## LABFILE (CEN 691) EMBEDDED SYSTEMS LAB

SUBMITTED BY : YASH VINAYVANSHI B.TECH COMPUTER ENGINEERING (6th SEMESTER) ROLL NO. 19BCS081 JAMIA MILLIA ISLAMIA FET, NEW DELHI

SUBMITTED TO : DR. WASEEM AHMAD PROFESSOR DEPARTMENT OF COMPUTER ENGINEERING JAMIA MILLIA ISLAMIA FET, NEW DELHI

Program No./ Concept	TABLE OF CONTENTS           Program Title / Problem Statement	Date of Sub. pg. no.
1	Study of Keil Micro vision IDE and Flash magic tool	17/01/2022 3-6
2	Design and implement Embedded System for blinking single LED with some delay in between, using 8051 Microcontroller and Keil.	24/01/2022 7-9
3	Design and implement embedded system for 3 bit led counter with some delay in between, using 8051 microcontroller and Keil.	07/02/2022 10-12
4	Design counter based on first two switches as input using 8051 microcontroller and Keil.	14/02/2022 13-15
5	Design counter based on first Three switches as input using 8051 microcontroller and Keil.	14/03/2022 16-19
6	Design and implement an Embedded System that interfaces an 8051 Board by taking input from switch and then completes its cycle (in reverse order) with a buzzer.	21/03/2022 20-23
7	To design and implement an Embedded System that displays the roll no and name on LCD screen using 8051 microcontroller.	28/03/2022 24-25
8	Design and implement an Embedded System that displays the factorial of a number (input through switch) on LCD screen using 8051 microcontroller.	18/04/2022 26-29
9	Design and implement an Embedded System that outputs factor of a number (input through switch) on LED with buzzer, in between every factor using 8051 Board.	21/04/2022 30-34

Program No./	TABLE OF CONTENTS	Date of Sub.
Concept	Program Title / Problem Statement	pg. no.
10	Design and implement an Embedded System that toggle only pin P 1.5 continuously every 250ms using 8051 board. Take crystal frequency=11.0592 MHz. 1. Using timer 0, mode 1 2. Using timer 1, mode 2	01/05/2022 35-38

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#### ES lab 1 : Study of Keil Micro vision IDE and Flash magic tool.

<u>Steps</u>

ReadMe 1) Install the drivers in the folder "DriverFor ThinkLABS" "Setup For HugePine.exe" 1) Install the drivers in the folder "DriverFor ThinkLABS"
 "Setup For HugePine.exe"
 "H]-340.exe"
 win7 - "PL2303\_Prolific\_DriverInstaller\_v110.exe"
 USBSim9.0 - "Setup.exe"
2) Copy the Provided header[p89v51rx2.h] to
"C:\keil\_v5\C51\INC\Philips" C:\Keil\_v5\C51\INC\Philips 3) Open Keil uvision IDE. Select Project>New uVision Project 5) From the Dropdown menu Select Legacy Device Database Search for P89v51RD2. Select and press OK. 6) Search for P89VSIRD2. Select and press own?
7) Click Yes
8) Right Click 'Target1'. Select Options For Target 'Target1'.
9) GoTo Output Tab. Check 'Create HEX File' tickbox..
10) Expand 'Target1'
11) Right Click 'Source Group 1'.
12) Add New Item to Group 'Source Group 1'.
13) Choose C file. Enter a name click Add.
14) Refer the exemplary code in this folder.
15) Press F7 to build the Code and generate hex file. [Hex File Generated in '/Objects']
16) Compect the USB cable to the PORT. 16) Connect the USB cable to the PORT. Attach the Power Adapter of the board in the right pin. 18) Press the PowerOn switch on the board. [The Large LED must turn 19) Right click on windows button in the bottom left corner. 20) Select Device Manager, Expand 'ports(COM & LPT)', Look at the COM number in the field for device. 21) Launch FlashMagic 22) Click on Select. Choose 89v51RD2. Choose Appropriate COM Port from step 20. 23) 24) Baud Rate : 9600 Interface : None(ISP) in Firmware section, browse and select your generated HEX file in Options make ure only the following are ticked - 'Verify after Programming', 'Prog Clocks Bit' 25) Click on Options>Advanced Options>Harware Config 26) Uncheck use DTR to control RST. Click OK Click on ISP menu 27 28) Select Read device Signature. 29) When Asked to reset ISP, Press the RESET button on your board.
The window will load some value in the fields.
30) Click Close
31) Check "Erase blocks used by Firmware"
32) Click "Start" 33) After the process is finished, Power off the Board using the power button, unplug the USB. 34) Power On the board.

#### Keil microvision IDE for code editing and Assembling



#### 17 JANUARY 2022

C code & hex code

```
#include<stdio.h>
void main(){
    printf("Hello world");
}
```

00 01 02 03 04 05 06 07 08 09 0a 0b 0c 0d 0e 0f 000000000 3a 30 33 30 30 30 30 30 30 30 30 32 30 43 31 31 44 :03000000020C11D 0000000010 45 0d 0a 3a 30 43 30 43 31 31 30 30 37 38 37 46 E..:0C0C1100787F 0000000020 45 34 46 36 44 38 46 44 37 35 38 31 32 31 30 32 E4F6D8FD75812102 0000000030 30 43 32 39 45 33 0d 0a 3a 30 43 30 43 31 44 30 0C29E3..:0C0C1D0 0000000040 30 34 38 36 35 36 43 36 43 36 46 32 30 37 37 36 048656C6C6F20776 0000000050 46 37 32 36 43 36 34 30 30 38 46 0d 0a 3a 30 39 F726C64008F..:09 0000000060 30 43 32 39 30 30 37 42 46 46 37 41 30 43 37 39 0C29007BFF7A0C79 0000000070 31 44 30 32 30 38 36 32 43 30 0d 0a 3a 31 30 30 1D020862C0..:100 0000000080 38 30 30 30 30 45 35 31 37 32 34 30 42 46 38 45 80000E517240BF8E 0000000000 36 30 35 31 37 32 32 37 38 30 38 33 30 30 37 30 6051722780830070 00000000a0 32 37 38 30 42 36 35 0d 0a 3a 31 30 30 38 31 30 2780B65..:100810 00000000b0 30 30 45 34 37 35 46 30 30 31 31 32 30 42 42 34 00E475F001120BB4 00000000c0 30 32 30 42 35 43 32 30 30 30 45 42 37 46 32 45 020B5C2000EB7F2E 00000000d0 44 32 43 41 0d 0a 3a 31 30 30 38 32 30 30 30 30 D2CA..: 100820000 00000000e0 30 38 30 31 38 45 46 35 34 30 46 32 34 39 30 44 08018EF540F2490D 0000000f0 34 33 34 34 30 44 34 46 46 33 30 30 34 30 42 44 43440D4FF30040BD 0000000100 30 0d 0a 3a 31 30 30 38 33 30 30 30 45 46 32 34 0..: 10083000EF24 0000000110 42 46 42 34 31 41 30 30 35 30 30 33 32 34 36 31 BFB41A0050032461 0000000120 46 46 45 35 31 38 36 30 30 32 31 35 43 44 0d 0a FFE518600215CD.. 0000000130 3a 31 30 30 38 34 30 30 30 31 38 30 35 31 42 45 :1008400018051BE 000000140 35 31 42 37 30 30 32 30 35 31 41 33 30 30 37 30 51B7002051A30070 0000000150 44 37 38 30 38 45 34 37 35 43 32 0d 0a 3a 31 30 D7808E475C2..:10 0000000160 30 38 35 30 30 30 46 30 30 31 31 32 30 42 42 34 085000F001120BB4 0000000170 45 46 30 32 30 42 41 32 30 32 30 42 45 41 37 34 EF020BA2020BEA74

