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Online Toll Gate Payment System using RFID &IoT

A.Chandra Suresh, M.Srinivasa Rao, D.V.Sridhar, G.Sita Annapurna

Abstract*: Road transportation system in Indiafacing big challenge to maintain sophisticate Toll plazas. In general method all Vehicles should stop at toll plazas to pay toll tax. One person at Tollgate collects the tax manually and issues the receipt. After payment, the gate will be opened either mechanical method or electrical method. This is a widely used method in India. Due to this, the wastage of time at toll plazas is the main cause to produce more traffic congestion on highways. Traffic congestion on highways at Toll plazas leads to huge economic loss, fuel and time wastage and causes more pollution. As all the people are very busy with their tight schedules they have no time to spare in the traffic. This traffic congestion leads to wastage of their valuable time causing inconvenience. To overcome the drawbacks of the manual method, Online Toll Payment System is developed to reduce the traffic congestion at toll plazas on highways which will become part of the metropolitan and urban cities these days. This system allows the user to make the payment of toll plazas taxes automatically. In this method we use the authentication cards with the help of radiofrequency. The vehicles should contain an RFID tag that has a unique identification number, like name and license number. (owner). RFID is placed on top of the vehicle and when it reaches the electromagnetic zone near toll plaza the RFID reader automatically captures data and electronically identify, track & store information contained on RFID tag then microcontroller sends the message to phone number placed in RFID card regarding payment. The GSM module is interfaced with Microcontroller to send the messages to the vehicle owner like a web link to pay the toll bill. This payment is done with the help of Payment gateways. If the owner should not pay the money within 20 minutes after crossing the toll plaza, this information is posted in the Cloud server using HTTP server. If he/she does not pay in couple days he receives notice from the respective RTO office with the help of* **data available in the server. It is repeated periodically may chance to cancel the license of the owner.** *In this proposed method the vehicles are not supposed to stop at toll plazas. They can directly pay the money through the link generated after crossing the plazas. After payment, the owner gets the message like your payment done successfully. This project uses the RFID cards to store vehicle number, owner mobile number and License number. RF scanner is used to scan the RFID cards and interfaced with LPC 2148 ARM Microcontroller. This controller sends message to owner mobile number with the help of the GSM module. This message contains the payment link. This process saves time, reduces money wastage and fuel consumption thus reduces pollution, congestion is reduced leading to speed transport also maintenance is less comparatively.

***Keywords:* ARM LPC2148,RFIDcards,RF ScannerSimcom 900A(GPRS),.**

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* Correspondence Author

A.Chandra Suresh*, Department of Electronics and Communication Engineering, Sri Vasavi Institute of Engineering and Technology, Nandamuru, Pedana, Andhra Pradesh, India.

Dr.M.SrinivasaRao*, Professor,Dept of C.S.E,LakireddyBalireddy College of Engineering, Mylavaram, A. P, India.

D.V.Sridhar*, Department of Electronics and Communication Engineering, Sri Vasavi Institute of Engineering and Technology, Nandamuru, Pedana, Andhra Pradesh, India

G.Sita Annapurna*, Department of Electronics and Communication Engineering, Sri Vasavi Institute of Engineering and Technology, Nandamuru, Pedana, Andhra Pradesh, India.

I. INTRODUCTION

There are three methods to collect tax of toll plazas on highways. First method is the traditional& manual method. In this manual method, one person at toll plazas collects toll tax money and issues a receipt. The second method is the smart card method when the vehicle enters into the toll plaza the vehicle persons should swipes the smart card on the devices given by the tollgate authorities. Now some amount of money (tax) will be deducted and generate the computerized bill. After payment, the gate will be automatically opened. If the card is not authorized gate will not be opened and the buzzer will produce sound. In the third method, the traveler should first register in the application and always be aware of the coming toll gates and must search for them in the mobile app which takes much time and also inconvenient to travelers. It also requires a gate sensor. Whenever a vehicle reaches the toll gate then the RFID scanner scans the RFID card and sends data to the cloud. There in the cloud payment details are checked. If the payment is done, then the gate will be opened while displaying "open the gate" on the LCD screen else the gate will not be opened and displays "close the gate". In this way, the existing technology will work.

