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INTRODUCTION

A dice is a throwable device with multiple resting positions and used for generating random numbers. The design is aimed at the die providing a randomly determined integer from one to six, each of those values being equally likely.

Playing with dice is an age-old game. Everyone loves to play with it too. Originally dice were used for sorcery and to predict the future, Wise man from the village would roll the dice and, depending on the outcome, would predict what auspicious or inauspicious events were going to happen in the future.

Playing with dice needs us to pick up a dice and make sure that it is unbiased. Generally, dice is made up of wooden and plastic which can be biased. A dice can become biased if it is not properly cut or if it has deformations. So, to solve these problems we have with our conventional dice we made a dice circuit which is totally unbiased. There is no chance of cheating as the circuit is operated at a very high speed which is almost imperceptible to the human eye.

So, it very reliable and a good alternative for conventional dice. Also, there is hardly any impact on aging and a very little maintenance. With the change in power supply voltage and aging of the active and passive components the frequency may vary a bit but still the randomness will be preserved.

There are many applications of dice which are listed below:

- Snakes and Ladders
- Chutes and Ladders
- Ludo
- Monopoly
- Business

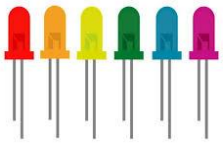
So, the objective of this project is to create unbiased dice which is far better and reliable than our conventional dice and can be used for many purposes. Also, the construction and working of the digital dice is discussed briefly.

DIGITAL DICE:

Digital dice is a device that displays, in random the numbers from 1 to 6 by flashing the LEDs. This is an alternative device that can be used to replace the traditional dice while playing games.

COMPONENTS USED:

- **LEDS X 6 :**



A Light Emitting Diode (LED) is an electronic component that gives out light when current passes through it and current can flow only in one direction. It is used as an indicator. In this project 6 different colours LED's is used for indicating random numbers from 1 to 6.

- **RESISTORS – 2.2KΩ, 100KΩ :**

2 Resistors are used to reduce the voltage in a circuit.
Here 2 types of resistors are used.

- **CAPACITORS – 1NF AND 0.1µF :**

A capacitor can temporarily store electricity.
Charging is slower than discharging.

- **PUSH BUTTON** -

It is an electronic component that detect movement. It is in two states ON and OFF. When the switch is activated, the input pin is connected to the positive battery supply (V+). This provides an on (logic level 1) signal and the circuit starts working.

- **9V BATTERY**-

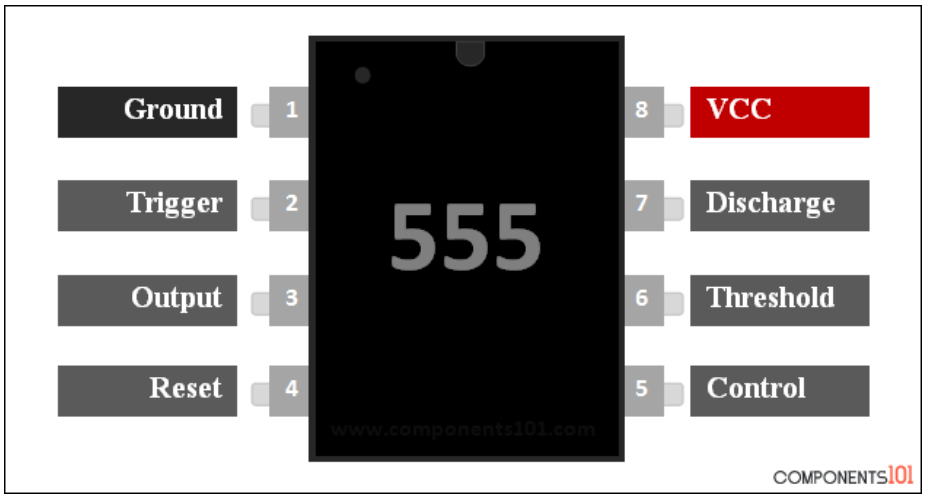
A battery is a source of electronic energy. It is a power supply. Batteries contain chemicals that store energy. When connected into a circuit the chemical energy is converted to electrical energy that can power the circuit.

- **CONNECTING WIRES**-

In electronics a wire is usually made of a conductive inner wire with a non-conductive shell around it. It is used for connections.

