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FPGA BASED TRAFFIC LIGHT CONTROLLER

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ABSTRACT

The traffic light sequence works on the specific switching of red, green and yellow lights in a particular way with stipulated time from. The normal function of traffic lights requires sophisticated control and coordination to ensure that traffic moves as smoothly and safely as possible and that pedestrians are protected when they cross the roads. This Traffic Light sequence Is generated using a specific switching mechanism which will help to control a traffic light system on road In a specified sequence. This paper focuses on the fact that the traffic lights can be varied in the day and night mode depending on the intensity of the traffic. It plays a vital role in supervising and running the metropolitan traffic and evades the possibilities of any unfortunatemishaps happening in and around the cities. It is a sequential machine to be scrutinized as per the requirements and programmed through a multistep development process. The methods that are used in this projects are proposing the circuit, write a code, simulate, synthesis and implement on the hardware. This paper presents the FPGA implemented low cost advance TLC system using chip scope pro and virtual input output. The TLC implemented is one of the real and complex signaling lights In kingdom of Bahrain, for pedestrian way included four roads and sensors and camera assisted motorway.

The Traffic light controller is designed to generate a sequence of digital data called switching sequences that can be used to control the traffic lights of a junction in a fixed sequence. The simulation results physically prove the efficiency of the traffic system in an urban area, because the average waiting time of cars at every intersection is sharply dropped when the red light duration is 65 s and the green light time duration is 125 s. Meanwhile, further analysis also shows if we keep the inter arrival time of roads A, B, and C and changes that of roads D, E and F from 1.7 to 3.4 s and the inter departure time at the three intersection on roads A, B and C are equal to 0.6 s the total performance of this is the best. Finally according to the data collected from RFID readers and the best, second and third best traffic light duration generated from the simulation model, the automatic and dynamic traffic light control expert system can control how long traffic signals should be for traffic Improvement.

Keyword: Traffic Light, Fpga, Signal, Chip, Controller.

I. INTRODUCTION

Traffic congestion has been causing many critical problems and challenges in most cities of modern countries. To a commuter or traveler, congestion means lost time, missed opportunities, and frustration. The traffic light controller is designed to meet a complex specification. That specification documents the requirements that a

successful traffic light controller must meet. It consist of an operation specification that describes the different functions the controller must perform, a user interface description specifying what kind of interface the system must present to users and a detailed protocol for running the traffic lights. Each of these requirements sets imposed new constraints on the design and introduced new problems to solve[1]. Traffic jamming is a critical predicament in many of the cities and towns all over the world. Traffic congestion has been causing many setbacks and challenges in the major and most occupied cities all over the globe. To travel within the cities to the place of work or recreation has become a big problem to the commutates all along. Due to these problems people lose time, money and most importantly the energy resources will be exhausted due to the continual use in the automobiles. This traffic jam directly impacts the productivity of the workers, traders, suppliers and in all effecting the market and raising theprices of the commodities in a way. To solve these traffic related problems, we have to build new conveniences & infrastructure but at the same time make it smart. The only drawback of making new roads on facilities is that it makes the surroundings more congested, but then this will make a way to have new ways to ease the traffic.

We have to build new facilities and infrastructure making its use smarter for its efficient use. For this many ideas about the traffic light systems have come up in the recent past to simplify the complex problem of the traffic congestion. Mostly we see that the time allocation is fixed for east and west side, similarly for north and south direction in a traffic light controller at crossroads.

Traffic light controller (TLC) has been implemented using microcontroller FPGA, and ASIC design. FPGA has many advantages over microcontroller, some of these advantages are; the speed, number of input/output ports and performance which are all very important in TLC design, at the same time ASIC design is more expensive than FPGA[2].

II. FPGA

Field Programmable Gate Arrays (FPGAs) are expansively used in quick prototyping and verification of conceptual design and also used in electronic systems where the mask-production of a custom IC becomes really expensive due to the small quantity. The use of the FPGA's is increasing to avoid the high costs for a custom VLSI for a small quantity. Many system designs that used to be built in custom silicon VLSI are now implemented in Filed Programmable Gate Arrays.

