# Digital Clock

## Introduction

Creating a digital clock using digital logic involves designing a circuit that can count seconds, minutes, and hours, and then display the time in a digital format, typically using 7-segment displays. In this response, I'll provide a simplified example of a digital clock using a few basic components and a simplified binary-coded decimal (BCD) counter for the seconds, minutes, and hours.

Components needed:

1. Clock source (e.g., a crystal oscillator or a clock signal generator).
2. Counters for seconds, minutes, and hours (Asynchronous counters).
3. 7-segment display for each digit of the time (HH:MM:SS).
4. Logic gates for controlling the display and other functions.

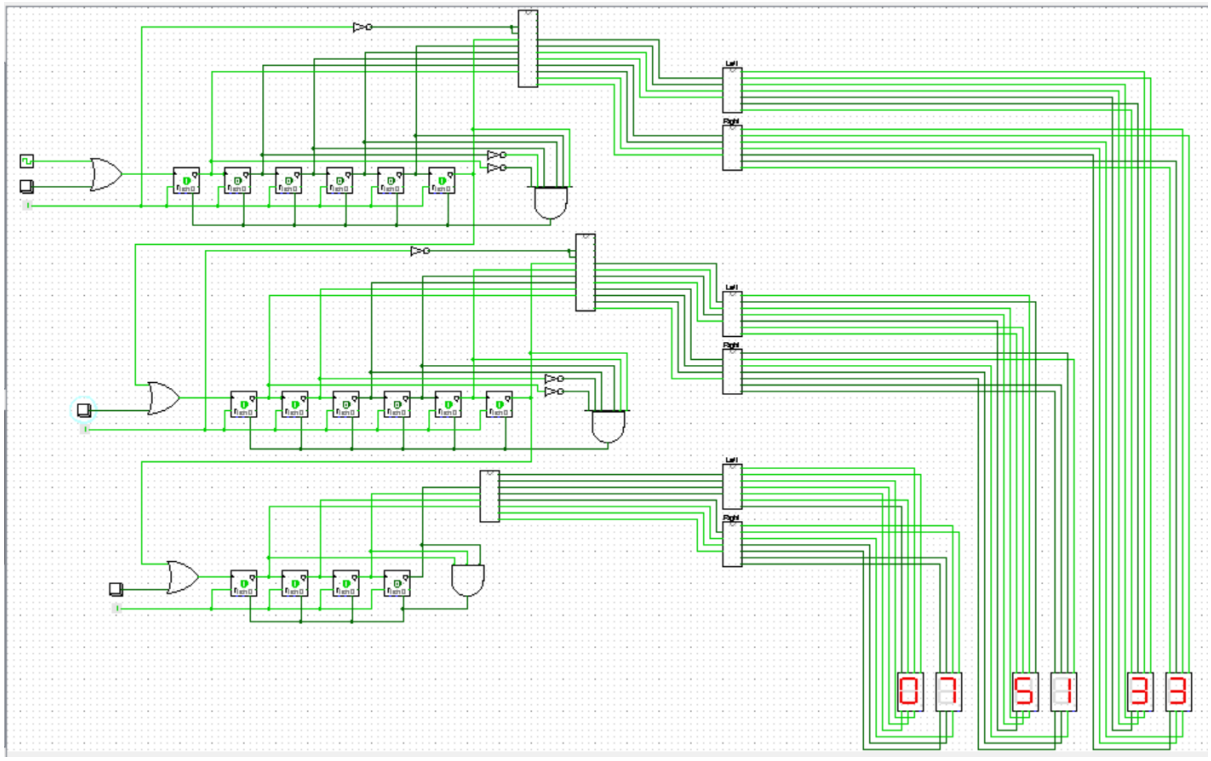
Software used: Logisim Simulator

The primary objectives of creating a digital clock project are to develop a practical understanding of digital electronics and circuitry, achieve accurate timekeeping, customize the clock to personal preferences, gain hands-on experience in electronics, and potentially integrate it with other systems.