- **555 TIMER IC:**

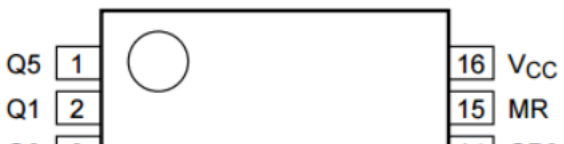
The **555 timer IC** is an integrated circuit (chip) used in a variety of timer, delay, pulse generation, and oscillator applications. In this circuit, it is used instable mode to generate clock pulse for decade counter to count.



Pin Number	Pin Name	Description
1	Ground	Ground Reference Voltage 0V
2	Trigger	Start of timing input. TRIG< ½ CONT sets output high and discharge open
3	Output	High current timer output signal
4	Reset	Active low reset input forces output and discharge low
5	Control	Controls comparator thresholds, Outputs2/3 VCC, allows by pass capacitor connection
6	Threshold	End of timing input. THRES> CONT sets output low and discharge low
7	Discharge	Open collector output to discharge timing capacitor
8	Vcc	Supply Voltage (Typical = 5V, Maximum = 18V)

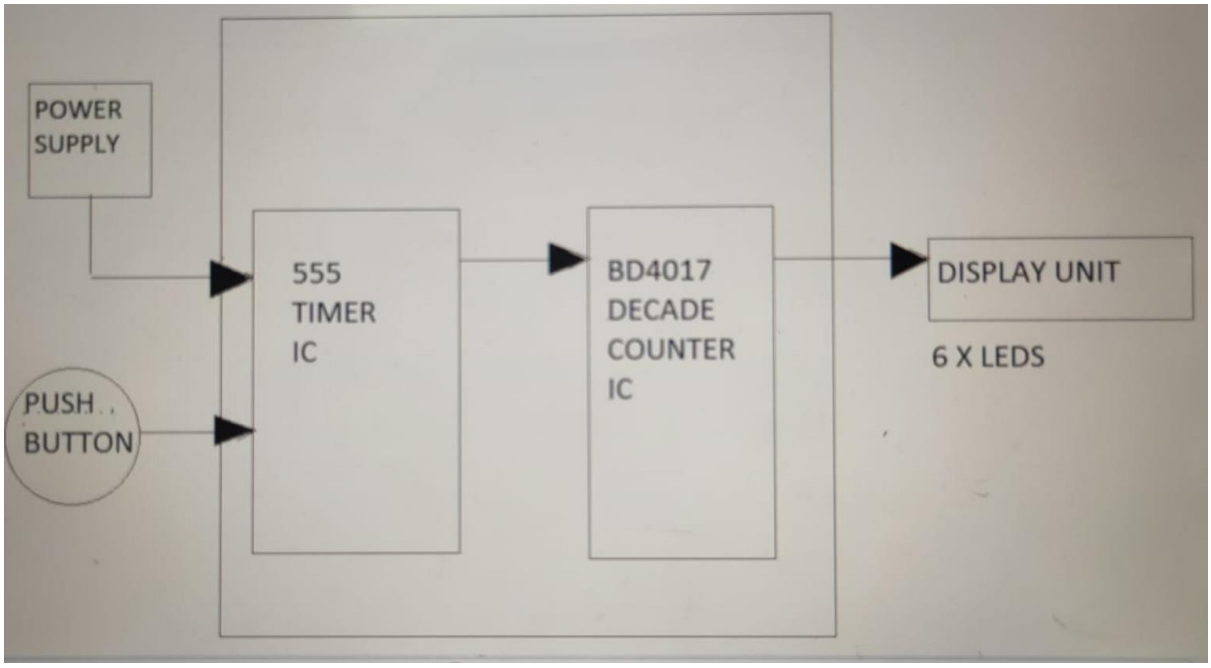
- **BD4017 DECADE COUNTER IC:**

CD4017 is a 16 pin CMOS decade counter/ Divider. It takes clock signal from the clock input and turns on the 10 output in sequence, each time when it receives clock input pulses.

