Digital Toll System

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Abstract : Nowadays, because of increase in number of vehicles, there are long queues at the toll stalls, this is because of the manual working of toll booths. So as to digitalize the toll accumulation, RFID innovation is being utilized which is the primary form in advanced toll gathering. It is being utilized widely in the world, yet in India, it isn't effective. Individuals are not prepared to acknowledge the change. Just 15% of vehicles are utilizing RFID labels and furthermore RFID based systems have prepaid payment strategy which is designed for clients. Hence the proposed system goes for furnishing a framework with negligible expense as picture preparing innovation for vehicle number recognizable proof is utilized rather than RFID labels. Vehicle number is extricated utilizing ANPR [Automatic Number Plate Recognition] which is stored in Database and the toll charges are collected at the main toll experienced for the entire way which the clients will use amid their voyage. Along with one time installment framework free stream framework is additionally present. When vehicle enters, specific toll sum will be deducted from the user's account. Since, in one time installment framework there is no requirement for vehicle to stop at each toll corner, time and fuel utilization is diminished And furthermore the framework minimizes vehicle robbery if this data is shared by the police division.

Index Terms -**Automatic Number Plate Recognition, Reduction in time and fuel consumption, One time payment, Database, theft vehicles.**

I. INTRODUCTION

In India toll collections are based on manual cash transactions. Such systems create a bottleneck in the high speed highways. These bottlenecks lead to possible error, wastage of time and longer queues and also in fuel wastage. An example if each vehicle on toll booth takes an approximate time of 60 seconds a day, then annually it needs 365 x 60 = 21900 sec = 6 hrs. If 1000 vehicles pass through a particular toll booth in a single year, total of 6000 fuel hours are wasted. This is a results in substantial loss of natural resources.

The conventional toll assortment system is time overwhelming, results in traffic jams and is inefficient. This project aims at providing solution to this problem by automating the process of toll collection. The system provides quick toll assortment and mechanically controls the vehicle movements at piece of ground through Image process. RFID and FASTag requires a smart device to be attached with the car. The proposed system neither needs anything to be installed at toll plaza nor needs anything to be attached with car.

The proposed system is a Raspberry pi based toll collection system for toll tax collection which implements a Digital toll collection system using Raspberry Pi, Pi camera and IR Sensor and has two systems free flow system and One time payment system in free flow system the electronic booths automatically collect toll from user account corresponding to the vehicle. The toll is deducted from the user account each time it passes through a toll plaza where as in Onetime payment system the toll charges are collected at the first toll encountered for the whole path which the customers will be using during their journey.

II. PROPOSED METHODOLOGY

The Collection of toll is done using two methods:

1. Free flow

2. Onetime payment

Free flow: In this type of system, the vehicle is registered by linking bank account to the vehicle number and hence there is no need for the vehicle to stop at any of the tolls, when the vehicle enters the toll booth, image of license plate is captured and ANPR is done. The toll amount is automatically deducted and the information is updated in the database.
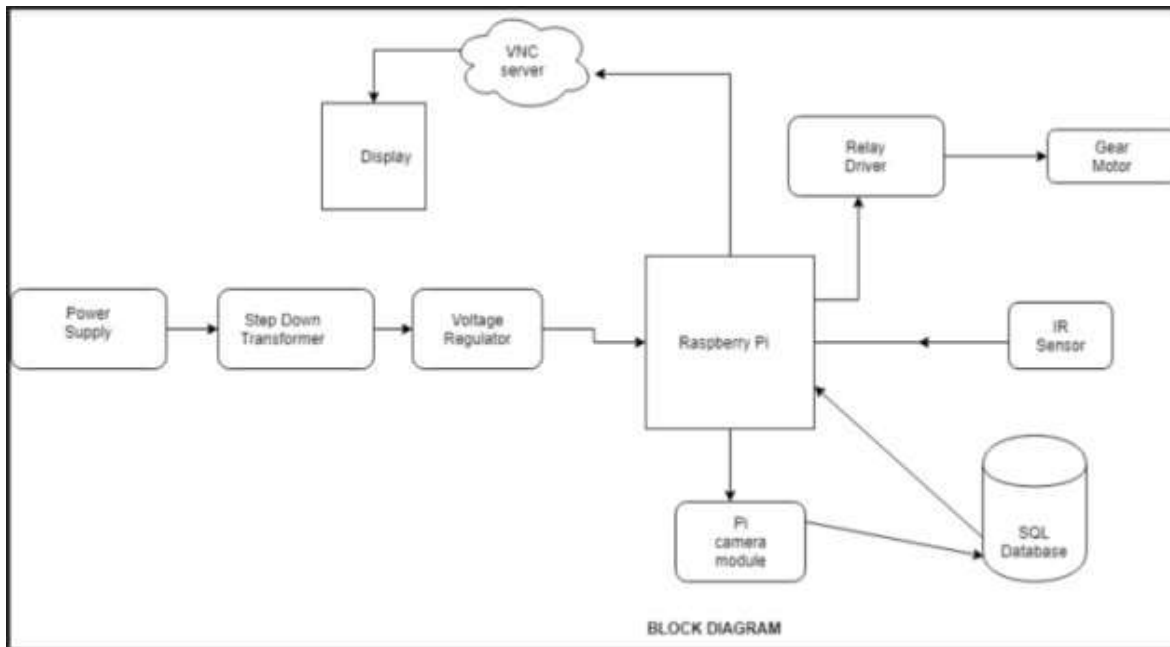
Fig. 1: Block diagram of proposed system