III. FPGA DESIGN FLOW

A simplified version of design flow is given in the following block diagram

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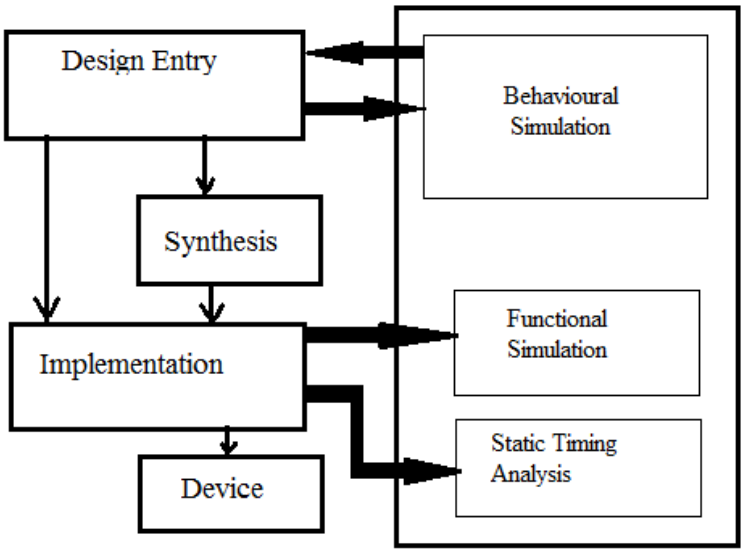

Fig.1 Block diagram for FPGA simulation Design Entry

There are various techniques for design entry. Schematic based, Hardware Description Language and combination of both etc. Selection of a method depends on the design and designer. If the designer wants to deal more with Hardware, then Schematic entry is the good choice. When the design is complex or the designer thinks the design in an algorithmic way then HDL is the better choice. Language based entry is faster but lag in performance and density.

HDLs represent a level of abstraction that can separate the designers from the details of the hardware implementation. Schematic based entry gives designers much more visibility into the hardware. It is the good choice for those who are hardware adapted to another method but rarely used is state-machines. It is the better choice for the designers who think the design as a series of states. But the tools for state machine entry ate limited. In this documentation we are going to deal with the HDL based design entry.[2]

IV. ELECTRONIC DESIGN WITH FPGAs

•Standard products-These products provide a functionality which is not associated with a specific application area but common to a broad range of devices. Typical parts in this category are processors and memories.

•Application specific standard products or ASSPs-These products provide functionality which Is not associated with a specific implementation, but common to an application area. Typical parts in this category are MPEG decoders.

• Custom Logic-This logic is associated with a specific application and is the essence of what distinct one product form another. Often this is glue logic, connecting standard products or ASSPs with each other. There are several option on how to implement custom logic, FPGAs being one amongst them.[1]

Traffic light controller can be designed by starting with certain assumptions. Initially Red signal is ON in North, East, West and South direction. Now when the reset is made high the North traffic will beallowed to move and traffic in all the remaining directions are stopped. Later the traffic in all the other direction is allowed to move in

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the sequence. The advantage of this particular Traffic light controller program is that modification can be done easily as per the requirements i.e., suppose the traffic on main road and the side road can be controlled by changing the states accordingly, when the main road traffic is heavy when compared to the side road traffic. In general Traffic light controller system consist of three lights (red, green and yellow) in each direction. The red light indicate stop, green light indicate to allow the traffic and yellow light indicates the caution that the traffic is going to be stopped in few seconds. The traffic light controller is a sequential circuit and is modeled as a finite state machine. [2]

V. TLC FLOW CHART

The Flow Chart shown in Fig. 2 illustrates the actions to be taken by the road users. Initially, all RED signals are ON and after few seconds, GREEN of a signal light in one particular direction will be ON to allow traffic in straight, right and left (left also sometimes needed) paths. The yellow light is split into two phases as yellow signal1 (Y1) and yellow signal2 (Y2. Pedestrian will be "OFF" in yellow sognal1 (Y1) and pedestrian will be "ON" in yellow signal2 (Y2) so as to allow the pedestrians to cross the road.

