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Electronic Toll Collection System

(ETCM)

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***Abstract*— The project "Electronic toll collection system" mainly deals with identification of vehicles and carries out transaction processing. The "ELECTRONIC TOLL COLLECTION SYSTEM" is an Embedded System which is used for automatic toll collection. This system can be used in highway, bridge & tunnel. The major area of implementation of our project is related with traffic management system. Radio Frequency module is a generic term for technologies that use radio waves to automatically identify people or objects. The various benefits expected could be summed up as Speed of transaction increased safety, Cost reduction, fewer queues, Easier evacuation, more reliable equipment, less frustration. Less violent crime. Faster processing of vehicles, Reduces fraud. We have underwent a detailed study about the RF module application and implementation and found it applicable to the upcoming industries. Vehicle tracking and ticketing is just a low level application to imprint the wide level of application possible in this field.**

We combine expertise with an attentive understanding of our needs to deliver a technology solution that will accurately match your particular rules and requirements. It is applicable in areas where toll can be collected automatically, preventing road accidents due to overloading of vehicles, avoiding corruption and reducing manpower.

Keywords—component; PIC microcontroller, RF module, MAX 232 ,LCD, Stepper motor, Automation.

I. INTRODUCTION

Electronic toll collection (ETC) system, aims to eliminate the delay on toll roads by collecting tolls electronically. It is thus a technological implementation of a road pricing concept. It determines whether the vehicles passing are enrolled in the program, alerts enforcers for those that are not, and electronically debits the accounts of registered car owners without requiring them to stop. Electronic toll collection systems rely on four major components: automated vehicle identification, automated vehicle classification, transaction processing, and violation enforcement. There are millions of drivers passing through toll booths every day. The conventional or the traditional way of collecting the toll from the vehicle owners or the drivers is to stop the vehicle by the toll booth and then pay the amount to the toll collector standing (or perhaps sitting!) by the side of the toll booth, after which the gate is opened either mechanically or electronically for the driver to get through the toll station. This huge waste of time and traffic congestion created in the toll booth is what it makes us to think out of the basket. There lies a huge investment that is done on the road construction and its maintenance; hence a minimum toll fee is collected even from a vehicle driver who has just travelled 4kms on the toll road or so. The other aspect of this is the toll collector who collects the toll fee from the vehicles. Sometimes owing to greediness he might collect more tolls or might let some cars to pass through for free. So in order to stop all these problems and inconvenience, we introduce an automated or a more convenient way of collecting the toll and traffic management. namely "Electronic Toll Collection System "Initially this project has a basic presumption that this project is implemented as a state project making it compulsory for all the vehicle owners to have a registered RF module attached with vehicle unit mounted on vehicles windshield. During registration the owner need to submit these details to the RTO Office: (i) Driver's / Owner's name and address details. (ii) His cell phone no. and his email id. (iii) His car and License details with proof. With all these details, he/she has to maintain a prepaid toll account in the office. So having all these as the prerequisite for the implementation of the project we move ahead with developing this project for the betterment of traffic policies.

II. FUNCTIONAL UNITS

1) Vehicle Unit

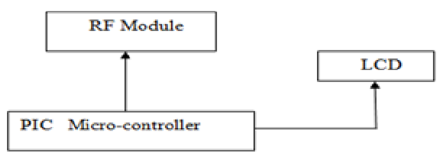

Figure 1: Vehicle Unit

As shown in figure 1 is the vehicle unit this unit transmit its data continuously. The data includes vehicle number, prepaid balance, and type of vehicle. This is done by PIC controller which transmits data serially through in-built UART. Also vehicle unit scans the received data buffer of UART to check if there is any data. Controller updates its balance if the received data is valid.

2) Balance deduction Unit

As shown in figure 2 is the balance deduction unit in this unit the controller checks its received data buffer of UART and if there is data. It deducts the appropriate amount depending upon the type of vehicle. The balance update is transmitted back to the vehicle module.

