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Research Paper

RFID based automatic tollgate collection

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Abstract

Automation within the transport system proved to be a remarkable investment inside the improvement of smart cities. ETC "Electronic Toll Collection" pursuits to cast off the holdup at toll gates by way of amassing toll fee electronically. Using this era we can reduce the congestion in tollbooths, in particular all through festive seasons while traffic has a tendency to be heavier than ordinary. The principle aim of this paper is to develop a conversation gadget to automate the vehicle access, go out toll series the usage of RF-Identification technology. Statistics can be without problems exchanged among the vehicle owners and toll management, thereby facilitating an extra effective toll collection by using decreasing traffic problems and abolishing feasible person made mistakes. Aurdino MEGA2560 microcontroller acts as the heart of the device. When any automobile passes thru the Toll Gate, the RFID tag, that's connected to the vehicle, receives scanned and an interrupt sign is dispatched to Aurdino from the RFID module. The microcontroller sends a signal to motor driver, GSM module and LED. On receiving the signal from Aurdino, LED turns from red to green because of this that the vehicle can pass thru the toll gate and the motor gets into movement via lifting the gate.

Keywords: *Arduino Microcontroller; Electronic Toll Collection (ETC); Global System for Mobile (GSM); Light Emitting Diode (LED); Radio-Frequency Identification (RF-ID).*

1. Introduction

ETC "Electronic toll collection" objectives to abolish the holdup on the toll roads by accumulating toll fee electronically. The ETC find outs whether passing automobiles or not passing and are enrolled in the software, alerts the enforcers for those that aren't, and auto debits the debts of registered vehicle like car owners without requiring them to prevent. Commonly automation in embedded systems performs primary position in various packages. The primary feature is to make the device compatible with all gadgets that may be linked to digital conversation networks. Automation reduces human attempt and saves lot of time. This task is based totally on Automation in Tollgates which especially makes use of GSM to transmit the repute of the user approximately his account info thru message. Also updates the transaction information with the server using internet and making bills much faster, simpler and at ease.

In present situations the toll gate billing is made by way of the consumer with the help of manual billing or computerized billing by way of getting into vehicle range, vehicle registration range, kind of automobile etc.

Because of this there are following risks:

- Time taking process to enter data and giving token printing and cash.
- Manipulation feasible at toll gate through the operator.
- Tough to stop the fast transferring motors on the tollgate.
- Extra manpower is wanted at toll gate.

The following Fig.1 shows Traffic accumulation due to delay in billing process.

The risks that are present in the current existing toll gates can be overcome as follows:



Fig. 1: Traffic Accumulation Due to Delay in Billing.

- Getting records swiftly from the automobile.
- By avoiding manual operator at the Toll booth.
- Rapid Cash transactions through online.

The above process all together called as Computerized or Automatic Billing System for Toll Gates [1]. Norway was the worlds predate inside the tremendous implementation about technology and many others become first delivered in Bergen, in 1986, functioning collectively with conventional tollbooths. In 1991, Trondheim was introduced the sector's first use of absolutely unaided complete-pace digital tolling. In Norway, they have 25 toll roads running with automatic Electronic Charge Collection (EFC). Portugal became as the first country to apply a common, popular system to all tolls inside the country in 1995. Also the Via Verde, which could utilized in parking masses and gas stations. America is every other us of a with massive use of and so on in several

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states, although many U.S. toll roads hold the manual series as choice.

Objectives of the paper

- To keep away from Time put off in toll collection.
- To keep away from manipulations by means of tollbooth operator.
- To limit man power wanted for operating the toll gates.

2. Implementation

Automatic Billing System for Toll gates can be carried out in three steps with 3 modules.

- Identification Module
- Controlling Module
- Banking Module

1.1. Implementation process

Automatic Billing System for Toll gate systems depend upon 4 major additives:

i) AVI (Automated Vehicle Identification)
ii) AVC (Automated Vehicle Classification)
iii) TP (Transaction Processing)
iv) VE (Violation Enforcement)

i) AVI

This is the system of figuring out the identification of an automobile challenge to management of tolls. Most of the toll people facilities file the journey of cars thru a constrained variety of toll gates. Here, the challenge is discovering of vehicles within that gate region.

ii) AVC

It was nearly matched to AVI. Major toll facilities fee specific rate of charges for extraordinary forms of motors, making it necessary to differentiate passing motors.

iii) TP

This dealing has maintaining of consumer accounts, posting of toll transactions and client bills to the bills, and coping with consumer inquiries. This issue of some systems is referred to as a "customer service center". This feature resembles banking, and several toll companies have contracted out the transaction processing to a financial institution like bank in many respects.

iv) VE

VE System is useful in lowering unpaid tolls, because as an unmanned toll gate gives a tempting target for toll evasion. Numerous techniques could used to discourage toll violators.

