FREQUENCY DIVISION OF A SIGNAL

D Flip Flop

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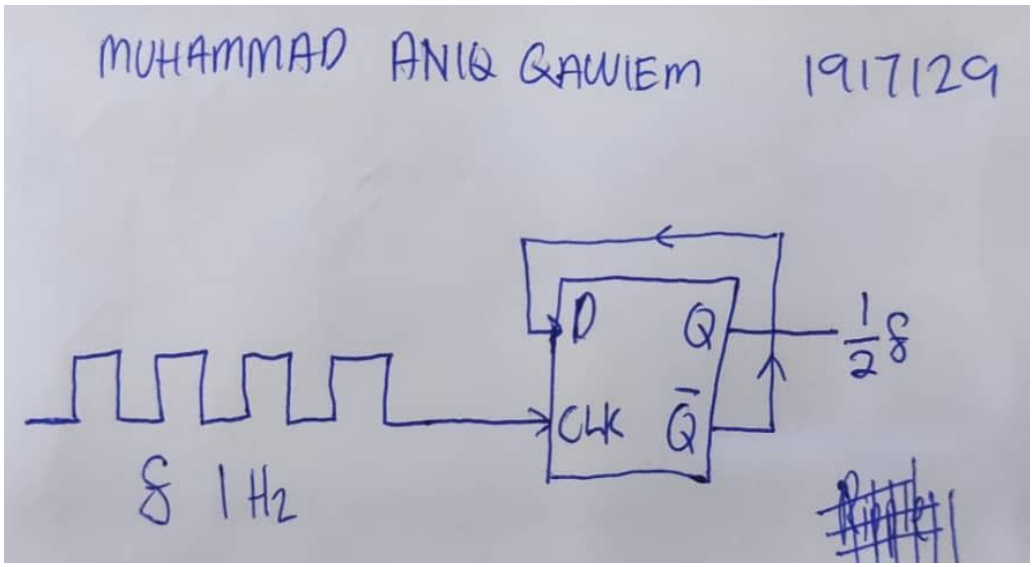
GOAL

1. To implement D Flip Flop in manipulating a signal of a system.
2. To manipulate the frequency of any periodic signal by doing ripple count half of the origin frequency of the signal.
3. To illustrate the function of D Flip Flop by various inputs of signal from signal function in TinkerCad.

