Control of a 7-Segment Display

Moises Jahir González Márquez, Marco Baez González, Manuel Fernández Mercado, Eduardo Estrada González
Meritorious Autonomous University of Puebla, Faculty of Computer Science
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In this practice, a numerical display system was implemented using a 7-segment display controlled by a 7447 decoder. The purpose of this experiment was to understand the operation of BCD-to-7-segment decoders, as well as the proper connection of their inputs and outputs. To achieve this, a circuit was designed in which four digital inputs (A, B, C, and D) represent a number in BCD code, which is then decoded to activate the corresponding segments (a, b, c, d, e, f, and g) on the display.
The circuit was assembled on a breadboard using a 7447 decoder, appropriate wiring, current-limiting resistors, a DIP switch for selecting input values, and a 5V power supply for system operation. During the experimentation, the output behavior was verified based on different input combinations, and possible wiring errors were analyzed. The results obtained validated the correct operation of the decoder and the accurate activation of the display segments according to the input BCD code.

***Index Terms*— 7-segment display, BCD decoder, digital electronics, DIP switch, logic circuits, protoboard, 7447 decoder, voltage**

I. INTRODUCTION

7-Segment displays are widely used in digital electronics to represent numbers and, in some cases, alphanumeric characters. They are commonly found in devices such as digital clocks, calculators, control panels, and other systems that require a visual interface to display numerical information.

To effectively control a 7-segment display BCD-to-7-segment decoders such as the 7447 integrated circuit are used. This decoder converts a numbers express in BCD (Binary-Coded Decimal) into a combination of signals that activate the corresponding segments of the display, allowing the representation of numbers from 0 to 9.

The applications of the 7447 decoder extend beyond simple numeric visualization; it is a key component in counting systems, timers, embedded systems, and electronic devices that require the conversion of binary information into a human readable format.

In this experiment, a circuit was designed to analyze the operation of the 7447 decoder and its application in a 7-segment display. The system was implemented on a breadboard, using current-limiting resistors, a DIP switch to select input values, and a 5V power supply to power the circuit.

This document details the design, assembly, and analysis of the circuit, as well as the results obtained and conclusions regarding the correct implementation of the 7447 decoder for controlling a 7-segment display.

II. PRINCIPLES OF OPERATION

A. Operation of the 7447 Decoder

The 7447 decoder is an integrated circuit used to convert numbers in Binary-Coded Decimal (BCD) into specific signals that activate the segments of a 7-segment display. This device simplifies numerical representation by reducing the number of connections required to control the display.

The 7447 has four digital inputs (A, B, C and D), which represent a number in BCD code. Based on this combination of bits, the decoder generates the appropriate signals on its seven outputs (a, b, c, d, e, f, and g), determining witch segments of the display should light up to show the corresponding number.

III. TYPES OF 7-SEGMENT DISPLAY

There are two main types of 7-segment displays:

1. Common Cathode (CC) Display:
   - All LED cathodes are connected to ground (GND).
   - To turn of a segment, the signal must be high (1).
2. Common Anode (CA) Display:
   - All LED anodes are connected to positive voltage (Vcc).
   - To turn on a segment, the signal be low.

The 7447 decoder is designed to work with common cathode displays, meaning that its outputs are active-low (when an output is 0, the corresponding segment lights up):
The following truth table shows how the 7447 decodes BCD inputs and activates the display outputs:

TABLE I

BCD(A B C D)	Displayed digit	Active Outputs (a-g)
0000(0)	0	a, b, c, d, e, f
0001(1)	1	b, c
0010(2)	2	a, b, d, e, g
0011(3)	3	a, b, c, d, g
0100(4)	4	b, c, f, g
0101(5)	5	a, c, d, f, g
0110(6)	6	a, c, d, e, f,, g
0111(7)	7	a, b, c
1000(8)	8	a, b, c, d, e, f, g
1001(9)	9	a, b, c, d, f, g

D. APPLICATIONS OF THE 7447 DECODER

The 7447 decoder is widely used in electronic and digital systems, such as:

- Digital counter
- Calculators and measurement systems.
- User interfaces in electronic devices.

- Embedded systems that require numerical display

The use of the 7447 simplifies circuit design by allowing the direct conversion of BCD numbers into visual representations on a display, reducing the numbers of connections needed.

IV. Results and Conclusions

The Proteus diagram of the circuit is shown in the next figure.

