

Advanced Automatic Toll Collection and Vehicle Detection System Using Internet of Things

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Abstract

Internet of things is an integral part in today's development of smart city, now without internet it has become like nothing is possible in the world especially for corporate systems where they use internet for communication purpose. Internet communicates through radio waves. Internet of things is expanding its outreach to every aspect of our daily life and our needs the energy consumption can also be reduced by utilizing network coding in Internet of things in day- to -day life. The Automatic Toll collection system uses RFID technology where they help to reduce the Toll gate traffic and avoid other illegal passage of vehicles through a Toll gate. This paper shows for the first time that Toll booth can be completely managed using the 'Internet of Things' concept based on the RFID technology.

Keywords – RFID Reader, GSM, RFID Tag, Arduino Uno, LCD display.

I. INTRODUCTION

Transportation is the major contributor to the nation's economy. Improvements in the field of transportation enabled us to have a fast pace lifestyle characterized by exceptional independence of movement, huge trades in manufactured goods and services, high jobs and social movements. The nation's economic treasure can be said to be directly proportional to the productive transportation methods. As we know numbers of vehicles on the road are increasing day by day, problems such as congestion, accidents, air pollution has become a major factor of concern [1]. Because of the major development in Roadways, there is an increase in the number of toll plazas and leading to have long queues in toll plazas and causing money leakage which leads to more delay. We have designed an IOT based Toll booth Manager System in which a person can use an RFID to pay the Toll charge. When the RFID is displayed, the system would check if it has sufficient balance and then deduct the toll charge and update the balance through IoT. Internet of Things is basically the 'things' which are

connected to networks and can exchange data with the help of sensors, electronics, software and connectivity. These systems do not require any human interaction. A trend of IoT Technology is found in many industries like healthcare, Energy, Transportation etc. Here the data of the RFID card is sent to the website, through network interconnected with IOT.

II. EXISTING SYSTEM

Designed a programming board to program the PIC microcontroller, It consists of JTAG in SpyBi Wire mode. When the power supply is connected with fuse blow protection additionally the port pins were attached with a single pole single throw (SPST) switch and LED for testing the code visually [4]. The IR transmitter/LED is a device that used to emit infrared light outside the visible spectrum. The device that is used to detect or receive, the IR light is called infrared sensor which sense aspects of its surroundings. In our example, the IR sensor is used to detect arriving vehicles. The SE555P Timer by Texas Instruments is used in the monostable mode. When IR radiation is received ("no vehicle" condition) triggering occurs, resulting in a high output. When a vehicle arrives at a toll plaza, the IR rays are blocked by the vehicle, and the output of the timer to toggle to low. The change in output of the timer is sensed by the microcontroller, which is programmed to turn on the IR transmitter.

DISADVANTAGES

- Time delay
- Does not applicable for wide range application

III. PROPOSED SYSTEM

IOT Based Toll collection system helps the toll booths to collect the toll by just displaying a card. Firstly the RFID card will be shown to the RFID Reader which scans the details of the RFID card and LCD displays the message by showing the number and

the sufficient balance available. Then the respective toll amount is deducted from the recharged amount of the users RFID card. Once the amount is deducted the acknowledgement/message is sent to the users registered mobile number, the operations default, processing and successful is indicated by the LED lights red, yellow, and green. If the transaction is successful the vehicle will be allowed to pass.

