UDC 004.9 DOI 10.52167/1609-1817-2022-122-3-287-294

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DEVELOPMENT OF LED SCREEN TO RECEIVE REAL-TIME TRANSMISSION OF EVACUATION INFORMATION

Abstract. In this paper, an LED screen with ultra-low power consumption is developed. The work proposes methods for modeling mechanical and electronic systems. The combination of these scientific works gives us an opportunity to reduce power consumption. Spatial-mechanical sweep is developed, which allows to refuse decoding circuits, which in turn consume 35-40% of the total power consumption. We studied the setup of SDRAM controller for reading video data stored in memory or entering data into memory, and developed a code for reading data from the controller memory and outputting it to the data bus on demand of the output device. The results of this study can be widely used by the system for the integrated operation of the evacuation information system in training mode in order to train and mobilize personnel responsible for evacuation, as well as to keep all information and communication resources in readiness.

Keywords. Evacuation, LED, data transfer, operational plan, controller.

Introduction.

At the present stage, the most effective tool for research and optimization of the evacuation process are computer evacuation models. By the present time, a large number of similar computer models have been created [1].

The work [2] contributed to the development of computer evacuation simulation models (CESM).

Modern CESM allow you to simulate to some extent the dynamics of human flow parameters during the evacuation of a building, estimate the total duration of the evacuation and solve the problem of selecting evacuation routes. However, the vast majority of modern CESM do not adequately account for the possibility of flow stratification by velocity [3]. In addition, there is virtually no consideration of the specifics and architectural features of educational institutions and enterprises in modern CESM. The main feature of flow formation in the buildings of educational institutions is nonstationary distribution of people in the inner rooms of the building, related to the schedule of classes [4]. This leads to the dependence of evacuation plans on the time of day, and also requires an assessment of the training schedule in terms of organizing the unobstructed movement of people during evacuation. The solution of these problems for educational buildings is complicated by the presence of moments of time when people move from one room to another, for example, during breaks between classes [5].

An overview of intelligent evacuation management systems is provided in [6], covering aspects of crowd monitoring, disaster prediction, evacuation modeling, and evacuation route recommendations. This review will assist researchers in developing robust automated evacuation systems that will help ensure the safety of evacuees, especially during emergency evacuation scenarios. The uncertainty of crowd behavior is inevitable in any evacuation scenario, especially during an emergency evacuation. Similarly, during an emergency evacuation scenario, finding the safest exit route is imprecise and inaccurate.

The article [7] presents a comprehensive and systematic review of existing research in the field of emergency management, both in terms of system design and algorithm development. New challenges and opportunities related to system optimization, modeling and optimization of evacuee behavior, computational models, data analysis, energy and cybersecurity aspects are proposed. But evacuation tasks depend on building architecture or population density. During an emergency, if the power goes out, organizing a comprehensive evacuation will be difficult.

In the time of informational and digital technologies smartphones, pads, table monitors, TV sets, projectors and devices of augmented reality have become the reflection of our everyday life; their wide usage was grasping from the end of 1960–ies and start of 1970- ies years, when there was developed LCD display [8-11]. Heavy cathode ray tubes since 2000 were gradually superseded, and their place was occupied with LCD displays and became the dominant technology [12,13]. Intensive development of materials [14] and devices of organic light emitting diode (OLED) [14] quickly grows, permitting to fold up other devices as well. At present there have appeared micro LEDs (μLEDs) [15-22] and mini LEDs (mLEDs) [21,22], which operate with transparent displays [19] and high intensity displays [18-19]. One of the biggest problem is defects repair, which will influence at the device cost. In the given research, there has been developed LED screen with ultralow energy consumption**.**

Materials and methods.

