

An Alternative Approach in Toll Path for Reducing the Traffic Collision by GPS and GSM

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Abstract—Transportation is one of the major emerging criteria in India. Toll plazas are very important in maintaining the road transportation. Now a day, the collection of money in toll plazas are done manually which results in major money loss also it will cause heavy traffic jam which consumes more amount of time. We have designed a project for the automation in toll tax payment using GPS and GSM Technology. We have made the automation of toll plaza using combination of PIC Microcontroller, IR transmitter and receiver, Global positioning system, Global system for Mobile. Also it explains the implementation of automation in toll plaza which step towards improves the vehicle monitoring, travelling in predestined routes. This project focuses on design a system, which automatically identifies an approaching vehicle and records the vehicles number and time of arrival. If the vehicle data and GPS data are matched, predetermined amount is automatically deducted from its account. It translates this information to reduced Traffic congestion at toll plazas and helps in lower fuel consumption.

Keywords—Infrared Transmitter and Receiver; GSM Module; GPS Module; PIC Microcontroller; Ignition Control;

I. INTRODUCTION

Automation means to replace the human being from the activities. This means the process handled by the humans from the present time will be carried out by the machines thereafter. Before moving further, we will just take the overlook of history of the toll booth. In 90th century the toll plazas were fully manual controlled. Such that there are two people for opening and closing of the gate and another two are for reception of the money also data keeping etc.

In the year of 1995 when the Express highways had been developed the system called semi-automatic toll plazas were put up in which data is stored in computers and operation of gate is automatic. It required only two personals are required for single toll plaza. But here we are going to see the human less toll plaza.

Electronic toll collection is a technology permitting the electronic collection of toll payments. The system has been

studied by researchers and applied in various highways and tunnels. It is capable of determining if the car is registered or not registered and then warn the officials of toll payment violations and debits and participating accounts. Almost obvious advantage of this technology is the opportunity to avoid congestion in toll plaza during festival seasons when traffic tends to be heavier than normal time.

Also this is a method by which to control complaints from motorists relevant to the inconveniences associated with manually making payments at the tollbooths. Another obvious advantage, applying ETC could also benefit the toll operators.

II. ANTERIOR WORK

The architecture proposed in this study is a multiple functional approach to get the data automatically through Global System for Mobile. But the current system of toll automation follows every vehicle that has to wait for some amount of time to pay the money and there should be a person to collect the money and to verify the vehicles in the database which was stored already at the time of registration of their vehicles. This system consumes time and there are possibilities of human mistakes and overcrowding of vehicles. This traditional system has got lots of disadvantages.

A. RFID Based Toll Plaza System

In this RFID system, 13.56 MHz passive RFID reader and tag pairs are used for authentication purpose. Amount deduction system is implemented by Microsoft Visual Studio and SQL Server as integrated development environment. The language is used to implement this system is C#.

The PIC microcontroller controls the stepper motor and displays the deposit on the Liquid crystal display. Then the authorized person at the toll gate can check the ID numbers individually allotted for each vehicle and the amount of balance with the database on Personal computer.

The new user can register by using Graphical User Interface easily in the toll path and the amount of deposits will also update instantly at the two database of the toll gate because of two modules are integrated into LAN network.

Drawbacks

- ❖ Need more time to Processing.
- ❖ Maximum of human effort is needed
- ❖ More expensive.
- ❖ More Manual Errors occurred.

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B. Image Processing Based Toll Booth

In this method, we examine the image & the respective information will be dealing with toll collection system and how to make more efficient and perfect. In this system camera is used to capture the image of the vehicle number plate. Then the captured image would be converted into the text using Automatic number plate recognition method and the toll tax would be deducted from the customer's account and then the gate will be opened.

Drawbacks

- ❖ More conversion time and error.
- ❖ Need more time to Processing.
- ❖ More expensive.
- ❖ More fuel loss.

III. PROPOSED APPROACH

Currently, the working system we have with us on the high ways consumes 2 to 3 minutes of total time to complete the toll collection process for one vehicle then move to another vehicle. By doing this automatic process, it will take just 30 sec. to complete the whole process without stop the vehicles.

As it includes reduced time for completion of the process, therefore indirectly results in no traffic as such and as there is no traffic so no fuel wastage takes place and the purpose of designing the highways is achieved such as reduction in journey time also the money loss will be less while compare others. The ability to make payments by having balance on the card itself or by charging a registered credit card.

