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Implementation of Power Saver Street Lighting and Automatic Traffic Management System

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ABSTRACT:

In India most of the power generation takes place from hydraulic power stations. In the present decade, cost of the power generation is very much expensive and we have very less water resources for hydraulic power generation i.e., 33 percent. Day by day cost per unit rises and it is unbearable for a common man and hence it is always better to depend on renewable sources. Therefore the use of solar energy with embedded system technology, the goal of the present study is to save energy in Street lighting and traffic system.

In the existing system, power consumption takes place due to continuous lighting throughout the night by street lights. Hence, an idea is implemented in such a way that the lights will be switch ON only in the presence of traffic on the roads at night times. Therefore, maximum power will be saved and the saved power can be used for some other useful purposes like agriculture, industries and domestic purposes.

In present scenario, we are facing the traffic problem in the rural as well as urban areas. It is essential to control the traffic density in an efficient manner in such a way that, it can control according to the priority of the more traffic density present in the street by using sensor network. The proposed idea was implemented by FPGA and sensor network on VHDL platform.

Objectives:-

1. To decrease power consumption by automatic street lighting
2. To provide the efficient automation of traffic management

INTRODUCTION

Street lighting provides a safe nighttime environment for all road users including pedestrians. Providing street lighting is one of the most important and expensive responsibilities of a city. Lighting can account for 10–38%

of the total energy bill in typical cities worldwide. Street lighting is a particularly critical concern for public authorities in developing countries because of its strategic importance for economic and social stability. Inefficient lighting wastes significant financial resources every year, and poor lighting creates unsafe conditions. Energy efficient technologies and design mechanism can reduce cost of the street lighting drastically.

The implementation of street light intensity control using LUX meter, traffic sensor and complex sub control machines are in process in the Norway. But the power consumption is reduced only by nearly 30%. There also exists a project in progress where in the street light power consumption is reduced using a remote controlled system, but the disadvantage is that it is not cost effective and that the initial investment is not economical.

The main objective of the present study is to reduce the power consumption and efficient utilization of renewable sources for the application of street lightening and traffic signaling. Hence, the present study is aimed at design and implementation of an automatic system to control the traffic and reduce energy consumption of a town's public lighting system up to the maximum possible extent. The density of traffic is sensed by using an array of Passive Infrared Sensors (PIR), which senses the traffic movement. LDR is used to detect the presence of day light. The proposed system is able to control the traffic during the day as well as night. In this system, the streetlights are switched ON/OFF automatically during the presence of the traffic only during the nights.

PRINCIPLE OF OPERATION

The proposed system is designed to implement the power saver street lighting as well as automatic traffic controlling mechanisms. The block diagram of proposed automatic street lightening and traffic control system corresponding to road safety is as shown in Fig.1. In this system, light presence will be detected by the Light Dependent Resistor **(LDR)**. LDR is used to switch ON and OFF the street lights based on detecting the light ambiance. Depending upon the illumination level the resistance of the sensing element varies, which varies the voltage at its output.

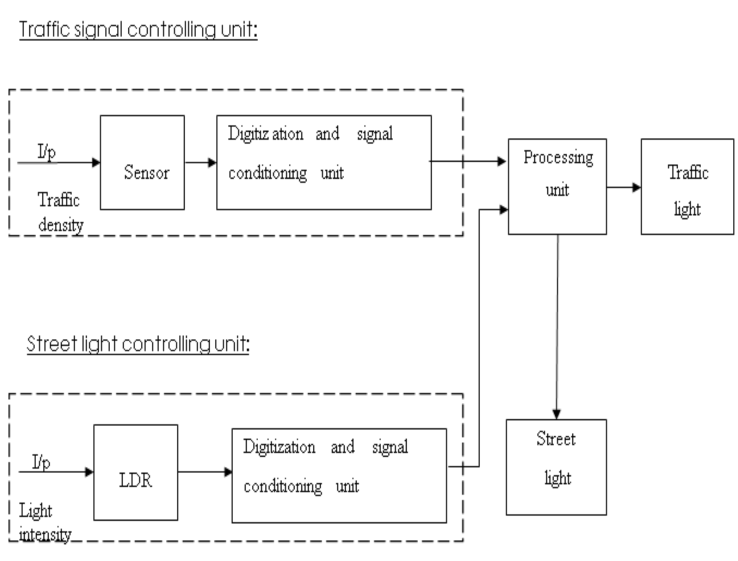

Fig.1: Power Saver Street Lighting and Automatic Traffic Management System

An analog output of sensor is converted in to digital form which is proportional to the intensity of the sun light present in the atmosphere. The digitized signal is connected to the processing unit FPGA (Field Programmable Gate Array).

