RFID & GSM Based Toll Tax System

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Abstract- This Paper proposes a approach for the toll Collection at toll booths which is automatized using RFID & GSM technology in order to reduce the time consumption. RFID Tag will be held in each Vehicle which contains unique identification number assigned. The identification is done with the help of radio frequency. RFID Tag will be held in each Vehicle which contains unique identification number assigned. All basic information & the amount that has been paid in advance will be stored in accordance with the number. The RTO or traffic governing authority will do the assigning process & the reader will be strategically placed at toll collection center. The tax amount will be deducted from the prepaid balance, whenever the vehicle passes the toll booth and the new balance will be updated. SMS messages is sent to the mobile owner regarding the balance information.As vehicles don't have to stop in a queue, this translates to reduced Traffic congestion at toll plazas and helps in lower fuel consumption. This is very important advantage of this system.

Index Terms- Global System for Mobile communication, RFID Reader, RFID Tag.

I. INTRODUCTION

The main idea behind implementing RFID BASED TOLL COLLECTION SYSTEM is to automate the toll collection process their by reducing the long queues at toll booths using the RFID tags installed on the vehicle[4]. The need for manual toll based systems is completely reduced in this method and the tolling system works through RFID.A complete RFID system consists of a transponder (tag), reader/writer, antenna, and computer host. The transponder, better known as the tag, is a microchip combined with an antenna system in a compact package[3]. The microchip contains memory and logic circuits to receive and send data back to the reader. These tags are classified as either active or passive tags. Active tags have internal batteries that allow a longer reading range, while passive tags are powered by the signal from its reader and thus have shorter reading range. Passive RFID have no internal power source and use external power to operate. These tags are powered by the electromagnetic signal received from a reader. The RFID tag is used as a unique identity for account of a particular user. When a vehicle drives through the toll plaza, its driver is prompted to scan his RFID tag. If the identity (serial number of the tag) is matched with the one already stored in the system, the toll amount is deducted from his account. After this, the vehicle gets immediate access to drive through. This RFID based toll system also has some additional features. A new user can register him with the system. Also an old user can recharge his account balance. The amount for recharge can be entered in the system. In beginning, the user is prompted to scan his tag or ID. The serial code of the tag is identified by the reader module and is sent for comparison with stored data. If the ID is matched by the microcontroller, the toll amount is deducted from user's balance and user gets to drive through the plaza. On the contrary, if the tag is not identified then image of car is captured by camera. A new user needs to register himself after which his identity is verified with RFID tag. The new record is then stored by the microcontroller to grant future access. Meanwhile, for the toll authorities also get the benefits mentioned below[4]. The benefits for the motorists include:

1. Fewer or shorter queues at toll plazas by increasing toll booth service turn around rates.
2. Faster and more efficient service (no exchanging toll fees by hand).
3. The ability to make payments by keeping a balance on the card itself.
4. The use of postpaid toll statements (no need to request for receipts).
5. Lowered toll collection costs.
6. Better audit control by centralized user account and
7. Expanded capacity without building more infrastructures.

II. EXISTING SYSTEM

Three systems of toll roads exist: open (with mainline barrier toll plazas); closed (with entry/exit tolls) and all-electronic toll collection (no toll booths, only electronic toll collection gantries at entrances and exits or at strategic locations on the mainline of the road)[3].On an open toll system, all vehicles stop at various locations along the highway to pay a toll. While this may save money from the lack of need to construct tolls at every exit, it can cause traffic congestion, and drivers may be able to avoid tolls by exiting and re-entering the highway. With a closed system, vehicles collect a ticket when entering the highway. In some cases, the ticket displays the toll to be paid on exit. Upon exit, the driver must pay the amount listed for the given exit. Should the ticket be lost, a driver must typically pay the maximum amount possible for travel on that highway. Short toll roads with no intermediate entries or exits may have only one toll plaza at one end, with motorists traveling in either direction paying a flat fee either when they enter or when they exit the toll road. In a variant of the closed toll system, mainline barriers are present at the two endpoints of the toll road, and each interchange has a ramp toll that is paid upon exit or entry. In this case, a motorist pays a flat fee at the ramp toll and another flat fee at the end of the toll road; no ticket is necessary. In an all-electronic system no cash toll collection takes place, tolls are usually collected with the use of a transponder placed before the Gate as soon as the vehicle reaches near the Transponder the amount is deducted and the gate will be opened customer account which is debited for each use of the toll road. On some roads automobiles and light trucks without transponders

