3C8 Project Report

Student Name:	**Vanaj Kamboj**
Student ID Number:	**21355100**
Assessment Title:	**Digital Dice**
Lecturer (s):	**Eugene Rourke, Cormac Molloy**
Date Submitted	**20.02.2022**

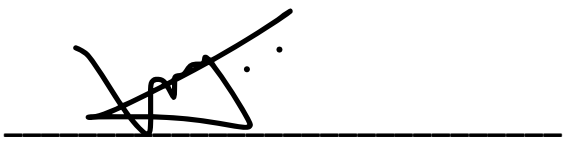
I hereby declare that this assessment submission is entirely my own work and that it has not been submitted as an exercise for a degree at this or any other university.

I hereby declare that I have not shared any part of this submission with any other student or person.

I have read and I understand the plagiarism provisions in the General Regulations of the University Calendar for the current year, found at: http://www.tcd.ie/calendar

I have also completed the Online Tutorial on avoiding plagiarism 'Ready, Steady, Write', located at http://tcd-ie.libguides.com/plagiarism/ready-steady-write

I am aware that the module coordinator reserves the right to submit my exam to Turnitin and may follow up with further actions if required should I be found to have breached College policy on plagiarism

Signed: 

Date: **20.02.2022**

Abstract

This report gives the outline of Group 2's approach to design and build the Digital Dice. The aim of this project was to familiarize ourselves with the designing software (Multisim) and use gate level logic to build a digital dice. The testing was done using Arduino.

Our groups approach towards building the digital dice was simple and efficient. No major issues arose during the designing and building of the project. The Digital Dice was fully-functional and met all of the requirements given to us for the project.

Introduction

The Digital Dice was made by 7 LEDs arranged in a dice layout controlled by 4 pins A, B, C and D. We used CMOS CD4000 series of logic devices for this circuit.

The task of the Dice is to generate any number between 1 to 6 by clicking a button and the probability of each number appearing on the dice was supposed to be equal.

Circuit Design and Implementation

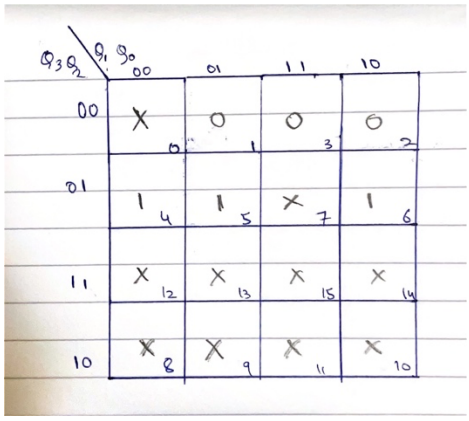
The template of the dice's schematic was provided to us which included the LEDs and how the pins were supposed to be connected to get the desired output.

After receiving the task of the project, the group started to discuss various methods for implementing the design. Everyone was set to design a circuit that would use the 4029 counter to count from 1 to 6 and use minimum number of gates to decode the signal to the input pins A, B, C, D of the Digital Dice.

The gate level logic for the decoder was built using truth tables and K-maps as shown below. Putting in desired outputs for A,B,C,D and using don't cares for values that are not useful in our circuit.

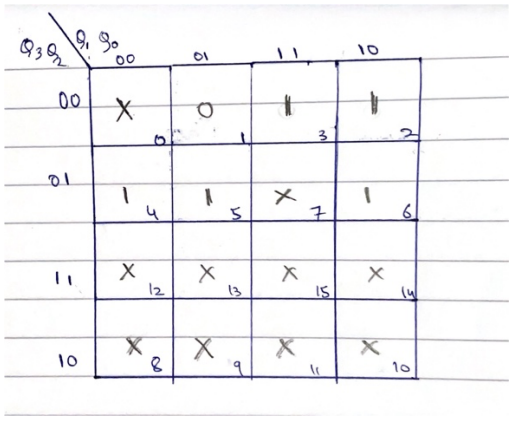
Q3	Q2	Q1	Q0	A	B	C	D
0	0	0	0	X	X	X	X
0	0	0	1	0	0	1	0
0	0	1	0	0	1	0	0
0	0	1	1	0	1	1	0
0	1	0	0	1	1	0	0
0	1	0	1	1	1	1	0
0	1	1	0	1	1	0	1
0	1	1	1	X	X	X	X
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
1	1	1	1	X	X	X	X

Solving for A:



