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Kozemjako V.P., prof; Doroshchenkov G.D.; Borbich M.P.

STRUCTURAL ORGANIZATION OF VIDEOINFORMATIVE SYSTEMS WITH TYPESETTING SCREEN ON LIGHT-EMITTING DIODES

Modern world achievements in the area of video-information output devices are analyzed, as optic-electronically geo-information power system component, particularly large image colour video screens. The drawbacks of two-co-ordinate addressing systems which provide minimum control channels indicators are considered. The structures of the matrix light-emitting diodes typesetting video screens which lack the drawbacks of addressing system are offered.

Keywords: *video screen, indicator, element of indication, cell of image, full color pixel, light-emitting diode.*

Subject of the discussion

The combination of the world-wide Internet structures with powerful networks which exist in Ukraine and in the entire world is a sufficient base for orientation on global geo-information-power networks. The last century gave globally geo-information network to humanity, but still there is a problem dealing with construction of necessary element base.

The optic-electronic geo-information power system (OE GIPS) which controls the infrastructure of the city or region [1] consists of servers of variants designation, connected with each other, namely the server of video information processing, integrated with devices intended for input and output of information. The video-information output devices contain multipurpose monitor, and in addition, colour video screen of large size. Consequently, systems of video information presentation based on typesetting screens are useable as an alternative screening projection. Practical realization was attained by typesetting screens from electron-beam tubes, gas-discharge panels of direct and alternating currents (plasma panel), liquid-crystal panels and light-emitting diodes.

Nowadays residents of large cities are aware of such phenomenon as video screens. If we studied the history of videoscreens, using the materials available in the Internet, we would learn that these devices appeared in CIS countries only in 90s of the last century. In fact these devices appeared in Ukraine earlier.

In the Soviet Union the first video screen of domestic production was installed in 1973 in Moscow in Kalininskiy Avenue. It was the full-color “television set” on automobile incandescent lamps with red, dark blue and green colour filters. The electronic informer was called - "Elin". A developer and the producer – the Central Designer Bureau of Informative Technique (CDBIT), located in Vinnitsa and subordinated to the Ministry of electronic industry of the USSR. An attempt appeared to be unsuccessful, and although a video screen was used long enough, its reliability was insufficient for such type of devices. The main reason of it was complicated operation mode of the elements of indication.

In 1979, in the central square of Vinnitsa, a monochromatic-experimental videoscreen was put into operation. The device was developed on the base of logic-temporal principle of brightness modulation cell of image [2]. Element of indication – incandescent lamp of 127 V rated for 30 Wt, information field size - 8×6 m, resolution – 128×96 image cells, brightness level - 16.

Experience obtained while development of this product, and successes in electronic industry in the area of the element base formation, permitted in the second half of 1983 to start development of full-color video screen on vacuum-luminescent indicators intended for replacement of outdated device, installed in Kalininskiy Avenue. The project was named “Elin 2”. CDBIT was the main manufacturer of the device. The elaboration was a joint invention CDBIT and VNTU- Vinnitsa Polytechnic Institute at that time [3]. “Elin 2” began to operate in summer of 1985 before the inaugeration of International festival of youth and students in Moscow. Screen size- 17×13 m, resolution – 192×144 pixels, brightness level - 16 each colors, forming scale is nonlinear. A video screen consisted of 1728 indicator modules - 48 in the line and 36 vertically.

Nowadays light-emitting-based devices are among installations ,most widely used in the world. In resent years considerable improvements have been made to increase the brightness and service life, expansion of spectral range. One of the limitations of light-emitting diodes is the necessity to install them at a certain distance from each other to achieve better heat dissipation. Due to this constraint they are not used for manufacture of monitor-type displays, but at the same time they are perfect means of outdoors information representation and can be used in

rather simple by construction devices, for instance, watches, indications of audio-visual equipment, traffic-lights and in complex units.

Huge screens based on light-emitting panels impress greatly. Among the last achievements it is necessary to mention the large size screen (2000×2000 elements) 60 inches (150 cm), a brightness 330 cd/m^2 with control charts, allowing to get the semi toning coloured images. Lumitex Inc.the company operating in the USA and Great Britain, made a number of developments based on long-life light-emitting diodes. Their operation life is 5000 – 100000 hours. Brightness of special application panels reaches 8000 cd/m$^{2.}$ English companies Picturebox, The Big Screen Co, made a typesetting screen with a dimension of 3,6×4,8 m, it can be easily transported to any place by means of specially equipped vehicle. A screen contains 221184 coloured pixels, 25 mm each. Brightness is 3000 cd/m^2 and it can be used at any hour of the day. To reduce heat dissipation the casing of the screen is painted using “Stels” technology [4].