Here, the street lights are powered through power supply. Switching ON or OFF of the street lights depends on the sensing output of LDR. If there is a sun light then the street lights are in OFF position, and the control is directly passed on to the traffic system. Otherwise, if there is no sun light then the street lights are to be switch ON and then the control is transferred to traffic system. However, even though at the absence of sunlight, the street lights remain in OFF position if there is no traffic.

Traffic signal controlling unit:

To control the traffic, IR sensors are connected on either side of the road. When vehicle passes on the road, the signal between IR sensors breaks and this condition is treated as presence of traffic. Automatically the system provides a control which will switch ON the street lights. At this moment the sensor output is logic low which is in the low voltage range. Hence, this analog signal is converted into digital signal by using digitization and signal conditioning unit. The digitized signal is connected to the processing unit (FPGA).

Here with the help of power supply, LDR and IR Sensors, the processing unit makes the street lights to glow only at the absence of sun light and that to in the presence of traffic only. If density of traffic is equal on four ways then priority is given to South side and the control signal generates to switch ON the green light on the East for prescribed time. If density of traffic is not equal on four sides then chooses any one of the following four conditions depending on traffic density.

a) If traffic on South side is more then, it switches ON the green light on South side and yellow light on West side and red light on North and East side for the prescribed time and then again check the traffic density.
b) If traffic on west side is more then, it switches ON the green light on West side and yellow light on North side and red light on East and South side for the prescribed time and then again check the traffic density.
c) If traffic on North side is more then, it switches ON the green light on North side and yellow light on East side and red light on South and West side for the prescribed time and then again check the traffic density.
d) If traffic on East side is more then, it switches ON the green light on East side and yellow light on South side and red light on West and North side for the prescribed time and then again check the traffic density.

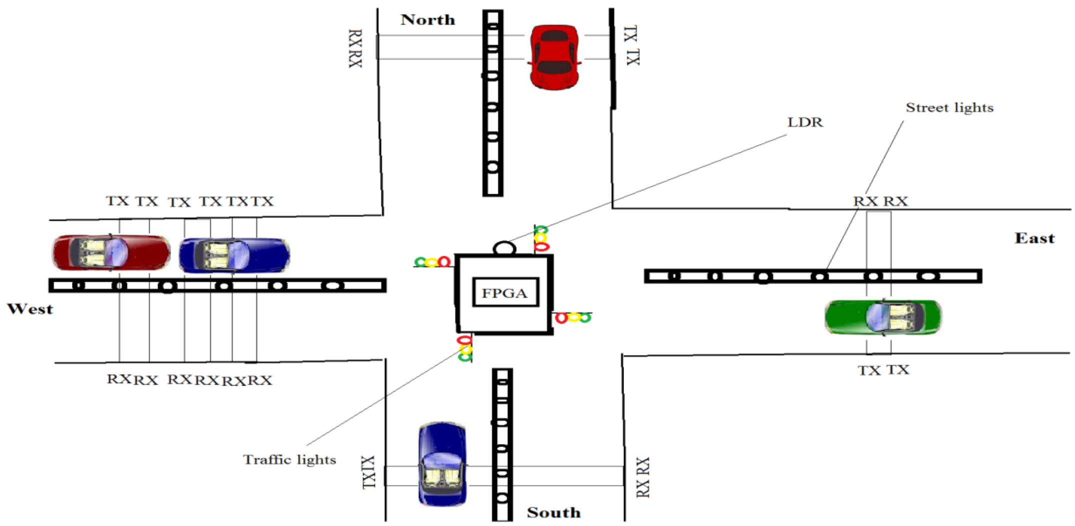

Fig.2: Traffic Signal Controlling Unit

If we consider an example of traffic system, firstly we can identify where the traffic is heavy by using traffic density. As shown in Fig.2, more number of vehicles are moving on west side. So, there is more number of signal breakings sensed by the IR Tx and Rx pairs. Hence, more density is identified by West direction. Hence, the density of signal is more in that area, these information sent to processer it can identify the traffic density. The remaining directions is also same procedure.