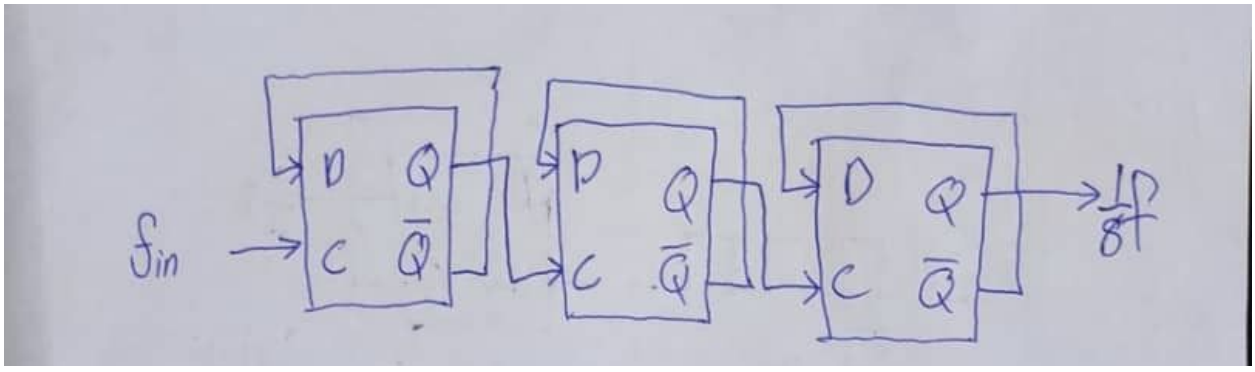
Design process

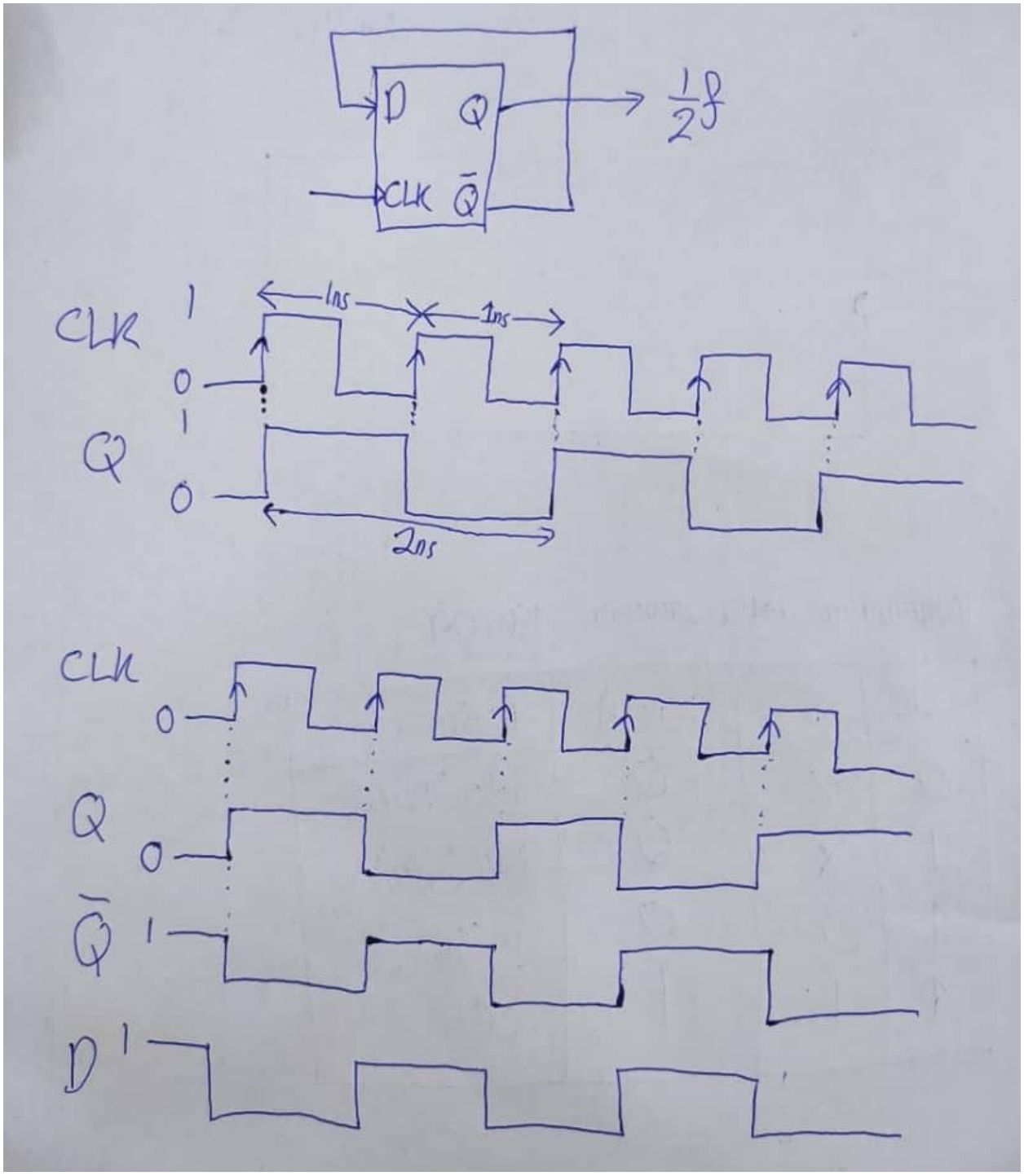
Designing D Flip Flop as a frequency divider, we have to use either 1, 2 or 3 numbers of D Flip Flop based on our desired output that we want. If we use one D Flip Flop, the output will be half of the frequency of the original signal. If we use two D Flip Flop. The output Q will be ¼ the frequency of the original signal if we apply the circuit as the same as one D F-F.

