ELECTRONIC TOLL CONTROL SYSTEM USING RFID

Lavanya Vashisth, Diya Bisht
College of Technology, GBPUA&T.

Reeta Verma
Assistant Professor, Department of Electronics and Communication , College of Technology, GBPUA&T.

ABSTRACT: **-** Electronic Toll Control (ETC) is the need of the hour for a developing country like India where the traffic congestion is massive due the high population and manual toll systems are unable to cope with the rising traffic levels leading to time delays and obstructions in the smooth flow of traffic. In this paper, we suggest a design of ETC System which incorporates vehicle classification and identification thereby overcoming the shortcomings of the present toll systems.

KEYWORDS: **Electronic toll control system, automation, RFID passive tags, vehicle detection.**

INTRODUCTION:

With the rapid development of the national economy, total mileage of expressways and vehicle population is constantly increasing in India leading to a number of problems such as congestion, increased accident rates and air pollution rates. Due to this, there is a need for automatic toll collection which is capable of eliminating congestion and regulation of traffic during those times when traffic seems to be higher than normal where the current manual system lags.

HARDWARE:

Arduino UNO (microcontroller), 16X2 LCD display, RFID cards (125 KHz), EM-18 RFID reader Module, LEDs, Motor Driver (L293D) and 9V DC Motor.

ADVANTAGES:

- Shorter queues at toll plazas due to reduced processing time at toll booths.
- Faster and more efficient service.
- Minimization of fuel wastage, waiting time of vehicle in queue.
- Reduced emissions by reducing deceleration rates and thus reducing air pollution.
- Higher vehicle security.
- Avoiding financial losses.

SYSTEM DESIGN:

This system includes the usage of RFID tags for the automatic detection of vehicles thus saving the efforts of carrying money and records manually.

When the RFID card that is attached to the car, just like number plates, is detected by the RFID detector in the toll plaza, a red LED will glow indicating the traffic behind to stop. The LCD will display the message showing the amount of toll deducted. The deduction of the toll will take place directly from a bank account linked with the RFID card. Then, after some delay, the green LED will glow and the boom barrier will rotate so that the vehicle can pass. The vehicles are classified into three categories: - Small **(S)**, Medium **(M)** and Large **(L)**. The toll deducted for vehicles of different categories will be different.

WORK FLOW OF ETC:

- Detection of vehicle
- Display of the charged toll
- Auto-reduction of the toll from the linked bank account

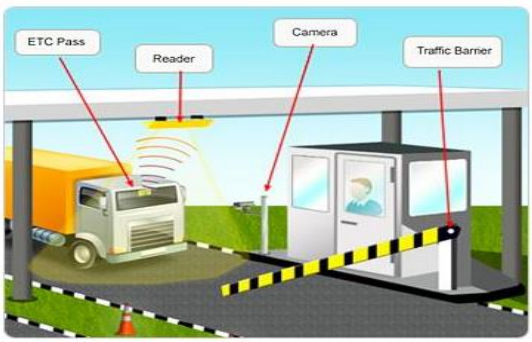

Fig 1 : Graphical representation of the proposed ETC system [7]

Case 1: For registered vehicles

Whenever any person buys a vehicle, the RTO will assign a number plate in which an RFID enabled tag is embedded. The tag will be marked with id and password, in addition, some information about the vehicle and its owner will be stored in the database, including ID, license plate number, type {large(L), medium(M), small(S) and tiny(T)}, name of the owner, telephone, linked bank account details, etc. Owner of the vehicle needs to deposit some minimum amount to this account.

Date	Time	RFID	Vehicle class	License Number	Name of owner
01-02-2020	0900	7890011	S	UK07BZ4955	XYZ

Table 1 : An example of data string used for communication between central server and toll booth

Case 2: For vehicles without RFID tag

Whenever any vehicle without an RFID tag approaches the toll booth, the camera in the ETC will take a snap of the vehicle's license plate and LCD will display an error message and a red LED will glow as an alerting mechanism. The vehicle will then be redirected to a manual toll booth system till the time full automation takes place. The manual toll payers will have to pay an excess of 2% so as to propagate digitalization.

