RESEARCH ARTICLE

FOOT STEP POWER GENERATION SYSTEM FOR RURAL ENERGY APPLICATION TO RUN AN AUTOMATED TOLL GATE SYSTEM

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Abstract— In the present day scenario, power is a major need for human life. There is a need to develop non- conventional sources for power generation due to the reason that our conventional sources of power are getting scarcer by the day. This paper emphasizes on the idea that the kinetic energy getting wasted while vehicles move can be utilized to generate power by using a special arrangement called "power hump" at toll gates. The main aim is to run the toll system using piezoelectric sensor. In turn we are saving the power needed for running the toll gate. Now a days there is a huge rush in the toll plazas in order to pay the toll tax. Therefore in order to reduce the traffic jam and to save time, & also to reduce the money loss of 300 cores / year. In this paper automation in toll tax payment using RFID is designed. Automation of toll plaza is made using the combination of microcontroller, RFID and Piezoelectric sensor. In addition, this paper also had solar panels, which would satisfy our power needs, when there is no vehicular movement.

Keywords— Automation of Toll gate; RFID sensor; Power harvesting; Energy generation; piezoelectric sensor

I. INTRODUCTION

"Design and develop a Automatic toll plaza which is based On microcontroller, RFID technology and load sensor(Piezoelectric sensor) to save the time at toll plaza and having cash free operation". As the name suggests "*Automatic Toll Plaza*" the key theme of this paper is the automation. So in very simple language the Automation means to replace the human being from the process with the machines [1]. Means what presently the human is doing on the process now onwards the machines are going to do. Before moving further we will just take the overlook of history of the toll plazas. So before the 90's decade the toll plazas were fully manual controlled. Means there are two people for opening & closing of the gate & another two are for reception of the

money & data keeping etc. But in 1995 when the Express ways had been developed the semi automatic toll plazas were launched in which data is stored in computers & gate operation is automatic, only two personals are required for single booth. But here we are going to see the human less toll plaza [2].

It has been observed that a lot of electrical energy is wasted at toll gates just to operate gates, computer systems and for lighting. Nearly 500 units of electrical energy is required to operate one toll gate in one day. If all the toll gates are considered, a huge amount of electrical energy is needed. Electrical energy can be generated at the toll gates by using PIEZOELECTRIC SENSORS and SOLAR ENERGY to overcome this problem. In recent years, piezoelectric sensors have been widely used in various applications of mechanical sensors. piezoelectric sensors have several beneficial properties, such as: flexible, lightweight, very wide frequency range and no need of power supply as it is self generating. The multilayer technology allows the component to convert (harvest) mechanical energy and produce electrical energy with low voltage that can be used for direct supply of electronic devices. This paper also operates solar panels by constantly facing towards sun at 90 degrees to produce maximum voltage. It can move the solar panel from east to west also from south to north & also to correct for the durational movement of the Sun in the sky. The set of light sensors give the input and it operates stepper motor with gear mechanism. This is based most demanded natural resources where recurring cost of energy is nil. This is an ideal solution urban agriculture area where electricity is not available or may be far from the available spot.

II. SYSTEM DESIGN

System Architecture and Business Logic

The most creative & challenging phase of the system like cycle is system design. The term "design" describes a final system & the process by which it is developed. It refers to the technical specifications that will be applied in implementing the candidate system. It also includes the construction of programs & program testing. The key question involved here is "How the problem should be solved? System design is a solution for the question of how to approach to the creation of a new system. This important phase is composed of several steps. It provides the understanding & procedural details necessary for implementing the system recommended in the feasibility study. Emphasis is on translating the performance requirements into design specifications. Design goes throughout logical & physical stages of development. Logical reviews the present physical system; prepares input & output specifications makes edit security & control specifications; details the implementation plan; prepares a logical design walkthrough. Physical design maps out the details of the physical design, plans the system implementation, devises a test & implementation plan & specifies any new hardware & software. The current system for collecting toll is on the basis of manual transaction. In this, each vehicle has to stop at the toll plaza for payment. It causes traffic congestion, increase in pollution, and wasting time of people. In Automated Toll System no need to stop vehicle at toll plaza, it will detect the RFID tag, which is on vehicle. After detecting RFID tag, the database on the screen will appear and the balance from the customer's account will get deducted. So there will not be any problem as mentioned above. Develop a micro simulation model, which reproduces the operation states of various tollgate systems: waiting time, passing time. With this simulator, we proposed the optimal operation strategy of highway tollgate by benefit-cost analysis on the basis of benefit in saving total waiting time and operating cost.

