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Research paper



Advanced Toll Plaza Monitoring by Utilization of WSN Modules

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Abstract

An innovative model that goals to design, develop and instrument by utilization of WSN modules for improved form of toll collection structure. In the proposed system when the user approaches to the payment lane, the Xbee wireless transceiver receives the signal that the automobile has arrived at the payment lane, then automatically the unique id of the passenger that is the Vehicle ID has been read via on-board unit, which will be attached to every motor vehicle and collects the day-to-day toll price for that particular route. The system is employed to every motor vehicles at the time of the registration of new vehicles or it can be attached in old vehicles. This system tends to cuts the time periods for paying the toll at faster rate rather than waiting in enormous queues. If the Vehicle crosses the toll without paying toll bill less than three times, the gasoline valve of the motor vehicle is locked using relay with the support of on-board unit.

Keywords: *RXbee, Wsn, On board unit, Relay.*

1. Introduction

The E-toll collection (ETC) is a technology used to collect toll payments electronically. The faster development of the Highways, E-toll collection (ETC) system is a way that can identify the vehicles without halting them. E-toll Collection System can get good profitable and other profits in the phases of the task, organization charge, in succession cost and numbers of vehicle plying through such contrivance. The advancement of the effective Cordless message technologies, such as RFID, Wi-Fi, Bluetooth helps in the greater applications in the Highway toll system and also transforms fresh ideas for emergent of advanced toll systems.. The RFID tag is an automated ID technology and currently operated in the toll system.

This paper aims for the RSSI technology to use in the vehicle identification to improve the effectiveness of the highway toll system. RSSI (IEEE 802.15.04) is a fast growing wireless network technology that has low complex structure, low power utilization, low data frequency and low cost effective. RSSI concept can be introduced to specify the purpose of the signal strength received on the board unit and helps for easier management of vehicle Id passing on the lane effectively. The project consists of a set of block called layers. These layer performs a specific set of required actions as necessary. The IEEE 802.15.04 standard defines the two layers: the physical layer and the medium access control (MAC) sub-layer, thus it works on this process by providing the network and the structure for the application layer that includes the application support system and the making clear application things. RSSI receives the signal strength in a wireless environment, in arbitrary units. It indicates the power consumption being received by the antenna, the more the arbitrary units, the stronger the indication. It is a unit of the power used in a received radio signal. RSSI is a generic radio receiver, which is usually invisible to the receiver, but is visible to users of wireless networking protocol family. The E- toll system comprises of the station, supporter and a toll system, that collects the fees effectively in automated manner. It also examines and switches every data on the principle of the IEEE 802.15.04/protocol. It records and maintains vehicle's information, which passes through the toll station and supports the system in effective manner and thus reduces the enormous queues and manual work errors.

2. Objective

This work aims to develop an advanced toll plaza system by utilization wsn modules which is faster and tends to cut enormous amount of time for the payment in the toll and avoiding standing in large queues. The development of inexpensive wsn modules attached with the vehicles on board. The wireless data transfer is intended to function in compliance with the RZigBee standard, and signal processing on sensed data is made through a self-adaptive transceiver at the zone. The aim of this system is to optimize the present existing system and to reduce the energy utilization, avoiding large queues, cash to cash exchange delays. Free flow access of highways are made with toll charge being debited automatically when occurring at the particular area of the payment zone. It has capacity to stop the vehicle if it crosses the toll more than two times without any transaction at the chargeable zone. It has inbuilt control system that cuts the gasoline off and makes the vehicle to stop .Wsn modules has the capacity of 16 bit addressing and hence more number of vehicles could pass freely without any congestion or disturbance

3. Literature Review

The first E-Toll system was introduced by William vick the Nobel Economics Winner in 1959 for the Washington Area which is a metropolitan city at that era. His idea was to use of the transponders undersides of vehicles and the readers that were located under the highway surfaces. After that Norway came to use of this technique. India started the development of the toll system in the cash to cash or manual tolling mechanism process by the national

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highway authority of India in 1988, then later at the year 2013 Mumbai was the first city to introduce the RFID card based Toll system and after which still development of rfid tags and other mechanism for faster access in the toll and camera are also introduced for looking into the license plate of the user and fixed amount is charged at the particular zone. Electronic Toll Collection system is considered as an effective method in order to alleviate traffic congestion and jams, enhance the convenience and safety of travelers, and minimize air pollution and fuel consumption for environmental protection need. ETC system determines whether the vehicles passing are enrolled in the program, alerts enforcers for those that are not, and debits electronically the accounts or the amount in the IC card of registered cars without their stopping An architecture for collecting vehicles toll using Near Field Communication(NFC) is presented in this paper. The basic idea is to develop the automatic challan system that can check for signal break by any vehicle. The NFC Reader reads the information like vehicles no. and automatically sends a report to the owner of vehicles and simultaneously information is given on the site itself through. This project will check all the document of the car which will about to cross. It uses a passive NFC tag as carrier to identify actual vehicle path in loop road. The ETC system will toll collection without parking, also census traffic flow and audit road maintenance fees. It is necessary to improve expressway management.