We have to note that in 80s, CDBIT conducted research concerning possibility to receive semi toning images using light-emitting diode indicators (the sample of light-emitting diodes manufactured by "Start" enterprise were used).

Principles of structural construction of videoscreens

In discrete indicating engineering, the most widespread system of two-co-ordinate addressing which provides a considerable reduction of amount of control channel and indicator outputs, the number of which makes the sum of M row and the N column buses (in single coordinate addressing system M×N channels are necessary).

Terminology of "two-co-ordinate addressing", in our opinion, is the most suitable, although other definitions for this type of addressing are used in literature, for example, matrix [5] or multiplexed [6].

The two-co-ordinate addressing system is characterized by the fact that every display element has two control inputs output, one of the inputs being connected to the appropriate row, and the second to the column of matrix bus. This addressing system is only possible during dynamic office hours and is carried out as follows: at one co-ordinate, for example to the row, expanding (scanning) is carried out by supplying one by one in every row of the pulses, and at the other co-ordinate, for example to the columns, synchronously the information pulses enter, thus their delivery is possible simultaneously in all columns. Naturally exciting state of display elements occurs during the coincidence of the appropriate pulses on a row and column.

During the two-co-ordinate addressing, there appears a serious problem which is caused by the cross connection of display elements and produces certain requirements to the electric characteristic of these elements. When the voltage, U is applied to the selected element of square matrix, to other elements which are connected with this row or column, the voltage will be applied: $U^* = U(n-1)/(2n-1)$, while all other elements will have voltage: $U^{**} = U/(2n-1)$, if resistance of image elements are equal (matrix n×n elements). From the given voltages of stray communication the most substantial is voltage U*, because in case of large n it tends to the value U/2, that results in so-called cross-effect, that is, the image in the form of two lines (cross) appears on the matrix, these lines illuminate, brighter point is in the place of crossing. If the threshold of switching is available at display elements, and if this threshold is greater than maximum possible voltage at the element, when it is not chosen, the cross-effect is not observed. Thus, switching threshold at display elements must exceed U/2.

Another important drawback of two-coordinate system of addressing is the presence of voltage (signal) at display element only in case of coincidence of corresponding pulses in a row and column of the matrix, that considerably reduces the efficient brightness of display elements. If certain control circuit is introduced in display element (cell), then hybrid system of addressing can be obtained, which combines the advantages of two-coordinate system of addressing and acquires needed properties of one-coordinate system of addressing, namely, the function of "memory". There are many television video informative systems, where the "memory" function located in the display elements due to parallel [7] or shifting registers [8, 9]. A great number of vertical buses (k×N) or outputs of semitones formation, (k) is a drawback of such video screens which substantially complicates implementation of matrix video screen in a typesetting-integral variant. The given drawback is eliminated in the developed videosystem, the operation of which is based on the method of KVP-transformations [10]. According to this method, every discrete value of video signal corresponds the adequate excitation duration of the image cells from initial to shooting period.

Structurally the system for reproduction of semitone colour images (Fig. 1) consists of matrix screen (MS), manufactured on high-brightness light-emitting diodes base and devices, of synchronization and information processing. Synchronization of processes and analog or digital video information input treatment is completed by the video processor device (VPD). Parallel-serial registers, with memory volume of video information row MS, is the base of RAM. Convolution device (CD) performs MS scanning by rows [11]. The base of typesetting matrix screen is the matrix (module) of image cells. A matrix has horizontal and vertical control buses, clock recording contacted and semitones formation buses. The first version of matrix cell (Fig. 2) contains register shift RG, three binary counters on the deduction CT2 and three luminous emission elements (light-emitting diodes) HL_R, HL_G, HL_B, which form the full colour pixels images due to the red, green and dark blue colors of emissions [9].

The second type of the matrix cell contains register shift RG, one binary counter on the deduction (subtrahend) CT2 and one light-emitting diode HL [12]. Formation of the full colour pixels image takes place due to four matrix cells; red, green and dark blue colors of light-emitting diodes radiation, the number of light-emitting diodes of one of radiation colours must be doubled. The locations of light-emitting diodes in the pixel of first variant (a) and second (b) variants are given in Fig. 3.