ADVANTAGES

- User friendly
- Easy to install

BLOCK DIAGRAM

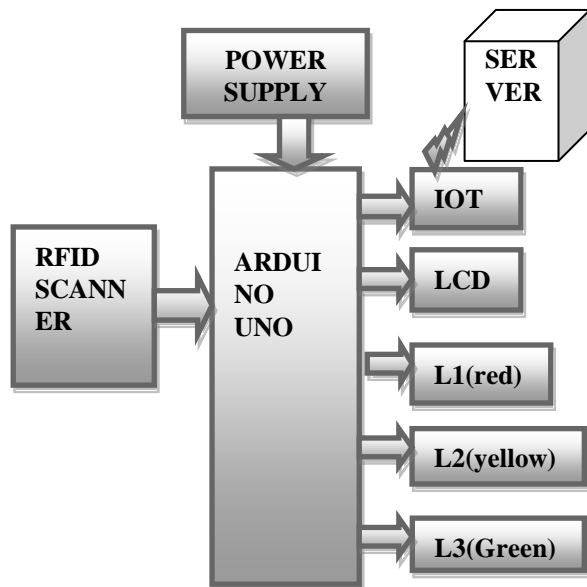


Figure 3.1 Block diagram of ATCS

IV. METHODOLOGY

A. ARDUINO UNO

The Arduino UNO is open-source microcontroller and Microchip ATmega328P microcontroller, which is developed by Arduino.cc. This board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced between various expansion boards (shields) and other circuits, and this board contains 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE via a type B USB cable.



Figure 4.1. Arduino Uno

SPECIFICATION

- Microcontroller: Microchip ATmega328P
- Operating Voltage: 5 Volt
- Input Voltage: 7 to 20 Volts
- Digital I/O Pins: 14 Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz
- Length: 68.6 mm
- Width: 53.4 mm
- Weight: 25 g

B. LIQUID CRYSTAL DISPLAY

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications, 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs.

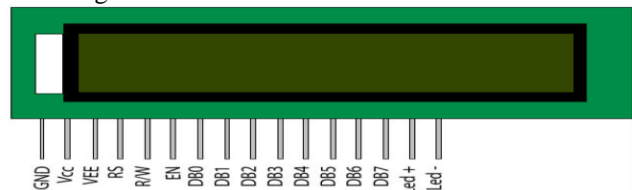


Figure 4.2 LCD

A 16x2 LCD means it can display 16 Characters per line and there are 2 such lines. In this LCD each

character is displayed in 5x7 pixel matrix. This LCD has two registers namely Command and Data.

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage :5V (4.7V – 5.3V)	V _{CC}
3	Contrast adjustment through a variable resistor	V _{EE}
4	Selects command register when low and data register when high	Register Select
5	Low to write to the register High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V _{CC} (5V)	Led+

Table 1. Pin Functions Specifications.

C. NODE MCU

NodeMCU is a LUA based interactive firmware for Espressif ESP8622 Wi-Fi SoC, as well as an open source hardware board consists of \$3 ESP8266 Wi-Fi modules includes a CP2102 TTL to USB chip for programming and debugging. It is breadboard-friendly and can simply be powered via its micro USB port. NodeMCU is a wifi SOC (system on a chip) produced by Espressif Systems. It is based ESP8266 -12E WiFi module and highly integrated chip designed to provide full internet connectivity in a small package.

D. RFID READER

An RFID reader function is to interrogate RFID tags. The interrogation is wireless and because the distance is relatively short line of sight between the reader and tags is not necessary. A reader contains an RF module which acts as both a transmitter and receiver of radio frequency signals. The transmitter consists of an oscillator to create the carrier frequency, a modulator to impinge data commands upon this carrier signal and

an amplifier to boost the signal enough to awaken the tag.

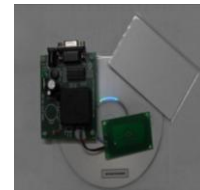


Figure 4.3 RFID Reader

E. RFID TAG

An RFID tag is a microchip combined with an antenna in a compact package. The packaging is structured to allow the RFID tag to be attached to an object to be tracked. "RFID" stands for Radio Frequency Identification. The tag's antenna picks up signals from an RFID reader or scanner and then returns the signal, usually with some additional data (like a unique serial number or other customized information). RFID tags can be very small the size of a large rice grain. Alternate pairs of diodes conduct changing over the connections so the alternating directions of AC are converted to the one direction of DC.

