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Design and Implementation of Automatic Street Light Controller for Energy Optimization Using FPGA

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Abstract: The street lightning consume huge amount of electric power. And the cost per unit is expensive also we have limited resources for power generation so it is always better to depend on renewable sources. Therefore the goal of the present study is to save energy in Street lighting. In the existing system, power consumption takes place due to continuous lighting throughout the night by street lights. Automatic Street Light Control System is not only easiest but also the powerful technique. It releases the manual work at most up to 100% Hence an idea is implement such system which dynamically switch ON and OFF light depending upon traffic and light intensity.. Therefore, maximum power will be saved. The proposed idea was implemented by FPGA and IR sensor.

Keywords: Field Programmable gate array (FPGA); Infrared Sensor (IRS); Pulse Width Modulation(PWM).

I. INTRODUCTION

The function of street light is to provide safe environment during dark hours. The lights operate nearly more than 12 hours. To turn ON all lights present on road indeed require large electrical power. About 30% of the total electrical power of any country is consumed in lighting the roads and the streets.. Automation is the parameter in present field of technologies so that we can reduce the man power the help of intelligent systems. As we all know the sources of power are getting diminished, power saving is also have to consider. Thus we need a system that automatically controls and monitors the street light. So that we can light only that part which have vehicles.

The main aim of the project is to use the recent technologies to reduce power consumption and to be more accurate. So we are saving power automatically instead of doing it manually, with LDR. As all cities growing rapidly, the automation system is also growing so using automation we can save energy consumption. In a day, the traffic changes dynamically, the variable meteorological conditions and uncertain situations on the streets, the ON & OFF status of light should change according to traffic. The light on or off dynamically. The proposed system is designed to implement the power saver street light system. Here, the street lights are switched ON or OFF of the street lights depends on the output of LDR. If there is a sun light then the street lights are in OFF position, in the absence of sun light the street light status will be OFF. However, in the absence of traffic at the absence of sunlight, then also the street lights are remaining in OFF position.

II. LITERATURE REVIEW

In this paper "Automatic Street Light Using Microcontroller" the proposed design used light sensor and LDR. The street light module has microcontroller, light dependent resistance and photoelectric sensor. With the help LDR we can control the lights, i.e. when the light was available then it has been in the OFF state and when it was dark the light will be in ON state, it means LDR is in reverse relative to light. If the light come in contact with the LDR it sends the commands to the microcontroller that it have to be in the OFF position then it put OFF the light, the photoelectric sensor will be used to turn ON or OFF the light according to the occurrence or missing of the object.

All these commands were sent to the controller with which that the device works. For the more efficient toggling ON/OFF operation relay is used which acts as a switch.

A. LDR

The LDR is used as darkness detector in circuit. The LDR works as resistor is shown in fig. As the amount of light falling on the surface of LDR, the resistance vary. The resistance increases when LDR detect light, thus if resistance decreases, LDR detected the light [4].

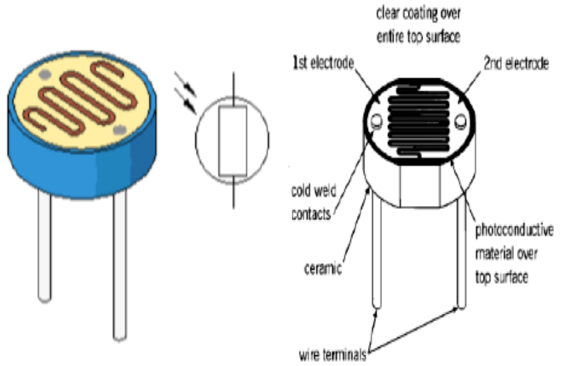

Fig 1: LDR

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B. Photoelectric Sensor

The photoelectric sensors have been used in this paper, to detect the movement on the street. Fig shows emitter and receiver. Reflected light is diffused from target surface in all possible direction, which is emitted from emitter. If the recipient receives enough reflected light the output will switch states. When none light is reflected reverse to the recipient the output takes its original state. In diffuse scanning the emitter is placed at a 90 degree angle to the target object. The recipient will be present at some angle in order to receive some of scattered (diffuse) reflection [4].