Onetime payment: In this system, when the vehicle enters the detection zone, the camera captures license plate and number is detected automatically using ANPR. If the number is a new entry in the database , its journey details are taken into account and the user pays for the total number of tolls ahead at one-go.

This information is updated in the database which is available to all the tolls which enables the other toll Operators to work more efficiently. Else, if the user has already paid the toll amount, it can easily by-pass the toll. In cases of low balance user can recharge at any of the toll booths. The system keeps track of the number of tolls a vehicle passes. Additionally, there is a vehicle blocking, theft detection and user alert features in this system which improves system security.

The IR Sensor detects motion and sends signal to Raspberry pi which triggers camera to capture an image. The captured image is used to perform ANPR (Automatic Number Plate Recognition). ANPR involves following steps:
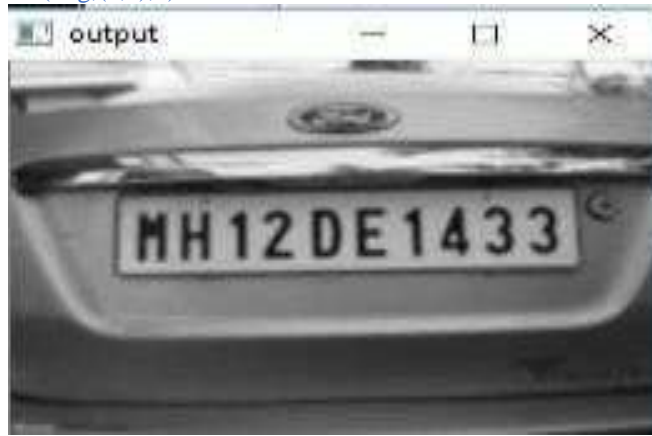
- **Conversion to Gray Scale:** The RGB color image is converted into a gray scale image.

Image=cv2.imread ('img.jpg',0) gr=c2v2.cvtColor(img,cv2.COLOR_BGR2GRAY)

- **Blur the image:** The image is blurred using Gaussian functions which provides detailing.
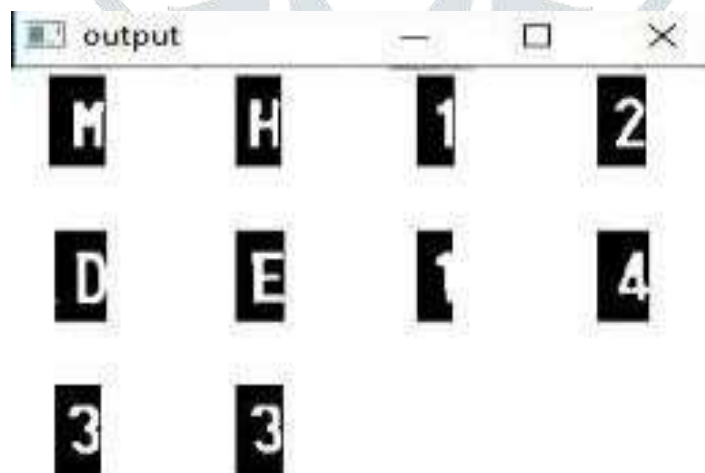
  Blur =cv2.GaussianBlur(img,(5,5),0)

- **Edge detection:** Vertical edge is detected using Sobel operator and the resultant image is binarized.

  sobelx=cv2.Sobel(blur, cv2.CV_8U, 1, 0, ksize=3)

- **Contours and Cropping :** Listing of contours in order to remove the image boundaries having same colour intensity and cropping it.

- **Character Matching:** Using **KNN algorithm (k- nearest neighbour)** find all possible characters with highest probability that matches with standard template.

- The recognised number plate is searched in the database and if it's a new entry it's registered after taking the destination details.

- Else ,if its already registered the vehicle is allowed to pass the toll without any interruption.

