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INFORMATION REPRODUCTION SYSTEMS IN INFORMATION BUSINESS LOGISTICS

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The article considers the fundamentals of the information reproduction systems formation in the optoelectronic element base for information logistics systems. The use of optoelectronic elements for information processing has been considered, namely discrete optoelectronic digital systems, analog systems, optical memory systems, optical systems of input-output of information in computers, systems based on fiber devices of neuristor type. It is emphasized that modern logistics is impossible without the active use of information technology.

The functions of information support of managerial influences can be performed by information technologies used today in logistics. To perform the tasks of financial flow management, these technologies can be supplemented by modules of eye-processing of the information. Logic-clock quantron automatic devices based on optocouplers are suitable for creating parallel information operating environments, which is a universal means of converting and presenting information. This approach leads to the creation of matrix-type devices that are able not only to receive information but also to process it. One of the promising areas of use of optoelectronic matrix systems is the creation of flat operating screens for parallel reception and display of information.

The paper presents the classification of operating screens according to such features as: the principle of displaying information, the type of input information, the type of output information, the method of image formation, the number of consumers of the information.

The analysis of electric circuit diagram of modern LED matrix video screens, in particular of a typesetting-modular design has been presented.

A comparison of the forms of organization of matrix video screens is made, and it is emphasized that the most economical in terms of the number of memory trigger elements per one LED of the display cell is a video information system based on the structure of the third group video screen.

The structure of the video information system is optimized according to the criterion of optimality – the maximum image quality on the matrix screen and the minimum screen complexity, which is determined by the circuit features of the microelectronic circuits.

Key words*: information logistics system, image reproduction system, matrix video screen, typesetting-modular design, LED, display cell, brightness, ergonomic characteristics.*

F. 5. Fig. 6. Ref. 19

1. Challenge problem

Intelligent management of large infrastructures of modern metropolitan cities is impossible without high-quality means of providing information and reproducing images. Modern image reproduction systems are focused on increasing effective brightness and increasing sustainability and reliability. In this regard, the most common are video information systems based on high-brightness LEDs [1].

The structure of information flows determines their homogeneity and heterogeneity. Homogeneous information flows are characterized by a single type of the environment, a single functional affiliation, a single type of documentary support. Heterogeneous information flows do not meet all the above requirements.

The efficiency of modern means of information and computer technology is ensured primarily by functional integrity, parallel processing of elements, variability of structure, homogeneity, multifunctionality, hierarchy, distribution of elements in space, economy and reliability.

Let us consider the use of optoelectronics elements for information processing.

1. Discrete optoelectronic digital systems, which are divided into integrated optics and coherent discrete optical devices. In integrated optics, optoelectronic elements are used for galvanic scanning in the design of large integrated circuits. Coherent discrete optical devices use the effect of quenching the generation of a semiconductor laser with the light of another laser. At this high speed logical and memory optical elements are achieved.

2. Analog systems, in which the main is the processing of optical images. These systems use coherent optical laser radiation. Image synthesis is performed using transparencies, i.e. systems such as "sequential filters", matrix scanner systems.

3. Optical memory systems. The construction of optoelectronic RAM is constrained by the lack of reliable reversible optical environment.

4. Optical I/O systems in computers. These devices use the principle of direct input of symbols by the operator using a pen connected by a pantograph to a laser that repeats the recording on the holographic plate. The conversion of signals into digital code is carried out by a matrix of silicon photodiodes. Optical I/O systems have significant advantages over mechanical or electrical methods of inputting and displaying information.

5. Systems based on fiber devices of the neuristor type. To build an analogue of a neuristor, fiberglass is used, which contains areas that modulate the light flux passing through the fiberglass [2].

Information systems (IS) and information technologies (IT) in logistics are understood as a set of software and hardware tools and subjects for the production, transmission, processing and use of information in logistics systems (LS).

The dominant trend in the development of IS and IT is information integration based on modern methods of processing, data transmission, which is defined by such a concept as telematics. The conceptual apparatus in this new trend is largely borrowed from modern software engineering and communication network theory.

Modern logistics is impossible without the active use of information technology. It is difficult to imagine the formation and organization of supply chains without intensive, rapid exchange of information, without a rapid response to market necessities. Today it is almost impossible to ensure the quality of goods and services needed by consumers without the use of information tools and software for analysis, planning and support of commercial decision-making in logistics systems. Moreover, due to the development of information systems and technologies and automation of typical technological operations, logistics has become the dominant form of trade in highly competitive markets of economically developed countries.

