

Embedded Systems

ECE 4010

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8051 PROGRAMMING IN C

8051 PROGRAMMING IN C – Time Delay (Software)

Write an 8051 C program to toggle bits of P1 continuously forever with some delay.

```
#include <reg51.h>
void main(void){
unsigned int x;
for (;;)                //repeat forever
{
p1=0x55;
for (x=0;x<40000;x++); //delay size unknown
p1=0xAA;
for (x=0;x<40000;x++);
}}
```

We must use the oscilloscope to measure the exact duration

8051 PROGRAMMING IN C – Time Delay (Software)

Write an 8051 C program to toggle bits of P1 ports continuously with a 100 ms.
Crystal Frequency = 12Mhz, 8051 – 1 instruction cycle = 12 clock cycles

```
#include <reg51.h>
void MSDelay(unsigned int);
void main(void)
{
    while (1)
    {
        p1=0x55;
        MSDelay(100);
        p1=0xAA;
        MSDelay(100);
    }
}
```

```
void MSDelay(unsigned int
itime)
{
    unsigned int i,j;
    for (i=0;i<itime;i++)
    for (j=0;j<Number;j++);
}
```

8051 PROGRAMMING IN C – Time Delay (Software)

Write an 8051 C program to toggle bits of P1 ports continuously with a 100 ms.
Crystal Frequency = 12Mhz, 8051 – 1 instruction cycle = 12 clock cycles

Time for 1 Instruction
Cycle = $12 / 12 \text{ Mhz} = 1\mu\text{s}$

$Y * 1\mu\text{s} = 100 \text{ ms}$

$Y = 100 \text{ ms} / 1\mu\text{s}$

$Y = 10000$

```
void MSDelay(unsigned int
itime)
{
    unsigned int i,j;
    for (i=0;i<itime;i++)
    for (j=0;j<Number;j++);
}
```

8051 PROGRAMMING IN C – Time Delay (Software)

Write an 8051 C program to toggle bits of P1 ports continuously with a 100 ms.
Crystal Frequency = 12Mhz, 8051 – 1 instruction cycle = 12 clock cycles

```
#include <reg51.h>
void MSDelay(unsigned int);
void main(void)
{
    while (1)
    {
        p1=0x55;
        MSDelay(100);
        p1=0xAA;
        MSDelay(100);
    }
}
```

```
void MSDelay(unsigned int
itime)
{
    unsigned int i,j;
    for (i=0;i<itime;i++)
    for (j=0;j<1000;j++);
}
```

8051 PROGRAMMING IN C – Time Delay (Software)

Write an 8051 C program to toggle bits of P1 ports continuously with a 20 ms.
Crystal Frequency = **11.0592 Mhz**, 8051 – 1 instruction cycle = 12 clock cycles

```
#include <reg51.h>
void MSDelay(unsigned int);
void main(void)
{
    while (1)
    {
        p1=0x55;
        MSDelay(100);
        p1=0xAA;
        MSDelay(100);
    }
}
```

```
void MSDelay(unsigned int
itime)
{
    unsigned int i,j;
    for (i=0;i<itime;i++)
    for (j=0;j<Number;j++);
}
```

8051 PROGRAMMING IN C – Input Output Ports

Write an 8051 C program to get a byte of data form P1, wait 1/2 second, and then send it to P2.

```
#include <reg51.h>
void MSDelay(unsigned int);
void main(void)
{
    ----- Logic-----
}
```

```
-----Logic-----
unsigned char mybyte;
P1=0xFF;           //make P1 input port
while (1)
{
    mybyte=P1;      //get a byte from P1
    MSDelay(500);
    P2=mybyte;      //send it to P2
}
```


8051 PROGRAMMING IN C – Bit Addressing

Write an 8051 C program to toggle only bit P2.4 continuously without disturbing the rest of the bits of P2.

```
#include <reg51.h>
sbit mybit=P2^4;

void main(void){
while (1){
mybit=1;
mybit=0;
}}
```

Ports P0 – P3 are bit- addressable and we use *sbit* data type to access a single bit of P0 - P3

Use the **Px^y** format, where x is the port 0, 1, 2, or 3 and y is the bit 0 – 7 of that port

8051 PROGRAMMING IN C – Bit Addressing + Delay (Software)

Write an 8051 C program to toggle only bit P2.4 every 100ms without disturbing the rest of the bits of P2.

Crystal Frequency = 12Mhz, 8051 – 1 instruction cycle = 12 clock cycles

```
#include <reg51.h>
sbit mybit=P2^4;
void MSDelay(unsigned int);

void main(){
while (1){
mybit= ~mybit;
MSDelay(100);
}}
```

```
void MSDelay(unsigned int
itime)
{
unsigned int i,j;
for (i=0;i<itime;i++)
for (j=0;j<1000;j++);
}
```

