medical equipment and the development of medical informatics.

Medical information systems can be divided according to the following criteria:

- Medical systems, which include scattered inconsistent programs
  that solve the narrow tasks of specialist doctors, such as radiologists, ultrasound, etc.
- Medical systems of the organization of office work of doctors
  and processing of medical statistics.

New requirements in healthcare, as well as the rapid development of computer technology, pose the challenge for software developers to create complex automation systems for medical institutions.

The development and implementation of such systems makes it possible to effectively solve the problems of integrating all available information sources, both medical and economic, and facilitate the work of medical personnel. This ensures the speed of processing information of various types, increasing the speed of decision-making.

2 Hospital information systems

The system for collecting and processing information in a modern hospital should perform many different functions, so they cannot be automated in a short time.

Attempts to create comprehensive automated hospital information systems at one software and hardware base ceased in the 1980s. Now the automation of information processing is provided by using a complex of interacting relatively autonomous information systems of individual departments or services.

The advantage of this approach is that the systems can be put into operation gradually, as financial possibilities allow and the degree of readiness of medical personnel to introduce such systems will increase. The life cycle of an automated information system consists of five main stages [4]:

- developing a system or acquiring a complete system;
- system implementation;
- software maintenance;
- system operation;
- dismantling the system.

The average lifespan of an automated information system is 10 to 15 years. Over the past thirty years there has been a tendency to reduce it.

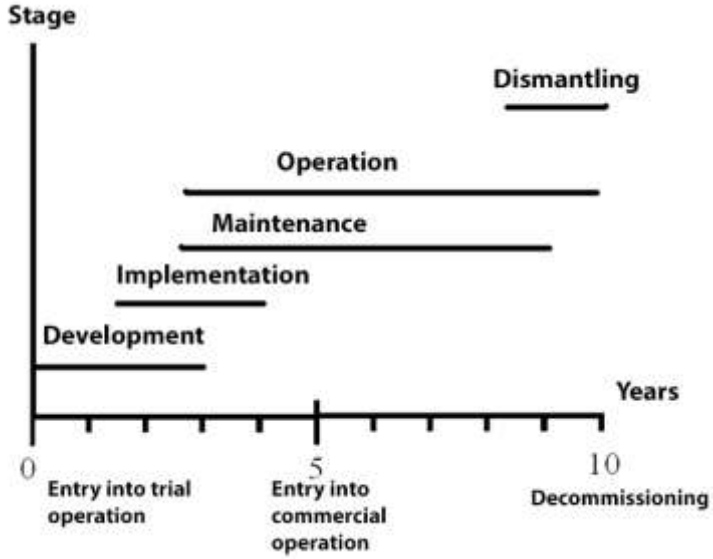

Fig.1. The life cycle of an automated information system.

3 Development of the system or the acquisition of the finished system

At the stage of developing an automated information system, a pre-project survey of existing data flows in an automated subdivision or hospital service is carried out. Then the technology of data acquisition and processing is designed. After that, software is developed that performs essential functions, and a project is being carried out to create or update hospital computer networks.

At the next stage, the developed software is implemented. This stage includes the creation or updating of computer networks (including the purchase or upgrading of computer equipment), the development or editing of reference and regulatory framework, training of medical personnel and accompanying programmers. The implementation phase is covered by the development phase.

When implementing developed or acquired software, design or development errors are identified. Over a long period of development, the working conditions of an automated unit or service may also change [5].

Errors and condition changes are corrected by programmers accompanying the information system software [6].

The automated information system is operated by its users with the help of specially designated personnel who maintain the computing networks used by the automated system, as well as its software and databases [7].

Operation of the system begins almost simultaneously with the maintenance of the software and lasts a little longer maintenance.

Upon expiration of the information system life cycle, it must be decommissioned, that is, dismantled. The decommissioning process includes the physical dismantling of obsolete components of computer networks, as well as specific preparatory operations that ensure the interaction of the system being dismantled with the one that is being replaced [8].

When replacing the old system with a new life cycles of both systems must be docked. Since the main condition for such a docking is the continuity of the line of operation, the result of the docking of life cycles must be as shown in Fig. 2.

The commissioning of the new system is marked on this figure with a dotted vertical line. This does not mean that the outdated system stops working: the process of dismantling it is still ongoing, for example, annual statistical reports are issued in the old system.

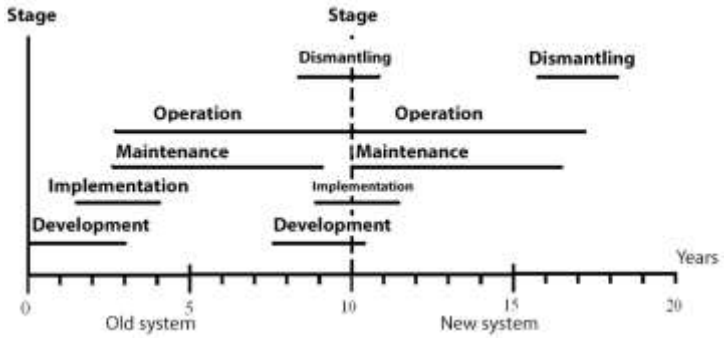

Fig.2. Connecting the life cycles of the old and new information systems.