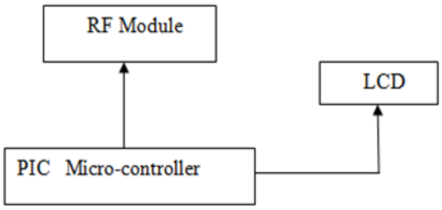

Figure 2: Balance Deduction unit

3) Balance Recharge Unit

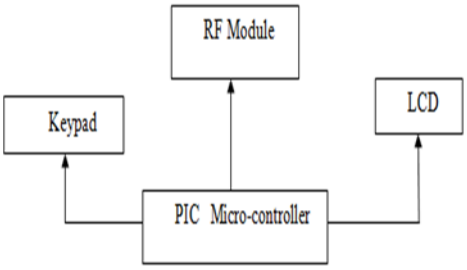

Figure 3: Balance Recharge Unit

As show in figure 3 is the balance recharge unit, where Controller checks the received data buffer, if data is received it is indicated on LCD .It waits for the authorized person to enter the amount of recharge and then scans the keypad. After recharge is done , updated balance is transmitted back to the vehicle unit.

4) Toll Unit

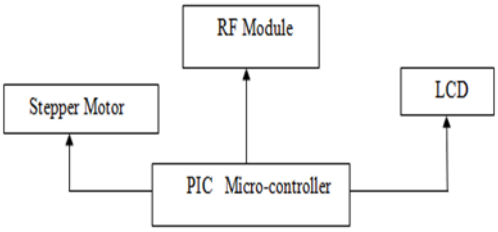

Figure 4: Toll Unit

Controller checks the received data buffer. Two Infrared sensors are used to ensure that vehicle has passed; first sensor is placed before gate assembly and second after the gate assembly. Controller checks the make-break status of the sensors and also the data received. If the received data is valid gate is opened else it remains closed. As shown in figure is the toll unit.

III. VARIOUS MODULES

1) PIC Microcontroller

As shown in figure 5 is the PIC Microntroller 16 F877A having following features:

a) High-Performance RISC CPU
b) 44 pin IC
c) Only 35 single-word instructions to learn
d) Operating speed: DC – 20 MHz clock input
e) Up to 8K x 14 words of Flash Program memory
f) Low-power, high-speed Flash/EEPROM technology
g) Fully static design
h) Wide operating voltage range (2.0V to 5.5V) Commercial and Industrial temperature ranges
i) Low-power consumption.

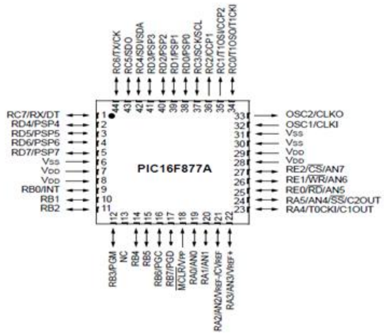

Figure 5: PIC Microcontroller

2) Radio Frequency Module (CC2500)

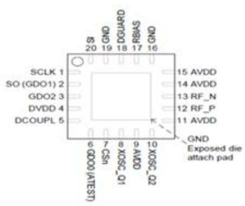

Figure 6: Radio Frequency Module

As shown in figure 6 is the radio frequency module , CC2500 is a low-cost 2.4 GHz transceiver designed for very low-power wireless applications. The circuit is intended for the 2400-2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band. The RF transceiver is integrated with a highly configurable baseband modem. The modem supports various modulation formats and has a configurable data rate up to 500 k Baud. CC2500 provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication, and wake-on-radio. The main operating parameters and the 64-byte transmit/receive FIFOs of CC2500 can be controlled via an SPI interface. In a typical system, the CC2500 will be used together with a microcontroller and a few additional passive components.

