

# Piezo Electricity and Object Presence Based Street Light

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## Abstract

The requirement for efficient energy storage is required in the present scenario. The other methods of energy harvesting doesn't involve the use of piezo. In general, the applications based on piezo utilize the voltage produced right at the moment. The proposed work is accomplished by using piezo Electric to produce the electricity and IR sensors that will control the light based on object's movement detection. The IR sensor is set to sense the objects passing the road. The electricity can be produced and stored at the same time using piezo electric. So, we proposed a method for the efficient storage of produced piezo electric voltage in a lithium metal hydride battery. This project requires a sensor to detect the object and an series of piezoelectric sensors to detect the vehicle's pressure and accordingly produce the voltage to store in a battery. So when there are no objects on the path lights remains off. IR Sensors used on the road senses vehicle movement and sends 0 or 1 to street lights to toggle them. Such a method of automatic toggle helps in saving a lot of energy and increases the efficiency of electric storage using piezo.

**Indexterms** - Piezo electricity generators(sensors), Object detection, Energy harvesting.

## I. INTRODUCTION

In the recent years, the street light control is developed to be easy and efficient, but as the number of streets in the town increases fast, the control and management of street lights become an issue. In general, street lamps control need a man to on or off regularly using a switch set in each of the street lamps. This is called the first generation of street lights but they have a drawback of inefficient use of electricity. Large amount of electricity is wasted. Also, the street lights have single control which implies each light cannot be controlled individually. Due to some disaster or weather conditions the light may be damaged and effects the connected system. High cost to maintain or repair the damages. Also the sodium vapour lamp used earlier is harmful to health. The sodium vapour lamp uses huge electricity for efficient use.

In recent years, the street light control is already automated and uses day night control but is not readily implemented. This system uses LDR to automatically turn on in the evening turns off

automatically in the presence of sun, but the reliability of this method is less. It does not depend on man power but on the other hand it does not conserve electricity consumed during night. It also explains the problem that it cannot meet the growing needs of electricity and street lights. Finally the earlier street light system is not worth of implementation.

The author [1] proposed an idea of storing electricity produced from piezo and storing it in lithium hydride battery by using a bridge rectifier. The bridge rectifier is used to convert the produced AC from piezo to DC to store in a battery during the morning and the switch is inverted during night to discharge for Street lights. Author [2] and [3] proposed an idea based on IR sensor. IR sensor detects the object passing on the road the power stored in battery (produced by piezo due to movement of vehicles and people on the road during day time) is consumed during night for efficient use.

## II. PROJECT AIM AND FOCUS

### A. Expenditure

The piezo electric generators are low-cost and around 20 to 50 rupee. The overall project is so cost effective including the IR sensors and piezo electric sensors. On scrutiny with any other sensing systems like solar sensing system, IR sensing system etc this model suggests an inexpensive and impressive method.

### B. Easy commencement and expansion

The positioning of the piezoelectric sensors below the road surface is rather soft and readying of wires, mending our master circuit and connecting it to the street lights are not challenging. If a new street light is to be included, the enlargement process is also so simple.

### C. Condition

Usual street lights do not always toggle therefore safety might not be high. The intent of the method is to sustain open safety and to preserve energy. To monitor public safety, streetlights that are inside the view of people or object but not near them must turn on; if somebody shroud behind something to onset people or physical object, people or vehicles must find

it to avoid the onset. Therefore, street lights whose areas are within the view of the people or object must

toggle on and street lights that are associated with safety of the people or vehicles must also toggle.

### III. PROBLEM SOLUTION

#### A. Sensor deployment

The piezoelectric sensors are arranged at regular measure on the road in rows near each street light. In this project we took about two IR sensors on one row. PCB plate with a bridge rectifier which is connected to the two IR sensors. The metal sheets give assistance to these sensors and also improve the outcome of the pressure applied by the passing objects or people footsteps. In order to improve and extend the movement evenly among these sensors we use rubber bars. These synthetic bars are placed in-between two sensors and two passably bigger pieces are used for the ends. In this mode one IR sensor is connected to a set of two piezo sensors attached in parallel. These sensors are connected in series with rubber bar for better suspension and covered with tar sheets. Since we use 2 sensors for a row we get 2 positive leads and one common negative lead. The main leads of the connections will be attached to the street light. A negative lead is taken by connecting the other end of the battery for recharge. From the positive terminal of the diode the positive lead is taken so that we have 2 positive leads and 1 negative lead from the whole charge pump circuit. The positive and negative leads of the charge pump circuit as well as the sensor circuit are affiliated comparably. To the controller board we connect the 2 positive leads to it and the negative one to the ground. It converts the analog signals likely to digital signals.

