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Automatic Electronic Toll Collection System on Highways for Smart Cities

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Abstract- Radio Frequency Identification (RFID) Card Readers provide a low-cost solution to read passive RFID transponder tags up to 2 inches away. The RFID Card Readers can be used in a wide variety of hobbyist and commercial applications, including access control, automatic identification, robotics navigation, inventory tracking, payment systems, and car immobilization. The RFID card reader read the RFID tag in range and outputs unique identification code of the RFID tag. The RFID reader can interface to microcontroller or PC and the unique identification code of the RFID tag received by the RFID reader is send through serial at baud rate of 9600. The softwares used are netbeans and jdk for hardware, mysql for database and mikro c for interfacing microcontroller. The basic advantages of the system is trvalling time is decreased, congestion free network, less emissions in toll area and no infrastructure cost is required. This gives a win win condition for both toll authorities and toll customers.

I. INTRODUCTION

As we all know that transportation is the backbone of any country's economy. Improvement in transportation systems result into the good lifestyle in which we achieve extraordinary freedom for movement, immense trade in manufactured goods and services, as well as higher rate of employment levels and social mobility. In fact, the economic condition of a nation has been closely related to efficient ways of transportation. Increasing number of vehicles on the road, result into number of problems such as congestion, accident rate, air pollution and many other. All economic activities for different tasks use different methods of transportation.

For this reason, increasing transportation is an immediate impact on productivity of nation and the economy. Reducing the cost of transporting resource at production sites and transport completed goods to markets is one of the important key factors in economic competition. Automatic toll collection is a technology allows the automated electronic collection of toll costs. The use of roads is rapidly increasing as the number of vehicles plying them keeps growing, leading to high maintenance costs. Toll collection was introduced as a means of raising funds for road maintenance, but it is traditionally a slow process prone to cause vehicular traffic congestion. Several efforts have been focused towards making the toll collection process faster and more transparent [4-10]. The numerous advantages of the toll collection system make the whole effort worthwhile, a few of which include revenue generation for the maintenance, rehabilitation and reconstruction of roads, as well as road use demand management and control. Therefore, automating this process is an indispensable task able to bring great benefits, and will help to increase the standard of living, while indirectly contributing to the goal of making cities smarter. Electronic toll collection system is the technology that enables the automatic electronic toll collection from the prepaid account registered on the name of vehicle owner, determining whether the vehicle is registered or not and informs the toll authorities avoiding toll violations. Over last decades, electronic toll collection systems have

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been implemented in United States and many other countries with a new improvement in it.

II. METHODOLOGY

This project is built on 8051 micro controller; the project consists of RFID reader, LCD, motor and a motor driver. When the vehicle approaches the toll gate, the user has to show the RFID card to the reader. Then the system will automatically deducts the predefined amount from the users account and the remaining amount is shown on the LCD, at the same time, a motor will be rotated to open the gate, with some delay the gate will be closed. This process continues until the amount in the users account exudes.

Here are some objectives about the ETC based on GPS system which tells us about purpose behind selecting this topic & the requirement of this type of project in our day to day life.

- To avoid the fuel loss.
- To Save the time in collecting toll at toll plaza. To avoid financial loss.
- To control the traffic.

According to the survey of Karnataka Government, in Sept.2012 they have proposed to get the annual toll collection about 2500 crores/year .But in the present situation they are able to collect only 900 corers of the toll value. Means there is loss of 600 cores due to human errors. So, in this situation we have to control this leakage.