1.2. Block diagram

Fig.2 shows the automatic toll gate billing system block diagram. Aurdino MEGA2560 microcontroller acts as the heart of the system. When any vehicle passes thru the Toll gate, the RFID tag, that's connected to the vehicle, gets scanned and an interrupt signal is sent to Aurdino from RFID module [2]. The microcontroller sends a signal to three devices Motor driver, GSM and LED.

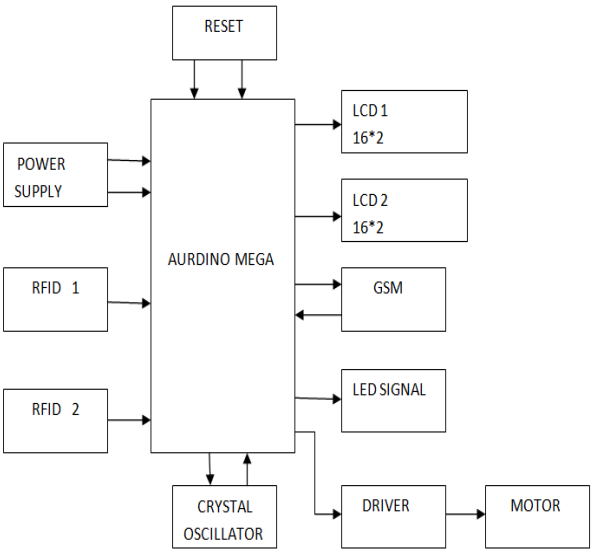


Fig. 2: Automatic Toll Gate Billing System's Block Diagram.

On receiving the signal from Aurdino, LED turns from red to green which means that the vehicle can pass via the toll gate and the motor gets into movement by lifting the gate. The amount that is deducted from our account for passing thru the toll gate is sent as a message (SMS) to the respective registered mobile number. The vehicle number and the balance in the account are displayed on LCD monitor.

1.3. RFID

Radio-frequency identification (RFID) uses an item usually called an RFID tag carried out to or integrated right into a product, animal, man or woman for the point of identity and monitoring the usage of radio waves. These tags can be read from numerous meters away and outside the line of sight of the reader [3].

Advantages of RFID

- RFID machine is non touch, non line of sight nature of the generation.
- Tags might read thru a selection of substances which include fog, snow, paint, crusted dirt, ice, and different environmentally and visually challenging situations.
- RFID tags also could read in difficult situations at first-rate speeds. In most cases responding is in less than 100ms.
- Read/Write capability of an energetic RFID device is a large advantage in interactive packages such as painting in system or preservation tracking.
- The high cease advantage of RFID is that it affords excessive security.

Major RFID tags comprise at least 2 parts. As first part is an IC for storage and processing of records, modulating & demodulating a radio-frequency (RF) sign, and different dedicated features. The second part is an antenna for receiving & transmitting the sign. Now days, RFID is used in enterprise supply chain management to enhance the performance of inventory tracking and management. RFID tags are intellectual bar codes that may natter to a networked gadget to tune each product. An RFID tag is a microchip which is combined with an antenna in a compact package; the wrapping is established to permit the RFID tag to be connected to an object to be tracked. The tag's antenna alternatives up signals from an RFID reader or scanner and then returns the sign, commonly with more extra data (like a completely distinctive serial quantity or different personalized statistics) [4]. A fundamental RFID Tag has been shown in Fig.3.

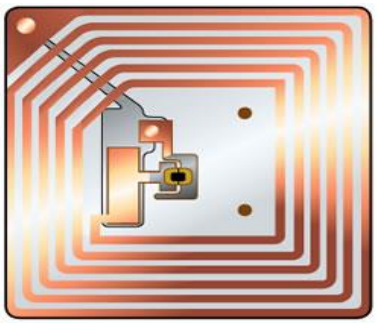


Fig. 3: Basic RFID Tag.