Fig.2. Photoelectric Sensor

C. ASLCS (Automatic Street Light Control System)

The ASLC System has the reliance among the different components. It is reliance between:

- LDR input
- IR Sensor input
- Processing input with microcontroller
- Final Output
- Response according to user

a) LDR input

If the light intensity is low down the resistance of the LDR is high. This prevents current from flowing to the transistors base. As a result the LED does not glow [2]. The resistance falls and current flows into the base of the first transistor when light fall on the LDR and later on the second transistor. The preset resistor can be toggle high or low to raise or reduce Resistance, in this way it can make the circuit more or less sensitive, LDR drive report to the 89S52 microcontroller.

b) IR Sensor input

A sensor is a device that produces a measurable response to modify in a material state, such as temperature or thermal conductivity, or to a change in chemical concentration. 89S52 microcontroller receives reply from IR sensors [4].

c) Process input with microcontroller

The 89S52 microcontroller is 40 pin IC, which is the most important part to process the input is highly depend upon the analyze input from LDR as well as IR sensors

.

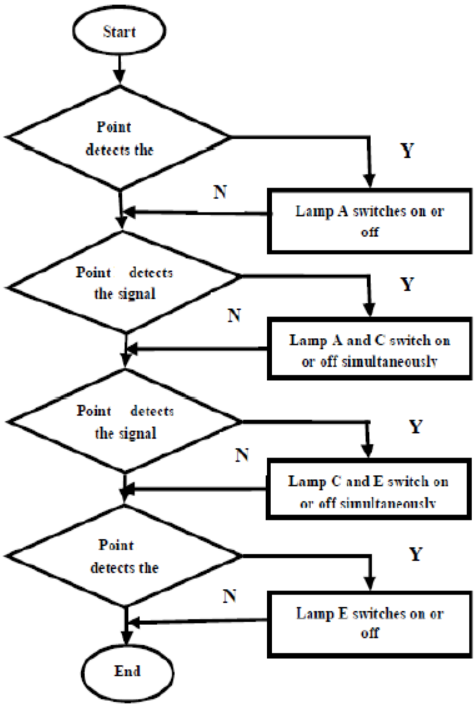
d) Output

Process with the input, which helps the microcontroller forms the user output to which the system has to offer the interactive reply hence output of user, has to depend upon the process input obtained from microcontroller.

e) Interactive response in accordance with the user's choice The system gives response to the street light control unit as per the output from the system.

D. Street light automatic control methodology

The street light control system adopts a active control style. From this, the initial state of the lights is set as off. Street light schematic control flow in below Figure. When the signal is detected at the point S, the state of lamp A switched toggles when the signal gets detected at the point B, the states of lamp A and lamp C are switched on or off at the same time, whereas the signal is detected by the point D, lamp C and lamp E are switched on or off simultaneously, when S detect the vehicle the status of E will be toggled [3].



III. PROPOSED PLAN OF WORK

In the proposed system, the switch ON and OFF of street lights depend on the output of LDR. When sun light is present street lights are in OFF position. If not, the street lamps are ON if there is no sunlight. However, the street lights are in OFF state if there is no traffic even at the absence of sunlight.

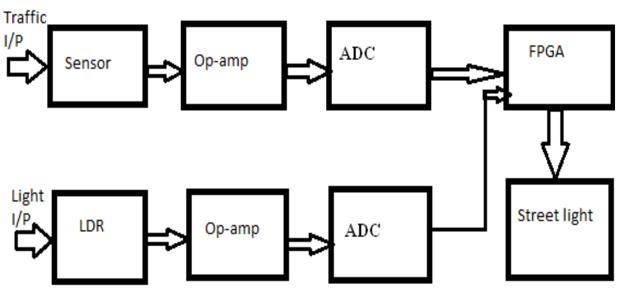


Fig.4.Proposed System

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A. Dimming control of LEDs
Many applications required to control the intensity of light not only aesthetic but also for functional requirement.
They may required to control state of light to fully Onto completely OFF state. There are two methods
1Current reduction
2Pulse reduction

a) Current Reduction (CR)
This is also called as analog method. In this method LED is driven at minimum possible forward current and voltage so as to obtain required output. The main drawback of this method is requirement of a very accurate current control to be effective, and so unless you choose the right controller it can be somewhat difficult to implement.

b) Pulse Reduction(PR)
The pulse reduction can be achieved by switching LED's. fully-on and fully-off at a frequency greater than the normal people can perceive. For a stationary light source this is 100 to 120 Hz, to avoid strobing effect we required a moving light source with a higher frequency. As long as the frequency is kept above this 'flicker fusion threshold' the eye integrates the pulses and so perceives a steady but dimmer light source which is roughly equal to the pulsed brightness averaged over time. If the frequency is any lower the eye will be able to see the individual pulses.

