

## DESIGN OF POWER SAVING SYSTEM FOR STREET LIGHT USING PIEZOELECTRIC MATERIAL

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**ABSTRACT :** A new approach to produce power energy to maintain the Streetlights or other uses. In this approach piezoelectric transducer is used to save the electricity power. Piezoelectric transducer is placed on platform. The piezoelectric transducer is used to convert mechanical vibrations into electricity power and then generated power is stored in a battery by using battery charging circuit. The IR transmission unit has IR transmission side and Receiver side. When Transmitter unit transmit the signal and receiver receives the signal. The receiver signal is given to the Microcontroller. The LDR is used to measure the Light signal. The ADC gets the LDR signals and converts the Digital signals. The digital signal is given to the Microcontroller unit. The Microcontroller get inputs from the receiver unit and it is programmed to control the MOSFET driver. Microcontroller controls the PWM signal. MOSFET driver gets controlled PWM signals and control the lamps. The Battery supplies essential power to all units. When at dark times the lamps are glowing in dim condition. When vehicles or human beings are cross the road and the lamp will be glow in bright condition. In lamps are glowing to take the particular time on bright condition then become a normal dim condition.

**KEY WORDS :** IR Transmission, Piezoelectric Transducer, Microcontroller, ADC, LDR, Lamp Driver, Lamp And The Battery Unit

### 1. Introduction

The main aim of this paper is to reduce the wastage of power. In recent days electricity shortage is the main issue faced by the government. The only solution of this problem is the reduced usage of power. Our idea is focused on the streetlights. In streets the lamps are glowing continuously throughout the night. Large amount of power is wasted by unwanted use of power. This wastage of power is reduced by the implementation of this project. Here the lamps will be glowing in dim condition normally. When a vehicle or a human being passes it is detected by the IR sensor unit and this signal is given to the microcontroller unit. This unit will give the signal to the lamp drive circuit and the lamp glows brightly. The added advantage of this project is that power can be generated by the piezoelectric transducer. The piezo transducer is placed in the road side. When an object passes the mechanical vibration is converted into electric power by the piezo transducer and it is stored in the battery.

The proposed method uses piezoelectric material. The rest of the paper is organized as follows, in section II presents the system description and its simulation. In section III presents hardware section. In that piezoelectric generator various components used are described. In section IV present the software description and section V presents the conclusion and working model of concept.