REQUIREMENTS OF PROJECT

- FPGA (FIELD PROGRAMMABLE GATE ARRAY XC3S200A)
- IR sensor (333)
- LDR (Light Dependent Resistor GL5528)
- Operation amplifier (LMV321)
- Schmitt trigger (SN74LVC2G14)
- Transistor (BC547)
- LEDS (Light Emitting Diodes)
- XILINX (14.1version)
- VHDL (**V**ery High Speed Integrated Circuit **H**ardware **D**escription **L**anguage)
- Acicular software console (To load the bit file into the FPGA)

HARDWARE IMPLEMENTATION

To design and implement the power saver street lighting and automatic traffic management system we use the following components: FPGA (scholar board), IR sensor, LDR and signal conditioning unit. The FPGA (scholar board) is main heart of this project. This scholar board processes the digital signal obtained from the digitization and signal conditioning unit and it is used for prototype verification of the street lighting and automatic traffic management system. IR sensor is used to sense the density of the traffic and are connected on either side of the road. When vehicle passes on the road, the signal between IR sensors breaks and this condition is treated as presence of traffic. According to the traffic density, logic is implemented as automatically the system provides a control which will switch ON the traffic lights. The presence of daylight is detected by LDR. The output of LDR is also connected to digitization and signal conditioning unit. As in the proposed method, street lights ON or OFF conditions are based on the status of the traffic density sensed by IR sensors as well as LDR. Here, even at night times, the street lights are switched ON only when there is a presence of traffic.

REQUIRED COMPONENTS OF THE HARDWARE

- FPGA (scholar board)
- IR sensor
- LDR (light dependent resistor)
- Digitization and signal conditioning circuit
- Processing unit (FPGA)

In this project we are using FPGA (scholar board) which is the main heart of this project. We can also use microcontroller, ASIC and CPLD instead of FPGA, but it has many advantages when compared with remaining ones. It has program facility and flexible and it has microcontroller for storing program and it can use for prototype project. It can process the digital signal. This scholar board processes the digital signal obtained from the digitization and signal conditioning unit and it is used for prototype verification of the street lighting and automatic traffic management system.

FPGA:

A Field-Programmable Gate Array (FPGA) is an integrated circuit designed to be configured by a customer or a designer after manufacturing—hence "field-programmable". The FPGA configuration is generally specified using a hardware description language (HDL), similar to that used for an application-specific integrated circuit (ASIC). FPGAs can be used to implement any logical function that an ASIC could perform. The ability to update the functionality after shipping, partial re-configuration of a portion of the design and the low non-recurring engineering costs relative to an ASIC design (notwithstanding the generally higher unit cost), offer advantages for many applications.

FPGAs contain programmable logic components called "logic blocks", and a hierarchy of reconfigurable interconnects that allow the blocks to be "wired together" somewhat like many (changeable) logic gates that can be inter-wired in (many) different configurations. Logic blocks can be configured to perform complex combinational functions, or merely simple logic gates like AND and XOR. In most FPGAs, the logic blocks also include memory elements, which may be simple flip-flops or more complete blocks of memory.

Some FPGAs have analog features in addition to digital functions. The most common analog feature is programmable slew rate and drive strength on each output pin, allowing the engineer to set slow rates on lightly loaded pins that would otherwise ring unacceptably, and to set stronger, faster rates on heavily loaded pins on high-speed channels that would otherwise run too slow. Another relatively common analog feature is differential comparators on input pins designed to be connected to differential signaling channels.

SOFTWARE IMPLEMENTATION

Hardware requirements and the implementation of the proposed system is discussed in the Chapter 2. The software used for the proposed system is Xilinx14.1, and the program logic is implemented in VHDL. Behavioral model, Accelar software console components. Here in Xilinx design entry, synthesis, implementation, verification, device configuration, project navigator window.

REQUIRED COMPONENTS OF SOFTWARE:

- XILINX
- VHDL
- ACCELAR SOFTWARE CONSOLE

Traffic signal controlling unit:

To control the traffic, IR sensors are connected on either side of the road. When vehicle passes on the road, the signal between IR sensors breaks and this condition is treated as presence of traffic. At this moment the sensor output is logic low which is in the low voltage range. Hence, this small voltage is to be amplified by using an op amp. This analog signal is converted into digital signal by using op amp/Schmitt trigger. The digitized signal is connected to the processing unit (FPGA).