### Using flash magic to burn code into 8051 mprocessor

a mpiab i						
🎲 Flash Ma	agic - NON PRODUCTION USE ONLY	r	-	-		×
ce File ISP	Options Tools Help					
۵   🖬 🍋	l 🎯 🎺 🛩 🌉 🗲   🕺   🔟	😮 😂				
Step 1 - Con	nmunications	Step 2 -	Erase			
Select	89CV51RD2	Erase blo	ock 0 (0x00	100-0x1	FFF)	
Flash Bank:	~ ~	Erase blo Erase blo	оск т (Ux2u ock 2 (0x40	100-0x3 100-0x7	FFF) FFF)	
COM Port:	~	Erase blo Erase blo	ook 3 (0x80 ook 4 (0xC0	100-0xB 100-0xF	FFF) FFFF)	
Baud Rate:	9600 ~			•.		
Interface:	None (ISP)	Erase Erase	all Flash+S blocks use	ecurity d hu Fi	+Clks	
				,		
2						
c						
Step 3 - Firm	iware					
File: C	:\Users\Hp microsoft\Desktop\mplab\0	bjects\mpla	b1.hex		Brov	vse
Mo	odified: Monday, January 24, 2022, 7:41:	28 AM	mor	<u>e info</u>		
Step 4 - Opt	ions	Ste	p 5 - Start!			
Verify afte	r programming 📃 Patch 🛛 Settings			Start		
Fill unused	Flash Set Security Bit 1			Jtait		
Gen block	checksums Set Security Bit 2					
Activate F	lash Bank Prog Clocks Bit					
CAN Bus Tin	ning Calculators at:					
	-					
www.esacac	pemy.com/en/library/calculators.html		0			<b></b>
			U			

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# ES lab 2 : Design and implement Embedded System for blinking single LED with some delay in between, using 8051 Microcontroller and Keil.

#### <u>Hardware</u>

<u>Microprocessor used</u> : NXP (founded by Philips) P89V51RD2 <u>Microprocessor specifications :</u> 40MHz, 5 Volt 8051-based Microcontroller with 32 I/O lines, 3 Timers/ Counters, 9 Interrupts/4 priority levels, 64K+8K FLASH, 1K on-chip RAM, SPI, Dual Data Pointers, WDT, 5-channel PCA.

#### Development board used : Thinklabs iboard 8051

#### <u>Development board specifications :</u>

Includes Philips 89V51RD2 Microcontroller with 64kB flash memory working at 11.0592MHz. 40 pin IC base for compatible PDIP microcontroller packages. Wide operating voltages 7V–15V. Power indicator LED. Buzzer. On board 2 Dual full H bridge motor driver with 600mA per channel for 2 Stepper or 4 DC/DC Geared motors. Separate ON/OFF switch for power and motor enable. 4 LEDs for status or debugging purposes. 4 Pushbutton switches for external inputs/interrupts. On board LCD connector. On board supply terminals for 6V Servo Motors. On board regulated power supply.

#### <u>Microprocessor PIN diagram</u>



Power Jack External Motor Connectors	Motor Connectors	PORTS
	M4	P2.6, P2.7
Motor	M3	P2.4, P2.5
Enable	M2	P1.6, P1.7
	M1	P1.4, P1.5
Content and and an	Switches	(active low)
ON-OFF	Swl	P3.2
Switch CHHII-0	Sw2	P3.3
Power Contrast	Sw3	P3.4
LCD Barret	Sw4	P3.5
Connector	LEDs	(active low)
WASHING .	D1	P3.0
iBoaru 8051	D2	P3.1
A COCCESSESSESSESSESSESSESSESSESSESSESSESSES	D3	P3.6
5 V Voltage	D4	P3.7
regmator P89V51RD2	LCD	El Constantino
	Data	P0.4 to P0.7
G C-1110-3	Control pins	P0.0 to P0.2
20 L-Illier-D www.thinklab.	ISP	Station Maria
Power In	p# RXD	P3.0
	TXD	P3.1
n tionisersor tionical data	Sensor Connectors	
D ROSISW OF ROS	P1.0 to P1.7	
A share a state of a second state of the secon	P2.0 to P2.7	
And the second of the second is the second s	F3.2 to F3.5	CORRECT OF THE PROPERTY OF THE
	a Buzzer	P0 3
Programmer VCC	Active Low Buzzer	Pin 18 and 19
Connector / 9 - c	Reset Switch	Pin 9
1 PI	Reset 5 witch	1

Header file : P89V51RD2.h **IDE used** : ARM keil microvision for burning : Flash Magic

#### Working

LED D1 at port 3\_0 (RxD) Blinks with chosen delay

#### <u>C program</u>

```
/* program to blink an LED */
/*YASH VINAYVANSHI 19BCS081*/
#include<P89V51RD2.h>
void delay(unsigned int dela){
      unsigned int i,j;
      for(i=0; i<=1000; i++){</pre>
             for(j=0; j<=dela; j++);</pre>
```

```
}
}
void main(void){
      while(1){
            RxD = 0;
            delay(20);
            RxD = 1;
            delay(20);
```

}

}

#### Hex code

:0300000020830C3 :0C083000787FE4F6D8FD758107020820EF :10080000E4FDFCE4FBFAD3EB9FEA9E50070BBB0030 :0F081000010A80F20DBD00010CBC03E7BDE9E455 :01081F0022B6 :10082000C2B07F147E00120800D2B012080080F01F :00000001FF

#### <u>Run</u>



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ES lab 3 : Design and implement embedded system for 3 bit led counter with some delay in between, using 8051 microcontroller and Keil.

#### <u>Hardware</u>

<u>Microprocessor used</u> : NXP (founded by Philips) P89V51RD2 <u>Microprocessor specifications :</u> 40MHz, 5 Volt 8051-based Microcontroller with 32 I/O lines, 3 Timers/ Counters, 9 Interrupts/4 priority levels, 64K+8K FLASH, 1K on-chip RAM, SPI, Dual Data Pointers, WDT, 5-channel PCA.

#### Development board used : Thinklabs iboard 8051

#### <u>Development board specifications :</u>

Includes Philips 89V51RD2 Microcontroller with 64kB flash memory working at 11.0592MHz. 40 pin IC base for compatible PDIP microcontroller packages. Wide operating voltages 7V–15V. Power indicator LED. Buzzer. On board 2 Dual full H bridge motor driver with 600mA per channel for 2 Stepper or 4 DC/DC Geared motors. Separate ON/OFF switch for power and motor enable. 4 LEDs for status or debugging purposes. 4 Pushbutton switches for external inputs/interrupts. On board LCD connector. On board supply terminals for 6V Servo Motors. On board regulated power supply.