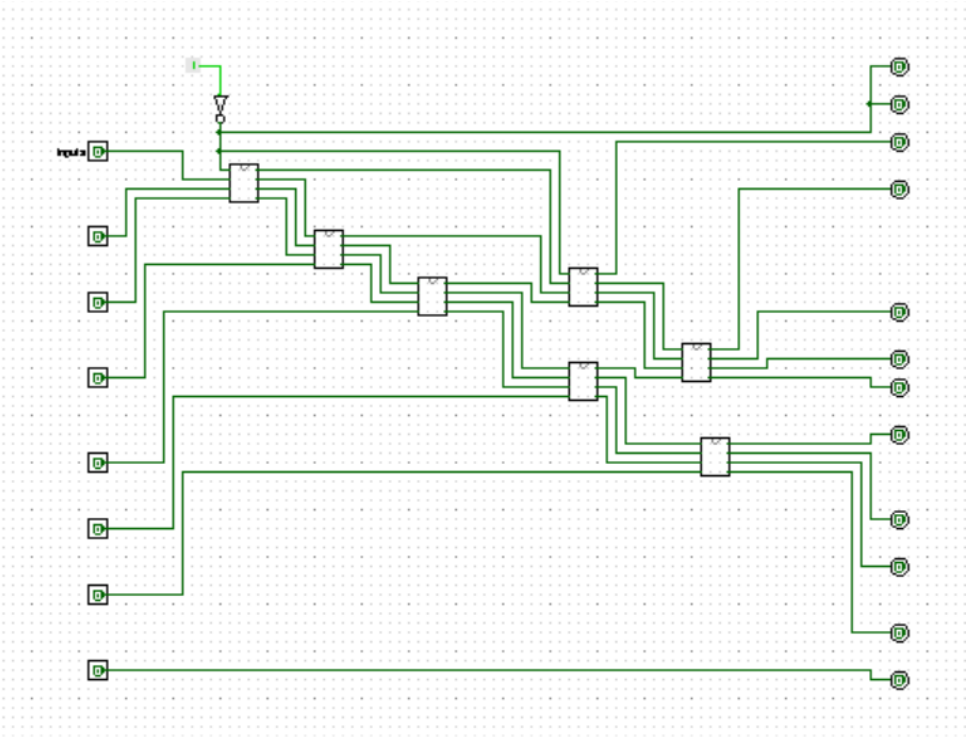
## Design

The project is based on a digital clock that shows time in the form of hours, minutes and seconds. We used asynchronous counters for seconds, minutes and hours. We used a 7-segment led display to show each digit of time. Logic gates are also used to control the display and for conversion purposes.