So, this is how the D Flip Flop work as a frequency divider :-



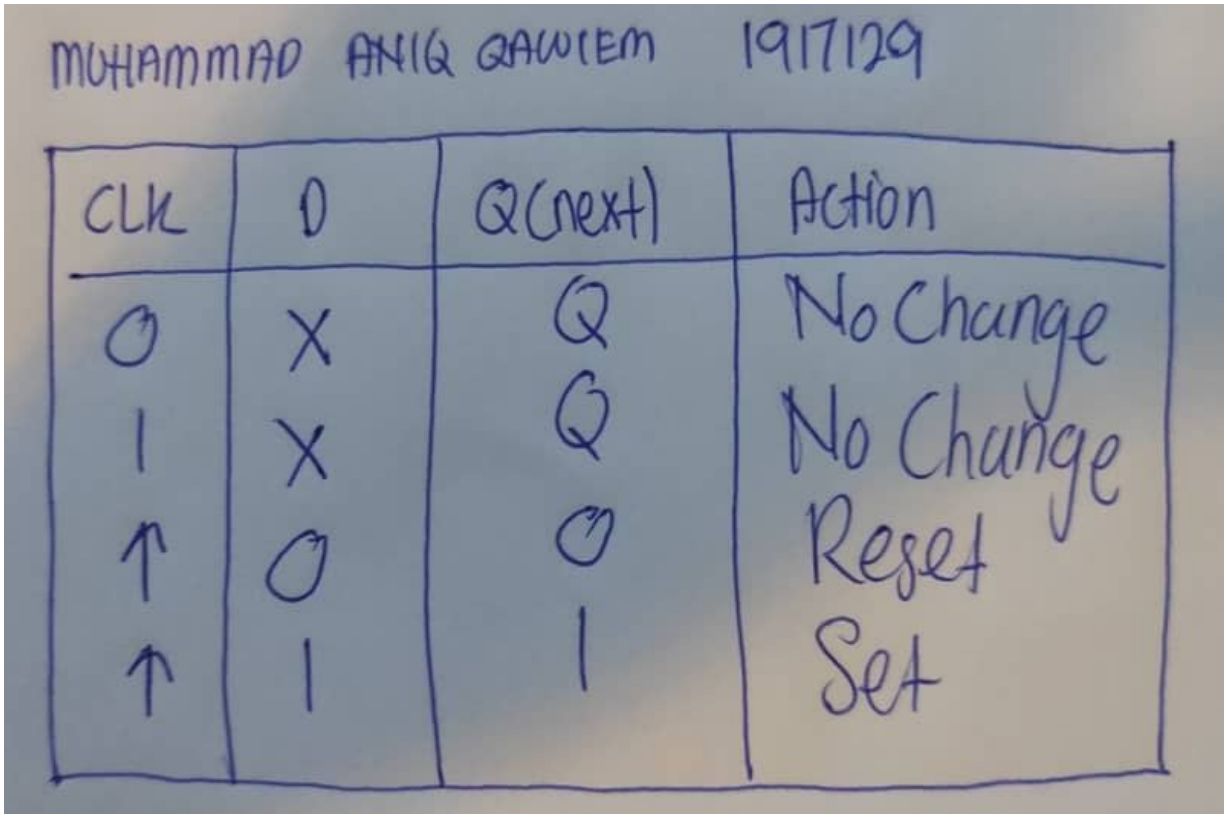
This is how combination of three flip flops that can make the output is ⅛ of the original frequency of the signal :-