are permitted to use the road a bill for the toll due is then sent to the registered owner of the vehicle by mail; by contrast, some toll ways require all vehicles to be equipped with a transponder. Modern toll roads often use a combination of the three, with various entry and exit tolls supplemented by occasional mainline tolls. Open Road Tolling (ORT), with all-electronic toll collection, is now the preferred practice being more efficient, environmentally friendly, and safer than manual toll collection.

III. Drawbacks of Existing System

The above mentioned methods for collecting toll tax is time consuming method[3]. Chances of escaping the payment of toll tax are there. It leads to queuing up of following vehicles. Suppose the manual toll collection system is very efficient then for one vehicle to stop and pay taxes total time taken is 50 seconds. And suppose 200 vehicles cross the toll plaza. Then, time taken by 1 vehicle with 60 second average stop in a month is: 50x30= 1500 seconds yearly total time taken = 1500x12 = 18000seconds = 5.0 hours. On average each vehicle that passes through the toll plaza has to wait 5.0 hours in engine start condition yearly. The figure is staggering if on an average we take 200 vehicles pass through the toll plaza each day, then yearly 72000 vehicles. pass through the toll plaza. And each year 72000 vehicles just stand still for 5.0 hours in engine start condition thereby aiding pollution and wasting fuel and money. This study is if the system is very efficient but what if the vehicle has to wait for 5 minutes? This is a figure considering one toll plaza. If considering 50 toll systems the above figure will drastically increase and the wastage of fuel, money will increase and pollution will also increase.

IV. 4.1 RFID Radio-frequency identification (RFID)

It is an automatic detection method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. A single RFID reader can cover up to 30,000 square feet of floor space[9]. The technology requires some extent of cooperation of an RFID reader and an RFID tag. An RFID tag is an object that can be applied to or incorporated into a product, animal, or person for the purpose of identification and tracking using radio waves. Some tags can be read from several meters away and beyond the line of sight of the reader. Most RFID tags contain at least two parts. One is an integrated circuit for storing and processing information, modulating and demodulating a radio frequency (RF) signal, and other specialized functions. The second is an antenna for receiving and transmitting the signal. There are generally two types of RFID tags: active RFID tags, which contain a battery, and passive RFID tags, which have no battery. This project uses passive tags. Read-only tags are typically passive and are programmed with a unique set of data (usually 32 to 128 bits) that cannot be modified. Future chip less RFID allows for discrete identification of tags without an integrated circuit, thereby allowing tags to be printed directly onto assets at a lower cost than traditional tags. Currently (2008) none of the chip less concepts has become operational.Today, RFID is used in enterprise supply chain management to improve the efficiency of inventory tracking and management.Radio-frequency identification (RFID) is the use of a wireless non-contact system that uses radio-frequency electromagnetic fields to transfer data from a tag attached to an object, for the purposes of automatic identification and tracking. Some tags require no battery and are powered by the electromagnetic fields used to read them. Others use a local power source and emit radio waves (electromagnetic radiation at radio frequencies). The tag contains electronically stored information which can be read from up to several meters (yards) away. Unlike a bar code, the tag does not need to be within line of sight of the reader and may be embedded in the tracked object. RFID tags are used in many industries. An RFID tag attached to an automobile during production can be used to track its progress through the assembly line. Pharmaceuticals can be tracked through warehouses. Livestock and pets may have tags injected, allowing positive identification of the animal. RFID identity cards can give employees access to locked areas of a building, and transponders mounted in automobiles can be used to bill motorists for access to toll roads or parking. Since RFID tags can be attached to clothing, possessions, or even implanted within people, the possibility of reading personally-linked information without consent has raised privacy concerns.

