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Approaches to Impose e-penalty using Vahan Smart Card for Improving Road and Transport Safety with the help of ICT: An e-Governanace Endeavour

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Abstract

With the help of information communication technology (ICT) and computer science, an effective e-Governance should provide an efficient solution for the offenders, who violate the traffic rules and cause unnatural deaths due to breaking of signals or rash driving in INDIA. Many Government Plans have been executed and running successfully like VAHAN and SARATHI related to transportation. This paper proposed some approaches to penalize the offenders electronically and automatically, who violate the traffic rules on road. Penalty can be imposed on offenders using EPS and Vahan Smart Card with the help of RFID and a software flow with wired and wireless e-centre architecture and hybrid approaches.

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Keywords: RFID; E-Penalty; ICT; E-Centres; E-Governance; Smart card

1. Introduction

Information and Communication Technology (ICT) is one of the facilitator for the development of effective e-Governance. E-penalty is the application of G2C (Government to Consumer) E-governance. VAHAN and

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SAARATHI are application Software developed by National Informatics Centre (NIC) for State Transport Authority. SAARATHI and VAHAN handle DL (Driving License) and Vehicle related issues like RC (Registration certificate) which is given now in the form of Smart Card, which stores all the data related to the Driver, Vehicle and Vehicle's owner respectively. This application software is used by different Regional Transport Offices (RTO) at district level and Assistant regional transport Offices (ARTO) in outlying subdivisions for issuing vehicle registration and driving license. In this proposed approach our focus is on road and traffic related issues like repetition of the traffic offences, jumping the signals, changing the lane and parking in prohibited area etc.

Due to rash driving and ignorance of traffic rules our society is facing a problem of frequent road accidents which cause human loss. High power cameras are installed at many places in a city to keep watch and control the terrorism by Government. These Cameras can also be used for identifying such vehicles on the road which violate the Traffic rules and can be penalized automatically under Regional Transport Authority (RTO), who handles issuing of RC and DL. In present scenario offenders violate the traffic rules; they pay some amount to police officer as a bribe which encourages them to repeat the same offence. There is no such record that how many times an offender has violated the traffic rules, by using this proposed approach we can penalize the repetitive offenders with more amount than the previous penalty amount.

Registration Plate recognition (RPR) system is a key to many traffic related applications such as road traffic monitoring or parking lots access control. The objective of the system is to identify the offender's vehicles which are violating the Traffic rules and penalize their owner at the same movement of the offence through EPS from their accounts and inform them through SMS. Automatic Penalty could also be implemented as ETC (Electronic Toll Collection) smart card model. This smart card is used to deduct the toll amount from the vehicle through ECS after identifying the vehicle using RFID antenna installed on car and Toll Gates. Whenever the card does not have the sufficient amount it can be recharged, like prepaid cards.

2. Problem analysis

The ideas came in mind after some horrible incidents had happened in society due to the violation of traffic rules. Motivation behind this work arrived after the reading that we have lost Our Transport Minister Gopi Nath Munde in an accident due to the breaking of signal by an offender in Delhi and it was a great loss for our nation. Another incident of motivation was that due to rash driving and breaking of the signal, only seven years old girl child was survived out of her family in an accident at Palm Beach road in Mumbai. Such incidents occur in other metropolitan cities across the India. Such incidents can be controlled by penalizing such vehicle's owner electronically and notify them at same movement through SMS, so that they would follow all traffic rules in future.
In this approach we have to design an automated system that should be able to detect vehicle and its owner's detail within few circumstances:
a) Designing and implementing Registration Plate Recognition (RPR) System.
b) Designing of Wireless network with the help of wired network to track the vehicle on the road.
c) Deduction of penalized amount from the owner's Bank account or from the master card.

3. Approaches for registration plate recognition

3.1 RFID and Camera based hybrid approach to identify the offending vehicle

In this approach, camera and RFID will help to identify the image of vehicles which are violating traffic rules and then vehicle's image will be processed to get the vehicle registration number plate and as well as the information of vehicle's owner by using VAHAN.

3.1.1 VIS and registration plate recognition system

The VIS and RPR systems are installed at the e-centres (area wise) which are connected with the state data centre SDC. SDC are linked with SWAN (State wise Area Network) and connected at Central Gateway. Cameras and RFID reader are installed at road side as shown in figure (1). Whenever any offence occurs, the offender's vehicle will be identified through RPR system by using SDC, which has all the details of registered vehicles in that state, and then RFID reader will extract the information of the owner with the help of VAHAN data.

