

An Intelligent Traffic Light System Based on Piezo- Electric Sensors



Naveen kumar, Syed Mohammad Shoaib

Abstract: (A) *Objective* –The project aim is to make a traffic light that will solve the traffic problem on crossroads by detecting movement of vehicle with the help of piezoelectric sensors and reducing the open time for that lane in which the traffic is low and increasing the green light open time for that lane in which there is a dense traffic.

(B) *Method*- This smart traffic light project required sensor that will sense the vehicle movement and the number or density of vehicle on a certain lane of a crossroad and send logical messages to the micro command that will change the time for opening the green light for a certain lane of crossroad

(C) *Finding*- In current years traffic is automatic and changing of the green light opening time for lane on crossroad is one by one and opening time for all the lane is same and many crossroad traffic are controlled by traffic police .The reliability of those method are less and also its take a men power to operate the traffic . This smart traffic light does not conserve energy for all the operations because the piezoelectric sensor that we are using that will give the power for operating all the systems

- It does not take external energy for operating all the operation
- The aim of the smart traffic light is to reduce the traffic problems
- This project will save the time

In my project I used piezoelectric material, which is cost effective. For the communication purpose we have used Zigbee communication is used to communicate between the traffic light and sensor which will calculate the parameter and store the information about the vehicle.

Improvement- The entire setup can be connected through the internet of thing (IOT) for process like data extraction. Which is particularly useful for place like four way junctions etc.

Keywords: Modern traffic light, Piezoelectric effect, Traffic light based on piezoelectric effect,

I. INTRODUCTION

Now a days there is huge crises of energy supply and it is urgent need to develop a renewable energy resource so for achieving our goal of saving energy we are going toward energy harvesting methods .Energy harvesting is that method in which we can supply energy by wind, solar, temperature gradient ,vibration and etc. there are many technologies such as photovoltaic, piezoelectric and etc.

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Those are taking all the attention for saving the energy but in this system energy which are generated due to vibration of machines and many other sources is not being captured hence this source of energy is wasting so for utilizing this source of energy we are using piezoelectric material so we are using these material for various purposes such as for making intelligent street light and installing this piezoelectric material on highways for generating the energy from the movement of vehicle hence we can also use this setup for our traffic control as well. Because the traffic jam problem is one of the biggest problem of many country and in India traffic jam is one of biggest problem in metro cities and every wants to give up from this problem for saving there time so for minimizing this problem we are going to develop an smart traffic light which can be able to minimize this problem.

In a past few decades there is a small no of vehicle in a town and city but as country develop into well off society and with urbanization the number of vehicle increased day by day and due to their increasing numbers the problem of traffic jam are having daily and for solving the traffic problem traffic light are used on every cross road . But this traffic light is automated and the green light opening time for all the lane of cross road is same and then the green light time for the lane which has dense traffic as well as low traffic are same. Many times it happens that a lane which has low traffic became empty but the green light open time is not completed and the other lane which has a dense traffic are waiting so for solving this problem I am making this smart traffic light

This smart traffic light can change the opening and closing time of traffic light for each lane according to their traffic density

All the operation can be operated without any external energy source because we use the piezoelectric material that will do the dual work it will sense the movement of vehicle and this movement of vehicle will give the power for operation as well as give the logical messages that will use to change the traffic light opening time for each lane. There are many sensors such as LDR sensor, laser, voice detecting sensors and etc. but piezoelectric sensors are reliable and easy to install give better result and the best one is that it very chip so it is cost effective. Piezoelectric material is those material which measure the changes in mechanical energy such as strain, temperature, pressure, acceleration & force by converting these changes in to electric charge and we can change these charges in to another signal as per our use.