The work herein offers then methods of modeling mechanical and electronic systems. Aggregate given scientific work, gives us the possibility to reduce energy consumption by means of the given research. Obtained images differ from conventional light-emitting diodes with their semitransparency and transparency effect, attracting people’s attention. Scientific novelty of the given research is usage of spatial-mechanical fold up, which gives the possibility to give up decoders, which in turn, consume 35-40% electrical power off the total consumption. Usage of mechanics in light-emitting diodes engineering creates a number of problems, which need solutions.

In research methodology we consider mechanics control by means of angle position sensor (PLIS), giving electrical impulse from angle position, there is created the algorithm, reading total number of impulses entering from the sensor of angle position. The electric impulses enter the input of programmable logical integral schemes. At the scheme thereof there is created an algorithm at the program level, reading total quantity of impulses. Simultaneously at PLIS there is created the matrix of video format. With each entering impulse PLIS loads vertical light-emitting diode drives with information from video format matrix. In whole, the sensor of angle position gives as many impulses, as necessary to complete synchronization of mechanics with electronics.

Video signal processing is made in real-time regime. Analog video signal enters the analog-digital transformer input, ADT. ADT transforms an analog green signal into 8- bit digital canal, each canal has main component colors RGB. On the PLIS there recorded the algorithm of video flow processing. Figure 1 shows principal diagram of LED screen with extra low energy consumption**,** device with minimal power consumption. After processing at PLIS the digital video flow is extracted through serial peripheral interface SPI.

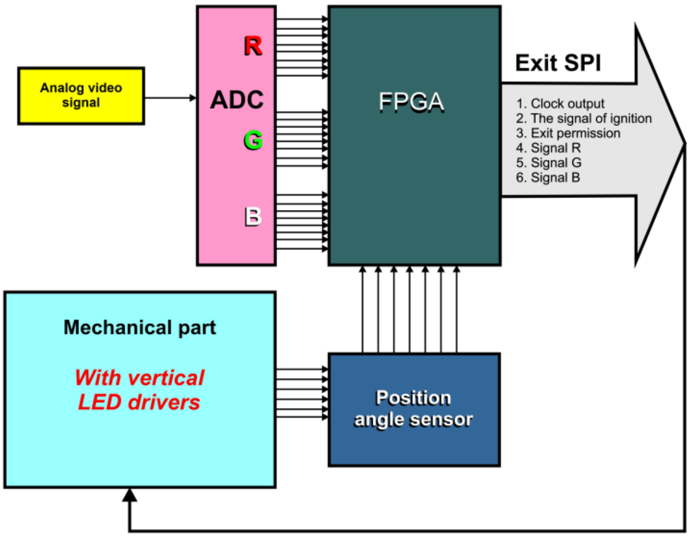

Figure 1 - Principal diagram of LED screen with low ultra-low energy consumption

Along the bus SPI the digital video flow is loaded into vertical light-emitting diode drives, consisting of three lines. With every impulse, entering from the angle position sensor and with a command of an ignition signal for light-emitting diode, the columns, loaded with data, are discharged in the form of light emitter flash. Columns quantity is selected in the way, that a human being from the distance of 2-3 meters could distinctly see full color semi-transparent image. Frequency of the image flashing can be regulated from 10 hz to 50 hz

