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Four-Way Traffic Light Controller System

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Abstract—The simple traffic light controller design project was introduced to alleviate this shortcoming and gain experience in solving implementation and interfacing problems of a modern digital system. we implement a fully functional traffic signal controller for a four-way intersection. The function of a traffic light controller requires sophisticated control and coordination to ensure that traffic moves as smoothly and safely as possible. The project was designed in DSCH by using a 4-bit counter. The software implementation of the circuit was simple and reliable.

Keywords— Counter, alleviate, DSCH, Traffic Control, flip-flop, timer, logic control.

I. INTRODUCTION

Traffic lights, also known as traffic lamps, traffic signals, stoplight, stop-and-go lights semaphore or robots, are signalling devices positioned at pedestrian crossings, road intersections, and other locations to control competing flows of traffic. Traffic lights have installed in most cities around the world to control the flow of traffic. It assigns the right of way to road users by the use of lights in standard colours (Red - Yellow - Green), using a universal colour code (and a precise sequence, for colour blind). Traffic lights are used at busy intersections to more evenly apportion delay to the various users. The increasing amount of traffic in the cities has a large impact on the congestion and the time it takes to reach a certain destination.

A Traffic light controller plays a very important role to control the vehicles on the busy roads. Nowadays there are occurring many accidents because of the lack of properly maintained traffic signals. Besides, it creates a huge traffic jam. For example, in Dhaka city, the flow of vehicles in most of the crossways is not properly maintained. As a result, Dhaka city is badly affected by the traffic jam. This traffic light controller can be used to solve the traffic problem.

To solve these congestion problems, we have to build new facilities and infrastructure. The only disadvantage of making new roads on facilities is that it makes the surroundings more congested. So, for that reason we need to change the system rather than making new infrastructure twice. The Main goals of this paper are improving safety, minimizing travel time and increasing the capacity of Infrastructures. Such improvements are beneficial to health, economy and the environment. Measurably improve traffic flow. Reduce

environmental pollution caused by traffic Most importantly increases road safety. Control down to 4-phases traffic system with the traffic flow optimization strategies are the main objective of this project.

II. TRAFFIC-LIGHT CONTROLLER DESIGN

This project describes a simple traffic light controller design project for a junior level VLSI class at the Bijoy Sarani. It requires to develop a state machine-based controller for traffic signals at a four-way intersection. This intersection has two travel lanes in each direction; east, west, north and south. This project stresses the difference of writing DSCH and Cadence Virtuoso for modelling and synthesis and Microwind for creating the schematic layout. Optimize the traffic flow at network junctions.

III. TRAFFIC-SIGNAL PHASE SEQUENCES

The traffic light controller must handle a four-phase signal intersection. If we consider only straight way direction when Bijoy Sarani street is on then traffic is followed by North to South or South to North alternatively. During this EW street traffic is stopped by Red signal. After completion of NS street now EW street traffic is followed by East to West or West to East alternatively. If we considered another possibility to follow traffic in another direction rather than straightway direction, we can see from fig.1 that during Bijoy Sarani street on vehicles can go to left or right direction according to North-South direction parallelly to main direction because EW street is OFF during this. Similarly, we can say about EW street.

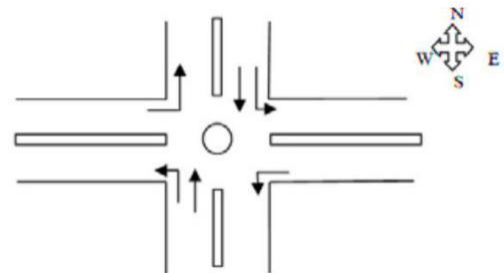


Fig.1: Four Way Road Structure.

IV. DESIGN IMPLEMENTATION

This project was implemented in DSCH v3.5 simulation software. This project is a combination of a 4-bit counter using D flip-flop, an inverter, 3 input and gate and Light emitting diodes. Design process:

- I. A D flip-flop was designed. Then the flip-flop schema was converted into a symbol.
- II. Using the 4 D flip-flop symbol a 4-bit counter was designed and then converted into a symbol.
- III. Finally, the traffic light controller was designed using the counter, an inverter, and an and gate.
- IV. With every count of the counter, the state of the traffic lights changed.

