MICROPROCESSOR BASED SYSTEMS

CMP 410

LECTURE 6

https://AssemSite8.wix.com/site8
Timer0 & Timer1

Timer0

TH0

TL0

TF0

Timer1

TH1

TL1

TF1

8 bits

8 bits

bit
Usage of Timer0 & Timer1

定时器0

- **Making delay times** (counting internal machine cycles)
- **Counting** external clock pulses via pins (T0 & T1)

定时器1

- **Adjusting** the generated baud rates for the **serial** communication
Operation modes of Timers

- **Mode 0** (oldest mode - counting up to $2^{13}$)
- **Mode 1** (counting up to $2^{16}$)
- **Mode 2** (counting up to $2^8$ with Reloading)
- **Mode 3** (split mode - counting up to $2^8$)
Important note
The counting value of any timer is measured from the **max** value (not Min value)
Controlling Timer/Counter operations
using the counter/timer bit \((C/T)\)

\[ C/T = 1 \]

\[ C/T = 0 \]

\[ n = 0 \text{ or } 1 \]

Machine cycles

External pulses

Pin \(T_n\)

Internal oscillator

Clock divider \((/12)\)

\(n\)
The structure of Timer1 in Mode1

Mode 1: 16-Bit Timer

<table>
<thead>
<tr>
<th>Timer Mode (TMOD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timer 1</td>
</tr>
<tr>
<td>Timer 0</td>
</tr>
<tr>
<td>Gate</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

‘0’ for stop counting

11/10/2018
The structure of Timer1 in Mode2

Mode 2: 8-Bit Auto-Reload

Timer Mode (TMOD)

<table>
<thead>
<tr>
<th></th>
<th>Timer 1</th>
<th></th>
<th>Timer 0</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate</td>
<td>C/T</td>
<td>M1</td>
<td>M0</td>
<td>Gate</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

‘0’ for stop counting

11/10/2018
- **TF1** ... Overflow flag of timer1 *(maximum value +1).*
- **TR1** ... T1-run *(to start/stop running).*
- **TF0** ... Overflow flag of timer0 *(maximum value +1).*
- **TR0** ... T0-run *(to start/stop running).*
Example of counting external CP

A module designed to count the instantaneous number of cars during enter a park. If the counted number of cars equal **500**, the system **makes alarm** and **closes the gates**. Write assembly code to perform the mentioned task (without interrupt) based on **T0** of AT89C51.

- **The Initial value of Timer 0** = 65536 - 500 = 65036 = **FE0Ch**

<table>
<thead>
<tr>
<th>Timer Mode (TMOD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Timer 1</strong></td>
</tr>
<tr>
<td>Gate</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td><strong>Timer 0</strong></td>
</tr>
<tr>
<td>Gate</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

- **Without interrupt**
- **Counter Oper.**
- **Mode 1**
AT89C51

Sensor → T0 → P0.0 → Controlling start alarm

→ P0.1 → Controlling Open/Close Gates

Sensor
ORG 30h
ALARM EQU P0.0
CLOSE_DOORS EQU P0.1

MOV TMOD, #05H ; Timer 0 as counter in MODE1
MOV TH0, #FEH  ; Loads TH0 register
MOV TL0, #0CH  ; Loads TL0 register
SETB TR0       ; Run the Timer
HERE: JNB TF0, HERE    ; Counting via (T0) until TF0 is set
SETB ALARM
SETB CLOSE_DOORS
CLR TR0        ; Stops Timer 0
CLR TF0        ; Clears TF0 flag
The Serial communications based on 8051
Interfacing between two microcontrollers

Microcontroller 1

Microcontroller 2
Interfacing between microcontroller & digital modules

Module (like GPS, GSM, IMU, SD, GPRS)
Interfacing with Wi-Fi module
Interfacing with USB module

UART- USB converter
Interfacing with **IR Transceiver** module
Interfacing with GSM module

Place Jumper to enable optional PWR ON key for MCU
Optional PWR ON key for MCU
Stat Indication
Power Indication
Network Indication

Power ON switch
SIM900A Module
Power Supply 12V,1A (AC/DC)
Case mounting stud
DTR CTS RTS MIC SPEAKER GND RX TX VIN (9 to 12V DC)

RS232 Serial Port (Female)
SIM900A

Tx Rx

Tx Rx
Interfacing with **GPRS & GPS** module

**GPS** *Global Position System*

**GPRS** *General Packet Radio Services* (internet communication)
Interfacing with **IMU** module

**IMU inertial measurement unit**

*(include: Accelerometers, Gyroscopes and magnetometers)*
The data stream & control of serial port

Any register or memory location

Serial Buffer register (SBUF)

Ti

Baud rate clock Gen.

Serial control and modes

Timer1

TXD

Any register or memory location

Serial Buffer register (SBUF)

Ri

Baud rate clock Gen.

Serial control and modes

Timer1
The serial protocol for sending/receiving (UART) in serial MODE 1

**NOTE:** The LSB is sent & received firstly

UART universal asynchronous receive/transmit
Example

Draw the Bit-stream of the **UART** (Universal Asynchronous Receiver/Transmitter) of MCS-51 in **Mode1**. Also draw the Bit-stream for sending character “A” (41H from ASCII).

![Diagram of UART Bit-stream for Mode 1](image)

![Diagram of sending character A](image)

0100 0001
The UART communication in AT89C51

The LSB is sent & received firstly

For interfacing between the microcontroller and either a computer device or other microcontroller via serial port (TXD & RXD)
8051’s UART interfacing with computer
Via the microchip “MAX-232” or “MAX-233”
See the lecture book

The Half and full duplex
See the lecture book