II. EXISTING METHOD

Nowadays India transportation system facing many challenges. some problems we can reduce by adopting good and sophisticated Toll plazas and payment systems on Highways. In the conventional Toll plaza system, one person at Tollgate collects the tax manually and issues the receipt. After payment, the gate will be opened either mechanical method or electrical method. This is a widely used method in India. Due to this, the wastage of time at toll plazas is the main cause to produce more traffic congestion on highways. Traffic congestion on highways at Toll plazas leads to huge economic loss, fuel and time wastage and causes more pollution.

As all the people are very busy with their tight schedules they have no time to spare in the traffic. This traffic congestion leads to a waste of their valuable time causing veryinconvenience in the existing system the traveler must wait until the

payment is verified at the toll gate. This is a very time-consuming process because all the vehicles must wait at the toll gate hence, the purpose of online toll payment is not fulfilled. In this, the toll is automatically paid from a prepaid account. If any user account doesn't have balance, then the payment will not be done and the gate will not be opened until payment is done again so remaining vehicles should also wait at the toll which is the major drawback of this existing system. The user must know and should always check the balance of the account. These are the drawbacks of the existing system. To overcome the drawbacks of the manual method Online Toll Payment System is developed for lessening the over congestion in toll plazas which became part of the metropolitan cities these days.

III. PROPOSED METHOD

The proposed technology "Online toll gate Payment system using RFID &IoT" allows the users or the travelers to pay the toll manually but not automatically as like existing technology. In this technology when the vehicle reaches the toll plaza, then the RFID card present on the top of the vehicle is scanned by the RFID scanner present at the toll gate and that is sent to the cloud where a payment link is generated and that link is sent as a message to the user through which payment is done. We design a toll plaza system that has the ability to know whether the vehicle is registered or not, if it is not registered then informing the authorities of toll plazas. In this method RFID is placed on top of the vehicle and when it reaches the electromagnetic zone near toll plaza the RFID reader automatically captures data and electronically identify, track & store information contained on RFID tag. This RFID scanner is interfaced with the ARM microcontroller. This Controller is also interfaced with GSM and GPRS Systems. Now the ARM Process the data given by the RFID scanner and generate payment link with the help of Microsoft azure. Now, this link is sent to the vehicle owner through message gateways. For each and every vehicle at toll plaza reads information of vehicle send to microcontroller in the control room, then each user gets a link or message regarding the payment and deduct the toll amount from account and will acknowledge the user by sending SMS and display on screen to open the gate if toll is paid otherwise to close the gate. This process saves time, reduces money wastage and fuel consumption thus reduces pollution, congestion is reduced leading to speed transport also maintenance is less comparatively.

IV.WORKING OF THE PROJECT

Table- I: Comparison between existing technology and proposed Technology

Existing Technology	Proposed Technology
The amount is sent manually from the postpaid account.	Automatically amount will be deducted from the prepaid account.
SMS is sent as an acknowledgment after deducting the amount.	A payment link is sent as an SMS to pay the amount.
Data is not stored in the cloud.	Data is stored in the cloud.
A gate sensor is used to operate the gate.	No need of operating the gate.

In this system, if any person buys a vehicle, the vehicle owner needs to take an authentication RFID card from the RTO office. RTO Authority will assign RFID card and a unique number. This card will have a unique ID and applicable to that particular vehicle only. ThatRFID Unique number is assigned to Vehicle register number, Owner name, and contact details. By adopting this technology create an account for that particular RFID card and maintain transaction history in the database.if any registered vehicle along with RFID card placed on the top approaches the tollgate, then the RFID scanner reads the information available in RFID card and sends it to controller available in the control room for processing. At this same time, that vehicle number will display on the display board of toll plaza. The data present in the RFID card is sent to the cloud through the RFID scanner and GPRS module that is interfaced with the LPC 2148 microcontroller, then a payment link is generated and is sent to the vehicle owner using the GSM present in the GPRS module. Then the user can pay the fee using that unique payment link and the transaction details will be posted on the cloud.

Fig.1.Online Toll plaza

If the user does not pay the fee within 20 minutes, then even after a limited time if the payment is not done, the RTO officer sends a notice to the user. Even though if the payment is not done after repeated notices, the user's license will be canceled. All the toll plazas across India will be connected with the centralized server using IoT. Any violation regarding payments at any toll plaza updates that information by posting in the cloud immediately.

