

Project Based Learning - 1

Mini Project Title: PC Based Notice Board

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Abstract

This project implements a PC-based notice board using an 8051 microcontroller. The system allows users to input messages through a computer interface, which are then displayed on an LCD screen connected to the microcontroller. This digital notice board offers a modern, efficient alternative to traditional bulletin boards, enabling real-time updates and improved information dissemination. The project demonstrates the practical application of microcontroller programming and serial communication in creating user-friendly information systems.

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Introduction

Objective of the Project

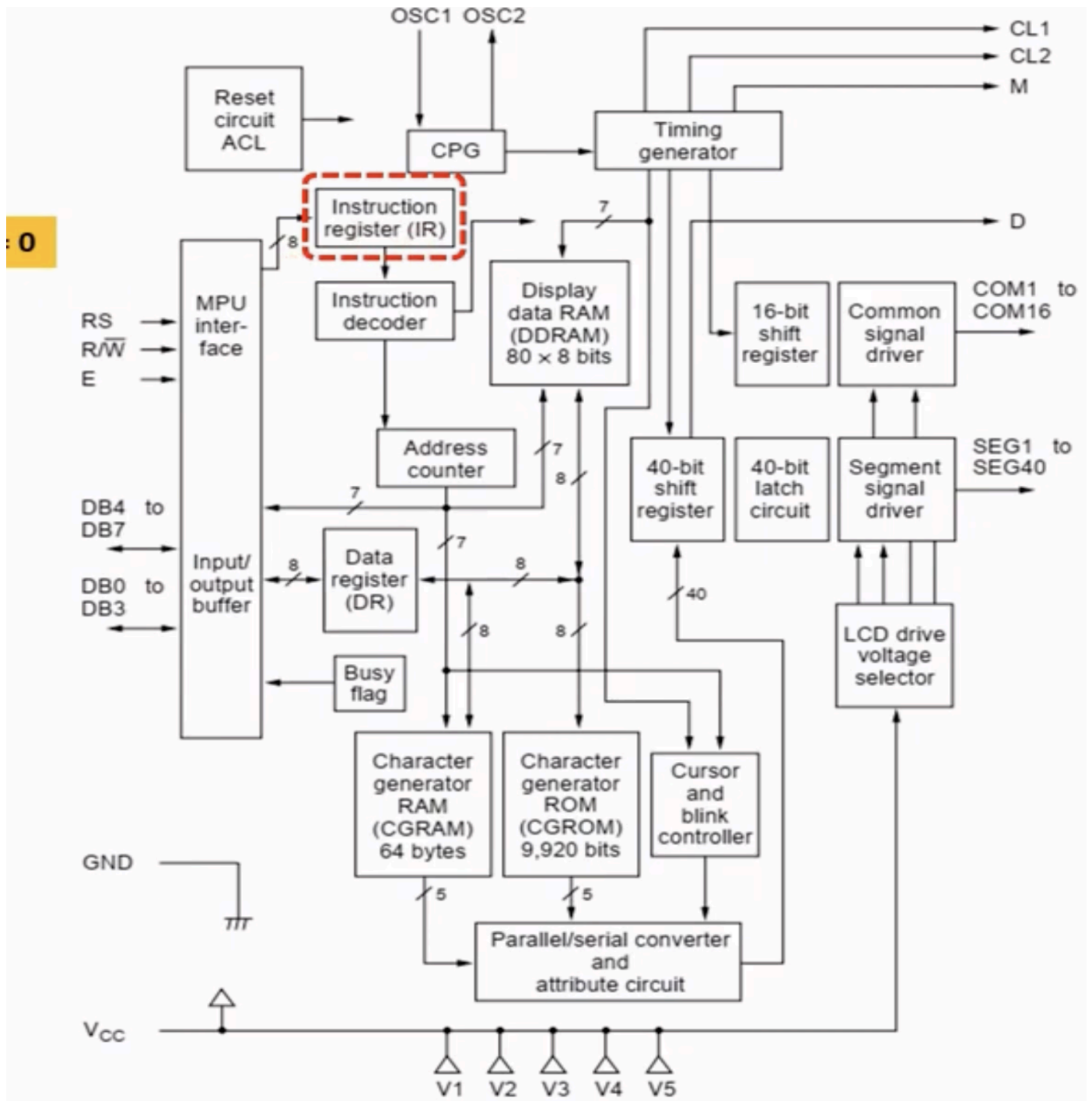
The primary objective of this project is to design and implement a PC-based notice board using an 8051 microcontroller. This system aims to modernize information sharing in various settings such as educational institutions, offices, or public spaces by replacing traditional physical notice boards with a digital, easily updatable alternative.