Information issues in logistics today are determined by the following areas:

• study of dynamically changing information flows in the LS industry in connection with the change of ownership, diversification of enterprises, the complexity of market relations;

• development of information and software systems for automation of company management (in terms of integrated logistics);

• improvement of mobile communication systems;

• Internet-technologies in the organization and provision of mobile control in LS.

New trends in logistics are related to the methodologies of distributed mobile management (m-logistics) and continuous support and continuous support (information and resource) of the life cycle of goods and services CALS - Continuous Acquisitions and Life Cycle Support.

2. Analysis of recent research and publications

A huge number of works on the problems of using information technology in the logistics area, was written by such prominent scientists as: Krykavskyi Ye.V., Chornopyska N.V. [3], Oklander M.A. [4]. Authors Pecheniuk A.V., Hutsol T.D. [5], Kovalenko O.O., Martseniuk T.O., Yavorska I.O. [5], Havrylenko A.V., Havrylko T.O. [7], Talan M.V. [8] considers logistics and information systems in the management of national enterprises in various sectors of the economy.

Nazarov M.I., Nizelska M.A. [9], Uhryn D.I., Shevchuk S.F. [10], Krykavskyi Ye.V., Chornopyska N.V. [3] in their works consider the method of building information logistics systems. The position of logistics management based on the use of information technology is also highlighted in the scientific works. Scientists Krivovyazyuk I.V. [11], Kulyk Yu. M. [11] consider the state and importance of information communication systems and technologies in logistics.

However, the issue of logistics development based on the introduction of digitalization processes is insufficiently covered, and therefore requires additional research. Each of the mentioned scientists took part in the study of the issues of corporate logistics activity information support. However, the issues of logistics, developed on the basis of the introduction of digital processes, are currently insufficiently covered, which necessitates further research. Selection of previously unsolved parts of the overall problem. The introduction of modern digital technologies in logistics leads to changes in business models and strategic plans, improving interaction between all participants in the logistics process, increasing productivity, thereby increasing the competitiveness of logistics companies in the market. In this case, it is especially important to study the implementation of the digital process as one of the components of innovation in the logistics system of enterprises, which defines the purpose and outlines the objectives of this article.

3. Research objective

The objective of writing this article is to analyze the key aspects of the development of the logistics industry based on the application of information technology and the use of the latest information reproduction systems. Thus, the main task of the study is to determine the nature, role and importance of information reproduction systems for logistics companies; identification of the main logistics operations that require the introduction of innovative information technologies.

4. Main findings of the research

The functions of information support of managerial influences can be performed by information technologies used in logistics today. To perform the tasks of financial flow management, these technologies can be supplemented by modules of eye-processor information processing. Transportation automation systems, transport management, document management and a number of other information logistics technologies will be more effective if they are adapted to financial flow management with the help of logic-clock functions. An appropriate mathematical apparatus can be used for a formalized description of financial flows: integration of logical-temporal functions, vector description, matrix methods, factor and functional analysis.

Optoelectronic systems include optoelectronic homogeneous environment of the neuristor-specific type with optical interconnection. It has been established that fiberglass communication is used to transmit information between computers, its blocks and between blocks. Optical communication features such as broadbandness, galvanic input and output scanning, unidirectionality, non-availability of “short circuits”, reliability, reduced cable weight, low cost, and insensitivity to electromagnetic interference are very important. Work on the creation of homogeneous systems is based on the use of electrooptics elements, namely, it is proposed to use logic-clock quantron automatic devices based on optical couplers.

Such systems are capable to create parallel information operating environments, which is a universal means of converting and presenting information.

This approach leads to the creation of matrix-type devices that are able not only to receive information but also to process it. One of the promising areas of use of optoelectronic matrix systems is the creation of flat operating screens for parallel reception and display of information.

All operating screens can be classified according to the following characteristics: the principle of displaying information, the type of input information, the type of output information, the method of image formation, the number of consumers of information.

The use of the latest achievements in the field of information technology makes it possible to develop high-performance means of processing optical information (operating screens) with the following functionalities (Fig. 1): parallel input or output of images directly into the computing environment; parallel calculation of optical information arrays; implementation of real-time decision-making procedures; combining the transmission and processing of information in a homogeneous environment; ensuring the reliability and survivability of the system.