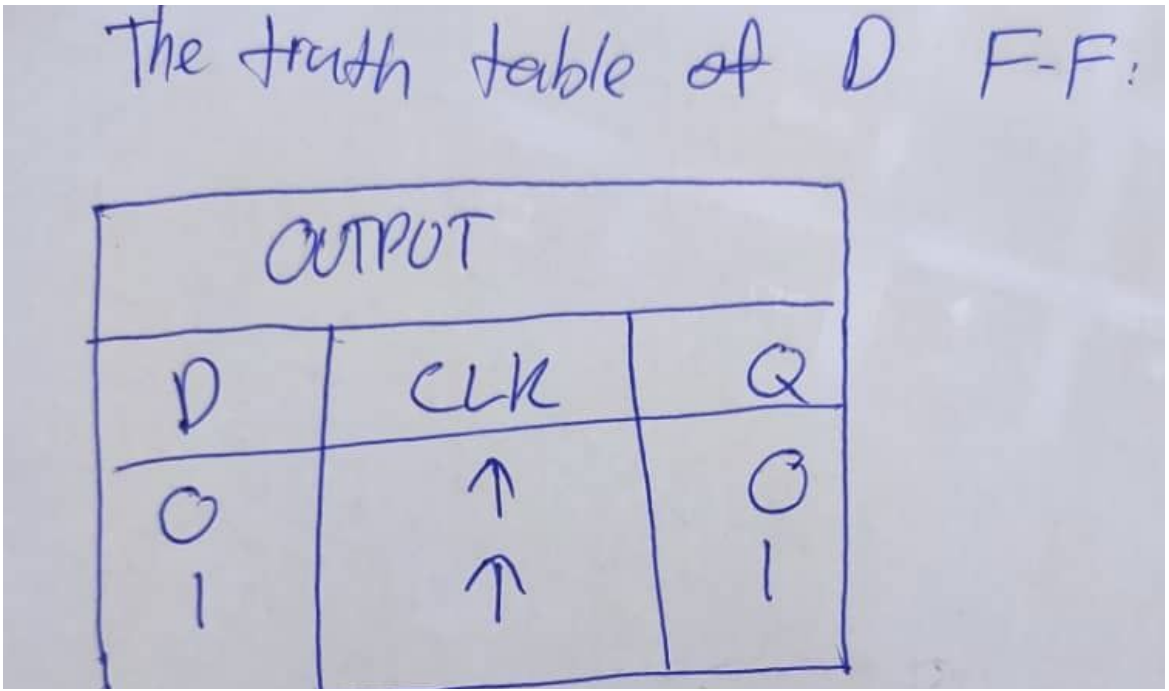

D
Q
CLK
$\bar{Q}$
$\frac{1}{2}f$
CLK
1
0
Q
1
0
1ns
1ns
2ns
CLK
0
Q
0
$\bar{Q}$
1
D'

Detailed design

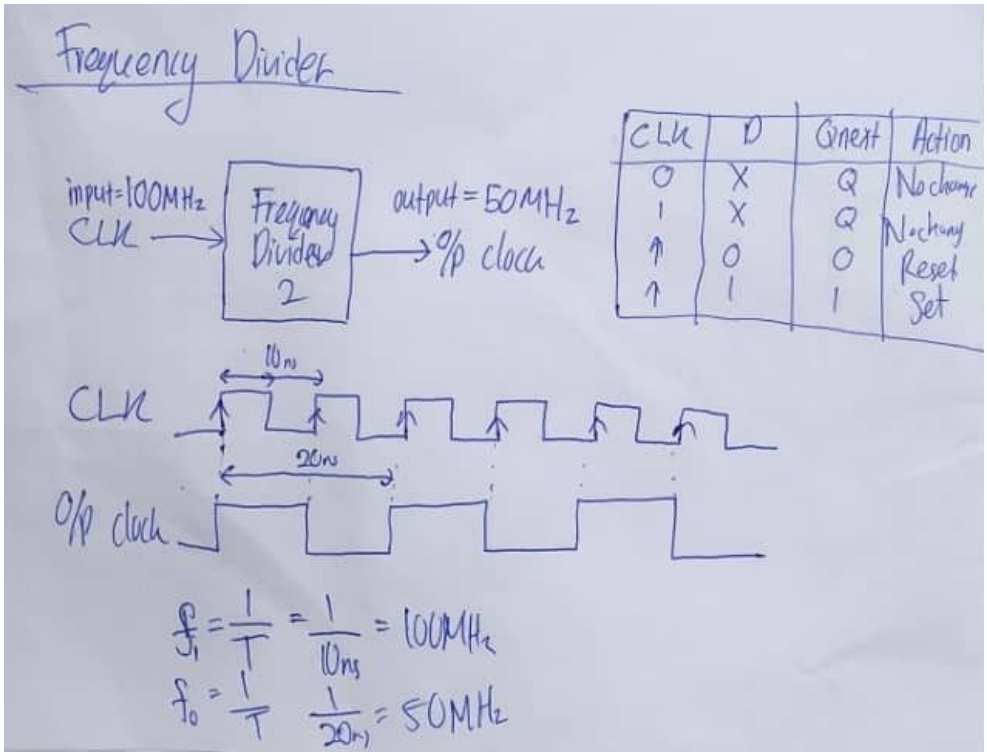
In designing D Flip Flop, first we have to know about the D Flip Flop. It has two inputs, clock input and D input. In Daily LIfe application, the input signal can be various from any sources, so users can just substitute the CLK input with another source of input to make it applicable in daily life. And then, it has two outputs, Q and Q'. The characteristic table is shown below:



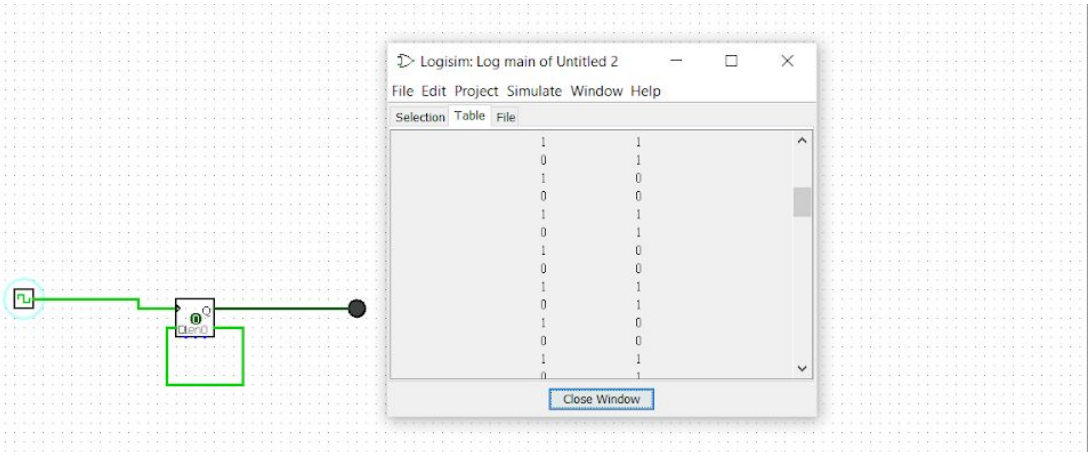
As a result, the truth table of the D Flip Flop is :-



From the truth table, we can use the D Flip Flop and we gain the frequency divider of 2 by using one D Flip Flop. Also, when we have another input of square wave, we can just divide it by 2 and pin it on the input clock, so the output signal for the Q is half of the input. This is the application of the D Flip Flop. :-

