

Study and demonstrating 8051 microcontroller simulators useful for educational purpose

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Abstract: *The 8051 Microcontroller is one of the most popular and most commonly used microcontrollers in various fields like embedded systems, consumer electronics, automobiles, etc. The simulator is a tool of 8051 microcontroller that is used for debugging a program previous to its real board design and development. A simulator is designed for a specific purpose. The simulator makes it easy to write and test code and learn about programming your microcontroller.*

This paper introduces many free 8051 simulators used for educational purpose like EdSim51, KEIL, etc. Also there are paid simulators available like BiPom, Pinnacle. A simulator facilitates testing of an application virtually. Here, one can test a circuit application built using 8051 using the simulator, without actually building the hardware. Also you can validate and test your 8051 program using the simulator for the desired output.

Key Words: 8051 Microcontroller, simulator, EdSim51, debugging, testing.

1. INTRODUCTION:

The simulator and emulators are the tools of 8051 microcontroller that are used for debugging a program previous to its real board design and development. The first microcontroller was introduced in the year 1980. It is a single chip that includes many functions like RAM, CPU, ROM, input/output ports, serial communication and timers, etc. 8051 controller is most popular 8-bit controller which is used in large number of embedded applications and many programmers writing programs according to their application. Programmers can test their programs in software simulators. Simulators will help the programmer to understand the errors easily and time taken for the testing is also decreased. Simulator is software which will execute the program and show the results exactly to the program running on the hardware, if the programmer found any errors in the program while simulating the program in the simulator, he can change the program and re-simulate the code and get the expected result, before going to the hardware testing. Programmer can confidently dump the program in the hardware when he simulated his program in the simulator and got the expected results.

These simulators are very useful for students because they need not to build the complete hardware for testing their program and validate their program very easily in an interactive way.

2. TYPES of 8051 MICROCONTROLLER SIMULATORS:

This section introduces various types of free and paid 8051 simulators

2.1 EdSim51 Simulator

EdSim51[3] is the most simple and popular simulator for 8051 microcontroller. In fact, this simulator is a virtual microcontroller with DC, Keyboard, DAC, ADC, UART, motor, seven segment display and other peripherals are interfaced externally. This is particularly designed for students and their educational purpose developed by James Rogers and it is very simple to use. Any student or beginner can learn this software quickly because of its simplicity and ease of use.

2.2 JSIM 51 Simulator

JSIM [4] is a free 8051 simulator [5] is developed by the designer who got fed up with the pricing of enterprise simulator softwares for 8051 microcontroller. This simulator is very popular and used across the world.

2.3 MIDE-IDE Simulator

MIDE-IDE [5] simulator is used for 8051 microcontroller from Opcube, with compiler, simulator and assembler. This simulator uses the SDCC free compiler and the free assembler which makes no code limit

2.4 KEIL

KEIL [6] is the most popular software simulator. It had many features like interactive IDE, supports both C and assembly languages for compilation and simulation.

2.5 J51 Simulator

J51 [7] simulator is based on JAVA, that includes an emulator integrated with a disassembler, SDCC symbol table and debugger, etc.

2.6 gSim51

gSim51 [8] is an open source simulator for 8051, which is completely free to download with source code. You can modify this simulator software for your specific requirement by editing the source code. And it runs on the Linux platform.

2.7 MCU 8051

MCU 8051 [9] is an 8051 simulator which is very simple to use and have an interactive IDE (Integrated Development Environment). It is developed by Mertin Osmere and most important of all is that it is completely free. It has many features:

- It supports both C and assembly language for compilation and simulation
- It has in-built source code editor, graphical note pad, ASCII charts, Assembly symbol viewer etc. Also supports number of 8051 IC's like at89c51, A89S52, 8051, 8052, etc.
- It will support the certain electronic simulation like LED, 7segment display, LCD display etc. which will help in giving the output when you interface these things to the hardware directly.
- It has having tools like hex decimal editors, base converters, special calculator, file converter, inbuilt hardware programmer, etc.
- It has syntax validation, pop base auto completion etc.