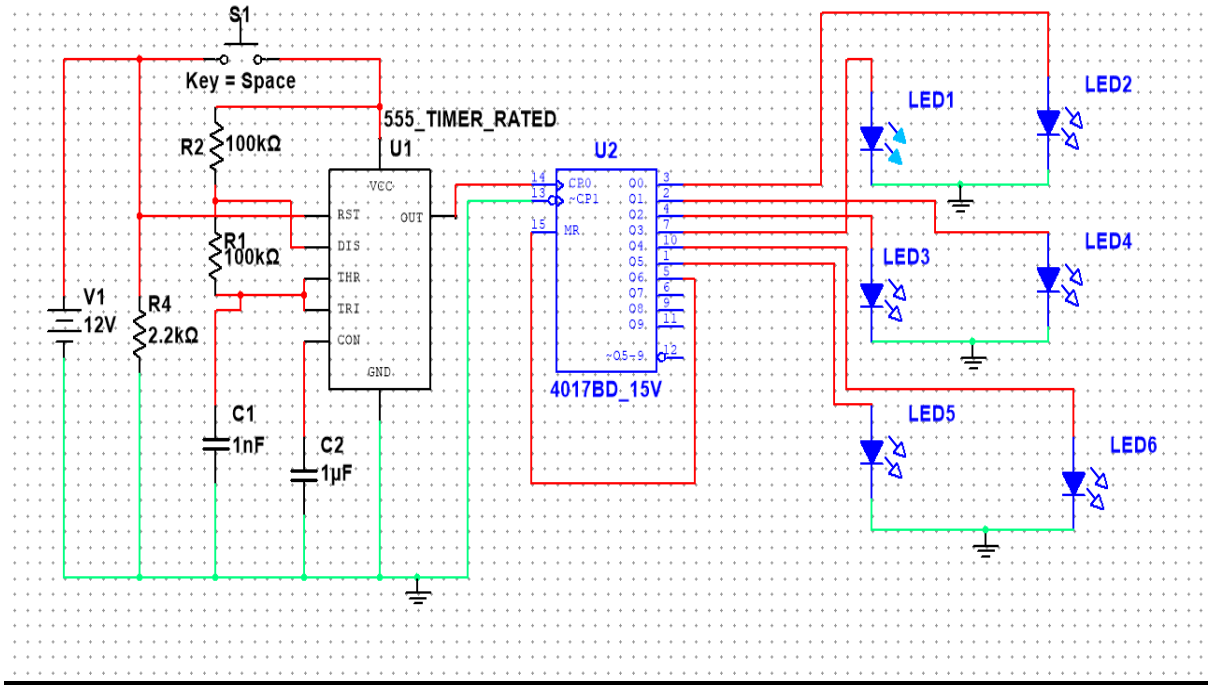


	PIN Name	PIN Description
1	Q5	Output 5: Goes high in 5 clock pulse
2	Q1	Output 1: Goes high in 1 clock pulse
3	Q0	Output 0: Goes high at the beginning – 0 clock pulse
4	Q2	Output 2: Goes high in 2 clock pulse
5	Q6	Output 6: Goes high in 6 clock pulse
6	Q7	Output 7: Goes high in 7clock pulse
7	Q3	Output 3: Goes high in 3 clock pulse
8	GND	Ground PIN
9	Q8	Output 8: Goes high in 8 clock pulse
10	Q4	Output 4: Goes high in 4 clock pulse
11	Q9	Output 9: Goes high in 9 clock pulse
12	CO –Carry out	Used to cascade another 4017 IC to makes it count up to 20, it is divided by 10 output PIN
13	CLOCK inhibit	Clock enable pin, should kept LOW, keeping HIGH will freeze the output.
14	CLOCK	Clock input, for sequentially HIGH the output pins from PIN 3 TO PIN 11
15	RESET	Active high pin, should be LOW for normal operation, setting HIGH will reset the IC (only Pin 3 remain HIGH)
16	VDD	Power supply PIN (5-12v)

BLOCK DIAGRAM



CIRCUIT DIAGRAM



CONSTRUCTION

In this dice circuit we have used 6 LED's. We have connected 6 LEDs to the output Q0 to Q5, and the seventh output Q6 is connected back to the RESET PIN 15. So that after LED 6 it starts from the First LED at Q0. 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. IC 4017 is CMOS decade counter chip, it produces output at the at the 10 pins, sequentially. The clock pulse at PIN14 controls the output. Initially output at pin3(Q0) is high and as the clock advances output advances to the next pin. Now, pin3 becomes lows and at output Q1 becomes high. Similarly, this cycle goes on and output at each pin becomes high sequentially from Q0-Q9. So, it creates sequential ON and OFF of all the 10 OUTPUT PINs Resistors are used to reduce the voltage in the circuit and battery is used to provide power supply.

