DIGITAL LOGIC AND DESIGN

PROJECT

TOPIC: RANDOM NUMBER GENERATOR USING ASYNCHRONOUS COUNTER

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ABSTRACT:

For this mini project we make a random number generator primarily with 555-Timer IC and IC 4017(decade counter) with the help of a 7 segment display. It works by pushing the push button and a random number is displayed in 7- segment display, just like when we roll a traditional dice, instead what we get here is a digital output.

INTRODUCTION:

A random number generator is a device in which we can generate any numbers from 1 to 6 using 7 segment displays. Here we are presenting a circuit to design a random number generator with the help of a seven segment display controlled by 555- timer, IC 4017 & IC 7447.

OBJECTIVE:

If it's a wood die, it can deform due to dampness in the atmosphere or due to mechanical stress. To solve of these issues that we've with a traditional dice, we have made a dice circuit which solves all the problems of a conventional dice. Electronic dice is nearly unbiased. There is no chance to cheat as the circuit operates and pulsates at such a high speed that the circuit is almost imperceptible to the human eye.

There is additionally very little maintenance and there's hardly any impact on aging of the circuit. The frequency may vary a bit with change in power supply voltage and varying the resistor, aging of the active and passive components but still the randomness will be preserved without any trouble.

SUMMARY OF RELATED WORKS:

This random number generator can be used to design similar simple digital games and this dice circuit will go hand in hand with that.

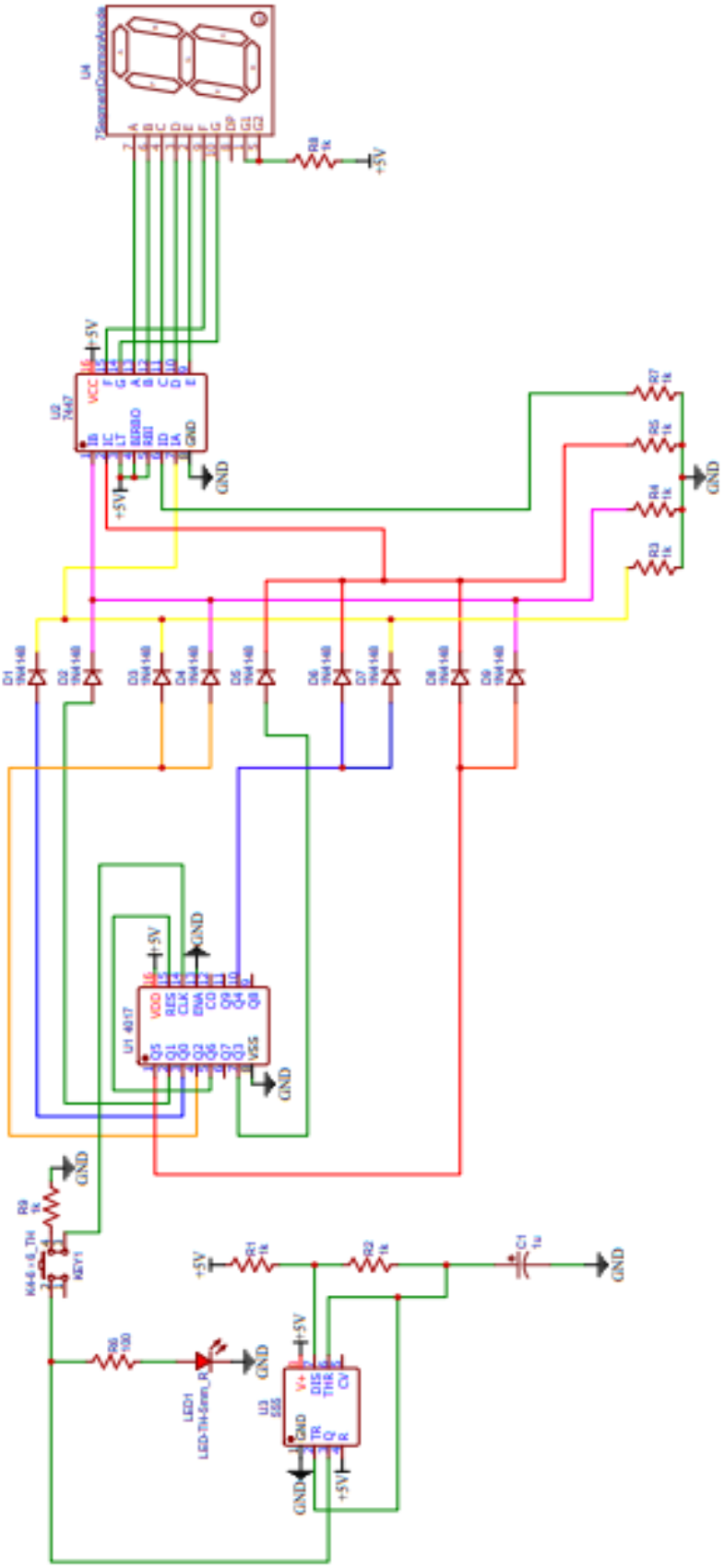
We can include a 555-Timer, IC 4017, IC 4511 to make an analogue based digital dice game using an electronic digital dice with the help of LEDs & 7 segment display. The game designed is simple. An electronic circuit with a push button that can be pushed and used like a normal dice in games. The dice works by switching Light Emitting Diodes (LEDs) on and off just like the pattern of dots found on a traditional dice & also the number is displayed in 7 - segment display, which make this game both analogue & digital.