FLOW CHART OF AUTOMATIC TOLL COLLECTION SYSTEM

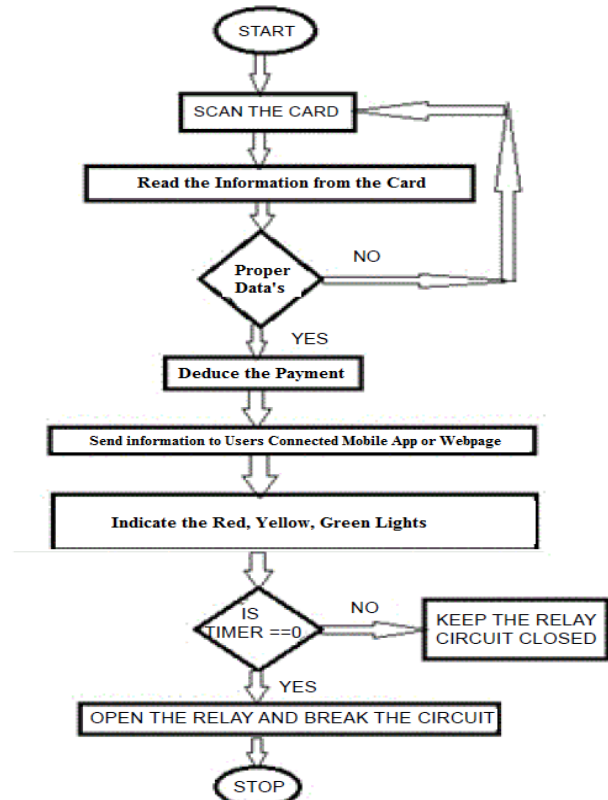


Figure 5.1 Working Flow of automatic toll collection system

The long queuing of Vehicles to pay toll tax at highway toll gate is commonly observed at toll plazas. The toll collection system mostly works on a manual process this has a cumulative effect of increasing traffic congestion, adding delays in travel time. To solve this problem we are designing an “Advanced automatic Toll Collection and Vehicle detection System”. This is an automatic system which leverages the “Internet of Things” technology to identify a vehicle via a unique identification tag. The RFID tag is used in order to identify the vehicle when it passes through a toll booth, the RFID card is used to track & bill the vehicle owner through a payment gateway.

The Flow chart working is described below:

1. A vehicle will approach at the toll booth, The RFID reader at the toll will read the RFID card displayed by the user.
2. Then it will pass the information stored in the card to the Arduino (microcontroller).
3. Then the Arduino Uno microcontroller will track information and will check whether the card is valid or not.
4. It checks whether the card is valid or invalid, the card is having sufficient balance or not which will be displayed on LCD.
5. The corresponding amount with respect to NH tolls will be deducted from the owner’s account.
6. Along with this, a green LED light will be glow and further the vehicle to pass on.
7. GSM module will send message to the owner informing him about amount deducted from their RFID tag.
8. If the card is not valid, the screen will show ‘invalid user’ and no amount would be deducted and a red LED light glows.

IOT Based Advanced automatic toll collection and vehicle detection system helps the toll to be collected automatically just by identifying the vehicle through a unique RFID tag detected by RFID scanner. the LCD displays the message by showing the vehicle’s number based on the RFID card payment the light will glow. After this the information present in card is passed to micro-controller Arduino, Aurdino will check if the card is valid or not. Then the GSM module will send a message to the owner informing him about amount deducted from their tag, and in case if the card is not valid, the screen will display ‘invalid user’ on the LCD screen and no amount will be deducted. Along with this a red LED light will glow.

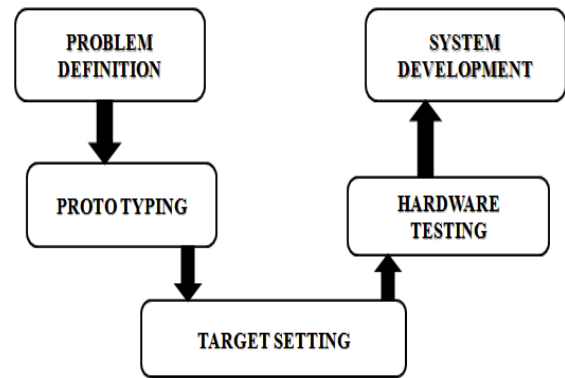


Figure 5. 2 General methodology steps

The diagram gives a general view of methodology

1. **Problem Definition:** Finding the problem that is identified in toll plaza i.e traffic congestion and time consuming due to queuing of vehicles so to solve this problem ATCS is introduced.
2. **Proto Typing:** Prototyping the project or circuitry that is done through available hardware.
3. **Target Setting:** The goal for working of the project.
4. **Hardware Testing:** Setting up hardware at initial stages and then interfacing the hardware with each other for developing proper system.