III. HARDWARE IMPLEMENTATION

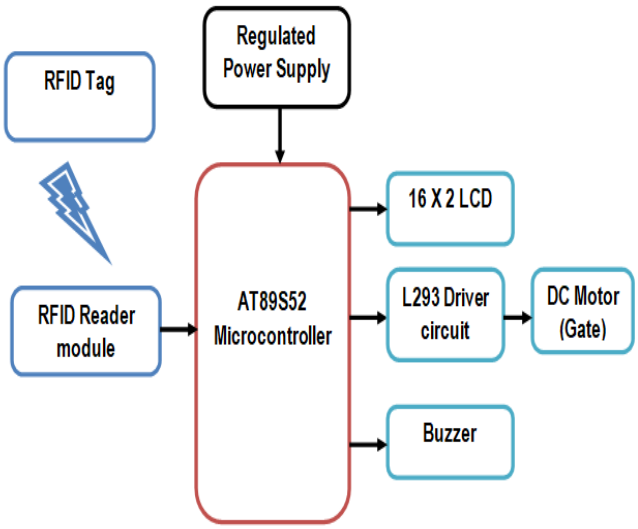

Fig.1 Proposed block diagram

A. Regulated Power Supply:

A variable regulated power supply, also called a variable bench power supply, is one where you can continuously adjust the output voltage to your requirements. Varying the output of the power supply is the recommended way to test a project after having double checked parts placement against circuit drawings and the parts placement guide.

B. LCD Interfacing

This section describes the operation modes of LCDs, then describes how to program and interface an LCD to art .8051 using Assembly and C.

LCD operation

In recent years the LCD is finding widespread use replacing LEDs (seven-segment LEDs or other multi segment LEDs). This is due to the following reasons:

1. The declining prices of LCDs.
2. The ability of display numbers, characters, and graphics. This is ain contrast to LEDs, which are limited to numbers and a few characters.
3. Incorporation of a refreshing controller into the LCD, thereby relieving the CPU of the task of refreshing the LCD. In contrast, the

LED must be refreshed by the CPU (or in some other way) to keep displaying the data.
4. Ease of programming for characters and graphics.

C. Buzzer:
Buzzer is an electronic device commonly used to produce sound. It is the phenomena of generating electricity when mechanical pressure is applied to certain materials and the vice versa is also true. Such materials are called piezo electric materials. Piezo electric materials are either naturally available or manmade. Piezoceramic is class of manmade material, which poses piezo electric effect and is widely used to make disc, the heart of piezo buzzer.

D. RFID Reader:
Radio frequency identification is a powerful emerging technology that enables companies to achieve total business visibility. By knowing the identity, location and conditions of assets, tools, inventory, people and more, companies can optimize business processes and reduce operational costs. Radio frequency identification (RFID) is a generic term that is used to describe a system that transmits the identity (in the form of a unique serial number) of an object or person wirelessly, using radio waves.

E. Motor Driver:
L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC).

It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor. In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. Given below is the pin diagram of a L293D motor controller.

F. DC Motor:
A DC motor is any of a class of rotary electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

IV. WORKING PRINCIPLE

This project is built on 8051 micro controller; the project consists of RFID reader, LCD, motor and a motor driver. When the vehicle approaches the toll gate, the user has to show the RFID card to the reader. Then the system will automatically deducts the predefined amount from the users account and the remaining amount is shown on the LCD, at the same time, a motor will be rotated to open the gate, with some delay the gate will be closed. This process continues until the amount in the users account exudes. Every time a registered vehicle approaches the toll booth, first the Infrared sensors will detect the presence of the vehicle which in turn activate the RFID circuit to read the RFID enable smart card fixed on the windscreen of the vehicle. Transaction will begin, depending upon the balance available toll will be deducted directly or the vehicle will be directed towards another lane to pay tax manually. If the vehicle is stolen the vehicle owner register his complaint to police station, only authorized person update it on website with registration ID and RFID tag number. When vehicle passed by toll plaza every vehicle tag number is compare with stolen vehicle tag number in database at toll plaza if it is matched buzzer will be alarm.

V. RESULTS

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In the design of the proposed Electronic toll collection (ETC) system, real time toll collection and anti-theft solution system have been designed. It also eliminates manual data entry, system improves the better management, leading to lower operational costs and increased revenue generation.