#### <u>Microprocessor PIN diagram</u>



Power Jack	External	Motor Connectors		17	Motor Connectors	PORTS
1	Fond			100	M4	P2.6, P2.7
Motor	A CONTRACTOR OF A CONTRACTOR O	Printing of the Party of the Pa	A REAL PROPERTY AND A REAL		M3	P2.4, P2.5
Enable	RARIOR				M2	P1.6, P1.7
	Charles brown		and the		M1	P1.4, P1.5
			CC-	- 12	Switches	(active low)
ON-OFF				51×	Swl	P3.2
Switch	III-0				Sw2	P3.3
Power Con	trast to		1		Sw3	P3.4
LCD			Ality Tomas		Sw4	P3.5
Connector	ENER	ANT PREMOVE	Bulle	85	LEDs	(active low)
	5-C-1 -	WASHING		RJ	D1	P3.0
	e	iBoard 8051			D2	P3.1
			a sv		D3	P3.6
5 V Voltage			I/O Supple		D4	P3.7
Regulator	P89V	51RD2	Selected Selected	10 E	LCD	
			Sunta	6. A	Data	P0.4 to P0.7
e			GV Serve		Control pins	P0.0 to P0.2
. 50	C-Illini-3	A A A A A A A A A	Supply	E.	ISP	
· · · · · · · · · · · · · · · · · · ·	22 2 2	Distantiant of	B Bower Input		RXD	P3.0
	1000				TXD	P3.1
· · · · · · · · ·	1 SW2 SW3 SW4	0 D1 D2 D3 D4		國	Sensor Connectors	
	D	IO2nitoton 1/03/	Sw Rest		P1.0 to P1.7	
			SWILD		P2.0 to P2.7	-
64	- Manal	20.22.2. V		1002	P3.2 to P3.5	
7711	and and a state of the state of	and the second	A second s	12	Misc	
Programmer ()	lec -			A. Ly Lo	J Buzzer	P0.3
Connector	p.a.	I/O Pins		ne mine	Crystal (11.0592Mhz)	Pin 18 and 19
1	PI				Reset Switch	Pin 9

Header file : P89V51RD2.h
IDE used : ARM keil microvision
for burning : Flash Magic

#### <u>Working</u>

LEDS D3 D2 D1 Blinks as mod 8 counter with chosen delay.

#### <u>C program 1</u>

```
/* 3 bit counter on LEDs*/
// Created by YASH VINAYVANSHI on 07/02/22.
#include<P89V51RD2.h>
void delay(unsigned int dela){
    unsigned int i, j;
    for(i=0; i<=1000; i++){
        for(j=0; j<=dela; j++);
    }
}
void main(void)
{
    while(1) {
        unsigned int j;
        for(j=0; j<=8; j++) {
            unsigned d=j;
            RxD = d%2; //Extracting bits from 3 bit bin no.
            d =d/2;
</pre>
```

}

```
TxD = d%2;
d=d/2;
WR = d%2;
delay(500);
```

}

<u>C program 2</u>

}

```
/* 3 bit counter on LEDs*/
// Created by YASH VINAYVANSHI on 07/02/22.
// D1 -> p3.0 -> RxD
// D2 -> P3.1 -> TxD
// D3 -> p3.6 -> WR
11
11
                // 7 6 5 4 3 2 1 0
                      value
                                cntr
// 0 0 0 0 0 0 0 0
                      0
                                0
// 0 0 0 0 0 0 0 1
                                1
                      1
// 0 0 0 0 0 0 1 0
                                2
                      2
// 0 0 0 0 0 0 1 1
                                3
                      3
11
         . . .
// 0 1 0 0 0 0 0 0
                      64
                                4
// 0 1 0 0 0 0 0 1
                      65
                                5
// 0 1 0 0 0 0 1 0
                      66
                                6
                                7
// 0 1 0 0 0 0 1 1
                      67
#include<P89V51RD2.h>
void delay(unsigned int dela){
    unsigned int i, j;
    for(i=0; i<=1000; i++){</pre>
        for(j=0; j<=dela; j++);</pre>
    }
}
void main(void){
    while(1){
        P3 = 0; delay(500);
        P3 = 1; delay(500);
        P3 = 2; delay(500);
        P3 = 3; delay(500);
        P3 = 64; delay(500);
        P3 = 65; delay(500);
        P3 = 66; delay(500);
        P3 = 67; delay(500);
    }
}
```

<u>Output :</u>

MSB		LSB
D3	D2	D1
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

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#### ES lab 4 : Design counter based on first two switches as input using 8051 microcontroller and Keil.

#### <u>Hardware</u>

<u>Microprocessor used</u> : NXP (founded by Philips) P89V51RD2 <u>Microprocessor specifications :</u>

40MHz, 5 Volt 8051-based Microcontroller with 32 I/O lines, 3 Timers/ Counters, 9 Interrupts/4 priority levels, 64K+8K FLASH, 1K on-chip RAM, SPI, Dual Data Pointers, WDT, 5-channel PCA.

## Development board used : Thinklabs iboard 8051 Development board specifications :

Includes Philips 89V51RD2 Microcontroller with 64kB flash memory working at 11.0592MHz. 40 pin IC base for compatible PDIP microcontroller packages. Wide operating voltages 7V–15V. Power indicator LED. Buzzer. On board 2 Dual full H bridge motor driver with 600mA per channel for 2 Stepper or 4 DC/DC Geared motors. Separate ON/OFF switch for power and motor enable. 4 LEDs for status or debugging purposes. 4 Pushbutton switches for external inputs/interrupts. On board LCD connector. On board supply terminals for 6V Servo Motors. On board regulated power supply.

#### Microprocessor PIN diagram



Power Jack	External Power M	otor Connectors		
Motor Enable	100100		600	
ON-OFF Switch			1	
LCD Connector		THE WAS	Buzzer	
5 V Voltage Regulator	P89V51	RD2	Addense Law Selecter Switch	ąć n
ROGELART		Climikiabs in οο Climikiabs in οο	Supply Supply Power	then bota
	IIIO I/Sensor	O2iMoton I/O3/	Sw B Ref	el (ch
Programmer Connector	and MC	) Pins		

Motor Connectors	PORTS
M4	P2.6, P2.7
M3	P2.4, P2.5
M2	P1.6, P1.7
M1	P1.4, P1.5
Switches	(active low)
Sw1	P3.2
Sw2	P3.3
Sw3	P3.4
Sw4	P3.5
LEDS	(active low)
D1	P3.0
D2	P3.1
D3	P3.6
D4	P3.7
LCD	
Data	P0.4 to P0.7
Control pins	P0.0 to P0.2
ISP	A Strange and Strange
RXD	P3.0
TXD	P3.1
Sensor Connectors	
P1.0 to P1.7	
P2.0 to P2.7	-
P3.2 to P3.5	
Misc	
re Low Buzzer	P0.3
Crystal (11.0592Mhz)	Pin 18 and 19
Reset Switch	Pin 9