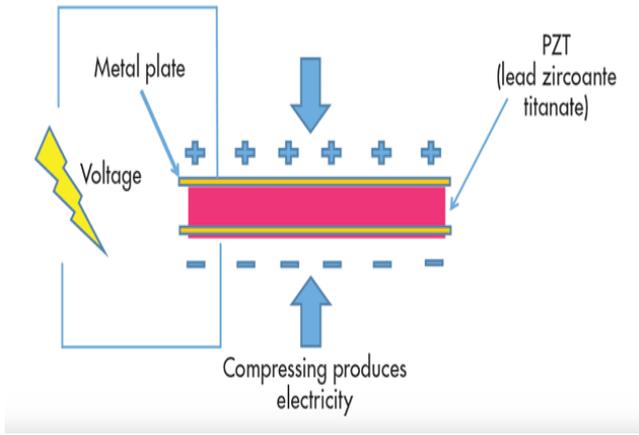


Fig (1): piezoelectric effect

The piezoelectric sensors convert mechanical changes into electrical voltage this effect can be mathematically represented by the following equation.

$$D = dT + \epsilon^E$$

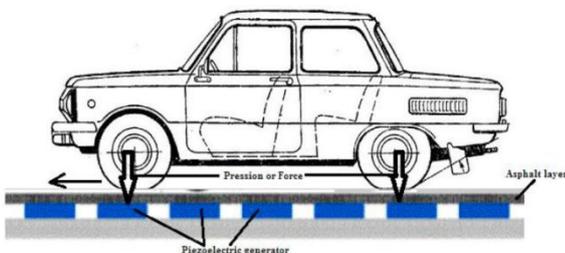
$$S = s^E T + d$$

Here,

| | |
|--------------|--|
| D | Electric displacement |
| s | strain |
| d | Piezoelectric charge constant |
| ϵ^T | Dielectric constant at Stress(T)= constant |
| T | Stress |
| s^E | Compliance at E=constant; |

A. Principle of working of an embedded piezoelectric generator

It is (piezoelectric generator) consist of one or more than one piezoelectric material. these materials are embedded in the ground in the form of layers for the harvesting of energy which is produced by the motion of vehicles as shown in figure. A pressure will be exerted by the vehicle movement on the layers which cause the change in pressure in piezoelectric material and the electric power will be generated with the help of these material.



Fig(2) piezoelectric material embedded in the ground

B. Easy Installation:

The installment of piezoelectric sensors in the form of layers inside the road surface is quite simple and doing all the wiring process is also simple, implanting the master wires connections and connecting the master circuit to the traffic light is not too difficult.

C. Low Cost:

The piezoelectric sensor which we are using is very chip. The price of these chips is around 5 to 10 rupees per chip. The total cost of this project is very less which is cost effective after including the cost of microcontroller (Arduino)used and the cost all other technologies used. On comparing these piezoelectric sensors with all other sensing elements just like IR sensing device etc. This is one of the most cheapest and easiest way.

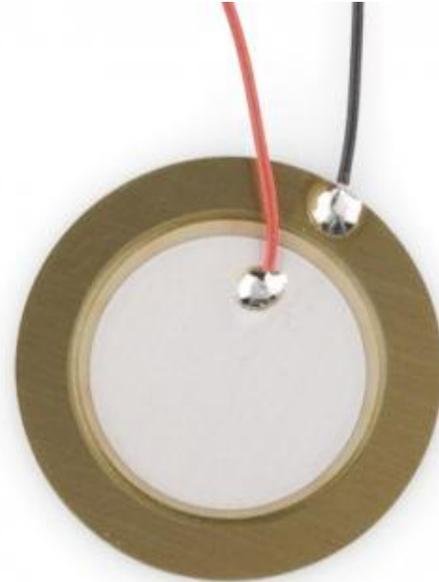


Fig (3) sensor

II. EXPERIMENTAL SETUP

- The set of two piezoelectric sensor will be place on the road one is near the traffic light and another one is 200 meters away from the traffic light.
- In each and every set of plates we take about 6 sensors. We make two rows of these 3-3 sensors.
- Two PCB (printed Circuit Board) plates have a thickness 3 cm are firstly placed on 2 tar sheets and the three sensors are installed between these PCB plates. These metal sheets used as a basement and also used for providing support to these sensors plates and also increase the impact of the pressure which is applied by the vehicles.
- For amplifying the vibration and distribute these vibrations equally among all the plates of these three sensors a rubber bar is used. These rubber bars are installed in between the two sensors (covering with metal sheets) and at the end we used slightly bigger pieces.