A traffic light at the intersection of north south (NS) and east-west (EW) streets goes through the following cycles of states: both red (30 sec), NS green (30 sec), NS yellow (5 s) -- both red(5s) EW green (30 sec) EW yellow (5sec). A 0.2 Hz clock signal is available for timing. Both streets are equipped with sensors that detects the presence of a car close to the intersection. Whenever there is a car close to the intersection on the street currently having its light red while there is no car approaching the intersection on the street with green light, the switchover takes place and green light immediately turns to yellow.

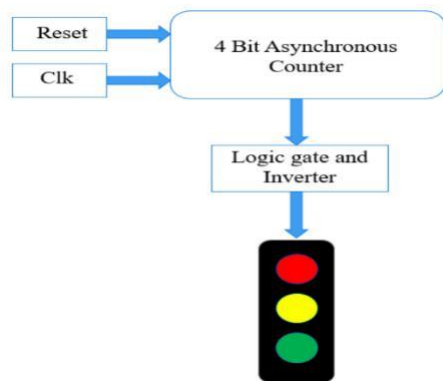


Fig. 2: Block diagram.

V. COMPONENT DESCRIPTION

Logic Gate: An AND gate and an INVERTER is used for this project. The inverter inverts high input to low output and low input to high output. Here inverter is also used for controlling lights.

D flip-flop: The D flip-flop tracks the input, making transitions with match those of the input D. In a D flip-flop there is one input and one clock. If the input is high when the clock pulse is applied the flip-flop will set.

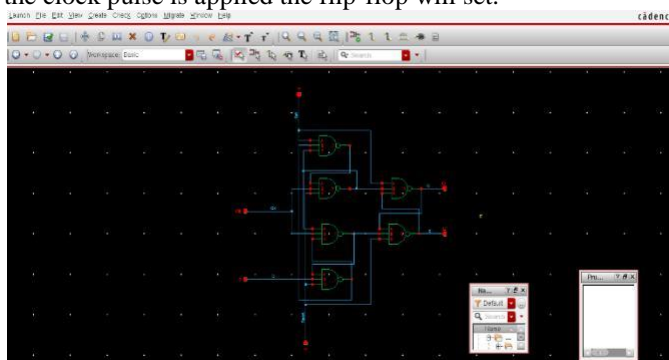


Fig.3: D flip-flop in cadence.

If there is low input when the clock pulse is provided the flip-flop will reset. In this project, D flip-flop has been used for designing the counter circuit.

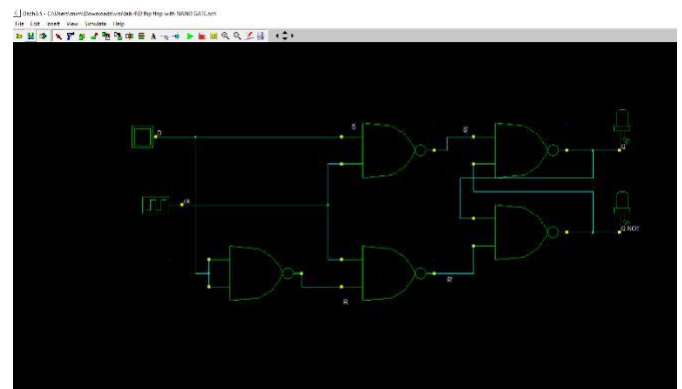


Fig.4: D flip-flop in DSCH.

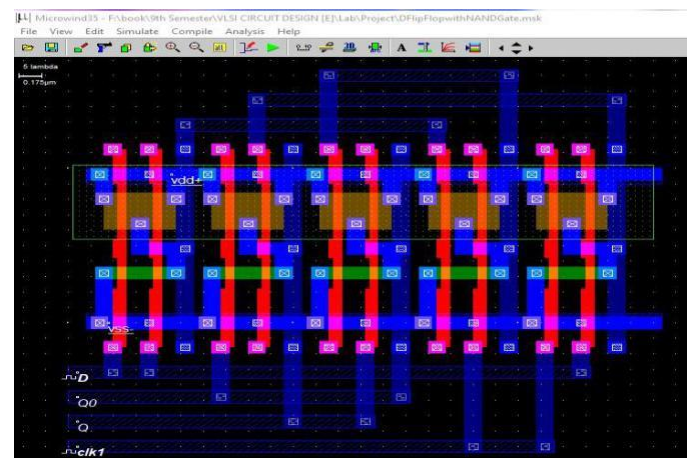


Fig.5: D flip-flop layout.