- ❖ Reduced queues at toll plazas by enhancing toll booth service turnaround times.
- ❖ Faster and more efficient service (no exchanging toll fees by hand).
- ❖ The use of post-paid toll statements (no need to request for receipts).
- ❖ Better audit control by centralized accounts.
- ❖ Less infrastructures, can be constructed in any places.

The main objective of this system is to provide a fast and secure environmental manner for toll plaza collection and to control the vehicle movements at the toll stations by Global Positioning System and Global System for Mobile Communications automatically. In this project are having three modules,

- ❖ Vehicle section
- ❖ Toll path section
- ❖ Central management section

Vehicle section: It consists of Global Positioning System receiver, Global System for Mobile Communications modem and IR receiver and Ignition Control.

Toll Path Section: It consists of Infra-Red Transmitter, Microcontroller.

Central Management Section: It includes GSM modem interfaced with PC.

PIC 16F877A Microcontroller: PIC controller is the main core of this system. The main aim of this controller is to provide communication link between the user and the system.

AT89C51: The controller is interfaced with IR transmitter in Toll Tax Unit for transmitting the IR signal to the receiver in order to identify the presence of vehicle.

A. VEHICLE SECTION

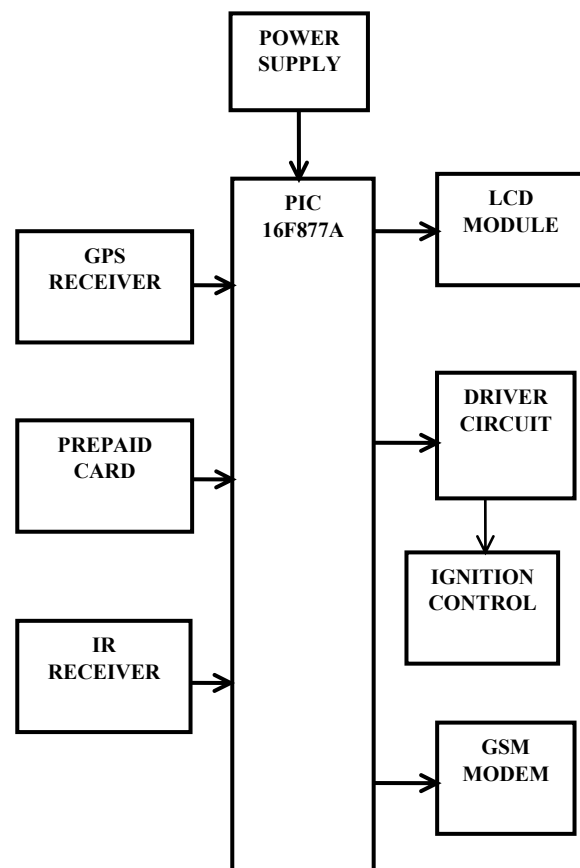


Figure: 1. Block Diagram of Self-Regulation Toll Path (Vehicle Section)

B. TOLL PATH SECTION

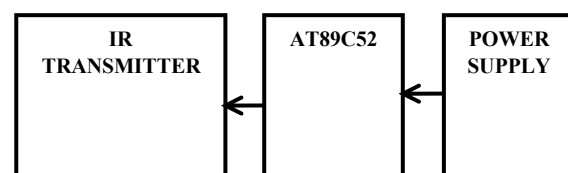


Figure: 2. Block Diagram of Self-Regulation Toll Path (Toll Path Section)

C. CENTRAL MANAGEMENT SECTION

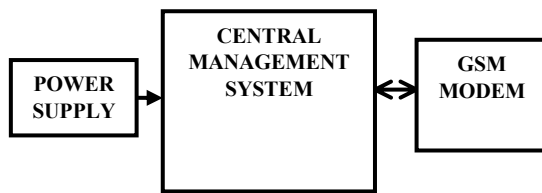


Figure 3. Block Diagram of Self-Regulation Toll Path (Central Management Section)

GPS Receiver: Global positioning System modem gets latitude and longitudinal distance of earth from satellite to find the location of vehicle which is travelling on the road.

GSM Modem: GSM is used to transmit vehicle ID from vehicle section to central management system also signals will be received in vice versa.

IR Transmitter and Receiver: IR Signal used to identify whether the vehicle enters in the toll unit.

Driver Circuit: This circuit will provide interfacing between the ignition control and the controller.

Ignition Control: An ignition control is a system for igniting a fuel-air mixture also these systems are well known in the field of ICE such as those who used in gasoline engines are used to power the many motor vehicles in many other applications such as in oil, gas fired boilers and rocket engines. In this vehicle owner's account having insufficient balance means, the control triggers to off state.