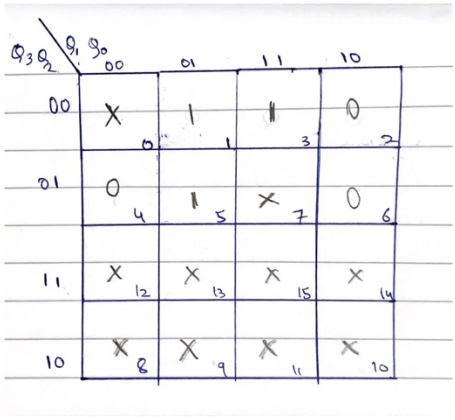
A = Q2

Solving for B:



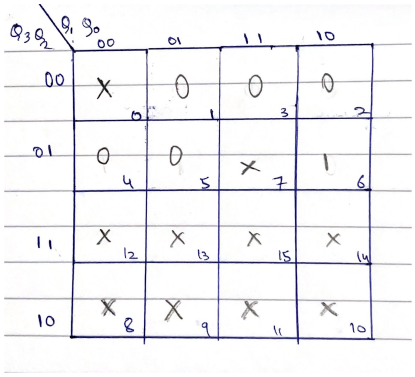
B = Q1 + Q2

Solving for C:



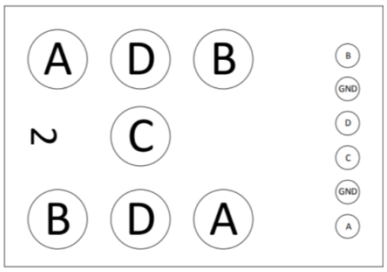
C = Q0

Solving for D:



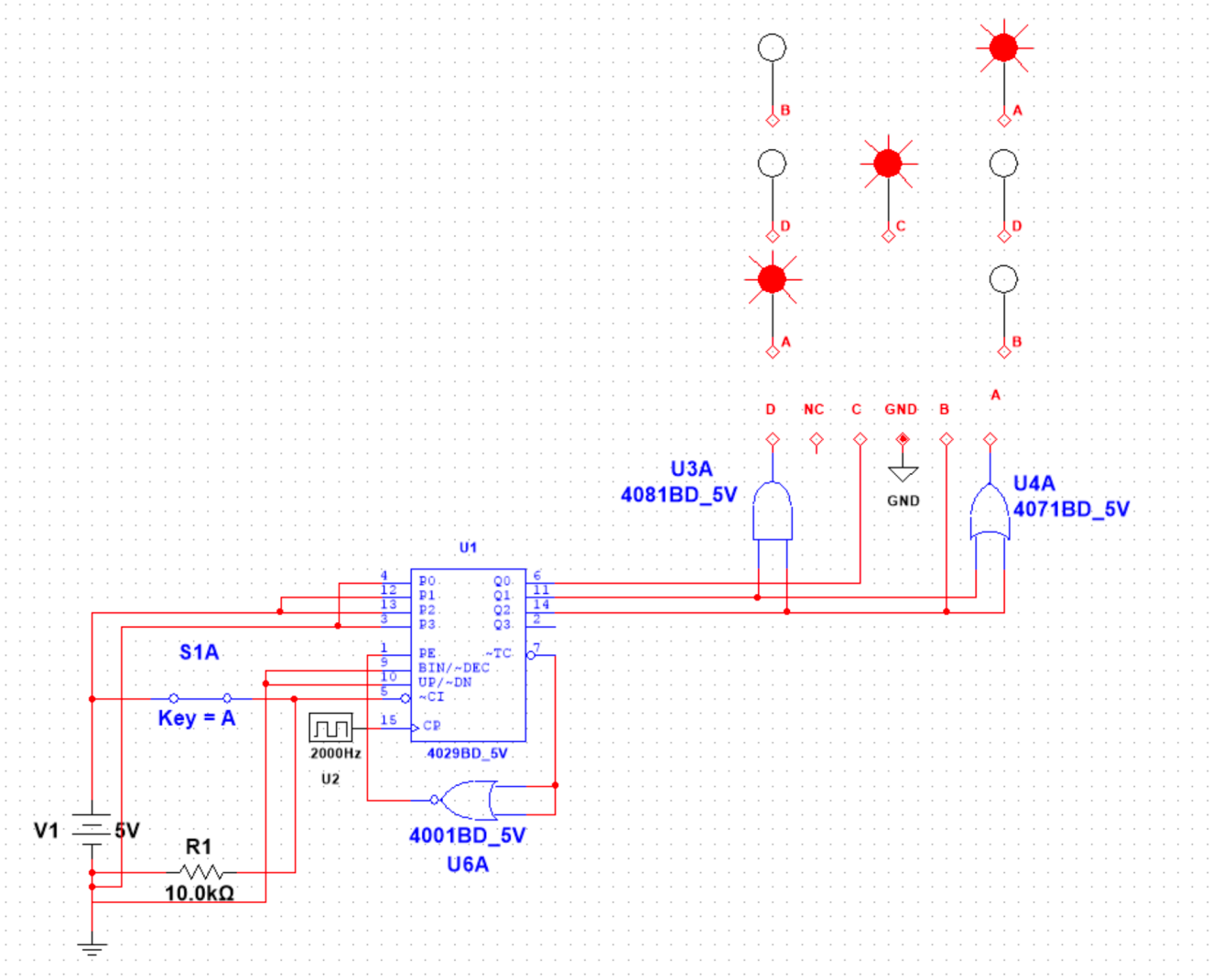
D = Q2Q1

Dice Layout used by group 2



The task was to generate random numbers from 1 to 6. Our group decided to design our dice in such a way that the 4029 counter counts from 1 to 6 and resets back to 1 after 6. To make this happen, we used the carry out signal. A NOR gate (4001) was connected between the carry-out pin and the enable pin on CD4029 device as shown in the schematic below.

In this way the enable pin would be set to 0 whenever the carry-out becomes 1 which would only happen when the device registers the number 6.



The role of the switch in this design is to stop the dice when the numbers run fast from 1 to 6 and give out a random number. In this design the switch (S1A) would “land” the dice when it is open as there is no input to the carry pin. The clock was added to the circuit to keep all the blocks synchronous.

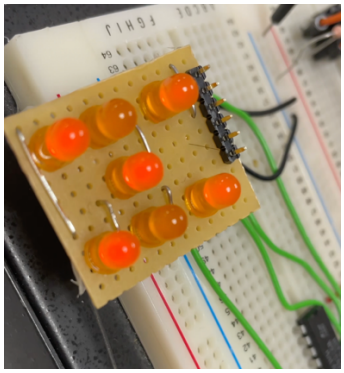
Testing

The testing of this device was fairly simple. First the design was tested on multisim by flipping the S1A switch open and close to see if random numbers were generated.

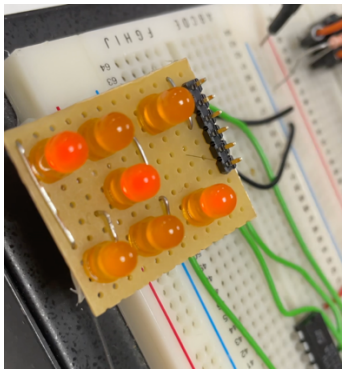
The frequency was decreased to visually check if all of the numbers from 1 to 6 are actually displayed on the LEDs and if there aren’t any irregularities in different cycles. This was done in multisim and also in Arduino by increasing the delay.

Results

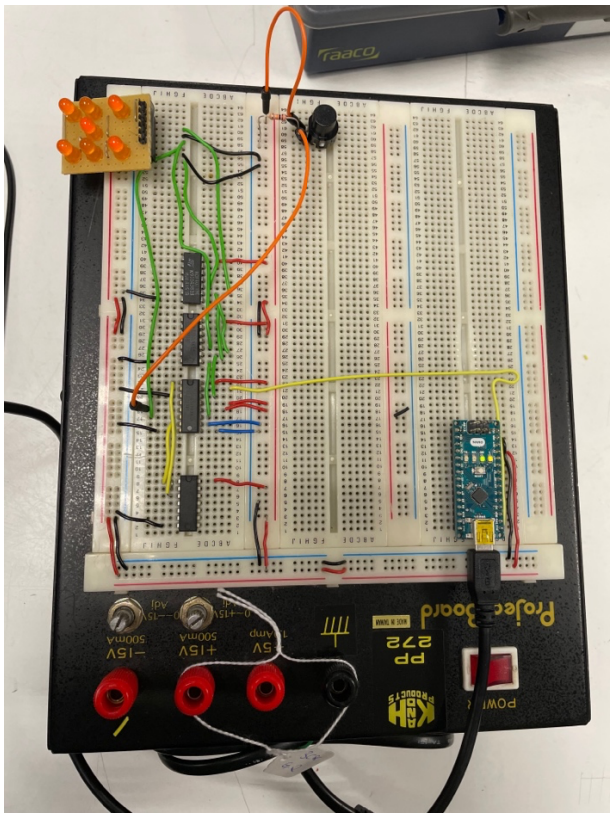
Our group built the following circuit on board and got the desired results. The results are shown in the pictures below.



Dice display random 5



Dice display random 3



Complete Circuit

Conclusion

It can be concluded that the project of designing and building the digital dice was successful. The group built a fully functional digital dice, in addition to gaining experience in team work, discussions and designing circuits. We also learned how to physically handle electrical components and build a circuit

References

There was no need of any references or specific source of information for this project other than our study material from college and guidance from our demonstrators during the lab.