V.DESIGN APPROACH

Whenever a person buys a vehicle like a car or two-wheeler he should take an RFID card from the RTO office.

That card has a unique number that includes Name of the person, vehicle number & License. According to that number then we store the traveler name, license number Vehicle number in the database and interlinked with the cloud using Microsoft azure.

Now we can log in to Microsoft Azure and deploy all vehicle owner phone numbers and type of vehicle those who are having RFID cards. And also deploy the account details or phone number of Toll plaza owner. In this project, we are linking the payment gateway likePaytm for payment purposes to the toll plaza owner. Now click save button in azure then it generates a URL link. In this project, we are using the free version of Microsoft azure. We can use these login credentials for a few months.

A. Implementation

```
Step1:
While(1)
{
If(Card reader==1)
{
   Send_Link();//* particular vehicle owner*//
   Delay();
}
Else
   {
      Delay();
}
Go to step1;
```

VI.HARDWARE IMPLEMENTATION

The main project consists of two parts

i)RF Cards

ii)RF card reader EM118

iii)Main controller board including ARM Processor.

The controller board consists of the following.

i)GPS Simcom 900A

ii) ARM LPC 2148 Microcontroller.

iii) RS-232 cable which connects the ARM processor with GPS module. Here the GPS module works like GPRS module. This module inserted with 4G Simcard for internet facility.

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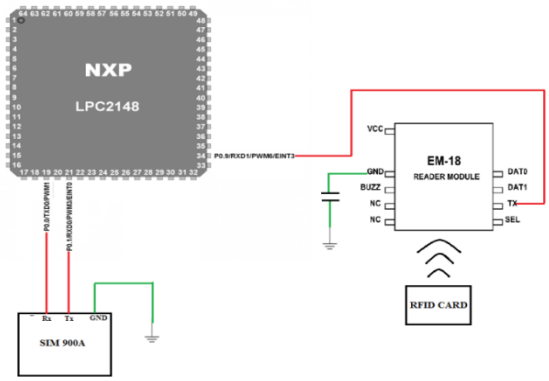

Fig.2.Block Diagram of the Project

A.RF Cards

Whenever a person buys a vehicle like a car or two-wheeler he should take an RFID card from the RTO office. That card has a unique number that includes Name of the person, vehicle number & License. According to that number then we store the traveler name, license number Vehicle number in the database and interlinked with the cloud. This RFID card applicable to with that particular vehicle only. The RTO Authorities will create an account for that particular smart card and maintain transaction history in the database.RFID tags are mainly two types i) Passive RFID tags ii) Active RFID Tags. The Passive RFID Tag does not consist of any internal power source. The Active RFID Tags are Tags they have the ability to generate power internally for their functionality. If no internal power source means that tag treated as ideal tags. The whole process starts with RFID transmitter. When a tag gets in range of the transmitter, the tag antenna coil gets energized through Electromagnetic Induction. Now the card is energized and identified by the microcontroller using its unique number. Every card has assigned with vehicle owner details. When the card energized and send this response to the transmitter antenna.. This Tag uses this energy to send a response to the transmitter. The transmitter receives this

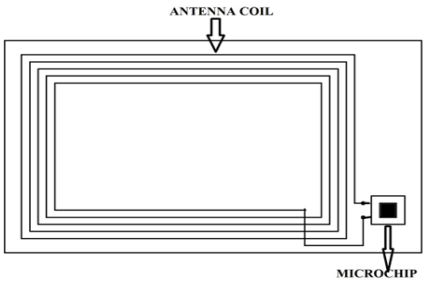

Fig.3.Internal Structure of RFID card

response which is unique to the tag and provides the corresponding output. Whenever the RF card is near to RF Card reader then Card energized and anticipated. Now the card reader reads the Unique number of card and sends this number to microcontroller board with using wired technology. This unique number is assigned to the information of vehicle number Vehicle owner details and phone number. These details are initially placed in the cloud using the LPC2148 ARM Processor.