APPARATUS REQUIRED:

COMPONENT	QUANTITY
9v battery	1
4017 IC	1
555(Timer IC)	1
7447 BCD to 7-segment display	1
IN4148 diode	9
1k ohms	9
Push button	1

0.1 micro farad capacitor	1
Breadboard	1
Connecting wires	1
7-segment Display	1

ARCHITECTURE DIAGRAM :



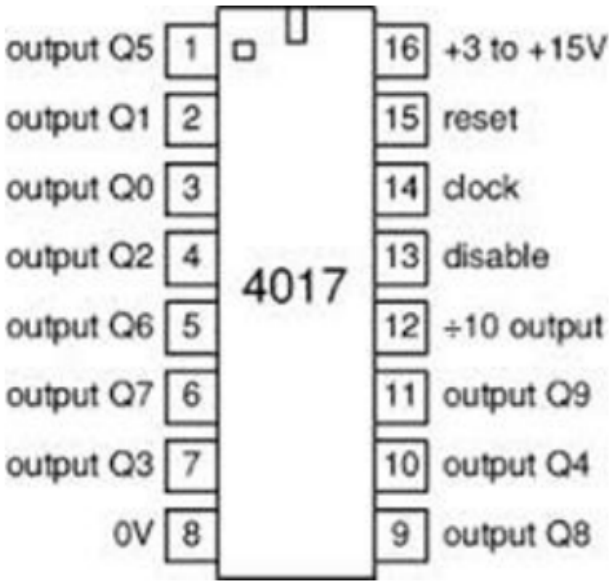
The main brain of this project is IC 4017 with the help of IC 555 toggles are happening at high speed. IC 7447 is used to display and provide the 7-segment display a specific Number. The main work is that when we press the switch, it starts series toggling and when we release the switch it stops at a random digit next to the sequence giving you a random number as that for dice.

COMPONENTS EXPLAINED:

IC 4017 - CMOS Counter

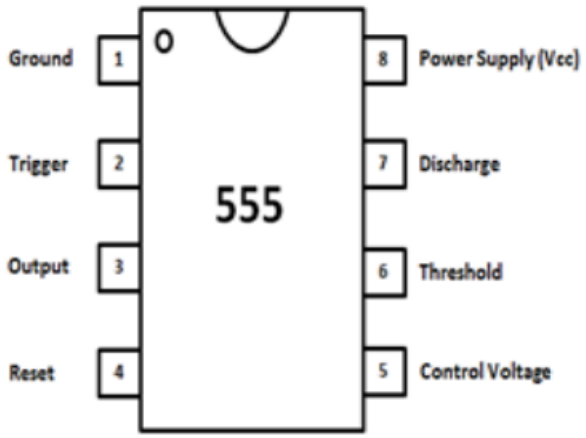
IC 4017 is a 5-stage Johnson Counter having 10 decoded outputs. Used to build all kinds of the timer, LED sequencers and controllers circuits. Pin sixteen is positive power provides and pin eight could be a ground. The power provide vary of three volts to sixteen volts and most power provide voltage at pin one should not be more than eighteen volts. Pin thirteen has Clock enabled pins to controls the clock. When it's "0" logic, the clock is enabled and the

counter advances one count for each clock pulse.



