25th International Electrotechnical and Computer Science Conference ERK 2016 (IEEE), Portoroz, 2016.

The Use of Microcontroler and Android Operating system for Control Matrix Display

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Abstract. *In this paper is described use of a microcontroller ATMEGA2560 and the Android operating system for control a LED dot-matrix displays. It is created the android application on the mobile device that use Bluetooth communication for sending the desired commands to the microcontroller ATMEGA2560. The received information is processed in microcontroller ATMEGA2560 and based on them images and text messages are showing on the LED dot-matrix display. In this way is enable the user to control, over mobile device, led advertising system and to change showing text and image. The only condition is that the user must be near led advertising system with a LED dot-matrix display.*

1 Introduction

The occurence of the microcontrollers and the microprocessors are regarded as one of the greatest technical achivements that characterized twentieth century. Main difference between microcontrollers and microprocessors is that they are the first optimized for speed and performance with computer programs, while microcontrollers are optimized towards integration of a large number of circuits real-time control, mass production, low cost and low power consumption [1]. The microcontrollers are also more resistant on variation of voltage, temperature, humidity, vibration, etc. Huge adventage is reflected in the fact that can be programmed, beside Assembler, and in high-level programming languages: C, Pascal, Basic, etc. [2]. This increases number of users who can write programs and thus also apply [1], [3]. They are used in a wide variety of modern devices such as: robots, telecommunication devices, satellites, cars, measuring instruments, mobile phones, cameras, etc. Also, they are widely used in many home devices such as washing machines, microwave ovens, breadmakers, etc. [3].

Arduino is an open-source platform designed for easy programming microcontroller [4]. Arduino has become a very popular platform for developing digital system exactly because it is open-source [5-8]. Arduino platform is composed of an Atmel AVR microcontroller with aditional components and standard connectors [7]. Standard connectors enable the user connect variety of add-on modules on the arduino shild.

Also, it is possible to connect more arduino shields parallel. Arduino shield options are numerous: different displays, sensors, actuators, communication shield GSM, Wi-Fi, Bluetooth, ZigBee, etc. Arduino is an ideal tool for fast development various designs and prototypes.

LED dot-matrix display have become popular for showing all types of messages to the public. With attractive and interesting displays, text or graphics can be easily and efficiently display during the day or night. Also, widely used in electronic and medical devices as well as the instrument panels [9-11]. These displays can be used to show information at bus stops, cinemas, squares and other public places [12-15].

LED dot-matrix display use simple xy addressing and made in different color: one color, two color and RGB [16, 17].

Mobile devices today, especially smartphones, can be compared even with the possibilities of computers. Such devices support applications that enable a wide spectrum of services such as Internet access, corporate networks, e-mail and electronic banking services, electronic payment and booking tickets. Electronic signatures of documents and transactions and synchronization mechanisms of user data is also becoming more important in the mobile world. Android is an operating system for mobile devices that is based on a modified version of the Linux operating system. The first version was developed by Android Inc. company. 2005, as part of a strategy for accessing the mobile market. The main advantage of customization of the Android operating system is the application of a unified approach to application development. Developers can program all under android platform, and their application should have the option of execution on numerous of different devices. These devices use the Android operating system [18-20].

In this paper is described the use of android applications for remote control LED dot-matrix display using a Bluetooth module HC-06 and the Arduino shield with ATMEGA2560 microcontroller.

2. Arduino shield with ATMEGA2560 microcontroller

Arduino shield with ATMEGA2560 microcontroller is designed for the development of more complex systems. It has 54 digital input / output pins, 16 analog inputs, 4 UARTs (hardware serial ports), 16 MHz crystal oscillator, USB connection, power connector, ICSP header, and reset button. It contains everything needed to support the microcontroller. Simply connects to a computer using a USB connector, AC / DC power adapter or batteries. Appearance microcontroller Arduino shield with ATMEGA2560 is shown in Fig. 1.

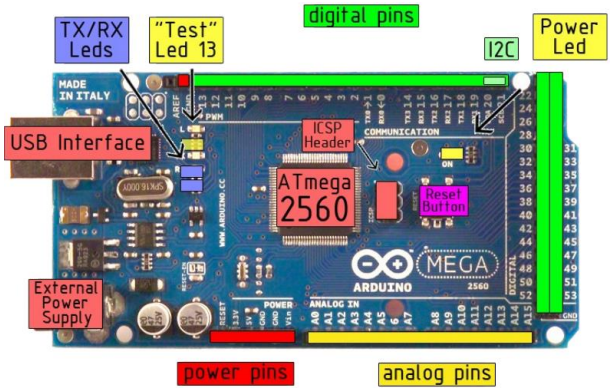

Figure 1. Arduino ATMega 2560 [21]

In Fig. 1 are marked parts which are built in arduino shield with ATMEGA2560 microcontroller.

