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Smart Traffic Light Controller Using Verilog

Mrs. K. Bhulakshmi
(Assistant Professor)
Teegala Krishna Reddy Engineering College, Meerpet, Hyderabad, Telangana,500097.
Corresponding Author: D. Naresh Yadav, B. Prabhakar, D. Ranjith

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ABSTRACT:
Traffic control is a challenging problem in metropolitan and developed cities. This is due to the large number of vehicles and the high dynamics of the traffic system. Poor traffic systems are the big reason for accidents, time losses. At some places due to the absence of traffic police, people would prefer jumping the traffic signal which leads to severe accidents and sometimes it may take the life of people. In this project the traffic light controller is designed as an automatic traffic controller system in which IR sensors and cameras will be installed in the four directions of roads (north, east, west and south). IR sensor senses the density of the traffic. FPGA compares the density values and gives the green signal to the high-density road. When the green signal is given in any one of the roads then the other three roads will be on red light. During this time period if any vehicle jumps the red signal, its motion is detected by the IR sensors. These sensors in turn trigger the camera so that it takes the image of that vehicle. The IR sensors here serves the two main purposes, one is triggering the camera while jumping the signal and the other one is measuring the density of vehicles. The project is being carried out using FPGA interfaced in IR sensors, camera module, Traffic Light Controller, Xilinx, Lab VIEW software.

KEYWORDS: IR sensors, camera module, Traffic Light Controller, Xilinx, Lab VIEW software.

I. INTRODUCTION

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. This traffic jam directly impacts the productivity of the workers, traders, suppliers and in all affecting the market and raising the prices of the commodities in a way light. The problem of heavy jam is happened because of never configure the level of jam in each way and set the delay time. Another problem represents when there is no jam, but the waiting still continues. The solution for these problems is to determine the level of jam and set the delay time. This problem needs of evaluation of the traffic policeman, and then there is need for manual control of the traffic. The target of this paper is to propose system provide solution for all above problems with least possible cost.

Traffic light controller (TLC) can be 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. Nowadays, FPGA becomes one of the most successful of today's technologies for developing the systems which require a real time operation. FPGA is a reconfigurable integrated circuit that consists of two-dimensional arrays of logic blocks and flip-flops with an electrically programmable interconnection between logic blocks. The reconfiguration property enables fast prototyping and updates for hardware devices even after market launch. Most of the TLC implemented on FPGA are simple ones that have been implemented as examples of Finite State Machine (FSM).

The VHDL language has been selected for programming the FPGA to fill two important needs in the design process. Firstly, it gives full description of the structure of a design that is how it is decomposed into sub-designs, and how those sub-designs are interconnected. Secondly, it allows simulating the design before starting the manufacturing. Accordingly, the designers can quickly compare alternatives and test for correctness without the delay and expense of hardware prototyping.

In this paper, a traffic light system is

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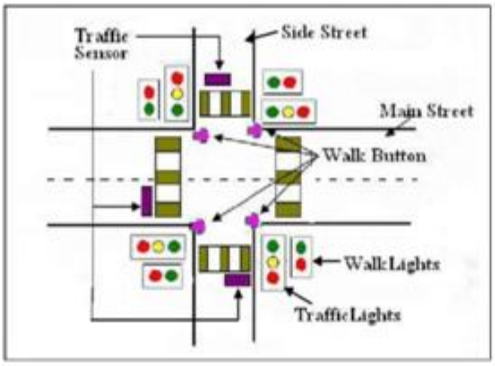
designed using VHDL and implemented by a single FPGA chip. The outline of the paper is structured as follows: Section 2 covers the related works of traffic light system which are deliberated via VHDL and realized through FPGA. Also, traffic light controller system design is the subject of section 3. Furthermore, a simulation of the proposed traffic light system and the simulation results with a discussion are demonstrated in section 4. As well, section 5 includes the hardware implementation of trafficlightsystemonXilinxSpartan3EFPGAanddisplaysthetestingandoperationofit.Finally, theconclusionsofthispaperareprovidedinsection6.

II. OBJECTIVE

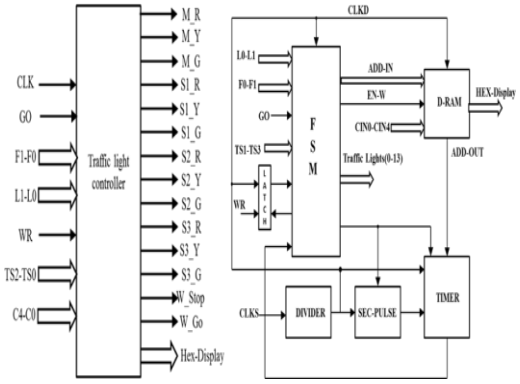
The project's overall objective was todevelop a Smart Traffic Light Controller System to innovate a system that can alleviate problems regarding traffic on intersection using Verilog andaim to achieve a wide range of transport and environmental objectives in addition to minimization of vehicle delays and stops.