4 The concept of "Electronic registry"

Electronic Registry - a program for recording clients to see a doctor or a private specialist. The system optimizes the work of the registry or secretary of the clinic, saving the secretary from paper journals. It gives you the opportunity to have an exact schedule of patients for doctors at any time, the ability to print schedules for each doctor, and also to collect statistics for further analysis of the work of the registry, marketing department, etc.

Some features of the Electronic Registry:

- Create a schedule of doctors and record patients for admission.
- Printout of the schedule for each doctor for a week or a month in advance.
- Transfer of records of doctors to the program and approval of enrolled through the Internet.
- Information about the free / busy time of each doctor can be displayed on the Internet on the customer's site.
- The patient can enroll independently by selecting a doctor, time and registering in the system.

5 Designing a Dynamic Site

At the design stage, the structure of the dynamic site is determined.
Designing a dynamic site is divided into several stages:

- analysis and design of the site structure;
- analysis and design of the site navigation system;
- analysis and design of the site content (the site);
- analysis and database design;
- description of the site functionality.

5.1 Designing a Dynamic Site

The structure of the site is a system of relative location and interrelations of files (pages) of the site. Often under the structure of the site is implied a block - site diagram.

There are several types of site structure:

1. Linear structure. Pages of the site are strictly one - for - one, convenient for creating a small by the number of pages of the site, with a small number of hyperlinks and consistent presentation of materials. Disadvantage: go to the next page only from the previous one.

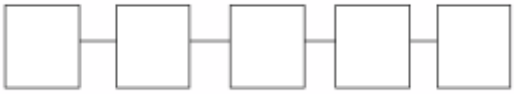

Fig.3. Linear structure.

2. Structure in the form of a lattice. It is based on building a site navigation system, when there is a mutual relationship between vertical and horizontal elements (pages) and the ability to quickly jump from one page to another without the need to visit intermediate pages. Disadvantage: an excessive increase in the number of hyperlinks and its use is limited for large sites, i.e. sites with a large number of pages.

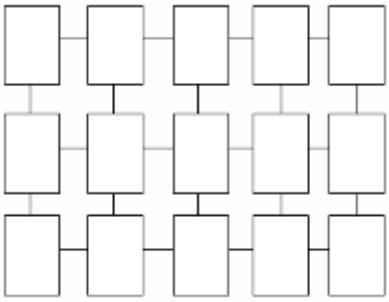

Fig.4. Structure in the form of a lattice.

The optimal site structure is the structure that meets the following criteria:

1. There is a main page, under which are the main sections of the site.
2. When clicking on one of the hyperlinks, the visitor goes to one of the main sections of the site, in which, similarly, hyperlinks can be placed on the other pages of this section.

When designing the structure of a dynamic site, it should be borne in mind that over time the amount of information on the site will grow and in order not to be spent on design in the future, the site structure will be optimized.

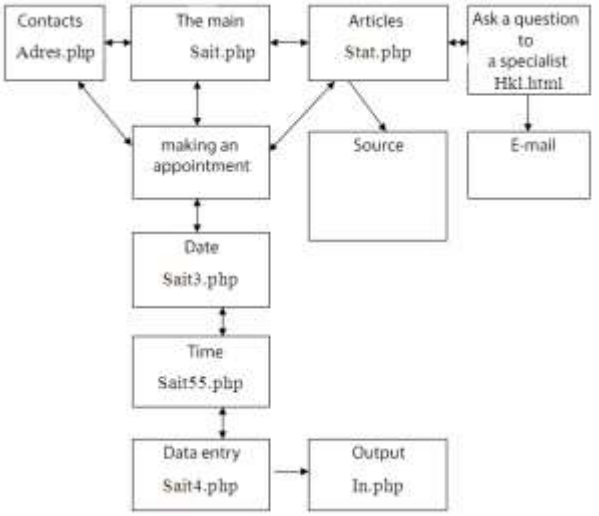

Fig.5. Structure of the dynamic site.

5.2 Dynamic Site Navigation System Design

Site navigation system - a set of text and graphic hyperlinks designed to search for information on the site. The best search engine will not be able to replace a well-constructed site navigation system.

How interesting and useful would not be the information posted on the site, the visitor will not be able to read it, if he can not find it on the site. This task should be solved by the site navigation system.