Fig.4.RFID cards

B.Types of Passive tags:

Passive tags are further divided based on operating frequency. As it is known the functioning distance depends on operating frequency, with higher frequency the Tag will be recognized from a farther distance. Also with higher frequency the system will be influenced less by other systems.

According to the operating frequency, the passive cards are 3 kinds i)Low frequency: It works at of frequency of 125 kHz and the working range is 10cm. Usually used to prepare ID cards for attendance system. ii)Medium frequency**:** It operating frequency is 13.5MHz and its range of operation is 1meters. Usually used at airport security. iii)High frequency: It works at a frequency of 900MHz and the working range is up to 30 meters. Usually used for File and Package tracking system.

C.Applications of Passive RFID Tags:

- Security systems
- Medical tags
- Package Identification
- Theft protection systems
- Data authorization
- Unique Identity
- Body implants
- Security systems
- Toll booths
- Industrial systems
- Data authorization
- System locating

D.RF ID READER/SCANNER(EM-18)

In this project, we used the EM18 module as RFIDReader/Scanner. This Scanner reads/Scans the ID information stored in **RFID Tags**. This ID information is unique for every TAG which cannot be altered.

The RFID scanner/reader EM-18 is used as a sensor module. If you want to use EM-18 module First, we have to select the type of communication between the module and the Controller. Next, we have to write the program to the controller to receive data from the module using UART. When the RFID tag is close to the RFID scanner/Reader EM-18 Modulereads the information in the RFID card and sends it to the ARM processor. The controller receives the information from the module and does activities written in the program. And microcontroller Generates the payment link and sends it to the vehicle owner's contact number with toll plaza name and location.

E.Communication

Step1: Selecting or creating the type of communication between module and processor is very impart ant.. EM-18 allows to output with two types of communications. First type of communication is s RS232 and the second one is WEIGAND. The type of communication is selected by the SELECT pin in the EM-18 module. If you want to use RS232 communication need to select SEL to pin HIGH in EM-18. If you want to use Weigand communication select sel pin low in EM-18.Generally, RS232 is preferable so SEL pin is pulled high.

Step2: The bit rate of EM-18 communication output is 9600bps (bit per second). The programmer has to programmed to receive information from MODULE at this rate only. If a bit rate of controller mismatches with EM-18 then the system will not work correctly. In our project, we are able to write the program to receive data with 9600 bps using timers & UART.

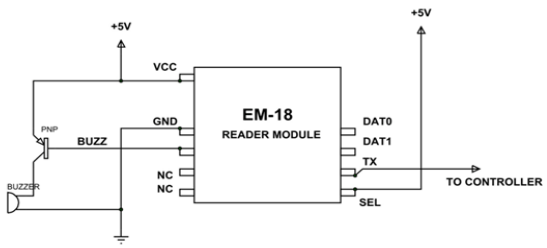

Fig.5.EM-18Card Reader

Whenever the Card reader reads/Scans the RFID card, the module produces the sound with Buzzer. The buzzer indicates information scanned by the circuit, Buzzer is optional in this module.. Whenever the RFID card is red by the reader circuit. The transmitter in module transmit this data and Controller which is to receive Data. The Module reads the RFID and sends the information to the ARM Processor in the 12 ASCII characters. Out 12 characters 10 characters represents TAG ID and the remaining two characters are XOR with the previous 10 characters.

Received data = 10ASCII characters represent Tag id No.) + 2ASCII characters (XOR with the previous result).

After transmitting the information is sent, the EM-18 module stops sending information. This information is serially received by the ARM processor through the RX pin. According to the tag information the processor process the data. And send a payment link to a particular vehicle owner mobile number.

F.EM-18 Pin Configuration

EM-18 RFID card reader/scanner having 9 pins. In total 9 pins, 2 pins are NO connection, so we have to consider this reader having seven pins only.