Header file : P89V51RD2.h
IDE used : ARM keil microvision
for burning : Flash Magic

#### <u>C program</u>

```
//To design n bit counter based on n on two switches
//created by yash vinayvanshi 19BCS081
/*
      P3.2 INT0(MSB)
Sw1
Sw2
      P3.3 INT1(LSB)
D1
      P3.0 RxD (MSB)
D2
      P3.1 TxD
D3 P3.6 RW (LSB)
*/
#include<P89V51RD2.h>
void delay(unsigned int dela){
      unsigned int i,j;
       for(i=0;i<1000;i++) {</pre>
             for(j=0; j<dela; j++);</pre>
       }
}
void main(void){
      unsigned int dela = 500;
      while(1){
             unsigned int count=1, bits=0, i=0, j=0;
             if(INT0 == 0) bits+=2;
             if(INT1 == 0) bits+=1;
             for(i=0; i<bits; i++) count*=2;</pre>
```

#### 14 FEBRUARY 2022

```
for(; j<count; j++){
    unsigned int d = j;
    WR = d%2;//Extracting bits from 3 bit bin no.
    d =d/2;
    TxD = d%2;
    d=d/2;
    RxD = d%2;
    delay(dela);
}</pre>
```

#### **Output** :

}

(user MSB   S1 S 0	<b>-)</b> <b>-SB</b> 52 0	MSB D1 X	D2 X	LSB D3 X				
1 bit 0	counter 1	0 0 0 0	0 0 0 0	0 1 0 1	t0 t1 t2 t3	and	so	on
2bit 1	counter Ø	0 0 0 0 0 0	0 0 1 0 0 1 1	0 1 0 1 0 1	t0 t1 t2 t3 t4 t5 t6 t7	and	50	on
3bit 1	counter 1	0 0 0 1 1 1 1 0 0 0 1 1 1 1	0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1	0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1	t0 t1 t2 t3 t4 t5 t6 t7 t8 t9 t10 t11 t12 t13 t14 t15	and	50	on

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#### ES lab 5 : Design counter based on first Three switches as input using 8051 microcontroller and Keil.

#### <u>Hardware</u>

<u>Microprocessor used</u> : NXP (founded by Philips) P89V51RD2 <u>Microprocessor specifications :</u>

40MHz, 5 Volt 8051-based Microcontroller with 32 I/O lines, 3 Timers/ Counters, 9 Interrupts/4 priority levels, 64K+8K FLASH, 1K on-chip RAM, SPI, Dual Data Pointers, WDT, 5-channel PCA.

## Development board used : Thinklabs iboard 8051 Development board specifications :

Includes Philips 89V51RD2 Microcontroller with 64kB flash memory working at 11.0592MHz. 40 pin IC base for compatible PDIP microcontroller packages. Wide operating voltages 7V–15V. Power indicator LED. Buzzer. On board 2 Dual full H bridge motor driver with 600mA per channel for 2 Stepper or 4 DC/DC Geared motors. Separate ON/OFF switch for power and motor enable. 4 LEDs for status or debugging purposes. 4 Pushbutton switches for external inputs/interrupts. On board LCD connector. On board supply terminals for 6V Servo Motors. On board regulated power supply.

#### Microprocessor PIN diagram



Power Jack	External Power Motor Connectors	
Motor Enable		
ON-OFF Switch		
LCD	THO CHILL BUTTER	
Connector		
E V Voltage		
Regulator	P89V51RD2	
	o ct tris-5 o ct-tris-5 www.thinktab o Supply Power and Power and	
	SWI SW2 SW3 SW40 D1 D2 D3 D4 STILL IIOI/Sensor D Reel Stilld	
A	A A A A A A A A A A A A A A A A A A A	
Programmer	que VOPins	Active

Motor Connectors	PORTS
M4	P2.6, P2.7
M3	P2.4, P2.5
M2	P1.6, P1.7
M1	P1.4, P1.5
Switches	(active low)
Swl	P3.2
Sw2	P3.3
Sw3	P3.4
Sw4	P3.5
LEDs	(active low)
D1	P3.0
D2	P3.1
D3	P3.6
D4	P3.7
LCD	
Data	P0.4 to P0.7
Control pins	P0.0 to P0.2
ISP	A President and Printers of
RXD	P3.0
TXD	P3.1
Sensor Connectors	
P1.0 to P1.7	
P2.0 to P2.7	-
P3.2 to P3.5	CONTRACTOR OF CONTRACTOR
Misc	DO 2
chrillow Buzzer	P0.3
Crystal (11.0592Mhz)	Pin 18 and 19
Reset Switch	Pin 9

Header file : P89V51RD2.h
IDE used : ARM keil microvision
for burning : Flash Magic

#### <u>C program</u>

/\*
This project is created by yash vinayvanshi 19BCS081 on
march 7, 2022

This code is designed to be tested on keil microvision debugger

onboa S1 3.2 MSB	ard S2 3.3	S3 3.4	S4 3.5 LSB	L1 3.0 MSB	L2 3.1	L3 3.2	L4 3.3 LSB
debug 7 3.7 L4	gging 6 3.6 L3	tool 5 3.5 54	4 3.4 53	3 3.3 52	2 3.2 51	1 3.1 L2	0 3.0 L1
		S4 LSB	<b>S</b> 3	52	S1 MSB		
L4 LSB	L3					L2	L1 MSB

= 4bit (on board) 0 0 1 1 1 0 = 4bit (on debugger) on board 0 0 0 0 0 1 0 0 0 1 0 1 0 0 2 1 1 0 3 0 0 0 1 4 0 ÷ . . . 1 1 1 15 1 on debgger 1 1 1 1 0 0 1 1 1 1 1 0 1 1 2 0 0 1 1 3 1 1 0 1 4 ÷ . . . 0 0 15 0 0 N bit counter : 0..2<sup>n</sup> - 1 counter 0 0 0 -> 0 bit counter 0..0 0 0 1 -> 1 bit counter 0..1 0 1 0 -> 2 bit counter 0..3 0 1 1 -> 3 bit counter 0..7 1 0 0 -> 4 bit counter 0..15 ---not possible ahead with 4 LEDS--so if pressed value > 4, it'll reamin a 4 bit counter 1 0 1 -> 5 bit counter 0..32 1 1 0 -> 6 bit counter 0..63 1 1 1 -> 7 bit counter 0..127 \*/ #include<P89V51RD2.h> void delay(unsigned int dela){ unsigned int i,j; for(i=0;i<1000;i++) {</pre> for(j=0; j<dela; j++);</pre> } } /\* sw1 : P3.2 INT0 sw2 : P3.3 INT1 sw3 : P3.4 T0 sw4 : P3.5 T1 D1 : P3.0 RxD : P3.1 TxD D2 : P3.6 WR D3 D4 : P3.7 RD \*/ void main(void){ unsigned int dela = 500; while(1){ unsigned int count=1, bits=0, i=0, j=0; **if**(INT1 == **0**) bits+=4; **if**(T0 == 0) bits+=2;

**if**(T1 == **0**) bits+=**1**;

#### 14 MARCH 2022

```
if(bits > 4) bits=4;
for(i=0; i<bits; i++) count*=2;
for(; j<count; j++){
    unsigned int d = count - j - 1;
    RD = d%2;
    d = d/2;
    WR = d%2;//Extracting bits from 4 bit bin no.
    d =d/2;
    TxD = d%2;
    d=d/2;
    RxD = d%2;
    delay(dela);
  }
}
```

 $\mathsf{NOTE}$  : with three switches we can input a count upto 7, but we have only four LEDS, so any input above 4 is taken as 4

#### **Output :**

}

counter based on first Three switches as input is achieved.