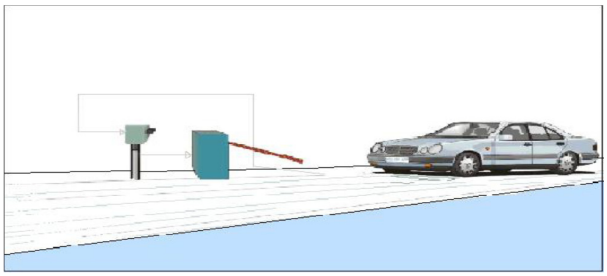

Fig. 1. VIS and registration plate recognition system

3.1.2 Detailed design of registration plate recognition (RPR) system

RPR system extracts the region containing the registration plate in captured vehicle's image. Number recognition system processes this extracted region to recognize the unique registration number of the vehicle. The captured original image initially processed in the RGB colour space; by using white colour filter, all the objects white in colour are extracted. All these white objects are tested against the features of the license plate (like rectangular in shape, upper bound and lower bound of the image, contains black letters only) to extract only that region which contains registration plate in captured image. The extracted number is then recognized using recognition system as discussed below.

3.1.2.1 Detailed design of the recognition system

The sub components of this approach are as follows

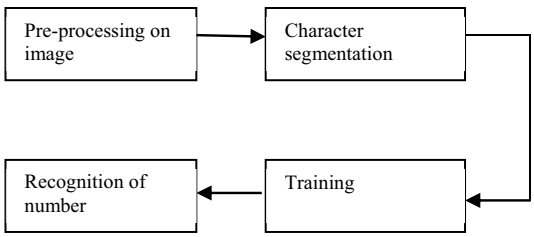

Fig. 2. Sub components of proposed system

3.1.2.1.1 Pre-processing of the image

This process has three phases. The first phase in our character recognition system is to convert the text image to Binary, whose pixels have only two possible intensity values and they are normally displayed as Black and White. The converted Character image has pixel value zero for Black and one for white. Thus the colour of the character is White and the background is black. In second phase, the image is further processed with image dilation operator in order to fill redundant gaps. The third Phase is getting the Skeleton image from the dilated image by using the Thinning Algorithms.

3.1.2.1.2 Character segmentation

This process is done using standard character segmentation algorithm.

3.1.2.1.3 Feature extraction

In a thinned image, extraction of the different features like, the line (Right slant line, Left slant line, Horizontal line, vertical line which present in a letter), curve and hole can be extracted by using the compass operator. This operator can only extract those lines which are exactly horizontal (0 degree), vertical (90 degree) and inclined to -45 and 45 degrees .Due to the different kinds of calligraphy used in registration plate, such situation is not possible in real scenario, so it is difficult to get exactly slant, horizontal and vertical lines

