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AUTOMATIC TOLL TAX COLLECTION SYSTEM USING AURDINO AND GSM MODULE

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Abstract— The aim of this research paper is to illustrate the convenience and versatility of an automatic toll plaza system using RFID technology and its advantages over toll plazas using other techniques. With the number of vehicles increasing every year, the time and fuel wasted on waiting at the toll plazas is ever increasing. Automatic toll plazas can eliminate this wastage of time, fuel and enhance the vehicle security by providing a host of other features such as sending a text message to the registered mobile number of the owner, displaying the information about the vehicle on the display in addition to automatic opening and closing of the barricade. The toll is deducted from the vehicle owner's prepaid account. A 125 KHz RFID reader is used for detecting the passive tags by the reader module. The motor for the barricade, on-site LCD display and GSM modules have been interfaced with the microcontroller (ATMega328). This system will cut down time and fuel wastage at the manually controlled toll plazas, provide a layer of security because the SMS sent and will ensure a smoother travel experience for the travelers.

Index Terms — ATMega328, GSM, LCD, RFID, Toll Plaza

I.INTRODUCTION

The project mainly focuses on the Automation of the Toll Plazas for smoother movement of the traffic to in turn benefit the people by saving their time and money. Suppose the manual toll collection system is very efficient, then Time taken by 1 vehicle at the plaza = 60 sec (approx.) Time taken by 1 vehicle/year = $60 \times 365 = 21900$ sec = 6 hours Suppose 10000 vehicles are passing through a toll plaza 60000 fuel hours get wasted per year and thus equivalent amount of fuel. By making the toll plaza fully automatic using the RFID technology, the cars can pass through the plaza at around 55

mph i.e. 86 kmph. The time and fuel wastage can be drastically brought under control by this. We here, are interfacing the RFID receiver to the microcontroller. The receiver is Active and the RFID tags are passive. The receiver will be fixed at the toll plaza constantly trying to search for the tag. As soon as the tag comes in the range of the receiver, the unique code from the tag is identified by the receiver and transmitted serially to the microcontroller. The controller then matches the unique code to the Central Database and checks if the owner of the tag is in good standing with

respect to the balance in his account. Stipulated price of the toll will be deducted from his account. Hence a complete cashless operation is made possible. Then an SMS will be sent to the owner using the GSM module about how much money has been debited from his account OR if there is insufficient balance. Moreover, the owner will be sent the information regarding the location of the toll plaza from where the vehicle has passed. In this way he will get a warning to maintain sufficient balance in his account and also be able to track his vehicle in case of theft. Also as he passes the portal he will be able to see his details on site on the LCD on site. Accordingly, if the toll is paid properly the gate will automatically open for him.

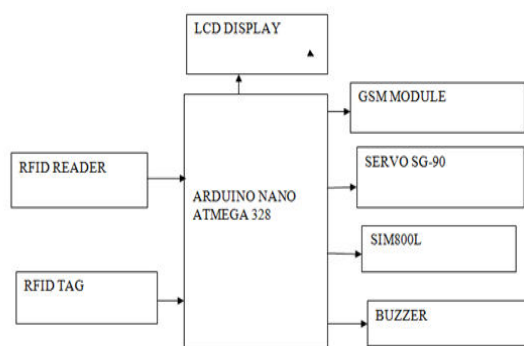
II. LITERATURE SURVEY

In [1], the automation of toll plaza has been done based on image processing. ANPR (Automatic Number Plate Recognition) system has been employed which uses a camera to capture the number plate of the vehicle and deducts the toll by matching it with the owner database.

In [2], the system is based on infrared sensors. In this, the user has to get the IR transmitter from the main toll office. The transmitter will be charged by the store office and the data of the user will be stored in the microcontroller. When the car arrives at the toll plaza the user will have to mount the transmitter on the car and press a button to turn it on. It must be in the line of sight of the receiver. The receiver will confirm the data from the transmitter with the database

and the amount of toll will get deducted. It uses a stepper motor for gate control.

In [3] also the system is based on the RFID technology. The controller used is PIC 18F4550 and has been connected with the system using USB. The RFID receiver senses the tag coming in its range and the amount gets deducted from the account of the owner after all the related information is checked from the database. The IR senses the vehicle motion for controlling the opening and closing of the gate. A stepper motor is used to control the gate. The rest of the references mentioned below have also employed the RFID technology and the working is quite similar to [3] except the database creation methods. The authors have put the GSM interfacing in their future scopes which we have implemented in our project