Project Motivation

In today's fast-paced digital world, the need for quick and efficient information dissemination is crucial. Traditional notice boards are often overlooked and require manual updates, which can be time-consuming and inefficient. By creating a PC-based notice board, we address these issues, providing a solution that allows for real-time updates, increased visibility, and improved information management. This project also serves as an excellent opportunity to apply our knowledge of microcontroller programming and interfacing in a practical, real-world scenario.

Implementation

Block Diagram (Architecture)



Explanation of Components

1. PC Interface: A simple GUI application running on a computer that allows users to input and send messages to the microcontroller.
2. 8051 Microcontroller: The central processing unit that receives data from the PC, processes it, and controls the LCD display.
3. MAX232 IC: Used for converting the PC's RS232 serial communication signals to TTL levels compatible with the 8051 microcontroller.
4. 16x2 LCD Display: Displays the messages received from the PC.
5. Power Supply: Provides the necessary voltage to run the microcontroller and other components.

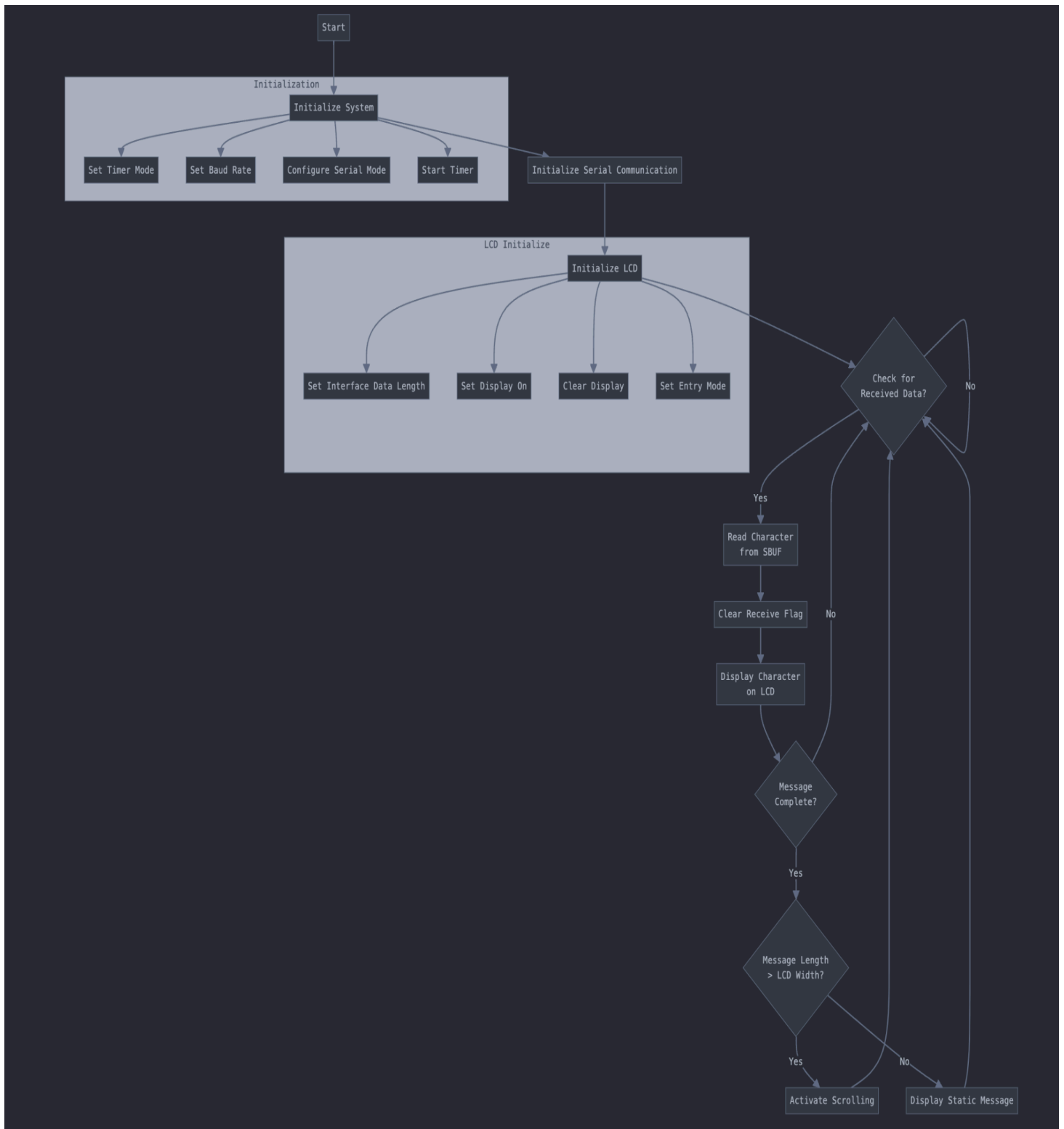
Hardware Specifications

- AT89S52 (8051 family) Microcontroller
- 16x2 LCD Display
- MAX232 IC
- 11.0592 MHz Crystal Oscillator
- 33pF Capacitors (2)
- 10µF Capacitors (4)
- 10KΩ Resistor
- 10KΩ Potentiometer
- Push Buttons (for additional functionality if needed)

Software Specifications

- Edsim51 for assembly programming

Flowchart



Implemented Code

Org 0000h

```
RS          Equ    P1.3
E           Equ    P1.2
; R/W* is hardwired to 0V, therefore it is always in write mode
; ----- Main -----
                Clr RS                ; RS=0 - Instruction register is selected.
                                   ; Stores instruction codes, e.g., clear

display...
; Function set
                Call FuncSet
; Display on/off control
                Call DispCon
; Entry mode set (4-bit mode)
                Call EntryMode
; Send data
