King Abdulaziz University Department of Information Technology

Faculty of Computing and Information Technology CPIT-210, Fall 2023

Computer Organization and Architecture Project

Presented to:
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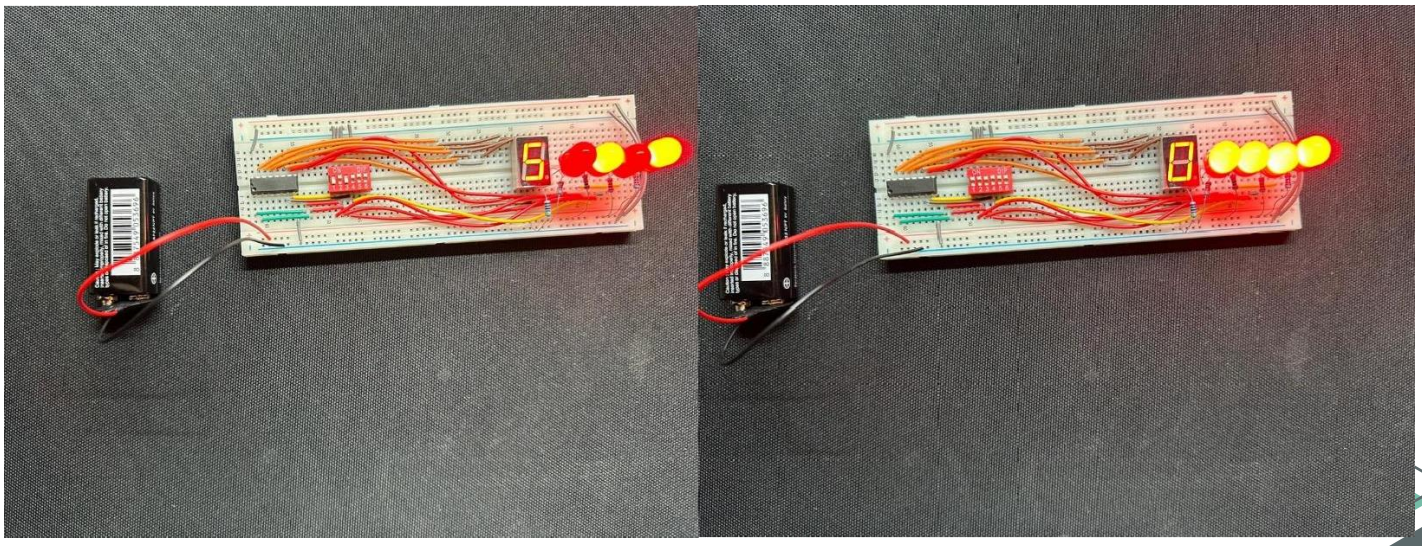

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Introduction

In the digital world, information is represented in binary code, a series of 1s and 0s. While this format is efficient and valid for computers to process, it is not easily understandable by humans. To bridge this gap, we use devices like the BCD to 7- segment decoder to convert binary data into a visually understandable form.

BCD stands for Binary Coded Decimal. It is a number representation system where each decimal digit is represented by a unique 4-bit binary pattern. For example, the decimal number 0 is represented by the BCD code 0000, the decimal number 1 is represented by the BCD code 0001, and so on.

BCD to 7-segment decoders is used in a wide variety of electronic devices, from digital clocks and calculators to electronic meters and appliances.

Project Proposal

Project Overview:

BCD to 7-segment decoder is a circuits that convert binary-coded decimal (BCD) data into a visually understandable format. BCD is a number system that uses four bits to represent each decimal digit.

Seven-segment displays are electronic displays that use seven LEDs to display decimal numerals.

By selectively activating the appropriate LEDs on a seven-segment display, a BCD to 7-segment decoder can display any hexadecimal numbers.

The 7-segment displays are a type of display device that consists of seven individual light-emitting diodes (LEDs) arranged in a specific pattern to display the digits 0 through 9.

Objectives:

The primary objectives of this project are as follows:

- Design and Simulation: Develop a deep understanding of BCD to 7-segment decoding through theoretical study and simulation using Logisim.
- Hardware Implementation: Construct a physical circuit of the BCD to 7- segment decoder on a breadboard, utilizing standard electronic components.
- Testing and Validation: Test the decoder under various BCD inputs to ensure accurate and reliable translation to 7-segment display output.
- Documentation: Provide a clear report of the design process, simulation circuit, and testing procedures.