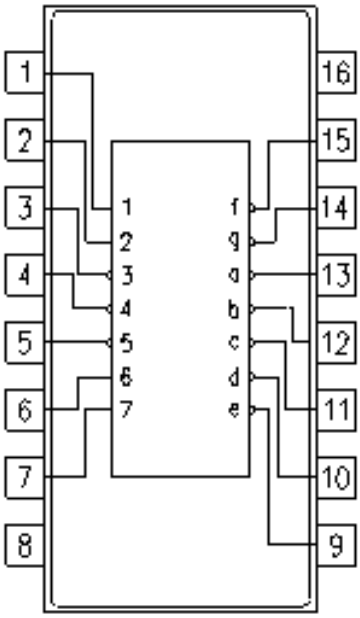
IC 555 – Timer:

The 555 timer datasheet specifies that 555 IC could be an extremely stable device for generating correct time delays or oscillation. Additional terminals area unit provided for triggering or resetting if desired. In the time delay mode of operation, the time is exactly controlled by one external electrical device and capacitance. For astable operation as associate degree generator, the free running frequency and duty cycle area unit accurately controlled with 2 external resistors and one capacitance. For our project, we are going with this approach.



IC 7447 –BCD to 7 Segment Decoder :

7447 IC accepts a binary coded decimal as input and converts it into a pattern to drive a seven-segment for displaying digits 0 to 9. Binary coded decimal (BCD) is an encoding method in which each digit of a number is represented by its own binary sequence (usually of four bits). It accepts four lines of BCD (8421) input data and generates their complements internally. The data is decoded with seven AND/OR gates to drive indicator LEDs of the seven segment display directly. The outputs correspond to common anode (CA) configuration of seven segment. The pin out diagram and the pin description for IC7447 are shown below.

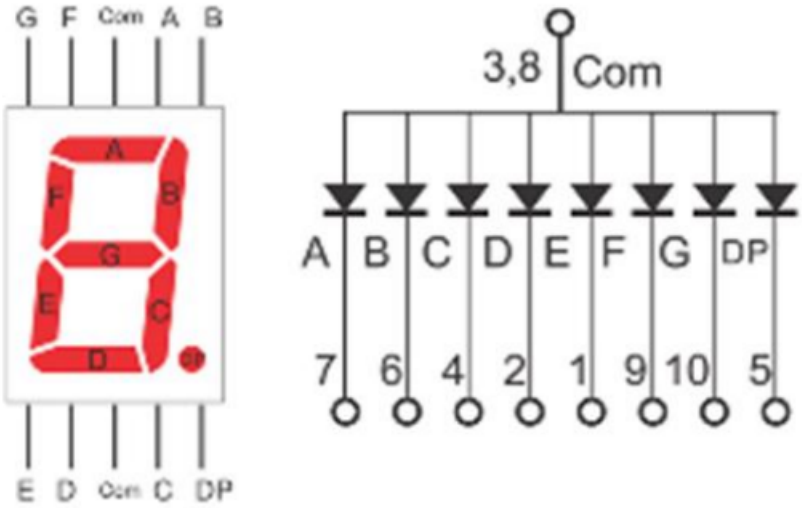


7447
BCD to 7-Segment

7- Segment Display

A seven-segment show (SSD) is a wide used electronic show device for displaying decimal numbers from zero to nine.
They are most ordinarily employed in electronic devices like digital clocks, timers and calculators to show numeric info.

As its name indicates, it's fabricated from seven totally different illuminating segments that square measure organized in such how that it will type the numbers from 0-9 by displaying different combinations of segments. It is also able to form some alphabets like A, B, C, H, F, E, etc.



IMPLEMENTATION DETAILS:

Generally, dice is made up of wooden or plastic, which gets deformed with time and become biased. A Digital dice is a good alternative of old fashioned dice, it can't be biased or deformed. It operates at such high speed its hardly possible to cheat. To create this digital dice circuit, we have mainly used 555 timer IC and 4017 IC.

4017 IC is a decade counter chip. It can produce output at the 10 pins sequentially (Q0 - Q9), which means it can produce output one by one at the 10 output pins. For a dice we only need 6 output states so we connect the seventh output Q6 back to the RESET PIN 15. So that after the 6th State it starts from the first. This output is controlled through the clock pulse at PIN 14.