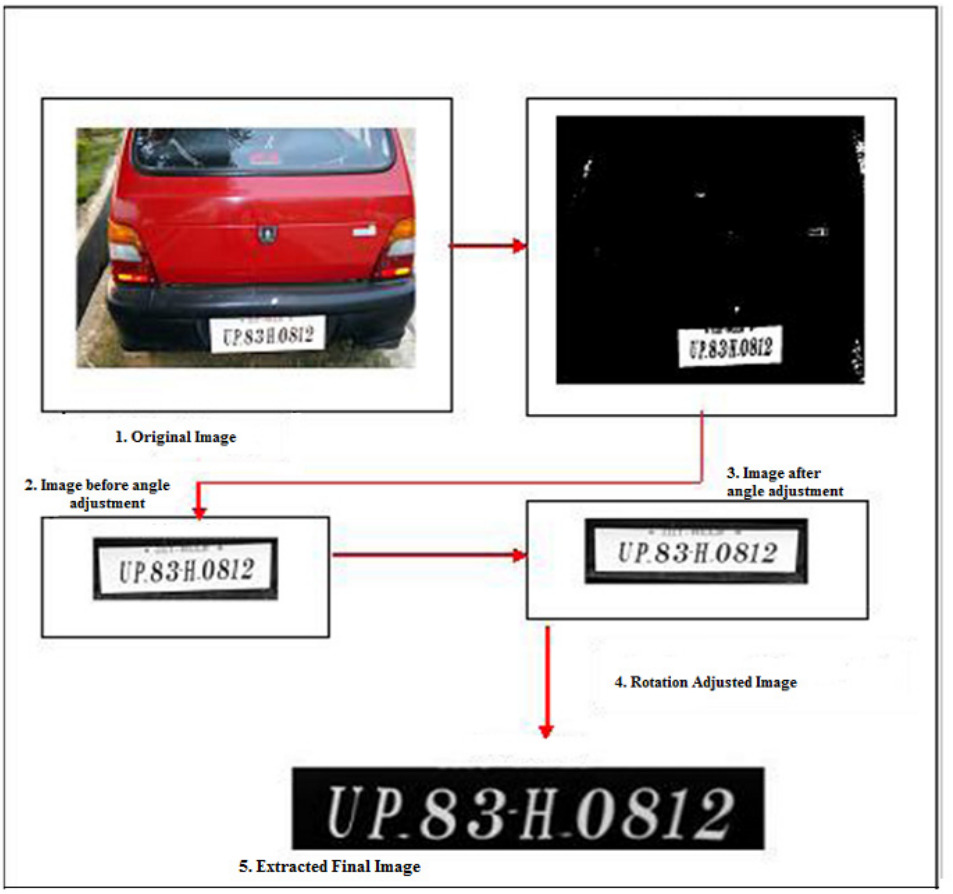

Fig. 3. Process showing extraction of the number plate

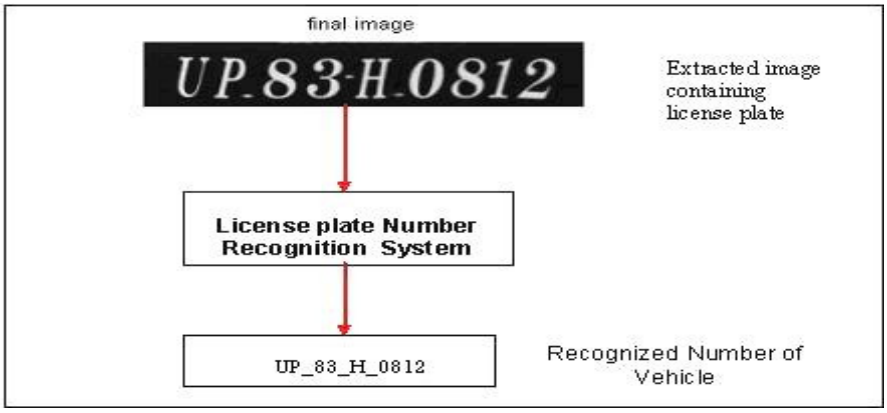

Fig. 4. Recognition of the registration plate number

3.1.2.2 The trained network

This network is used to recognize the number plate.