III. **ARCHITECTURE**

A. RFID sensor

This deals with the transmitter section where the vehicle Number , smart card number details of the vehicle are taken they are verified with the data base and checked, if the details satisfy, after transferring the data the comes to the receiving section the encoded signal is decoded and the given to the microcontroller the microcontroller does the two things, it displays the data on the PC which is to be verified by the security and the vehicle gets the relevant receipt, if the details are verified after the transaction then goes to actuator unit and then the gate opens automatically.
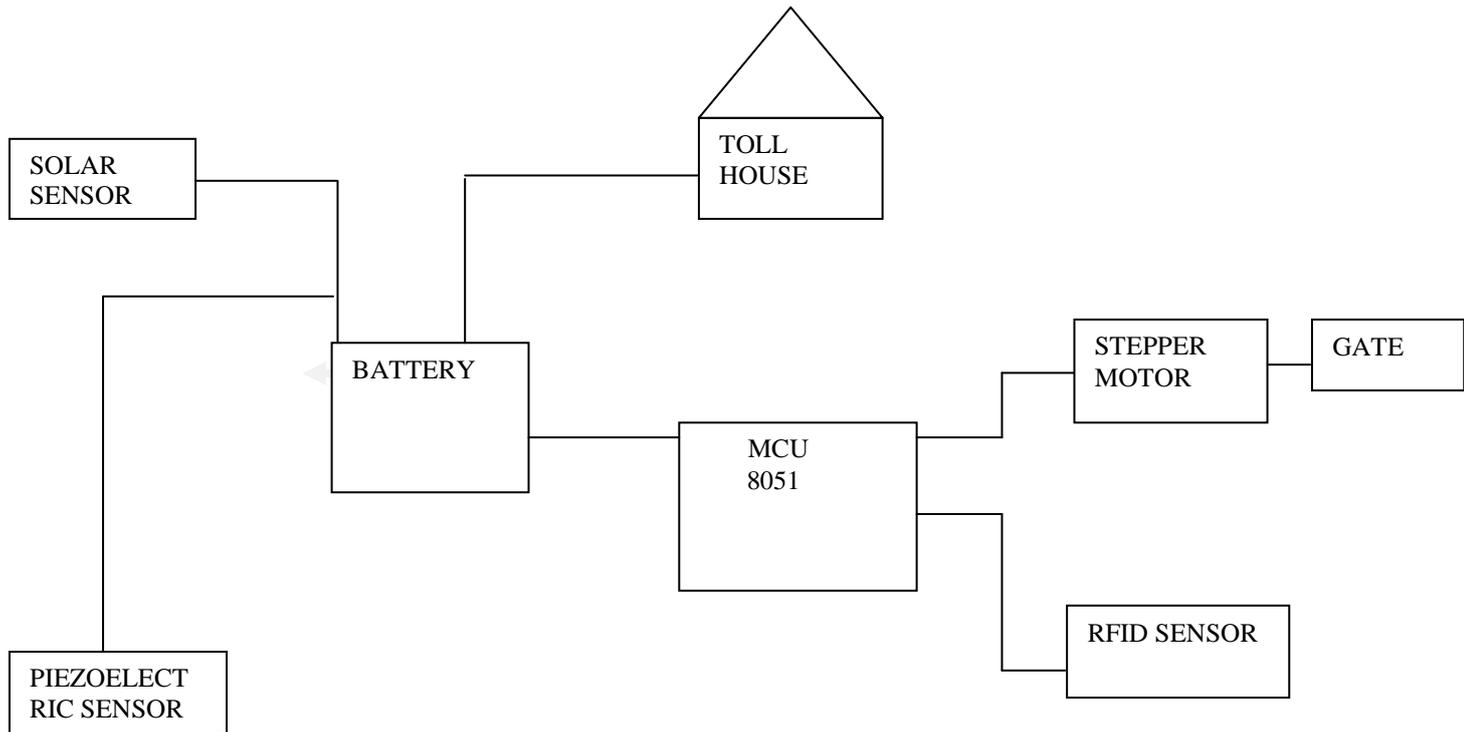

Fig1. Module Block Diagram

Radio frequency identification (RFID) is a method of remotely storing and retrieving data using devices called RFID tags. An RFID tag is a small object, such as an adhesive sticker, that can be attached to or incorporated into a product. RFID tags contain antennae to enable them to receive and respond to radio-frequency queries from an RFID transceiver.

