Electronic Penalty an Initiative for E-Governance using RFID and Camera-based Hybrid Approach

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ABSTRACT
With the development of information communication technology (ICT) and computer science, an effective e-Governance should provide an efficient solution for most of the problems in many government and public sectors in India. Transportation sector is not the exception for the e-Governance. Many Government Plan have been executed and running successfully like VAHAN and SARATHI related to transportation. This paper proposed an approach to penalize the offenders, who violate the traffic rules on road, by using RFID and Camera based Technique which are installed at road side. In this approach the main key area is to recognize the Registration Plate Number and extract the vehicle's owner data and penalize owner through ECS using e-Commerce automatically. So the main targetable area in this vehicle Identification system is Registration plate recognition. For this purpose RFID, cameras system and a software flow with wired and wireless e-centre architecture could resolve the problem with the help of Registration Plate recognition system. In addition, human resource is not possible to checkout every vehicle, so offenders can easily violate the traffic rules which may cause the casualty of the people. Therefore, a Vehicle Identification system using RFID and Camera scheme is necessary to identify such traffic rule violators and penalized them automatically.

General Terms
E-Governance

Keywords
RFID Tag and Reader, Camera, e-centre, Vehicle Detection system, Registration plate recognition, E-penalty.

1. INTRODUCTION
Information and Communication Technology (ICT) is one of the frontier disciplines in the development of e-Governance. E-penalty is the application of G2C (Government to Consumer) E-governance. SAARATHI and VAHAN handles DL (Driving License) and Vehicle related issues like RC (Registration certificate) which is given now in the form of Smart Card which store all the data related to the Driver and Vehicle. Various Motor Vehicle Offices across the State known as Regional Transport Office (RTO) at district level and Assistant regional transport Office (ARTO) in outlying subdivisions. In this proposed system our focus is on road and traffic related offences like jumping the signals, changing the lane, parking in prohibited area, repetition of the offences etc.

Now a day's Society is facing a problem of rapid accidents and human loss. It has been observed that Road accidents are taking place frequently due to rash driving, jumping of the signal, cross the speed limit of vehicle; change the lane on the road. Drivers do not follow the traffic rules. Government is planning to install the high power cameras at every place in a city to control the terrorism. Implementation of installing the Cameras can also be utilised for identifying such vehicles on the road which violate the rules of Traffic and can be penalised under Regional Transport Authority (RTO) who handles issuing of RC and DL. Proposed approach is to control the violation of Traffic rules by citizens with the help of e-Governance and Information and Communication Technology (ICT) by detecting the vehicle through Installed cameras and Radio Frequency Identification (RFID) system and penalize them through ECS (Electronic Clearance System). Registration Plate recognition (RPR) system is a key to many traffic related applications such as road traffic monitoring or parking lots access control. The main Goal of the system is to identify all the vehicles that are violating the Traffic rules and penalize their owner at the same movement of the offence through ECS from their Bank accounts and send them SMS about it.ECS forms can also get filled by them at RTO offices at the time of their vehicle's registration mandatorily or this could also be implemented as ETC (Electronic Toll Collection) smart card model. This smart card is used to detect 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 comes in mind after some essential incidents, motivation behind this work arrived after the reading that only one gird child of age seven is survived in an accident at Palm beach road in Mumbai and she had lost her all family members due to rash driving. Such incidents do not occur only in Mumbai but also in other metropolitan cities across the India. Such incidents can be controlled by penalizing them on line, after identifying the vehicle and the owner's detail and send them SMS ,so that they can control their vehicle speed and would follow the traffic rules. The basic problem is how 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 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.
Problem definition in details and possible solutions and sub systems of the proposed approach

- **Vehicle Identification System** (VIS) and **Registration Plate Recognition System** (RPR) for recognising all the vehicles and their owner violating the traffic rules.
- **Electronic Penalty System** (EPS) which will identify the owner's detail from the registration data of vehicle and deduct the penalty amount.

2.1. Vehicle Identification System

Vehicle Identification System mainly captures a picture of vehicle which is violating the traffic rules on the road with the network of RFID and camera, captured images further used for various purposes as given below-

• It will be used by Registration Recognition Plate subsystem for extraction of vehicle number.

• The number will be stored with the timestamp and will be used as proof in case of security breach against the vehicle owner.

2.2. Registration Plate Recognition System

The main purpose of Registration plate Recognition is to process the picture taken by the VIS system and extracts the registration number of vehicle, on registration plate. The registration number of the vehicle is unique identity of the vehicle and its owner.

2.3. Electronic Penalty (EPS) System

After extracting the registration number by RPR, EPS will search the RTO area, the vehicle belongs to and find owner's detail and impose a penalty and deduct the amount. After deducting the amount a SMS will be sent to the owner's registered mobile number and save all transactions in database for the future use. Data will be stored in e-centre in a area and ultimately the data will be stored in centralized database.

