JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 07, ISSUE 15, 2020

INTELLIGENT STREET-LIGHT SYSTEM AND TRAFFIC CONTROLLER USING VERILOG (ISLTCV)

Khriselene Karen Cos, Rodolfo Tenioso II, Carlo Soriano, Camille Joyce Recto,Joevell P. Jovellano and RionelCaldo

[1]Department of Computer Engineering,
Tanauan City College,Trapiche 1,4232Tanauan City,Batangas, Philippines.

[2]Faculty of Computer Engineering,
Tanauan City College,Trapiche 1,4232Tanauan City,Batangas, Philippines.

Corresponding Author's Email:[1]khriselene.19@gmail.com

Article History: Received Oct. 29; Revised Nov. 6; Accepted Nov.15, 2019

ABSTRACT: Among people around the world, electricity is one of the basic demand and produce. However, it does not satisfy the exact demand. Many countries across the world consume extensive amount of electricity to light streets. For areas with very few vehicles passing by, great amount of electrical energy are wasted due to lighting system without the presence of direct consumer who uses the light. The current switching system is manually operated and some are time-controlled. This project proposes a systematized way of switching the lights on and off on streets with less frequent vehicles passing. The system switches the lights on automatically once it detects vehicles and pedestrians and automatically adjust its luminance based on which among is present. Furthermore, it detects the presence of vehicles on intersection for the traffic controller to signal which lane will have the green or red light and remains off when no vehicles are present. This system offers solution to inefficient electrical consumption and reduction of lamps going on its late stage on street-lights through a snappy lamp post that could detect the daytime and night time. The structure is made and re-sanctioned using Verilog code.Different sensors are also used for varying detections of the system. LDR (Light Dependent Resistor) acts as the main switch of the system that allows the PIR (Passive Infrared) and MEMS (Micro-electromechanical Systems) sensor to detect pedestrian and vehicles.

KEYWORDS:*Verilog HDL, MEMS thermal sensor, Passive Infrared sensor, LDR, Xilinx ISE*

1.0 INTRODUCTION

Cities worldwide uses 10- 38% of energy bill by lighting. Significant resources are

ISSN- 2394-5125 VOL 07, ISSUE 15, 2020

wasted because of inefficient way of lighting streets and may also lead to unsafe conditions [1]. Most cities use timers and photo sensors to switch lights on and off that leads to late stage of lamps being left ON even on daytime. Reduction on costs of energy consumption and maintenance of safety can drastically happen through the use of smart street-lighting [2]. In this paper, the researchers used noncontact MEMS thermal sensor to detect human presence, passive infrared sensor (PIR) to detect traffic movement and LDR to detect luminance. Furthermore this project is implemented on Xilinx ISE that uses Verilog language.

Dr. Phil Moorby, Chief Designer for Verilog-XL designed Verilog HDL. In 1985, it was renamed to Gateway Design and Automation formerly Automated Integrated Design System. Verilog HDL is a hardware description language used to design and simulate electronic systems [3]. Open Verilog was born an opened to public due to market pressure in 1990. The same year, the IEEE Verilog Standard 1364 was produced by an IEEE working group under the Design Automation SubCommittee. VSG, the Institute of Electrical and Electronics Engineers Standards Group for Verilog, was established in October 1993 to standardize the Verilog Language. The IEEE P1800 took over works of the IEEE 1364 group, and the group is no longer active. The IEEE P1800 worked on standardization of System Verilog as well as taking maintenance ownership of IEEE 1364 [4].

Inefficient power consumption costs cities 10-38% of the electrical bills. Lamp post being left on even during daytime could cost more because it would require frequent replacement of the lamp itself. This study aims to design and implement an intelligent street-lighting and traffic controlling system for an efficient energy consumption of various cities through Xilinx ISE. Specifically, this study aims to create a design for systematized way of switching on/ off of the lights, utilize the use of lamps that may reduce the frequency of replacement on street-lights, and to design an intelligent street-light that can detect the presence of vehicles and human and vary its luminance according to what is present.

1.1 Literature Review

B. Dilip, Y. Alekhya and P. DivyaBharathi in 2012 made a research on FPGA Implementation of an Advanced Traffic Light Controller using Verilog HDL. The input and output was simulated using Xilinx ISE representing large number of outputs for easier implementation and verification of the design [5].