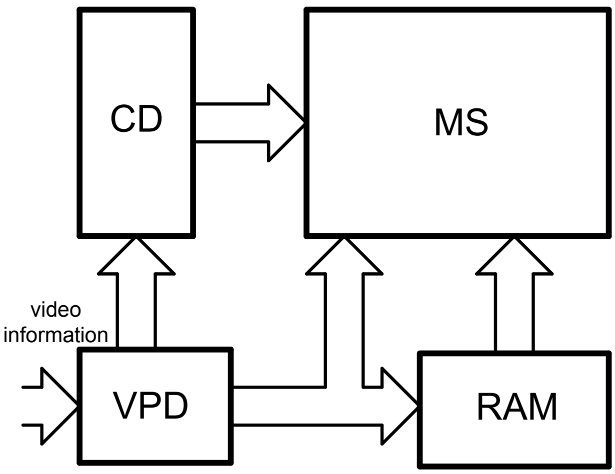

Fig. 1. Structure of light-emitting diode metrical videoscreen

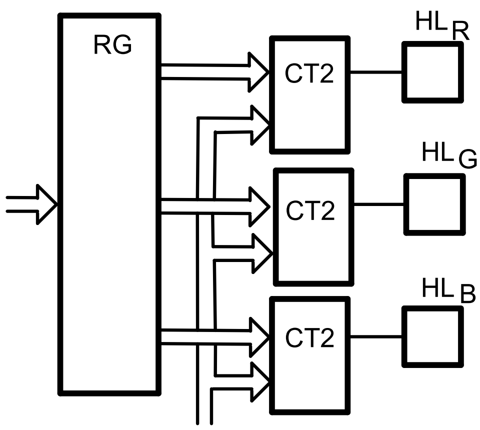

Fig. 2. Flow diagram of pixel

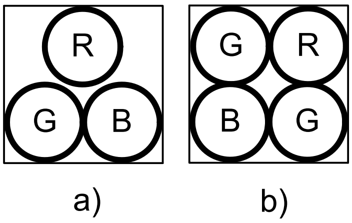

Fig. 3. Variants of cells location

Information enters VPD from analog or digital video sources. In the case of the input analog signal VPD converts it in to digital video signal- parallel binary code with definite amount of digits. The necessary synchronization signals are also produced by VPD. Each k digits carry information of elements brightness of certain color, first for example, red, another k digits - green and the last k digits - dark blue. From information outputs of VPD digital video signal arrives to RAM, which consists of registers shift. Information regarding the brightness of image cells by clock recording signals is accumulated in the given registers due to the shift of binary code from the first register to the last one, after that it is read into shift registers RG of MS selected row by CD signals. After recording of the information into shift registers RG of the matrix by frame clock signal, recording of the information will be performed into each subtrahend CT2.

The process of image reproduction goes as follows. As soon as in any subtrahend CT2 a code different from the zero is set, a signal appears in the output of the subtrahend deduction, which allows to reduce its own state by one unit in every clock pulse. The pulse enters to its own clock input from clock bus of semitones formation. The below mentioned signal of deduction permission will be at the output of every subtrahend CT2 from the moment of information recording from register shift RG to the moment of zero code installation. Thus duration of signal in subtrahend CT2 output depends on initial binary code, the longest duration of output signal will be obtained by code11…1. It corresponds to the larges brightness gradation of light-emitting diode HL. Intermediate brightness gradations will be obtained at other initial codes. Signals from the subtrahends outputs CT2 pass to light-emitting diodes HL through the commutation elements (not indicated in the diagram).

The scientific-production company "Planet-M" (Vinnitsa) elaborated and manufactured video system with a typesetting screen on light-emitting diodes (Fig. 4, Fig. 5). The basis of video screens is the indicator panel (Fig. 6), manufactured on the printed board and contains 16×8 full colour pixels on one side. Each pixel is formed by four light-emitting diodes - two red, one of green and dark blue colors of radiation. On the opposite side, control circuits of the light-emitting diodes and connectors are located. The printed circuit board is placed in metallic casing and is sealed by a compound. 12 indicator panels form indicator module with common control unit.

Power supply unit is also the component of the indicator module. The indicator module contains 96×64 pixels. 10×10 indicator modules form a typesetting video screen, the information field of which contains 960×640 pixels with the size of 1,92×1,28m. The brightness of video screen is 7600 cd/m^2, which allows the use it during solan illumination at any time of the day.

