# DIGITAL DICE

## LOGIC PROJECT

**PRESENTED BY :**

**TEAM 11**

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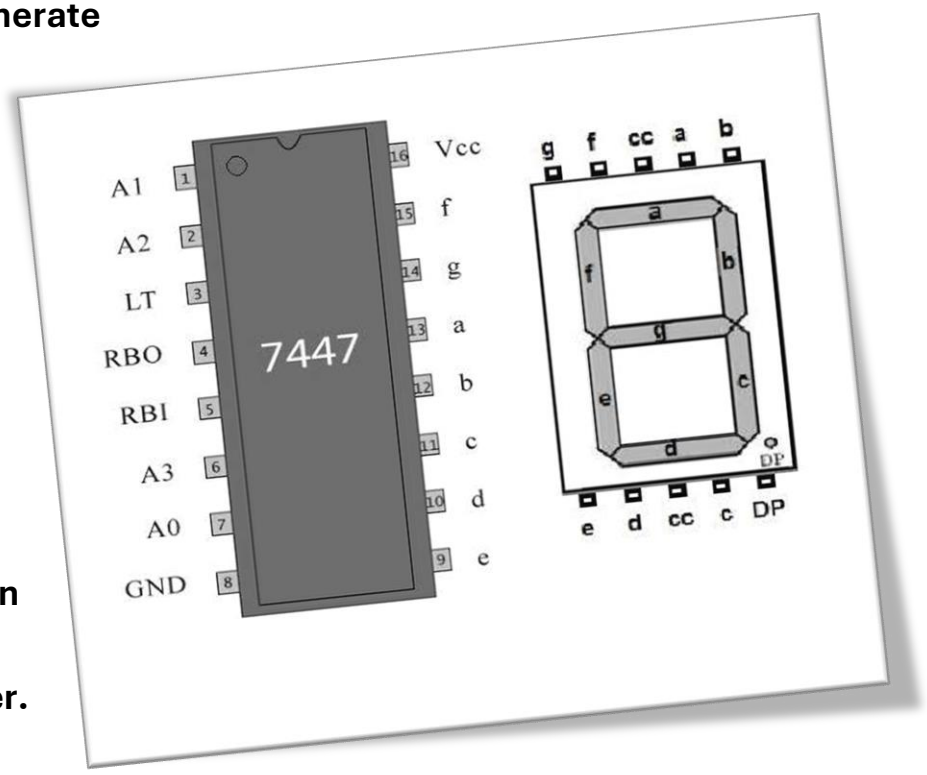
# THE ASSIGNMENT AIM

**Digital dice are commonly used in electronic games or simulations where mechanical dice are impractical or need to be automated. This project helps in understanding counters, timing circuits, and display mechanisms in digital electronics.**