### 2. SYTEM DESCRIPTION

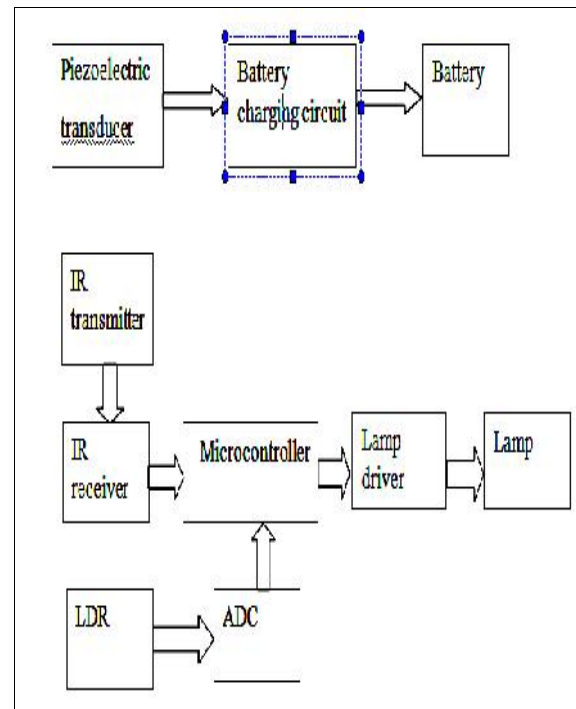


Fig2.1 Block Diagram

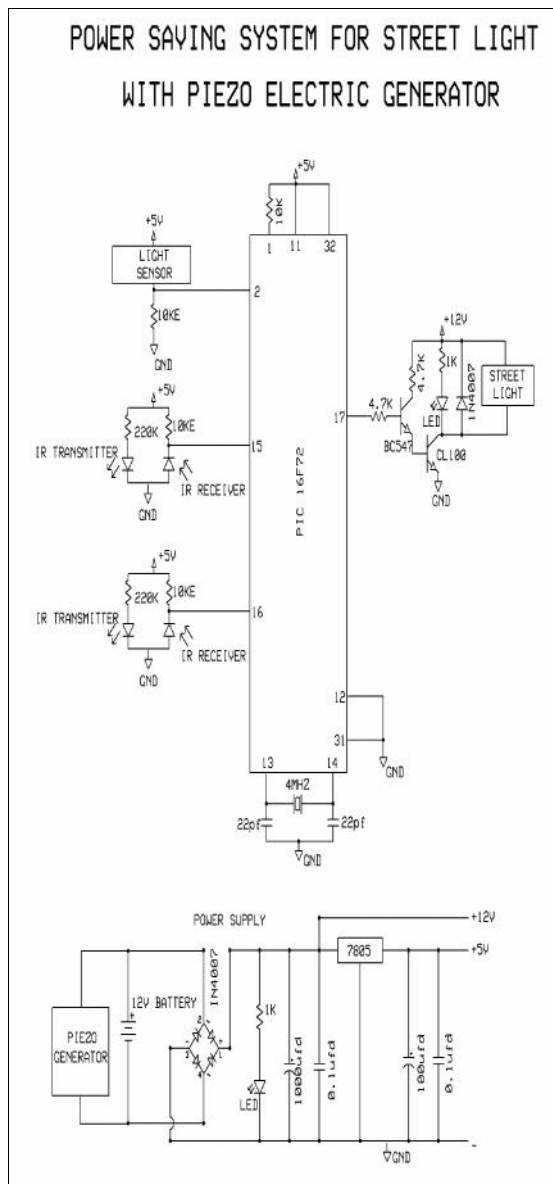


Fig 2.2 Circuit Diagram

Piezoelectricity refers to the ability of some materials to generate an electric potential in response to applied pressure. Harvesting of energy which means energy is already available, but is going to waste if not utilized. Embedded piezoelectric material can provide the magic of converting pressure exerted by the moving people into electric current. Fig 2.1 shows the Block diagram, Fig 2.2 shows circuit diagram [2] and Fig 2.3 shows simulation diagram.

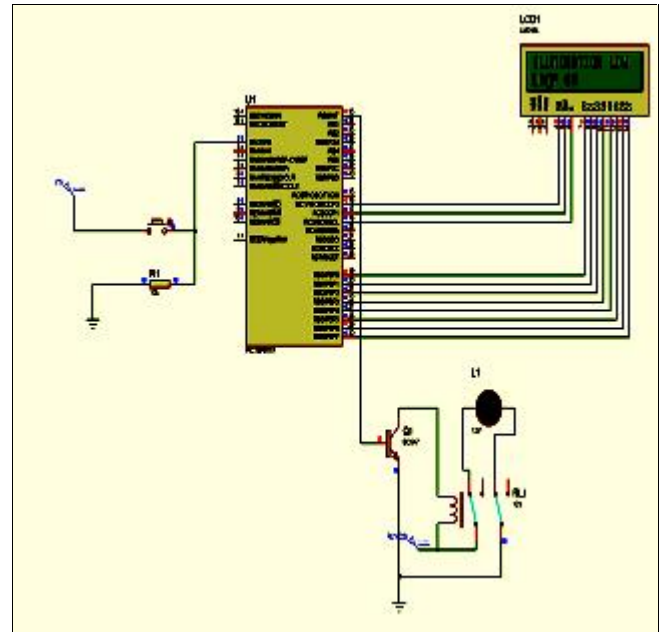


Fig 2.3 Simulation Diagram

### 3. HARDWARE DESCRIPTION

The system consists of the following components

- PIC microcontroller(PIC16F877A),
- IR Transmitter receiver module,
- Piezoelectric generator,
- Battery,
- LDR.

#### 3.1 PIC MICROCONTROLLER (16F877A)

PIC Microcontroller is the first RISC based microcontroller fabricated in CMOS (complementary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory.

