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# A Novel Toll Gate Design Using Plate Recognition

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**Abstract:** This paper presents the look and development of vehicle plate recognition for automated toll collection. Vehicle plate recognition (LPR) is that the extraction of car plate information from a picture since it's simpler and faster than the normal token based ticket system, it's all the potential to interchange the prevailing system. Moreover, it saves users valuable time by reducing the queue length before of the toll counter. A vehicle plate is installed on each vehicle. A recognition device at the gate reads this knowledge from the vehicle and compares it with the info within the on-line database and permits the access consequently by gap the gate. This model has low complexity and takes fewer times in terms of car plate segmentation and character recognition. This Licence plate system was carried out using MATLAB. For this licence LPR system we interface tollgate hardware which was designed with interface with FPGA. For FPGA we interface pressure sensor for weight calculation and security purpose we interface gas sensor. The proposed open-end credit has been designed using very (high-speed integrated circuit) hardware description language (VHDL). Finally, it's downloaded in a very field programmable gate array (FPGA) chip and tested on some given scenarios. The FPGA implementation is administrated in one among the applying area automatic toll assortment.

**Keywords:** License plate Ecognition,FPGA,VHDL, MATLAB.

## I. Introduction

Massive integration of information technologies into all aspects of modern life caused demand for processing vehicles as conceptual resources in information systems. Because a standalone information system without any data has no sense, there was also a need to transform information about vehicles between the reality and information systems. This can be achieved by a human agent, or by special intelligent equipment which is be able to recognize vehicles by their number plates in a real environment and reflect it into conceptual resources. Because of this, various recognition techniques have been developed and number plate recognition systems are today used in various traffic and security applications, such as parking, access and border control, or tracking of stolen cars. AUTOMATIC car place recognition (LPR) plays a crucial role in various applications like unattended parking heaps security management of restricted areas traffic enforcement congestion rating and automatic toll assortment. Attributable to totally different operating environments, LPR techniques vary from application to application. Pointable cameras produce dynamic scenes after they move. A dynamic scene image could contain multiple car places or no license plate the least bit. Moreover, after they do seem in a picture, license plates could have impulsive sizes, orientations and positions. And, if complicated backgrounds area unit concerned, detective work license plates will become quite a challenge. Typically, Associate in Nursing LPR method consists of 2 main stages (1) locating license plates and (2) distinctive license numbers. Within the 1st stage, car place candidate's area unit determined supported the options of license plates. Options ordinarily used are derived

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from the car place format and therefore the alphanumeric characters constituting license numbers. The options concerning car place format embody form, symmetry height-to dimension magnitude relation color texture of achromatic color abstraction frequency and variance of intensity values Character options embody line blob the sign transition of gradient magnitudes, the ratio of characters the distribution of intervals between characters and therefore the alignment of characters. In reality, atiny low set of sturdy, reliable, and easy-to-detect object options would be adequate. The car place candidates determined within the locating stage area unit examined within the identification number identification stage. There area unit 2 major tasks concerned within the identification stage, variety separation and variety recognition. Variety separation has within the past been accomplished by such techniques as projection morphology relaxation labeling, connected elements and blob coloring. Since the projection methodology assumes the orientation of a car place is thought and therefore the morphology methodology needs knowing the sizes of characters. A hybrid of connected elements and blob coloring techniques is taken into account for character separation. For this, we tend to developed our own character recognition technique, that is predicated on the disciplines of each artificial neural networks and mechanics.

## II. License Plate Recognition

Most of the quantity plate detection algorithms fall in additional than one class supported totally different techniques. To sight vehicle variety plate following factors ought to be considered:

(1). Plate size: a plate will be of various sizes in a very vehicle image.

(2). Plate location: a plate will be settled anyplace within the vehicle.

(3). Plate background: A plate will have totally different background colours supported vehicle sort. as an example a government vehicle variety plate may need totally different background than different public vehicles. (4). Screw: A plate might have screw which may be thought-about as a personality.