Within pulse reduction there are three different methods of pulse reduction

1Pulse width modulation (PWM): A constant current pulsed at variable pulse duration and at a constant frequency.

2. Pulse frequency modulation (PFM): A constant current pulsed at fixed pulse duration and at a variable frequency.

3. Pulse code modulation (PCM): A constant current pulsed at random pulse durations.

The luminous output of an LED is directly proportional to duty cycle or On Duty that the LED is driven at. Therefore by varying the duty cycle from 0% to 100%, the luminous output is also scaled from 0% to 100% .PWM is by far the most common method currently used for LED pulse dimming.

IV. SYNTHESIS AND SIMULATION RESULTS

The output of proposed system when simulate on Modelsim. From that we can see that when vehicle is detected at that instant at most three lights will glow when IR sensor detect traffic present on the road in the absence of sun light.

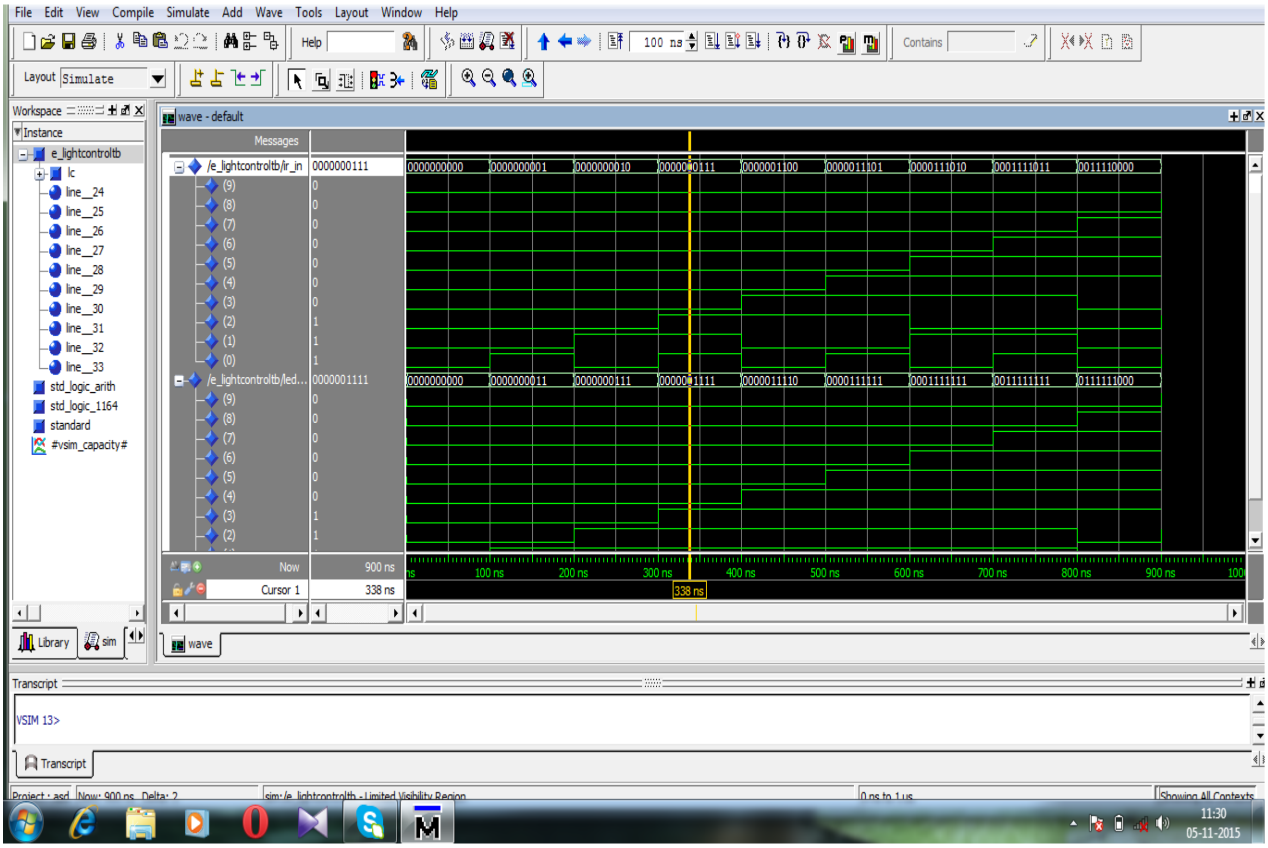