Fig.2. General RFID based Toll Tax Image

Microcontroller is used to controlling the process.IR sensor is used to detect whether the vehicle gone or not to close the gate again and to make nails down. The system is connected to a PC using the RS232C interface in the embedded system. This allows the system to read and write data from/to a database that is from the account. From this database send the user update about his balance. And from that send the reminder on him mobile and balance update. RS232 is used for serial communication. By using RS232 signal is transferred from RFID to pc. An RFID tag is installed on each vehicle with read/write memory. A reader device reads this data when near to toll system from the vehicle and compares it with the data in the computer database, if ID is in *defaulter i.e.* complaint is in police station about lost or something for security purpose nails get up so that it will not able to go outside and it will get automatically caught then allows the access accordingly by opening the gate. But, ID is not in the defaulter list, toll collection is taken and nails goes down and gate get open .The entire system is developed as an embedded system using micro-controller and associated devices. The system is connected to a PC using the RS232C interface in the embedded system. This allows the system to read and write data from/to a database that is from the account. Keypad is used to control the gate and nail position. IR sensor is used to detect whether the vehicle gone or not to close the gate again and to make nails down.

B. Piezoelectric sensor

A **piezoelectric sensor** is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical signal. As seen in Figure 1, the unit cell contains a small positively charges particle in the centre. When a stress is applied this particle becomes shifted in one direction which creates a charge distribution, and subsequent electric field. These materials come in several different forms. The most common is crystals, but they are also found as plastics and ceramics.
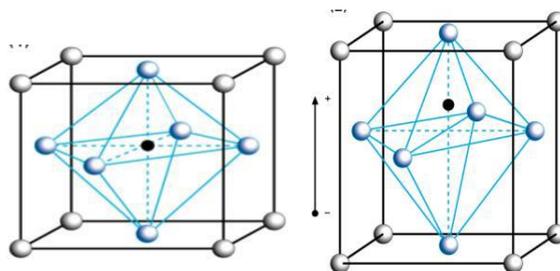

Figure3. Lead Zirconate Titanate unit cell

Piezoelectric sensors have proven to be versatile tools for the measurement of various processes. They are used for quality assurance, process control and for research and development in many different industries it was only in the 1950s that the piezoelectric effect started to be used for industrial sensing applications. Since then, this measuring principle has been increasingly used and can be regarded as a mature technology with an outstanding inherent reliability. It has been successfully used in various applications, such as in medical, aerospace, nuclear instrumentation, and as a pressure sensor in the touch pads of mobile phones. In the automotive industry, piezoelectric elements are used to monitor combustion when developing internal combustion engines. The sensors are either directly mounted into additional holes into the cylinder head or the spark/glow plug is equipped with a built in miniature piezoelectric sensor.
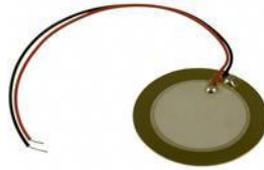
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Figure4. Tourmaline Piezo Electric Sensor

One disadvantage of piezoelectric sensors is that they cannot be used for truly static measurements. A static force will result in a fixed amount of charges on the piezoelectric material.