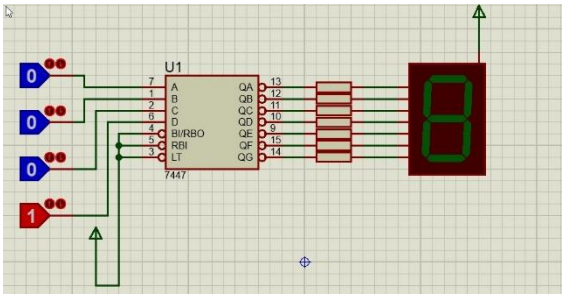

Fig. 1 Proteus Diagram

To achive the correct behavior in this implementation we set the LT and BI/RBO inputs at HIGH, and RBI input at LOW. With this in mind the physical circuit was designed as follows

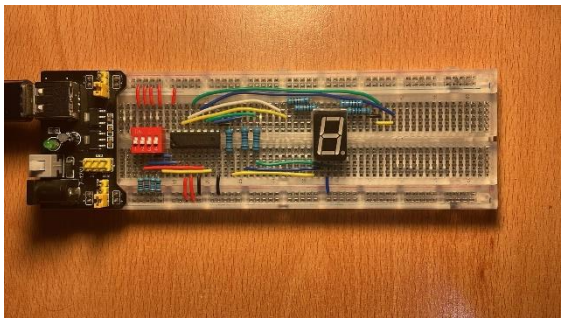

Fig. 2 Physical Implementation

On the Dip Switch output 4 correspond to A input on the IC, output 3 to B input and so on, also every resistor used was of 1k. For purposes of this practice only two significant functionality examples are shown.

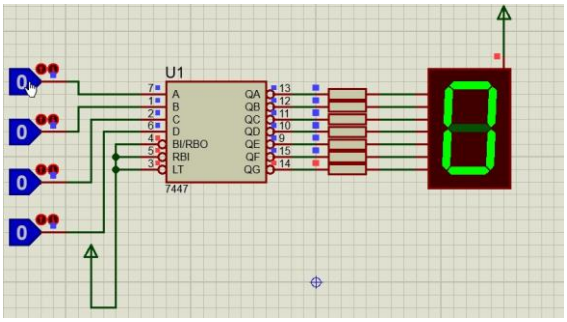

Fig. 3 Simulation BDC input zero

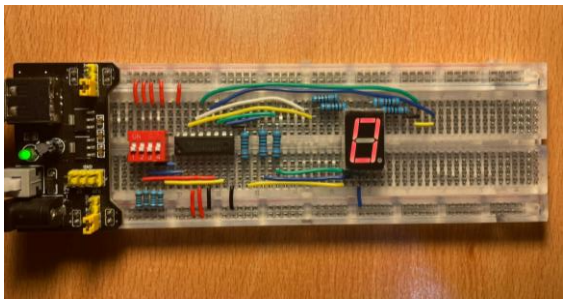

Fig. 4 Circuit BCD input cero

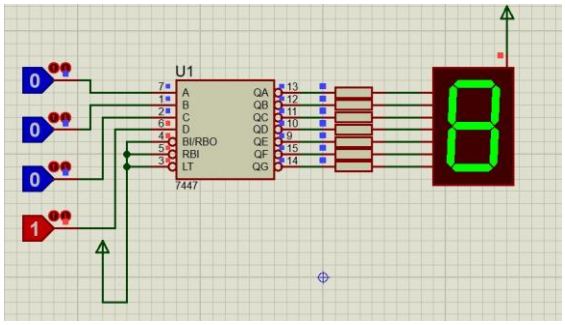

Fig. 5 Simulation BCD input eight

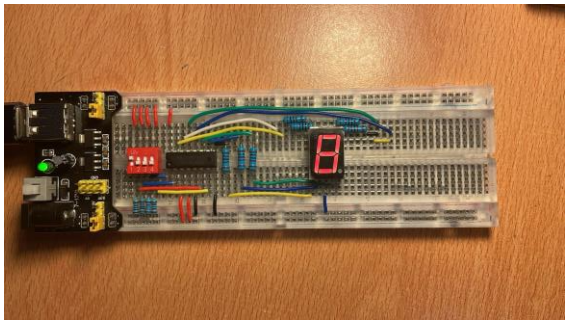

Fig. 6 Circuit BCD input eight

As we can see comparing Figures 3 and 4, as well as Figures 5 and 6, the results are identical. Thus, the decoding capacity of the IC and the handling of the 7-segment display is verified. It also shows the relative ease of the circuit compared to its implementation from scratch with simple logic gates.