8051 PROGRAMMING IN C –Delay (Hardware)

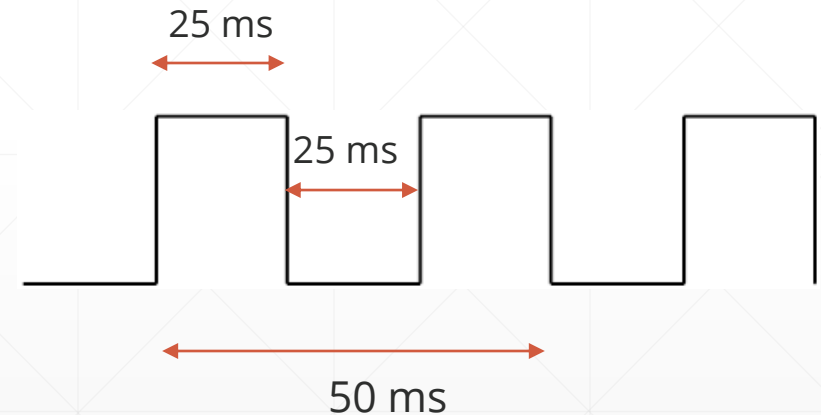
Write an 8051 C program to generate frequency of 20Hz on Pin P2.4
Crystal Frequency = 11.0592Mhz, 8051 – 1 instruction cycle = 12 clock cycles

Frequency = 20Hz, Time = $1/20 = 50\text{ms}$
Time = 50ms = 25ms (ON) + 25ms (OFF)

Delay of 25 ms

Timer 0, Mode 1

(Use 8051 hardware ref manual for registers)



8051 PROGRAMMING IN C –Delay (Hardware)

Write an 8051 C program to generate frequency of 20Hz on Pin P2.4
Crystal Frequency = 11.0592Mhz, 8051 – 1 instruction cycle = 12 clock cycles

Delay of 25 ms

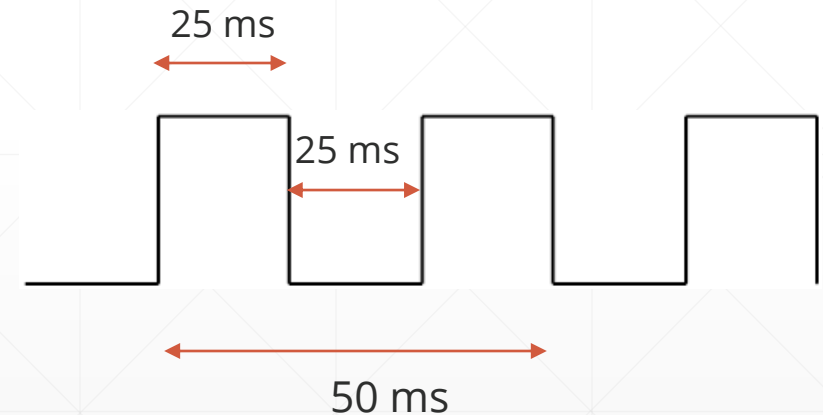
Timer 0, Mode 1

TMOD – Set timer/counter + mode

TCON – TR0, TF0

TR0 – Start timer

TF0 – Timer overflow



8051 PROGRAMMING IN C –Delay (Hardware)

Write an 8051 C program to generate frequency of 20Hz on Pin P2.4
Crystal Frequency = 11.0592Mhz, 8051 – 1 instruction cycle = 12 clock cycles

```
#include <reg51.h>
sbit mybit = P2^4;
void MSDelay(void);

void main(){
    TMOD = 0x01;
    while(1){
        mybit = ~mybit;
        MSDelay();
    }
}
```

```
void MSDelay()
{
    TL0 = Lower Byte;
    TH0 = Upper Byte;
    TR0 = 1;
    while (TF0 ==0);
    TR0 = 0;
    TF0 = 0;
}
```

8051 PROGRAMMING IN C –Delay (Hardware)

Write an 8051 C program to generate frequency of 20Hz on Pin P2.4
Crystal Frequency = 11.0592MHz, 8051 – 1 instruction cycle = 12 clock cycles

Delay Calculation

XTAL = 11.0592 MHz

Time for 1 instru = $12/11.0592\text{MHz}$

Time for 1 instru = 1.085 μs

Delay of 25ms = $25/1.085 \mu\text{s} = 23037$

Count = $65536 - 23037 = 42499$

42499 = A5D1 (Hex)

TH0 = A5, TL0 = D1

```
void MSDelay()  
{  
    TL0 = D1;  
    TH0 = A5;  
    TR0 = 1;  
    while (TF0 == 0);  
    TR0 = 0;  
    TF0 = 0;  
}
```

8051 PROGRAMMING IN C -Interrupts

- Interrupts are useful in many cases wherein the process simply wants to continue doing its main job and other units(timers or external events) seek its attention when required
- In other words, the microcontroller, need not monitor the timers, the serial communication or the external pins P3.2 and P3.3
- Whenever an event related to these units occur, it is informed to the microcontroller with the help of interrupts

8051 PROGRAMMING IN C -Interrupts

- A single microcontroller can serve several devices by two ways:
- Polling
 - The microcontroller continuously monitors the status of all the devices.
 - Whenever any device needs the service, it provides the service and moves on to the next device until everyone is serviced.
 - This will be done in an infinite loop.
- Interrupts
 - Whenever any device needs its service, the device notifies the microcontroller by sending it an interrupt signal
 - Upon receiving an interrupt signal, the microcontroller interrupts whatever it is doing and serves the device.
 - The program which is associated with the interrupt is called the interrupt service routine (ISR) or interrupt handler