IV. OPERATION

Once the System has been implemented completely then next task is to observe how system is supposed to operate to carry out different operations involved in System. When vehicle will cross the sensor which are fixed at some meter distance from processing unit, Tag will read by RFID Reader. Sensor may fixed vertically at both sides or at the centre of road depend upon where the TAG is mounted on vehicle. TAG contains unique identification number. Then data read by the RFID reader will be taken by Microcontroller (8051) which will process the data for authentication of authorized user.
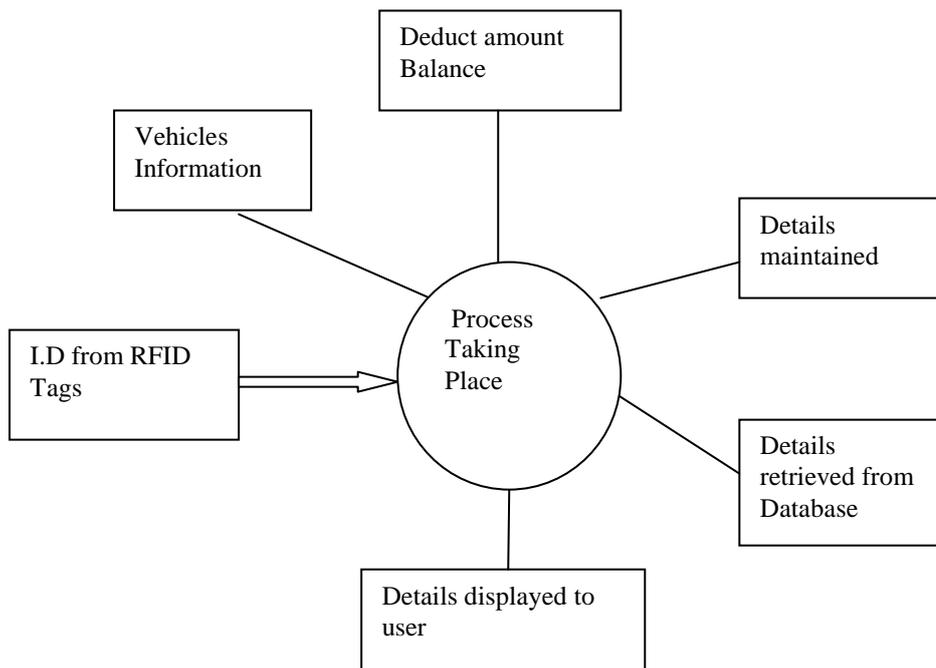

Fig.5. Detailed of processes working simultaneously

If valid user then data will send to processing unit which then check the respective account of that user from database to ensure weather user have sufficient amount for toll payment or not. If amount is not sufficient to pay toll then user must have to recharge its account by paying manually. If sufficient amount then user is allow to pass by iron bar which will rise up with the help mechanical assembly after receiving the permission signal from processing unit. If user is not valid then iron bar will remain down and appropriate action will be taken against invalid user.

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V. ADVANTAGES AND DISADVANTAGES

Advantages

Below is the list of advantages due to the usage of the technique mentioned in this paper.

1. Enables very specific detection of vehicles.

2. Simultaneous multiple detection of vehicles are possible using RFID.

3. Proximity of loop antenna and tag provides potential for increased reliability.

4. Saves time and money.

5. Minimizes work stress

6. Pollution free power generation.

7. Simple construction, mature technology and easy maintenance.

8. No consumption of any fossil fuel which is non-renewable source of energy.

9. No fuel transportation required.

10. No external source is needed for power generation.

11. Energy available all year round.

Disadvantages

1. 1. Low frequency results in lower maximum data rate, although it is fast enough to allow multiple transmissions   to increase reliability.

2. 2. Tag usually requires power from vehicle (active tag).

3. 3. Tag installation is not as convenient as that of a windshield-mounted tag.

4. 4. Moderate difficulty in duplicating tags.

VI. CONCLUSION AND FUTURE SCOPE

In coming days, this will prove a great boon to the world, since it will save a lot of electricity of power plants that gets wasted at Toll gates. As the conventional sources are depleting very fast, then it's time to think of alternatives. We got to save the power gained from the conventional sources for efficient use. So this idea not only provides alternative but also adds to the economy of the country. Now, vehicular traffic in big cities is more, causing a problem to human being. But this vehicular traffic can be utilized for power generation by means of new technique called "power hump". It has advantage that it does not utilize any external source [12]. Now the time has come to put forte these types of innovative ideas, and researches should be done to upgrade their implication.

Designed a system to give complete solution for traffic and transport related problems such as Toll gate control, traffic signal control, traffic rules violation control, parking management and special zone alert using the latest RFID technology. It is proposed as a low cost optimized solution using RFID and GSM mobile technology. At the toll plaza, there will be a large LCD screen for displaying details of the transaction.

At the same time, it will show:

1. Total cost of that road.

2. The duration of toll plaza.

3. And the remaining balances after each transaction.

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