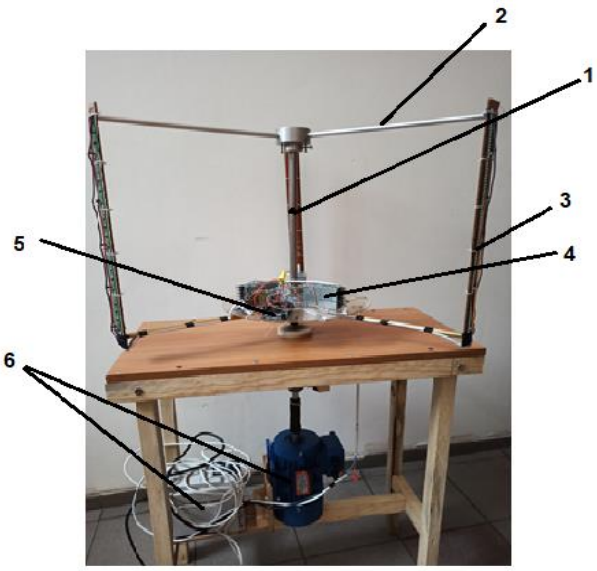

Figure 2 - Mockup of LED screen with ultra-low energy consumption

Figure 2 presents LED screen mockup with ultra-low energy consumption, where 1- major axis with explosive grenade, 2- upper and bottom arms, 3- vertical wing ribs with light-emitting diodes drives RGB, 4- power unit at every feeding line RGB, 5-microprocessor control unit, 6- electric motor with variable frequency control.

Figure below demonstrates controller setting up (Figure 3), which is quite simple.

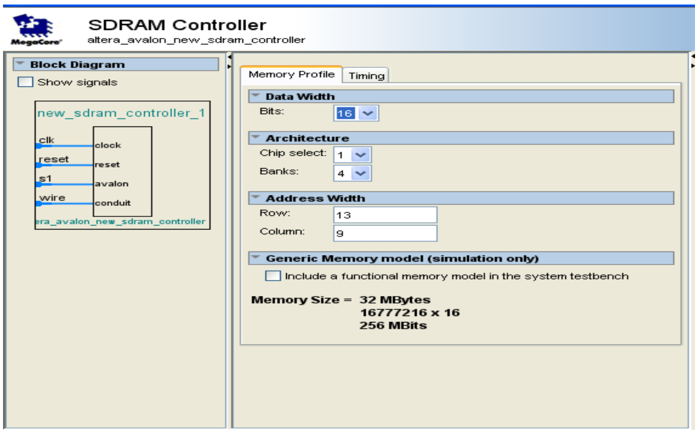

Figure 3 – SDRAM bit setting up

Data bus is installed on 16-bit length, it means, that in parallel there might be obtained 16-bit data from the memory, banks accepted as two. Number of lines is 13, columns quantity is accepted as 9.

Results.

Memory controller is monitored with controller NIOS II. Controller is programmed in the language C. Programming environment is Eclipse. Memory controller function is reading the video data, saved in the memory, or data input into the memory. The controller thereof provides straight-chain compound with SDRAM.

As a central processor there has been selected controller NIOS II, represented by company Altera, with a possibility of integration into PLIS. Controller supports 32 bits, several interfaces. Graphical processor function is memory fastening, data output unit, processing data from the memory. Controller is programmed in the language C. Code for reading data from controller's memory and outputting it to the data bus according to output unit request on the screen is given below.

```
int val=0;
int last_val=0;
IOWR_ALTERA_AVALON_PIO_DATA(EN_BASE,0x1);
int x=0;
while(1){val=IORD_ALTERA_AVALON_PIO_DATA(REQ_BASE);
if (val!=last_val && val==1)
```

This code part checks the data in respect of the signal, incoming from output unit to the light-emitting diode screen, and request is accepted, if entering signal is shifted from the bottom level to the upper one.

```
{ IOWR_ALTERA_AVALON_PIO_DATA(DATA_BASE, buffer[x]);
x++;
if (x==30976)
{ x=0;   }}
 last_val=val;}
return 0;}
```

Upper code incrementally reads data addresses every time, if the request comes from data buffer. Data reads are sent to data bus.

3.Results

Thereon, as a video controller has been designed and launched, a vector image has been loaded into the memory. That image is given below (Figure 4). In the result of work there were obtained following images on light-emitting diode screen.

:

Figure 4 – Vector image, built into videocontroller

Figure 5 – Images, obtained in the device

Discussion.

Creating an integrated evacuation information system based on mathematical modeling of multicriteria optimization problem of flow distribution and design, building technology of data reception-transmission and information notification systems for the selected type of building in order to adopt an operational evacuation plan.