Fig 1: RFID Card

4.2 RFID Reader

In order for an RFID system to function, it needs a reader, or scanning device, that is capable of reliably reading the tags and communicating the results to a database. A reader uses its own antenna to communicate with the tag. When a reader broadcasts radio waves, all tags designated to respond to that frequency and within range will respond. A reader also has the capability to communicate with the tag without a direct line of sight, depending on the radio frequency and the type of tag (active, passive, or semi passive) used. Readers can process multiple items at once, allowing for increased read processing times. They can be mobile, such as handheld devices that scan objects like pallets and cases, or stationary, such as point-of-sale devices used in supermarkets.

EM-18 RFID Chip

Figure 2: RFID Reader chip

Features of RFID Chip EM-18

RF Transmit Frequency : 125 KHz
Supported standards : EM4001 64-bit RFID Tag Compatible

Communications Protocol	: Specific ASCII
Communications Parameter	: 9600 bps, 8,N,1
Power Supply	: 4.6V-5.5V DC +/- 10% regulated.
Current Consumption	: 50mA<10mA at power down mode.
Communications Interface	: TTL Serial Interface, weigand output.
Reading Distance	: Up to 100mm,depending on tag.
Antenna	: Integrated
Size(L*W*H)	: 32*32*8mm

V. PROPOSED SYSTEM

This work is a standalone Automatic two door interlo control system for toll tax using AT89S52 microcontroller. Primarily, the two main components involved in a Radio Frequency Identification system are the Transponder (tags that are attached to the object) and the Interrogator (RFID reader). Communication between the RFID reader and tags occurs wirelessly and generally doesn't require a line of sight between the devices. RFID tags are categorized as either active or passive. This project uses passive tags. Read-only tags are typically passive and are programmed with a unique set of data (usually 32 to 128 bits) that cannot be modified. The reader has three main functions: energizing, demodulating and decoding. The antenna emits radio signals to activate the tag and to read and write data to it. the RFID module reader typically contains a module (transmitter and receiver), a control unit and a coupling element (antenna). This module is interfaced with the micro controller and when the card is brought near to the RFID module it reads the data in the card and displays on the LCD. RFID reader, tags are used in this project to identify the entry or exit of the vehicle. The RFID reader is placed at the toll tax collecting area and each and every vehicle is provided with a RFID card. Each and every time when we place the RFID card on the reader the current value (in Rs) in the card has to be stored in the EEPROM. Once we pay the tax through RFID card the value of the card get decremented which can shown on 16X2 LCD. Initially the gate is closed. Whenever any vehicle comes in front of the entry gate, the reader detects the RFID card owned by the vehicle owner and certain value of amount is detected automatically which will be displayed on 16X2 LCD. By using serial communication the data will be processed by the microcontroller and opens the entry gate by rotating the DC motor. After some delay, the gate will be closed. The user places the RFID card in the RFID reader for collecting the tax, then. Then the exit gate opens for the vehicle to leave. The microcontroller closes the gate only after the vehicle exits out .If certain amount is not there in the card then he/she can renewal the RFID card. Once the amount is successfully deducted from RFID card only the gate opens. And again the RFID reader will be waiting for the next vehicle to enter. A GSM modem is also interfaced to the controller to send the SMS

VI. METHODOLOGY

A radio-frequency identification system uses *tags*, or *labels* attached to the objects to be identified. Two-way radio transmitter-receivers called *interrogators* or *readers* send a signal to the tag and read its response. The readers generally transmit their observations to a computer system running RFID software or RFID middleware. The tags information is stored electronically in a non-volatile

