16 Digitalization of the Teaching Process at the University in Gjilan

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16.1 Abstract

This is a project with objectives to study and to apply the surface of the hardware and software part of the panel with LED diode lamps. Much more is focused on the programming of LED matrix diodes located on 16X96 electronic panels, respectively 16 rows of 96 columns. Also, there is elaborated the study of the mode of operation, composition, coding and use of software for panel diodes. In the focus of all this is the introduction of diode panels in use at "Kadri Zeka" University exactly at the Faculty of Computer Science to provide digital information to students, professors or anyone passing through the premises of the university what is happening inside the classrooms of the Faculty of Computer Science. This happens in real time in accordance with the schedule of lectures and exercises in the respective classrooms of the FCS. In fact, this project explains in detail the concept of LED diodes and microcontrollers, their features, operation, power supply and work with 0 [VDC] and 5 [VDC] voltages, respectively 0 and 1 logic bits. Meanwhile, the project also explains how coding, software building that locks, and unlocks LED diodes on a 16X96 LED diode panel, thereby producing text on the panel (display, screen) in static, mobile, animation or up-down, left and right movements according to the time allocated to the timers of the microcontrollers. Such action achieves the goal of the digitalization project of the classrooms of the Faculty of Computer Science.

Keywords: LED diodes, light-emitting diode panels, digitization, microcontrollers, memory, microprocessors, programming codes, software.

16.2 Characteristics of LED Matrix Panel

The panel that is the object of study and review is not the most qualitative in the market, but performs the function for which it is explored, and any other model works according to the same principles.

Figure 1: *LED display 96x16 unlit diode*

Figure 2: *Two panels physically connected presenting the inscription of the University*

Model	HD – E65
Type of chip	Only supports green color
Distance between LEDs	10 [mm]
Supply voltage and electricity	5 [V] 40 [A]
Luminance	≥ 7500 cd/m^2 (in the external environment)
Module light format	32 X 16 LED
LED number for module	512 LED
Panel Dimensions	110 x 10 x 22 [cm]
The amount of power consumption	20 [W] – 40 [W]
Number of modules	3
Angle of view	120° horizontal, 60° vertical
Working temperature	-20 [°C] ~ +60 [°C]
Supply to the city's electrical network	Alternative energy 100 ~ 240 [VAC]
LED diode for panel	96 X 16 LED
Total number of LEDs on the panel	1536 LED

***Table 1**: Characteristics of LED panel 96 X 16 diode; [7]*

The digital desktop is able to emit static text, motion, displacement, animation, cyclic, scroll, slug, blinker, that text moves from left to right, from right to left, bottom-up, top-down similar. Show the correct time, date, temperature and even one or more rows depending on the number of diodes according to the line of the display. Relatively high resolution. 24 Types of animation can be selected for text you can adjust the speed of the text movement. The possibility of the timer display option that automatically locks the device programs within certain time intervals. Through the USB card after in the computer is formed a text, the module is programmed and it can be stored and then transferred to USB connected to the appropriate port of the diode panel and transferred as text on the display. The text on the digital display is easily programmed through software that works in the Windows operating system. The system recognizes and can perform different types of fonts that are used on the Windows operating system. The LED panel programming is performed through the respective software installed on the personal computer and transferring the program through Memory Floppy to the USB port, via RF and Wi-Fi technologies! LED is the abbreviation of English words "light-emitting diode", that is, a light-emitting diode. The illuminating diode is built in the same way as the usual semiconductor diode. It will work if it is polarized on the right side. The intensity of the light is regulated by the current which flows through the diode also exponentially. The diode will not emit light when it is polarized in the opposite direction. The color of the light emitted depends on the type of semiconductor and the added impurities. The diode produced by gallium phosphate (GaP) emits red light while that of gallium arsenide phosphite can emit light green or yellow. The graphic symbol and characteristics of the light-emitting diode are shown in Figure 3 as follows:

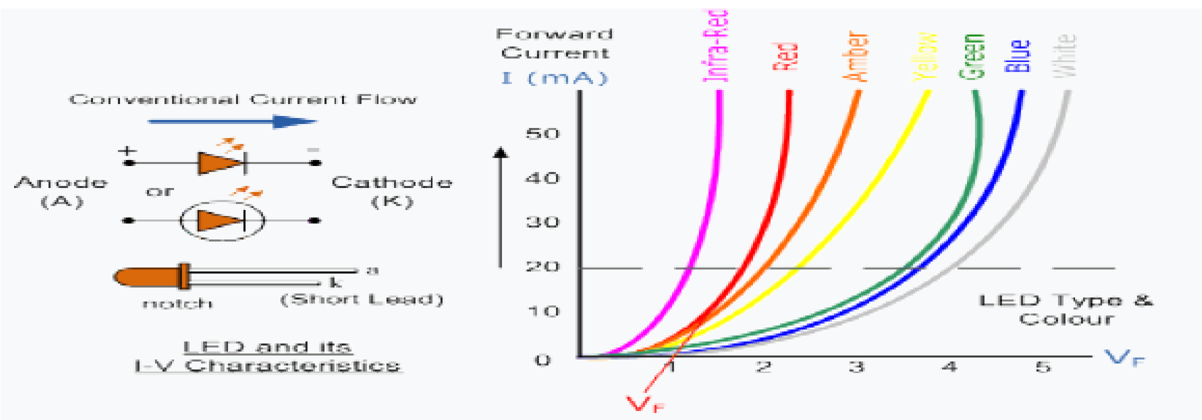

***Figure 3:** Characteristics of LED diodes; [5]*

The advantages of lighting diodes are:
- small size
- safety at work
- long term service
- work with tensions and small currents
- small losses of electricity, great work speed; Use: [4] and [5]

LED Light-emitting diode are used for signaling, through which the locked or unlocked status of an electronic circuit is indicated. Especially they are implemented in bright light indicators or indicators. Blue light (Blue) emits LED diodes in the electromagnetic waveband from 450 to 500 [nm] - (nanometers). Green light (Green)emits LED diodes in the electromagnetic waveband from 500 to 600 [nm] - (nanometers). Red light (Red) emits a Led diode in the electromagnetic waveband from 600 to 690 [nm] - (nanometers). At the moment of power supply of LED diodes with semiconductor material content of gallium arsenide phosphite and its positive polarization leads to electron bulging causing the production of light waves in the range of 550 to 640 [nm]. Breaking light on the conic lenses of the observer's eye (human) creates a sense of perception of the green color according to the spectrum of the colors of the light waves. In other cases, semiconductor material and semiconductor diodes will produce light beams at other intervals of the value length and create a sense of perception of the respective color, always according to electromagnetic spectrum ranges of electromagnetic wavelengths.

16.3 Disadvantages of LED Usage

LEDs are more expensive currently than other lighting technologies. LED performance generally depends on the ambient temperature in which it works. By operating the LED at high ambient temperatures, this may result in overheating of the diode and lead to damage (drilling effect) and to malfunction.

16.4 Microcontrollers

The microcontroller [3] contains microprocessor, memory and a large number of peripheral devices such as timers (timer relays), serial ports, input / output input terminals, numerators, analog inputs and so on. All of these are within a silicon circuit in the form of a built-in system. Examples of built-in systems are: calculators, computers, and smart cell phones. The microcontroller system architecture has changed from time to time, but what is left behind is the programming language C. The programming language consists of alphanumeric characters, syntax of commands, functions which constitute a program code comprehensible to man, respectively the programmer. On the other hand, the execution of the programming code on the computer is performed when the program code is compiled in the machine language. This implies that each alphanumeric sign of the programming code is converted to the binary code (0 and 1 logic) according to the international agreement according to the ASCII table or the extended EBDCIC table. This, in effect, represents the string of square time voltages of the lowest level 0 [VDC] and highest 5 [VDC] respectively. Meanwhile, 5 Vdc voltage supplies LED light-emitting diodes, which causes LED diode brightness, while 0 [VDC] voltage fails to arouse the illumination of LED diodes. All input data is placed in the microcontroller memory. From the microcontroller memory, the input data is processed in the microprocessor for processing and the results obtained according to the respective software or programming code are stored in the memory and transmitted to the respective ports of peripheral devices and in this case the 96 x 16 diode panel diodes sorted within an electonic plate. If the microcontroller memory inserts the letter B and the voltmeter (voltage measuring instrument) it will be possible to measure the voltages of each bits in turn we will show the voltage measurements as in the following figure 4:

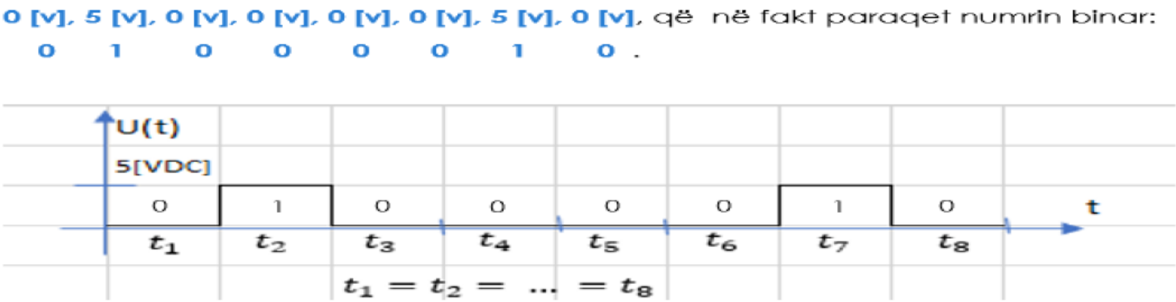

Figure 4: *Chart tensions 0 [VDC] 5 [VDC], presentation by binary numbers 1 and 0 logic*

Presentation of binary 1 voltage with voltage 5 [VDC] or any other value depends on the technical characteristics and electronic components of the microcontroller system. 8-bit string: $(01000010)_2$ belongs to the decade number $(66)_{10}$ because: $(\mathbf{01000010}) = \mathbf{0 \cdot 2^0 + 1 \cdot 2^1 + 0 \cdot 2^2 + 0 \cdot 2^3 + 0 \cdot 2^4 + 0 \cdot 2^5 + 1 \cdot 2^6 + 0 \cdot 2^7 = 2 + 64 = 66} = (\mathbf{66})_{\mathbf{10}}$ viewed at the ASCII - code table, this belongs to letter B (see Appendix B).

16.5 Why work with binary numbers?

Programming of built-in electronics such as microcontrollers consists of communication with hardware devices that are related to the microcontroller, as well as the devices located in the microcontroller itself (memory, processor, time relay and the like). Let us consider the microroller to which four light-beam diodes are connected to the output as shown in Figure 5.

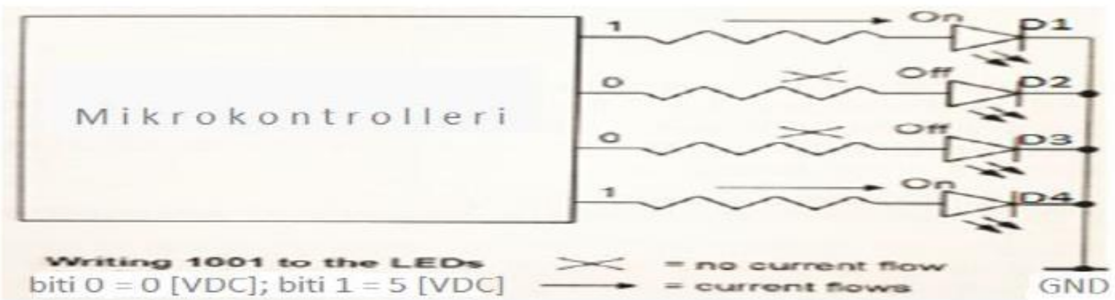

Figure 5: *Logic circuit, how the diodes are turned on by the microcontroller; [3]*

To connect the LEDs D1 and D4 to the LED diode, these LEDs will be able to depict binary digits 1 0 0 1. As binary numbers [3] are archived in the form of voltage levels. Indeed, we connect the 5 [VDC] voltage to the diode D1, 0 [VDC] anodes with the diode D2, 0 [VDC] anode with the diode D3 and 5 [VDC] anode with the D4 anode diode. In this case, the LEDs D1 and D4 will illuminate while the LEDs D2 and D3 will not illuminate.