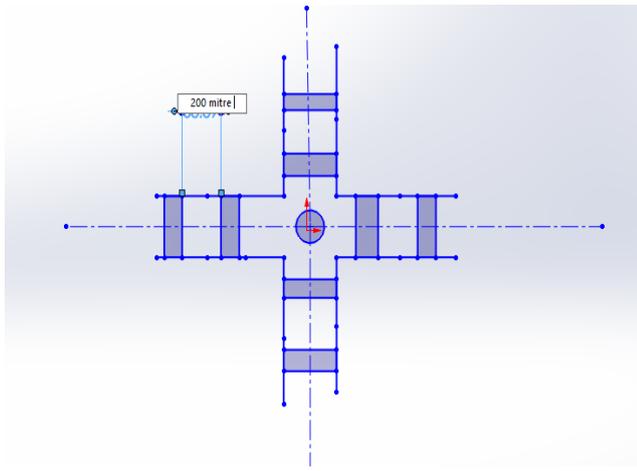


Fig (4) proposed system overview

A. Traffic control and safety:

Now a days traffic is controlled by an automated traffic light and many place it is controlled by person and due to mistake of people it may occur accident and due to traffic jam many peoples times also waste so this smart traffic light will help us for minimize the chance of accident as well as save our time.

B. Proposed system:

The final aim of this project is for solving the traffic jam problem and this principle is used for sensing the movement of people and vehicle with the help of piezoelectric sensors embedded on the roads and controlling the green light opening time for each lane according to the decision taken by the microcontroller used.

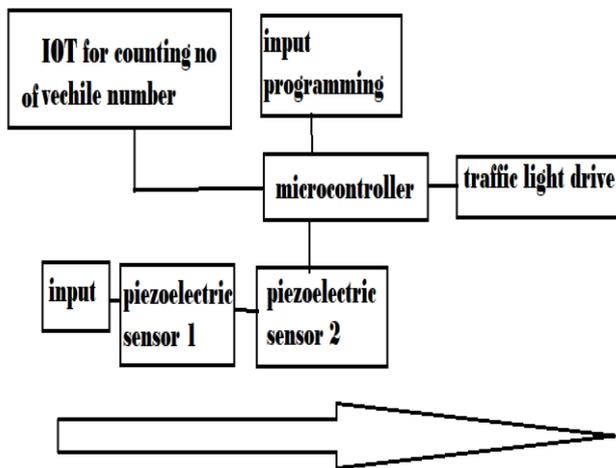


Fig (5) Block diagram of proposed system

There are many ways by which we can sense the movement of vehicles. We can detect the vehicles by sensing vibration (piezoelectric sensor) pressure (pressure sensor) interference (IR sensor) sound (ultrasonic sensor). We can't use ultrasonic sensor even it is good because this sensor will not work in sound prone area. Pressure sensors are little bit costly and use of IR sensor on both side of road will have many interventions therefore the most reliable and cost effective way is to use the piezoelectric sensor. Cost of these is near about 10 Rs to 15 Rs and it can be embedded in to the road surface easily for detecting the vibration.

III. GRAPHICAL INTERPRETATION AND RESULT

We obtain and accessed data from MATLAB software and stored it in the form of text files. Following 2-d graph is different for different cases. These cases are Perimeter that decide the nature of the curve are contact time, pressure applied and speed.

$$speed \propto pressure$$

$$speed \propto \frac{1}{contact\ time}$$

And the time of contact and pressure will show the density of traffic in a certain row. Time of contact for pedestrian's, two wheeler's and four wheeler's with different speed will be different and their will also be different.

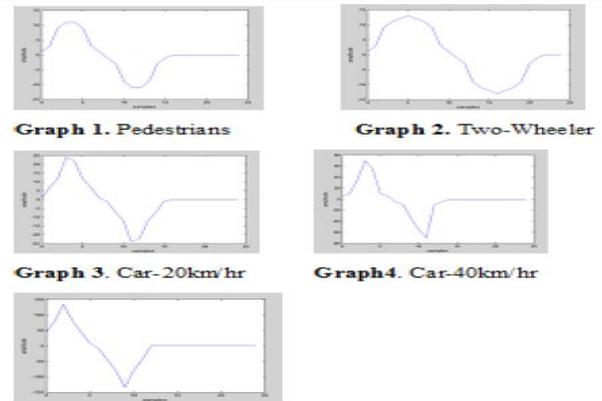


Fig (6) a sensors unit

IV. CONCLUSION

In all over the world there are many cross roads and people are wasting their time on crossroad due to traffic jam. Modern cities are using many new ways to overcome the problem of traffic problem and this project will help them to minimize their traffic problem.

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