VI. RESULT AND DISCUSSION SNAPSHOTS

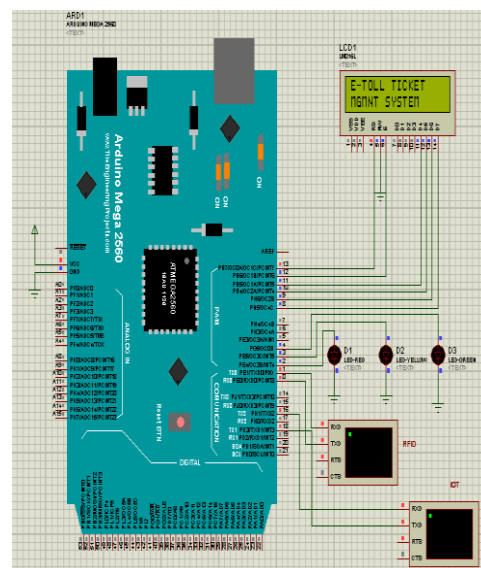


Figure 6.1 LCD displaying welcome condition.

Figure 6.1 describes Simulation for this project implemented using Proteus software. Here RFID reader connected to 0 pin of Arduino three color LED is connected to 2, 3, 4 pin of Arduino. LCD display (RS,EN,D4,D5,D6,D7) connected to Arduino uno (13,12,11,10,9,8).

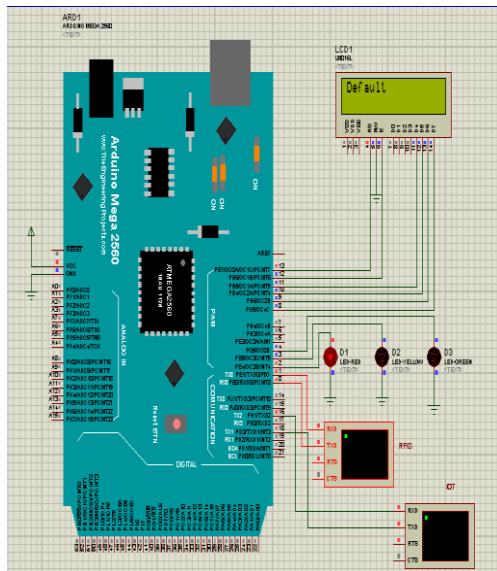


Figure 6.2 LCD displaying default condition
At normal condition red LED will glow as shown in this figure.

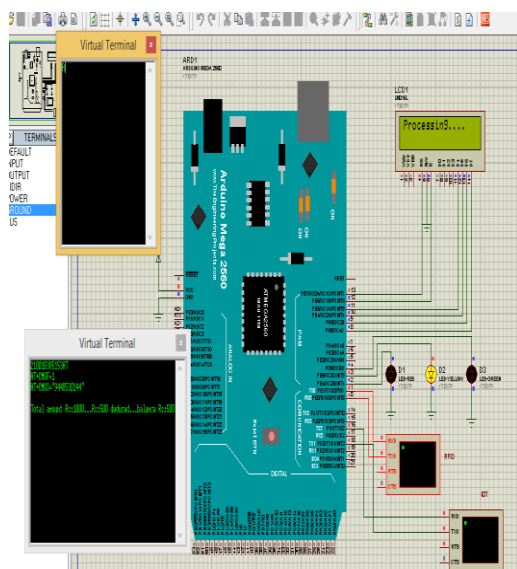


Figure 6.3 LCD displaying processing condition

Figure 6.3 shows the RFID Reader reads the signal, Arduino will check if the card is valid or not, if the card is valid then it will check for the sufficient balance at that time yellow LED will glow.