Goals:

The goals of this project are to :

- Design and construct a BCD to 7 segment decoder circuit.
- Build a BCD to 7 segment decoder circuit that can be used to display hexadecimal numbers.

Circuit Components

Components for BCD 7-Segment and Binary Display :

1. 7-segment display (Cathode)
2. to 7-segment decoder/driver IC 7447
3. Current-limiting 0.6 Ω resistors
4. DIP switch 4
5. Wires
6. breadboard
7. Power supply
8. Four LEDs

How these components work :

7-Segment Display (Cathode):

A 7-segment display is a visual indicator that can represent numbers (0-9), The "cathode" designation means the common connection is the low active (Maxterm).

7-Segment Decoder/Driver IC 7447:

The 7447 is a BCD-to-7-segment decoder/driver IC. BCD (Binary Coded Decimal) is a way of representing numbers in decimal form. The 7447 takes a 4-bit BCD input and decode it to activate the segments needed to display the corresponding decimal digit.

Current-Limiting Resistors:

Each vcc(Voltage Common Collector) of the 7-segment display needs a current-limiting resistor to ensure that the LED segments operate within their specified current range.

DIP Switch (4):

A DIP (Dual In-line Package) switch is a set of manual switches in a compact package. In this circuit, it's used to set a 4-bit binary input, representing the decimal digit you want to display.

Wires:

Wires are used to establish connections between components on the breadboard. They create electrical pathways for signals to flow.

Breadboard:

The breadboard is a prototyping tool that allows you to quickly build and test electronic circuits without soldering. It has interconnected rows and columns of metal clips beneath the surface

Power Supply:

The power supply provides electrical power to the circuit. It could be a battery or an external power source. Ensure that the voltage supplied is suitable for the components in use.

Four LEDs:

LEDs are light-emitting diodes. In this context, you've mentioned four LEDs, and they can be used for additional visual indicators or status lights in your project.

How does the circuit work

Circuit Operation:

Setting the Binary Input:

Set the DIP switch to a specific binary configuration by turning the switches on or off. This represents a 4-bit binary number.

Binary Input to 7447 IC:

The binary input from the DIP switch is connected to the BCD inputs (Binary-Coded Decimal) of the 7447 IC.

Decoder Operation:

The 7447 IC decodes the binary input and activates the appropriate output pins based on the binary number it receives.
For a common cathode display, the segments are activated when the input is LOW (0).

Segment Activation:

The activated output pins of the 7447 drive the corresponding segments of the 7-segment display.
For example, if the binary input represents the decimal digit '6,' the 7447 activates the segments to display '6' on the 7-segment display.

Displaying the Decimal Digit:

The 7-segment display visually represents the decimal digit set by the binary input. Each segment lights up or remains off to form the desired digit.

Current-Limiting Resistors:

The 7-segment display visually represents the decimal digit set by the binary input. Each segment lights up or remains off to form the desired digit.

Example:

If you set the DIP switch to '1001 (binary), this corresponds to the decimal digit '6.' The 7447 decodes '1001' and activates the segments needed to display '6' on the 7-segment display

Key Components and Functions:

DIP Switch (4):

Function: Provides a binary input to the circuit.

Operation: Set each switch to either high (1) or low (0), representing a 4-bit binary number.

7-Segment Decoder/Driver IC (Common Anode):

Function: Converts the binary input into signals to drive the 7-segment display.

Operation: Decodes the binary input and activates the appropriate segments in the common cathode 7-segment display.

7-Segment Display (Common Anode):

Function: Visual indicator for displaying decimal digits.

Operation: Each segment is an LED; segments light up based on signals from the 7447, forming the desired digit.

Current-Limiting Resistors (0.6 Ω):

Function: Limits current through the LED segments to prevent damage.

Operation: Connected in series with each segment of the 7-segment display.

Wires and Breadboard:

Function: Establish electrical connections between components.

Operation: Connect components on the breadboard to create a complete circuit.