**The aim of this project is to design and implement a digital dice using basic digital logic components.**

**The dice should generate a random number between 1 and 6 when the user presses a push button.**

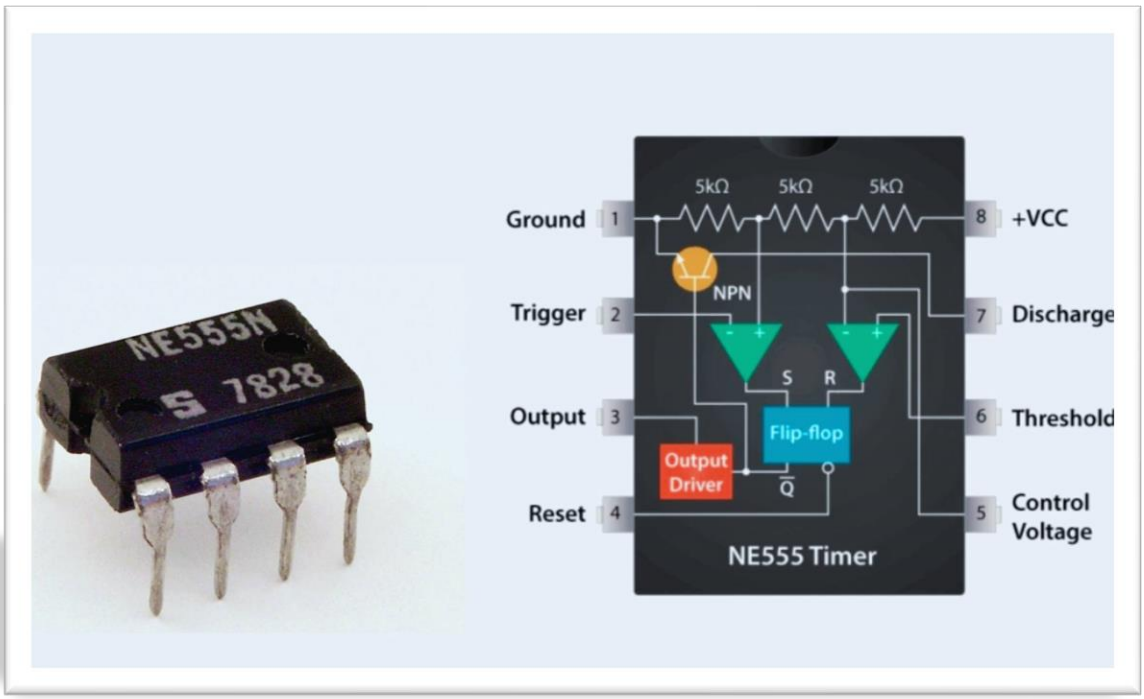



**The number is displayed on a 7-segment display using a combination of a counter, logic circuit, and decoder.**

**This system uses a 555 timer as a pulse generator to trigger a 4017-decade counter.**

**The output of the counter is then decoded and displayed using a 4511 BCD to 7-segment decoder.**

# THE PROBLEM SOLUTION




**Problem : The 7 – segment is displaying numbers more than the desired (from 1 to 6)**

**Solution : Only 6 outputs are used from the IC 4017 (Q0 to Q5), each representing numbers from 1 to 6.**

**The solution uses a 555 Timer as a clock pulse generator, connected to a 4017 decade counter that sequentially activates one output pin for each pulse.**

**A diode network converts the active output to a 4-bit BCD code, which is fed into a 4511 BCD to 7-segment decoder to display the result.**

# INPUTS AND OUTPUTS

## Input

- Clock signal from 555 Timer
- Push button (user interaction to trigger rolling)

## Output

- 4-bit BCD signal
- Visual number from 1 to 6 on 7-segment display 8. Logic Circuit Design

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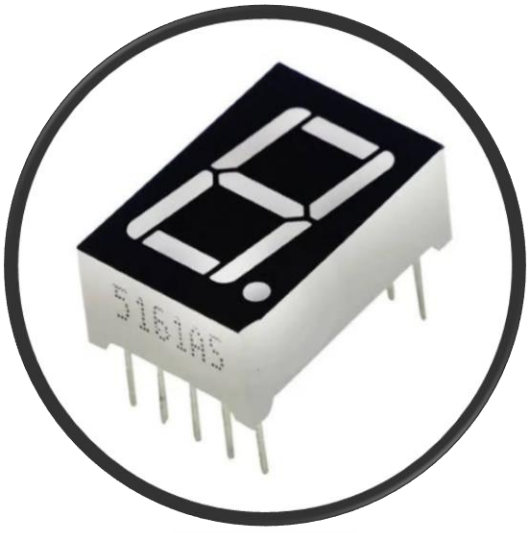
# THE FULL CIRCUIT CONSISTS OF

- 555 Timer configured in astable mode to generate pulses
- 4017 Counter receiving pulses and activating outputs Q0–Q5.
- Diode matrix to encode Q outputs to BCD
- 4511 IC to decode BCD to 7-segment signals.
- Common cathode 7-segment display to show the final number



# THE TRUTH TABLES / STATE TABLE

**The 4017 decade counter has 10 outputs (Q0 to Q9), but we only utilize Q0 to Q5 to represent the dice values 1 through 6. The 7-segment display is driven by a decoder that activates the corresponding segments to display each digit. The system resets itself once it reaches Q6, to loop back and simulate the dice rolling again.**