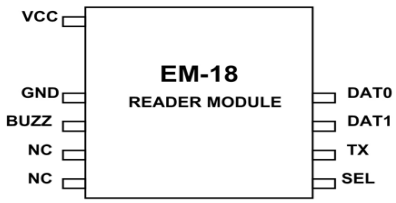

Fig.6.Pin diagram of EM-18

Table-II: Pin Configuration of EM-18

Pin Number	Description
Vcc	Should be connected to positive of the power source.
GND	Should be connected to ground.
Buzz	Should be connected to BUZZER
Buzz	Should be connected to BUZZER
NC	No Connection
NC	No Connection
SELECT	SELECT=1 then Communication is =RS232 SELECT=0then communication is WEIGAND
TX	Data comes out through TX of RS232
DATA1	Weigand interface DATA HIGH pin
DATA0	WEIGAND interface DATA LOW pin

G.ARM Processor

The LPC214X microcontrollers are 16-bit and 32-bit ARM7TDMI-S microcontrollers., The microcontroller has high-speed flash memory ranging from 32 kB to 512 kB.

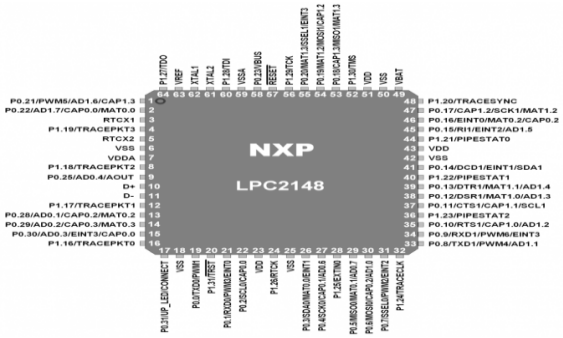

Fig.7.Pin diagram of LPC2148

This ARM processor occupies less space due to this reason it consumes low power.hence this processor is called LPC low power consumption, LPC214X controllers are ideal for applications where low power consumptions and speed are a key requirement, It supports Serial communications interfaces ranging from a USB 2.0. It supports multiple UARTs, SPI, SSP to I2C-bus and on-chip. It also inbuilt SRAM ranging from 8 kB to 40 kB. Hence this makes these devices very well suited for communication gateways and protocol. It consists of 32-bit timers, and 10-bit Analog to Digital convertor(s), 10-bit Digital to analog converters, PWM channels. The main important feature of ARM 2148 is consists of 45 fast GPIO lines. It also supports up to nine edge or level sensitive external Hardware interrupt pins. That's why these ARM 2148 controllers are very popularly used in industrial and medical applications.

H.Features of LPC2148

ARM7 LPC 214X microcontroller is available on 16 and 32 bit tiny Quadra flat package 64.

- It consists of 8 kB to 40 kB of on-chip SRAM and 32 kB to 512 kB of on-chip flash memory.
- It is 128-bit and operates at a speed 60 MHz.
- It supports In-System Programming/In-Application Programming (ISP/IAP) via on-chip boot loader software.
- It supports USB 2.0
- The conversion time of ADC in LPC2148 is 2.44 us per channel.
- It consists of Two 32-bit timers/counters
- It also consists of Watchdog timers..
- It consists of Low power Real-Time Clock (RTC) with a clock input of 32 kHz.
- It consists of Multiple serial interfaces.
- It consists of TWO UARTs (two Fast I2C-bus (400 kbit/s),.
- It also supports SPI and ISP.
- The most powerful feature of ARM is it supports Vectored Interrupt Controller (VIC) with configurable priorities and vector addresses.
- Total 21 external interrupt pins are available.
- The maximum clock is 60 MHz.
- The on-chip oscillator operates with an external crystal clock from 1 MHz to 25 MHz.
- Single power supply chip with POR and BOD circuits:

I.GPRS(simcom sim900A):

In this project we are posting the data in the cloud to generate the link for payment. For that purpose this require internet. This internet facility can be obtained by inserting a 4G Simcard with data in the GSM module. In this project, the GSM module acts as GPRS. Whenever the RF Card reader reads the RF Tag that card information along with vehicle information is sent to the microcontroller. This microcontroller sends this data to cloud in the form of packets. That can be done with the help of GSM.

This is an ultra-compact and reliable wireless module. The SIM900A is a complete Dual-band used as GSM/GPRS. The SMT module(Surface mount technology)is inbuilt available in SIM900A. Hence this module can meet the requirements of industrial applications. The SIM900A uses ass GSM/GPRS. And it works at a frequency of 900/1800 MHz for voice, SMS, Data and Fax with lower power consumption. The physical configuration of SIM900A is 24mm*24mm*3mm, This module SIM900A can be used for all communication applications including space applications also. It best suited for user applications because of slim and compact.