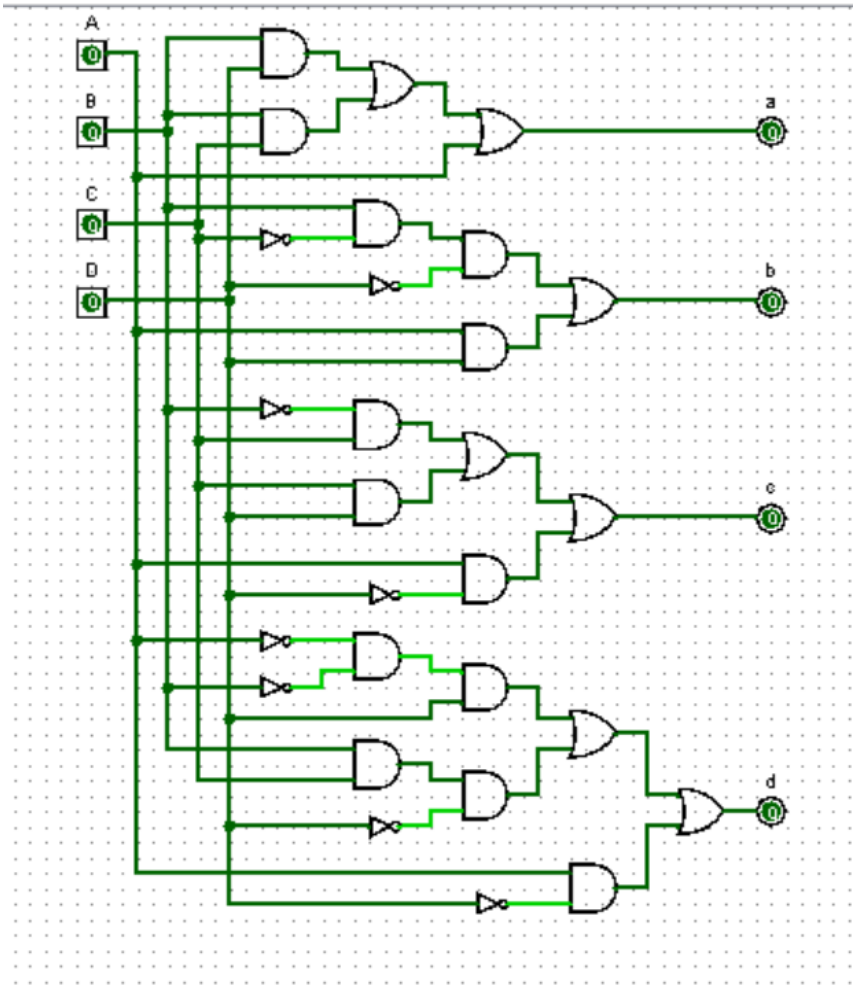
The main clock circuit: -



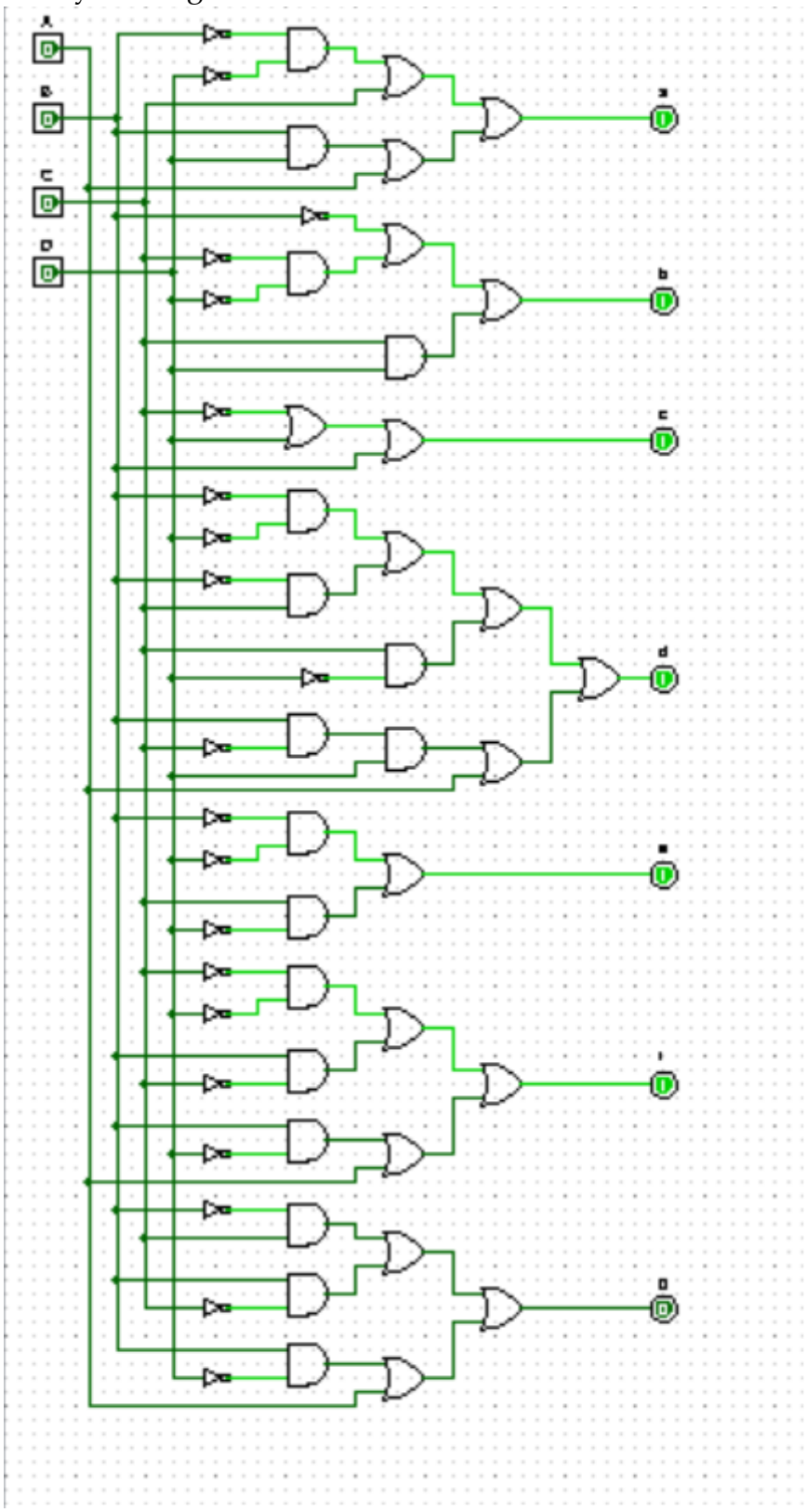
The Double Dabble Circuit: -



The Dabble Circuit: -



Binary to 7-Segment: -



## Working

**In the main clock circuit : -**

For the seconds counter, we have used a MOD-60 asynchronous counter. Therefore, this counter will count from 1 to 60 and as it reaches 60 it will reset back to zero.
The same scenario is with the minutes counter it is also using mod-60 counter and it will run from 1 till 60.
The working with the hour counter is a bit different as it is a 12-hour clock and not a 24-hour clock we have used MOD-12 counter. Here the counter will run from 1 to 12. And the after hitting 12 it will again reset to 1.
So, to summaries all this, as the seconds counter hits 60 and after that as it resets to 0 it will increment the minutes counter by 1. This loop will continue as the minute counter hits 60 and as it resets to zero again it will increment the hour counter by 1.
This is how this particular project can be used as a stop watch and a digital watch as well.

**In the double dabble circuit: -**

This circuit is used to separate a 2-digit number to 2 separate digits so that each digit can fit in a single LED display. Here the process of left shifting is used to separate the numbers. For e.g. If the number inputted is 12 then by the help of this circuit it can be separated into 1 and 2 so that one LED can show 1 and the other can show 2.

**In the dabble circuit: -**

While the circuit is being left shifter the dabble circuit adds up 3 to the number if the binary code of the number is equal to or exceeds 5.

**The whole process of double dabbles and dabble circuit with an example**

If the number is 10: - (1010)
_ _ _ _ _ _ _ _ 1 0 1 0
Left shifting operation will be done
_ _ _ _ 0 0 0 1 0 1 0
Left shifting operation will be done
_ _ _ _ 0 0 1 0 1 0
Left shifting operation will be done
_ _ _ _ 0 1 0 1 0
Now 0 1 0 1 is the binary code for number 5
As 5*2=10
Hence 3 will be added to 5. Therefore, 3+5=8