In 2015, Y M Jagadeesh, S Akilesh, S Karthik, Prasanth proposed an intelligent street light that uses PIR sensors to detect density of passerby and flow of the lane that sends signal to a microcontroller for processing [6]. Consequently, PayalRodi, Leena Chandrakar, SayleeGindeSivanantham S and Sivasankaran K proposed an energy conserving automatic lighting system and was simulated using Verilog HDL for FPGA

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implementation. The system achieved around 65%-75% reduction on electrical consumption. [7].

In 2016,Malhotra Shagunand Vivek Kumar used LDR to switch on the lights to create an energy efficient smart streetlight [8]. The same year, AfraNawarKabir and K. M. A. Salam made a research on the implementation of traffic control system using FPGA and Verilog HDL and used RFID UHF technology to identify emergency vehicles [9].

Mr. Amey J.Manekar and Dr. R .V. Kshirsagar designed an automatic street light controller for energy optimization using FPGA. The study was simulated through Xilinx ISE using Verilog HDL code and used IR sensors for vehicle detection and reduced nearly 60% of power consumption [10].

The following researches served as the guide for the proponents in developing the ISLTCV. These are proven relevant in establishing the research. The related works use IR sensors to detect vehicles for energy optimization, LDR for detection of daytime, RFID technology to identify emergency vehicles and Verilog HDL for simulation and implementation of the designs. This study differ through the use of intelligent sensor identifiers that detects what is present on the road – pedestrian or vehicle. This system uses PIR and MEMS sensors to identify the presence of vehicle and pedestrian and vary its luminosity. The main sensory identifier, the LDR, serves as the main switch to allow the system to detect the entity that is/are present and automatically adjust its brightness giving off 75% for pedestrians and 100% for vehicles. The system was also implemented using Verilog for the logical circuit that allows numerous input/output signals.

2.0 METHODOLOGY

2.1 Proposed System

This system uses LDR to detect the luminance, the MEMS thermal sensor to detect human presence and Passive Infrared sensor to detect the moving vehicles. The lamp switches on as it receives signal from the sensors detecting the presence of any of human or vehicles passing. In addition, traffic control systems on intersections are managed through the sensors in two way junction by lighting indicators lights, red and green.

2.2 Block Diagram

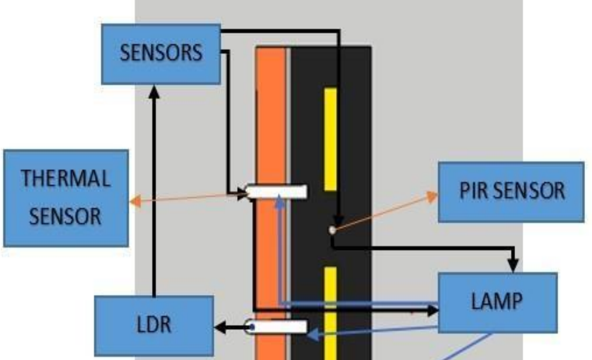

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Figure1:Block diagram of street light

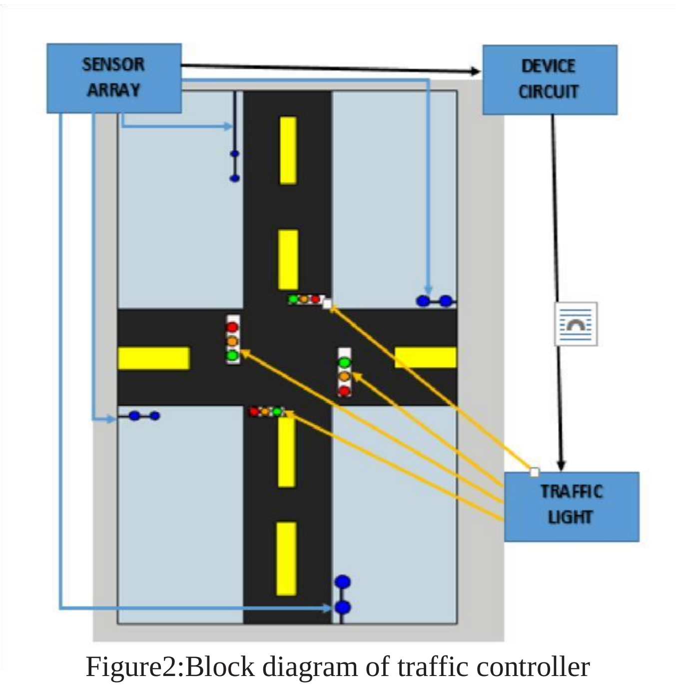

Figure2:Block diagram of traffic controller

2.3 Flow Chart and Table

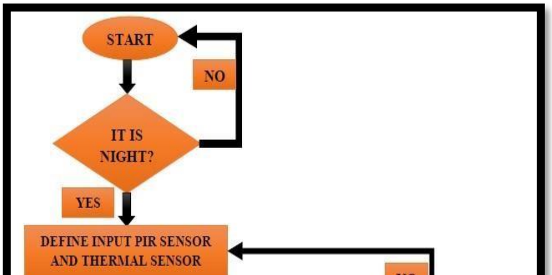

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Figure3:Flow chart of street light