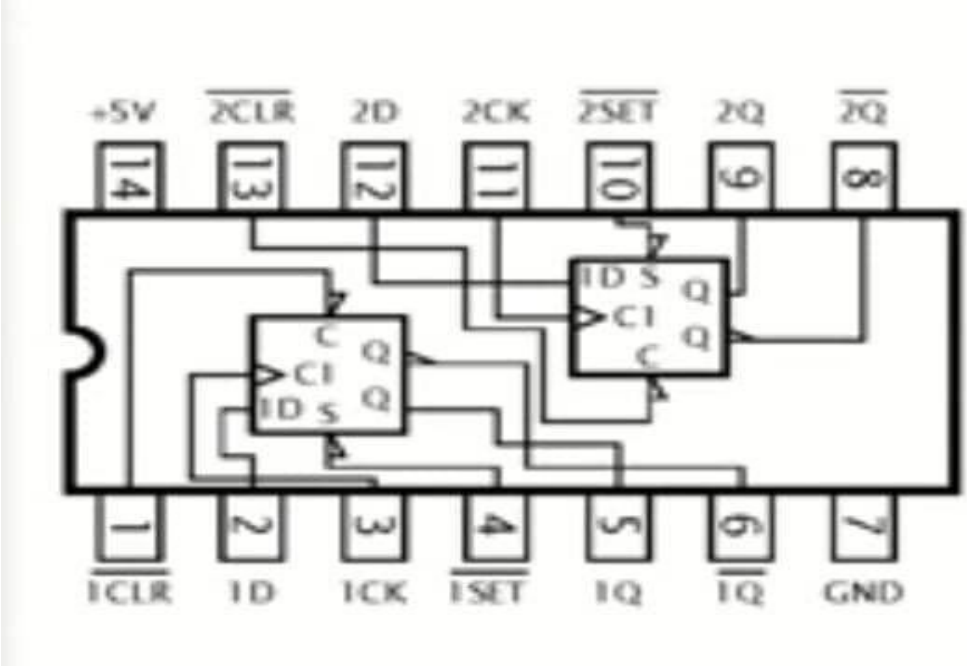


In Logisim, we can see the result of Q by substituting the Q with LED, and I apply the D Flip Flop to get the result of frequency divider of 2. The Table below shows the Input Clock(which can be various in daily life) and LED(right column; output).



Design verification

In Tinkercad, I use Dual D flip flop (74HC74),



First and foremost, I dont use the 2nd D Flip Flop in the 74HC74, so the output for Q will be half frequency as before. If I use 2 D Flip Flop. The output Q will be ¼ frequency with the input signal.

Pin 1 is connected to power supply

Pin 2 is connected to pin 6 because we want to gain Frequency divider

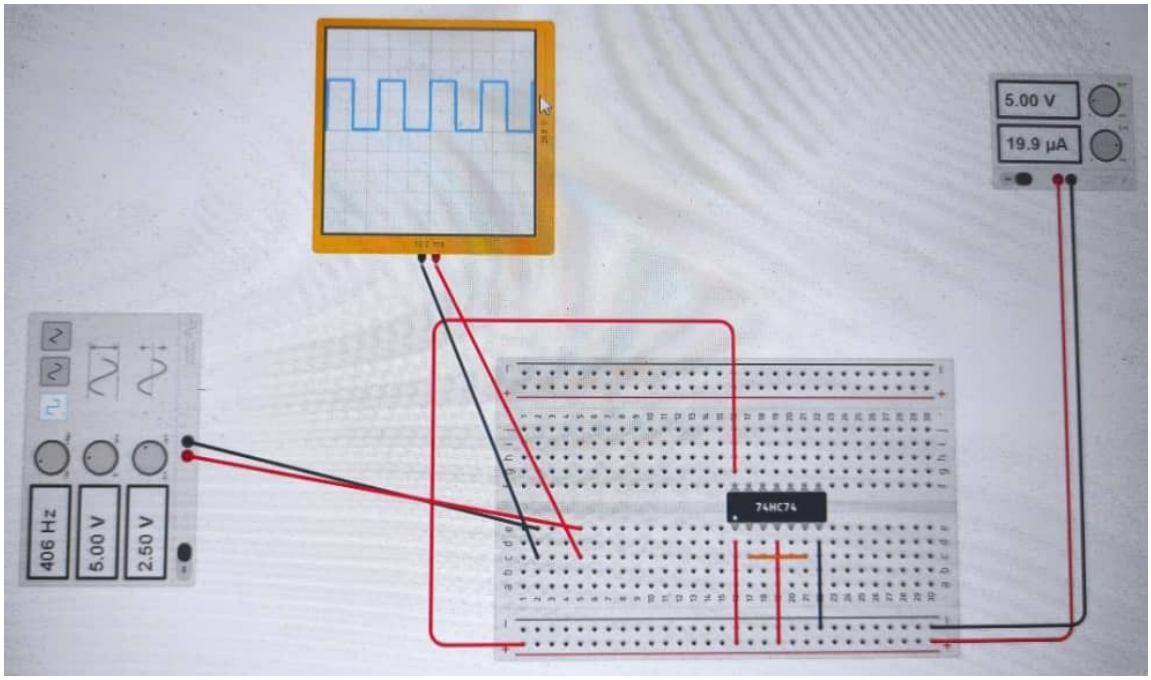
Pin 3 is connected to the source of the signal function