16.6 Memories

In microcontrollers and built-in systems there are two types of memories [3], called ROM and RAM.

16.7 Microprocessor Access to Peripheral Memory and Devices

The microprocessor contains the addresses (Adress Bus), the Data Bus, and the Control Bus. The memory connection with the processor is performed through the respective buses of the two main microcontroller devices. When the microprocessor is supplied with power its programmer is set to 0. If the permanent memory (RAM) that contains the program is connected through the microprocessor circuit, the microprocessor will receive the first instruction (instruction is a binary number) of the programming code and executes it. The microprocessor program counter increases for one and receives the next programming instruction at address 1 of the memory and executes it. The microprocessor programming counter continues to increase for one by enabling execution of the codebook instructions to the latest programming instruction as in Figure6.

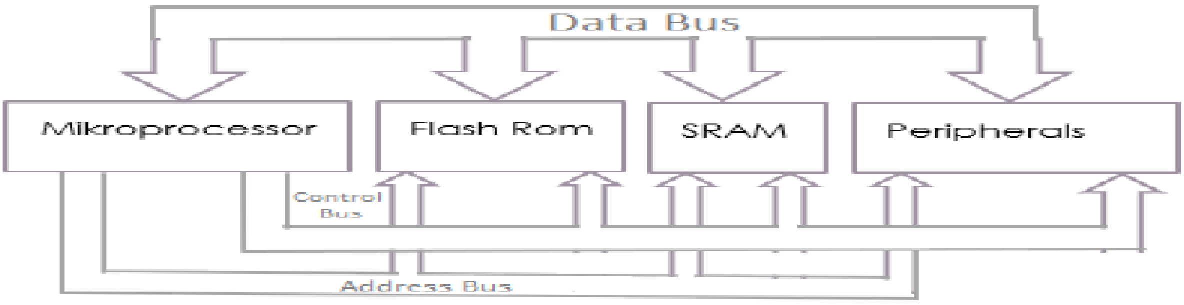

Figure 6: *Connecting microprocessor with memory and peripheral devices*

16.8 Pints and Microcontroller Ports

Microcontrollers possess a relatively large number of pin counts known as input / output pins (I / O - Input / Output) of general implementation. Pints are defined as outputs serving to connect the microcontroller output connections as in the present case for switching and disconnection of LED lighting diodes as well as input pints for reading logic levels 0 or 1 located in the microcontroller pin.8-bit microcontrollers possess 8-bits ports that represent pin I / O groups labeled as ports A (PORTA), B (PORTB), C (PORTC), and so on.The programming code example C in the programming language C for diode input is defined as follows:

```
int main(void)
{
DDRB = 0x20;   //  set bit 5 of DDR register which makes PB5 an output
while(1)
{
PORTB = 0x20;  //  swich LED on
Delay();
PORTB = 0x0;   //  swich LED off
Delay();
}
}
void Delay(void)
{
volatile unsigned long count = 100000;
while (count--);
}
```

Figure 7: *Programming code example*

The result of this programming code in the programming language C is that in the electronic plate where LED diode is connected, the same to lock it or unlock it or LED diode to pulsate by locking and unlocking at a high frequency! The file: io.h located at the beginning of the program code enables the registry to be accessible for access. Setting logic 1 to the set bit position in the DDRB registry creates the corresponding pin declaration option as OUTPUT PIN on the PORTB port. In the cycle while (1) the PORTB register is set to enable the diode LED to light up, provided that the corresponding bit in the log has the logical value 1, the same bit is again set but in logical value 0 in order to disconnect the LED diode light. Calling the Delay () function between the LED diode switch lock ensures that the LED diode remains in the locked state and disconnected enough at a high frequency so that it is visible to the human eye, creating the impression of the constant illumination. With the while (count) command is reached that the program cycle is repeated whenever the counter count = 100000 decreases for one to the 0 value when also the command while (count--) gets the false value. This actually determines the timing of the LED dialing switch disconnection. At the end of this time according to volatile unsigned long count counter (100000) the program comes out of the cycle and completes its work.