A number plate will be extracted by mistreatment image segmentation technique. There ar various image segmentation strategies accessible in numerous literatures. In most of the strategies image binarization is employed. Some authors use Otsu's technique for image binarization to convert color image to grey scale image. Some plate segmentation algorithms ar supported color segmentation. A study of car place location supported color segmentation is mentioned. within the following sections common variety plate extraction strategies ar explained, that is followed by elaborate discussion of image segmentation techniques adopted in numerous literature of ANPR or LPR.

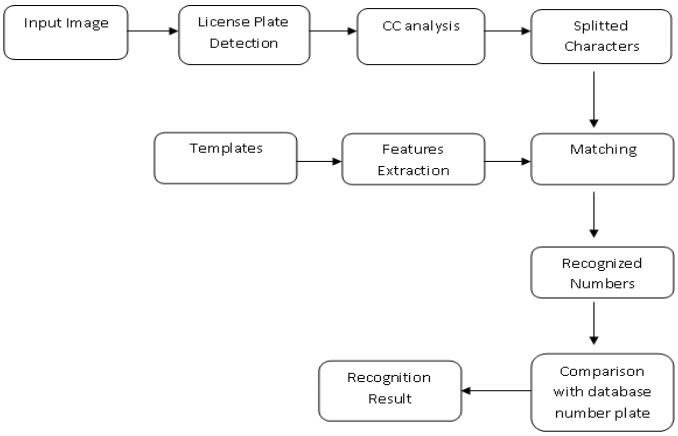


**Figure1:** License Plate recognition

The templates that square measure almost like the registration number plate character is known by the comparison method with the character hold on within the information. Extracted registration number plate characters could have some noise or they'll be broken. The extracted characters could in addition be inclined. example matching may be a straightforward and straightforward technique in recognition. The similarity between character and therefore the example is measured. example matching is performed once resizing the extracted character into an identical size. each example scans the character column by column to calculate the

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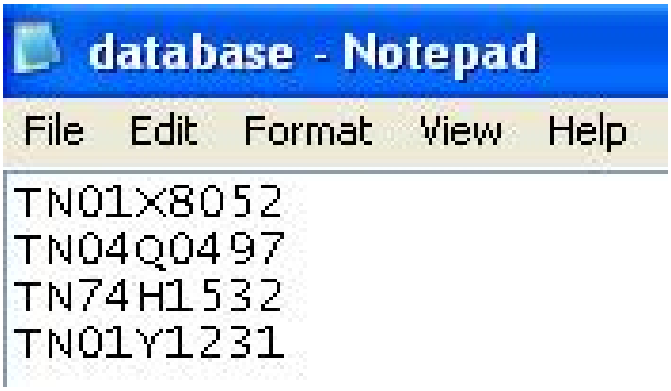
normalized cross correlation. The example with the most price is that the foremost similar one. example matching is useful for recognizing single-font, rotated, broken, and fixed-size characters. If a personality is completely totally different from the example, the example matching produces incorrect recognition result. among the disadvantage of recognizing inclined characters is solved by storing several templates of an identical character with totally different inclination angles.


