

## SMART STREET LIGHT USING PIEZO ELECTRIC TRANSDUCER

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### Abstract

The project aims at saving energy by detecting the vehicle movement on highways and switching on the block of street light ahead of it and simultaneously reduces the intensity of the trailing lights. This project requires a LDR to detect day or night. The Smart street light provides a solution for energy saving which is achieved by sensing an approaching vehicle using the piezoelectric transducer which is cost effective and sends it to the AT mega328 microcontroller. Amount of generated electrical energy is unable to keep up with the demand, and also there is scarcity of raw materials for producing the energy. In countries like India, 1/5th of energy consumption is through street lighting. So, we have to save energy for future use. The conventional street lights are still designed according to old standards of reliability. Because of this, large amount of energy is wasted and it puts a lot of stress on the natural resources used for generating electricity. Smart Street light is an automated system which automates the street. The main aim of Smart Street light is to reduce the power consumption when there are no vehicle movements on the road. The Smart street light will turned to be ON when there are vehicles on the road otherwise the lights will be switched OFF. With advancement of technology, things are becoming

simpler and easier for everyone in the world today. Automation is the use of control systems and information technologies to reduce the need for human

work in the production of goods and services .Automation greatly decreases the need for human sensory and mental requirements as well. Automation plays an increasingly important role in the world economy and in daily experience. Automatic systems are being preferred over manual system. The research work shows automatic control of streetlights as a result of which power is saved to an extent. As the vehicle passes by, the trailing lights switch OFF automatically. Thus, we save a lot of energy. So when there are no vehicles on the highway, then all the lights remains to glow in low intensity.

### Introduction

The highly discussed topic in the present situation in Science and Technology is "Energy conservation and reduction of workforce". The existing prototypes should be improvised in the manner of low power consumption, which is a major priority. Especially in developing countries like India. In rural areas vehicle movement are less so need of full intensity street light is less. This paper gives solution to

controlling the intensity of the lights considering the movement in the road. In this conventional system, the street lights have group based control which means individual lights cannot be controlled. Due to some natural calamities like storm, if there is a breakage in wire, the entire system gets affected. Maintenance cost will be high in order to repair this system. Also they make use of sodium vapour lamp which is harmful. The low pressure sodium vapour lamp produces 33,000 lumens which consumes more amount of energy. The existing systems are mounted with IR sensors which is used to detect movement requires external power source to function. These systems are installed on either side of the road in such a way that they are vulnerable to external factors and natural calamities. A major drawback in it is that it cannot detect multiple vehicles passing simultaneously. Hence the intensity of the light that is depending on density of vehicles will have considerable errors. The combination of LDR and piezoelectric sensor would predict the movement on the roads as well as the density of vehicles on the roads, which may increase the efficiency of energy conservation operation. The vehicles moving on the road tends to vibration of the piezoelectric material placed below the road due to deformation, caused by the pressure of vehicle passing. The possibilities of damage are reduced considerably as they are mounted under the road. And moreover the sensors are self-aided, which operates on pressure difference that produces a voltage that is sufficient to give digital 1 or 0.

### Smart street lighting

- 1. Energy savings:** Energy use and costs decline, because the lights dim/switch off at night when there is no activity.
- 2. Cost reduction:** Maintenance costs are reduced because it takes more time before the lamps have to be replaced
- 3. Reduction in CO<sub>2</sub> emissions:** With this energy reduction comes a reduction in CO<sub>2</sub> emissions.



- 4. Reduction of light pollution:** Light pollution is reduced, because the street lights don't shine at full brightness anymore. Street scenes become calmer looking.
- 5. Maintenance of safety:** Safety is maintained, because it becomes clear from far away when movement is approaching (the lights brighten).

### Major components

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

## 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 the intensity of light is detected which helps the microcontroller to switch the system on and off based on the environment's lighting conditions. A LDR may have resistance of 300k ohms in complete darkness and drops to 3k ohms in bright light. This LDR is used as an analog sensor from which the analog inputs are given to the AT mega328 microcontroller.

