12th International Research/Expert Conference
"Trends in the Development of Machinery and Associated Technology"
TMT 2008, Istanbul, Turkey, 26-30 August, 2008

MICROCONTROLLER BASED FIRE PROTECTION SYSTEM

Miroslav Kostadinović
Faculty of Traffic and Transportation
Doboj
Bosnia and Herzegovina

Dušanka Bundalo
New Banja Luka Bank
Banja Luka
Bosnia and Herzegovina

Zlatko Bundalo
Faculty of Electrical Engineering
Banja Luka
Bosnia and Herzegovina

Perica Gojković
Faculty of Traffic and Transportation
Doboj
Bosnia and Herzegovina

ABSTRACT
Realization of microcontroller based real time fire protection system is considered and described in the paper. Given solution is based on application of microcontroller AT89S8253. The system is consisted of set of sensors connected to control device (microcontroller module). Control, monitoring and diagnostic are performed via computer of PC type serially connected with control device. Characteristics and structure of system are described first. Then the practical realization of the system is given and described. For development and testing of realization it was used microcontroller development system Easy-8051B. Simulation of the system was performed using software package ISIS Proteus.
Keywords: Microcontroller, Fire protection, Control, Monitoring, PC type computer

1. INTRODUCTION
Applications of microcontrollers are suitable and used in many practical designs and realizations in many areas [1-4]. One concrete practically realized model of device with function of fire protection and temperature regulation in industry plants is described in the paper. It is based on application of microcontroller Amtel AT89S8253 [1,2,4]. The device is by serial connection and RS232 interface connected with PC type computer. From the PC computer are defined working mode and system parameters, as is temperature treshold for turn on of cooling of workroom and fire indication that is shown on the computer. Source code of the device was writen in asembler language using software Keil μVision [5], and work of device was simulated by software package ISIS Proteus. Concrete results of programming and operation of the device were checked and confirmed on development system Easy 8051B, where program and work of device were tested in real working conditions. In Fig.1 it is shown principle block-scheme of realized fire protection and temperature regulation control system where the control unit (realized control device) is central part of the system that communicates with other input and output elements.

2. INTERACTIVE DEVICE SIMULATION
Operation of designed device is first completelly simulated using software package ISUS Proteus. Appearance of Proteus program working environment is very similar as for the most commercial applications writen for Windows operating system. The working environment consists of tools, menues, selectors and other components. Appearance of the working environment with shown scheme of designed device, what was used in concrete simulation, is given in Fig.2.

The first step in simulation is connection of microcontroller with prepared and translated source code of program for microcontroller, i.e. with file with extension HEX. The program is transfered into microcontroller in such a way that first is selected microcontroller model that is placed onto working area of the simulator. After that the window *Edit Component* is shown on the working area (Fig.3).

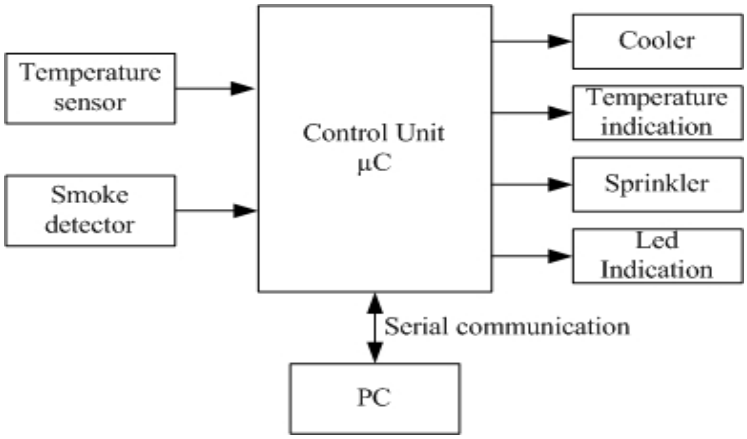

Figure 1. Principle block-scheme of system for fire protection and temperature regulation.