**Figure2: Input Images**

**Figure3: Different Template Images**




**Database Image:**

**Block Diagram for Toll Gate System:**

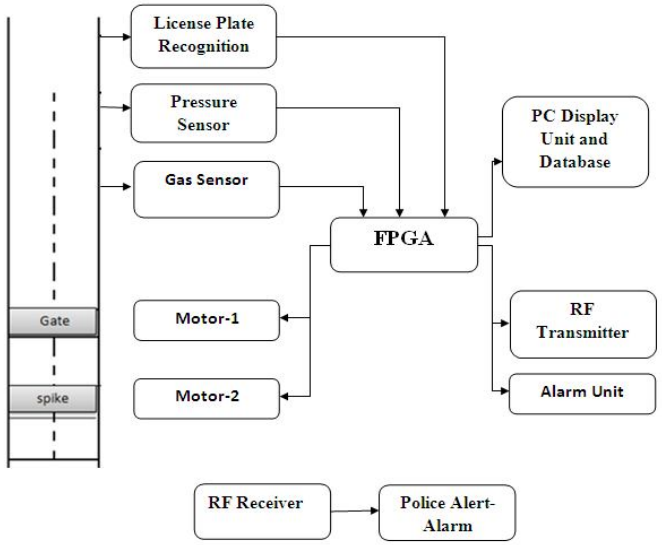



**Figure4: New Toll Gate system**

The planned system makes certain that the traffic at the toll gates is efficient and security is additionally gift. The tax that is collected is predicated on the load carried by the vehicle. Through this technique we will additionally determine taken vehicles. The reading the knowledge from vehicle plate recognition system , computer compares the information within the info and permits the access consequently by opening/closing the gate. This knowledge is employed to print a daily or monthly bill for toll assortment from the vehicles. This fashion even taken vehicles is known. The pressure of the vehicle is obtained victimization the pressure sensing element and consequently the pressure of the vehicle is showed on the display. A counter is employed to count the quantity of vehicles. the quantity on the idea of weight & the count of vehicles is additionally displayed on the screen. the quantity to be paid is mechanically deduced from the various checking account. If a vehicle carries any reasonably gas that shouldn't be carried, the gas sensing element detects the gas within the vehicle. just in case if there's any reasonably gas that's detected, the RF transmitter is employed to alert the close police headquarters associated an alarm is enabled to alert the encircling areas. Afterwards motor one is employed to shut the gate and at the

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same time motor two is employed to drag up the spikes so as to puncture the vehicle. The pressure of the vehicle is obtained victimization the pressure sensing element and consequently the pressure of the vehicle is showed on the display. A counter is employed to count the quantity of vehicles. the quantity on the idea of weight & the count of vehicles is additionally displayed on the screen. the quantity to be paid is mechanically deduced from the various checking account. If a vehicle carries any reasonably gas that shouldn't be carried, the gas sensing element detects the gas within the vehicle. just in case if there's any reasonably gas that's detected, the RF transmitter is employed to alert the close police headquarters associated an alarm is enabled to alert the encircling areas. afterwards motor one is employed to shut the gate and at the same time motor two is employed to drag up the spikes so as to puncture the vehicle.

## III. FPGA (Field-Programmable Gate Array)

The FPGA is an integrated circuit that contains many (64 to over 10,000) identical logic cells that can be viewed as standard components. Each logic cell can independently take on any one of a limited set of personalities. The individual cells are interconnected by a matrix of wires and programmable switches. A user's design is implemented by specifying the simple logic function for each cell and selectively closing the switches in the interconnect matrix. The array of logic cells and interconnects form a fabric of basic building blocks for logic circuits. Complex designs are created by combining these basic blocks to create the desired circuit. Field Programmable means that the FPGA's function is defined by a user's program rather than by the manufacturer of the device. A typical integrated circuit performs a particular function defined at the time of manufacture. In contrast, the FPGA's function is defined by a program written by someone other than the device manufacturer.

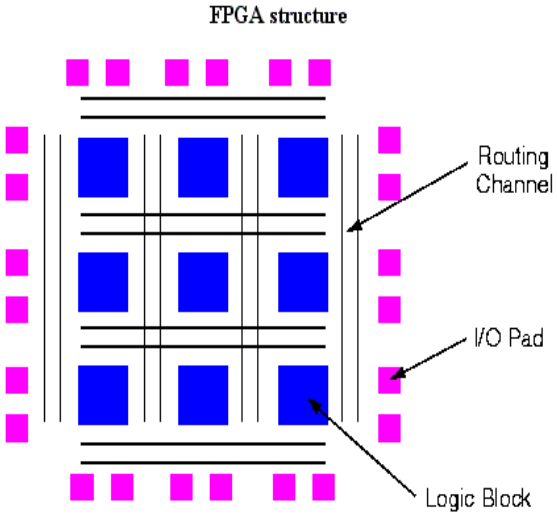


**Figure 5** FPGA structure

**Figure 5** shows the FPGA structure. The logic cell architecture varies between different device families. Generally speaking, each logic cell combines a few binary inputs (typically between 3 and 10) to one or two outputs according to a boolean logic function specified in the user program. In most families, the user also has the option of registering the combinatorial output of the cell, so that clocked logic can be easily implemented. The cell's combinatorial logic may be physically implemented as a small look-up table memory (LUT) or as a set of multiplexers and gates. LUT devices tend to be a bit more flexible and provide more inputs per cell than multiplexer cells at the expense of propagation delay.