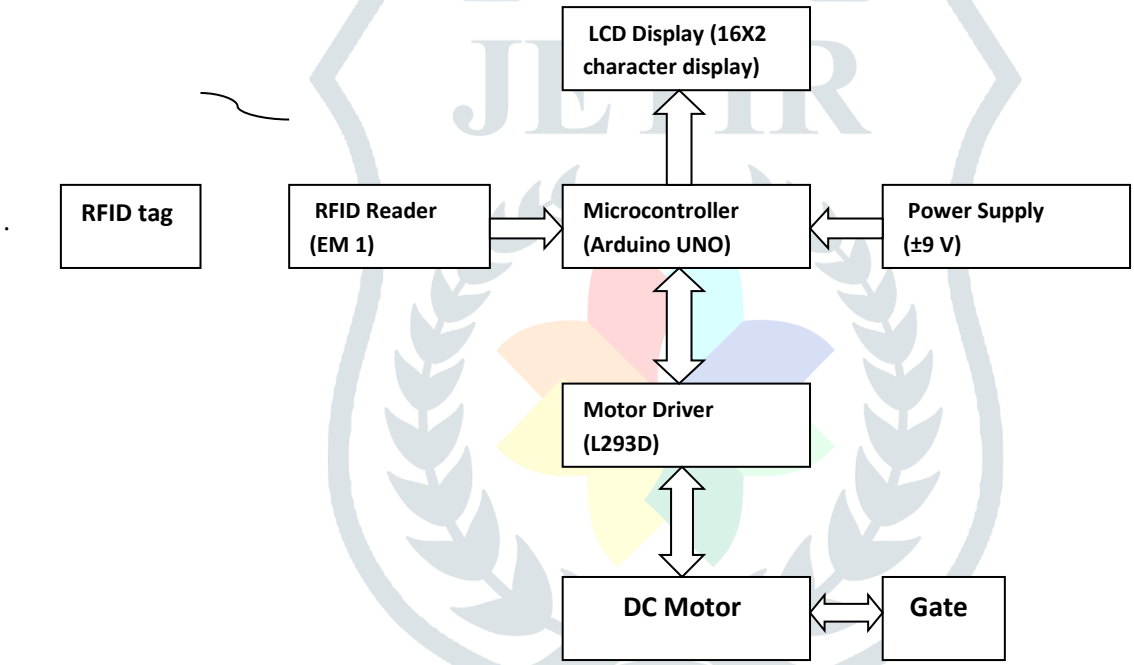

Fig 2: Block diagram of RFID ETC

SOFTWARE AND HARDWARE IMPLEMENTATION:

The electronic toll control system has been simulated on Proteus for checking the feasibility for the hardware implementation.

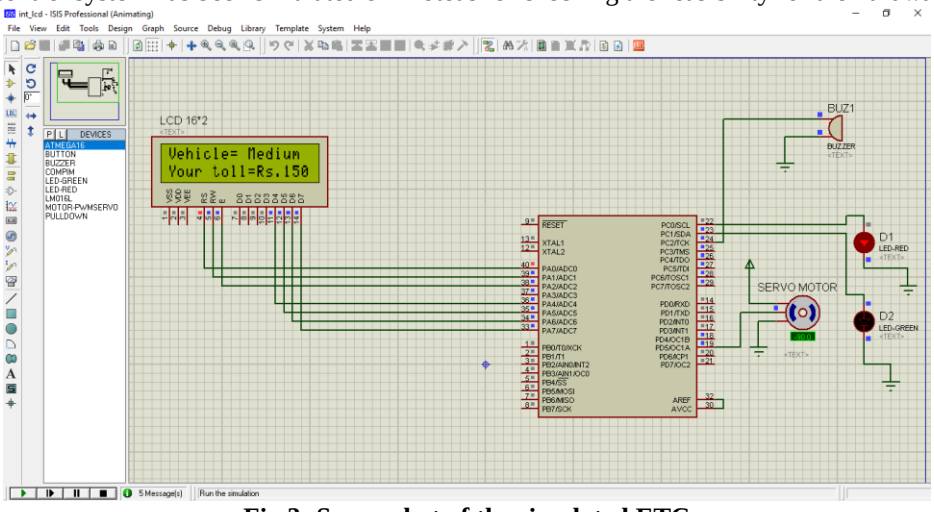

Fig 3: Screenshot of the simulated ETC

The hardware implementation of the electronic toll control system had been restricted to a prototype with limited functionality but the real life implementation would have massive outcomes in streamlining the current chaotic state of affairs of the traffic in the country.