Here with the help of power supply, LDR and IR Sensors, the processing unit makes the street lights to glow only at the absence of sun light and that to in the presence of traffic only. If density of traffic is equal on four ways then priority is given to South side and the control signal generates to switch ON the green light on the East for prescribed time. If density of traffic is not equal on four sides then chooses any one of the following four conditions depending on traffic density.

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b) If traffic on west side is more then, it switches ON the green light on West side and yellow light on North side and red light on East and South side for the prescribed time and then again check the traffic density.

c) If traffic on North side is more then, it switches ON the green light on North side and yellow light on East side and red light on South and West side for the prescribed time and then again check the traffic density.

d) If traffic on East side is more then, it switches ON the green light on East side and yellow light on South side and red light on West and North side for the prescribed time and then again check the traffic density.

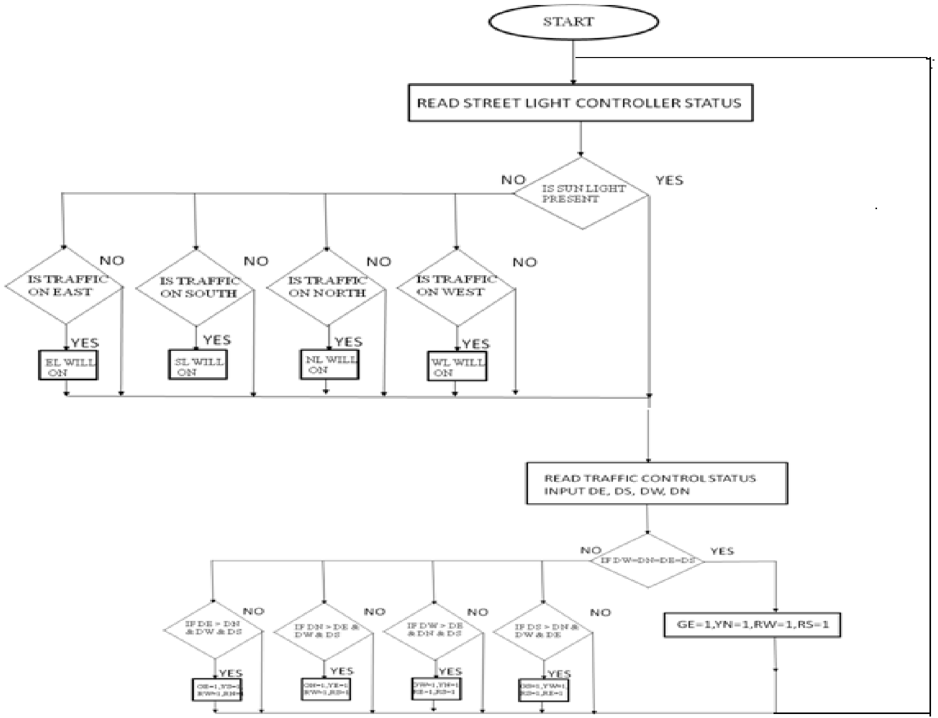

Fig.22: Flow Chart Diagram

RESULTS:

1. If there is traffic in south side and if there is no sunlight then the LDR in the south side will glow and the green traffic light also glows in south side.

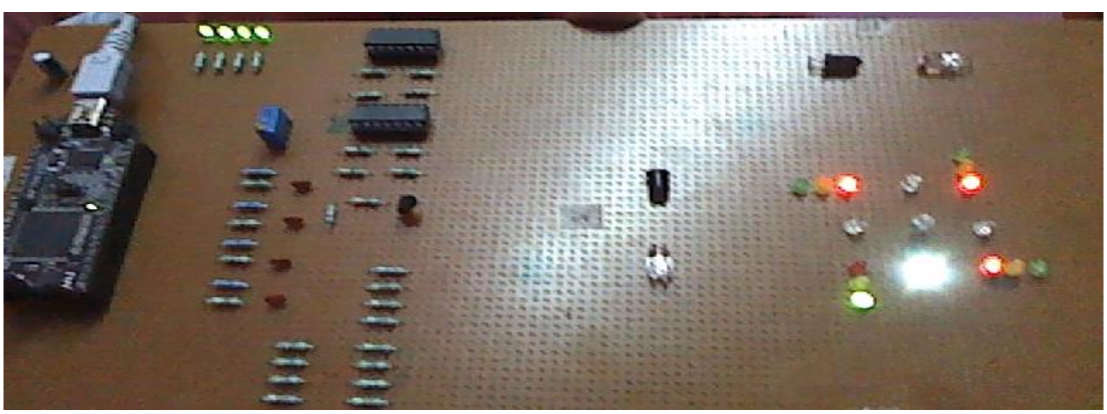

Fig.30: Street Light on South Side

2. If there is traffic in west side and if there is no sunlight then the LDR in the west side will glow and the green traffic light also glows in west side.