Features

i. High sensitivity (–104 dBm at 2.4 kBaud,1% packet error rate)

ii. Low current consumption (13.3 mA in RX, 250 kBaud,

iii. Excellent receiver selectivity and blocking performance

iv. Programmable data rate from 1.2 to 500 k Baud

v. Frequency range: 2400 – 2483.5 MHz

3) Stepper Motor

Figure 7: Stepper Motor

As shown in figure 7 is a stepper motor is widely used device that translates electrical pulses into mechanical movement. Stepper motors commonly have a permanent magnet rotor surrounded by a stator Commonly they have a four stator winding that are paired with a center tapped common. It allows a change of current direction in each of two coils.While a conventional motor shaft runs freely, the steeper motor shaft moves in a fixed repeatable increment, which allows one to move it to a precise motion. The repeatable fixed movement is possible as a result of basic magnetic theory where the poles of same polarity repel and opposite poles attract. The direction of rotation is dictated by a stator poles. The stator poles are determined by the current sent through the wire coils. As the direction of current is changed, the polarity is also changed causing the reverse motion of the rotor. The stepper motor discussed here (PM55L-048) has a total six leads, 4 leads representing the four stator winding and two commons for the centre tapped leads. The movement depends on internal construction of the motor, in particular the number of teeth of the stator and rotor. It is called as the step angle.

4) Liquid Crystal Display

In the present circuit use of 16×2 lines crystal display is used. Equipped with Intelligent alphanumeric displays with a built in microcontroller that has been optimized for the application in expensive displays are represented by multi character LCD windows, which are becoming increasingly popular in hand held wands, factory floor terminals and automotive dashboard.

FEATURES

i. 16×2 LINES DISPLAY

ii. 5×7 DOT MATRIX DISPLAY

iii. 8 BIT DATA INTERFACE

5) MAX232

The **MAX232** is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case.

The receivers reduce RS-232 inputs (which may be as high as ± 25 V), to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis is of 0.5 V. The later MAX232A is backwards compatible with the original MAX232 but may operate at higher baud rates and can use smaller external capacitors – 0.1 μF in place of the 1.0 μF capacitors used with the original device The newer MAX3232 is also backwards compatible, but operates at a broader voltage range, from 3 to 5.5 V. It is helpful to understand what occurs to the voltage levels. When a MAX232 IC receives a TTL level to convert, it changes a TTL Logic 0 to between +3 and +15 V, and changes TTL Logic 1 to between -3 to -15 V, and vice versa for converting from RS232 to TTL. This can be confusing when you realize that the RS232 Data Transmission voltages at a certain logic state are opposite from the RS232 Control Line voltages at the same logic state. As shown in figure 8.

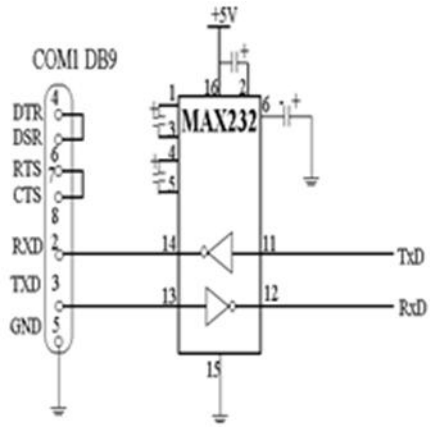

Figure 8: Max 232

IV FUTURE SCOPE

1. Pressure sensors and IR sensors can be installed in addition to this to collect more tolls from heavy vehicles.

2. Multiple lanes for cash and prepaid tolls for vehicles coming from other state.
3. CCTV's for security and tracking of vehicles.

V CONCLUSION

Use and implementation of Electronic Toll Collection System is of a need which can expand capacity of the system.

It will reduce the cost of recovery due to which the indirect benefit to toll agencies and government too.

The Electronic Toll Collection system can provide vehicle-to-roadside communication and ease to perform an electronic monetary transaction between a vehicle passing through a toll station and the toll agency.

Toll agencies should come forward and do the innovative efforts to install Electronics Toll Collection System to reduce overall cost of the project and can provide fast clearance to the vehicle which is need of today's era.

Use of ETCS will revolves around whole development of traffic policies and it deals with highway traffic management systems.

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