System Design And Implementation

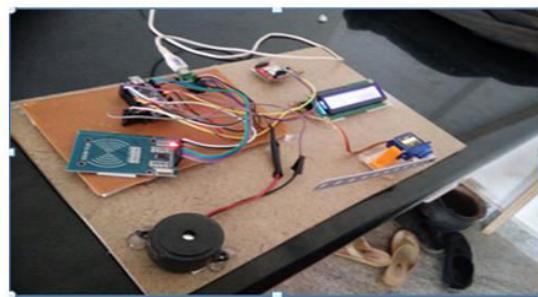
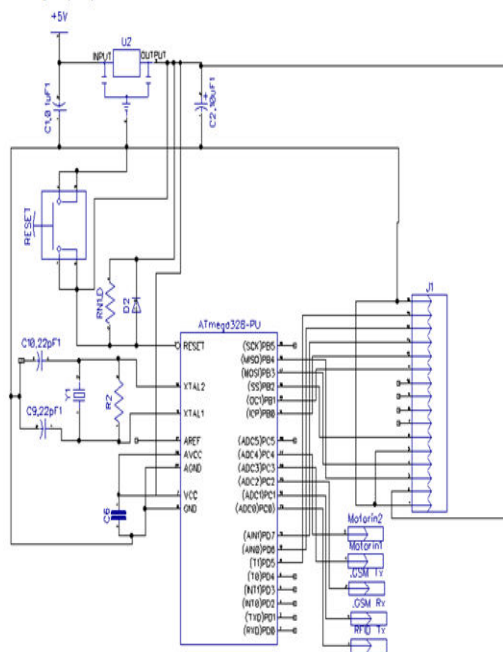


Figure 1: Block Diagram of the system



III. PROPOSED SYSTEM:

Each vehicle will be provided by an RF Transmission tag containing a unique ID. This unique ID can be assigned to the vehicle by authority body of country like we can have this ID as the vehicle's number. This tag will continuously emit RF signals. When the vehicle will reach at the toll booth the RF receiver will detect these RF signals. The signals are amplified and are passed to microcontroller. This microcontroller will display the id on LCD. Now, with the help of PC interface unit the data collected is passed to PC through serial port. Software developed will show all the details about the vehicle on the screen. Details like date, time, address and id will be stored in the access database. Based on these details a report will be prepared. Message of payment deduction, less balance or prepaid the account, etc. will be sent to vehicle owner by using GSM module present at toll booth.

IV. METHODOLOGY:

Flow of RFID based toll tax are:

- Detection of vehicle
- Weighing of vehicle
- Display of toll
- Payment through RFID card

Whenever any person buys a vehicle, first he/she need to do her vehicle registered at the RTO office. RTO people will assign a number plate to it along with it they will give a RFID enabled tag. This card will have a unique ID feasible to use with that vehicle only. They will also create an account for that particular smart card and maintain transaction history in database. Owner of the vehicle needs to deposit some minimum amount to this account. 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. The software further updates the details in the Centralized database server. It also triggers mechanism to generate the bill and will be sent to user as a text message. On the other hand, whenever any vehicle owner registers a complaint at the RTO office regarding theft of the vehicle respective entry is made in the database. Now any vehicle arriving at toll booth with same ID as already present in stolen vehicle category will be easily identified as the ID assigned with it is unique. All the toll plazas

will be connected to each other along with the centralized server in the form of LAN. Updates of any sort of transaction will be immediately updated to local database and centralized server.

V.SOFTWARE:

We are using BASCOM for programming. BASCOM-8051© is the Windows BASIC COMPILER for the 8051 family. It is designed to run on W95/W98/NT/W2000 and XP. It has Fast machine code instead of interpreted code. Compiled programs work with any 8051 up such as AT89C1051, AT89C2051, 8031, 8032, 8051, 8052, 80552, 80535 and 80537 m Processors. Special commands for LCD-displays, I2C chips and 1WIRE chips. We also used Visual Basic 6.0. The “Visual” part refers to the method used to create the graphical user interface (GUI). Rather than writing numerous lines of code to describe the appearance and location of interface elements, you simply add prebuilt objects into place on screen. We used in our system at main server.

The major components of the gate control system are as follows:

- ATMega328PUMicrocontroller
- EM-18 (RFID readermodule)
- SIM900 (GSM module)
- DC Motor with driver(L293D)
- LCDdisplay
- Power supplyunit

1.ATmega328-PUµC:

Features:

28 Pin I/O

RESET Pin NO. 1 (ACTIVE LOW)

Crystal Pins at 9-10 PIN Software Declarable Serial Ports

We have selected this controller because it has programmable UARTs required for both RFID and GSMmodules.

2.EM-18 (RFID readermodule):

Features:

Operating Distance – 10cm Operating Voltage – 5V Operating Frequency – 125 KHz Current Consumption - <50 mA

This is the stationary Active RFID receiver module situated at the toll plaza. It continuously keeps monitoring for the RFID tags. As soon as the tag comes in the range of the receiver, the buzzer on the module gives an indicative beep and sends the data serially to the microcontroller.