                SetB RS                ; RS=1 - Data register is selected.
                                   ; Send data to data register to be displayed.

Back:          Mov DPTR,#LUT1
                Clr A
                Movc A,@A+DPTR
                Jz Next
                Call SendChar
                Inc DPTR
                Jump Back

Next:          Call CursorPos ;Put cursor onto the next line

                SetB RS                ; RS=1 - Data register is selected.
                                   ; Send data to data register to be displayed.

Again:        Mov DPTR,#LUT2
                Clr A
                Movc A,@A+DPTR
                Jz EndHere
                Call SendChar
                Inc DPTR
                Jump Again

EndHere:      Jump $
; ----- END -----

; ----- Subroutines -----
; ----- Function set -----
FuncSet:      Clr P1.7                ;
                Clr P1.6                ;
```



```

        SetB P1.5          ; bit 5=1
        Clr P1.4           ; (DB4)DL=0 - puts LCD module into 4-bit mode

        Call Pulse

        Call Delay         ; wait for BF to clear

        Call Pulse

        SetB P1.7          ; P1.7=1 (N) - 2 lines
        Clr P1.6
        Clr P1.5
        Clr P1.4

        Call Pulse

        Call Delay
        Ret
;-----
;----- Display on/off control -----
; The display is turned on, the cursor is turned on
DispCon:    Clr P1.7      ;
            Clr P1.6      ;
            Clr P1.5      ;
            Clr P1.4      ; high nibble set (0H - hex)

            Call Pulse

            SetB P1.7      ;
            SetB P1.6      ; Sets entire display ON
            SetB P1.5      ; Cursor ON
            SetB P1.4      ; Cursor blinking ON
            Call Pulse

            Call Delay     ; wait for BF to clear
            Ret
;-----
CursorPos:  Clr RS
            SetB P1.7      ; Sets the DDRAM address
            SetB P1.6      ; Set address. Address starts here - '1'
            Clr P1.5      ;
            '0'
            Clr P1.4      ;
            '0'
                                ; high nibble
            Call Pulse

            Clr P1.7      ;
            '0'