## IV. FPGAs VS Microcontrollers

Microcontrollers are based on CPU architecture. As all CPUs, they execute instructions in a sequential manner. FPGAs are programmable logic and run in a parallel fashion. Microcontrollers have on-chip peripherals that also execute in parallel with their CPU. But they are still much less configurable than programmable logic.

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## V. Pressure Sensor

A piezoelectric sensor as shown in **figure 6** is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical charge. Here a simple pressure sensor is used to protect door or window. It generates a loud beep when somebody tries to break the door or window. The alarm stops automatically after three minutes. The circuit uses a piezo element as the pressure sensor. Piezo buzzer exploits the piezoelectric property of the piezo electric crystals. The piezoelectric effect may be direct piezoelectric effect in which the electric charge develops as a result of the mechanical stressor reverse or indirect piezoelectric effect (Converse piezoelectric effect) in which a mechanical force such as pressure develops due to the application of an electric field.

**Figure 6:** Piezo electric sensors

A typical example of direct piezoelectric effect is the generation of measurable amount of piezoelectricity when the Lead Zirconate Titanate crystals are deformed by mechanical or heat stress. The Lead Zirconate Titanate crystals also shows indirect piezoelectric effect by showing pressure when an electric potential is applied.

## VI. Operation

Operation of pressure sensor is very simple. Here we have two plates that is one is input plate and the other is output plate, whenever pressure is applied as shown in **figure 7** then these two plates come into contact we get voltage as a output then this output is send to the FPGA in turn it shows the weight of the vehicles is shown in the display as per our project. Accordingly toll tax is calculated. It is made up of a piezoelectric crystal. Depending on how a piezoelectric material is cut, three main modes of operation can be distinguished into transverse, longitudinal, and shear.

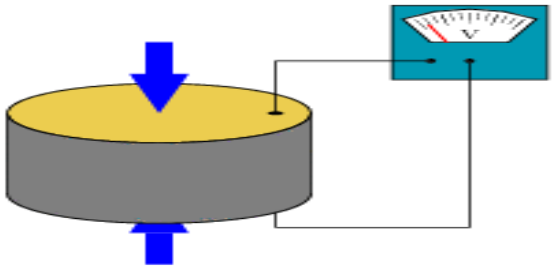

**Figure 8:** Pressure sensor operations

**LM 324:**

**LM324** is a 14pin IC consisting of four independent operational amplifiers (op-amps) compensated in a single package. Op-amps are high gain electronic voltage amplifier with differential input and usually a single- Ended output. The output voltage is many times higher than the voltage difference between input terminals of an op-amp. These op-amps are operated by a single power supply and thus the need for a dual supply is eliminated. They can be used as amplifiers, comparators, oscillators, rectifiers etc. The **figure9** shows the pin diagram and pin details of LM 324.

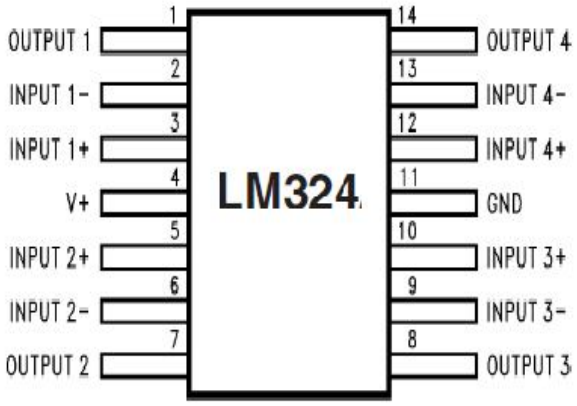


**Figure 9:** pin diagram and pin details of LM 324

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**GAS SENSOR:**

The Flammable Gas and Smoke sensors can detect the presence of combustible gas and smoke at concentrations from 300 to 10,000 ppm. Owing to its simple analog voltage interface, the sensor requires one analog input pin from the FPGA.