2.8 HTE 8051

HTE 8051 [10] is an 8051 simulator developed for IBM computers. This simulator is mainly used in the DOS environment and uses Intel HEX file for the simulation. We can set break points, step by step execution etc. it provides color display and has tools like hex calculator variable screen display and help window.

2.9 8051 IDE

8051 IDE [11] simulator is exclusively for windows operating system (98/xp). The features of this simulator are

- Text editor, assembler, and software simulate in one single program.
- Has facilities like Break point setter, execute to break point, predefined simulator watch window etc.
- It is available in both free version and paid version.

2.10 BiPom Simulator

BiPom Simulator [12] is very expensive, when we compared with other simulators. But the developers thought that to give away an evaluation version with free of cost. By using this tool anybody can write 500 lines of C source & 1000 lines of assembly code. This software is actually IDE for the windows OS.

2.11 Pinnacle Simulator

Pinnacle simulator [13] is used for 8051 microcontroller development and it is also expensive. But the trial version of this software is available with free of cost. It is a microcontroller development environment for all types of microcontrollers, that uses the MCS5 simulator architecture, This tool is lightweight and used for only the windows OS.

3. SIMULATION RESULTS:

This section shows the simulation results by interfacing LCD (Liquid Crystal Display) and Keypad to 8051 microcontroller. The LCD display is an output device and matrix-type Keypad is an input device.

EdSim51 simulator is used for interfacing. EdSim51 is one of the most popular and useful simulator for educational purpose.

3.1 Simulation of interfacing an LCD to an 8051

LCD (Liquid Crystal Display) interface LCDs can display numbers, characters, and graphics. To produce a proper display, the information has to be periodically refreshed. This can be done by the CPU or internally by the LCD device itself. Incorporating a refreshing controller into the LCD relieves the CPU of this task and hence many LCDs have built-in controllers. These controllers also facilitate flexible programming for characters and graphics. Figure 3.1 shows the simulation result of interfacing LCD to 8051 microcontroller. The example sends the text XYZ to the display.