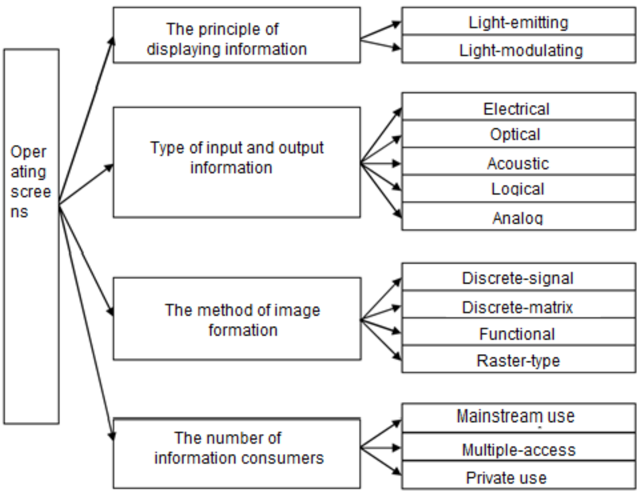

Fig.1. Classification of information reproduction systems

Generalized by the author on the basis of [2].

At the present stage of designing optoelectronic information display devices, the latest achievement is the creation of matrix screens, which allow to expand the functionality of the devices and provide image storage.

The architecture of halftone color imaging systems consists of a matrix screen (MS) based on high-brightness LEDs and devices for scanning, synchronization and information processing. Process synchronization and handling of input analog or digital video information is performed by a video processor device (PD). Parallel serial registers with the amount of storage of MS line of video information are the basis of the device of random-access memory (RAM). The scanning device (SD) scans the MS line by line.

Analysis of electrical schematics of modern LED matrix video screens, in particular typesetting-modular design allows us to divide the latter into three main groups:

1. the display cell is formed by a LED and a memory element [15, 12];
2. the display cell is formed by a LED and two memory elements [12, 16];
3. the display cell is formed by a LED and n memory elements [17-19].

A two-coordinate addressing system is sufficient to control the matrix video screen of the first group. For example, each display element DE_{ij} as a memory element contains a D-flip-flop T with information input D and clock input C. Information inputs D of display cells can be connected by columns, column (vertical) control buses VB_j are formed, and clock inputs C can be connected by the lines of the matrix video screen, line (horizontal) control buses HB_i are formed (Fig. 2). The D-flip-flop T controls the radiation of the HL LED.

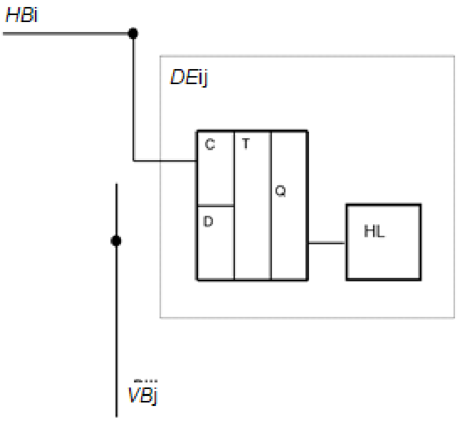

Fig. 2. Control structure of the first group matrix video screen [12, 15]

In the display cell of the matrix video screen of the second group there are two memory elements that form a two-operating system: the first memory element T1 receives information, and the second T2 controls the radiation of the HL LED through the “logic element I”. The first memory elements of a group of display cells are connected in a shift register, the maximum bit rate of which is limited mainly by the duration of the minimum gradation of the brightness of the video screen and the speed of the shift register, i.e. the shift clock speed.

To control the matrix video screen of the second group, a single-coordinate addressing system is required for the information inputs *II* of the shift registers of the display cell groups. The shift clock buses *T1* and transcription *T2* and the radiation permit bus RP can be common to the entire video screen (Fig. 3).