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SUBMITTED TO : DR. WASEEM AHMAD PROFESSOR DEPARTMENT OF COMPUTER ENGINEERING JAMIA MILLIA ISLAMIA FET, NEW DELHI

#### ES lab 6 : Design and implement an Embedded System that interfaces an 8051 Board by taking input from switch and then completes its cycle (in reverse order) with a buzzer.

#### <u>Hardware</u>

<u>Microprocessor used</u> : NXP (founded by Philips) P89V51RD2 <u>Microprocessor specifications :</u> 40MHz, 5 Volt 8051-based Microcontroller with 32 I/O lines, 3 Timers/ Counters, 9 Interrupts/4 priority levels, 64K+8K FLASH, 1K on-chip RAM, SPI, Dual Data Pointers, WDT, 5-channel PCA.

#### Development board used : Thinklabs iboard 8051

#### <u>Development board specifications :</u>

Includes Philips 89V51RD2 Microcontroller with 64kB flash memory working at 11.0592MHz. 40 pin IC base for compatible PDIP microcontroller packages. Wide operating voltages 7V–15V. Power indicator LED. Buzzer. On board 2 Dual full H bridge motor driver with 600mA per channel for 2 Stepper or 4 DC/DC Geared motors. Separate ON/OFF switch for power and motor enable. 4 LEDs for status or debugging purposes. 4 Pushbutton switches for external inputs/interrupts. On board LCD connector. On board supply terminals for 6V Servo Motors. On board regulated power supply.

#### <u>Microprocessor PIN diagram</u>



Power Jack	External Motor Con	nectors		Motor Connectors	PORTS
	Power			M4	P2.6, P2.7
Motor		A REAL PROPERTY AND A REAL		M3	P2.4, P2.5
Enable	BR BBBBB	() () () ()		M2	P1.6, P1.7
				M1	P1.4, P1.5
				Switches	(active low)
ON-OFF				Swl	P3.2
Switch		C		Sw2	P3.3
Pewer Co	ntrast 200			Sw3	P3.4
LCD		Contraction of the		Sw4	P3.5
Connector	正式馬克里島! 0 .	EWONE BUILT		LEDs	(active low)
	6 - C - ' *	WASHING		D1	P3.0
	iBo	aru 8051		D2	P3.1
		RESES AN		D3	P3.6
5 V Voltage		J/O Suppl		D4	P3.7
Regulator	P89V51RD2	6 Selection		LCD	
		ONIC		Data	P0.4 to P0.7
E		GV Serve		Control pins	P0.0 to P0.2
	C	Supply		1SP	
11-54	22 2 0 0	Power Input		RXD	P3.0
				TXD	P3.1
· · # St	VI SW2 SW3 SW40 D1 D2	0 D3 0 D4		Sensor Connectors	
	D	D LOSISW Resel		P1.0 to P1.7	
		D III B BUILD		P2.0 to P2.7	-
477	Annand,			P3.2 to P3.5	-
TIC		Contraction of the second s		Misc	DO 2
Programmer	Vec		Active	.ow Buzzer	P0.3
Connector	June I/O Pins			Crystal (11.0592Mhz)	Pin 18 and 1
6	PI			Reset Switch	Pin 9

Header file : P89V51RD2.h
IDE used : ARM keil microvision
for burning : Flash Magic

#### <u>C program</u>

/\*

This project is created by yash vinayvanshi 19BCS081 on march 21, 2022

This code is designed to be tested on keil microvision debugger

Page 2 of 4

onbo S1 3.2 MSB	ard S2 3.3	S3 3.4	S4 3.5 LSB	L1 3.0 MSB	L2 3.1	L3 3.2	L4 3.3 LSB
debu 7 3.7 L4	gging 6 3.6 L3	tool 5 3.5 S4	4 3.4 S3	3 3.3 52	2 3.2 S1	1 3.1 L2	0 3.0 L1
		S4 LSB	<b>S</b> 3	S2	S1 MSB		
L4 LSB	L3					L2	L1 MSB

YASH VINAYVANSHI

pressed 4 **S**4 S2 S3 S1 Х 1 0 0 = 4 (on board) fact1 -> switches gets reversed & inverted on debugger **S**4 **S**3 S2 S1 (reverse) 0 0 1 Х 1 1 0 Х (invert) = 4(on debugger)pressed 3 S1 S2 S3 S4 (on board) Х 0 1 1 p3.5 p3.4 p3.3 p3.1 (on debugger) S4 S3 S2 S1 X (reverse) 1 1 0 0 0 1 X (invert)

4bi	t ct	r boa	ard			4 bi	t ct	r on	debug	ger			
					(rev	erse	)		(i	nver	t)		
D1	D2	D3	D4		D4	D3	D2	D1	D4	D3	D2	D1	L
0	0	0	0	(0)	0	0	0	0	1	1	1	1	(15)
0	0	0	1	(1)	1	0	0	0	0	1	1	1	(14)
0	0	1	0	(2)	0	1	0	0	1	0	1	1	(13)
0	0	1	1	(3)	1	1	0	0	0	0	1	1	(12)
0	1	0	0		0	0	1	0	1	1	0	1	
0	1	0	1		1	0	1	0	0	1	0	1	
0	1	1	0		0	1	1	0	1	0	0	1	
0	1	1	1	(7)	1	1	1	0	0	0	0	1	
•													
•									•				
•					•								
1	1	1	1	(15)	1	1	1	1	0	0	0	0	(0)

N bit counter : 0..2<sup>n</sup> - 1 counter

```
0 0 0 -> 0 bit counter 0..0
 0 0 1 -> 1 bit counter 0..1
 0 1 0 -> 2 bit counter 0..3
 0 1 1 -> 3 bit counter 0..7
 1 0 0 -> 4 bit counter 0..15
 ---not possible ahead with 4 LEDS---
 so if pressed value > 4, it'll remain to begin as a 4 bit counter
 1 0 1 -> 5 bit counter 0..32
 1 1 0 -> 6 bit counter 0..63
 1 1 1 -> 7 bit counter 0..127
*/
#include<P89V51RD2.h>
sbit buzz = P0^3:
void delay(unsigned int dela){
    unsigned int i,j;
    for(i=0;i<1000;i++) {</pre>
```

```
for(j=0; j<dela; j++);</pre>
    }
}
/*
 sw1 : P3.2 INT0
 sw2 : P3.3 INT1
 sw3 : P3.4 T0
 sw4 : P3.5 T1
 D1 : P3.0 RxD
D2 : P3.1 TxD
D3 : P3.6 WR
D4
    : P3.7 RD
*/
void main(void){
    unsigned int dela = 500;
    while(1){
        unsigned int count=1, bits=0, i=0, j=0, k=0;
        //sw1(MSB) don't care as 3 switches to be used
        if(INT1 == 0) bits+=4;
        if(T0 == 0) bits+=2;
        if(T1 == 0) bits+=1;
        if(bits > 4) bits=4;
        //bit to mod conversion
        for(i=0; i<bits; i++) count*=2;</pre>
        while(count != 0){
            j = 0;
            for(; j<count; j++){</pre>
                 //down count
                 unsigned int d = count - j - 1;
                 RD = d^2;
                 d = d/2;
                WR = d%2;//Extracting bits from 4 bit bin no.
                 d = d/2;
                 TxD = d%2;
                 d=d/2;
                 RxD = d%2;
                 delay(dela);
            }
            //to reduce counter
            count = count/2;
            buzz = 0;
            delay(dela);
            buzz = 1:
        }
    }
}
```