Asynchronous counter: Asynchronous counters are those whose output is free from the clock signal. Because the flip flops in asynchronous counters are supplied with different clock signals, there may be a delay in producing output. Asynchronous counter is a type of counter where clock pulse is provided to the clock input of the first flip-flop only. The second flip-flop is triggered by the output of the first flip-flop, the third flip-flop is triggered by the output of the second flipflop, and so on.

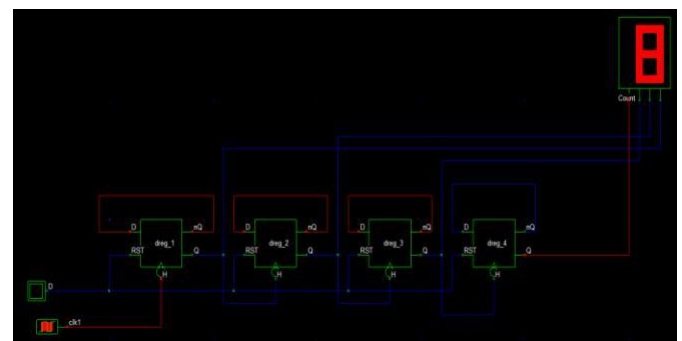


Fig.6: 4 Bit Counter in DSCH.

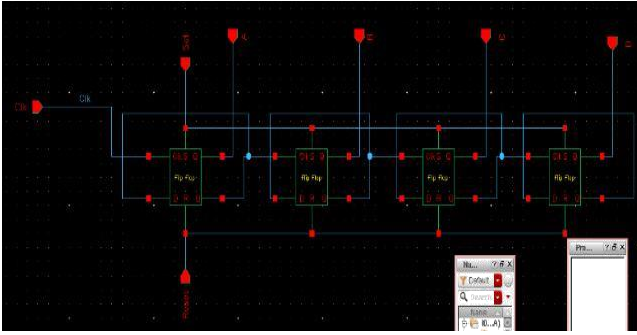


Fig.7: 4 Bit Counter in Cadence.

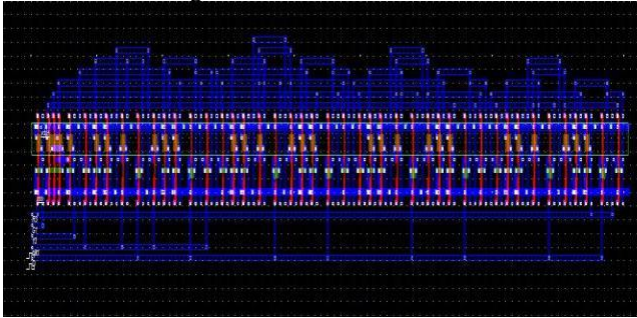


Fig.8: 4 Bit Counter Layout.

VI. WORKING PRINCIPLE

The system consists of an asynchronous counter inside which there are four D flip- flops. Using the clock pulse and Reset switches, the traffic lights are controlled. A reset and a clock are given as input to the counter. With every clock pulse, the counter counts one bit, and the state of the light change. While two face to face lights (street 1 & 3) would be turned green another two would be red and vice versa. The circuit was designed according to the proper logic diagram to fulfil this operation. The pulse rate of the clock can be set according to wish. The complete circuit is shown in the figure below.

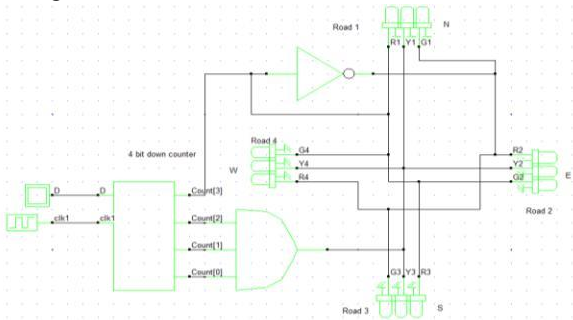


Fig.9: Traffic light controller in DSCH.

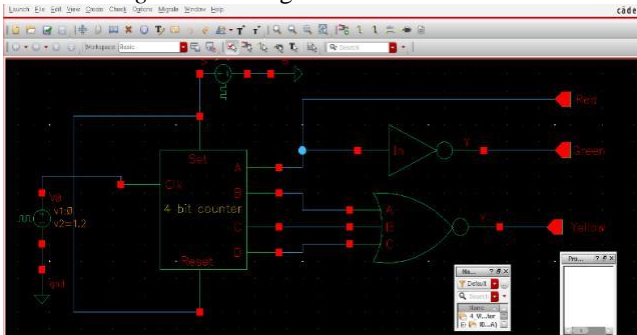


Fig.10: Traffic light controller in Cadence .