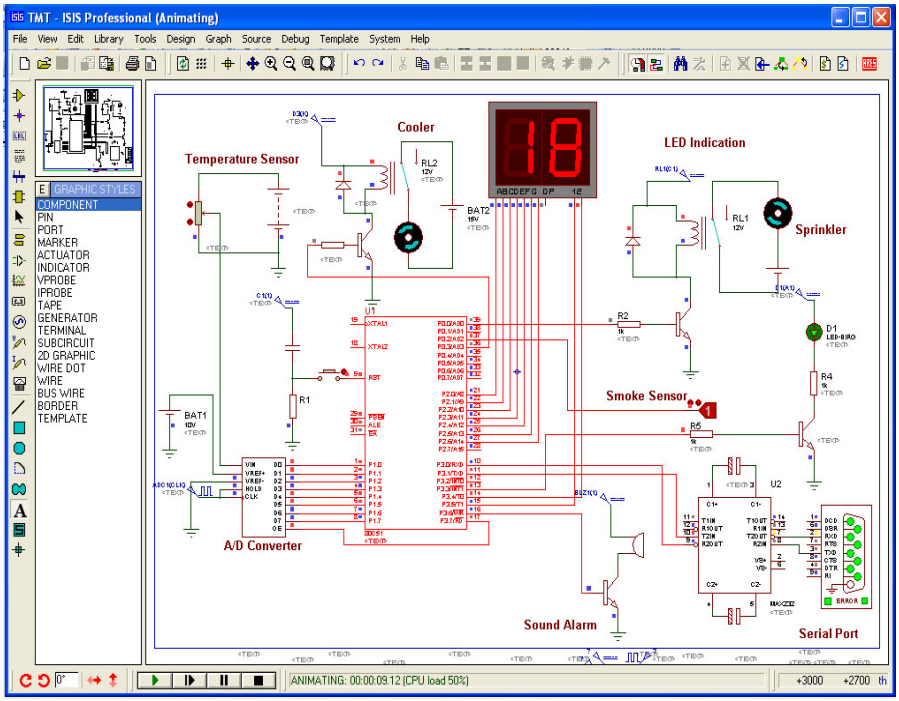

Figure 2. Working environment of ISIS Proteus during device simulation.

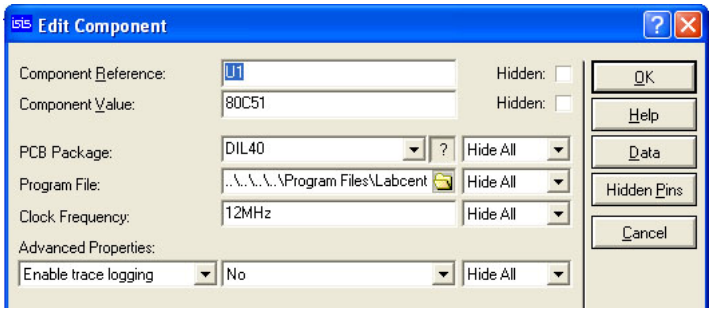

Figure 3. Edit component window of simulator.

In the field *Program File* it is needed to put the path to program file of concrete translated program with extension HEX. In the field *Clock Frequency* it is selected and ajusted working frequency of the microcontroller. In the field PCB Package it is selected socket and package type of used microcontroller. It is important if at the end is wanted to design printed board of the device. After connection of external parts and drivers it can be started simulation.
There are two different ways of simulation: continual simulation (to press button Play) and step by step simulation (to press button Step). Continual simulation is performed as long as user wants it. Step by step simulation is performed by user command, i.e. next step is performed only when user wants it (press button Step). In Fig.4 it is shown appearance of window for view and control of source program code execution. With this same option it is seen in any moment what instruction is momentally executed, what is marked with blue line. Execution of any instruction can be stoped in any moment and can be transfered to other instruction that will be executed in next step.

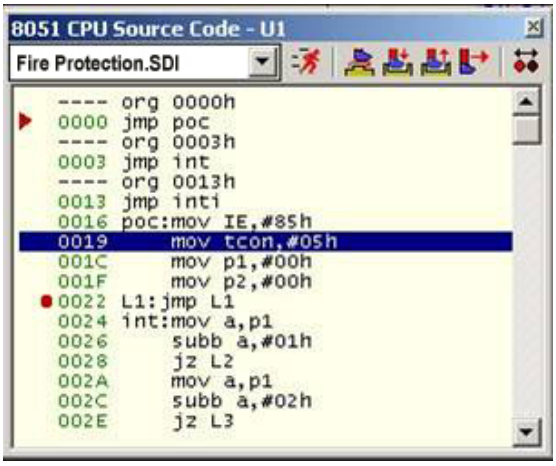

Figure 4. Window for view and control of source program.

In case that it is wanted to make corections or addition of part of source program, it is simple needed to open menu *Source*, select option with name of file with source code and make change in program code. Then it is selected option *Build All* in menu *Source* and started simulation. Now simulation is performed with corected program code.