Fig 4: Simulation Result

4.1 Device Utilization Summary
The system was synthesized & Simulated using Xilinx ISE 9.2i tools. The operating frequency of 63.629MHz with minimum period 15.716ns. The Minimum input arrival time before clock is 9.943nsand Maximum output required time after clock is 10.353ns.

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GK Project Status			
Project File:	gk.ise	**Current State:**	Synthesized
Module Name:	E_LightControl	• **Errors:**	No Errors
Target Device:	xc3s1400a-5fg676	• **Warnings:**	2 Warnings
Product Version:	ISE 9.2i	• **Updated:**	Tue Jun 14 07:12:19 2016

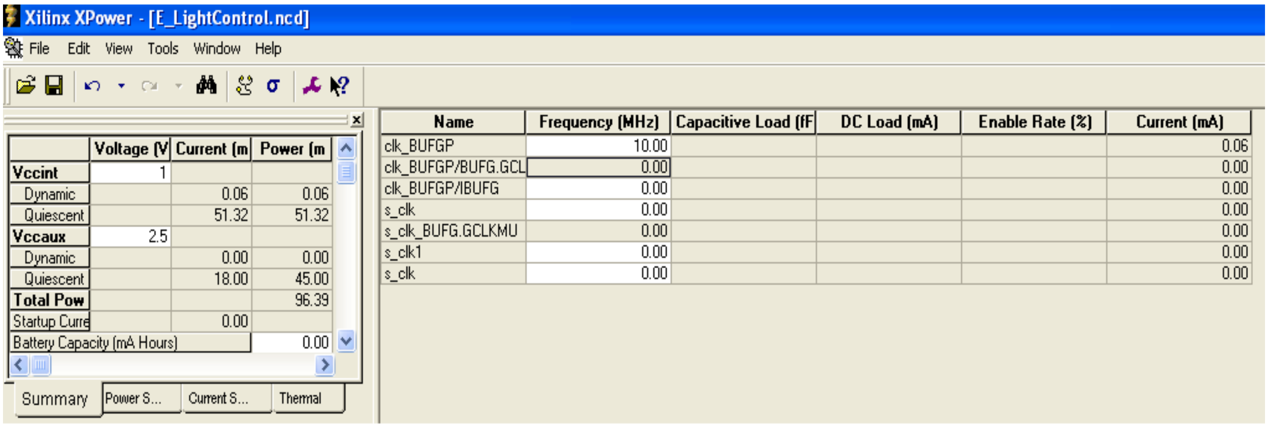
GK Partition Summary
No partition information was found.

Device Utilization Summary (estimated values)			
Logic Utilization	**Used**	**Available**	**Utilization**
Number of Slices	618	11264	5%
Number of Slice Flip Flops	395	22528	1%
Number of 4 input LUTs	1025	22528	4%
Number of bonded IOBs	22	502	4%
Number of GCLKs	2	24	8%