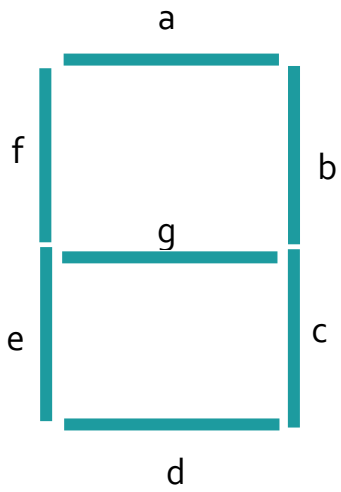
- Truth Table:

Note:

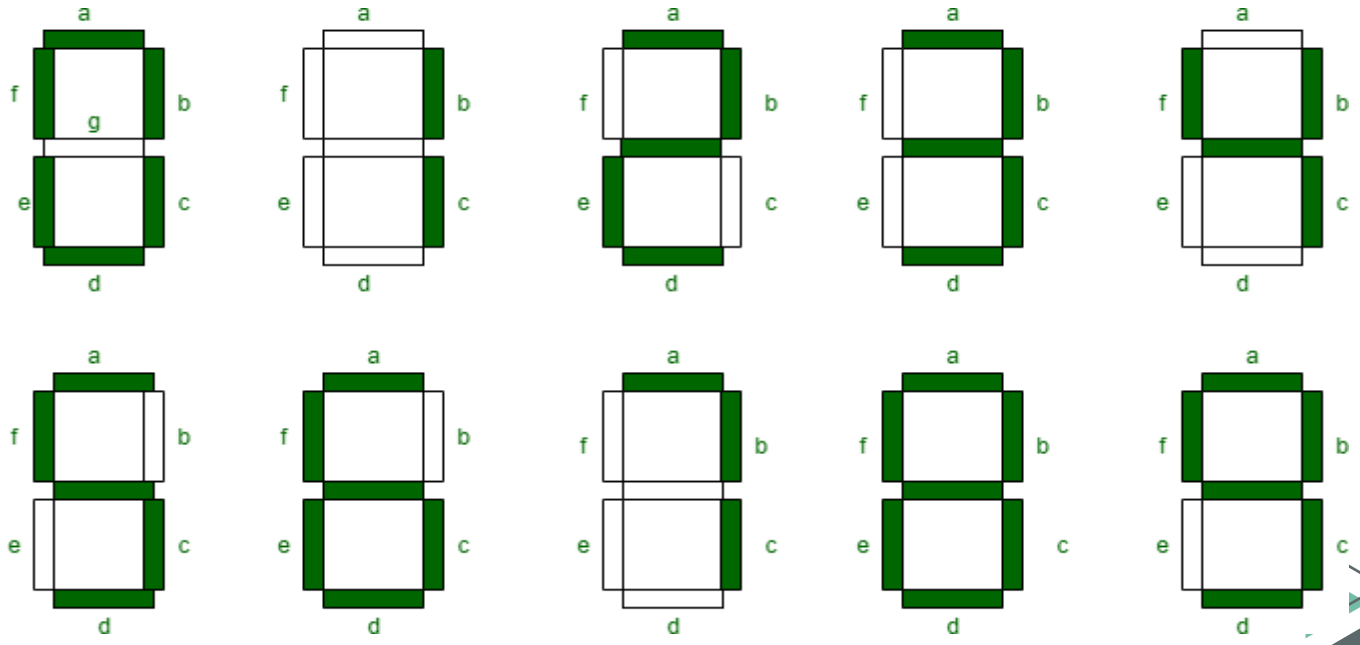
In our hardware components we use Anode-Seven-Segment, so in output display we consider 1 to be 0 and vice versa.

7 Segment Display Outputs	Inputs	Outputs
	X Y Z W	a b c d e f g
0	0 0 0 0	0 0 0 0 0 0 1
1	0 0 0 1	1 0 0 1 1 1 1
2	0 0 1 0	0 0 1 0 0 1 0
3	0 0 1 1	0 0 0 0 1 1 0
4	0 1 0 0	1 0 0 1 1 0 0
5	0 1 0 1	0 1 0 0 1 0 0
6	0 1 1 0	0 1 0 0 0 0 0
7	0 1 1 1	0 0 0 1 1 1 1
8	1 0 0 0	0 0 0 0 0 0 0
9	1 0 0 1	0 0 0 0 1 0 0