16.9 The HD-E65 LED Panel Software

The HD-E65 LED panel software, consisting of 96 LED diode arrays and 16 rows also LED diodes (96X16) is known as: HD2016; [7]

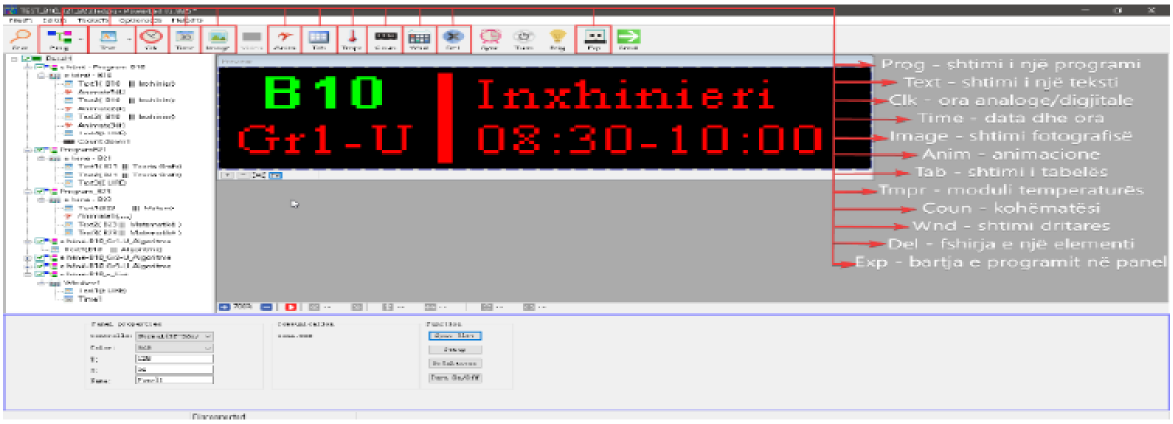

Figure 8: *The look of the PowerLed 96X16 Test software*

PowerLed is a software used for programming RGB matrix panels, it contains a collection of tools that can be used to program different panels.

PowerLed consists of:

- Menu bar
- Toolbar
- Window class
- Virtual Panel Window
- Feature Window

16.10 Menu Bar

The software for programming LED Panels contains menus by which we work and manipulate with PowerLed. With this software you can choose text with a great opportunity of using different fonts, setting the analogue but also the digital clock, adjusting the time of text display on the screen, full programming according to a time period for one or more days, weeks, months and so for several years. Meanwhile, a temperature thermometer (Type: AM2301) can be set for temperature measurement. The LED panel, according to the software, can also be used for numbering by increasing or decreasing number, as a device can be used for the numbering of vacancies in a smart auto parking. Next, some programming methods will be displayed according to the menus defined by the programming software.

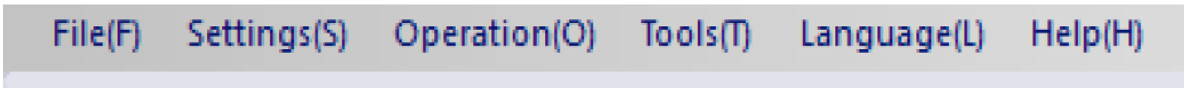

Figure 9: *Menu bar*

16.11 Conclusions

There are many ways of digitalization that could happen on the university areas, one of them we have used to digitalize our campus in the university using LED display panels. In our project this feature of panels who do have all the possibilities to write the information and the data could be transfer using USB disk it was very helpful on communicating with the LED panels in our University campus. The software that uses codes makes it easy to write the text, make animations, and set timers to the LED display panel. We have tested and fully implemented on our university campus where we have digitalized all possible information for students, professors, and others who do use our campus.

This was very helpful with U disk exporting the parameters to the LED diode panel display and was quite easy for the places where the panels are reached by people but for the places where the panels are placed on the high height it could not be easy to put the program each time you change. In order to make easier to put the parameters to panels for the future work we do propose there could be done also communication using RFID and wireless technology.

16.12 References

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