

Design Of A Digital Clock

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1 Basic Overview of Design

The digital clock is intended to have two modes. The Mode-1 of clock displays hours and minutes using seven-segment displays with the dot present after minutes display flashing for every second. Mode-2 displays minutes and seconds using seven-segment display. Switching between modes is done by using push-buttons. We will label push-buttons as 1,2,3,4,5 and mode is switched to minutes and seconds display when 1 is kept pressed since there are only two modes. Button-2 is so that when it is kept pressed, we will be able to reset. Button-3 is used to increment the value in hours by 1 and works only in Mode-1. Buttons 4 and 5 are used to increment the value of individual digits of minutes in Mode-1 and those of seconds in Mode-2.

2 Circuits Used in Design

In 24 hours format current time in HH:MM:SS format can be displayed as H1H0:M1M0:S1S0 where

1. $0 \leq H1 \leq 2$
2. $0 \leq H0 \leq 9$
3. $0 \leq M1 \leq 5$
4. $0 \leq M0 \leq 9$
5. $0 \leq S1 \leq 5$
6. $0 \leq S0 \leq 9$

For S0, M0 we can use a synchronous modulo 10 counter or any equivalent implementation. For M1 and S1 we can use synchronous modulo 6 counters or any equivalent implementations.

For displaying hours, we will use a 5-bit modulo 24 counter which counts from 0 upto 23 and then goes to 0 again and a combinational circuit which converts these 5-bit output from counter to two 4 bit inputs with first 4-bits denoting the digit H1 and last 4-bits denoting H0. We will use a combinational circuit to ensure that the four bit output obtained from each counter is converted into the seven input bits for seven-segment display which can be made using Karnaugh maps. We will use T-flipflops to design the modulo counters.

We will use a sequential circuit to switch between the modes and a similar circuit is used to reset the digits. Switching between modes is also ensured by using T-flipflops. The light which displays seconds in Mode-1 flashes at the frequency of 2Hz. The clock corresponding to the S0 display has frequency of 1 Hz and that of S1 has $\frac{1}{10}$ Hz. The clock corresponding to the M0 display has frequency of $\frac{1}{60}$ Hz and that of S1 has $\frac{1}{600}$ Hz. The clock corresponding to hours display has a frequency of $\frac{1}{3600}$ Hz.