Arduino shield with ATMEGA2560 microcontroller can be programmed with Arduino software (IDE). In Arduino shield with ATMEGA2560 microcontroller is built bootloader that enable upload new code to the Arduino Mega2560 without use of external hardware programmer. It communicates using the STK500 protocol. Also, the microcontroller can be programmed using ICSP (In-Circuit Serial Programming) header using Arduino ISP.

3. Designing a system for remote control LED dot-matrix display using ATMEGA2560 microcontroller and Android operating system

In this chapter is described practical realization system for remote showing messages on LED dot-matrix display using the android applications. Fig. 2 shows the functional block diagram of the project for remote control of LED dot-matrix display using the android application.

On Fig. 2. is shown that for programming used computer. On it is installed Andriod Studio for creating android application which is used for remote control the LED dot-matrix display and the Arduino IDE software used for programming ATMEGA2560 microcontrollers.

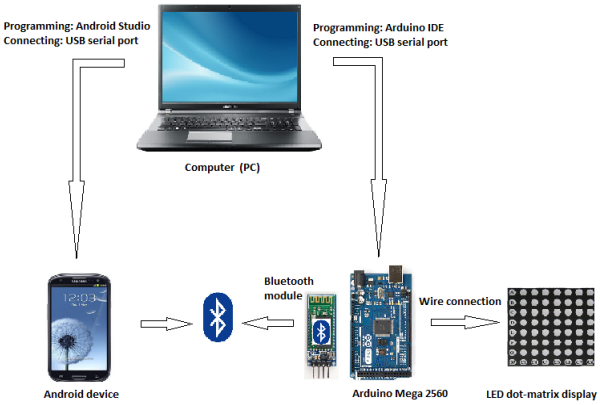

Figure 2. Functional block diagram of the project for remote control of LED dot-matrix display using the android application

Android application after creating in the android Studio should be transferred to a mobile device using a USB port. Arduino program using the USB port is sent to the ATMEGA2560 microcontroller. For further work computer is no longer required.

The mobile device using the android developed applications, over bluetooth communication, sends control signals to the ATMEGA2560 microcontroller. ATMEGA2560 microcontroller is processing and memoring received information. In this way, the desired display on the LED dot-matrix display is sent only once and will showing until is send new information from a mobile device using the Android developed applications. ATMEGA2560 Microcontroller based on received informations controls output ports and thereby work matrix display. Led dot-matrix display used in this paper is two-color 16 x 32 and the desired text (images) can be displayed on it in three colors: green, red and in the same time green and red, which is orange. All letters and images that need to be shown on the LED dot-matrix display, need to be programed. One example of this programming is shown in Fig. 3 where is programmed letter K.

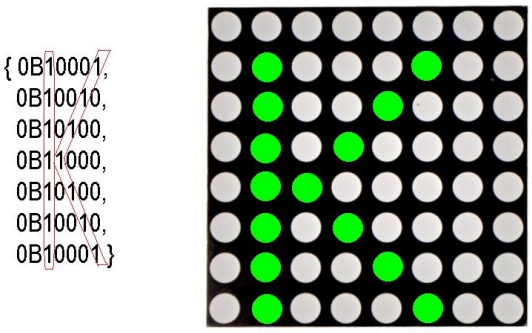

Figure 3. Programmed letter K

In Fig. 3 can be seen that the letter created on the dot-matrix field 5 x 7 is K. On the left side is the program code for the letter K while on the right side is the look LED dot-matrix display when the program code is run.

In Fig. 4 is shown system designed for remote control LED dot- matrix display using the Arduino shiled with ATMEGA2560 microcontroller and Bluetooth module HC-06.

