

Power the Lamps with Less Power Using Piezo-Electricity

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Abstract: *Energy conservation plays a vital role in today's world. This paper deals with energy saving, in order to reduce the overall power consumption of our country. In this regard energy used by the street lights ought to be saved. This may be important mainly in urban areas where abundant power is wasted by the street lights even during nights when there is a minimum traffic flow. To implement less power consumption IR Sensors are used. They are kept on either sides of the road. It sends logic commands to the LEDs. When there is vehicle movement sensed the LEDs glow. This can save immense amount of energy. Thus it dynamically changes its state i.e. switching ON and OFF automatically. Day and night times are sensed and indicated by the LDR sensors. Hence LEDs are in off state during the day and glows in dim state during nights. It glows brightly only when the object is sensed. This is one of the ways to control wastage of electricity. Utilization of mankind can also be reduced. Electricity required to light the street lights can be given through the voltage developed by the piezoelectric crystals based on the piezoelectric effect. Piezoelectricity is the accumulation of charges in response to the mechanical stress applied.*

Keywords: IR sensor, LDR, Piezo electric crystal effect, Energy reduction

1. Introduction

There are plenty number of advancements in the field of embedded system. This can be made use even for street lights. Each engineer working in this area should be concerned about the power required to light the lamps in large areas with a maximum possible intensity. Our new ideology makes up with the need of lower consumption of energy. Street lights are essential for the safe driving and also for the pedestrians to be safe in addition to avoid accidents. Poor lighting conditions may lead to unsafe environment[6]. Therefore almost all the areas have street lights installed. Street lamps provide a good neighbour-hood environment during dead of night. Providing street lights is of immense importance as far as a city is concerned. This leads to surplus power consumption. Lighting drastically increases the bill for overall energy consumption up to 10-38%[5]. Manually controlling the ON/OFF of the street lights though not impracticable leads to lot of power wastage. This also involves plenty of human beings in all part of the cities to control the ON and OFF[9]. Thus this is a tiring process. To reduce this usage of electricity, plenty of techniques are being implemented. But we haven't got the best solution for it.

If the energy is getting used up in this rate, there won't be sufficient resources available for the next generation. Therefore conservation techniques ought to be implemented as soon as possible. Power wastage is due to over usage of resources i.e. consuming them at unnecessary times [9]. Automation is one of the upcoming technologies now. In this technological world lighting of streets can be automated [9]. This is because humans are too busy that they do not have time to spend on all these works[5]. All are very much interested in making use automated technologies. It is also one of the best technique which could be used for immense

reduction in power usage. Street lights consume large amount of energy because they are lit for many hours a day. Here our work minimizes the power usage by the use of piezoelectric crystals, as they can produce electricity when there is a mechanical deformation. If this produced voltage is used to light the street lights, the power conservation is possible. Mechanical stress and electric charge was related by René Just Haüy and Antoine César Becquerel. The nature of the piezoelectric effect is closely related to the occurrence of electric dipole moments in solids. By the use of embedded system we can automate the lighting of street lights.

LDR is used for the identification of day and night. Micro controller is the heart of the circuit which are programmed using C language [5]. LEDs are used as they consume only less power than HID (High Intensity Discharge Lamps)[8]. Therefore our aim is design an advance technology which can help us to save power. Now a days the life style is changing and people expect that everything should be automated [5]. The computer hardware and software and other mechanical parts are designed to perform a special type of function which forms a embedded system.

An embedded system is a microcontroller-based system[8]. It is driven by a software, reliable, real-time control system, autonomous, or human or network interactive, operating on diverse physical variables and in diverse environments and sold into a competitive and cost conscious market[8]. An embedded system is not a computer system that is used primarily for processing, not a software system on PC or UNIX, not a traditional business or scientific application. High-end embedded & lower end embedded systems. High-end embedded system. Generally 32, 64 Bit Controllers used with OS. Examples Personal Digital Assistant and Mobile phones etc[8]. Lower end embedded systems - Generally 8,16 Bit Controllers used with an minimal

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operating systems and hardware layout designed for the specific purpose. Examples are small controllers and Microwave Ovens, where they are embedded in. Embedded systems have been employed in a variety of fields including industrial, commercial, and consumer and in military services. Embedded systems are widely used in telecommunication [8]. It is employed from telephone switches for the network to the end-user (mobiles).

Data is routed through network bridges and educated routers in networking through computers. Electronics of consumer consist of personal digital assistants (PDAs), mp3players, mobile phones, video game consoles, digital cameras, DVD players, GPS receivers, and printers[8]. Many household appliances, such as microwave, washing machines and dishwashers have embedded systems which provide reliability, effectiveness and advanced features.