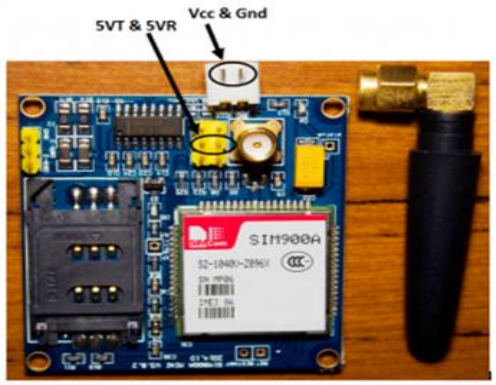

Fig.8.Simcom900A

VII.SOFTWARE IMPLEMENTATION

For project implantation, we require a cross compiler. For this purpose we are using s Kiel µVision IDE. This IDE(Integrated Development Environment) includes a cross compiler and Debugger. The Kiel µVision IDE provides project management and run-time environment,.This IDE provides the facilities like source code editing, and program debugging in a single powerful environment. This IDE is very easy-to-use and very easy to develop an application program. This µVision supports multiple window screens and allows the users to create separate programming layouts.

The IDE µVision Debugger provides a single environment in which are used to test, verify, and debugging our project application code. The debugger Consist of breakpoints. This debugger allows the user to define how many numbers of lines required for compiling.

We can develop the code in Keil like the flow chart given below. And generate a hex file and burned in to flash using flash magic software.