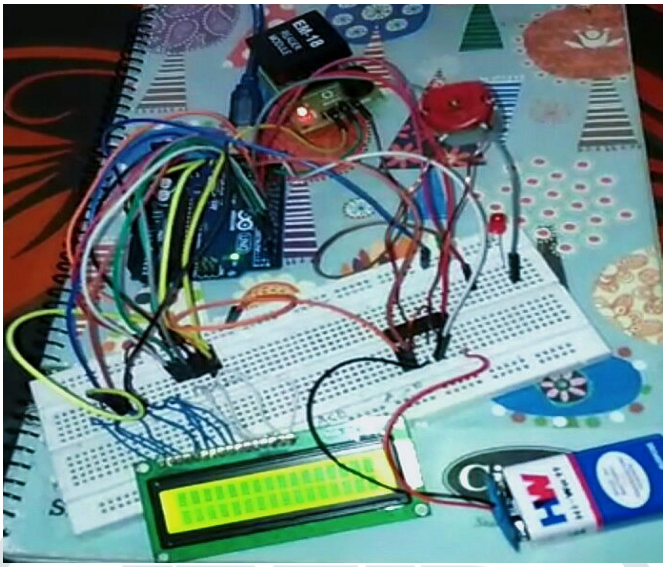

Fig 4: Hardware prototype of ETC

IMPROVEMENT:

We can use a camera to click a picture of all the vehicles passing through the Toll Plaza. This will be useful in the **Theft Detection**. When the vehicle is stolen, the owner can register a complain on the website with its registration ID and a unique RFID tag number. Now when the stolen vehicle passes by the toll plaza, the tag fixed on it is matched with the stolen vehicle's tag in the database at the toll booth. The camera at the toll plaza will click the picture of the front number plate and the system will notify the nearby police station.

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APPENDIX 1: Code for Proteus simulation

```
#include <avr/io.h>
#include <util/delay.h>
#include "lcd.h"
void Wait()
{
	uint8_t i;
	for(i=0;i<50;i++)
	{
		_delay_loop_2(0);
		_delay_loop_2(0);
		_delay_loop_2(0);
	}
}
```

```
int main(void)
{
        //DDRA=0xf0;//PC0 to PC3---< DIR INPUT
        DDRC=0xff;
        PORTC=0x01;
        lcdinit();
        lcdcmd(0x80);
        PORTC=0b00000001;
        PORTC=0b00000100;
        _delay_ms(2000);
        lcdstring("WELCOME TO TOLL");
        lcdcmd(0xc0);
        lcdstring("     CENTER   ");
        _delay_ms(2000);
        lcdcmd(0x01);
        lcdcmd(0x80);
        lcdstring("Vehicle=Small");
        lcdcmd(0xc0);
        lcdstring("Your toll=Rs.50");
        _delay_ms(2000);
        lcdcmd(0x01);
        //Configure TIMER1
        TCCR1A|=(1<<COM1A1)|(1<<COM1B1)|(1<<WGM11);       //NON Inverted PWM
        TCCR1B|=(1<<WGM13)|(1<<WGM12)|(1<<CS11)|(1<<CS10);       //PRESCALER=64       MODE       14(FAST
PWM)
        ICR1=4999;  //fPWM=50Hz (Period = 20ms Standard).
        DDRD|=(1<<PD4)|(1<<PD5);   //PWM Pins as Out
        while(1)
        {
        lcdstring("Toll Deducted");  _delay_ms(1000);
        lcdcmd(0x01);  lcdstring("  Thankyou  ");
        _delay_ms(2000);  PORTC=0b00000010;
        _delay_ms(2000);  PORTC=0b00000001;
                _delay_ms(2000);  lcdcmd (0x01);
        lcdcmd(0x80);     lcdstring("WELCOME TO TOLL");
        lcdcmd(0xc0); lcdstring("     CENTER   ");
                _delay_ms(2000); lcdcmd(0x01); lcdcmd(0x80);
              lcdstring("Vehicle= Medium"); lcdcmd(0xc0);
          lcdstring("Your toll=Rs.150"); _delay_ms(1000);
              lcdcmd(0x01);  lcdstring("Toll Deducted");
    _delay_ms(1000); lcdcmd(0x01);
    lcdstring("  Thankyou  "); _delay_ms(2000);
    PORTC=0b00000010; _delay_ms(2000);
    lcdcmd(0x01);  lcdcmd(0x80);
    lcdstring("WELCOME TO TOLL");  lcdcmd(0xc0);
    lcdstring("     CENTER   "); _delay_ms(2000);
    lcdcmd(0x01); lcdcmd(0x80);
    lcdstring("Vehicle= Large"); lcdcmd(0xc0);
    lcdstring("Your toll=Rs.250"); _delay_ms(1000);
    lcdcmd(0x01); lcdstring("Toll Deducted");
    _delay_ms(1000); lcdcmd(0x01);
    lcdstring("  Thankyou  "); _delay_ms(2000);
    PORTC=0b00000010; _delay_ms(2000);
    OCR1A=97;   //0 degree
    Wait();
    OCR1A=316;  //90 degree
    Wait();
    OCR1A=425;  //135 degree
    Wait();
    OCR1A=535;  //180 degree
    Wait();
                }
        }
```

```
 #include <avr/io.h>
#include <util/delay.h>
#define rs PA0
#define rw PA1
#define en PA2
void lcdinit()
	{
		DDRA=0xff;
		//DDRB=0xff;
		lcdcmd(0x02);
		lcdcmd(0x28);//display cursor,cursor blinking
		//lcdcmd(0x0c);//display cursor,cursor blinking
		lcdcmd(0x0e);
		lcdcmd(0x06);
		//lcdcmd(0x80);
	}
	void lcdcmd(char x)
	 {
		PORTA=x&0xf0;
		PORTA&=~(1<<rs);//rs=0
		PORTA&=~(1<<rw);//rw=0
		PORTA|=(1<<en);//en=1
		_delay_ms(40);
		PORTA&=~(1<<en);//en=0

		PORTA=((x<<4)&0xf0);
		PORTA&=~(1<<rs);
		PORTA&=~(1<<rw);
		PORTA|=(1<<en);//en=1
		_delay_ms(40);
		PORTA&=~(1<<en);//en=0
	}
		void lcddata(char x)
	{
		PORTA=x&0xf0;
		PORTA|=(1<<rs);
		PORTA&=~(1<<rw);
		PORTA|=(1<<en);
		//PORTB|=(1<<en);
		_delay_ms(40);
		PORTA&=~(1<<en);
		PORTA=((x<<4)&0xf0);
		PORTA|=(1<<rs);
		PORTA&=~(1<<rw);
		PORTA|=(1<<en);
		//PORTB|=(1<<en);
		_delay_ms(40);
		PORTA&=~(1<<en);
}
void lcdstring(char *msg)
{
	while(*msg!='\0')
	{
		lcddata(*msg);
		msg++;
	}
}
```