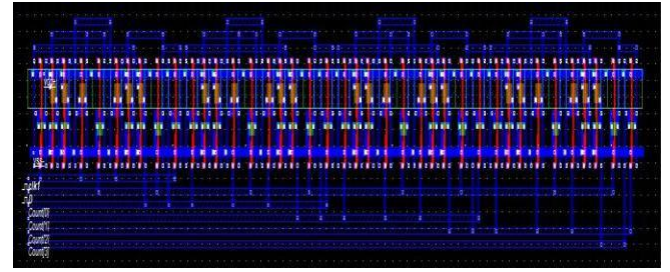


Fig.11: Traffic light controller system circuit layout.

Table I : Truth Table

Counts				Street 1			Street 2			Street 3			Street 4		
C1	C2	C3	C4	G1	Y1	R1	G2	Y2	R2	G3	Y3	R3	G4	Y4	R4
0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	1
0	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0
0	0	1	0	1	0	0	0	0	1	1	0	0	0	0	1
0	0	1	1	0	0	1	1	0	0	0	0	1	1	0	0
0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	1
0	1	0	1	0	0	1	1	0	0	0	0	1	1	0	0
0	1	1	0	1	0	0	0	0	1	1	0	0	0	0	1
0	1	1	1	0	0	1	1	0	0	0	0	1	1	0	0
1	0	0	0	1	0	0	0	0	1	1	0	0	0	0	1
1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0
1	0	1	0	1	0	0	0	0	1	1	0	0	0	0	1
1	0	1	1	0	0	1	1	0	0	0	0	1	1	0	0
1	1	0	0	1	0	0	0	0	1	1	0	0	0	0	1
1	1	0	1	0	0	1	1	0	0	0	0	1	1	0	0
1	1	1	0	1	1	0	0	1	1	1	1	0	0	1	1
1	1	1	1	0	1	1	1	1	0	0	1	1	1	1	0

VII. RESULT

After the implementation, we observed every state. Among them, three observations are shown below.

First observation:

Two opposite signal's red lights are on (Road 2 and 4) while the other two signal's green lights are on (Road 1 and 3).

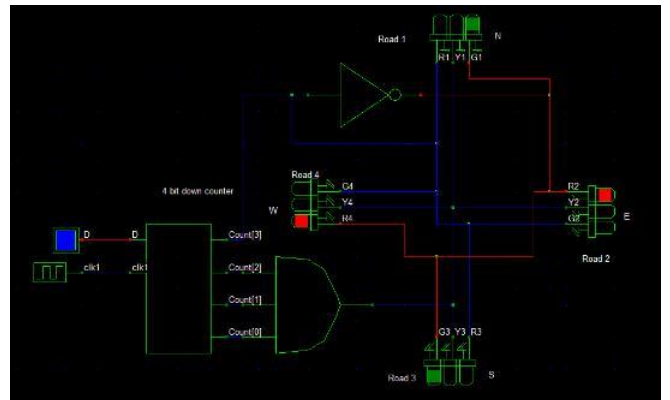


Fig.12: Observation 1 .

Second observation:

Now in every road all yellow light will turn on with previous state. In this way with every count of the counter, the state of the traffic lights changed.

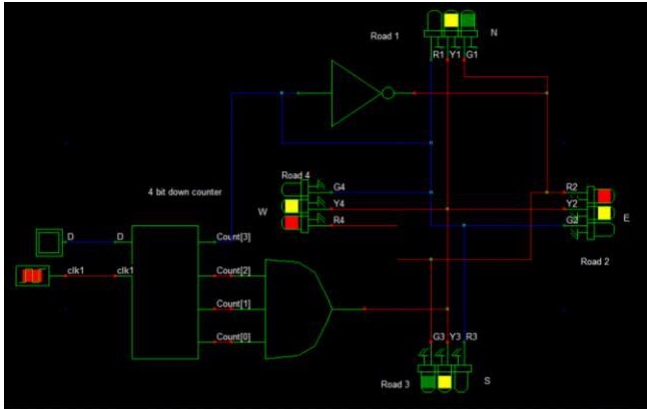


Fig.13: Observation 2.

Third observation:

In this state of the counter road 1 and 3 will block by turning on the red led on the other hand the road 2 and 4 will free to move the vehicle by turning on the green led.