3.SIM900 (GSMmodule):

Features:

- Quad-Band GSM/GPRS 850/ 900/ 1800/1900 MHz
- Built in RS232 Level ConverterMAX3232)
- Configurable baud rate
- SMA connector with GSM L TypeAntenna.
- Built in SIM Cardholder.
- Built in Network StatusLED
- Inbuilt Powerful TCP/IP protocol stackfor internet data transfer overGPRS.
- Normal operation temperature: -20 °C to +55°C
- Input Voltage: 5V-12VDC

4. DC Motor withdriver(L293D):

L293D contains two inbuilt H-bridge driver circuits.

In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction.

The L293D is a Dual Full Bridge driver that can drive up to 1 Amp per bridge with supply voltage up to 24V Two H bridges of L293D can be connected in parallel to increase its current capacity to 2 Amp.

Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal

Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

Technical Specification:

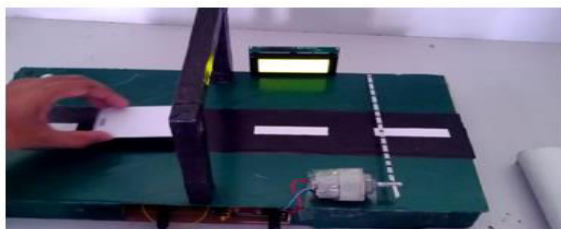
Power Supply: Over FRC connector 5V DC
External Power 9V to 24V DC
Temperature Range: 0°C to +70°C

5. LCD display:

20X4 lines display 5X7 dot matrix display 4 bit data interface

6. Power supply unit:

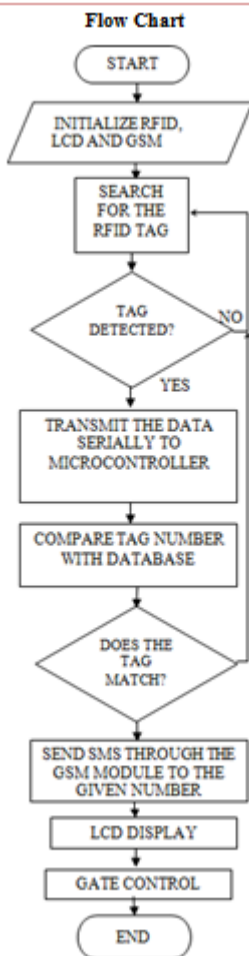
Specifications: 12 V, 2A



BACKGROUND OF OUR PROJECT

Transportation is the backbone of any country's economy. Advancement in transportation systems has created a lifestyle characterized by freedom of movement, trade in manufactured goods and services, high employment levels and social mobility. In fact, the economic wealth of a nation has been closely tied to efficient methods of transportation. Rapid development of the country especially in providing good infrastructure facilities to the people has constantly become an important agenda to the Government. To realize the Government's aspirations the Roads and Highways Department of Bangladesh strives to guarantee modern, efficient, quality highway's that are attuned towards growth of the nation. Talled highways were built looking at many factors, one of them being the heavy traffic and congestions around Meghna Bridge Toll Plaza. For many cases, tolled highways in major cities are basically roads that have been upgraded to highways. The situation becomes more complex when it involves a spectrum of local infrastructure that consists of housing areas, industries, factories and schools. The network of highways built, however, helps with the development of surrounding communities and defines the highways as the main route for local residents. The strategic location also encourages locals to use the highway more than once and here is where during peak hours toll plazas become as congested as normal roads. The vehicles moving through this route have to cross the Meghna Bridge and pay tolls at Meghna Toll Plaza. But due to delay in collection system, the users of

this road normally have to face long queue. All the parties concerned are being negatively impacted by this delay. The passengers and the transport owners are to sacrifice the time while the toll collection authority is being deprived of getting more tolls within a stipulated time. According to a traffic survey in 2005, about 3584314 vehicles were recorded to cross Meghna Ghattoll plaza



VI. ADVANTAGES

- RFID system does not need Line Of Sight (LOS) unlike bar-codes or image processing based system. Thus it can be installed inside the car from where it is not visible, which

saves tampering with the process in case of theft.

- As in [1], the cars need to be at a specified position for the system to scan the number plate which is not required in RFID based system. Also, the number plates can easily be exchanged which has no way to get detected.
- High speed passage of car is possible (55 mph or 86 kmph).
- Wastage of fuel is substantially reduced.
- Traffic jams are avoided to a great extent.
- Security is an added advantage - The location of a stolen car can be notified to the concerned owner through the GSM module.
- The owner will also be informed about the amount deducted and the remaining balance which will help him to maintain a sufficient balance in his account.

VII. CONCLUSION

We can reduce the prevalent problem of skipping the payment of toll at toll plazas because of automatic deduction and enhance the security of the vehicle due to GSM interfacing. The long queues at the toll plaza and need for human intervention is reduced greatly. This system will ensure a smoother and safer journey for the passengers.

VIII. FUTURE SCOPE

In addition to the current work, image processing can be combined with the RFID system to make the system more reliable and secure. By combining the positives of the two we can eliminate any possible discrepancies in the system. Internet banking as well as SMS banking can be used for recharging the account of the user to make it convenient.

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