**Figure 10:** Gas Sensor (type-MQ2)

The product can detect the pressure of the smoke and send the output in the form of analog signals. Our range can function at temperature ranging from -20 to 50 degree Celsius and consume less than 150 mA at 5V. Sensitive material of MQ-2 gas sensor in the **figure 10** is SnO2 (Tin dioxide), which with lower conductivity in clean air. When the target combustible gas exist, the sensor's conductivity is higher along with the gas concentration rising. MQ-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane.

## VII. Structure and Configuration

Structure and configuration of MQ-2 gas sensor is shown as **figure11**, sensor composed by micro AL2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-2 has 6 pin, four of them are used to fetch signals, and other two are used for providing heating current.

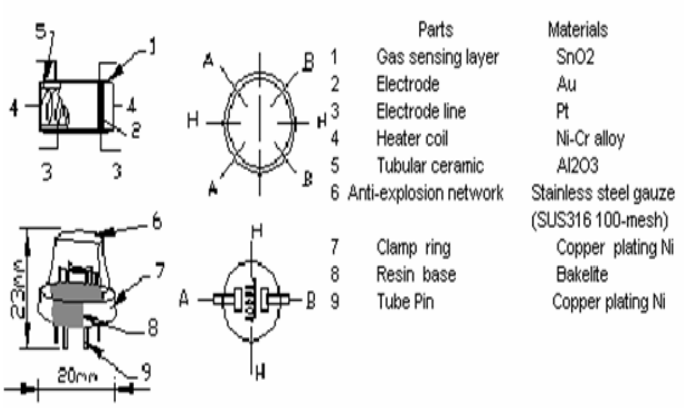


**Figure11:** Structure and Configuration of MQ2 sensor

**LM 358:**

LM 358 series consists of two independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the lower power supply current drain is independent of the magnitude of the power supply voltage. The **figure 12** shows the pin diagram and pin details of LM 358.

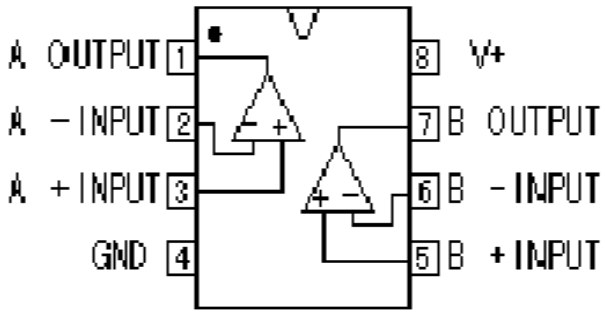


**Figure12:** Pin details of LM 358

## VIII. Wireless Communication Module

A general RF communication block diagram is shown in **figure 13**. Since most of the encoders/decoders/microcontrollers are TTL compatible and mostly inputs by the user will be given in TTL logic level. Thus, this TTL input is to be converted into serial data input using an encoder or a microcontroller. This serial data can be directly read using the RF Transmitter, which then performs

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ASK (in some cases FSK) modulation on it and transmit the data through the antenna. In the receiver side, the RF Receiver receives the modulated signal through the antenna, performs all kinds of processing, filtering, demodulation, etc and gives out a serial data. This serial data is then converted to a TTL level logic data, which is the same data that the user has input.

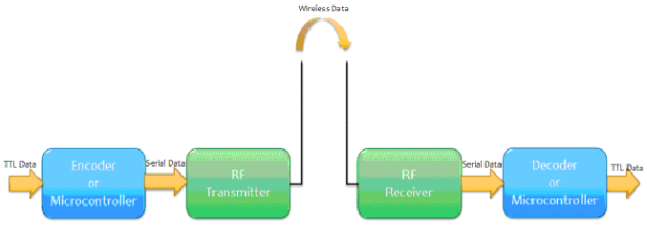


**Figure13:** RF communication block diagram

**1). RF Transmitter:**

An RF transmitter generates radio frequency waves in its circuits, and to the carrier signal, it adds the information part by modulating the carrier signal. This composite signal (carrier plus information) is then fed to an antenna. The antenna induces a corresponding signal into the atmosphere, by altering the Electric and Magnetic fields at the same frequency. The following are its features.