NOTE : with three switches we can input a count upto 7, but we have only four LEDS, so any input from switches above 4 is taken as 4

#### **Output** :

Embedded System to receive input from 3 switches and then complete its cycle (in reverse order) with a buzzer beep in between each counter cycle is implemented.

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## ES lab 7 : To design and implement an Embedded System that displays the roll no and name on LCD screen using 8051 microcontroller.

#### <u>Hardware</u>

<u>Microprocessor used</u> : NXP (founded by Philips) P89V51RD2 <u>Microprocessor specifications :</u>

40MHz, 5 Volt 8051-based Microcontroller with 32 I/O lines, 3 Timers/ Counters, 9 Interrupts/4 priority levels, 64K+8K FLASH, 1K on-chip RAM, SPI, Dual Data Pointers, WDT, 5-channel PCA.

## Development board used : Thinklabs iboard 8051 Development board specifications :

Includes Philips 89V51RD2 Microcontroller with 64kB flash memory working at 11.0592MHz. 40 pin IC base for compatible PDIP microcontroller packages. Wide operating voltages 7V–15V. Power indicator LED. Buzzer. On board 2 Dual full H bridge motor driver with 600mA per channel for 2 Stepper or 4 DC/DC Geared motors. Separate ON/OFF switch for power and motor enable. 4 LEDs for status or debugging purposes. 4 Pushbutton switches for external inputs/interrupts. On board LCD connector. On board supply terminals for 6V Servo Motors. On board regulated power supply.

#### Microprocessor PIN diagram



Power Jack	External Power Motor C	Connectors
Motor Enable		(00000)
ON-OFF Switch		
LCD Connector		REAL ROSS
5 V Voltage Regulator	P89V51RD2	State
Toom And		abiliti o o Supply Power Impt
25. 25.	IIIO I I Sensor D Rozan	alors I/O3/Sw Refel
Programmer	qua Vo Pins	

175	Motor Connectors	PORTS
Da.	M4	P2.6, P2.7
	M3	P2.4, P2.5
	M2	P1.6, P1.7
	M1	P1.4, P1.5
- 65	Switches	(active low)
24 m)	Swl	P3.2
	Sw2	P3.3
	Sw3	P3.4
	Sw4	P3.5
82	LEDs	(active low)
RUS.	D1	P3.0
	D2	P3.1
	D3	P3.6
	D4	P3.7
13	LCD	
6.6	Data	P0.4 to P0.7
	Control pins	P0.0 to P0.2
55	ISP	S. F. Lawrence and Street
81.5	RXD	P3.0
	TXD	P3.1
國	Sensor Connectors	
Local Statement	P1.0 to P1.7	
	P2.0 to P2.7	-
1007	P3.2 to P3.5	-
A State	Misc	a superior and the
in Lou	J Buzzer	P0.3
(	Crystal (11.0592Mhz)	Pin 18 and 19
	Reset Switch	Pin 9

Header file : lcd.h for P89V51RX2
IDE used : ARM keil microvision
for burning : Flash Magic

```
<u>C program</u>
```

```
11
// led.c
// Created by YASH VINAYVANSHI on 28/03/22.
11
//#include <P89V51RX2.h>
#include <lcd.h>
void main(){
   LCD_INIT();
   LCD_WRITE("YASH VINAYV.", 0, 0);
   LCD_WRITE("19BCS081", 1, 0);
   while(1);
}
Output :
On display board
     0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
col
line 0 Y A S H V I N A Y V.
     1 1 9 B C S 0 8
                           1
```

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# ES lab 8 : Design and implement an Embedded System that displays the factorial of a number (input through switch) on LCD screen using 8051 microcontroller.

#### <u>Hardware</u>

<u>Microprocessor used</u> : NXP (founded by Philips) P89V51RD2 <u>Microprocessor specifications :</u> 40MHz, 5 Volt 8051-based Microcontroller with 32 I/O lines, 3 Timers/ Counters, 9 Interrupts/4 priority levels, 64K+8K FLASH, 1K on-chip RAM, SPI, Dual Data Pointers, WDT, 5-channel PCA.

#### Development board used : Thinklabs iboard 8051

#### <u>Development board specifications :</u>

Includes Philips 89V51RD2 Microcontroller with 64kB flash memory working at 11.0592MHz. 40 pin IC base for compatible PDIP microcontroller packages. Wide operating voltages 7V–15V. Power indicator LED. Buzzer. On board 2 Dual full H bridge motor driver with 600mA per channel for 2 Stepper or 4 DC/DC Geared motors. Separate ON/OFF switch for power and motor enable. 4 LEDs for status or debugging purposes. 4 Pushbutton switches for external inputs/interrupts. On board LCD connector. On board supply terminals for 6V Servo Motors. On board regulated power supply.

#### <u>Microprocessor PIN diagram</u>





Motor Connectors	PORTS
M4	P2.6, P2.7
M3	P2.4, P2.5
M2	P1.6, P1.7
M1	P1.4, P1.5
Switches	(active low)
Sw1	P3.2
Sw2	P3.3
Sw3	P3.4
Sw4	P3.5
LEDs	(active low)
D1	P3.0
D2	P3.1
D3	P3.6
D4	P3.7
LCD	
Data	P0.4 to P0.7
Control pins	P0.0 to P0.2
ISP	
RXD	P3.0
TXD	P3.1
Sensor Connectors	
P1.0 to P1.7	
P2.0 to P2.7	-
P3.2 to P3.5	
Misc	and the second second
I low Buzzer	P0.3
Crystal (11.0592Mhz)	Pin 18 and 19
Reset Switch	Pin 9