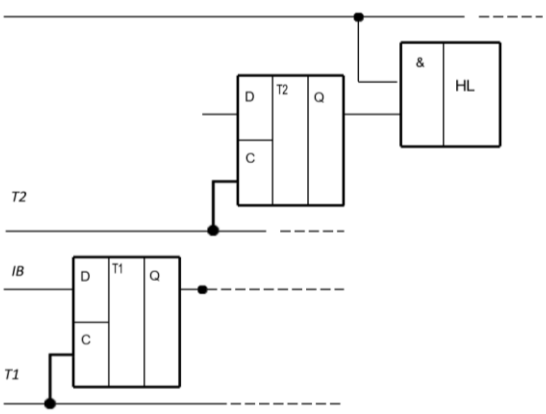

Fig. 3. Control structure of the second group matrix video screen [16]

When forming a multi-gradation image in the matrix video screens of the first and second groups, both the method of addition and the method of the sum of segments can be used. In the matrix video screens of the third group, the method of forming a multi-graded image determines the structure of the display element. Thus, in the matrix video screen [17] the method of addition is used, and in the matrix video screen [19] – the method of sum of segments.

To control the third group matrix video screen requires a two-coordinate addressing system and additional clock buses for recording information *T1* and the LFF *T2* formation, which may be common to the entire video screen. Each display element DE_{ij} as *n* memory elements contains a shift register RG with information input D and clock input C. Information signals to the inputs D come from the column (vertical) control buses VB_j, and – to the clock inputs C they come from the clock bus recording information *T1* or LFF formation clock bus *T2* according to the control signal from the line (horizontal) control buses HB_i (Fig. 4).

RG shift register controls the radiation of the HL LED through the "I-HI logic element" due to the corresponding supply of clock signals to the input of the LFF *T2* formation.

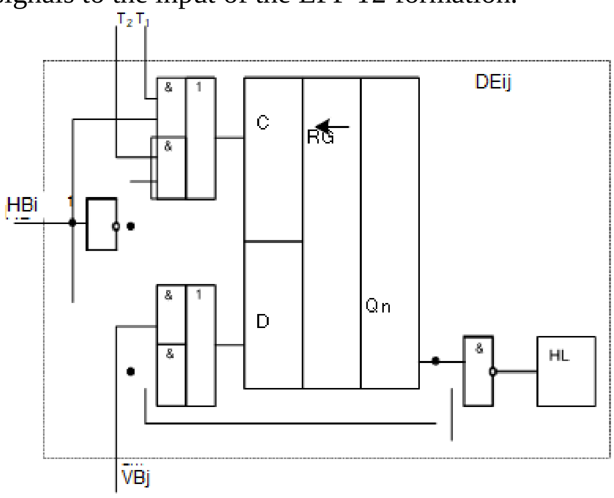

Fig. 4. Control structure of the third group matrix video screen [17, 18, 19]

The matrix video screens of the first and second groups, in addition to the memory elements in the display cells, require Random Access Memory with the volume of the full image matrix, i.e. RAM. Modern RAM is a dual-port random access digital random access memory device that has separate addressing inputs for both information recording mode and information reading mode, which allows to perform these operations independently at the same time. The required bit rate (q) of each RAM memory cell is determined by the number of brightness gradations that the display cells reproduce. For example, to reproduce 256 gradations of brightness, which satisfies modern digital television, you need q = 8 bits of memory for each cell of the video screen. In the mode of reading information from the RAM, signals are obtained in the form of q-bit parallel binary code, which must be converted into a pulse periodic signal of the corresponding LFF to supply to the LED of each cell of the video screen, which can be performed by the method of addition or sum of segments. The general electrical block diagram of the matrix video screens of the first and second groups with the formation of information flows by the method of addition is shown in Fig. 5, where: VPU – video processor unit; RAM – random access memory; DU - decoding unit; SPRU – serial-parallel register unit; MVS – matrix video screen; SU– scan unit (used for MVS of the first group).

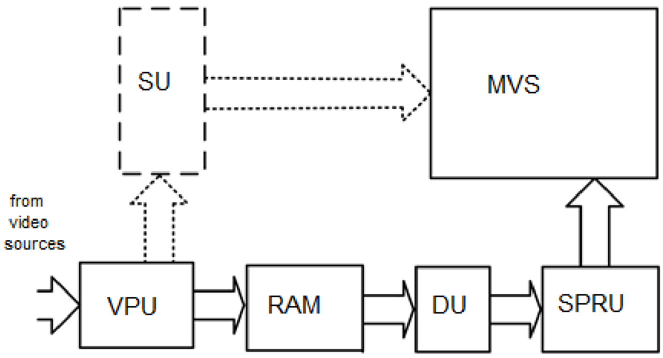

Fig. 5. General control flow chart of group 1 and 2 matrix video screen control (addition method) [12]