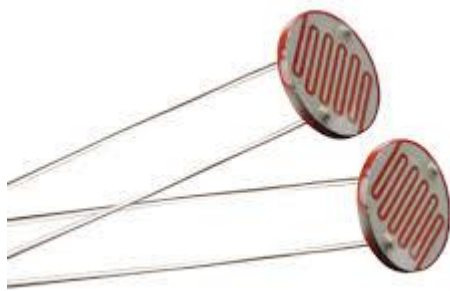


Figure: LDR

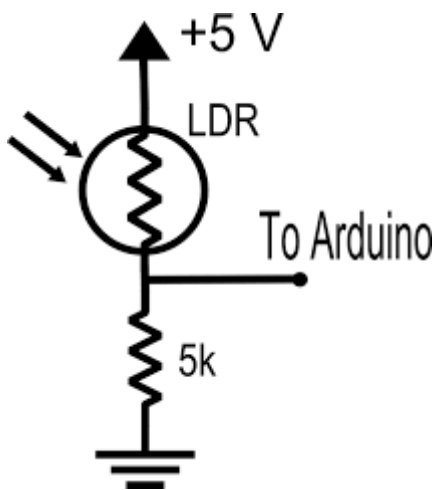


Figure: LDR connected to aurdino

## Piezoelectric Transducers

Piezoelectric Transducers is based on the piezoelectric effect. It is the ability of certain material to generate an electric charge in response to applied mechanical stress (pressure). It is used as a knock sensor to detect the movement of vehicles in the roads.. 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. The pressure is directly proportional to voltage.

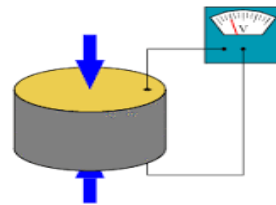
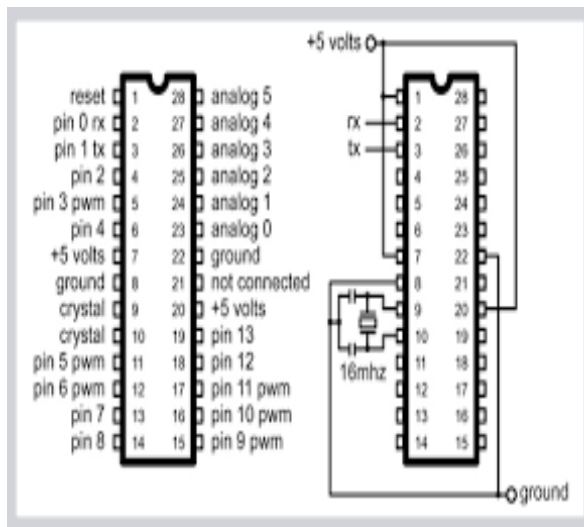


Figure :piezoelectric transducer.

## AT mega 328 micro controller

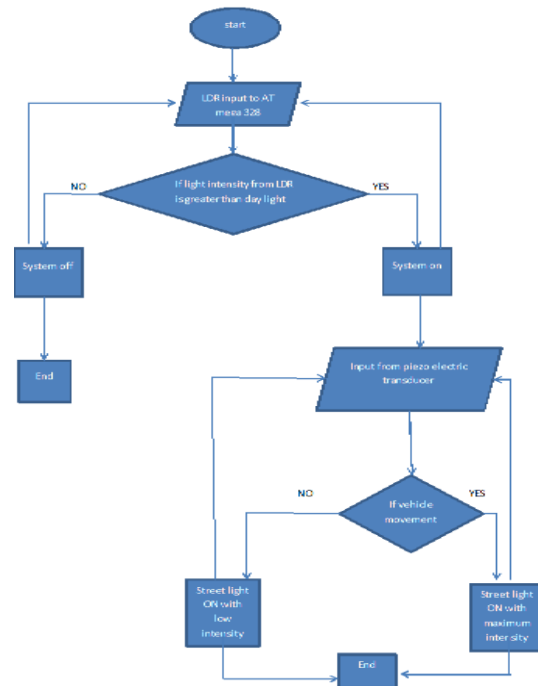
The Atmel 8-bit AVR RISC-based microcontroller combines 32 kB ISP flash memory with read-while-write capabilities, 1 kB EEPROM, 2 kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz.



### 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 . Hence the street lights glows with full intensity.

### Methodology



### The Construction and Working of Smart Automatic Street Lighting

The system starts to work only at low or poor lighting conditions. Piezoelectric crystal strips are embedded inside the roads at calibrated intervals. The strips can be 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 AT mega

238 micro controller does not receive any analog electrical signal from the piezo transducer. Hence the street light glows with a partial intensity around 35 to 40 percentage of its maximum intensity during the low lighting conditions.



### Leverages of the proposal

- One of the greatest advantages of this system is that the piezo sensors work without any external power sources.
- They do not cause any radiation exposure to the pedestrians and vehicles.
- They provide conservation of electric without compromising on viewing comfort and safety.

### Drawbacks

- The piezo can produce voltage only when there is constant pressure difference.
- The piezo can't give digital HIGH, if any vehicle halts for longer time.

- The integration of this for pedestrian cross can help the late night drivers to detect any movement in the highways.
- It switches on the light even due to the movement of animals

### Conclusion

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

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