Header file : lcd.h for P89V51RX2
IDE used : ARM keil microvision
for burning : Flash Magic

```
<u>C program</u>
11
11
    main.c
11
    switch factorial
11
    Created by YASH VINAYVANSHI on 11/04/22.
11
11
    0! = 1
11
       1! = 1
//
    2! = 2
11
       3! = 6
11
11
       4! = 24
       5! = 120
11
//
11
    14! = 87178291200
    15! = 1307674368000 (13 digits : display capacity in a line = 16
11
digits)
//
```

```
18 APRIL 2022
```

```
#include <lcd.h>
void main(){
    while(1){
        unsigned long fact=1;
        unsigned int num = 0;
                      unsigned int i = 0;
                 char factorial[16];
        unsigned int index = 0;
        unsigned int length = 0;
                 char number[3];
                      char temp:
        if(INT0 == 1) num+=8;
        if(INT1 == 1) num+=4;
        if(T0 == 1) num+=2;
        if(T1 == 1) num+=1;
        //if(num > 12) num=12;
        if(num > 0){
            for(i=1; i<=num; i++){</pre>
                 fact*=i;
            }
        }
        //convert factorial value to string
        while(fact != 0){
             factorial[index] = (char)(fact%10+48);
            fact = fact / 10;
            length++;
            index++;
        }
        factorial[index] = '\0';
        //reverse string
        for(i=0; i<length/2; i++){</pre>
            char temp = factorial[i];
            factorial[i] = factorial[length-i-1];
            factorial[length-i-1] = temp;
        }
        index = 0;
        length = 0;
        //convert number value to string
        while(num != 0){
            number[index] = (char)(num%10+48);
            num = num / 10;
            length++;
            index++;
        }
        number[index] = ' \\ 0';
        //reverse string
        for(i=0; i<length/2; i++){</pre>
             temp = number[i];
            number[i] = number[length-i-1];
            number[length-i-1] = temp;
        }
        LCD_INIT();
```

```
18 APRIL 2022
        LCD_WRITE(number, 0, 0);
        LCD_WRITE(factorial, 1, 0);
        delay(100000); //abt 10sec delay if T = 1microsec
    }
}
```

#### **Output**

The system takes as input a number between 0 and 15 in binary through 4 switches and displays the factorial of input number on the LED screen.

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SUBMITTED TO : DR. WASEEM AHMAD PROFESSOR DEPARTMENT OF COMPUTER ENGINEERING JAMIA MILLIA ISLAMIA FET, NEW DELHI

#### ES lab 9 : Design and implement an Embedded System that outputs factor of a number (input through switch) on LED with buzzer, in between every factor using 8051 Board.

#### <u>Hardware</u>

<u>Microprocessor used</u> : NXP (founded by Philips) P89V51RD2 <u>Microprocessor specifications :</u>

40MHz, 5 Volt 8051-based Microcontroller with 32 I/O lines, 3 Timers/ Counters, 9 Interrupts/4 priority levels, 64K+8K FLASH, 1K on-chip RAM, SPI, Dual Data Pointers, WDT, 5-channel PCA.

#### Development board used : Thinklabs iboard 8051

#### <u>Development board specifications :</u>

Includes Philips 89V51RD2 Microcontroller with 64kB flash memory working at 11.0592MHz. 40 pin IC base for compatible PDIP microcontroller packages. Wide operating voltages 7V–15V. Power indicator LED. Buzzer. On board 2 Dual full H bridge motor driver with 600mA per channel for 2 Stepper or 4 DC/DC Geared motors. Separate ON/OFF switch for power and motor enable. 4 LEDs for status or debugging purposes. 4 Pushbutton switches for external inputs/interrupts. On board LCD connector. On board supply terminals for 6V Servo Motors. On board regulated power supply.

#### <u>Microprocessor PIN diagram</u>



Power Jack External Motor Connectors	Motor Connectors	PORTS
1 Innu	M4	P2.6, P2.7
Motor	M3	P2.4, P2.5
Enable	M2	P1.6, P1.7
	M1	P1.4, P1.5
Contention a l'annual annual annual	Switches	(active low)
ON-OFF	Swl	P3.2
Switch CHHID-D	Sw2	P3.3
Hower Contrast	Sw3	P3.4
LCD CALINATION AND CALINATION DATE	Sw4	P3.5
Connector	LEDs	(active low)
WASHING	D1	P3.0
iBoard 8051	D2	P3.1
	D3	P3.6
5 V Voltage	D4	P3.7
Regulator P89V51RD2 Switch	LCD	
0	Data	P0.4 to P0.7
G C GV Serve	Control pins	P0.0 to P0.2
20 c-(lise-) www.thatklab	ISP	E. P. L. P. Land M. L. Land
Power Int	RXD	P3.0
	TXD	P3.1
HID1/Sensor	Sensor Connectors	
D HOSISW OF Ran	P1.0 to P1.7	
A an a second a secon	P2.0 to P2.7	-
Aller Frank, Franklin, State	P3.2 to P3.5	CONTRACTOR STATES
	Buzzer	P0 3
Programmer VCC	Active Low Buzzer	Pin 18 and 19
Connector Connector	Peret Switch	Pin 0
PI	Reset Switch	1 11 3

Header file : lcd.h for P89V51RX2
IDE used : ARM keil microvision
for burning : Flash Magic

#### <u>C program</u>

/\*
This project is created by yash vinayvanshi 19BCS081 on 18/04/22.
This code is designed to be tested on keil microvision debugger

onboa S1 3.2 MSB	ard S2 3.3	S3 3.4	S4 3.5 LSB	L1 3.0 MSB	L2 3.1	L3 3.2	L4 3.3 LSB
debug 7 3.7 L4	gging 6 3.6 L3	tool 5 3.5 S4	4 3.4 S3	3 3.3 52	2 3.2 51	1 3.1 L2	0 3.0 L1
		S4 LSB	S3	S2	S1 MSB		

21 APRIL 2022

D4 LSB	D3					D2	D1 MSB
presse	ed 4						
	S1	S2	S3	S4			
	Х	1	0	0	= 4	(or	n board)
fact1	-> SI	witche	es get	ts r	reversed	&	inverted on debugger
	S4	<b>S</b> 3	S2	S1	(rev	ers	se)
	0	0	1	Х			
	1	1	0	Х	(inv	ert	t) = 4(on debugger)
presse	ed 12						
	S1	S2	S3	S4	(	on	board)
	1	1	0	0			· · · · · ·
	p3.5	p3.4	p3.3	p3.	1 (	on	debugger)
	S4	S3	S2	S1			
	0	0	1	1	(revers	e)	
	1	1	0	0	(invert	:)	