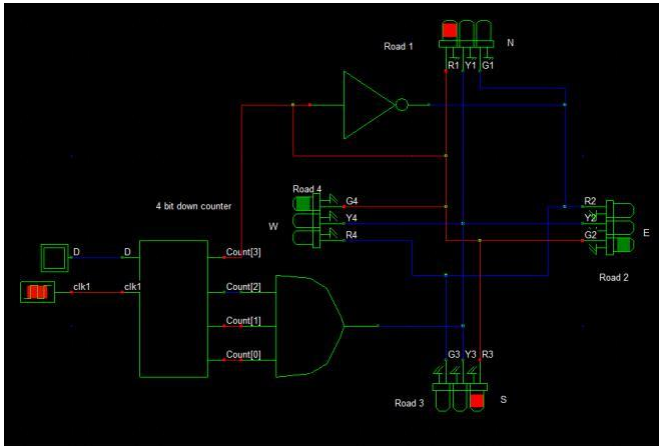


Fig.14: Observation 3.

According to counter input our design will work and the cycle will be continuing

Timing Diagram:

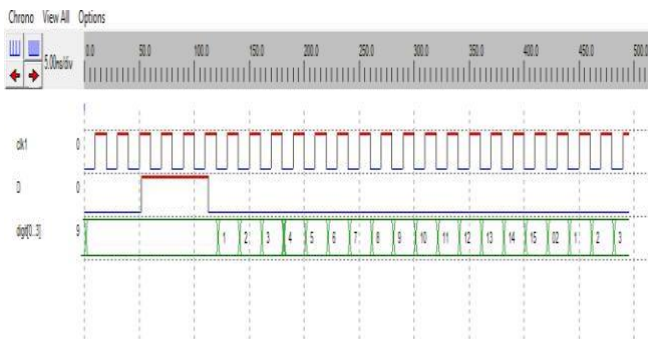


Fig.15: Timing Diagram for counter.

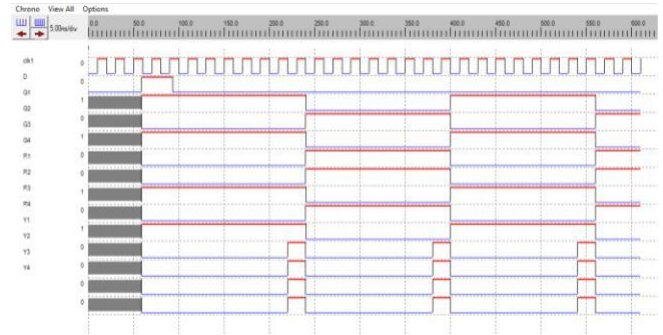


Fig.16: Timing Diagram of the system.

VIII. ADVANTAGES AND DISADVANTAGES

This design Process may be done in many ways. For example, by using Arduino, by using 555 timers, counters, and so on. Here we have used 4-bit asynchronous counter. Every design has its purpose. Based on that every design has some advantages and disadvantages.

The advantages of these projects are, this design process is simple and easy to design by using. The hardware implementation will cost low. As we have followed a simple design process. Easy to find the errors. Traffic control signals provide for an orderly movement of traffic. There is less chance of error as the face-to-face traffic lights depend on the counter.

Disadvantages are, as we have used D flip-flop, a delay flip flop in this circuit increased the circuit's size. There are associated with propagation delays. Traffic control signals may result in a re-entrant collision of vehicles. They may cause a delay in the quick movement of traffic. Another main disadvantage is we cannot set the times for signals individually.

IX. SOCIAL AND ECONOMIC IMPACT

Today's world is almost fully autonomous. For a heavy traffic city, it is a bad way to control traffic signals manually where it can create big problems for a tiny mistake. The project will work in a fully autonomous process which will reduce the dependency on manual traffic signal changing. Besides, it will reduce traffic jams and accidents as it will work in a sequential process. And it is a good solution to control traffic signals because of its simple design and low-cost implementation and maintenance.

X. CONCLUSION

We have designed full system of Traffic-Light Controller by implementing the logic of block diagram of the system and could simulate the result on LED 7-segment display using counter and switchover of LED during this counter interval. Instead of a manual traffic signal, we could go for an autonomous traffic light simulator, where the controller on each crossway will determine the duration of signal lights for the traffic of that particular road. The controller, on detecting

the traffic amount will trigger the control and ensure that the green signal is given for the required duration. A simulation-based traffic light controller system is good for analysing and making necessary modifications. Further development would be done on the traffic control system to become a more suitable and less costly model.

XI. REFERENCES

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