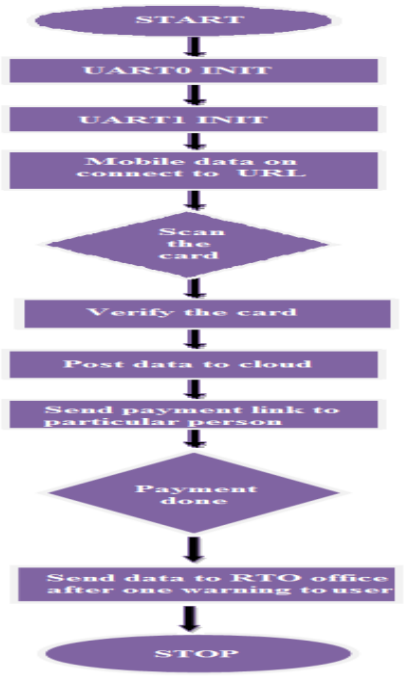

Fig:9.Flow Chart

A. Execution Steps of Keil:

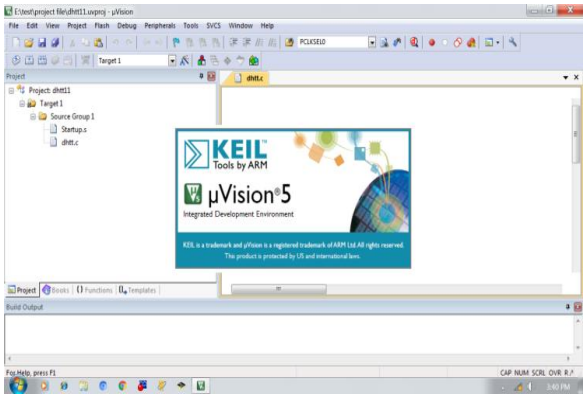

Fig.10.Selecting ARM 2148

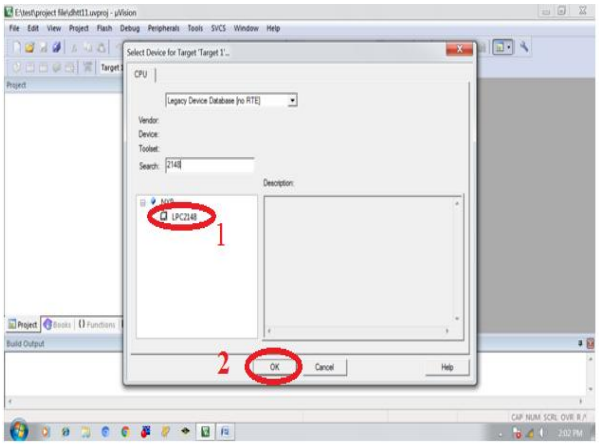

Fig.11.Select the target

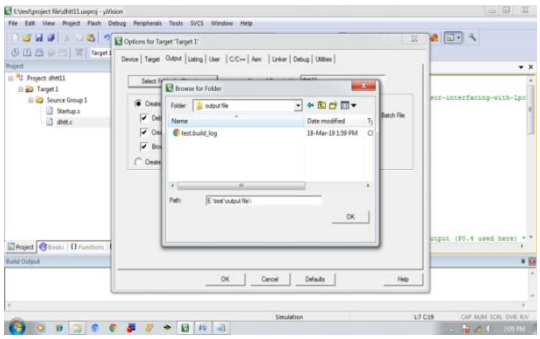

Fig.12.Select the path for the hex file

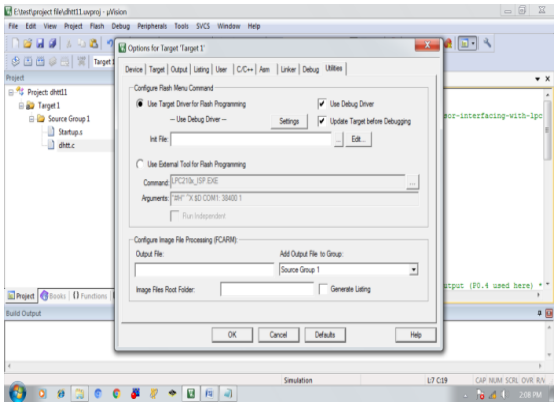

Fig.13.Open Flash magic from the start menu

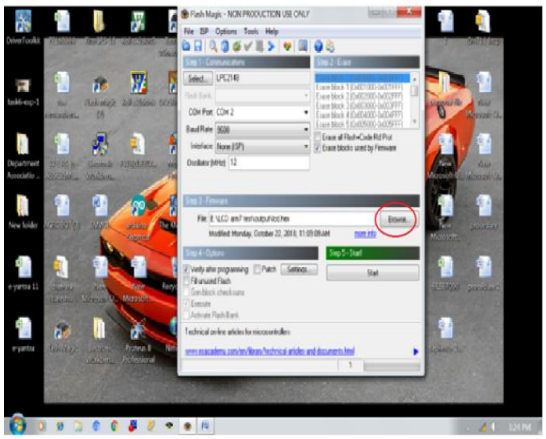

Fig.14.Selecting the hex file using flash magic

Fig.15.Transferring Hex file to Target machine

VIII.RESULT ANALYSIS

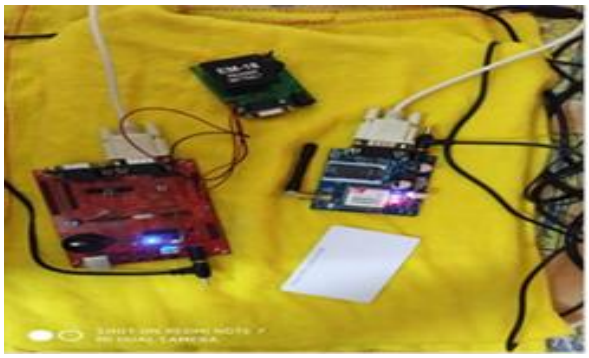

Fig.16. Project output

Whenever the RFID Card is scanned by the RFID Scanner, the details of the user are processed by the microcontroller and then send to the cloud by using the GPRS module. Now the link is generated by the Cloud and sends to the user with the help of GSM, by which we can do the payment. This reduces traffic congestion at the Toll Plazas.

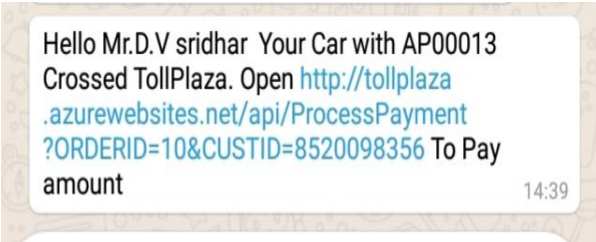

Fig.17.Payment link send to a particular user as a message

Now the owner of that particular vehicle receives the payment. Then click on that link then it opens the payment gate of the way of paytm. Then the fields are filled and like amount and then submit. The amount will deduct from the owner's account and credited into the plaza owner account. That particulars pic attached here. After payment acknowledge will generate to the user for reference for payment.