4bit ctr board					(rev	4 bi	t ct	r on	debu	gger inver	-+)			
D1 0 0 0 0 0 0 0	D2 0 0 1 1 1 1	D3 0 1 1 0 0 1 1	D4 0 1 0 1 0 1 0	(0) (1) (2) (3)		D4 0 1 0 1 0 1 0 1 0	D3 0 0 1 1 0 0 1 1	D2 0 0 0 1 1 1 1	D1 0 0 0 0 0 0 0	D4 1 0 1 0 1 0 1 0	D3 1 1 0 0 1 1 0 0	D2 1 1 1 0 0 0	D1 1 (15 1 (14 1 (13 1 (12 1 1 1 1	) ) ))
1	1	0	0	(12)		0	0	1	1	1	1	0	0	
1 exa	1 mple	1	1	(15)		1	1	1	1	0	0	0	0 (0)	
inp	ut:	0	1 0	1	(1	2)								
out	put	: 0	1 1	1	(1	)								
		1 be	ер 1 0 ер	0	(1	2)								
		be 1 he	ep 0 1 en	1	(2	)								
		1 be	00 ep	1	(6	)								
		be Ø be	ep 0 1 ep	1	(3	)								

```
21 APRIL 2022
         1 1 0 1
                     (4)
         beep
         beep
         0100
                       (4)
         beep
         0011
                       (3)
*/
/*
 sw1 : P3.2 INT0
 sw2 : P3.3 INT1
 sw3 : P3.4 T0
 sw4 : P3.5 T1
 D1 : P3.0 RxD
 D2 : P3.1 TxD
 D3 : P3.6 WR
 D4 : P3.7 RD
*/
#include<P89V51RD2.h>
sbit buzz = P0^3;
unsigned int dela = 1000;
void delay(unsigned int dela){
    unsigned int i,j;
    for(i=0;i<1000;i++) {</pre>
           for(j=0; j<dela; j++);</pre>
    }
}
void print_number(unsigned int n){
    unsigned int d = 15 - n;
    RD = d^2;
    d = d/2;
    WR = d%2;//Extracting bits from 4 bit bin no.
    d = d/2;
    TxD = d%2;
    d=d/2;
    RxD = d%2;
    delay(dela);
}
void main(void){
    while(1){
        unsigned int number=0, i=0;
        if(INT0 == 0) number+=8;
        if(INT1 == 0) number+=4;
        if(T0 == 0) number+=2;
        if(T1 == 0) number+=1;
        //find factors
        for(i=1; i<=number; i++){</pre>
            if(number%i == 0){
                //display factor 1
                print_number(i);
                //buzzer beeps
                buzz = 0; delay(dela); buzz = 1;
                //dipslay factor 1's pair
                print_number(number/i);
            }
            //one pair shown : buzzer beep beep
                                 Page 4 of 5
```

```
buzz = 0; delay(dela); buzz = 1;
buzz = 0; delay(dela); buzz = 1;
}
}
```

#### <u>Output</u>

The system takes as input a number between 0 and 15 through switches on board and shows its factor pairs in binary on LEDs on board with one beep between numbers and two beeps between pairs.

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# ES lab 10 : Design and implement an Embedded System that toggle only pin P 1.5 continuously every 250ms using 8051 board. Take crystal frequency=11.0592 MHz. 1. Using timer 0, mode 1

2. Using timer 1, mode 2

#### <u>Hardware</u>

Microprocessor used : NXP (founded by Philips) P89V51RD2

<u>Microprocessor specifications :</u>

40MHz, 5 Volt 8051-based Microcontroller with 32 I/O lines, 3 Timers/ Counters, 9 Interrupts/4 priority levels, 64K+8K FLASH, 1K on-chip RAM, SPI, Dual Data Pointers, WDT, 5-channel PCA.

## Development board used : Thinklabs iboard 8051 Development board specifications :

Includes Philips 89V51RD2 Microcontroller with 64kB flash memory working at 11.0592MHz. 40 pin IC base for compatible PDIP microcontroller packages. Wide operating voltages 7V–15V. Power indicator LED. Buzzer. On board 2 Dual full H bridge motor driver with 600mA per channel for 2 Stepper or 4 DC/DC Geared motors. Separate ON/OFF switch for power and motor enable. 4 LEDs for status or debugging purposes. 4 Pushbutton switches for external inputs/interrupts. On board LCD connector. On board supply terminals for 6V Servo Motors. On board regulated power supply.

#### Microprocessor PIN diagram





Motor Connectors	PORTS				
M4	P2.6, P2.7				
M3	P2.4, P2.5				
M2	P1.6, P1.7				
M1	P1.4, P1.5				
Switches	(active low)				
Swl	P3.2				
Sw2	P3.3				
Sw3	P3.4				
Sw4	P3.5				
LEDS	(active low)				
D1	P3.0				
D2	P3.1				
D3	P3.6				
D4	P3.7				
LCD					
Data	P0.4 to P0.7				
Control pins	P0.0 to P0.2				
ISP					
RXD	P3.0				
TXD	P3.1				
Sensor Connectors					
P1.0 to P1.7					
P2.0 to P2.7	**				
P3.2 to P3.5	wanter second design and				
Misc	a constant and a second se				
Low Buzzer	P0.3				
Crystal (11.0592Mhz)	Pin 18 and 19				
Reset Switch	Pin 9				

1

Header file : P89V51RD2.h for P89V51RD2 **IDE used** : ARM keil microvision **for burning** : Flash Magic

#### <u>C program</u>

/\* This project is created by yash vinayvanshi 19BCS081 on 18/04/22. \*/

/\* TMOD

```
GATE C/T M0
                                         M1 GATE C/T M1
                                                          M0
T0M1(16 bit)
                            0
                                 0
                                      0
                                          0
                                              0
                                                  0
                                                       0
 T1M2(8bit auto reload)
                            0
                                 0
                                      1
                                          0
                                              0
                                                   0
                                                       0
                                                           0
*/
#include<P89V51RD2.h>
sbit Tpin = P1^5;
void T0M1Delay(void);
void T1M2Delay(void);
void main(void){
    unsigned char i, j, k;
    //run this loop for 5 sec : 20*250ms = 5 sec
    for(k=0; k<20; k++){
        Tpin = !Tpin;
```

```
01 MAY 2022
        for(i=0; i<5; i++){</pre>
             T0M1Delay();
          }
    }
    CEX3 = !CEX3;
    //run this loop for 5 sec : 20*250ms = 5 sec
               for(k=0; k<20; k++){
        Tpin = !Tpin;
         for(i=0; i<10; i++){</pre>
             for(j=0; j<100; j++){</pre>
                 T1M2Delay();
             }
        }
    }
               while(1);
}
void T0M1Delay(void){
    /*
     Max Delay generated = 65536 * 1.085us = 71106.56us
     To generate 250ms, loop = 250ms/71.1065us ~3.5
     round off non negligible
     Generate delay in chunks 50us
     for 50ms : 50ms/1.085us-1 = 46082 = 4BFDH
     FFFFH - 4BFDH = B402H
     */
    TMOD = 0 \times 01;
    TL0 = 0 \times 02;
    TH0 = 0 \times B4;
    TR0 = 1; //start timer
    while(TF0==0);
    TR0 = 0;
    TF0 = 0;
}
void T1M2Delay(void){
    /*
                Generate delay in chunks of 250us
     Delay generated = 250/1.085us = 230;
     to generate 250 ms, loop = 250 \text{ms}/250 \text{us} \sim 1000 \text{times}
     Assuming 8 bit registers, they can hold value upto 256
           DELAY for instructions and for loop not taken into
consideration
     */
    TMOD = 0 \times 20; //00100000B = 32D = 20H
    TH1 = 0 \times 1A; //256 - 230 = 26D = 1AH
    TR1 = 1; //start timer
    while(TF1==0); //run timer until overflow
    TR1 = 0; //reinit timer
    TF1 = 0;
}
```

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Pin P1.5 toggles at every 250ms for 5 seconds using timer 0 mode 1 and then again toggles at every 250 ms for 5 seconds using timer 1 mode 2. Pin1.6 is high when timer 0 is employed for toggling and low when timer 1 is employed for toggling.