Pin 4 is connected to the power supply

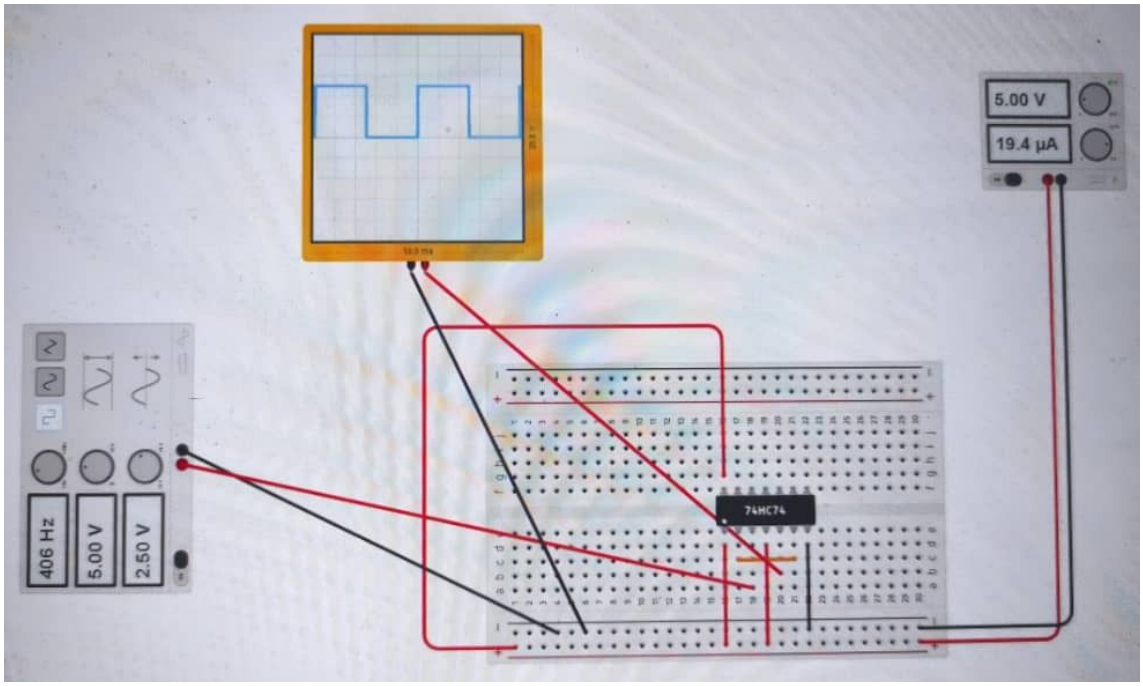
Pin 5 is connected to the oscilloscope to see the result of the divider using graph

Pin 6 is connected to pin 2 so that we can gain Frequency Divider

Comparison part for the application of D Flip Flop. This is my circuit before we apply the D Flip Flop, (The Oscillator is not measuring the Q output pin number 5 of the first D Flip Flop) :-



Next one is the circuit of the application of D Flip Flop in frequency division:



Conclusions

Using the simplest flip-flop as D Flip-Flop can make various functions in real life. Any variety of square wave input can be manipulated in terms of its frequency by using D Flip-Flop. Meanwhile, it can also act as a ripple counter by doing the same way of frequency divider.

Despite having advantage in manipulating signals. There are few limitations of the usage of D F-F. During the propagation delay between input and D, the stretch pulse must not exceed one clock cycle.

To conclude, although JK FF and SC FF can be applied for frequency dividers, D Flip Flop is the simplest frequency divider. In fact, it is easiest one to make an output divider by 2,4,8 or etc. So, the function of this D Flip Flop gives a big impact in designing any of signaal in our Digital Design.