III.PRACTICAL DESIGN OF PROJECT

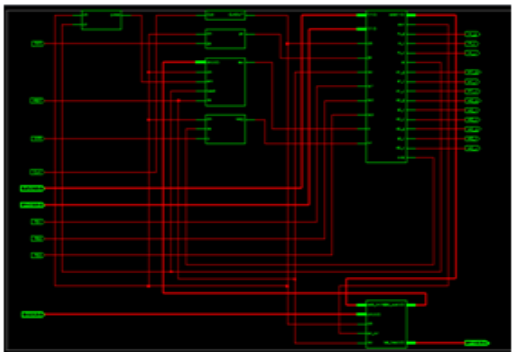


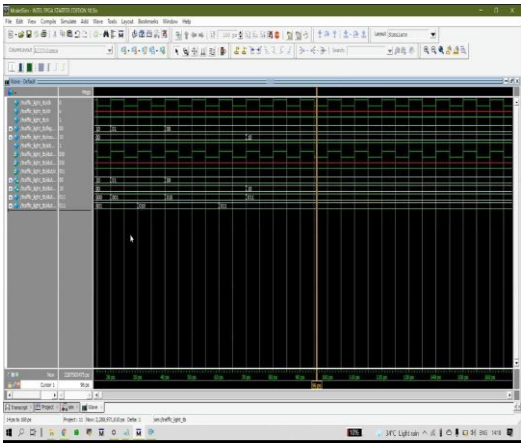
Above figure illustrates the structure of the selected traffic light model for four road intersections (one Main Street and three side streets). In general, Traffic Light Controller System consists of three lights (red, green and yellow) in each direction. The red light indicates to Stop, green light indicates to allow the traffic and yellow light indicates the caution that the traffic is going to be stopped in few seconds. While, turning in yellow and red lights at the same time indicates the caution that the traffic is going to be moving in few seconds. The intersections fitted with a sensor for side street traffic and with walk request button.

This traffic light controller also has provision for walk light (which consists of two lights red and green, where, green light allows the walkers to pass the street while red light avoids the walkers from passing the street) and for the traffic sensors in each one of the side streets. A simple block diagram of the traffic light controller system is exposed in the below Figure. The design is composed of finite state ma-chine (FSM), data storage(D_RAM), timer, divider, and various synchronizers (latch, and synchronizer).



IV. EXPERIMENT DIAGRAM





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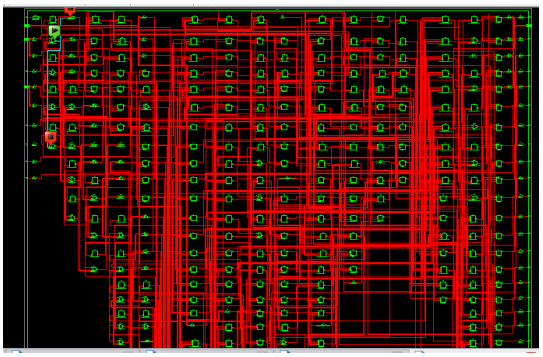

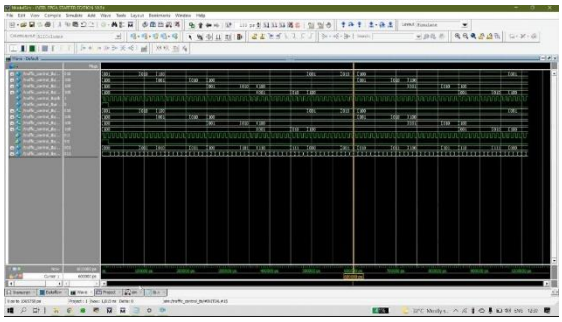

The key advantage in using the VHDL in systems design is allowing the behavior of the required system to be described (modeled) and verified (simulated) before synthesis tools translate the design into real hardware (gates and wires). Figure indicates the RTL and technology schematic diagram of the traffic light controller system. All component of the system is simulated using Xilinx ISE 14.7i. Viewing a schematic allows to see a technology level representation of HDL optimized for specific device architecture, that it may be assisted to discover the scheme issues early in design process. The simulation result of the traffic light controller system in reading and writing modes are exhibited in Figure. In this case, all traffic light outputs are off and HEX_LEDs display the output of memory location which represents the selected time mode. Furthermore, the normal mode is displayed in Figure, which denotes the operation of TLC system as appeared in Figure. The synthesis process generates net list for each design element. Synthesis process checks code syntax and analyzes the hierarchy of the design to ensure that the design is optimized for the system.

V. CONCLUSION

An antecedent of the traffic signal system is successfully simulated using simulating software i.e., Xilinx 14 ISE simulator. The system is designed using Verilog Hardware Description Language. This system works efficiently during the rush hours as well as in normal hours of the day. As the system is simulated on Xilinx more functions can easily add to the system without changing the full architecture. The future scope of this work is to implement this on chosen field. As a real time, traffic signal system and arbitrate the challenges like low power consumption, perception accuracy of sensors.

VI. ADVANTAGES FROM ABOVE RESULTS.

- Traffic signals assist traffic engineers in controlling traffic in a safe, orderly and efficient manner.
- They benefit the traveling public by providing orderly movement of vehicles, improved safety, reduced travel times and increasing the amount of traffic that an intersection can handle.
- The smart traffic management system helps traffic light to operate in real-time conditions. Traffic operates based on traffic congestion automatically.
- Due to the deployment of this system, the chances of road accidents can be minimized.

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