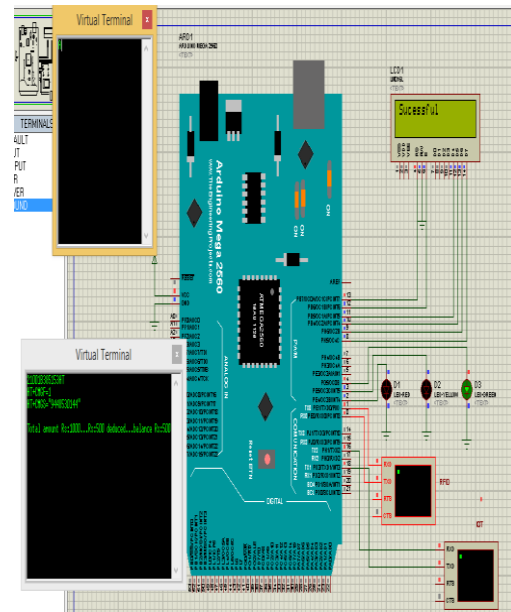


Figure 6.4 LCD displaying successful condition

When the RFID reader reads the signal, from the Tag the respective toll amount will be deduced from the recharged amount, when the amount is deduced the system sends the message to the users registered mobile number about payment details, the green light will glow indicating the process is successful and the vehicle is allowed to pass.

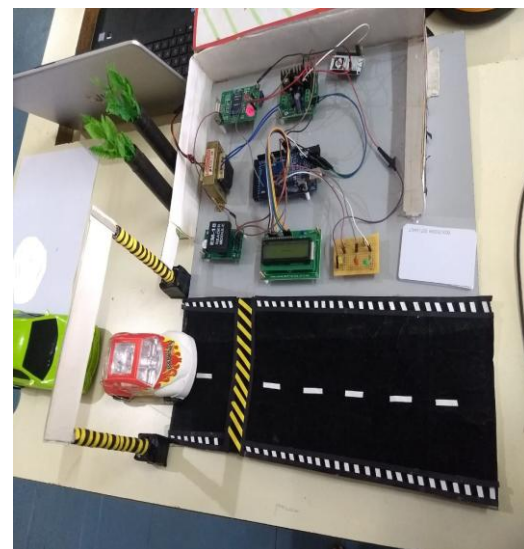


Figure 6.5 the visual representation of the components connected.

When vehicle approaches near the toll plaza, the user has to display the RFID tag to the RFID reader, which reads the information from the card. The amount will be deduced and the vehicle will be allowed to pass.

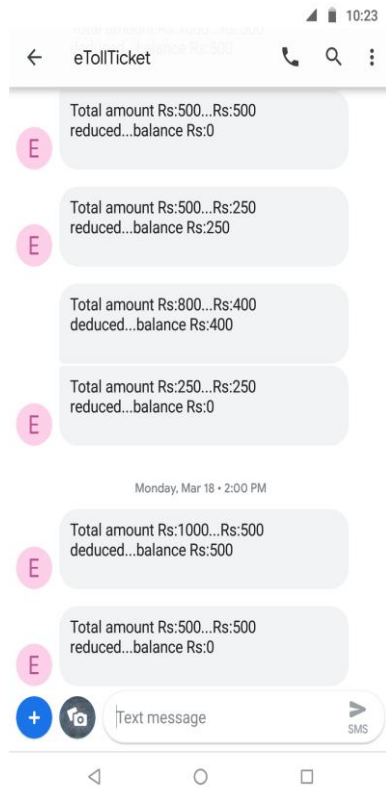


Figure 6.6 Message sent to the users registered mobile number.

VII. CONCLUSION

Here we have tried to analyze some of the current RFID and GSM technology, toll collection systems and their practicality. All system tries to reduce the traffic overheads at toll plaza. This system includes some of the benefits to both toll authorities and facility users in terms of time and cost saving improved security and high capacity. Today transportation is the major contributor to the nation's economy. IoT Toll Collection systems are aimed at automating the toll plazas so as to maintain fairness in the transactions during toll collections. Every industry has its different method of transportation to reduce excessive costs spent on transportation. thus, providing good quality transportation will significantly contribute to better economy and productivity.