Binary code for 8 is: 1 0 0 0
Now the progress is: -
_ _ _ _ 1 0 0 0 0
Left shifting operation will be done
0 0 0 1 0 0 0 0
Hence now both the digits are separated
Here 0 0 0 1 is the binary code for number 1 & 0 0 0 0 is the binary code for number 0

This is how 1 will be displayed in 1 LED and 0 in the other.

**Binary to 7-Segment: -**

This particular circuit is used to change the 4-digit binary input to an output that can fit in the 7-segment display. So that the display can work and show the required digit.

## Applications of a digital clock

1. Home and Office: Digital clocks are widely used for keeping time in homes, offices, and workplaces. They provide a clear and easily readable display of the current time, making them practical for everyday use.
2. Schools and Educational Institutions: Digital clocks are used in classrooms, auditoriums, and other educational settings to help students and teachers stay on schedule.
3. Public Transportation: Digital clocks are often installed at bus stops, train stations, and airports to display departure and arrival times, helping travelers plan their journeys.
4. Hospitals and Healthcare Facilities: Accurate timekeeping is crucial in healthcare settings for medical procedures, medication administration, and monitoring patient care.
5. Manufacturing and Industrial Facilities: Digital clocks play a role in scheduling production processes, shift changes, and coordinating operations in manufacturing and industrial environments
6. Commercial and Retail Spaces: Digital clocks are used in stores, shopping malls, and commercial spaces to help employees and customers keep track of opening and closing hours.
7. Sports and Fitness Facilities: Digital clocks with timers and countdown features are used in sports arenas, gyms, and fitness centers to time workouts, matches, and events.
8. Communication Systems: Digital clocks are used in network equipment and communication systems to timestamp data and synchronize devices.

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