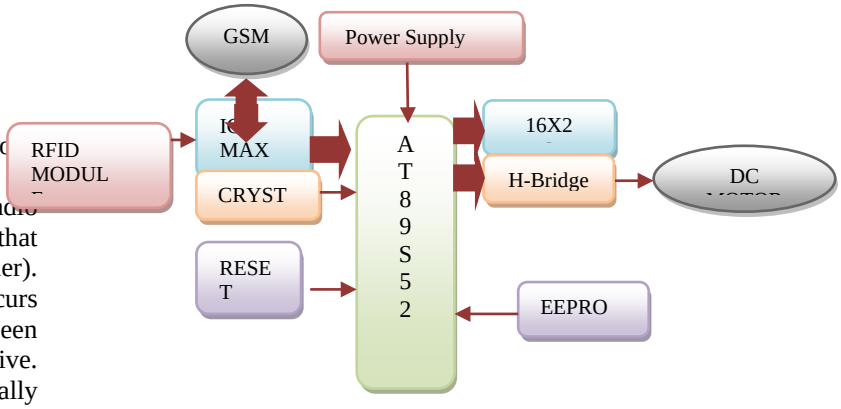

Figure 3: Block diagram of the proposed system

memory. The RFID tag includes a small RF transmitter and receiver. An RFID reader transmits an encoded radio signal to interrogate the tag. The tag receives the message and responds with its identification information. This may be only a unique tag serial number, or may be product-related information such as a stock number, lot or batch number, production date, or other specific information. RFID tags can be either passive, active or battery assisted passive. An active tag has an on-board battery and periodically transmits its ID signal. A battery assisted passive (BAP) has a small battery on board and is activated when in the presence of a RFID reader. A passive tag is cheaper and smaller because it has no battery. Instead, the tag uses the radio energy transmitted by the reader as its energy source. The interrogator must be close for RF field to be strong enough to transfer sufficient power to the tag. Since tags have individual serial numbers, the RFID system design can discriminate several tags that might be within the range of the RFID reader and read them simultaneously. Tags may either be read-only, having a factory-assigned serial number that is used as a key into a database, or may be read/write, where object-specific data can be written into the tag by the system user. Field programmable tags may be write-once, read-multiple; "blank" tags may be written with an electronic product code by the user. RFID tags contain at least two parts: an integrated circuit for storing and processing information, modulating and demodulating a radio-frequency (RF) signal, collecting DC power from the incident reader signal, and other specialized functions; and an antenna for receiving and transmitting the signal.Fixed readers are set up to create a specific interrogation zone which can be tightly controlled. This allows a highly defined reading area for when tags go in and out

of the interrogation zone. Mobile readers may be hand-held or mounted on carts or vehicles.

WORKING PROCEDURE

1. The RFID reader is operated with **+5v** power supply. As Soon as you give supply, the reader indicates the user that it is ready.
2. After giving supply to the reader, connect the serial cable of the reader to the DB-9 Connector of the MAX 232 IC.
3. After the above connections are over, a message is displayed on the LCD as "**Welcome to RFID reader**".
4. After some delay, a message is displayed as "**Starting system**" with a **led blinking** for Sometime till the message is appeared on the LCD.
5. Then again a message is displayed as "**System Ready**" with a second **led blinking** till the message is appeared.
6. Now, a message will be continuously appearing as "**Place the Card**" till we place the card into the reader with a simultaneous led blinking.
7. After placing the card near the reader, the reader indicates with an buzzer that a card has been accepted.
8. Next if the data is matched with the data existing in the card and stored in the code memory then it displays a message as "**Authorized**" in the first line of the LCD and "**Wineyard welcomes**" in the second line of the LCD.
9. When it is matched then a message is again displayed as "**Gate Opens**" along with the DC motor rotating in Clockwise direction.
10. After the door is opened a message is displayed as **"Plz Get In…".**
11. Then after some time, a message is displayed as "**Gate closes**" along with a DC motor rotating in an anti-clockwise direction.
12. Hence in this way we are providing security.

6.1 SOFTWARE USED

Software used is Proload. Proload is a software which accepts only hex files. Once the machine code is converted into hex code, that hex code has to be dumped into the microcontroller placed in the programmer kit and this is done by the Proload. Programmer kit contains a microcontroller on it other than the one which is to be programmed. This microcontroller has a program in it written in such a way that it accepts the hex file from the keil compiler and dumps this hex file into the microcontroller which is to be programmed. As this programmer kit requires power supply to be operated, this power supply is given from the power supply circuit designed above. It should be noted that this programmer kit contains a power supply section in the board itself but in order to switch on that power supply, a source is required. Thus this is accomplished from the power supply board with an output of 12volts or from an adapter connected to 230 V AC.

VII. RESULTS

Figure 4: Experimental Result

VIII. CONCLUSION

RFID is increasingly used with biometric technologies for security. Hence this work can be very useful and can be implemented in real time applications, eg.for recording the attendance. This system makes travelling more convenient, reduces travel times, savesfuel, reduces auto emissions, and increases highway capacity.

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