We can control the speed of flashing LEDs by using the potentiometer, rotating the potentiometer knob will change oscillation frequency of 555 timer, hence the rate of clock pulse. Speed of LED flashing is directly proportional to the oscillation frequency of 555, High the frequency, as high the speed of flashing so no one can cheat. So, in this way you can increase the randomness.

The frequency of the 555 can be calculated using this formula:

$F=1.44/((R1+2*RV1)*C1)$

WORKING

When we press the push button, the counter (555 timer IC) starts from zero and generates the series of clock pulses with frequency in order of kilo hertz. This means that the circuit produces a clock cycle of about 0.00021 seconds. The values change so fast that it is almost imperceptible to human eye. The clock pulse is given to the counter cum decoder IC and the seventh output given to reset because we have to only count till 6 as dice has only 6 sides. So, first six outputs are given to 6 LEDs and corresponding LED will glow for each count. LEDs start flashing with the count when push button is pressed and stops when it is released.

If the count is one LED-1 will glow, and the clock pulse advances LED-2 will glow and so on until the sixth count. After the sixth count, when the next pulse is generated the counter will advance the count increment to seven, but as seventh output is connected to reset, the circuit resets itself and start the cycle again from Q0. After its release the LED which is glowing will tell you the number you got on dice.

VERILOG CODE

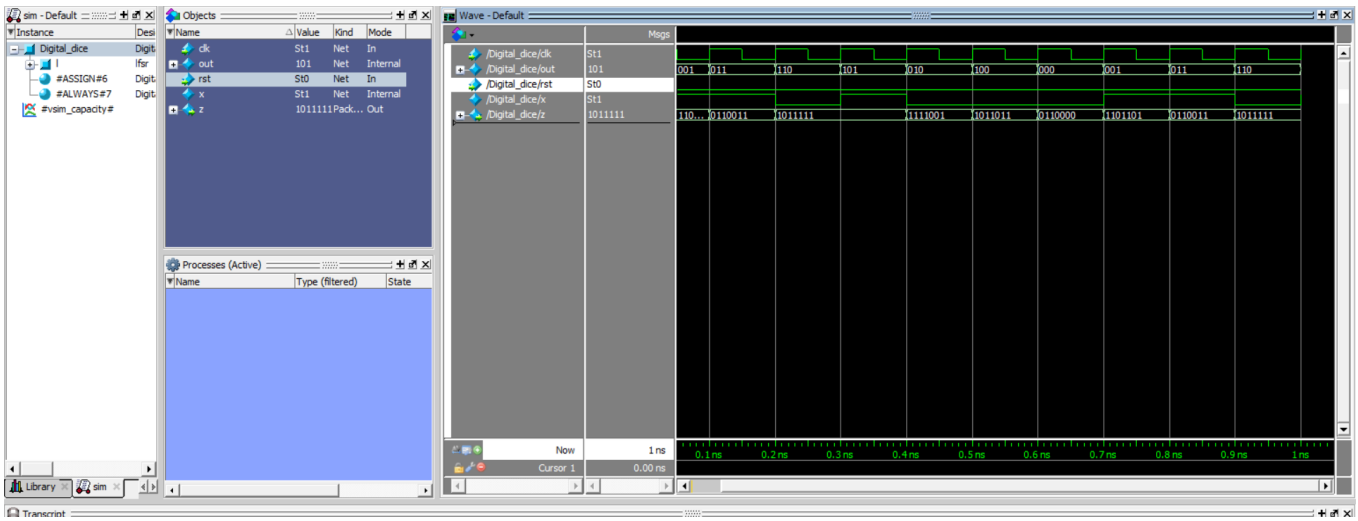
- *LFSR*

```
module lfsr(out,clk,rst);
output reg[2:0]out=3'b000;
input clk,rst;

wire feedback;

assign feedback=~(out[2]^out[1]);

always @(posedge clk, posedge rst)
begin
if(rst)
out=4'b0;
else
out={out[2:0],feedback};
end
endmodule


// testbench code

`timescale 1ns / 1ps

module lfsr_tb();

reg clk_tb;

reg rst_tb;

wire [3:0] out_tb;


initial

begin

   clk_tb = 0;

   rst_tb = 1;

   #15;

   rst_tb = 0;
```