Fig. 4. Typesetting video screen of the "Planet-M" company

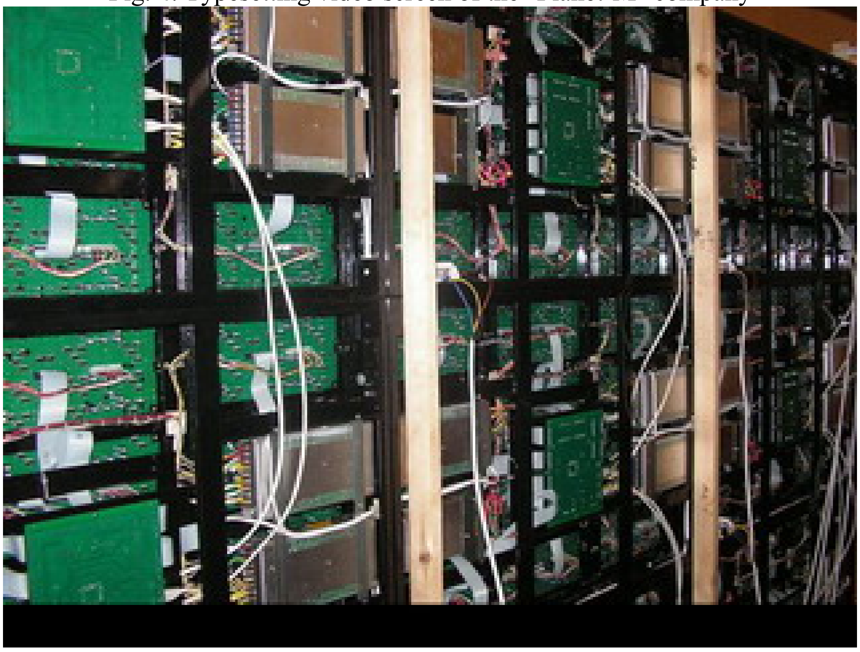

Fig. 5. A typesetting video screen-view from the setup side

Besides the above-mentioned, a videoscreen has the following technical descriptions:
- step of pixels is 20 mm;
- number of brightness gradations is 256;
- number of the coloured tints is 16,7 million.;
- shooting frequency no less than 50 Hz;
- consumable power of the video screen 930 watt/m^2;
- maximal light-emitting diodes current 20 mA;
- the scale of forming brightness gradations is nonlinear, adapted to the features of sight;
- current through light-emitting diodes is stabilized;
- the brightness of video screen is automatically regulated depending on external illumination.

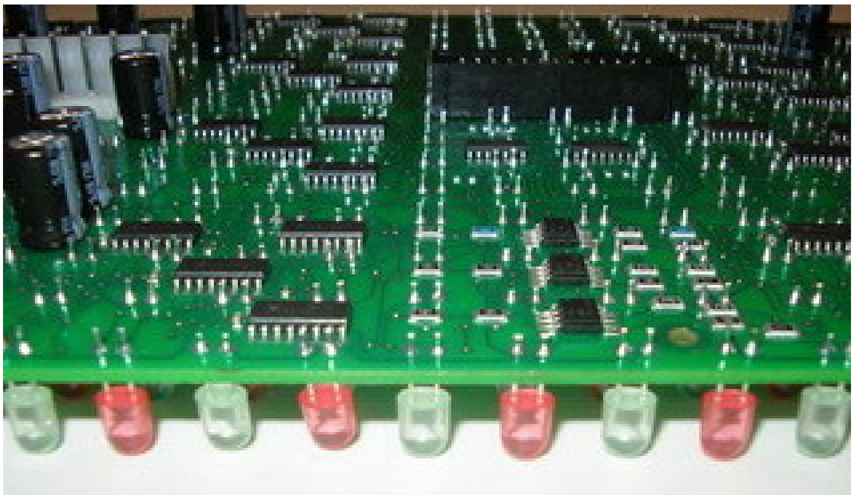

Fig. 6. Indicator panel

A computer is the video information source for the video screens, from the DVI-output of the computer video signal passes to the adapter device, where the video signal division into R,G, B components and preliminary processing takes place. Information signals pass to indication module from the adaptor across LVDS-interface. Reconstruction of the image by each indication module is independent on each other.

Conclusions

1. As a result of research carried out requirements regarding hybrid addressing of full-colour typesetting video screens, intended for reconstruction of semitone colour images are formulated.

2. The efficiency of construction of super-bright light-emitting diode videoscreens on the base of KVP-transformations method, according to which each discrete value of videosignal level corresponds adequate duration of image cell excitation in the range from zero to duration of shooting period.

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Kozemjako Vladimiyr Prokopovich – head of laser and optoelectronic engineering department.

Doroshchenkov Genadiy Dmytrovich – associate professor of laser and optoelectronic engineering department.

Vinnitsa National Technical University.

Borbich Myxael Pablovich – director of Scientific-production company “Planet-M”.