3. REALIZATION DESCRIPTION

In Fig.5 is shown scheme of designed device for fire protection and temperature regulation in industry area.
As it can be seen from Fig.5, input part of system consists of two sensors: smoke sensor and temperature sensor. Temperature sensor is connected to 8-bit A/D convertor. Outputs from the A/D convertor are connected to port1 of microcontroller. Temperature value is taken from port1 and compares with referent temperature value of 18^0C. If temperature in industry plant exceedes value of 18^0C then it is turned on ventilator for cooling space what is operating until the temperature reaches given referent velue. Showing of temperature value is realzed by two seven-segment displays. Segments of the displays are connected to port2 of microcontroller and time multiplexing is used for operation of displays. Turning on and turning off for cooling motor is performed by relay connected in colector circuit of bipolar transistor.
Fire protection is performed by sensor for smoke existence indication that is connected to pin P0.2 of microcontroller. Reading of the sensor state is performed using ststus bit with address 82h. In case of fire the smoke sensor will have logic 1 state at its output. In that case it is set pin P0.0 that turns switching transistor into saturation and closes relay that turns on sprinkler with water. Sprinkler turning on and turning off is realized using small power DC motor. In the same moment it is set pin P3.4 that turns on light indication. After that it is set also pin P3.6 that turns on sound signalization realized by buzzer working on 500Hz frequency. This gives squeaky sound that is not possible to

ignore. Such states of pins reserved for control of fire protection are kept until smoke sensor changes its output state into logic 0.

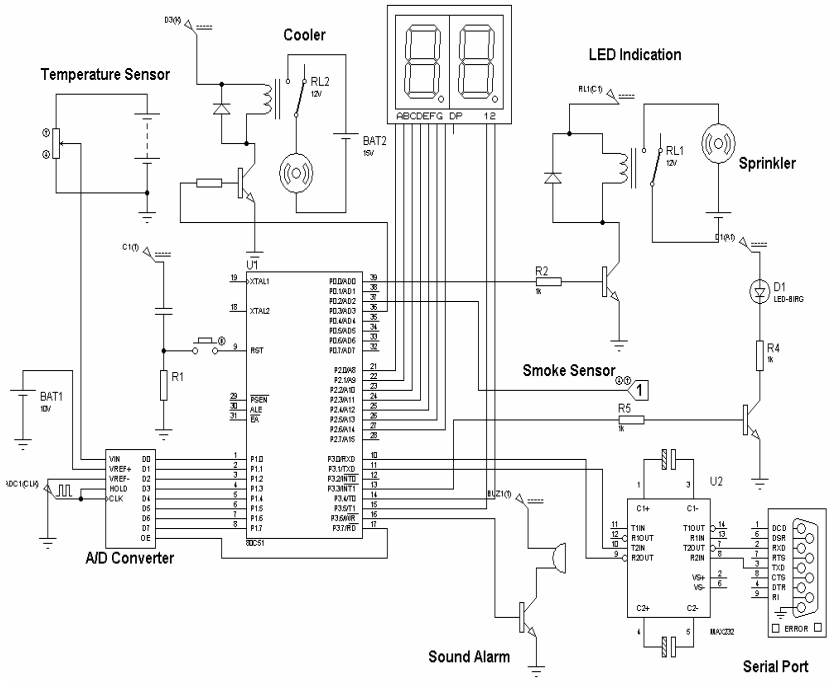

Figure 5. Scheme of designed device for fire protection and temperature regulation.

To be possible serial communication between PC type computer and this realized device it is used circuit MAX 232 that makes adaptation of voltage levels, since serial communication voltage levels of PC computer are +10V and –10V, and for microcontroller are +5V and 0V.
Complete developed program is writen into internal microcontroller 4kB memory and there is not need for external memory circuits. Because of that EA input of microcomtroller is connected to voltage supply and has logic 1 level. Also, automatic power on starting of device is provided using adecvate microcontroller reset circuit.

4. CONCLUSIONS

Because of application of microcontroller and possibilities of programming it is used simple hardware in described and designed device and system for fire protection and temperature regulation. Concrete realized control functions are mainly implemented by appropriate software. It is very easy possible to modify, adapt to some new requirements or to change realized solution. There is, also, possibility of interconnection with other devices and systems that use serial RS232 interface, and there is possibility to be used in different applications. The device is intended for and is possible to use it mainly in PC controlled systems. Software simulation and development system have used at development and design of the device what considerable makes easier and facilitates design and realization of such microcontroller based devices and systems.

5. REFERENCES

[1] Kenneth J. Ayala,: The 8051 Microcontroller: Architecture, Programing and Applications, Western Carolina University, 1991.
[2] Martin Bates: Interfacing PIC Microcontrollers Embedded Design by Interactive Simulation, Elsevier, 2006.
[3] Stuart R. Ball: Analog Interfacing to Embedded Microprocessor Systems, Elsevier, 2004.
[4] Tammy Noergaard: Embedded Systems Architecture-A Comprehensive Guide for Engineers and Programmers, Elsevier, 2004.
[5] µVision2-tools for 8051, www.keil.com