APPENDIX 2: Code for programming Arduino UNO

```
#include <SoftwareSerial.h>
#include <LiquidCrystal.h>
const int motorpin1= 10;
const int motorpin2 =7;
LiquidCrystal lcd (12,11, 5, 4, 3, 2);
```

```
SoftwareSerial mySerial(9, 10);
char RFID[12];
char small[]= "59005E7F0179";
boolean flag= false;
int count=0;
int led1=13;
int led2=8;
void setup()
{
 mySerial.begin(9600); // Setting the baud rate of Software Serial Library
 Serial.begin(9600);  //Setting the baud rate of Serial Monitor
 analogWrite (6,50);
 lcd.begin (16, 2);
 pinMode(led1, OUTPUT);
 pinMode(led2, OUTPUT);
  pinMode (motorpin1, OUTPUT);
 pinMode (motorpin2, OUTPUT);
 }

 void loop()
{
  if(mySerial.available()>0 && count<12)
  {
  RFID[count]=mySerial.read();
  ++count;
  delay(5);
  }
 if(count == 12)
   {
      count =0;
      flag = 1;
       while(count<12 && flag !=0)
      {
        if(RFID[count]==small[count])
        flag = 1;
        else
        flag= 0;
        count++;
   }
   }
if (flag == 1)
{
 digitalWrite(led2, HIGH);
 digitalWrite(led1, LOW);
 digitalWrite (motorpin1, LOW);
 digitalWrite (motorpin2,LOW);
 delay(3000);
 lcd.print("Small vehicle");
 lcd.setCursor(0,1);
 lcd.print("Toll= RS 50");
 digitalWrite(led2, LOW);
 digitalWrite(led1, HIGH);
 delay(3000);
 RFID[2]='_';
 digitalWrite (motorpin1, LOW);
 digitalWrite (motorpin2,HIGH);
 delay (2000);
 digitalWrite (motorpin1, LOW);
 digitalWrite (motorpin2,LOW);
 digitalWrite(led2, HIGH);
 digitalWrite(led1, LOW);
  }
lcd.clear();
```