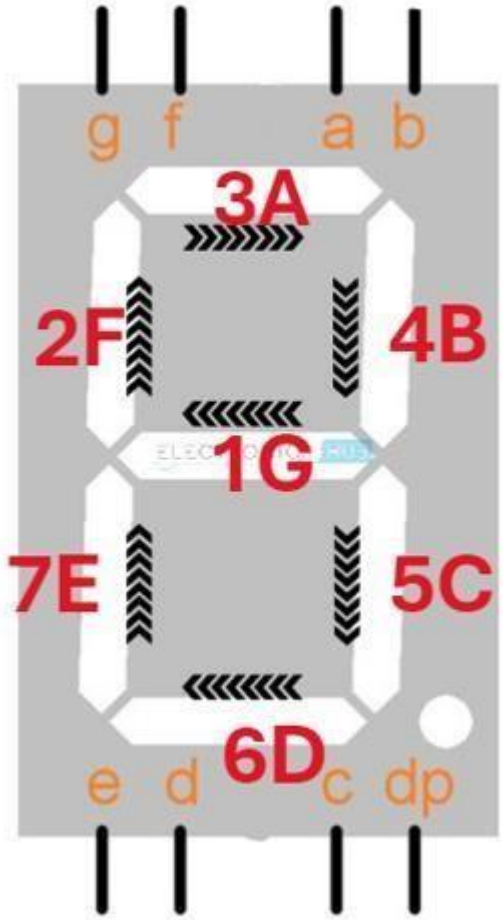
7- Segment Display:



This figure illustrate all cases:

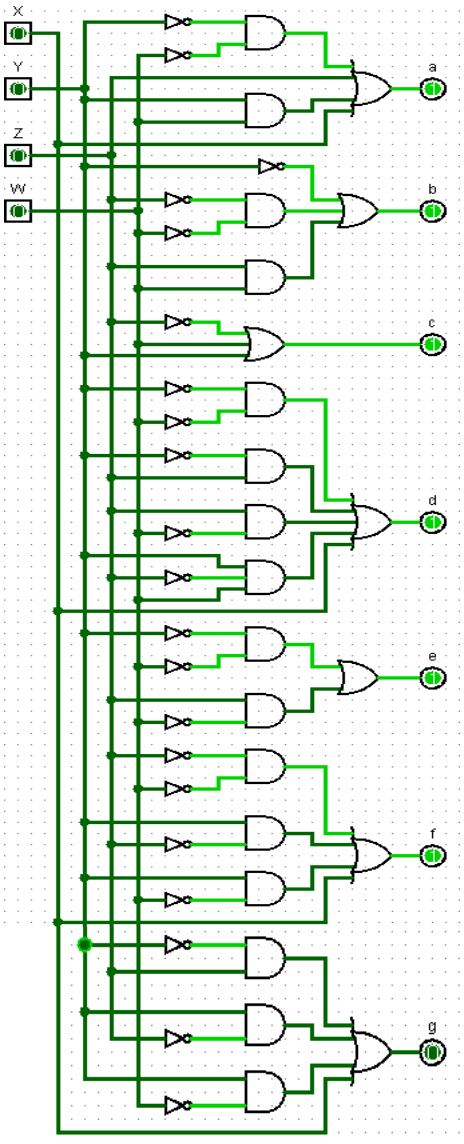


Logic Circuit

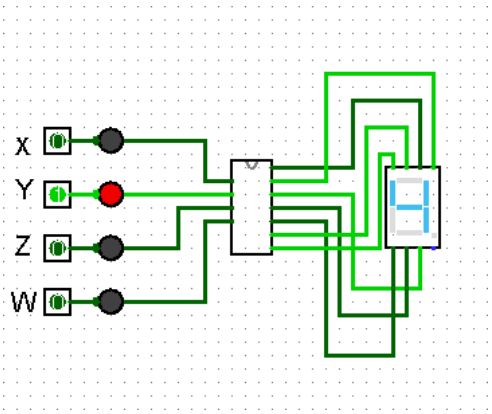


This diagram depicts the pin configuration of a 7-segment display, arranged sequentially from the uppermost to the lowermost pins (G, F, A, B, C, D). The bottommost pin is unimportant for our purposes, and thus, it remains unconnected.

Here is the implementation of the truth table



Here is implementation of the 7-segment:



The implementation here was to convert our Logisim circuit into small part to simplify the result

Conclusion

In this project, we successfully designed implemented, and tested a BCD to 7-segment decoder circuit.

The circuit effectively converts binary-coded decimal (BCD) data into a visually understandable format using a 7-segment display.

The project provided a comprehensive understanding of BCD to 7-segment decoding through theoretical study, simulation using Logisim, and hardware implementation on a breadboard.

The circuit demonstrated accurate and reliable translation of BCD inputs to 7-segment display outputs, successfully displaying the digits 0 through 9.

The project achieved its goals of designing, constructing, and testing a functional BCD to 7-segment decoder circuit.