Central Database System: It consists of Personal computer that having details of all vehicles those who registered already at the time registering their vehicle.

In vehicle, the Global Positioning System modem receives latitude and longitude distance information of earth from satellite and fed to PIC Microcontroller.

In vehicle section the PIC Microcontroller checks the status of IR receiver regularly and if the vehicle enters toll tax unit the IR receiver attains the signal from IR transmitter in Toll tax unit. Then the PIC Microcontroller sends message about vehicle ID and current location to Management centre.

In management centre the PC obtains the information through GSM modem and analyse it based upon the GPS value and vehicle ID. Once all authentications satisfy then the charges will be applied for that vehicle ID and amount will be reduced from the vehicle owner account (Prepaid Card Account). Suppose the vehicle's owner accounts insufficient means Management center send message to vehicle using GSM and also instruct to stop the vehicle. In vehicle section the message will be received based on the message instruction the vehicle will be controlled.

IV. FLOW CHART

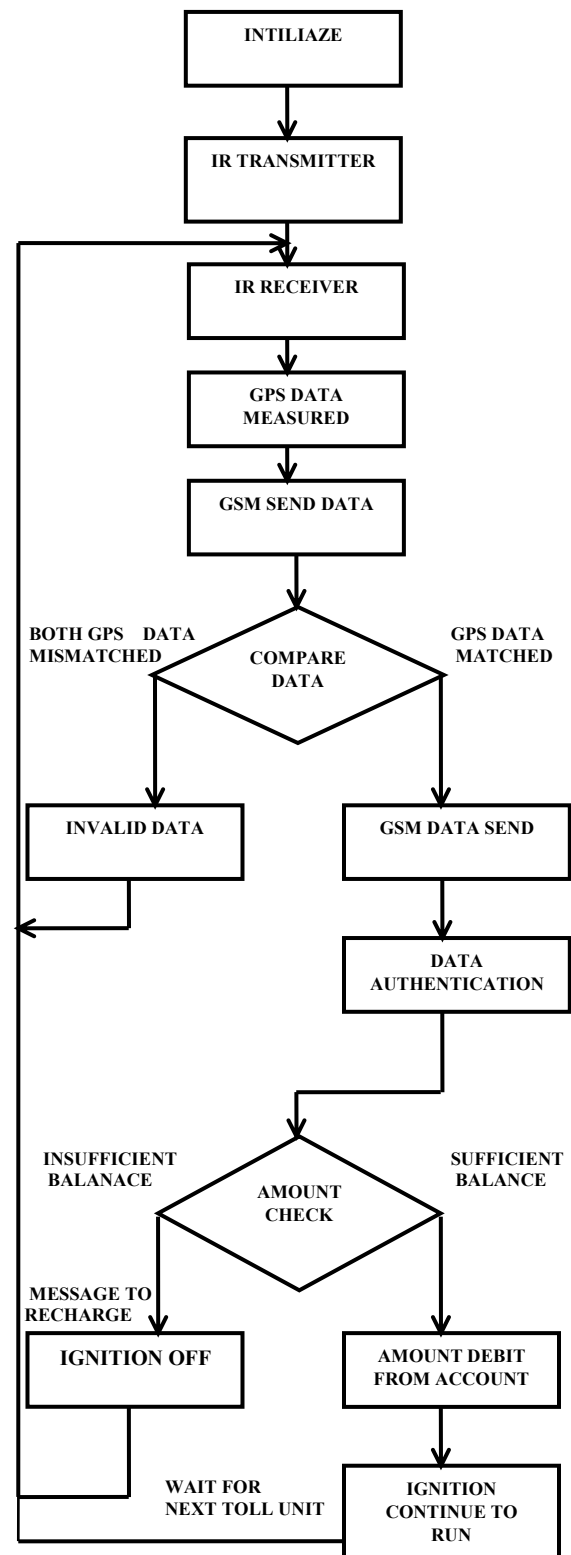


Figure 4. Self-Regulation Toll Path

V. HARDWARE

A. GSM MODULE

A Global System for Mobile Communications modem is a functional type of modem which accepts a subscriber identity module or subscriber identification module (SIM) card and functions over a subscription to a mobile operator like mobile phone techniques. The modem exposes an interface that permits the applications such as message to send and receive messages over the modem interfacing part. The operator charges for the corresponding data sending and receiving as if it had performed directly on a mobile phone but it does not happen in GSM modem. In order to perform these tasks, a GSM modem would aid an extended AT command set for sending and receiving SMS as instructed in the ETSI GSM 07.05 version and 3GPP TS 27.005 specifications.