VPU receives video information from video sources and performs general management of the video information system. Formation of the corresponding LFF is carried out by DU and SPRU by cyclic readings of the information from RAM. When applying the method of addition, the number of cyclic readings is 2^q, i.e. 256 when q = 8. In the process of first reading at the DU output, "logical 1" is formed for all values of q-bit parallel binary code except zero, for which "logical 0" is formed, in the process of the second reading "logical 0" is already formed for both zero and for the next code and so further up to the 2^qth reading when "logical 1" is formed only for the oldest code having digits in all categories. The information from the DU enters the SPRU shift register, then in parallel it is rewritten in the SPRU output register and transmitted to the MVS display elements. The duration of each reading corresponds to the duration of the minimum gradation of brightness, which forms pulse periodic signal of the corresponding LFF for each LED. The SU is required in the first group video screens to determine the appropriate line of MVS display elements to receive information from the SPRU. For the second group video screens SU is not required because the information from the SPRU is transmitted to the appropriate elements of the MVS by means of the offset.

The general electrical control flow chart of matrix video screen of the first and second groups with the formation of information flows by the method of the sum of segments differs from that shown in Fig. 6 by the fact that instead of a DU the switching unit is used. The formation of the corresponding LFF is performed by the SU and SPRU blocks also by means of cyclic readings of information from the RAM. When applying the method of the sum of segments, the number of cyclic readings is equal to q, i.e. 8 when q = 8. In the process of the first reading the lower digit of the q-bit parallel binary code is switched on the output of the switching unit, in the process of the second reading the next digit is switched and so on to the switching of the higher bit in the process of the q-th reading. In this case, the segments of the existence of "logical 1" LFF have the duration of a series of geometric progression 1: 2: 4:…: 2^q for the first, second,…, q-th readings, which forms on the LEDs of the MVS display elements the corresponding amount of pulse periodic signals.

The general electric block diagram of matrix video screens of the third group control is given in Fig. 6. In this case, the method of forming LFF depends solely on the selected basic electrical circuit of the cells of the MSE display, for example, when using the circuit in Fig. 4 the method of sum of segments will be applied.

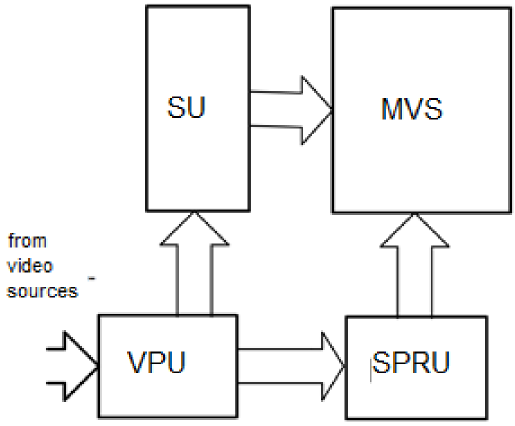

Fig. 6. General control flow chart of the matrix video screen control of the third group [12]

As can be seen from Fig. 6 this video screen does not require additional RAM, and SPRU directly accepts q-bit parallel binary code to the input shift registers from VPU. Next, from the source registers, the information, also by the shift method, is overwritten in the shift registers of the cells displaying the MVS line selected by the SU.

You can estimate the relative amount of hardware consumption by the number of memory triggers per LED display element, which determines some component of the complex difficulty factor of the video screen. So, we have the following values in the case of reproducing 256 gradations of brightness:

- video screen of the first group – video screen includes two triggers and RAM includes eight triggers, i.e. 10;
- video screen of the second group – video screen includes one trigger and RAM includes eight triggers, i.e. 9;
- video screen of the third group – video screen includes eight triggers.

Thus, the most economical in terms of the number of memory trigger elements per LED of the display element is a video information system based on the structure of the video screen of the third group.

Under the actual use of character master video screens, the efficiency factor can change its values according to many factors. Such changes can be estimated in the case of experimental modeling based on stochastic connectivities of the dependence of partial coefficients upon changes in the technical and operational characteristics of the developed screen.