Fig4.1: Design Summary

V. CONCLUSION

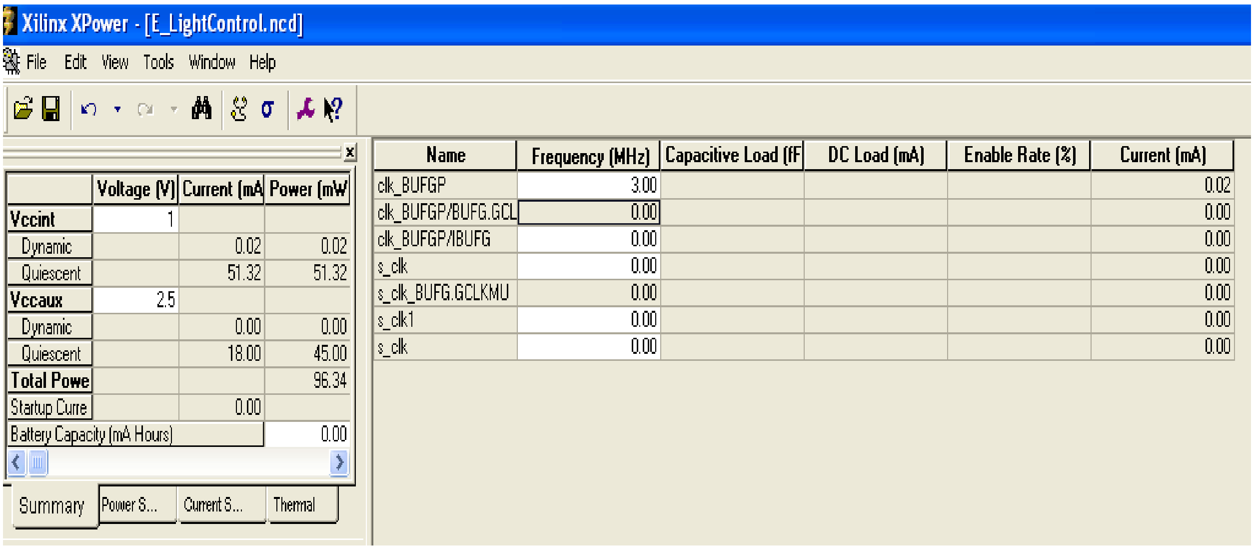
In this paper, Automatic Street Light Controller for Energy Optimization is synthesized and simulated using VHDL tools. The VHDL code has been successfully synthesized and simulated using Xilinx ISE 9.2i tools. The output of the system is verified using FPGA EP2C35 family. The power consumption is reduced nearly about 60%



	Voltage (V	Current (m	Power (m
Vccint	1		
Dynamic		0.06	0.06
Quiescent		51.32	51.32
Vccaux	2.5		
Dynamic		0.00	0.00
Quiescent		18.00	45.00
Total Pow			96.39
Startup Curre		0.00	
Battery Capacity (mA Hours)			0.00

Name	Frequency (MHz)	Capacitive Load (fF	DC Load (mA)	Enable Rate (%)	Current (mA)
clk_BUFGP	10.00				0.06
clk_BUFGP/BUFG.GCL	0.00				0.00
clk_BUFGP/IBUFG	0.00				0.00
s_clk	0.00				0.00
s_clk_BUFG.GCLKMU	0.00				0.00
s_clk1	0.00				0.00
s_clk	0.00				0.00

Fig5:Power Consumption without PWM



	Voltage (V)	Current (mA	Power (mW
Vccint	1		
Dynamic		0.02	0.02
Quiescent		51.32	51.32
Vccaux	2.5		
Dynamic		0.00	0.00
Quiescent		18.00	45.00
Total Powe			96.34
Startup Curre		0.00	
Battery Capacity (mA Hours)			0.00

Name	Frequency (MHz)	Capacitive Load (fF	DC Load (mA)	Enable Rate (%)	Current (mA)
clk_BUFGP	3.00				0.02
clk_BUFGP/BUFG.GCL	0.00				0.00
clk_BUFGP/IBUFG	0.00				0.00
s_clk	0.00				0.00
s_clk_BUFG.GCLKMU	0.00				0.00
s_clk1	0.00				0.00
s_clk	0.00				0.00

Fig5.1:Power Consumption without PWM

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VI. FUTURE SCOPE

If the proposed system used for LED street light we reduce more power consumption. The traffic signal can also be interface with FPGA and can the ON & OFF time can be calculate depending upon traffic i.e. dynamically. For safety purpose we can interface camera so that all time surveillance is possible.

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