Fig.31: Street Light on West Side

3. If there is traffic in north side and if there is no sunlight then the LDR in the north side will glow and the green traffic light also glows in north side.

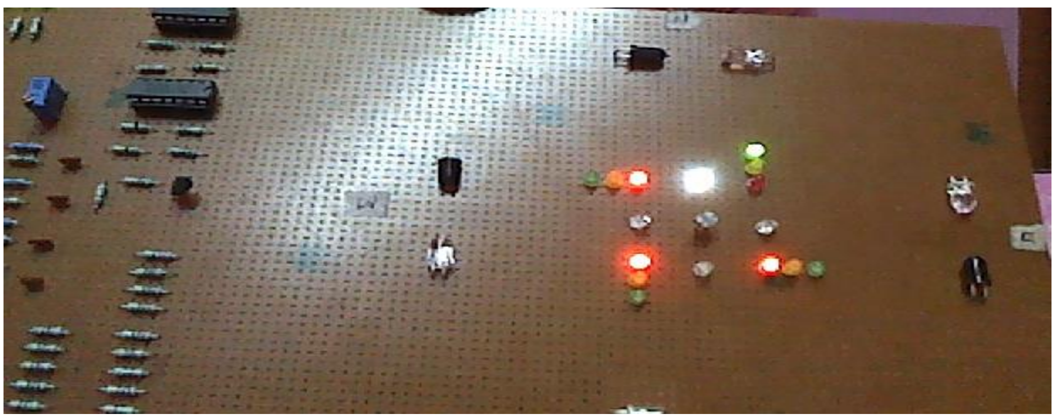

Fig.32: treet Light on North Side

4. If there is traffic in east side and if there is no sunlight then the LDR in the east side will glow and the green traffic light also glows in east side.

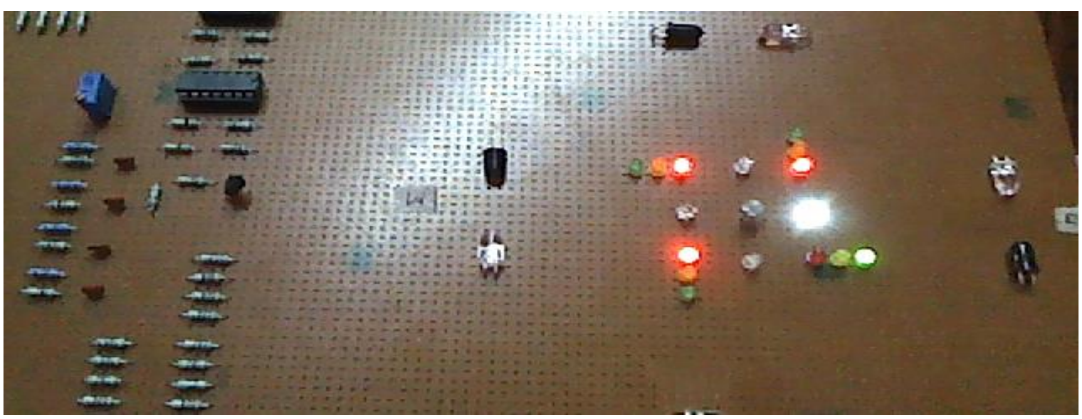

Fig.33: Street Light on East Side

CONCLUSION & FUTURE SCOPE

The design implementation and prototype verification of Automatic Street light and traffic control system is done successfully by using FPGA based system. It requires the only initial cost for designing and installation and not for utilization. Hence, such systems are very much useful for the government to reduce the utilization of conventional power. Therefore, such systems are once implemented on a large scale can bring significant reduction of the power consumption caused by street lights and traffic control lights. This initiative will help us to save the energy and meet the domestic and industrial needs. This idea can overcome the drawback of conventional traffic controllers where, the traffic signaling is done in equal intervals of time. But in the proposed system, with the capability of providing varying green cycle interval based on dynamic traffic load changes at every lane in a 4-way junction control.

In the proposed system, only power saving technique is implemented. In the place of conventional power, we can use solar power as a source to the proposed system.so that renewable source also used.

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