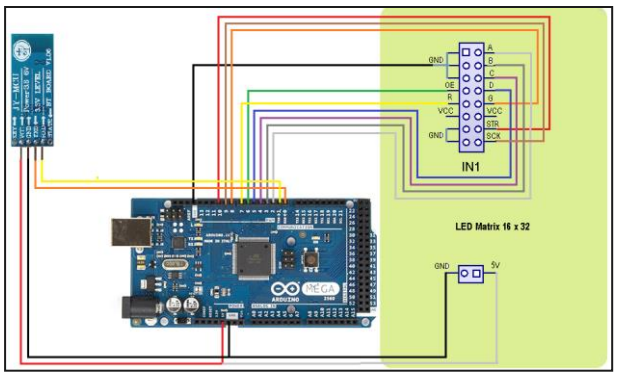

Figure 4. Designed system for remote control LED dot-matrix display using the Arduino shiled with ATMEGA2560 microcontroller and Bluetooth module HC-06

In Fig. 5 is shown appearance of the finished system for remote control LED dot-matrix display using mobile devices and Bluetooth communications.

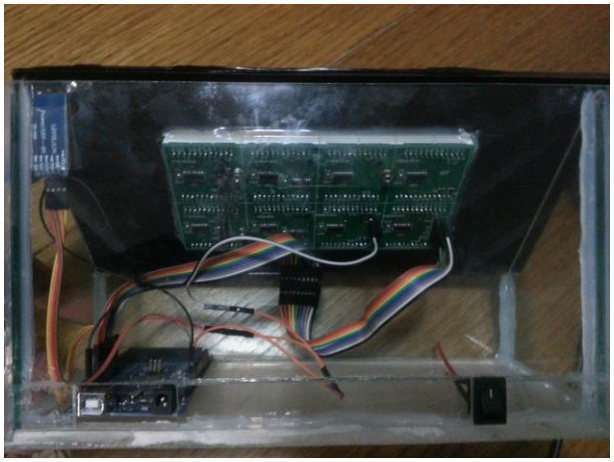

Figure 5. Appearance of the finished system for remote control LED dot-matrix display using mobile devices and Bluetooth communications

4. Testing of the projected device

In this part of the paper was done testing of the projected device. After establishing the Bluetooth communication, need on the mobile device enter the desired display on the LED dot-matrix display. In the first test of work, entered text will move from left to right on the LED dot-matrix display. It is shown in Fig. 6.

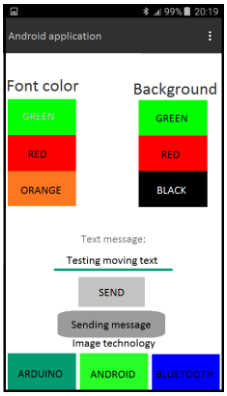

Figure 6. Appearance creating android applications after a written text

After that, on the LED dot-matrix display is showing the entered text that moves from left to right. It is shown on Fig. 7. For background is used green color and for the text is used red color.

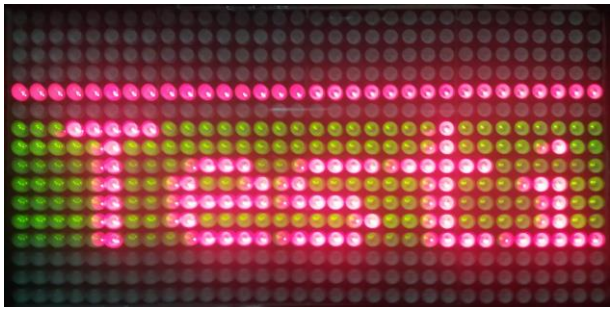

Figure 7. The appearance LED dot-matrix display after the text is entered in the android application

For the second test, the display image is used android logo. On the created android application need to click the button titled "ANDROID". In Fig. 8 is shown appearance of android applications on the mobile device after clicked the button "ANDROID".

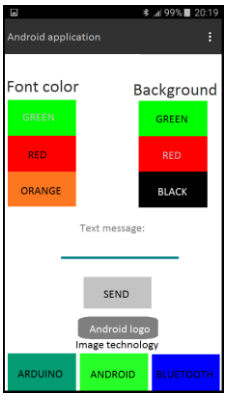

Figure 8. Appearance of android applications on the mobile device after is clicked the button "ANDROID"

After click the button "ANDROID" is sending data over Bluetooth to the Arduino shild where, based on received data, calls methods to showing the android logo. Fig. 9 is shown logo of android technology to LED dot-matrix display.

Figure 9. The appearance LED dot-matrix display after click on button "ANDROID" on mobile device

Based od Fig. 9 can be concluded that the designed system works well and that can be used to display advertisement system created using LED dot-matrix display.

5. Conclusion

On the basis of the test it can be concluded that the designed system works well and that can be used to display advertisement system created using LED dot-matrix display. Entering the desired text (image) is very simple and can be done from any mobile device that has installed the Android operating system. For bigger LED dot-matrix displays working principle is completely the same.

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