### IV. WORKING AND IMPLEMENTATION

When the object moves on the road, there is distortion of the piezo due to the press/force basically pressure applied by the moving object. In our task, we suggest to place the array of piezoelectric crystal sensors placed below the surface of road. Hence, due to distortion of road, these piezoelectric sensors vibrate to some degree, producing electricity because of the law of piezoelectric effect. The electricity produced from single piezo is in very low-level, but the total energy from array of piezo is appreciable. The electricity so produced is then given to the energy harvesting and transducer. The electricity from piezo is Alternating Current and hence it is rectified to get the Direct Current output voltage from bridge rectifier circuit. This DC voltage is then accumulated by the capacitor. The transistor is used as the switch guiding the flow of current. At the start, the transistors are in cut-off and therefore, the capacitor gets charged. As the voltage on capacitor crosses diode voltage, the capacitor discharges, toggling the circuit. Once capacitor discharges by charging the battery, the circuit inverts and starts charging again. The 12V output of the circuit is stored

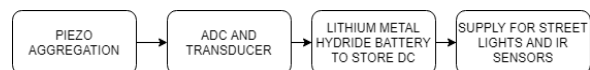
in 12V lithium metal hydride rechargeable battery. During day, only the charging of the battery is done and the circuit remains in off state. The second aggregation consists of street light IR sensor dependency. The relay is so planned such that, in the charging state, energy from battery is not utilized by Sensor or other encircles and hence energy is stocked in the battery without getting discharged. In the night time IR sensors will be powered by the battery. This is based on rule of comparator. One set works as the input for the inverting and the other for non-inverting input. Accordingly, at charging state, output of circuit is low and transistor is off. In night time, circuit gives high output toggling transistor on and battery discharges. IR sensors acts as the toggle making system for the street lights. So the lights will be on only during night when an object is passed in front of it during night. As the object pass away light will switch to off. This will save energy and will be especially of great application after midnight.

### V. FUNCTIONS

1. Automatic Street light toggling.
2. Day Night Toggling.
3. Piezo electrical energy harvesting.
4. Easy Implementation.

### VI. BLOCK DIAGRAM

There are four leading aggregations in our project. The primary aggregation is the piezo block. This aggregation is the source of energy. It generates the electrical energy from mechanical energy. This aggregation consists of piezoelectric substance like PZT. These materials are enclosed underneath the road so as to transduce pressure exerted by objects on the road into electrical energy. Next aggregation is for energy harvesting. The energy so generated is converted to dc to store in a battery and raised so as to become of practical function. Next aggregation is of energy storage consisting of lithium metal hydride battery, the main purpose of which is to store the energy for later use. The final aggregation is the automation circuit, as it determines the daytime and night time, controls the toggling of street lights, and hence street lights are used efficiently.



### VII. FUTURE SCOPE

The whole equipment can be affiliated to the IOT for activities like data collection from roads, monitoring traffic consequently and caution the specific vehicle if it is above the speed limits or if it is using a forbidden road. This concept can be of much use if the IOT can be used in a 4-way junction. The

instrumentality can also be used in accident inclined zones like the mountain curves, junctions. For illustration in the mountain curves if a light is placed at the curve corner, the vehicle from either side of it can know if a vehicle is coming on the other side and how far is it from the degree of the lamp.

### VIII. CONCLUSION

The loss of electrical energy in the country due to the huge number of unmonitored street lights is high and must be controlled. This even helps in using the saved electrical energy for developing villages and industries. Many cities and smart towns have already adopted different sensor disciplined street lighting systems like IR, ultrasonic systems, they are very expensive and non relevant to implement in regular places, roads and other places. Since we make use of piezoelectricity, the prescribed method is cost effective and doesn't have any major imperfections. It also has a lot of future scope. Thus we end up by saying that this efficient system can be implemented in any small or large streets of our country for saving electricity, which is a requirement for growing nation.

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