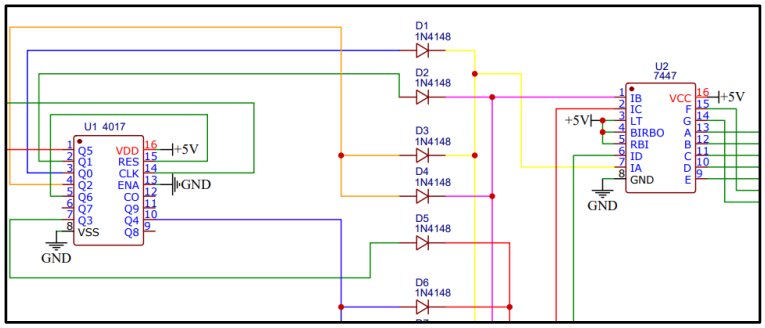
To apply the clock pulse at PIN 14 of 4017 IC, we have used 555 timer IC in astable mode. The oscillated output generated at PIN 3 of 555 has been applied to the PIN 14 of 4017, so that output can be advanced with each clock

pulse. The frequency of the 555 can be calculated using this formula: F=1.44/((R1+2*RV1)*C1),R1=1K,R2=1K,(F=4.81kHz). With this configuration, the circuit operates as a pulse generator with a frequency in order of kilo hertz. This means that the circuit produces a clock cycle of about 0.0002 seconds which is imperceptible to the human eye. We cannot observe the values which change at that faster rate so there is hardly any possibility of getting the dice biased.

IC 7447(BCD to 7 segment display) has 4 input pins a,b,c,d each representing 1,2,4,8 of 8421-BCD code. For dice we need to show numbers 1-6.

d	c	b	a		
8	4	2	1	Decimal	o/p pins
0	0	0	1	1	Q0
0	0	1	0	2	Q1
0	0	1	1	3	Q2
0	1	0	0	4	Q3
0	1	0	1	5	Q4
0	1	1	0	6	Q5

For decimal 1 pins a value of pins Q0, Q2, Q4 should be 1. So we short the wires from those pins and give it to pin 7(input for a) in 7447 IC. Similarly other connections are given.