```

```

        Clr P1.6      ;
'0'      Clr P1.5      ;
'0'      Clr P1.4      ;
'0'

; low nibble
; Therefore address is 100 0000 or 40H
; Ref:
http://web.alfredstate.edu/faculty/weimandn/lcd/lcd\_addressing/lcd\_addressing\_index.html
; Ref:
https://mil.ufl.edu/3744/docs/lcdmanual/commands.html
    Call Pulse

    Call Delay          ; wait for BF to clear
    Ret

;----- Entry mode set (4-bit mode) -----
; Set to increment the address by one and cursor shifted to the right
EntryMode:    Clr P1.7      ; P1.7=0
              Clr P1.6      ; P1.6=0
              Clr P1.5      ; P1.5=0
              Clr P1.4      ; P1.4=0

    Call Pulse

    Clr P1.7          ; P1.7 = '0'
    SetB P1.6         ; P1.6 = '1'
    SetB P1.5         ; P1.5 = '1'
    Clr P1.4          ; P1.4 = '0'

    Call Pulse

    Call Delay          ; wait for BF to clear
    Ret

;----- Pulse -----
Pulse:        SetB E      ; P1.2 is connected to 'E' pin of LCD module
              Clr E      ; negative edge on E
              Ret

;-----
;----- SendChar -----
SendChar:     Mov C, ACC.7      ;
              Mov P1.7, C      ;
              Mov C, ACC.6      ;
              Mov P1.6, C      ;
              Mov C, ACC.5      ;
              Mov P1.5, C      ;
              Mov C, ACC.4      ;
              Mov P1.4, C      ; high nibble
              ;Jump $

```

```

Call Pulse

Mov C, ACC.3      ;
Mov P1.7, C       ;
Mov C, ACC.2      ;
Mov P1.6, C       ;
Mov C, ACC.1      ;
Mov P1.5, C       ;
Mov C, ACC.0      ;
Mov P1.4, C       ; low nibble

Call Pulse

Call Delay        ; wait for BF to clear

Mov R1, #55h
Ret

;----- Delay -----
Delay:      Mov R0, #50
           Dinz R0, $
           Ret

;-----
;----- End of subroutines -----
;----- Look-Up Table (LUT) -----
           Org 0200h
LUT1:      DB 'N', 'O', 'T', 'I', 'C', 'E', ' ', 'B', 'O', 'A', 'R', 'D', 0
LUT2:      DB 'P', 'B', 'L', ' ', 'I', 'S', ' ', 'B', 'E', 'S', 'T', 0
;-----
Stop:      Jmp $

           End

```

Conclusion and Result

Test Cases

1. Single line message display
2. Multi-line message display
3. Special character handling
4. Message scrolling for long texts

Results

The PC-based notice board successfully receives and displays messages sent from the computer interface. All test cases were executed with the following outcomes:

1. Single line messages are displayed correctly and instantly.
2. Multi-line messages are handled by automatically scrolling or switching between lines.
3. Special characters are displayed without any issues.
4. Long messages scroll smoothly across the LCD screen.
5. The system properly handles and notifies users of invalid inputs.

Screenshots

EdSim51DI - Version 2.1.37

System Clock (MHz) 12.0

100 Update Freq.

RST Step Pause New Load Save CFY Paste BP

Time: 21ms 129us - Instructions: 10800

R/O W/O TH0 TL0 R7 0x00 B 0x00

0x00 0x00 0x00 0x00 R6 0x00 ACC 0x00

RXD TXD 1 1 TMOD 0x00 R5 0x00 PSW 0x80

SCON 0x00 TCON 0x00 R4 0x00 IP 0x00

pins bits TH1 TL1 R3 0x00 IE 0x00

0xFF 0xFF P3 0x00 0x00 R2 0x00 PCON 0x00

0xFF 0xFF P2 0x00 0x00 R1 0x55 DPH 0x02

0x1B 0x1B P1 0x00 0x00 R0 0x00 DPL 0x19

0xFF 0xFF P0 0x00 0x00 PC 8051 SP 0x07

0x0026 PSW 1 0 0 0 0 0 0 0

Modify RAM

Data Memory

addr 0x00 0x00 value

0 1 2 3 4 5 6 7 8 9 A B C D E F

00 00 55 00 00 00 00 00 00 00 23 00 B5 00 00 00 00 00

10 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

20 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

30 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

40 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

50 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

60 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

70 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

Remove All Breakpoints

0000| Clr RS ; RS=0 - I

0002| ; Function set

0004| Call FuncSet

0006| ; Display on/off control

0008| Call DispCon

000A| ; Entry mode set (4-bit mode)