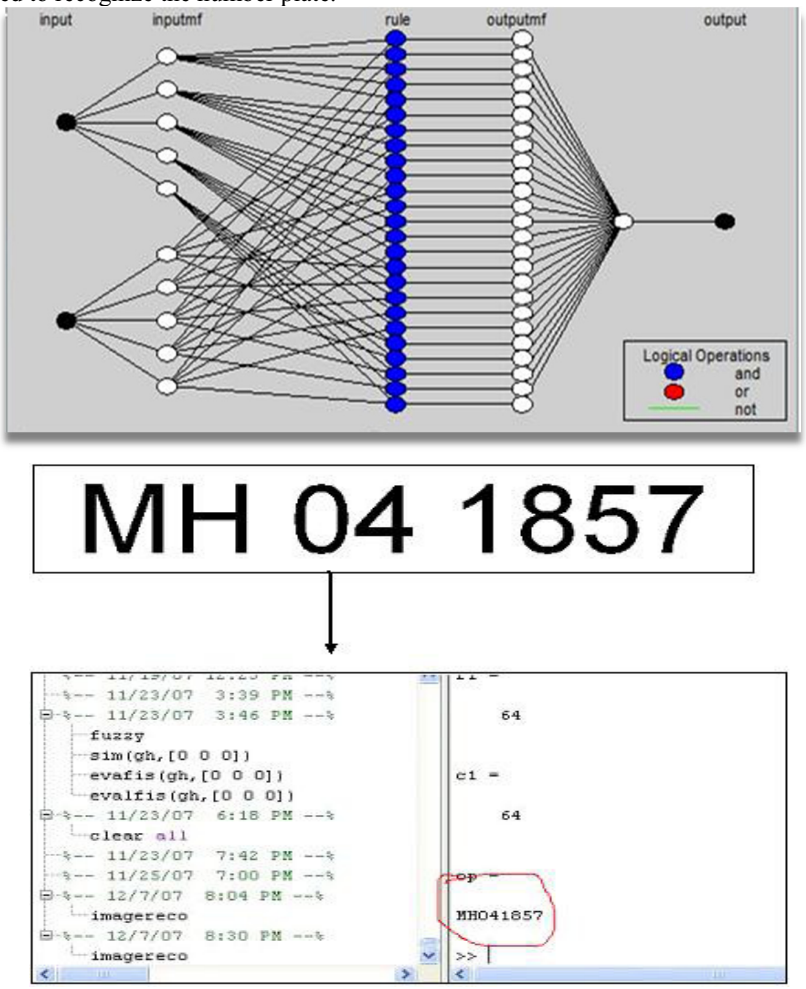

Fig. 5. Number plate recognition system using neuro fuzzy system

3.1.2.3 Related work

Huge literature is available on the object extraction and recognition. The idea about License plate recognition system and tracking system, given by the author Groft Eric, Andrews Kirby, Kuff Howard in their patent is very useful[1]. To extract the useful features of the number and character to recognize them, given by K.B.M.R. Batuwita, G.E.M.D.C. bandara in their technical paper Fuzzy Recognition of offline Handwritten Numeric is really useful[3]. Due to variability in calligraphy (similarity among the characters, various varieties of shapes and various varieties of writing styles) produced by different writers, identifying the unique feature of a character is really tedious for recognition of the character in number plate. Other methods like neural network approaches[6], structural approaches, statistical approaches and recently support vector machine (SVM) have their own pros and cons.

3.1.2.4 Problems with this approach

Problem with this approach is that design of number plates, colour of number plates, font and styles of numbers are different in vehicles, so it would be difficult and tedious to apply all kinds of filters and segmentation methods on different types of images captured by Camera to get owner's data. System cannot identify automatically which kind of filter should be used for which kind of image, so performance of this approach is poor and automatic penalty is difficult to implement in this approach.

3.2 Bangalore traffic model approach to identify the offending vehicle

This approach uses the CCTV and enforcement cameras to keep a close watch on traffic in the city, recording cases of lane violation, jumping signals and parking the vehicle in non parking areas. Cops are equipped with Black Berry and wireless printer as soon as they enter the registration no of vehicle they get the how much amount of penalty a defender has to pay according to the no of attempts of offences. Offender has to pay on the spot fine accordingly and this data goes to central database for future reference.

3.2.1 Problems with this approach

Cops may ask for the bribe from the offenders and hence the corruption and the Revenue Leakage can not to be controlled in this approach. This system is performing well in Bangalore and traffic violation is very less compare to previous system but in this approach automatic penalty is difficult to implement.

3.3 The hi-tech number plate approach to identify the offending vehicle (Proposed approach)

The state transport department is set to introduce high-security registration (number) plates. There will be two new RFID chip embedded plates - for the front and rear of the vehicle - and a sticker (for the windscreen) bearing chromium-based holograms. The RFID chip embedded in the number plate will help to digitize records and keep track of any vehicle on the road and can fetch the details about owner and car from 200 feet away, by scanning it using a chip reader. The microchip will store data of the car owner, including registration details, chassis number and RTO details.

3.3.1 Specifications of number plate for its uniqueness

The number plates will be of 1mm aluminium with round corners and the registration mark in English hot-stamped. The registration mark will be displayed on the front, rear and windshields of vehicles .The plates will be tamperproof and unreplaceable. The acronym IND will be in blue on the left side of the plate. It will have a unique 7-digit laser code. This approach is very much suitable as there is uniqueness in number plates and data will be fetched using chip scanner. By using this unique Number Plate approach, offending vehicle data can be fetched and e-penalty can be imposed on the vehicle owner using EPS (Electronic Penalty System).