RFID reader is a tool which is used to grill an RFID tag. This reader has an antenna that releases radio waves and the tag reacts through transfer again its statistics. A no. of things can have an effect on the gap at which a tag may be examined the read range. The frequency used for identity, the antenna advantage, the direction and divergence of the reader antenna and the transponder antenna, in addition to the location of the tag at the item to be identified will all have an effect at the RFID system's examine range [5].

Reader has 3 most important functions which are energizing, demodulating and decoding. Similarly, readers may be fitted with an extra interface that exchanges the radio waves back from the RFID tag right into a form which can be exceeded on to some other machine, like a computer device or any programmable common sense controller.

1.4. Aurdino MEGA2560

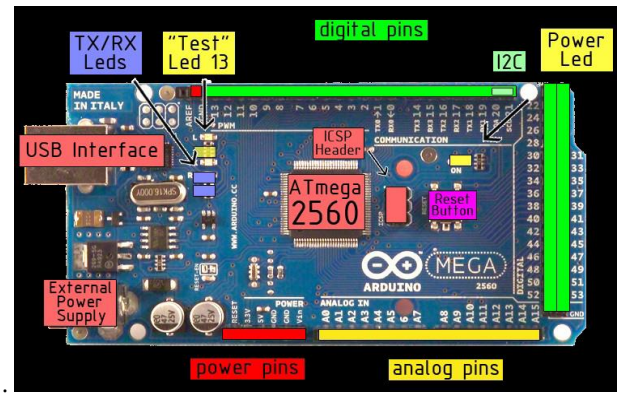


Fig. 4: Aurdino Mega2560.

Fig.4 shows the layout of Aurdino MEGA2560. The Aurdino Mega 2560 is a microcontroller board which is based on the ATmega2560. It has 54 digital I/O pins (of which14 can be used as PWM outputs) 16 analog i/p's, 4 UARTs (h/w serial ports), a 16 MHz crystal oscillator, a power jack, a USB connection, an ICSP header, and a reset button [6].

Specifications:

- Microcontroller ATmega2560.
- DC Current for 3.3V Pin 50 mA.
- DC Current per I/O Pin 40 mA.
- Digital I/O Pins 54 (of which 14 provide PWM output)
- Input Voltage (recommended) 7-12V.
- Input Voltage (limits) 6-20V.
- Analog Input Pins 16.
- Operating Voltage 5V.
- Flash Memory 256 KB of which 8 KB used by bootloader.

1.5. ULN 2003 motor driver

The ULN2003 is constructed from high voltage, high-modern Darlington drivers with seven NPN Darlington pairs. The ULN motive force is used to switch information. On this driver especially the current is being amplified keeping the voltage level constant as a consequence growing the output power [7]. Table.1 shows the specs.

Table 1:

Symbol	Parameter	Value	Unit
Vo	Output Voltage	50	V
Vin	Input Voltage	30	V
Ic	Continuous Collector Current	500	mA
Ib	Continuous Base Current	25	mA
Tanb	Operating Ambient Temp Range	-20 to 85	° C
Tstg	Storage Temp Range	-55 to 100	° C
Tj	Junction Temp	150	° C

1.6. Wi-Fi module ESP8266

ESP8266 offers a full and self-contained wi-fi networking solution, permitting it to either host the software or to dump all wireless networking capabilities from every other utility processor. While ESP8266 is the simplest utility processor in the device, it may boot up immediately from an external flash. It has included cache to enhance the overall performance of the machine in such applications, and to limit the memory needs. Alternately, serving as a wireless adapter, wireless net get right of entry to can be introduced to any microcontroller-primarily based layout with easy connectivity via UART interface or the CPU AHB bridge interface [8].

Key Characteristics of ESP5266

- 802.11 b/g/n protocol
- SDIO 2.0, SPI, UART
- STBC, 1×1 MIMO, 2×1 MIMO
- Integrated TR switch, balun, LNA, power amplifier and matching network
- Integrated TCP/IP protocol stack
- Integrated PLL, regulators, and power management units
- Supports antenna diversity
- Power down leakage current of< 10uA Integrated low power 32-bit CPU could be used as application processor
- +19.5dBm output power in 802.11b mode
- Wi-Fi Direct (P2P), soft-AP
- Integrated temperature sensor
- Wake up and transmit packets in< 2ms Standby power consumption of< 1.0mW (DTIM3)
- A-MPDU& A-MSDU aggregation & s guard intervalμ0.4

1.7. Liquid crystal display (LCD)

The LCD's are used appreciably in watches, calculators and measuring units for show. They may be simple seven-section shows.