4. Related Work

The present system where every time the user passes the toll they have to wait in enormous queues and should pay in cash and collect the receipt or using debit or credit card for making payments.
Cash change creates more problem and more time or swiping the debit or credit cards also creates more time for accessing the authentication of the user details and accounts. This is time- consuming and toll has staffs for assistance in this process (Man Power).The Gate which is available in the toll gate takes a minimum amount of time to open/close by motor action every time only after payment for every vehicles and there is chance of gate hitting the vehicle if the action is not processed at a faster rate. New rules and policies of the government stating that standing more than 2 min in the toll provides free access to service and creates loss for the organization and funds cannot be established for development further. Few toll have RFID tag or the smart cards, which consumes more power because readers and tag requires more power and even tags are expensive and complex in nature and is linked with the prepaid account from which the applicable amount is withdrawn according to the payment zone.



Fig 1: Present Toll System



Fig 2: Traffic Congestion at the toll

4.1 Drawbacks of Related Work

The Present existing system which operates in cash to cash exchange and cannot be operated automatically and also it contains E-toll cards or pass tags connected to a prepaid account from which the appropriate toll charge is deducted like using Radio-frequency Identification (RFID) technology affixed on the vehicle's windscreen or reader is attached near the toll stand. Cash change problem occurs if paid by cash and while swiping debit or credit cards it takes more time for transaction from the customer account and also these tags are costly and requires more power for access and verbal spat occurs between user and the supervisor in case of any misunderstanding leading to unwanted delays and traffic
In the RFID cases the transceiver location is not always constant and some booth have ahead of the gate or some near to it and sometimes there is better chances that the tag may not be read since the vehicle may have crossed the same before it would read it, such cases we have to reverse the vehicle and it's not best option as many cars are behind and even a separate lane has to be maintained for the vehicles which hold the RFID features.

5. Proposed Work

In The proposed system is in which each Vehicle needs to be register with traffic department to get the on-board unit with fuel control system that is for the case of old vehicles and for new vehicles it will be already registered with the traffic department by the vehicle manufacturing company and attached directly to the Vehicle unit. This on board unit consists of the wsn modules for wireless communication that is by using of the rssi xbee and once the vehicle crosses the payment zone or lane the unique id of the on board unit will be communicated with the local server with the help of the xbee transceiver attached to it and thus information gets stored. Once the data has been received by the unit, it will compare or checks the information from database that is when the vehicle first registered with on board unit and eventually the amount or charge will be deducted from the owner account and information will be passed to on board unit of the vehicle. If the user account have insufficient fund or failed transaction, a warning message will be intimated via voice module to the on board unit and if the vehicle crosses the toll without paying the bill less than three times, the relay which is inbuilt with the on board unit closes the gasoline valve and thus vehicle stops automatically .There will be voice message from the unit indicating the approach of toll zone, reaching and debiting
The amount and crossing the toll zone .This is done via the signal strength indicator at these zones from the wireless modules and signal strength measured in dBm (decibel-mill watt) and it is also energy efficient as it reduces the power consumption.

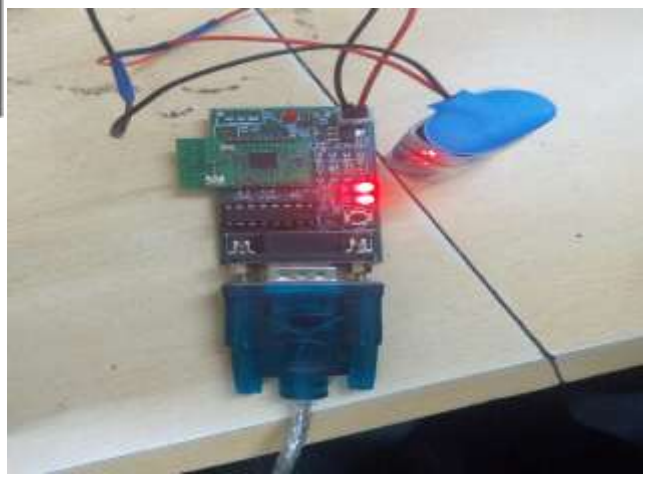


Fig 3: Toll Section Unit

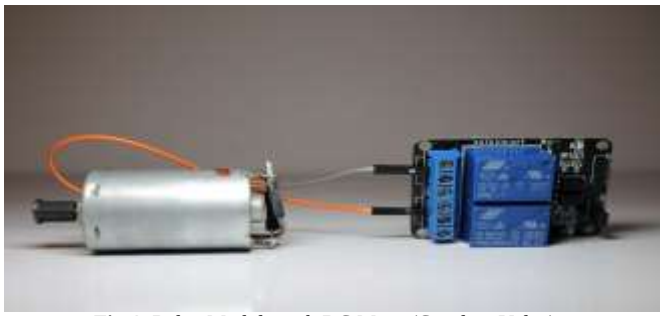


Fig 4: Relay Module with DC Motor(Gasoline Valve)