4. Electronic penalty system

4.1 Detailed design of electronic penalty system (EPS)

At the time of Vehicle registration, RTO has to make mandatory to get a VAHAN SMART CARD (VSC) by a vehicle owner from RTO office along with the Registration Certificate (RC, a plastic card).This VSC will be identified by vehicle number and will be loaded with some amount as a plastic money. Whenever a vehicle offends, the penalty amount can be deducted from the VAHAN SMART CARD and SMS will be sent to the owner. This VAHAN SMART CARD can be recharged, if available amount reaches to a minimum amount. If same offender offends repetitively, can be penalized with two fold amount or more and after a certain limit of offends, vehicle registration certificate (RC) can be cancelled and SMS will be sent to the Vehicle owner, which can be renewal after paying a handsome penalty amount. This all can be imposed with the help of an Intelligent Software System (ISS).

4.2 Framework of EPS

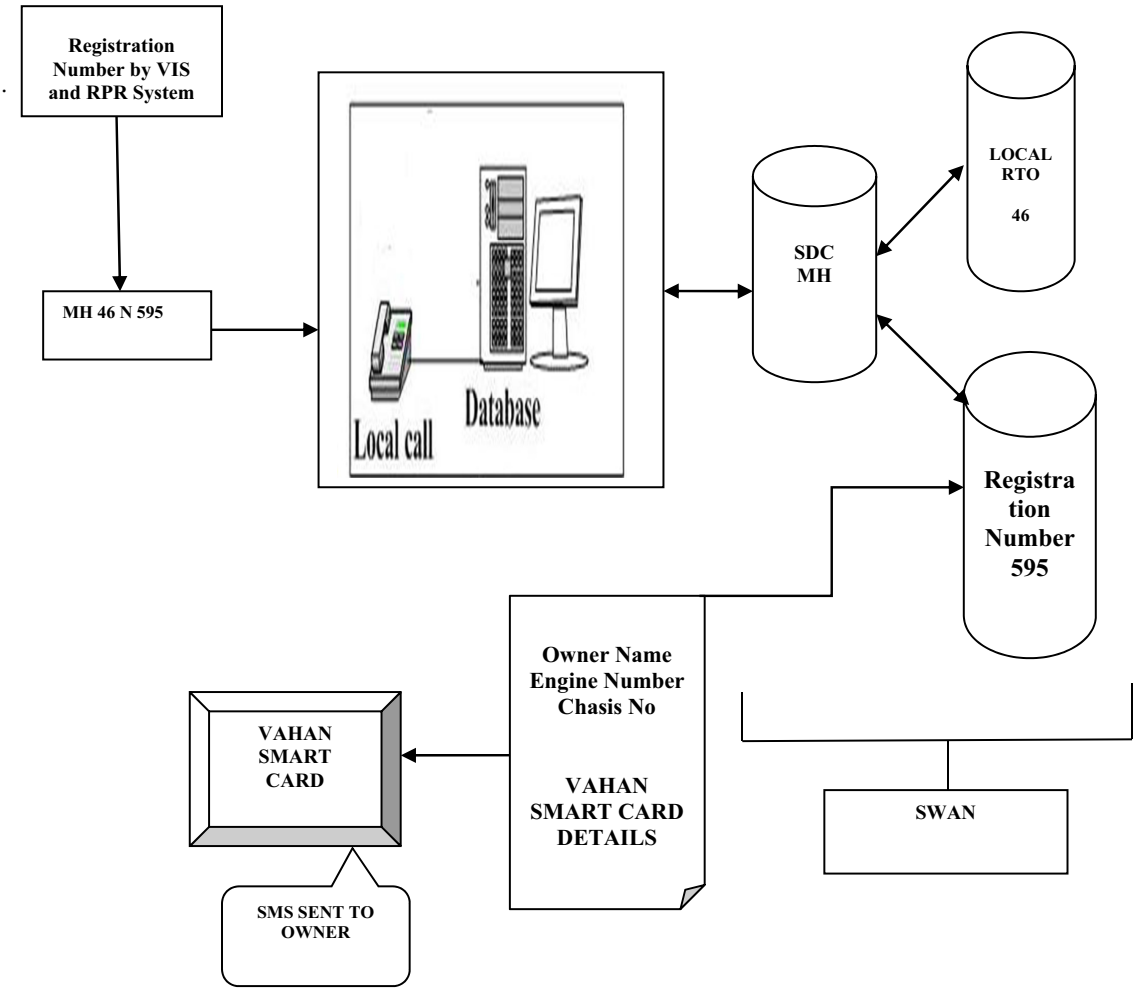

Fig. 6.EPS framework with vahan smart card

4.3 Workflow of EPS system

Step1. Extracted registration number received from chip reader (Example: MH 46 N595) will be matched with the state data centre (SDC) in which the vehicle belongs to, for this purpose the first two character will identify the state. Here MH i.e. Maharashtra.