- Range in open space(Standard Conditions) : 100 Meters
- TX Frequency Range : 433.92 MHz
- TX Supply Voltage : 3V ~ 6V
- TX Out Put Power : 4 ~ 12 Dbm
- Low Power Consumption
- Easy For Application

The pin diagram of RF transmitter is shown in **figure**.


**Figure14:** Pin diagram of RF transmitter

**2). RF Receiver:**

An RF receiver receives the signal from the atmosphere, from its own antenna. The receiver antenna is often quite simple and the signal level is typically of a few microvolts. This gets rid of unwanted signals and amplifies only the wanted ones. The receiver circuits then strip the information part of the signal from the carrier part. The following are its features

- Range in open space(Standard Conditions) : 100 Meters
- RX Receiver Frequency : 433 MHz
- RX Typical Sensitivity : 105 Dbm
- RX Supply Current : 3.5 mA
- RX IF Frequency : 1MHz
- Low Power Consumption
- Easy For Application
- RX Operating Voltage : 5V

The pin diagram of RF receiver is shown in **figure 15**.

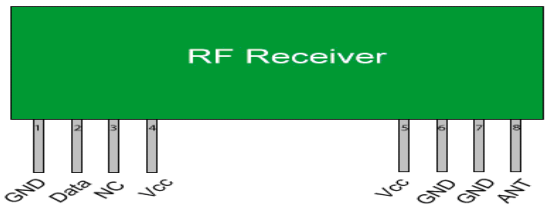


**Figure15:** pin diagram of RF receiver

**3). DC Motor:**

The steel can forms the body of the motor in addition to an axle, a nylon end cap and two battery leads. If the battery leads of the motor are hooked up to a flashlight battery, the axle will spin. If leads are reversed, it will spin in the opposite direction. Here are two other views of the same motor. The nylon end cap is held in place by two tabs that are part of the steel can. By bending the tabs back, the end cap can be made free and remove it. Inside the end cap are the motor's brushes. These brushes transfer power from the battery to the commutator

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as the motor spins. The **figure 16** shows all the parts of the DC motor.


**Figure 16:** parts of a DC motor

**4). Relay With Uln2003A:**

A relay is an electrical hardware device having an input and output gate. The output gate consists in one or more electrical contacts that switch when the input gate is electrically excited. A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts.

**5). Relay Operation:**

Relay uses an electromagnet. This is a device consisting of a coil of wire wrapped around an iron core. When electricity is applied to the coil of wire becomes magnetized, hence the term is called electromagnet. The A B and C terminals are a SPDT switch which is controlled by the electromagnet. When electricity is applied to V1 and V2, the electromagnet acts upon the SPDT switch so that the B and C terminals are connected. When the electricity is disconnected, then the A and C terminals are connected. It is important to note that the electromagnet is magnetically linked to the switch but the two are NOT linked electrically. The

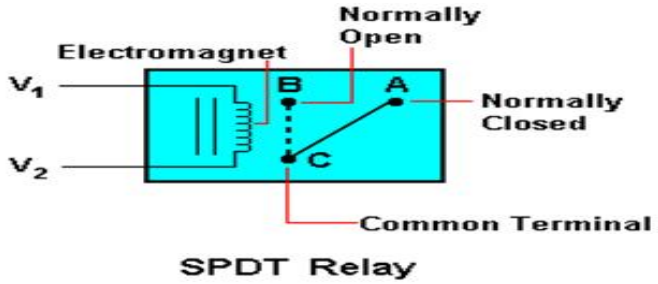


**Figure17:** shows the relay used here.

**Figure 17 Relay:**

General operation of relay is when a current flows through the coil, the resulting magnetic field that attracts an armature that is mechanically linked to a moving contact. The movement either makes or breaks a connection with a fixed contact. When the current to the coil is switched off, the armature is returned by a force, approximately half as strong as the magnetic force, to its relaxed position. Usually this is a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. If the coil is energized with direct current, a diode is often placed across the coil to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a voltage spike dangerous to semiconductor circuit components. If the coil is designed to be energized with alternating current (AC), a small copper "shading ring" can be crimped to the end of the solenoid, creating a small out-of-phase current which increases the minimum pull on the armature during the AC cycle.