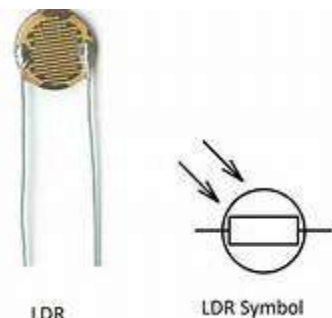
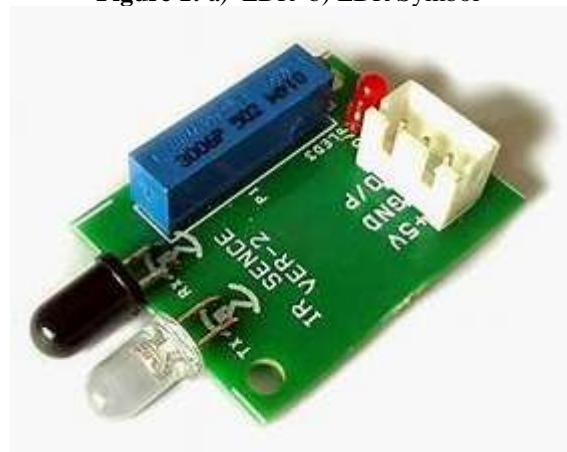


Figure 1: a) LDR b) LDR Symbol



c) IR –sensor

2. Related Works

Mustafa Saad, Abdalhalim Farij, Ahamed Salah and Abdalroof Abdaljalil developed a prototype using LDR, microcontroller, IR sensors and photo electric sensor to bring about a decrease in power usage and have made them automated too.

K.S. Ruchitha, Neelakshi Agarwal, Soumya Anand, Anurima Das, Rajasree P.M have proposed a system in which the intensity of light is controlled by the use of relays according to the environmental conditions which results in reduction of power requirement.

S. Suganya, R. Sinduja, T. Sowmiya & S. Senthilkumar have made use of photo diode and microcontroller and zigbee module. They have designed an efficient system to

work during low traffic conditions. Cameras can be used to see the infrared rays which are placed on the road sides. This is most effective in rural and urban areas.

Upendra Pal Singh, Shubham Kumar, Pankaj Mishra, Arun Sisodia, Vishwadeep Singh have developed a system in which all the LEDs glow when it is dark and gets switched off after a few seconds. Considering the security reasons the first LED is kept in the ON state throughout the night and rest all of them are switched off until objects are sensed. The lights are in off state as the vehicle passes by and the next set of lights begins to glow. Solar panels are being used for the purpose.

3. Existing Work

The HID lamps are being replaced by LEDs as they consume less power. LEDs switch faster than HID lamps and have a longer lifetime[8]. The existing work has a separate supply given for the street-lamp for its glow. Whenever the IR-sensor detects the vehicle movement, it indicates the micro-controller to switch on the street-lamps[6]. The micro-controller in return sends a control signal to the street-lamp to turn on. The street-lamp then draws voltage from the voltage line given and starts to glow. We can also maintain minimum intensity using PWM without completely switching it off and so the street light will glow in dim state during the night and will glow in brighter state during vehicle approach. The day and night are detected by LDR. The microcontroller waits for the signal from LDR and when the intensity of light on LDR decreases, the output of the microcontroller is activated and the street lights start to glow. Here the street-lamp draws voltage from the separate voltage line given to it after receiving the control signal from the micro-controller.

Further one can also make use of the PIC161F877A microcontroller to carry on with the objective of energy saving. PIC161F877A microcontroller is interfaced with light sensor to sense amount of light available[5]. Control signal is generated with the help of pic16f877a microcontroller after analyzing amount of light. In proposed work we use the voltage generated by the piezo-electric crystals to acts as a voltage source for the street-lamp to glow.

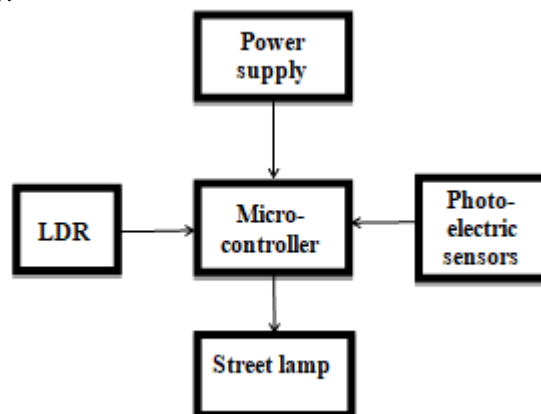


Figure 2: Block diagram of existing system

4. Proposed Work

The proposed work aims at maximum reduction in consumption of energy. Automation and cost effectiveness are the two major factors of today's industry. There are many developments upcoming in the field of electronics and electrical industries. Our system builds upon the usage of piezoelectric crystals which works on piezo-electric effect. The word piezo means squeeze which is a greek word. In 1880 the brothers Pierre Curie and Jacques Curie demonstrated the direct piezo electric effect. It was the first demonstration. When a mechanical stress is being applied on a piezo-electric crystal, electric charges are produced across the crystal. This is called as piezo-electric effect. This effect is also a reversible one. The proposed work makes use of this effect to illuminate the lamps i.e. these crystals generate enough voltage so as to supply voltage to the street lamps.