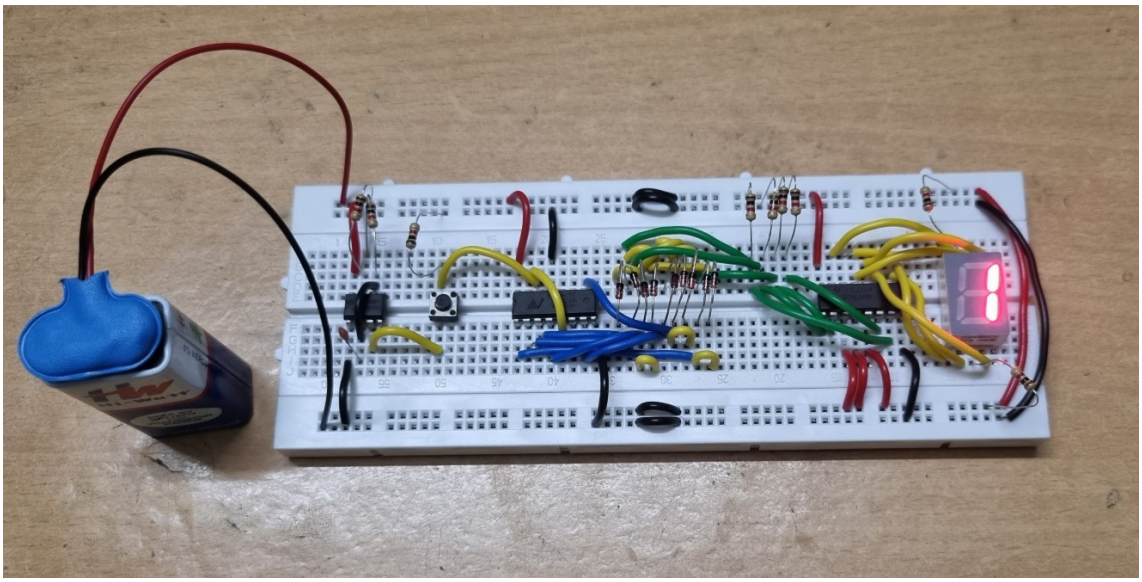


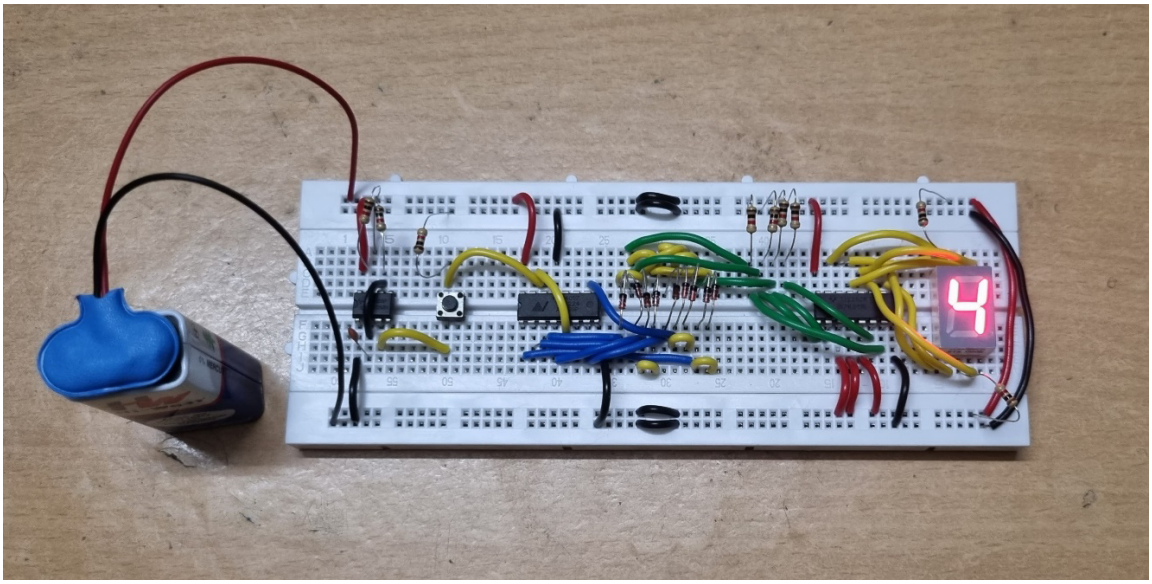
The yellow line represents this explanation.

Finally, the output from Q6 is given to Q15(reset pin) to continue the cycle.

In this random number generator we have used 7 segment display (common anode). The display starts flashing as soon as we press the push button but we cannot actually see that because the clock frequency is set very high. The flashing stops when we release the button. After release, display shows the numbers, which we get got on Dice.

SNAPSHOTS:





APPLICATIONS:

1. Designing and implementing a digital instruction assisted system
2. It can be used as a normal dice in any board games
3. It can give any random value from 1 to 6.

HDL CODE :-

```
module LFSR (
    input clock,
    input reset,
    output [12:0] rnd
    );

wire feedback = random[12] ^ random[3] ^ random[2] ^ random[0];
```

```
reg [12:0] random, random_next, random_done;
reg [3:0] count, count_next; //to keep track of the shifts

always @ (posedge clock or posedge reset)
begin
 if (reset)
 begin
  random <= 13'hF; //An LFSR cannot have an all 0 state, thus reset to FF
  count <= 0;
 end

 else
 begin
  random <= random_next;
  count <= count_next;
 end
end
```

```
always @ (*)

begin

 random_next = random; //default state stays the same

 count_next = count;


  random_next = {random[11:0], feedback}; //shift left the xor'd every
posedge clock

  count_next = count + 1;


 if (count == 13)

 begin

  count = 0;

  random_done = random; //assign the random number to output after 13
shifts

 end


end




assign rnd = random_done;
```

```
endmodule


module test;


 // Inputs
 reg clock;
 reg reset;

 // Outputs
 wire [12:0] rnd;

 // Instantiate the Unit Under Test (UUT)
 LFSR uut (
  .clock(clock),
  .reset(reset),
  .rnd(rnd)
 );
```

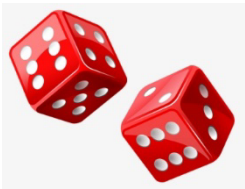
```
initial begin
 clock = 0;
 forever
  #50 clock = ~clock;
 end

initial begin
 // Initialize Inputs

 reset = 0;

 // Wait 100 ns for global reset to finish
 #100;
    reset = 1;
 #200;
 reset = 0;
 // Add stimulus here

end
```

```
 initial begin
 $display("clock rnd");
 $monitor("%b,%b", clock, rnd);
 end
endmodule
```

CONCLUSION:

The working of IC 4017 along with IC 555- timer have been observed with implementation of the 'Electronic Dice'. The desired digital dice has been designed and the complete system is working as per the initial specifications and requirements of our project. As the users play with the system, they develop various new ideas for the development and enhancement of the project.

REFERENCES:



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Digital Dice by 7-Segment Display, 555,4017,7447 without microcontroller - YouTube