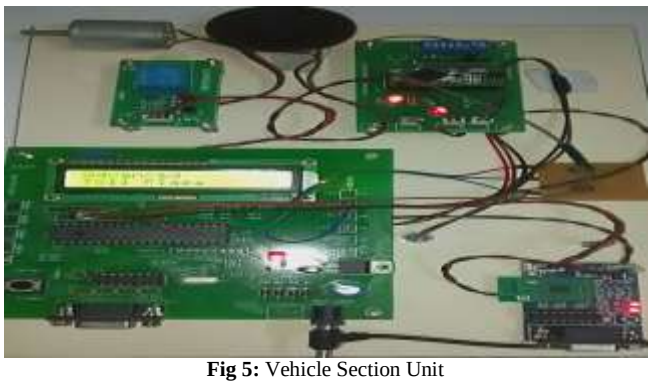


Fig 5: Vehicle Section Unit

5.1 Advantages of Proposed System

The proposed system is energy efficient as it reduces the power consumption. The main intention is to reduce the manual paper work and to save time, effort, and man power through processing the toll payment automatically and more vehicles and move freely because of wsn modules since it has capacity of 16 bit addressing. Barricade is not required and can easily avoid traffic problems in highways

6. Architectural Diagram

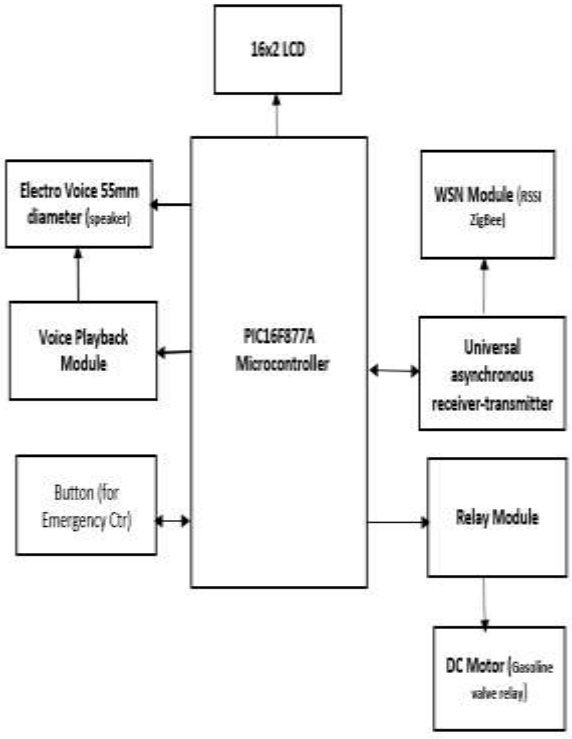


Fig 6: Vehicle Section

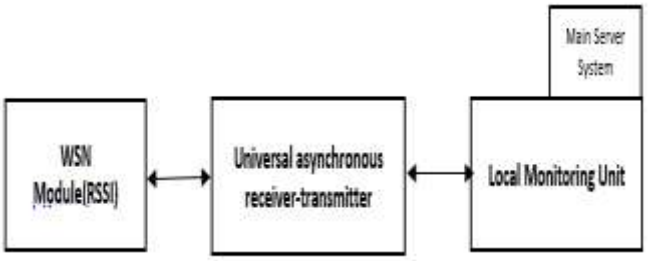


Fig 7: Toll Section

7. Design Components

7.1. Microcontroller (PIC16F877A)

The PIC16F877A is an 8 bit microcontroller and executes 200 instructions per nanoseconds and features 256 bytes of EEPROM data memory, High Performance and best standard for use. It has an LCD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, Universal Asynchronous Receiver Transmitter .The microcontrollers are typically programmed using a dialect of features from the programming languages embedded C . *In* addition to using traditional compiler tool chains, the project provides an Integrated Development Environment (IDE).All of these features make it ideal for more advanced level A/D applications in motorized, manufacturing, machines and user applications.