### Truth Table (Q0-Q5)To BCD

| Display num | DCBA | Q0 | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|---|---|
| 1 | 0001 | 1 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0010 | 0 | 1 | 0 | 0 | 0 | 0 |
| 3 | 0011 | 0 | 0 | 1 | 0 | 0 | 0 |
| 4 | 0100 | 0 | 0 | 0 | 1 | 0 | 0 |
| 5 | 0101 | 0 | 0 | 0 | 0 | 1 | 0 |
| 6 | 0110 | 0 | 0 | 0 | 0 | 0 | 1 |

**A = Q0 + Q2 + Q4**
**B = Q1 + Q2 + Q5**
**C = Q3 + Q4 + Q5**
**D = 0**

## Truth Table - 4017

| Clock Pulses | Q0 | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |

## Truth Table (4511)

| Dice num | DCBA | a | b | c | d | e | f | g |
|---|---|---|---|---|---|---|---|---|
| 1 | 0001 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 2 | 0010 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 3 | 0011 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 4 | 0100 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 5 | 0101 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| 6 | 0110 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |

# K-MAPS

## Truth Table of the 7 - segment

| D | C | B | A | a | b | c | d | e | f | g |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |

## K-Maps

### a

| DC \ BA | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | X | 0 | 1 | 1 |
| 01 | 0 | 1 | X | 1 |
| 11 | X | X | X | X |
| 10 | X | X | X | X |

$$a = B + AC$$

## b

| DC \ BA | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | X | 1 | 1 | 1 |
| 01 | 1 | 0 | X | 0 |
| 11 | X | X | X | X |
| 10 | X | X | X | X |

$$b = \overline{D}\overline{C} + \overline{B}\overline{A}$$

## c

| DC \ BA | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | X | 1 | 1 | 0 |
| 01 | 1 | 1 | X | 1 |
| 11 | X | X | X | X |
| 10 | X | X | X | X |

$$c = A + C$$

## d

| DC \ BA | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | X | 0 | 1 | 1 |
| 01 | 0 | 1 | X | 1 |
| 11 | X | X | X | X |
| 10 | X | X | X | X |

$$d = AC + B$$

## e

| DC \ BA | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | X | 0 | 0 | 1 |
| 01 | 0 | 0 | X | 1 |
| 11 | X | X | X | X |
| 10 | X | X | X | X |

$$e = B\bar{A}$$

f

| DC \ BA | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | X | 0 | 0 | 0 |
| 01 | 1 | 1 | X | 1 |
| 11 | X | X | X | X |
| 10 | X | X | X | X |

$$f = \bar{D}C$$

g

| DC \ BA | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | X | 0 | 1 | 1 |
| 01 | 1 | 1 | X | 1 |
| 11 | X | X | X | X |
| 10 | X | X | X | X |

$$g = B + C$$

# Implementation of the system

- **To implement the digital dice system, the components were assembled on a breadboard following the designed schematic. The 555 timer was set in Astable mode using appropriate resistor and capacitor values to generate a continuous pulse signal. This signal was fed into the 4017-decade counter, which activates one of its outputs sequentially from Q0 to Q5,representing the numbers 1 to 6.**

- **A diode matrix was used to convert these outputs into 4-bit binary coded decimal (BCD), which was then input to the 4511 decoder. The 4511 decoder translated the BCD signals into signals suitable for a 7-segment display, showing the corresponding digit from 1 to 6.**

- **The system was powered using a DC source, and a push button was included to simulate rolling the dice by starting or stopping the timer pulses.**