The use of mathematical methods and information technology significantly increases the efficiency of evacuation systems, so the development of new integrated and intelligent info-communication approaches to solving the problem of evacuation.

Conclusion.

In the work herein there has been designed a video controller in PLIS and set its work algorithm. Video regulator, in its turn, has been broken down into memory unit, memory controller, central processor, output video data to the light-emitting diode screen. There is given structural scheme of devices. Installed connection with light-emitting diode line with SPI protocols. In the work outcome, in the installation initially there has been obtained the image with gradation of grey color, afterwards there appeared the possibility to get a travelling line, to obtain the image with 8 colors gradation. To raise the image gradation color there has been fulfilled delta modulation. As a result, there has been obtained different color gradation. Thanks to using the SDRAM module with volume 32 Mb there appeared the possibility to translate various sizes. Along with simple imaging we have obtained animated images.

This work is supported by grant from the Ministry of Education and Science of the Republic of Kazakhstan within the framework of the Work №AP08855903 «Development of intelligent information technology for the real–time evacuation task», Institute Information and Computational Technologies CS MES RK.

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НАҚТЫ УАҚЫТ РЕЖИМІНДЕ ЭВАКУАЦИЯ ТУРАЛЫ АҚПАРАТ АЛУ ҮШІН ЖАРЫҚДИОДТЫ ЭКРАНДЫ ЖОБАЛАУ

Аннотация. Бұл жұмыста ультра төмен қуатты жарықдиодты экран жасалды. Жұмыста механикалық және электронды жүйелерді модельдеу әдістері ұсынылған. Осы ғылыми еңбектердің үйлесуі энергияны тұтынуды азайтуға мүмкіндік береді. Кеңістіктік-механикалық сканерлеу әзірленді, бұл декодтау схемаларынан бас тартуға мүмкіндік береді, олар өз кезегінде жалпы энергия тұтынудың 35-40% тұтынады. Жадта сақталған бейне деректерді оқуға немесе жадқа деректерді енгізуге арналған SDRAM контроллерінің конфигурациясы зерттелді, контроллердің жадынан деректерді оқуға және шығыс құрылғысының сұранысы бойынша оларды деректер шинасына шығаруға арналған код жасалды. Осы зерттеудің нәтижелері эвакуацияға жауапты персоналды оқыту және жұмылдыру мақсатында, сондай-ақ барлық ақпараттық және коммуникациялық ресурстарды дайын ұстау үшін оқу режимінде эвакуацияның ақпараттық жүйесінің жан-жақты жұмыс істеуі үшін кеңінен қолданыла алады.

Түйінді сөздер. Эвакуация, LED, деректерді беру, жедел жоспар, контроллер.

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РАЗРАБОТКА СВЕТОДИОДНОГО ЭКРАНА ДЛЯ ПОЛУЧЕНИЯ ИНФОРМАЦИИ ОБ ЭВАКУАЦИИ В РЕЖИМЕ РЕАЛЬНОГО ВРЕМЕНИ

Аннотация. В данной работе разработан светодиодный экран с ультранизким энергопотреблением. В работе предложены методы моделирования механических и электронных систем. Сочетание этих научных трудов дает возможность снизить энергопотребление. Разработана пространственно-механическая развертка, которая позволяет отказаться от схем декодирования, которые в свою очередь потребляют 35-40% от общего энергопотребления. Исследована настройка контроллера SDRAM для чтения видеоданных, хранящихся в памяти или ввода данных в память, разработан код для чтения данных из памяти контроллера и вывода их на шину данных по запросу устройства вывода. Результаты данного исследования могут быть широко использованы для комплексного функционирования информационной системы эвакуации в режиме тренировки с целью обучения и мобилизации персонала, ответственного за эвакуацию, а также для поддержания в готовности всех информационных и коммуникационных ресурсов.

Ключевые слова. Эвакуация, LED, передача данных, оперативный план, контроллер.

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