ECO-FRIENDLY SELF OPERATED STREET LIGHT

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Abstract: Nowadays, most street lighting consumes high electrical power due to inefficient design. Energy efficiency and ease of maintenance with minimal involvement of manual work in street lights management are two top priorities of a smart city. To fulfil these purposes, the project aims to design and develop a smart street lighting system based on wireless sensing network technology and a novel adaptive control mechanism for the benefits of energy-saving and ease of maintenance. Experimental results show up to 48% potential energy saving compared to a conventional street lighting system.

Keywords: Street Lighting, Energy Efficiency, Wireless Sensing Network, Energy efficient system, Light Dependent Resistor (LDR), Light Emitting Diode (LED), Microcontroller.

1. INTRODUCTION

A Smart Street Lighting System is an intelligent street lighting control system that has to light up at the right time and function seamlessly. A city's street lights meant for providing safer traffic conditions, safer pedestrian environment and can represent a great improvement to the city's architectural, touristic and commercial output. By implementing this system individual dimming and ON/OFF switching of the street lights becomes an easy task. We can choose our pre-programmed schedules; plan a schedule of our own to manage every street lamp, automatically according to our needs [1], [2]. When the street lighting needs to decrease in a certain area or within a certain time span, this system helps to dim the lights accordingly. If the pedestrian traffic decreases significantly say between 1:00AM and 5:00AM, then dimming the lights is the right solution. It will reduce the illumination of the street lights to 20% whenever no pedestrian or vehicle was detected. By this we will considerably reduce energy consumption and CO2 emissions, also reducing light pollution and overall environmental impact.

2. METHODOLOGY

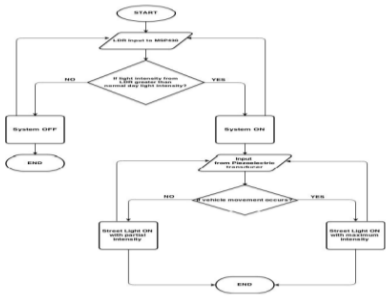

Figure 1 Block diagram of proposed work

3. BLOCK DIAGRAM DESCRIPTION

The above flowchart operates the smart auto street light during lack of daylight. It starts with a decision from LDR, only when there is no sufficient daylight, the microcontroller switch ON the system that controls the street light mechanism. During this period, the street lights glows with partial intensity. That is, during evening, night and early morning. Once the system is switched ON, micro controller will be waiting for the signal from embedded piezo. If at all any movement is detected by the piezo that gives digital HIGH to the input pin of MSP430. Hence the street lights glows with full intensity.

4. MAJOR COMPONENTS USED FOR AUTOMATIC STREET LIGHT

The major components of proposed innovations are discussed in a brief touch below. First in the lot is LDR and is expanded as Light Dependent Resistor.

4.1 LDR – An Understanding of How it is Used?

The constructed microcontroller system switches on the street lights when the lighting conditions become poor (i.e. evening till early morning). By using suitable Light Dependent Resistor like Cadmium Sulphide (CDS) LDR, the intensity of light is detected which helps the micro controller to switch the system on and off based on the environment's lighting conditions. A LDR may have resistance of 300k ohms incomplete darkness and drops to 3k ohms in bright light. This LDR is used an analog sensor from which the analog inputs are given to the MSP430 microcontroller.

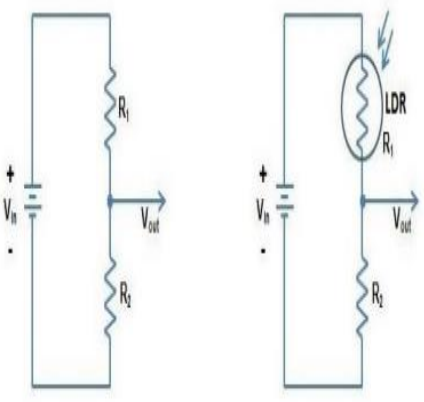

Figure 2 Voltage driver circuit

Figure 3 LDR

4.2 Piezoelectric Transducers Piezoelectric Transducers is used as a knock sensor (Figure 4.) to detect the movement of vehicles in the roads. A change in mechanical energy (pressure) produces electrical signal as the output, which is basic working principle of piezoelectric transducers. Whenever there is vibration or pressure over the piezoelectric transducer it produces an electrical signal which is given to the micro controller as an analog value (Figure 5).