- Also, the vehicle events are updated in the database and send to other toll authorities.
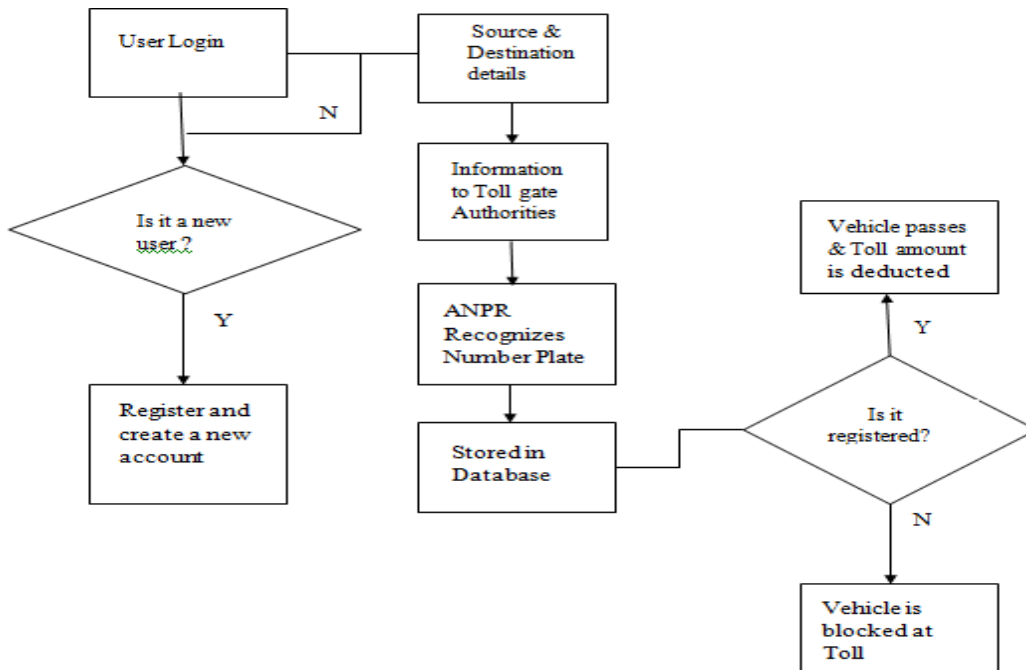
Fig. 2. Flow chart of proposed system

III. RESULTS AND DISCUSSION

The prototype of the project is tested for several different cases. The designed system has several benefits like faster processing ,higher security ,fuel savings since there is no need for vehicle too stop repeatedly. Also, the system has good tracking features with vehicle blocking and theft detection.

Table 1 Time taken for old system vs proposed system in toll booths

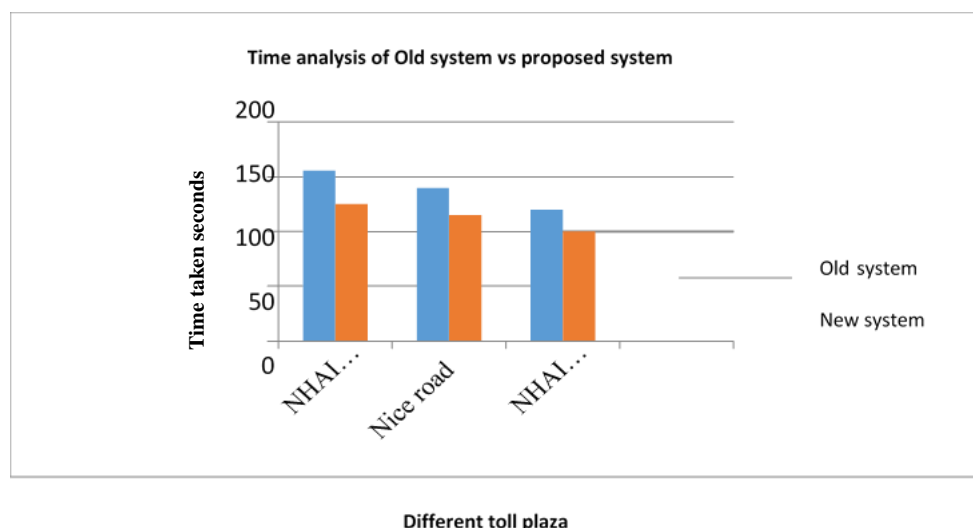| Name of the toll plaza	Time taken in old system(sec) (wait time+payment)	Time taken in proposed system(Sec) (wait time+processing +payment)
NHAI(Parle Factory)	120	100
NICE Road	140	115
NHAI (Nelamangala)	155	125

Fig. 3: Graphical Analysis of old system vs proposed system

IV. CONCLUSION

In this paper, we tried designing a real time system to ensure a faster toll collection along with security features which would contribute to avoid crimes. Using this process of toll collection system, there is reduction in time, fuel and man power. The systems keeps track of number of vehicles passing a particular tollgate. Although, the system works quite well but for few cases there is a need for improvement. The Camera used in this system is having a longer shutter time with an average quality and hence the performance of the system gets limited for fast changing targets. Employing a high resolution camera system robustness and speed can be increased. The IR sensor can be blocked by water droplets or fog. The template matching method used has some problems for detecting characters which are similar like 8 is recognized as B or D is recognized as O. Frequency transformation can be used to improve number recognition of the system. The proposed system is 19% more efficient than the existing system in terms of wasted fuel hours.

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