## IX. Results

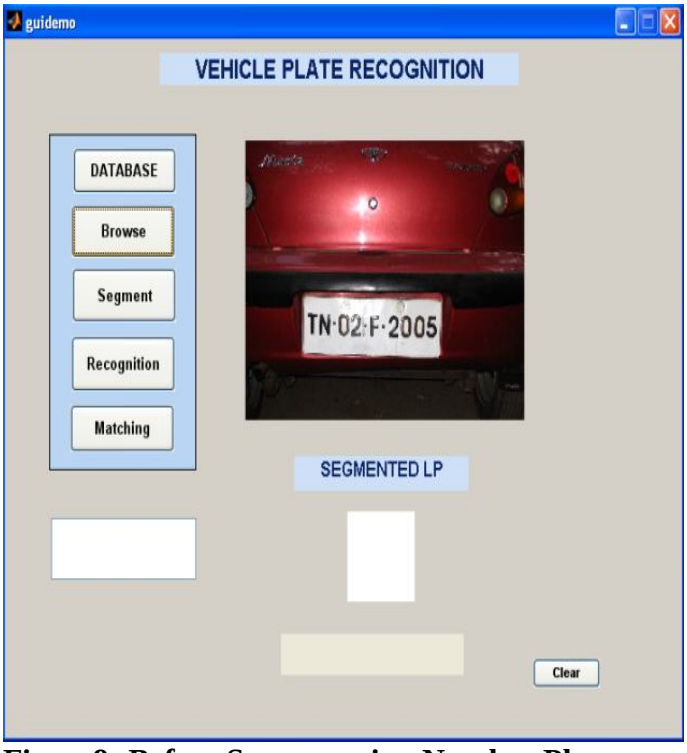


**Figure9: Before Segmentation Number Plate**

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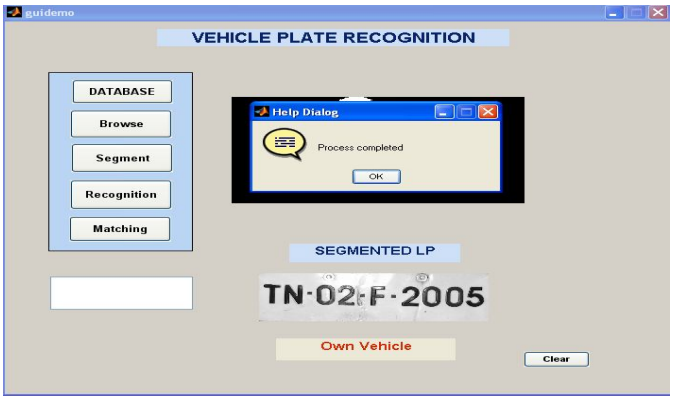


**Figure10: After Segmentation Number Plate**

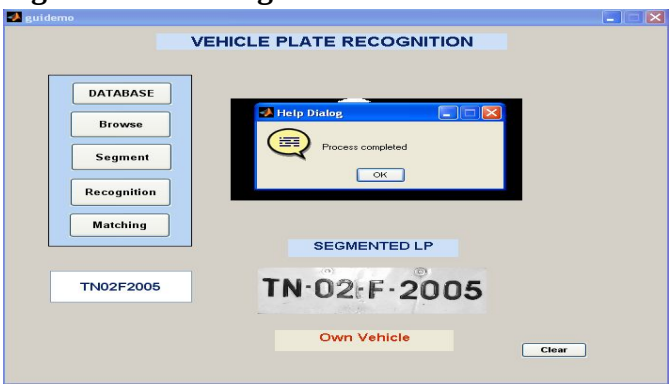


**Figure11: Number Plate Recognition**


**Figure12: After Matching**

## Conclusion:

Motive of this projected system is to detect the images of the vehicle plate accurately. The automated real-time vehicle plate recognition system has been demonstrated to provide correct identification of vehicles captured images from the camera. The system makes accuracy of amount reduction depending upon vehicle weight by using a pressure sensor and here we apply security automatic security check up by using sensor and wireless passage of information when any suspect was found by using RF signal. This makes a new automated tollgate system for present generation.

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