Lec 6. Time delay

Time delay: it is number of instructions that written to keep a track for certain interval. Time delay or (software delay) can be designed through executing group of instruction number of times

Types of time delay: there are types of time delay as shown below

1. **Time Delay for no loop program**

   Calculation Steps :

   1. calculate the value of one T-STATE by frequency value t= $\frac{1}{f}$
   2. calculate No. of T-state for each instruction
   3. multiply the number of T-state by the value of one pulse

Example: calculate time required for this program to be executed, if the crystal frequency is 1Mhz

```
MVI C 05h
MVI A 04h
ADD C
MOV B A
```

Sol:

instruction	No. of bytes	No of T-state
MVI C 05h	2	7
MVI A 04h	2	7
ADD C	1	4
MOV B A	1	4
	total	22

1. t$- state = \frac{1}{f}$, $t = \frac{1}{1 * 10^6}$ = 1µs
2. no of t-state = 22
3. $t_o = t - state(total) * t$, $t_{total} = 22 * 1$µs = 22µs

Note: Time delay for NOP instruction does nothing but take 4 T-states of processor time to execute

t= 4 ∗ 1µs = 4 µs

2. **Time Delay Using Counter**: Time delay can be created using counting process which means executing number of instructions many times where the initial value of counter required to get specific time delay can be determined. there are two types of delay using counter as below:

   a. **time delay using one register (8-bit counter):** in this type of time delay the register delay is one register loaded with 8-bit number in one loop the interval of any program can be calculated by using the equation below:

$$t_{total} = t_o + t_i$$

Where t_{total} is total time interval. t_o is the out loop instructions time. t_i is in loop instructions time.

$$t_o = t - state(total) * t$$

$$t_i = t - state(total) * t * N_{10}$$

Where N_{10} is the number that loaded in delay register in decimal. t is the processor time clock.

Example: Calculate the time delay to program below, (let the microprocessor frequency is 1MHz)

	MVI C,37	**(delay reg.)**	**$7T_{state}$**
LOOP1	**MVI A, 33**		**$7T_{state}$**
	RAR	**(some ins.)**	**$4T_{state}$**
	DCR C	**(decr. delay reg.)**	**$4T_{state}$**
	JNZ LOOP1	**(condition)**	**$10/7T_{state}$**
	HLT		**$6T_{state}$**

Sol: $t-state = \frac{1}{f}$, $t = \frac{1}{1*10^6}$ = 1μs

$T_t = T_o + T_i$

T_o = [7T_{state} (**MVI C,37**) + 7T_{state} (**JNZ loop1**) + 6T_{state} (**HLT**)]*t

=20 T_{state}*1 μS =20 μS

T_i=[7T_{state} (**MVI A,33**) + 4T_{state} (**RAR**) + 4T_{state} (**DCR C**) + 10T_{state} (**JNZ loop1**)]*t*55

=[25T_{state}]*t*55

=[25 μS]*55=1375 μS

T_t=20 μS+1375 μS=1395 μS =1.395 mS

b. **time delay using register pair**: in this type of time delay the register delay is register pair loaded with 16-bit number in one loop

Example: Calculate the time delay to program below, (let the microprocessor frequency is 1MHz)

	LXI B,234B	**(delay reg.)**	**10T_{state}**
LOOP1	**MVI A, 33**		**7T_{state}**
	RAR	**(some ins.)**	**6T_{state}**
	DCX B	**(decr. delay reg.)**	**4T_{state}**
	MOV A,C		**4T_{state}**
	ORA B		**4T_{state}**
	JNZ LOOP1	**(condition)**	**10/7T_{state}**
	HLT		**6T_{state}**

Sol:

T_o=[10T_{state} (**LXI B,234B**) + 7T_{state} (**JNZ loop**) + 6T_{state} (**HLT**)] = 23 μS

T_i=[7T_{state} (**MVI A,33**) +4T_{state} (**RAR**) + 4T_{state} (**DCX B**) + 4T_{state} (**MOV A,C**) +4T_{state} (**ORA B**) + 10T_{state} (**JNZ loop1**)]*9035 = (33 T_{state})*9035=(33 μS)*9035=298155 μS

T_t=23 μS+298155 μS=298178 μS=298.178ms