Step2. After identifying the state, next step is identifying the RTO area, for this next two digits are used. Example MH 46 then 46 belongs to Kalamboli RTO in Navi Mumbai.

*Step 3.*After this the next numbers are Registration number, here in example N595 will be matched with the registration digitalized data of VAHAN with the help of Registration Certificate (RC)handled by RTO.

Step4. After this the owner's detail will be identified and penalty will be deducted from his VAHAN SMART CARD (VSC) and SMS will be sent to the vehicle owner and this data will be stored for future references.

5. Data centres and vahan details at different levels

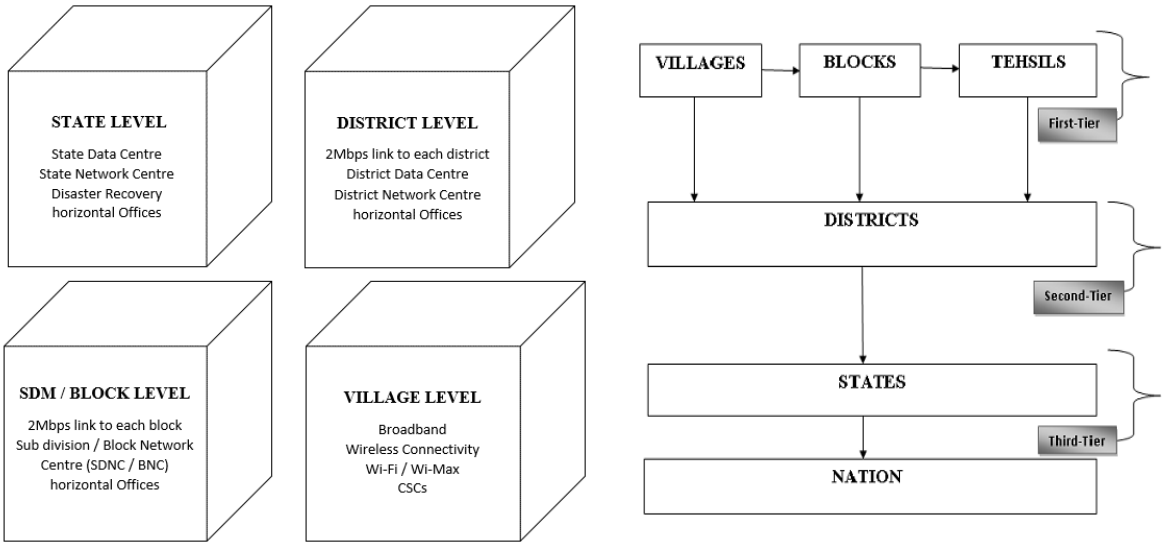

Fig. 7. State data centres (SDC), with SWAN (State wide area network)

6. Conclusion

We proposed a system which will help the government and as well as society in many ways. Government may generate more revenue by Traffic control Department as there is no chance of bribe in e-Penalty system so the corruption; bribes have either been eliminated or significantly reduced. Citizens will not be harassed by the Traffic Control Officer which is a very general case in case of a offender caught by a police officer after violating the traffic rules .If a Vehicle caught more than one time in violation of Traffic rule it can be penalized two or more fold the previous amount which is not possible in present scenario manually. In case of repetitive offences by the same offender, offending vehicle RC can also be cancelled and to get it renew the owner has to pay handsome amount as a penalty, which will stop him to do the offence in future. This system can work like the ETC (Electronic Toll System) model for automatically deduction of penalty amount and to interaction or communicate among the village, district, state and nation wise data it can work like Bank Transaction System Model. So proposed system can be used for

penalized the offenders who violet the traffic rules. This system can also use Cloud computing concepts, as centre has launched its own cloud computing project to boost e-Governance named “MEGHRAJ”.

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