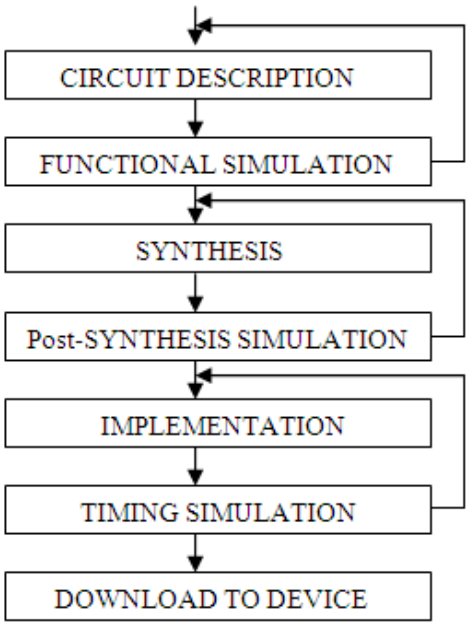

Fig.2 FPGA Design Flow

At first the North traffic will be allowed to move and then traffic in the East, South and West direction will be allowed to move in sequence. The advantage of writing Traffic Light Controller program is that in a program, modifications as per requirements can be done easily i.e., suppose the traffic on main road should be allowed for more time and for side roads the traffic should be allowed for less time; then the clock is divided in such a way that foe main road the clock period will be more and for side roads the clock period will be less, this is because the main road traffic is heavy when compared to the side road traffic. In general TLC System will be heaving three lights (red, green and yellow) in each direction where red light stands for traffic to be stopped, green light stands for traffic to be allowed and yellow light stands for traffic is going to be stopped in few seconds. But in this paper, yellow light is split into two phases and are included in the signaling lights along with red and green

lights in order to indicate that in the first phase of yellow light, pedestrian will be OFF in the second phase, pedestrian will be ON.

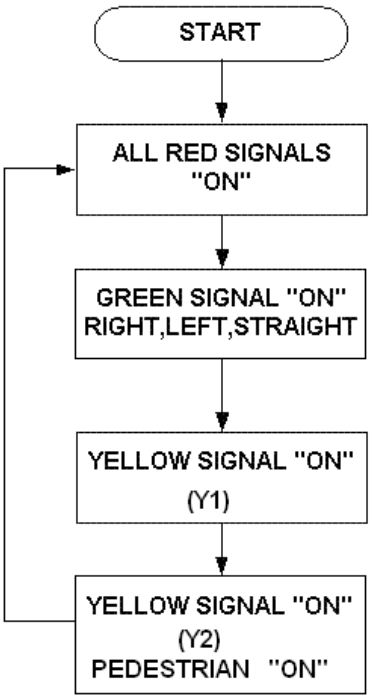

Fig. 3 TLC Flow Chart

The sequential order of the flow chart helps the programmer in the design regarding the flow of the program. North/ south-bound traffic will start with a green signal light while all the other lanes being red, the traffic will be stoped. After a predetermined time, the north/south traffic light turns yellow and then red, allowing the east/west signal light to be green and the same sequence as the north/south-bound traffic is followed. The system will continue to be in this loop until an indication of a vechile in a left turn lane occures. When the signal light turns yellow, the controller scans the inputs. If high, then the program will jump to a sub routine which has a different light sequence. This sequence controls the main lights along with the left turn lights. After completion of the subroutine sequence, the program returns to the main loop. The flow chart can be applied to any number of road structures. In this paper, a four road structured is considered in which the four direction labeled with four labels namely North, South, East and West. Each traffic lane has set of three traffic light signals, “Red, Yellow and Green”, which operates similar to genera signaling lights i.e., it changes from red to green and then yellow and after that back to red signal.[3]

VI. CONCLUSION

Desigining the intelligent traffic signal controller based on Neuro-Fuzzy neuro controller implemented on FPGA will provide effective solution for Traffic control. The average preformance closely follows the performance of system developed by MATLAB simulation. This paper uses the mathod of fuzzy logical control to predict in advance with prediction data to solve the problem. The method implements intersection signal controland precise countdown timing function during the whole journey. By the study of the neural network, we the fuzzy model can be adjusted. It can overcome the drawbacks of the convrntional traffic controllers with the accuracy

of providing variation in green cycle intervals based on the heavy traffic loads that changes at every lane in a four way junction control.

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