000C| Call EntryMode

000E| ; Send data

0010| SetB RS ; RS=1 - Da

0012| ; Send data to

0014| Mov DPTR, #LUT1

0016| Back: Clr A

0018| Movc A, @A+DPTR

001A| Jz Next

001C| Call SendChar

001E| Inc DPTR

0020| Jmp Back

0022| Next: Call CursorPos ;Put

P0.7 1 Display-select Decoder CS|DAC WR

P0.6 1 Keypad Column 2

P0.5 1 Keypad Column 1

P0.4 1 Keypad Column 0

P0.3 1 Keypad Row 3

P0.2 1 Keypad Row 2

P0.1 1 Keypad Row 1

P0.0 1 Keypad Row 0

P1.7 0 LED 7|Seg. dp|DAC DB7|LCD DB7

P1.6 0 LED 6|Seg. g|DAC DB6|LCD DB6

P1.5 0 LED 5|Seg. f|DAC DB5|LCD DB5

P1.4 1 LED 4|Seg. e|DAC DB4|LCD DB4

P1.3 1 LED 3|... d|..DB3|..DB3|.. RS

P1.2 0 LED 2|... c|..DB2|..DB2|LCD E

P1.1 1 LED 1|Seg. b|DAC DB1|LCD DB1

P1.0 1 LED 0|Seg. a|DAC DB0|LCD DB0

P2.7 1 SW 7|ADC DB7

P2.6 1 SW 6|ADC DB6

P2.5 1 SW 5|ADC DB5

P2.4 1 SW 4|ADC DB4

P2.3 1 SW 3|ADC DB3

P2.2 1 SW 2|ADC DB2

P2.1 1 SW 1|ADC DB1

P2.0 1 SW 0|ADC DB0

P3.7 1 ADC RD|Comparator Output

P3.6 1 ADC WR

P3.5 1 Motor Sensor

P3.4 1 Display-select Input 1

P3.3 1 AND Gate Output|Display-se..t 0

P3.2 1 ADC INTR

P3.1 1 Motor Control Bit 1|Ext. UART Rx

P3.0 1 Motor Control Bit 0|Ext. UART Tx

DI / LD

7 6 5 4 3 2 1 0

0.0 V output

Scope

DAC

1 2 3

4 5 6

7 8 9

* 0 #

AND Gate Disabled

Key Bounce Disabled

Standard

U No Parity 8-bit UART @ 19200 Baud

Rx Rx Reset

Tx Tx Send

0.0 V

Input

11111111

ADC

MAX

MIN

Motor Enabled

NOTICE BOARD

PBL IS BEST!

BF 0 AC 0x4C IR 0xC0 DR 0x21 i

8888

NOTICE BOARD

PBL IS BEST!

BF 0 AC 0x4C IR 0xC0 DR 0x21 i

Conclusion

The PC-based notice board project successfully demonstrates the practical application of 8051 microcontroller programming in creating a modern information display system. By integrating computer interfaces with microcontroller-driven hardware, we have created a versatile and efficient alternative to traditional notice boards.

This project has not only met its primary objectives but also provided valuable insights into serial communication, LCD interfacing, and real-time data processing. The system's ability to quickly update displayed information makes it suitable for various environments where timely information dissemination is crucial.


Future enhancements could include wireless communication capabilities, support for multiple display units, and integration with existing information management systems.


References

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4. Davies, J. H. (2008). MSP430 Microcontroller Basics. Elsevier.
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www.microcontrollerslab.com/8051-tutorial/. Accessed 11 Oct 2024.
6. "LCD Interfacing with 8051 Microcontroller." ElectronicWings,
www.electronicwings.com/8051/lcd-interfacing-with-8051.
Accessed 11 Oct 2024.
7. Links followed are listed below

<https://edsim51.wordpress.com/wp-content/uploads/2024/08/hd44780.pdf>

 #32 EdSim51 LCD - Display Two Lines of Text

 #28 EdSim51 LCD Module