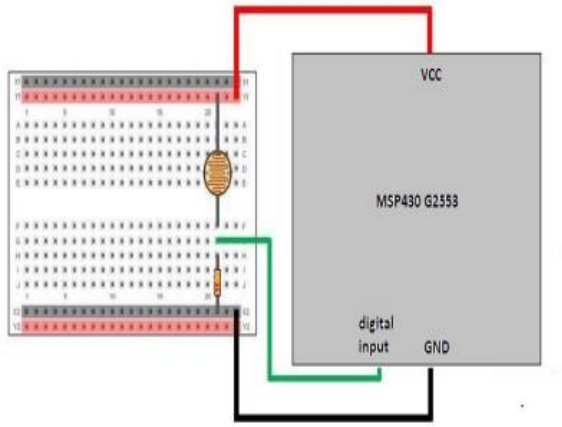

Figure 4 Basic LDR Circuit

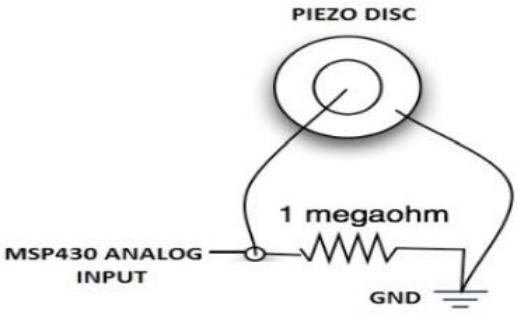

Figure 5 Piezo knock sensor

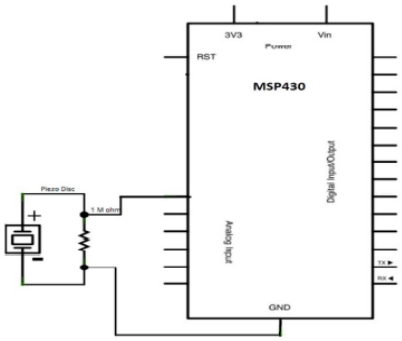

Figure 6 knock sensor connected to analog of MSP430

5. THE CONSTRUCTION AND WORKING OF SMART AUTOMATIC STREET LIGHTING

The system starts to works only at low or poor lighting conditions. Piezoelectric crystal strips are embedded on the roads6 at calibrated intervals. There are strips can arranged in many ways depending on the road conditions provided. In a highway, whenever a vehicle moves over a piezo transducer, an electric pulse is generated due to the pressure created by the vehicle. This electric pulse is responsible for efficient and smart automatic street lighting in the roadways. The electric pulse is sensed by the microcontroller and it triggers the intensity of the street light to maximum associated with it for a predefined time. As the vehicle moves on, each street light gets triggered one by one providing a better vision to the driver and efficiently conserving energy. When there is no movement of vehicles, the MSP430 micro controller does not receive any analog electrical signal from the piezo transducer. Hence the street light glows with a partial intensity around 30 to 40 percentage of its maximum intensity during the poor lighting conditions. The energy for lighting a street lamp can be obtained from solar energy which is a renewable source of energy

6. ADVANTAGES OF THIS SYSTEM

- The greatest advantage of the system is that the piezo sensors act independently without any external power sources.
- They do not cause any radiation exposure to the pedestrians and vehicles.
- They provide energy conservation without compromising on viewing comfort and safety.
- And since the lights go back to their normal intensity after the vehicles move over the next piezo strip, the energy saved is very high.

7. RESULTS BASED ON THE PROTOTYPE

- When vehicles move over the piezo embedded road, the microcontroller reads a digital HIGH and the code actuates the street light to glow with full intensity for considerable amount of time until the vehicles crosses that particular street light.
- In the prototype we used a basic piezo knock

transducer. The terminals are connected to the MSP430 Launchpad into with a high resistance connected parallel to diminish loading effect.

Figure 7 STREET LIGHT

8. CONCLUSION

LEDs are going to be vital lighting option in near future due to its peculiar low power consumption and cost effective nature. Our prototype will help in eliminating the current sodium vapour street lamps with better LED comprised lamps operated smartly using LDR, and piezo knock sensor. And also the integration of solar powered street lights with this concept, the power saving factor can be solved and the backup energy duration for street lights could extend.

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3. Saad M, Farij A, Salah A, Abdaljalil A. Automatic street light control system using microcontroller. World Scientific Figure 7. Glows with reduced intensity. Figure 6. Our prototype with few street lights. Figure 8. The first street light glows with full intensity as the toy car passes. Akshay Balachandran, Murali Siva, V. Parthasarathi, Surya and Shriram K. Vasudevan Vol 8 (17) | August 2015 | www.indjst.org Indian Journal of Science and Technology 5 and Engineering Academy and Society. 2013; 92–6. ISBN: 978-960-474-339-1.
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