The main advantage of CMOS and RISC combination is low power consumption resulting in very small chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques.[2]

Flash Memory is used in PIC16f877A so that the data is retained even when power is switched off. Easy programming and erasing are the other features of PIC 16f877A

#### 3.2 RELAY DRIVER

The relay driver circuit is enabled certain time duration only, such enable pulse is depended by delay programming of microcontroller, here darlington circuit has been two transistors made connection of cascade network, if input is set to base of the first transistor, then that is turn on and emitter current of that turn the another one. Hereby the circuit is closed through coil and second transistor, now the energized coil is controls the

contactors that are change the normally open to close and normally closed to open connection. The enabled signal is not essential after energized that coil because transistor collector current maintains the transistors in saturation state continuously.

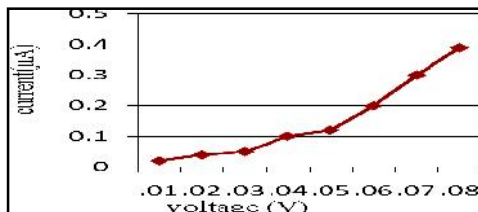
The induction effect may be affect the indication components and another thing, so diode is connected across the coil which can prevents the chopping effect the inverse magnitude of magnetic field shorted across from coil.

### 3.3 PIEZOELECTRIC GENERATOR

Human population all over the world and hence energy demand is increasing day by day linearly. Accordingly, it is an objective of the present invention to provide a method of electrical power generation from this ever increasing human population that does not negatively impact the environment. This technology is based on a principle called the piezoelectric effect, in which certain materials have the ability to build up an electrical charge from having pressure and strain applied to them. Piezoelectricity refers to the ability of some materials to generate an electric potential in response to applied pressure. Harvesting of energy which means energy is already available, but is going to waste if not utilized. Embedded piezoelectric material can provide the magic of converting pressure exerted by the moving people into electric current.

#### 3.3.1. STUDY OF PIEZO MATERIAL:

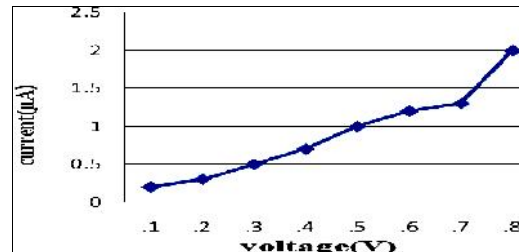
Piezoelectric ceramics belong to the group of ferroelectric materials. Ferroelectric materials are crystals which are polar without an electric field being applied. The piezoelectric effect is common in piezo ceramics like  $PbTiO_3$ ,  $PbZrO_3$ , PVDF and PZT. The main component of the project is the piezoelectric material. The proper choice of the piezo material is of prime importance. For this, an analysis on the 2 most commonly available piezoelectric material - PZT and PVDF, to determine the most suitable material was done. The criterion for selection was better output voltage for various pressures applied. In order to understand



#### a.V-I graph of PVDF material

the output corresponding to the various forces applied, the V-I characteristics of each material namely, PZT and PVDF were plotted. For this the Piezo transducer material under test is placed on a Piezo force sensor. Voltmeters are connected across

both of them for measuring voltages and an ammeter is connected to measure the current. As varying forces are applied on the Piezo material, different voltage readings corresponding to the force is displayed. For each such voltage reading across the force sensor, various voltage and current readings of the Piezo test material are noted

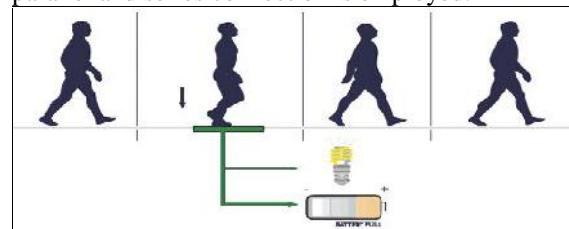


#### b.V-I graph of PZT

**Fig 3.3.1. V-I graph of piezo material**

#### 3.3.2 WORKING

The piezoelectric material converts the pressure applied to it into electrical energy. The source of pressure can be either from the weight of the moving vehicles or from the weight of the people walking over it.[4] The output of the piezoelectric material is not a steady one. So a bridge circuit is used to convert this variable voltage into a linear one. Again an AC ripple filter is used to filter out any further fluctuations in the output. The output dc voltage is then stored in a rechargeable battery. As the power output from a single piezo-film was extremely low, combination of few Piezo films was investigated.[7] Two possible connections were tested - parallel and series connections. The parallel connection did not show significant increase in the voltage output. With series connection, additional piezo-film results in increased of voltage output but not in linear proportion. So here a combination of both parallel and series connection is employed.