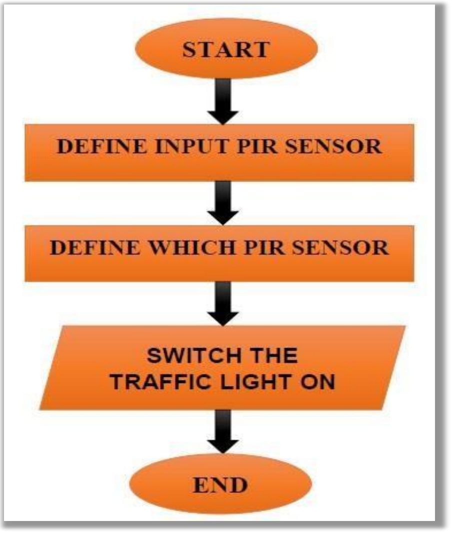

Figure4: Flow chart of traffic controller

Table1:IPO of ISLTCV

INPUT	PROCESS	OUTPUT

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MEMS Thermal Sensors	**Detecting presence of human or vehicle**	**Illuminates the lamp according to what is present on the road**
PIR Sensors	**Detects the traffic movement and which comes first**	**Switches the traffic light according to which comes first**

Table 1 shows the input-process-output of the intelligent system having the sensors as the input and will process the detection and gives outputs of switching the lamp ON and varying its luminosity.

2.4 Pseudocode

1.Start.
2. Is the evening recognized?
3. LDR switches ON and allows the PIR and MEMS sensor detection.
4. Human?
5. Lamp brightens 75%,assuming no, continue to the next step.
6. Vehicle?
7. Lamp brightens 100%.
8. End.

3.0 RESULTS AND DISCUSSIONS

3.1 Project Description

The street light and traffic controller system were programmed through Xilinx ISE with the use of Verilog language. The system allows two different input sensors, the PIR and thermal, for the street light that will define the luminance of the lamp when switched on as its output. PIR sensor is also used to detect the traffic movement on the intersection and tells which lane will have green and red light. The LDR is used as the main switch to detect the luminosity of the surroundings and decides whether the two sensors should detect what is present on the road. Considerably, total or partial turning off of street lights through energy-saving techniques impacts the lifespan of lamps [11]. Applying the intelligent system that automatically adjusts its luminosity may imply significant reduction on maintenance and replacement of lamps. Lamp life

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maybe increased up to 100% [12].

3.2 Properties of the Project

The system was programmed using Verilog language. Nested loops of if-else statements are used for the sensors. A 4bit lamp output indicates whether it is the thermal sensor, or PIR sensor that is at high state, or both. The light illuminates in full brightness if the PIR input is on high state and gives 75% luminance if the thermal sensor is in high state. The sensors used in intersections are also programmed on if-else condition. The first sensor to be triggered on high state gives the go signal and turns the green light in high state where as on the remaining lanes, the red lights are on. A 4-bit selector is used to identify which lane will give a green light ad red on the remaining lanes. The 4 x 2 decoder is used to implement the first-in-first out sequence for the traffic controller.

3.3 Functions of the System

The system allows an efficient consumption on electrical energy through automatic switching on and off of the street light and controls the traffic. LDRis a component that has a variable resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits [13]. The LDR serves as the main trigger for the system to function. The luminance of the lamp varies according to which sensor is in high state. Non-contact MEMS thermal sensors are used as it is capable of sensing human presence whether moving or not [14]. PIR are also used on the intersections for reliable sensing of vehicles processing signal to which lane shall output a green light while the remaining are red [15]. In case sensors are all in high state, the system follows the “right-of-way” rules. The rule states that if the vehicle enters the intersection at the same time, yield to vehicle on the right [16].

3.3 Tools and Methodologies of the System

The system was implemented in Xilinx ISE that allows limitless design for circuits. An input of LDR sensor will give the program the signal to process detection on sensors. The sensors will give output according to which case is at high state. A 4-bit selector switch will give the intersection case statements as to which lane shall give the output of green light. The test bench was simulated to the Isim simulator to show signal outputs of which lamp shall be at high state and in the case of streetlight, what brightness shall the lamp give.