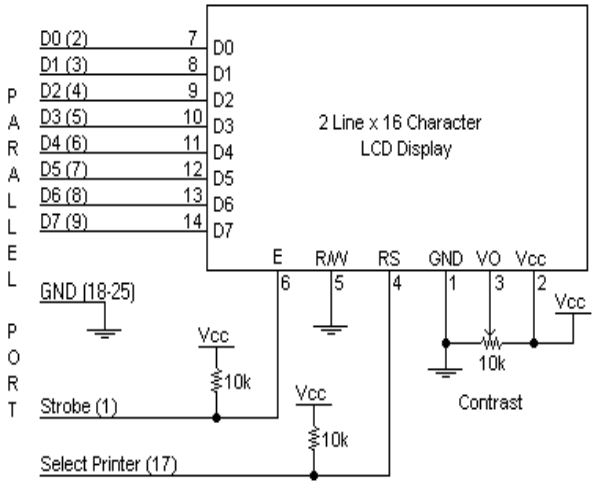


Fig. 5: Pin Diagram of LCD.

Fig.5 shows the pin configuration. Vcc and Vss are supply pins. VEE (Pin no.3) is used for controlling LCD contrast. RS pin which is Pin No.4 for selecting the register, inside the LCD there are 2 very vital registers are there.
The Working of RS pin for their selection as follows. If RS=0, the instruction command code register is chosen, permitting the user to launch information to be present at the LCD.
R/W is Pin, which lets the consumer to note down statistics to the LCD or interpret data from it. R/W=1 is reading R/W=0 is writing. The LCD to handle information presented to its data pins uses the enable (E) pin. The 8-bit data pins, D0 to D7, are used to mail information to the LCD or interpret the contents of the LCD's inner registers. To show letters and numbers, we ought to ship ASCII codes for the letters A-Z, and number 0 -9 to these pins at the same time as making RS=1 [9].

1.8. Interfacing LCD to the aurdino

Fig.6 represents the LCD and Aurdino Interfacing.

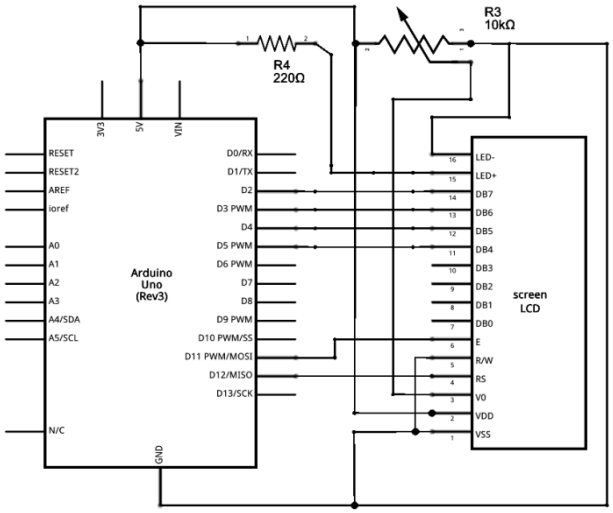


Fig. 6: LCD and Aurdino Interfacing.

1.9. Required S/W packages

- MySQL

It is an open-source RDBMS (Relational Database Management System). "SQL" means Structured Query Language. MySQL was sponsored by the Swedish company MySQLAB who was sole owner. And now it has possessed by Oracle Corporation. Many paid editions are exist for proprietary use, and present additional functionalities. It is a central component of the LAMP which is a web application software stack as open-source. LAMP is an ellipsis for "Linux, Apache, MySQL, Perl/ PHP/ Python" [10].

- Features

This MySQL is offered in 2 different editions: First one is MySQL Community Server which is open source and the Second one is proprietary Enterprise Server. MySQL Enterprise Server is differentiated by a chain of proprietary extensions which install as server plug-ins, but otherwise allocates the version numbering system and is built from the same code base.

Predominant features in MySQL 5.6:

- A broad subset of ANSI SQL 99, as well as extensions
- Updatable views
- Triggers
- Cursors
- Cross-platform support
- Stored procedures, using a procedural language that closely adheres to SQL/PSM.
- Online DDL when using the InnoDB Storage Engine.
- Information schema and many more.