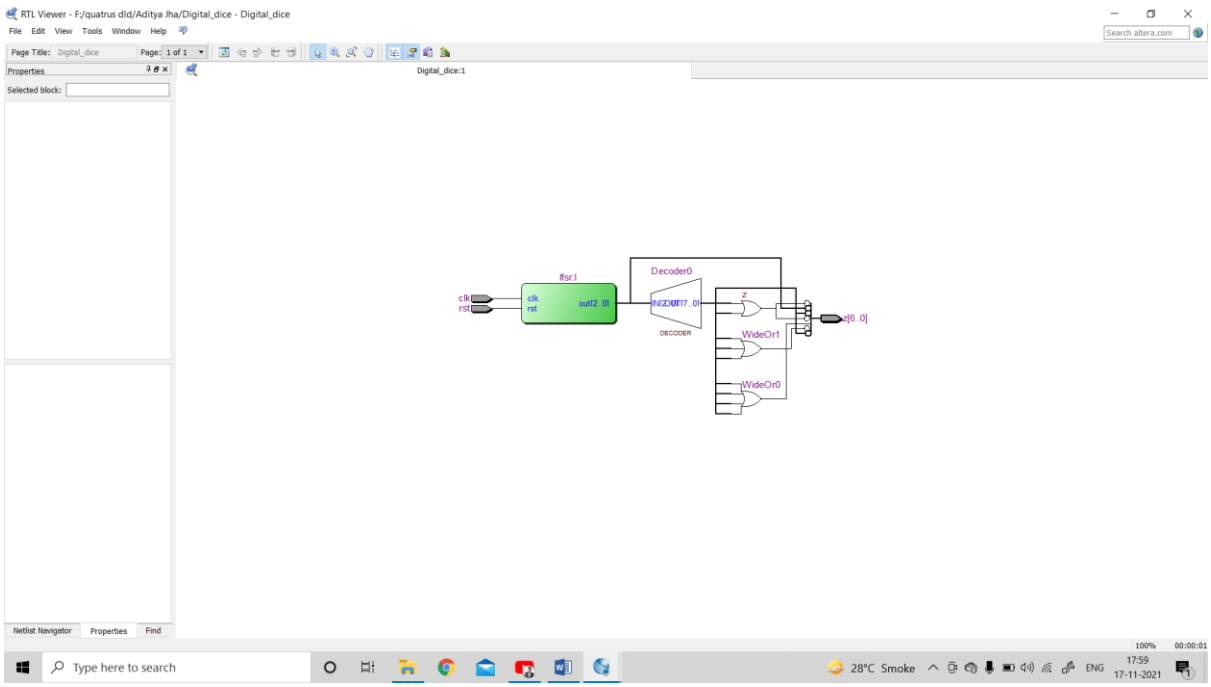
```
   #200;
end

always
begin
   #5;
   clk_tb = ~ clk_tb;
end

lfsr DUT(out_tb,clk_tb,rst_tb);
endmodule
 // main module
        module Digital_dice(clk,rst,z);
        input clk, rst;
        wire [2:0]out;
        output reg [6:0] z;
        lfsr l(out, clk, rst);
        assign x=out;
        always @(*)
        case (out)
        3'b000:begin
                z=7'b0110000;
                end
        3'b001:begin
                z=7'b1101101;
                end
        3'b010:begin
                z=7'b1111001;
                end
        3'b011:begin
                   z=7'b0110011;
                end
        3'b100:begin
                z=7'b1011011;
                end
        default:begin
                z=7'b1011111;
                end
```

endcase
endmodule

RTL SIMULATION ON MODELSIM



RTL VIEW



CONCLUSIONS

- An alternate device is used to replace the conventional dice while playing games.
- It can efficiently work at 15V supply.
- 555 can generate pulse when connected in astable mode.
- Games turned into digital and more fun rather than manual as earlier.
- There is no chance of cheating in any manner.

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