By inversely, which mean Receiver pin of microcontroller connect with Transmitter pin of GSM module and Transmitter pin of microcontroller connect with Receiver pin GSM module. We need only these two pin to send or receive message and to make or receive call on GSM module through microcontroller.

AT commands send information via SMS

Set format to Text: AT+CMGF=1

Receiver number: AT+CMGS=91944XXXXXX Then type message Cntrl+z

AT commands for call= ATD91944XXXXXX;

AT commands to disconnect call= ATH

B. GPS MODULE

A Global Positioning System tracking unit is a device that uses to determine the precise location of a vehicle and person or other parameters which it is inbuilt to measure the point of the object at regular intervals of time.



Figure: 5. GPS Module

GPS TRACKING UNIT ARCHITECTURE

A Global Positioning System tracker essentially comprises of GPS module to receive the GPS signal and compute the coordinates such as longitudes and latitudes. In case of data loggers, it contains large memory to store the coordinated pulses, data pushers additionally contain the GSM/GPRS modem to transmit this information related to a

central database computer either via SMS or GPRS in form of IP packets.

C. IR TRANSMITTER AND RECEIVER

The IR Transceiver gate are using in our project to detect the presence of the vehicle in the toll path unit.

The Infra-Red transmitter is continuously emitting the Infrared rays towards the Infrared receiver. As, the vehicle is going to come across the location the rays are absorbed from the Infrared receiver which is presence in the vehicle unit. The IR Receiver will give the replying signal to the controller to get the GPS location. Here for IR transmitter, IR LED's are used. The design of IR transmitter in our home by just connecting desired value of resistance in +ve arm & another is grounded. The Infra-Red receiver has three pins i.e. 5V supply, GND. Line, signal line.

VI SOFTWARE ANALYSIS

A module (firmware) code is developed in C language is Programmed into the microprocessor's code memory area and it controls the operation of the complete hardware part. Generally, the microcontrollers and the processor execute their own instructions which are in machine language. But early days the applications were written in assembly languages.

In embedded system the development of the enormous application is very difficult by using the normal assembly level languages because of their readability features. Later for the fast development of high levels languages are introduced into the embedded system. The most commonly used in the embedded system is c language. The American National Standards Institute (ANSI) C version is modified by including the hardware related functionality and information also the modified c language is commonly termed as embedded c.

A. MIKRO C COMPILER

A *mikroC PRO for PIC* is a powerful, feature-rich development tool for PIC microcontrollers. This has been built up to serve the programmer with the finest solution to making applications for controlling the embedded systems without compromising performance.

PIC is the most popular 8-bit chip in the world, used among the variety of applications and C prized for its efficiency and it is the natural choice for developing embedded systems. It provides a successful match featuring highly advanced Integrated Development Environment, American National Standards Institute, broad set of hardware libraries files, comprehensive documentation and plenty of ready-to-run examples. Also it allows you to quickly develop and deploy complex applications:

- 1). Our C code is written using the built-in Code Editor.
- 2). By using *mikro C PRO for PIC* libraries to dramatically speed up the development like memory, displays, conversions, data acquisition, communication.
- 3). In order to monitor our program Syntax, variables names,

and various functions in the Code Explorer window in mikro pro c.

4). Also to generate commented human-readable assembly codes, and standard HEX codes compatible with all programmers.

5). By using the integrated mikro In-Circuit Debugger (ICD) which is a Real-Time debugging tool to monitor program execution on the hardware level to avoid errors in hardware manufacture.

6). Inspect program flow and debug executable logic with the integrated Simulator of mikro c pro.

7). Get detailed reports and graphs about Random access memory and Read only memory map, code statistics analysis, assembly code listing, calling tree, and more others are available.

8). Mikro C PRO for PIC provides plenty of examples to develop and use as building bricks in your applications

VII CONCLUSION

By doing automation in toll plaza we will be able to provide the best solution over money loss that has not been recovered using man power. We can also reduce the traffic indirectly resulting in reduction of time at toll units. In our project we have introduced the techniques such as Global Positioning System and GSM, which in coordination with each other can be used to identifies the vehicle or object identity. The IR Trans receiver is used for detecting the presence of vehicle at different locations which will act as the gate pass to the toll units. with the efficient utilizing these two techniques at different stages of our project we can able to represent the autonetics in the toll units which will reduce the processing time by less than a 60 seconds which is very useful as well as to reduce money in a very cost effective and efficient manner.

VIII.ACKNOWLEDEMENT

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BIOGRAPHY



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