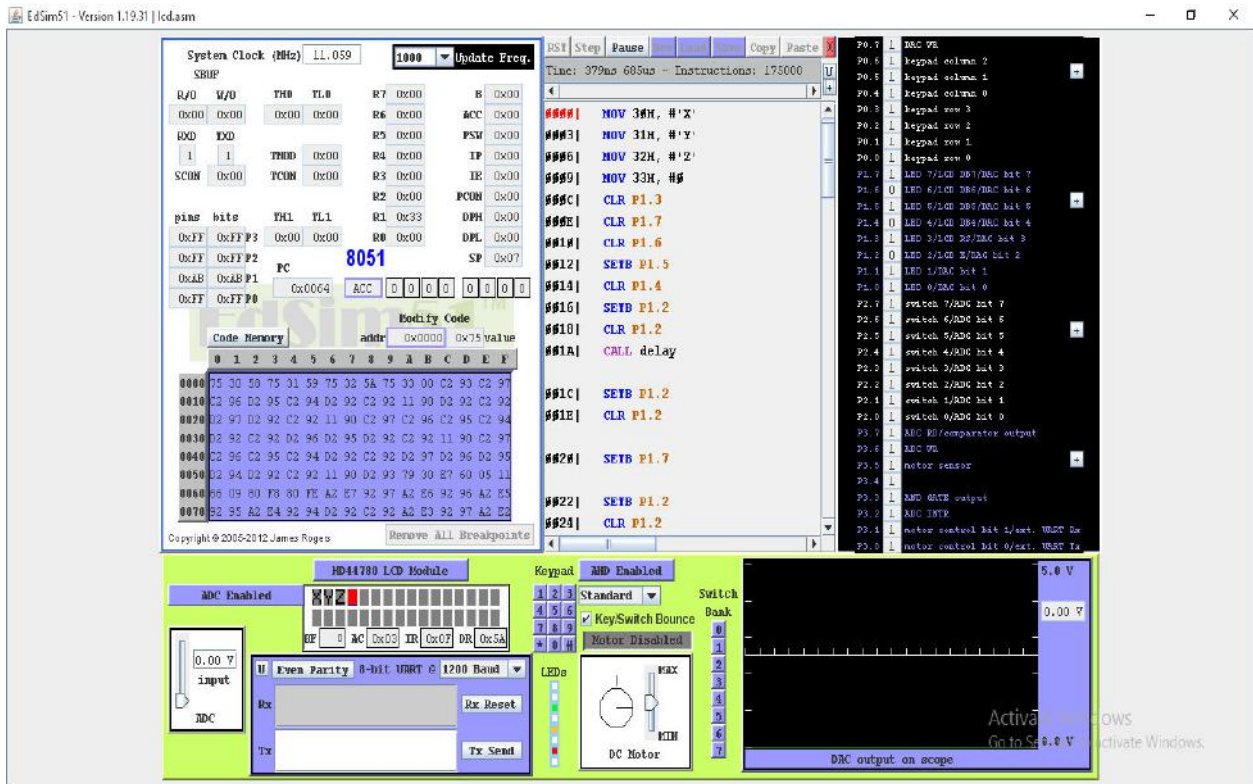


Fig. 3.1 Interfacing LCD with 8051

3.2 Simulation of keypad interfacing to an 8051 microcontroller

Figure 3.2 shows simulation of interfacing keypad to the 8051 microcontroller. The 4 X 3 keypad is interfaced in a standard format. All of port 0's pins, except pin 7, are used by the keypad.

A scanning process is used to identify the key that is pressed. While no key is pressed the program scans row0, row1, row2, row3 and back to row0, continuously. When a key is pressed, the key number is placed in R0. Key number is the position of key in the matrix and not the number on keypad. Figure 3.2 shows number 2 on the keypad.