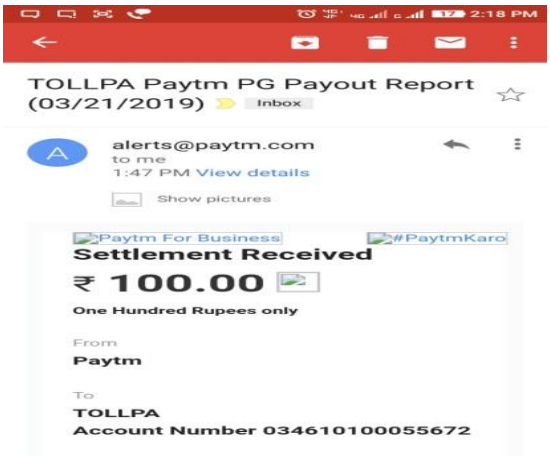

Fig.18. Payment Acknowledgement

IX.CONCLUSION

Technology changing and consequently changes in the Manual Technique for Taxation at toll station has to change. The mindset of individuals or groups is also changing. They are not interesting to wait at toll plazas for taxation. And we would see that paying Toll at the Toll station will not be that time consuming and much accurate and preferred across every nook and corner of the globe wherever there would be a toll station. And as described above about the merits of this Toll station we do not think that its not that far enough when we would see this technology being used in India and in terms benefiting the whole society as well as the company which is involved in Toll taxation. IoT is an advanced and powerful technology that will change the living style of people.

By using IoT it reduces the cost of deployment and installation. By comparing this project with existing toll plaza systems consumes less time and no need to wait at toll plazas and maintaining the proper valid database.

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AUTHORS PROFILE

Mr. A. Chandra Suresh, Completed his B.Tech Degree in Electronics and Communication Engineering from JNTU College of Engineering Ananthapur and M.Tech degree in Embedded Systems from JNTU, Kakinada, A.P-India.He also completed Post Graduation Diploma Course in Embedded systems from ISO certified Institution. Presently he is working as an Associate Professor in the Department of Electronics and Communication Engineering in Sri Vasavi Institute of Engineering &Technology-Nandamuru, Pedana, A.P-India. He had 13 years of teaching experience and two years of industrial experience. He conducted a number of workshops in various engineering and Diploma colleges on Embedded Systems. His area of interest in research is on Embedded system, Real-Time Operating Systems, Cloud computing, and IoT.

Dr.M.SrinivasaRao received hisB.Tech Degree in Computer Science &Engineering from NagarjunaUniversity,Guntur andM.Techdegree in Software Engineering from JNT University, Masabtank, Hyderabad, India.. He received Ph.D. degree from JNTUK, Kakinada in 2018. He is having nearly 18 years of teaching and industrial experience. He is currently working as Professor,Dept of C.S.E, Lakireddy Balireddy College of Engineering, Mylavaram, Andhra Pradesh, India. He is a life member of ISTE and CSI.His current research areas are IoT, BlockChain.

Mr. D.V.Sridhar received his B.Tech Degree in Electronics and Communication Engineering from JNTU, Hyderabad and M.Tech degree in Digital Electronics &Communication Systems from JNTUK, Kakinada, A.P-India. He is currently working as an Assistant Professor in the Department of Electronics and communication engineering in Sri Vasavi Institute of Engineering &Technology- Nandamuru Pedana, A.P-India. He had 10years of teaching experience. His research interests on Embedded systems, Real-Time Operating Systems and IoT.

Ms.G.Sita Annapurna received her B.Tech Degree in Electronics and Control Engineering from JNTU, Kakinada and M.Tech degree in Embedded Systems from JNTU, Kakinada, A.P-India. She is currently working as an Assistant Professor in the Department of Electronics and Communication Engineering in Sri Vasavi Institute of Engineering &Technology-Nandamuru Pedana, A.P-India. She had 8 years of teaching experience. Her research interests on Embedded Systems, VLSI and IoT.