# The schematic diagram

**The schematic diagram of the digital dice system includes the following main components:**

**1. Clock Generator (555 Timer in Astable Mode):**

**- Generates a continuous square wave signal (clock pulses).**

**- Resistors R1, R2 and capacitor C1 set the frequency of pulses.**

**2. Counter (4017 Decade Counter):**

**- Takes input clock pulses from the 555 timer.**

**- Activates one of its outputs (Q0 to Q5) sequentially with each pulse.**

**- Q6 is connected to the reset pin to cycle the count between 1 and 6.**

**3.Diode Encoding Network**

**- The outputs from the 4017 are fed through diodes into a binary encoder logic.**

**- maps each Q output to a corresponding BCD value.**

**4. Display Section (4511 Decoder + 7-segment Display):**

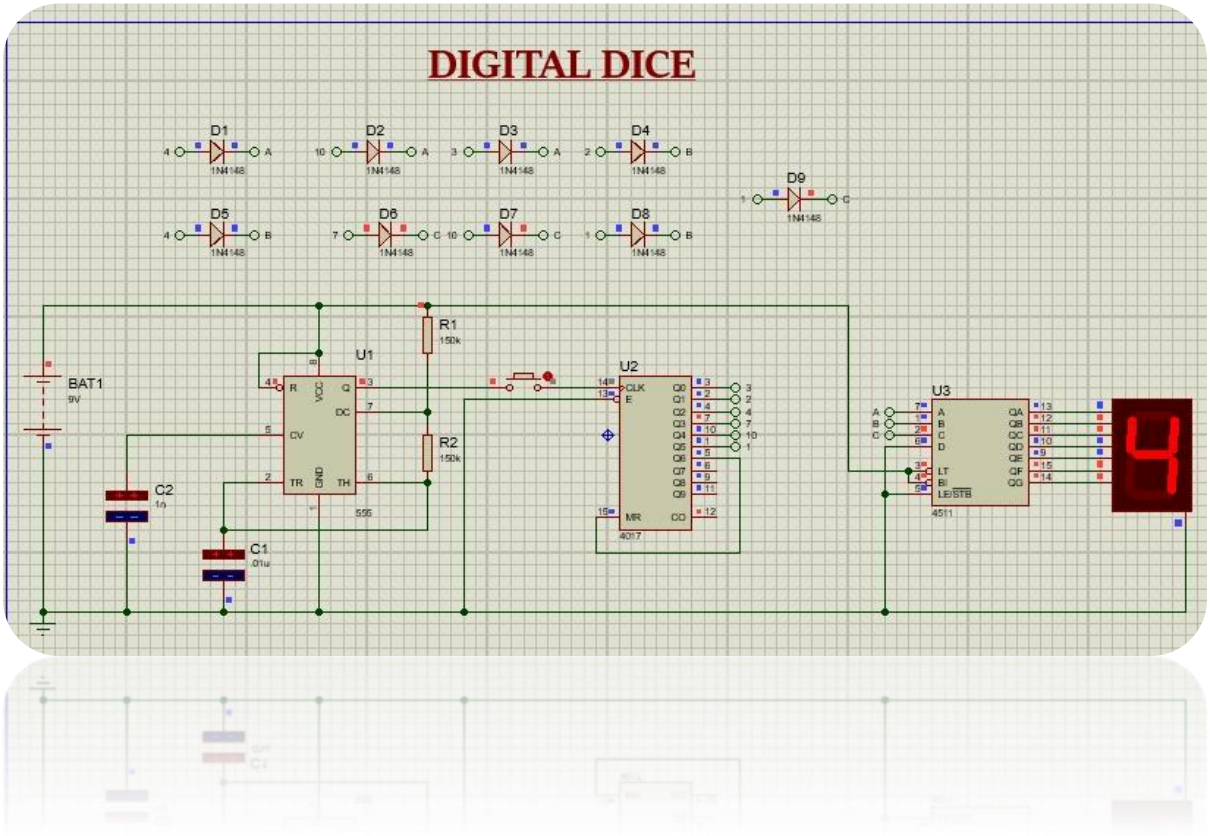
**- This binary output is passed to the 4511 BCD to 7-segment decoder.**

**- 4511 BCD to 7-Segment Decoder : receives the BCD input and drives the 7-segment display.**

**- The 7-segment display then shows the corresponding number.**

**- Common Cathode 7-Segment display : displays the dice number.**

# Circuit simulation




# Test the design

**The design was tested by powering the circuit and pressing the push button to simulate rolling the dice. The 555 timer produced pulses that cycled through the counter outputs. The diode matrix and decoder translated these outputs into visual digits on the 7-segment display.**

**The system correctly displayed numbers from 1 to 6 in a random sequence. Each time the button was pressed, a new number appeared, emulating the function of a real dice.**

**The system was tested for accuracy, response time, and stability. All components performed as expected, and the dice generated outputs reliably without glitches.**