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REFERENCES

- [1] Prof.NiveditaKadam, Miss.Shubhangi Waghmare, Miss.Shradha Adhalkar, Mr.GunwantSirsat, Mr.NikhilPatil "A Survey on Toll Collection System Using Different Method" International Journal for Science and Research in Technical Education (IJSRTE) 2017.
- [2] Venkatesh Suvarna "A Review on Various RFID Based Automated Highway Toll Collection Systems" International Journal of Computer Science and Information Technologies (IJCISIT), Vol. 6 (3), Issue 1, pp. 2130-2133, 2015.
- [3] Devyani Bajaj, NeeleshGuptha "GPS Based Automatic Vehicle Tracking using RFID" International journal of Engineering and Innovative Technology (IJEIT), Vol. 1, Issue 1, pp.31-35, January 2012.
- [4] S. Abirami, K. Amudha, S. Lavanya, R. Deepa "Automatic Toll E-Ticketing System using RFID and GSM Technology" International journal of Electronics, Electrical and Computational System (IJEECS), Vol. 6, Issue 3, pp.201-204, March 2017.
- [5] PurvikaBhisikar, AlpitaUmredkar, Ankitha Vidya, Sneha Samrit "Automatic Toll Plaza using RFID" International Journal of Engineering Science and Computing (IJESC), Vol. 7, Issue 3, pp.6264-6270, 2017.
- [6] Chandrashekar V "Automatic Toll Collection and Anti Theft Alert System using RFID and Microcontroller" International Research journal of Engineering and Technology (IRJET), Vol. 4, Issue 6, pp.128-131, 2017.
- [7] Pranoti Salunke, Poonam Malle, Kirti Datir, Jayashree Dukale "Automated Toll Collection System using RFID" IOSR journal of Computer Engineering(IOSR-JCE), Vol. 9, Issue 2, pp.61-66, 2013.
- [8] Surya.K.Narayan,Thushar.C,Sandhya.C, Saranya.N,Sreepriya.P.V"Automatic Tollgate System using RFID and GSM Technology" International Journal of Science, Engineering and Technology (IJSET) Vol.3, Issue 5, pp.1273-1279, 2015.
- [9] Prof.D.A.Doshi,MhaskeMayuri.S, WakchaureKalyani.S "Electronic Toll Collection System Based on RFID with GSM" International Journal of Advance Research and Innovative Ideas in Education(IJARIIE), Vol. 2, Issue 2, pp.838-843, 2016.
- [10] Vishnupriya.R,Dr.N.P.Ananthamoorthy "Automatic Toll Collection System using RFID and GSM Technology" International journal of Advanced Research in Computer and Communication Engineering(IJARCCCE), Vol. 6, Issue 10, pp.285-290, 2017.
- [11] Preethi Rajasekaran, Ragavi Pala Janardhan "A Smarter Toll Gate Based on Web Of Things" IEEE, 2016.
- [12] Sagar.B.Shinde,KomalPatil, SaundaryaNakka, Lakshmi Dayanandan, Akanksha Ovhal "Toll Automation System Using NFC" Journal of Emerging Technologies and Innovative Research (JETIR), Vol. 3, Issue 1, pp.18-22, 2016.
- [13] Prof.ChhayaAthavale,SurajShinde, AkshayRajemane,Nishant Mohite"Raspberry Pi Based Smart Toll Collection System" ,International Research Journal of Engineering and Technology (IRJET) , Vol. 4, Issue 5, pp.3318-3321, 2017.
- [14] Amol A. Chapate, D.D. Nawgaje "Electronic Toll Collection and Theft Detection System on ARM-7 and RFID Technology", International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) Vol. 4, Issue 4, pp.924-927, 2015.
- [15] Aadish Joshi, Gaurav Bhide, Shreyas Patil, R. D.Komati "IoT Based Toll Booth Management System" International Journal of Electrical, Electronics and Computer Systems(IJEECS), Vol.5, Issue2, pp.1163-1169, 2017.