The criterion of video screen efficiency is a complex indicator of the product of partial efficiency criteria:

$$K_{EF} = K_{IC}/K_{SC}, \quad (1)$$

where: K_{EF} – is the comprehensive criterion for the effectiveness of the video screen; K_{IC} – is the coefficient of image perception comfort; K_{SC} – is the coefficient of complexity of the video screen.

The level of suitability of indicators for image reproduction on the screen is assessed by a complex coefficient of image perception comfort calculated by the formula:

$$K_{IC} = K_L \times K_{\Delta L} \times K_\rho \times K_A \times K_H, \quad (2)$$

where: K_L – is the coefficient of brightness level optimality; $K_{\Delta L}$ – is the coefficient of homogeneity in brightness; K_ρ – is the coefficient of contrast optimality; K_A – is the coefficient of filling the area of the image field; K_H – is the coefficient of optimality of the linear dimensions of the indicator elements (image elements).

Coefficient of complexity determined by the circuit technology features of the typesetting screen microelectronic circuit:

$$K_{IC} = K_R \times K_S, \quad (3)$$

where: K_R – is the relative number of outputs per image cell; K_S – is the relative number of switching elements per LED.

Then the functional dependence between the partial coefficients in the complex efficiency can be defined as follows:

$$K_{ef} = \frac{K_{IC}}{K_{SC}} = \frac{K_L \cdot K_{\Delta L} \cdot K_\rho \cdot K_A \cdot K_H}{K_R \cdot K_s} \quad (4)$$

Taking into account that the partial efficiencies of K_A, K_R and K_S are constant and are determined only by the technical characteristics of the screen, let us introduce a constant value $\alpha = \frac{K_A}{K_R \cdot K_S}$, then the final functional dependence takes the form:

$$K_{еф} = f(K_L, K_{\Delta L}, K_\rho, K_H) = \alpha \cdot K_L \cdot K_{\Delta L} \cdot K_\rho \cdot K_H. \quad (5)$$

The estimation of K_{EF} on the basis of this dependence is complex and is carried out taking into account experimental restrictions, which are technical and operational characteristics:

- The geometric dimension of the typesetting video screen is 3 × 4 m.
- The level of outdoor lighting has a following gradation: day – 50,000 lux, twilight – 5000 lux, night – 50 lux.
- The number of samples of expert evaluation options is 15 units.
- The video image on the screen is evaluated by experts from a distance that is taken as an observer-target range of 15 to 19 m.
- The average brightness of display elements (LEDs) is 8000 Nits.
- The video screen has a matrix structure of construction based on shift registers with decoding.
- The coefficient of filling the screen area K_A = 1.
- The relative number of outputs per cell of the K_R image = 0.312.
- The relative number of switching elements per LED K_S = 1.78.

5. Conclusion

The architectural organization of information reproduction systems with the use of logical-clock image transformation models has been analyzed, which made it possible to increase the realism of image reproduction due to the more precise determination of the brightness level of display elements.

Shift and parallel register structures for managing LEDs with typesetting-integrated implementation of the matrix video screen on high-brightness LEDs can be made as integrated structures simultaneously with LEDs, and as separate structural elements.

Based on the created automated image reproduction system, which uses methods of parallel control and nonlinear reproduction of brightness gradations, the structure of the video information system is optimized by the criterion of optimality – the maximum image quality on the matrix screen.

The coefficient of image perception comfort is estimated and the complex criterion of efficiency of the video information system that considers both qualitative characteristics of the image, and cost and complexity of the design execution has been developed.

Thus, the comfort of image perception is a complex indicator of the effectiveness of the video information system depending on both the hardware design and conditions of its use, and the features of its physiological perception by the human eye.

Further research and implementation of logistics information and software modules based on logic-clock functions will allow to effectively move from the management of individual logistics functions or operations to business process management as the most adequate objects of implementation of the concept of integrated logistics.

It is recommended to introduce into production a nanotechnology video information system based on the third group display cell, which is the most economical in terms of the amount of memory for one energy-saving high-brightness LED on superlattices.