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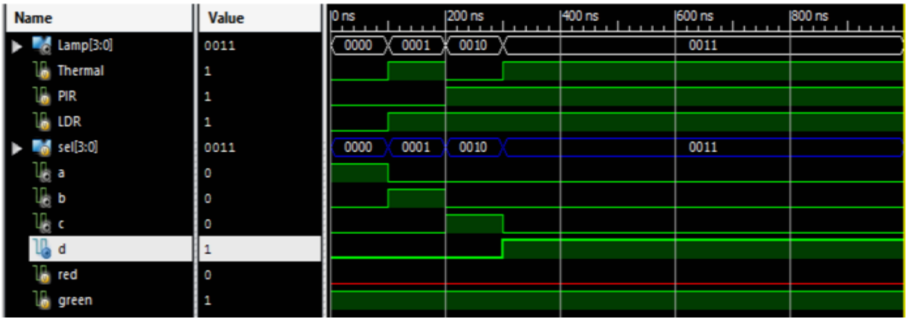

Figure 5: Sim Result

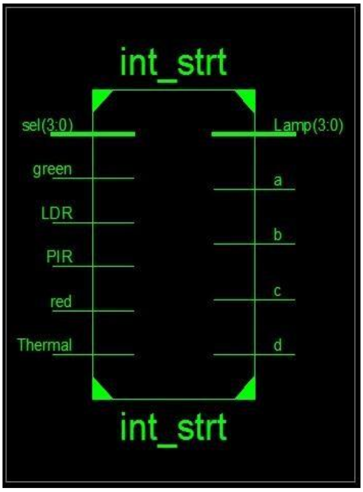

Figure6: Top Level RTL

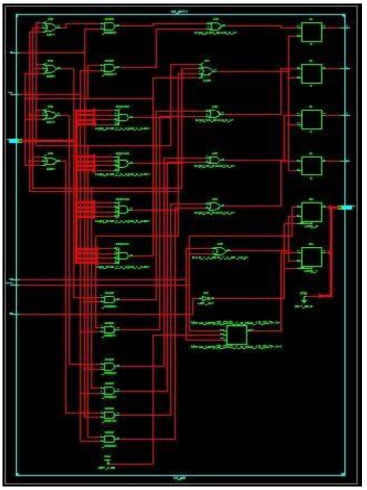

Figure7: Low Level RTL

Figure 5 shows the simulation result and different signals according to the functionality of the inputs and the outputs. Signal indicating that the LDR sensor is at high state gives way for the system to identify the variance of luminosity as to which signals from the sensors indicates the presence of the pedestrian or the vehicles on the road. When the thermal sensor is at high state, the 4 bit lamp output identifies the signal that it should give 75% of luminosity for the pedestrians and adjusts to a hundred percent as PIR sensor detects the presence of vehicles. In addition, if the system detects that both sensor identifiers are at high state, it will give full brightness of the light considering the vehicle passing as the priority for illuminance. Otherwise, the light remains OFF if the LDR remains at off state or the sensor identifiers does not detect any entity present on the road. Similarly, when the traffic controller does not recognize presence of vehicles on the intersections, the signal lights will remain at OFF state.

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Figure 6 and Figure 7 shows the RTL schematic for the street light and traffic light. Selector is connected to the green and red light for XOR gates to give the output for the lanes namely a, b, c, and d. The sensors are connected through NAND gates and to the multiplexor to give the output for the lamp's brightness.

4.0 CONCLUSION

The design and implementation of the system was made successfully through Verilog. The HDL language allows complex circuits to be designed and integrated. Smart cities are rapidly growing, thus consumption on resources such as electricity are growing. The ISLTCV is designed detect vehicles and pedestrians present on the road and automatically adjust its luminance according to what is present. With cities where roads are lit even when the direct consumer of lights are not present, significant amount of electrical energy is wasted.The system can save wasted energy and give a safer environment for the traffic. Lamp lifespan may be extended for up to 100% longer.The use of intelligent street lighting can save between 30%-50% of electrical energy consumptions [17].

ACKNOWLEDGMENTS

The researchers would like to express their gratitude to Engr. Rionel Belen Caldo for the knowledge he has imparted to the team.The study was supported by the Department of Computer Engineering, Tanauan City College, TanauanCity, Batangas, Philippines. Also, the references of the researchers where they get the idea of developing such system. Most of all, to the sovereign God from above who blessed the researchers the wisdom to complete the study.

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