- Deployment

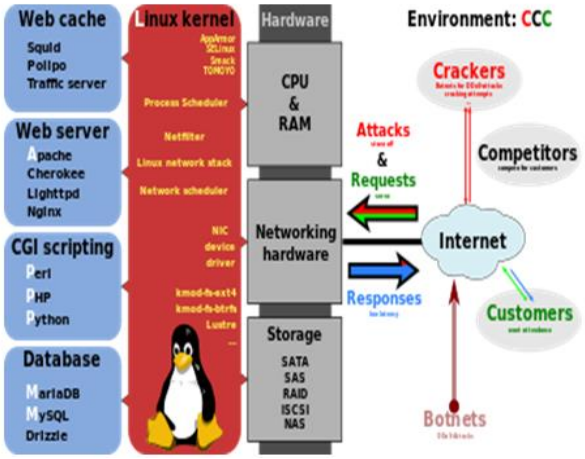


Fig. 7: LAMP Software Bundle, Displayed hear Together with Squid.

- MySQL Workbench

It was developed by MySQL AB. This is the reliable incorporated surroundings for MySQL. It permits clients to administer MySQL databases as graphically & design database systems as visually. This can substitute the previous software packages. MySQL was using as front end, MySQL Workbench lets users manage database design and also modeling, SQL development [11].

- Database Workbench

To develop and administrate multiple relational databases using SQL, with inter-operationality between diverse database systems, we need to use a software application developed by Upscene Productions called as Database Workbench .
Since Databases Workbench supports more than one database systems, it could offer s/w developers with the same interface and development environment for these.

- Navicat

This software is used for a cycle of graphical database management and development, which was developed by Premium Soft Cyber Tech Ltd for Oracle, MySQL, MariaDB, PostgreSQL SQLite, and Microsoft SQL Server. It has an Explorer-like graphical person interface and helps a couple of database connections for nearby and remote databases. Navicat's design motto is to satisfy the wishes of a selection of audience, from database directors & programmers to diverse business (es) that serve customers and share data with companions.

- phpMyAdmin

This free & open source tool written in PHP intended to knob MySQL running by using a web browser. It could execute several tasks like creating, deleting or modifying databases, rows or fields, tables; working of SQL statements; or management of users and permissions. This can import information from SQL and CSV, and exports stored information into any other formats by using a set of pre-defined functions, like exhibiting images and/or download links of BLOB-data.

- SQLBuddy

This web-based application which is also as open-source written in PHP only proposed to manage the MySQL and SQLite administrations with the usage of a Web browser.

3. Results

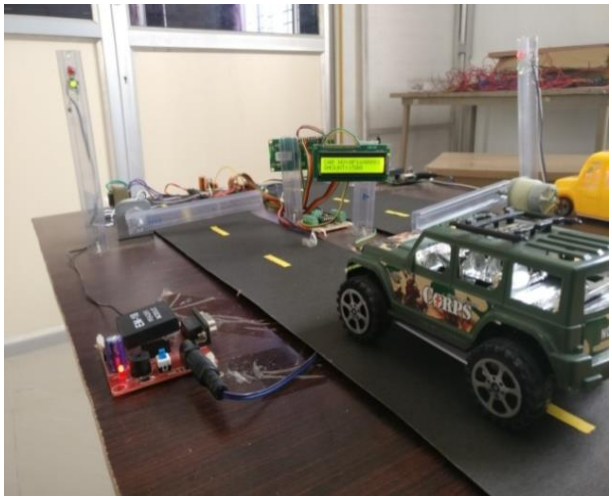


Fig. 8: A Car Entering Into the Toll Gate.



Fig. 9: Car Number and Account Balance Display.

4. Conclusion

- Increases consumer ease and protection with nonstop payment.
- Get better traffic float.
- Diminish client trip time.
- Shrinks traffic congestion.
- Decreases fuel use of client's vehicle.
- Shrinks emissions that are a major purpose of pollutants.
- Wanting of new roads was reduced.
- Diminish running prices for toll management.
- Presents demonstrated consistency and remarkable correctness.
- The banking module can be applied with advanced software's like Oracle, visual basic in order that it may be greater best in future implementations. The banking module can be applied dynamically so that the toll bill can be numerous at each and each toll gate.

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