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СИСТЕМИ ВІДТВОРЕННЯ ІНФОРМАЦІЇ В ІНФОРМАЦІЙНІЙ ЛОГІСТИЦІ

В статті розглядаються основи створення систем відтворення інформації в оптико-електронній елементній базі для інформаційних логістичних систем. Розглянуто використання елементів оптоелектроніки для обробки інформації, а саме дискретні оптоелектронні цифрові системи, аналогові системи, системи оптичної пам'яті, оптичні системи вводу-виводу інформації в ЕОМ, системи на основі волоконних пристроїв нейристорного типу. Наголошено, що сучасна логістика неможлива без активного використання інформаційних технологій.

Функції інформаційної підтримки керівних впливів можуть виконувати інформаційні технології, що сьогодні застосовуються у логістиці. Для виконання задач управління фінансовими потоками ці технології можуть бути доповнені модулями око-процесорної обробки інформації. Логіко-часові квантрон-автомати на базі оптронів придатні для створення паралельних інформаційних оперативних середовищ, що є універсальним засобом перетворення і подання інформації. Такий підхід зумовлює створення пристроїв матричного типу, які здатні не лише приймати інформацію, але й обробляти її. Однією з перспективних галузей використання оптоелектронних матричних систем є створення пласких операційних екранів для паралельного прийому та відображення інформації.

В роботі наводиться класифікація операційних екранів за такими ознаками як: принцип відображення інформації, тип вхідної інформації, тип вихідної інформації, спосіб формування зображення, кількість споживачів інформації.

Наведено аналіз електричних принципових схем сучасних світлодіодних матричних відеоекранів, зокрема набірно-модульної конструкції.

Проведено порівняння форм організації матричних відеоекранів, та наголошено, що найбільш економічною за кількістю тригерних елементів пам'яті на один світлодіод комірки відображення є відеоінформаційна система, побудована на базі структури відеоекрану третьої групи.

В роботі оптимізовано структуру відеоінформаційної системи за критерієм оптимальності - максимум якості зображення на матричному екрані та мінімум складності екрану, що визначається схемотехнічними особливостями мікросхем.

Ключові слова: *інформаційна логістична система, система відтворення зображень, матричний відеоекран, набірно-модульна конструкція, світлодіод, комірка зображення, яскравість, ергонометричні характеристики.*

Ф. 5. Рис. 6. Літ. 19

СИСТЕМЫ ОТОБРАЖЕНИЯ ИНФОРМАЦИИ В ИНФОРМАЦИОННОЙ ЛОГИСТИКЕ

В статье рассматриваются основы создания систем воссоздания информации в оптико-электронной элементной базе для информационных логистических систем. Рассмотрено использование элементов оптоэлектроники для обработки информации, а именно дискретные *оптоэлектронные цифровые системы, аналоговые системы, системы оптической памяти, оптические системы вводу-выводу информации в ЭВМ, системы на основе волоконных устройств нейристорного типа. Отмечено, что современная логистика невозможна без активного использования информационных технологий.*

Функции информационной поддержки руководящих влияний могут выполнять информационные технологии, которые сегодня применяются в логистике. Для выполнения задач управления финансовыми потоками эти технологии могут быть дополнены модулями око-процессорной обработки информации. Логико-часовые квантрон-автомати на базе оптронов пригодны для создания параллельных информационных оперативных сред, которые являются универсальным средством превращения и представления информации. Такой подход предопределяет создание устройств матричного типа, которые способны не только принимать информацию, но и обрабатывать ее. Одной из перспективных отраслей использования оптоэлектронных матричных систем есть создание плоских операционных экранов для параллельного приема и отражения информации.

В работе приводится классификация операционных экранов по таким признакам как: принцип отражения информации, тип входной информации, тип исходной информации, способ формирования изображения, количество потребителей информации.

Проанализированы электрические принципиальные схемы современных светодиодных матричных видеоэкранов, в частности наборно-модульной конструкции.

Проведено сравнительный анализ форм организации матричных видеоэкранов, и отмечено, что наиболее экономической за количеством триггерных ячеек памяти на один светодиод ячейки отражения есть видеоинформационная система, построенная на базе структуры видеоэкрана третьей группы.

В работе оптимизирована структура видеоинформационной системы по критерию оптимальности – максимум качества изображения на матричном экране и минимум сложности экрана, который определяется схемотехничными особенностями микросхем.

Ключевые слова: *иинформационно-логистическая система, система отображения информации, матричный видеоэкран, наборно-модульная конструкция, светодиод, ячейка изображения, яркость, энергометрические характеристики*

Ф. 5. Рис. 6. Лит. 19

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