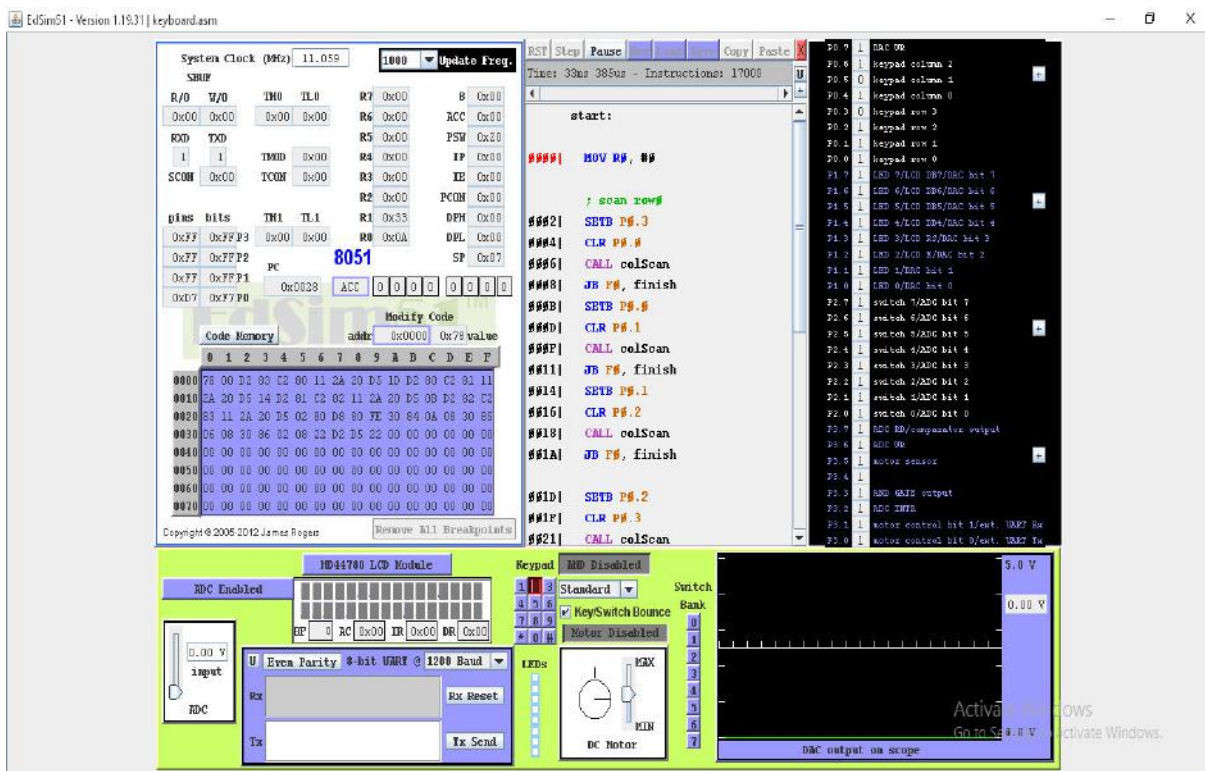


Fig.3.2. Simulation of Interfacing Keypad with 8051 microcontroller

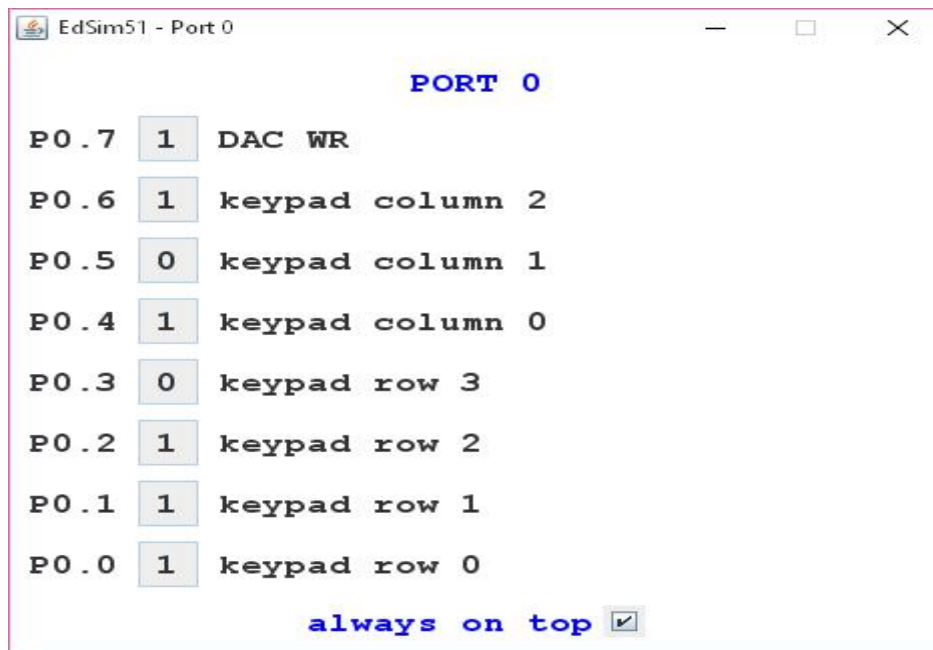


Fig. 3.3 Status of key pressed (key number10).

4. CONCLUSION:

Simulation is a virtual imitation of the actual process or system which means that you can test and verify your work before even touching the hardware. Simulation is normally performed on a computer through specially designed software called simulator. A simulator is designed for a specific purpose.

The 8051 Microcontroller is one of the most popular and most commonly used microcontrollers in various fields like embedded systems, consumer electronics, automobiles, etc. The simulator is a tool of 8051 microcontroller that is used for debugging a program previous to its real board design and development.

This paper gives the study of several simulators and their features. EdSim51 is the most simple and popular simulator for 8051 microcontroller. The paper also shows the result of simulation of LCD and Keypad interfacing with 8051 microcontroller using EdSim51 simulator. Using these simulators is very useful for students because they need not to build the complete hardware for testing their program. They can validate their program very easily in an interactive way. As an example simulations of interfacing LCD (output device) with 8051 and interfacing Keypad (input device) to 8051 are discussed.

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