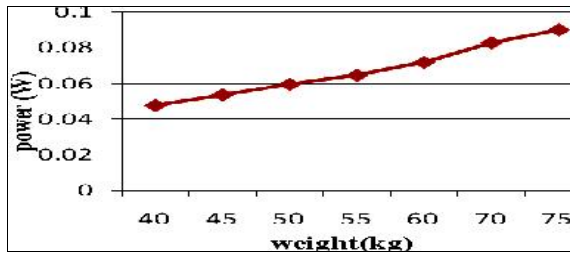


**Fig 3.3.2 Schematic representation of working model**

#### 3.3.3 ANALYSIS DONE ON PIEZO MODEL

People whose weight varied from 40kg to 75 kg were made to walk on the piezo tile to test the voltage generating capacity of the Piezo tile. The relation between the weight of the person and power generated is plotted in figure 8. From the graph it can be seen that, maximum voltage is generated when maximum weight/force is applied.

Thus, maximum voltage of 40V is generated across the tile when a weight of 75 Kg is applied on the tile.



**Fig 3.3.3 Weight vs power graph of piezo tile**

### 3.4 LDR

A photoresistor or light dependent resistor or cadmium sulfide (CdS) cell is a resistor whose resistance decreases with increasing incident light intensity.

### 3.5 BATTERY

A lead-acid battery is a electrical storage device that uses a reversible chemical reaction to store energy. It uses a combination of lead plates or grids and an electrolyte consisting of a diluted sulphuric acid to convert electrical energy into potential chemical energy and back again. The electrolyte of lead-acid batteries is hazardous to your health and may produce burns and other permanent damage if you come into contact with it.

Batteries are typically built for specific purposes and they differ in construction accordingly. Broadly speaking, there are two applications that manufacturers build their batteries for: *Starting and Deep Cycle*.

### 3.6 LED

The transducers in Units 9.4 and 9.5 produce electrical signals from light; the opposite is done by a light-emitting diode. The cathode lead is nearer the 'flat' at the base of the LED and some, but by no means all, manufacturers make it shorter than the anode lead.

## 4. SOFTWARE DESCRIPTION

### 4.1 MP LAB

MPLAB Integrated Development Environment (IDE) is a free, integrated toolset for the development of embedded applications employing Microchip's PIC<sup>®</sup> and dsPIC<sup>®</sup> microcontrollers.[1] MPLAB IDE runs as a 32-bit application on MS Windows<sup>®</sup>, is easy to use and includes a host of free software components for fast application development and super-charged debugging. MPLAB IDE also serves as a single, unified graphical user interface for additional Microchip and third party software and hardware development tools. Moving between tools is a snap, and upgrading from the free software simulator to

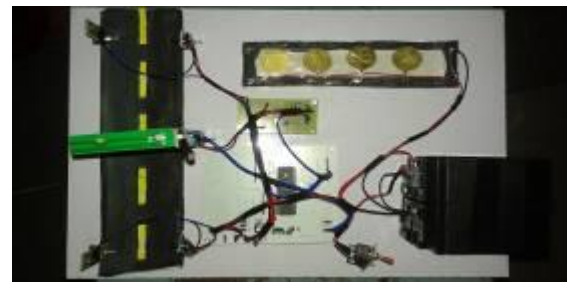
hardware debug and programming tools is done in a flash because MPLAB IDE has the same user interface for all tools.

### 4.2 C COMPILER

MPLAB C Compilers, the highly optimized compilers for the PIC18 series microcontrollers, high performance PIC24 MCUs, dsPIC digital signal controllers and PIC32MX MCUs. Or, use one of the many products from third party language tools vendors. Most integrate into MPLAB IDE to function transparently from the MPLAB project manager, editor and debugger

## 5.CONCLUSION

This project makes use of energy generated by using piezo transducer and is stored in battery.Thus power requirement is greatly reduced.The main advantage of this project is that it reduces the wastage of power. The use of PIC microcontroller gives an added advantage that it controls the power automatically. If implemented, This paper may be benefited the electricity board a lot.



**Fig 5.Proto Type Model**

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