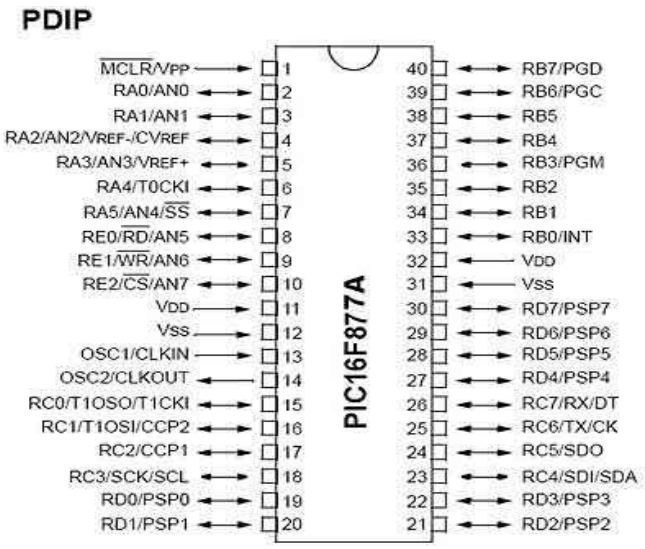


Fig 8: PIC16F877A

7.2. Liquid Crystal Display

A 16x2 LCD shows that it will display 16 characters for a line and there will be 2 such lines. In this LCD every character is shown in 5x7 pixels matrix.

7.3. UART

UART is Universal asynchronous receiver transmitter that a component of computer hardware that tends to translate the data's between parallel and serial forms

7.4. APR Voice Module

Advancement in the technologies has made great difference in the environment that facilitates the human to computer interactions by using the voice modules. These voice modules has the capacity for recording as well act as play back mechanism .Best example in current era is the use of the amazon Alexa that computes with the users to a great extent and thus all kinds of work as suggested by the user. Voice module used here is the APR9600 that facilities the required actions needed in the projects. This module will be attached with electro voice that is speaker of 16ohm capacity of 55mm diameter range. It also enables voice features of human delivered to a machine or computer through machine this Apr9600 the total recording period is of 60 seconds with sampling rate at 4.2 kHz

7.5. Relay Module Supported with DC Motor

A relay is switch capable of remotely operated or controlled. First type of relay is based on the electro mechanical actions and computers are first being built out in those ways. Later advancement of the relay lead to development of the solid state relay that contains no moving parts such as coils or springs in it whereas mechanical relays consists of these.
It is quite faster and switching time is greater compared to the previous versions. DC motor is attached with relay for showing the actions and functions of the relays. Dc motors are usually cheap and very much easily configured with the relay module.

7.6. WSN Modules

The RXbee is a true system on chip (SoC) solution for IEEE 802.15.4 applications. It combines the excellent performance of a leading RF Tran receiver and provides reliable wireless data transfer and it also adds security and network structure. It is simpler and less cost compared to the bluetooth or any other devices and it needs only low data rate with long battery life. It is used along with the received signal strength indicator. RSSI measures the strength of the radio signal received, RSSI ranging need less communication ,lower implementation complexity and low cost. Very much suited for the nodes in wireless sensor networks which have limited power.
Helps in the detection of vehicles and things nearby to it at a faster response rate. Its signal rate is measured in dBm.

7.7. Software Requirements

Software requirements includes the use of the MP lab IDE which is single software package for integrated Development environment. It is free and tools are used in embedded development applications on microcontroller. It runs on 32 bit application on the Microsoft windows and has simulator and debuggers in it.It can create, edit, assemble and compile and link source code and also embedded c is the set of language extensions for the c programming language by c standard committee. It is lesser and meeker to learn, know, program and restore. Compared to the assembly code, it is more scalable and reliable in nature and more portable between different platforms.

8. Future Scope

Alcohol sensor is used for detecting alcohol concentration on the breath of a person and it is fixed with permissible limit in the output, if it crosses the permissible limit the vehicle doesn't turn ON thus preventing accidents from drunk drivers. Tilt sensors can also be used to estimate the severity of the accident. Accident information can also be passed from one vehicle to other vehicle through ZigBee device that uses the ad-hoc technique and can be transmitted on way to nearest ambulance on the highway attached with the ZigBee. In future Toll booth can be attached with renewable energy sources equipment's like use of solar panels to power the wsn modules and charge the batteries thus saving more and more energy source.

9. Conclusion

The precise location of the target is accomplished via the wsn modules, the user doesn't need to use any card or cash for transaction in the toll booth and the barricade are removed for the free flow access. Each vehicle would have the unique id and it is read by the Rxbee that is the wsn module on the toll booth and information will be provided in the LCD and electro voice about the toll bill charges to the user .By using this approach traffic at the toll booth can be avoided and users can pass freely without halting their vehicles. Thus it aimed for fully automated system and reduces the human error that brings an advanced development in the E-toll collection (ETC) system.

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