There are vertical, horizontal and combined site navigation. The dynamic site will use the combined navigation, the main horizontal menu will consist of the following items:

1. Home;
2. Articles;
3. Contacts;
4. Make an appointment;
5. Ask a question to a specialist.

5.3 Dynamic Site Functionality Modeling

Modeling is an important tool when building complex systems. Using modeling, you can design a system at an abstract level, while eliminating unnecessary details, having received information about its structure. At the initial stage, this is very useful, since, properly modeled structure of the system, can be applied during its creation.

Now for these tasks CASE - modeling tools (Computer Aided Software Engineering) are used, their occurrence is related to the need for tools that would allow to simulate the system / processes, as well as support known modeling standards.

One of the most famous CASE modeling tools is Rational Rose (RR). RR contains tools for modeling business processes, as well as tools for modeling databases, is a software implementation of a unified modeling language UML. UML (Unified Modeling Language) is a graphic description language for object modeling in the field of software development, designed to facilitate the work of the developer at all its stages.

In connection with the development of the UML language, developers began to present their models, which until then could only be understood by them, in general notations, thereby making a huge contribution to the development of object-oriented modeling.

The site will be designed using CASE - tool Rational Rose Real Time, a program that is an extension of the standard UML, the purpose of which is to simulate real-time systems.

5.4 Designing a Dynamic Site Database. Choosing a Data Model

There are several types of data models:

- Hierarchical model;
- Network model;
- Relational model.

The hierarchical model is a logical data model in the form of a tree structure, which is a set of elements arranged in order of their subordination from the general to the particular and forming an inverted tree (graph).

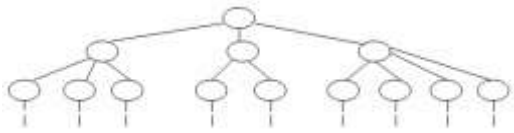

Fig.6. Hierarchical data model.

This model is characterized by such parameters as levels, nodes, and connections. The principle of the model is such that several nodes of a lower level are connected by means of communication with one node of a higher level. A node is an information model of an element located at a given hierarchy level.

The advantages of a hierarchical data model include efficient use of computer memory and good performance indicators for performing operations on data.

The disadvantage of the hierarchical model is its cumbersome to process information with quite complex logical connections.

A network model is a logical data model, representing their network structures of record types and the associated power relations one-to-one or one-to-many.

The difference between the network structure and the hierarchical one is that each element in the network structure can be associated with any other element.

The advantage of the network data model is the ability to effectively implement in terms of memory costs and efficiency.

The disadvantage of the network data model is the high complexity and rigidity of the database schema built on its basis.

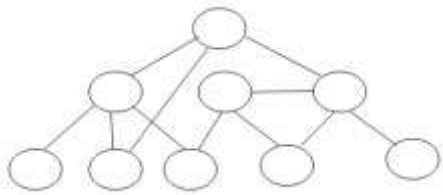

Fig.7. Network Data Model.

The most common acquired relational data model. A relational database is a repository of data organized in the form of two-dimensional tables. Any relational database table consists of rows (also called records) and columns (also called fields). The rows of the table contain information about the facts presented in it (or documents, or people, in a word, about similar objects). At the intersection of the column and row are specific values contained in the data table.

5.5 Physical Implementation of a Dynamic Site

Site links related to viewing news, articles, and achievements are of the form http://vdgkbn1.vv.si/view_cat.php?cat= number, where "cat" is a category, when choosing a post from any category, instead of a variable "cat", select the variable "id" - a unique key entry in the database.

When accessing the site, the following sequence of actions occurs:

1. The HTML document is being built, the style information is extracted from both external CSS files and style elements.
2. The presence of the id variable is checked.
3. A request to fetch data is sent, in accordance with the page id.
4. When forming the page, the title property is displayed, then meta. There is a connection to the file "pieces" of the php code, includ's.
5. Formed the contents of the page.

After the formation is completed, the page is sent to the client's browser.

5.6 Implementing a dynamic website design

The site design was created using the HTML5 hypertext markup language using CSS3 cascading style sheets. The design of the site is made in accordance with the recommendations of the W3C. The main recommendations are:

Do not use tags for positioning page elements for marking up tabular data. To specify the location, you should use special tags - containers, that is, tags </ div> and entered in HTML5 <article> </ article>, <section> </ section>, <nav> </ nav>, <footer > </ footer>.

When implementing the design of a dynamic site, non-catchy colors and textures were used. For better perception, text information is located on a white background. Information blocks are separated by color and display, which simplifies working with the site. Site navigation bar is located on top of the content block.

The site contains graphic inserts. What characterizes the hospital and its specialization. All images of the site are saved in pnp and jpg format, which reduces the download speed of the site and allows you to quickly obtain information even with a low-speed connection to the Internet.

Conclusion

In this paper, we analyzed the software development tools and selected tools for building the site. MySQL was chosen for working with the database. The main criteria for choosing an Apache web server were its prevalence among hosting providers, reliability and speed. Also in the chapter was described the physical design of the database. A database has been created in MySQL DBMS.

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