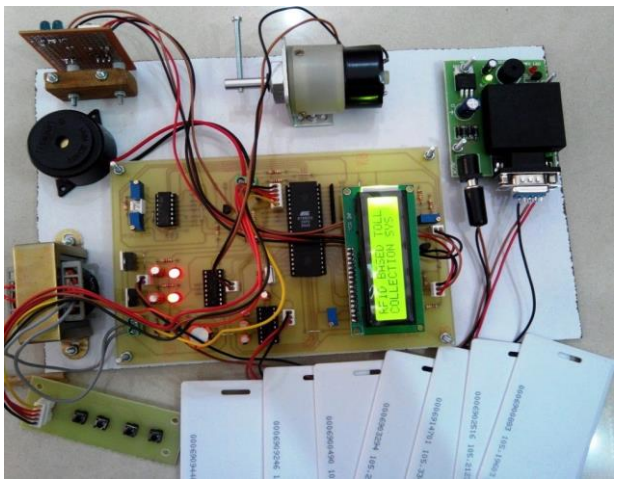

Fig.2 Typical Hardware setup

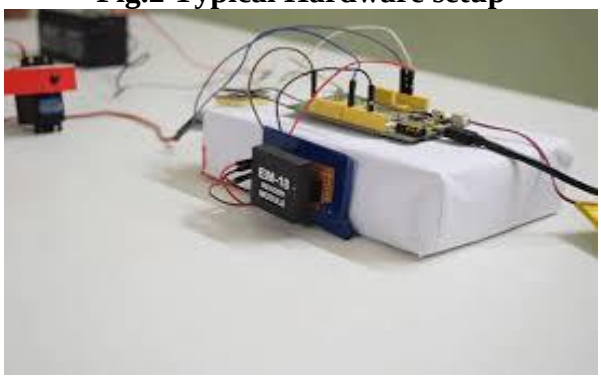

Fig.3: Prototype designing of toll system

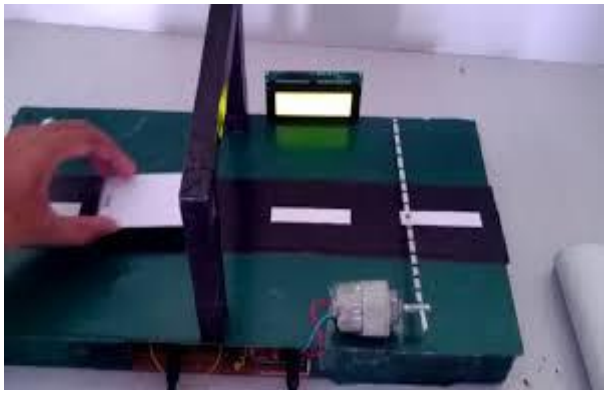

Fig.4: Using RFID Tags

VI. CONCLUSION

RFID is a highly stable and reliable technology. The RFID automatically detect the identities of the vehicles, reading items in motion and tracking of the vehicles can be done accurate. With the elimination of human interaction in the entire toll collection process and also reduction of time at toll plaza, we can create a better ETC system to be implemented. As shown, there are distinct advantages and disadvantages to using ETC technology. The benefits seem to exceed the drawbacks in major ways - for example, by increasing capacity of the toll plazas, decreasing environmental consequences of toll collection, and making toll roads more convenient for users. The Electronic Toll Collection system in expressway based on RFID, a design scheme was put forward. It is low cost, high security, far communication and efficiency, etc. It not improve the passage ability of expressway but also improve the technology level of charge.

VII. FUTURE SCOPE

Since all the payments are done in prepaid mode, a single person is always required at the toll plaza. If a postpaid mechanism is established wherein the user need not recharge at the toll plaza but can recharge his/her account on the internet no person will be required at the toll plaza. In the postpaid technique the user can pass through as many toll plazas without paying and at the end of the month the user will have to pay the entire payment via internet. At the toll plaza's cameras as well as software's are used to keep a track of all users and the amount paid by them. This would make the toll plazas completely automatic and no person would be required at the toll plaza.

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