This system mainly consists of LDR, microcontroller, IR sensors, battery, piezo electric crystals(quantz).In general applying mechanical stress to the piezo-crystal generates voltage of a few milli volts, which is very small .This small voltage is not sufficient to light the lamps of the city. Hence piezoelectric crystals are arranged in cascading manner to obtain large voltages.

At first, the piezoelectric crystals are laid in cascaded manner(i.e. in series) beneath the road. Generally normal quartz crystals can be used as they do not affect the environmental conditions. When vehicles run over, the crystals i.e. quartz experience a mechanical stress and so enormous amount of voltage is generated which is alternating in nature. This is followed up by a battery which stores up the generated voltage and is discharged when required, supplying it to the street lamp. Therefore if we utilize this energy, huge power can be conserved. Sustainable Energy Floor(SEF) tiles are available with dimensions 75x75cm. They are placed on the pavements and on the roads so that the electricity obtained can be used to power street lamps. Micro-controller plays a vital role in this system and it is the brain of the system. Power supply should be given to the micro controller. It probably requires only less power. The codes are loaded in the micro controller. It is a single chip which controls the whole system. Instructions are executed one by one. Though there are many types we use PIC16F877A micro controller. This requires only less memory for the program storage. Its of low cost and has high clock speed.



Figure 3: Micro controller

The LDR and ir-sensors are interfaced with the micro-controller. LDR is needed for the identification of day and night. Street lamps can be switched on depending on the

intensity of sunlight on LDR. If the intensity of sunlight on LDR is low, its resistance value is high. This value increases and becomes completely high when it is completely in dark[6]. This resistance value decides when the street lamps are required to switch on. The minimum intensity of light is maintained using PWM [Pulse Width Modulation] when it does not detect any vehicle movement and the intensity becomes maximum on detection of vehicles. During the dark there will be minimum intensity of light and during the detection of vehicle there will be maximum intensity and during the day the lamps will be in the off state[6]. The ir-sensors are placed on the roads for the detection of vehicles. IR sensors are also called as obstacle detector. It transmits an ir signal and it bounces from the surface of the obstacle. The signal that is bounced back is received by the infrared receiver. The ir-sensors are programmed using c in such a way that on vehicle detection the micro-controller generates control signal. When this control signal is received the entire circuit is closed (i.e. short circuited) and paves a path for the voltage generated by the normal quartz crystal (piezo-electric crystal)and the street lamp, causing it to glow at maximum intensity. The circuit remains open as long as the control signal is received from the micro-controller. Thus the storage of voltage in the battery will be stopped if it reaches its maximum capacity. We need to place a battery with high capacity and its wear and tear should be less.

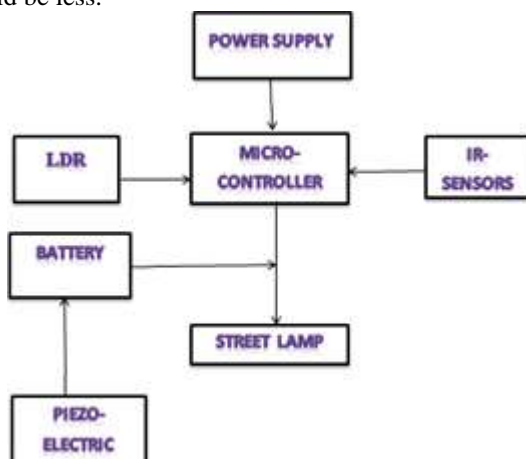


Figure 4: Block diagram of the proposed system

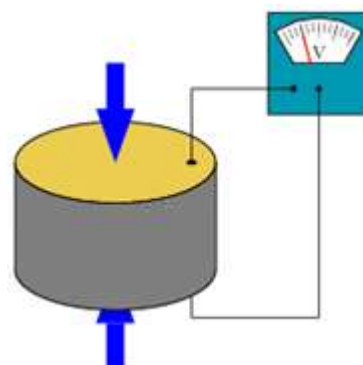


Figure 5: Piezo-electric effect

5. Result

One of the energy saving techniques is seen in this paper. Focus of decrease in power utilization can be achieved by the piezo- electric crystals placed on the roads. They supply

energy to the lamps to light when they undergo mechanical stress.

6. Conclusion

As the technology is growing day by day we have many new techniques coming up which makes life easier. Automation is of great importance in today's industry. Over a few years almost everything will be automated. These techniques do reduce the costs and present efficient method to conserve the resources. The prototype is designed in such a way that it provides good visibility in the dark and offers a safe as well as a comfortable drive. Extensively power is being used up in loads in the highways. By implementing this system we can reduce major part of power usage of our cities. This is an eco-friendly way too. By the use of this system man power is also reduce. Street lamps which use up a lot of power can be made energy efficient and automated. The overall bill for the power consumption due to the lamps can be saved to a considerable amount. Our countries economy increases. This would be a great boon for the fore coming generations. Since this is effective, safe, and cheap we can save a huge amount of electricity it can be used efficiently for the street light illumination.

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