3. RELATED WORK

There are many literatures on the object extraction and recognition. The Guidelines provided by the author Groft Eric, Andrews Kirby, Kuff Howard in their patent are really useful in getting the idea of the License plate recognition system and tracking system [1].The techniques explained by the K.B.M.R. Batuwita, G.E.M.D.C. bandara in their technical paper Fuzzy Recognition of offline Handwritten Numeric are really useful in extracting the essential feature of the number and character both in order to recognize them [3]. Every character has some features that make it unique but identifying such features is really tedious for recognition of the character in the number plate because character recognition is NP hard computational problem due to variability of someone's calligraphy
over time, the similarity among the characters, infinite variety of shapes and infinite variety of writing styles produced by different writers.

On the other hand few other techniques like Statistical approaches, structural approaches, neural network approaches, and recently support vector machine (SVM) have all been well studied on this problem. Each method has its pros and cons. Statistical approaches are simple but not very accurate. Neural network approach is good in learning, capturing features and their generalization. The neural network is also good at handling inaccurate, incomplete and imprecise information [6].

Bangalore Traffic Management model 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 spot accordingly and this data goes to central database so there is no harassment but cops may ask for the bribe so corruption and the Revenue Leakage cannot be controlled in this scenario.

4. PLAN OF WORK

Initially the attention will be focused on the development of the vehicle Identification system and the registration plate recognition system and then Electronic Penalty System.

4.1 VIS and Registration Plate Recognition System

The VIS and RPR systems are installed at the e-centres (area wise) which are linked with the state data centre SDC. SDC are connected with SWAN (State wise Area Network) .All state data is connected at Central Gateway. Cameras and RFID reader are installed at road side as shown in figure (1). The State level Data centre SDC will have list of all registered vehicles in the state. Whenever some offence occur the offender's vehicle will be deducted through RPR system by using SDC. Then RFID reader will extract the information of the owner with the help of VAHAN data, now that
Vehicle is identified with the help of unique registration number.

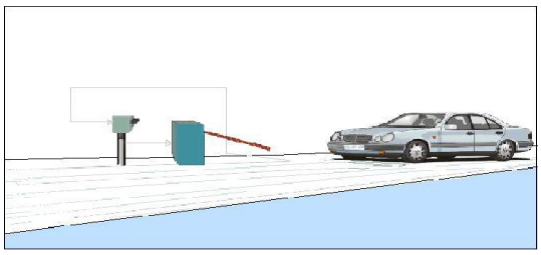


Figure 1: VIS and Registration Plate Recognition system

4.2 Detailed Design of Registration Plate Recognition System

The main aim of the Registration plate recognition system is to extract the region containing the registration plate in the captured image. This extracted region is processed by the number recognition system to recognize the registration plate's registration unique number of the vehicle. The original image initially processed in the RGB colour space. On the original image initially white colour filter is used and all the objects white in colour are extracted. All these objects are then tested against the features of the license plate in order to extract only the region of the image containing only registration plate.

The properties of the registration plate under consideration with some limitations are as follows

- The license plate should be rectangular in shape.
- The expected area in the image containing vehicle and registration plate (upper bound and lower bound etc. for area).
- The license plate contains black letters only.

The extracted number is then recognized using recognition system whose details are given below.

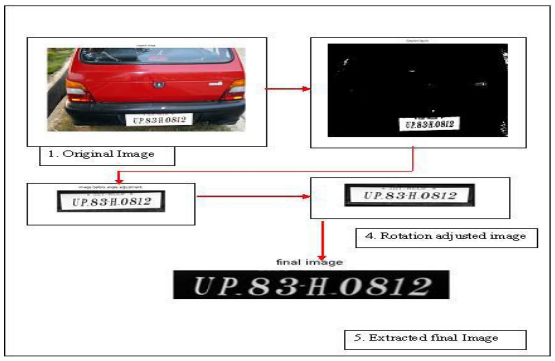


Figure2: process showing extraction of the number plate

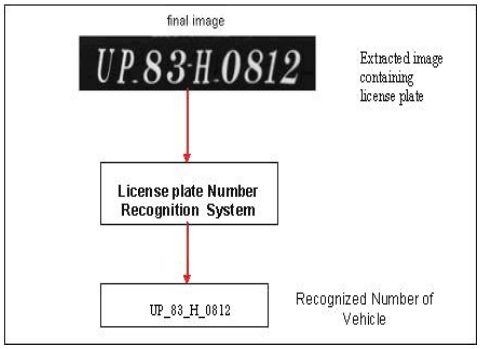


Figure 3: Recognition of the Registration Plate number

4.3 Detailed design of the Recognition System

The sub components of the proposed system are as follows

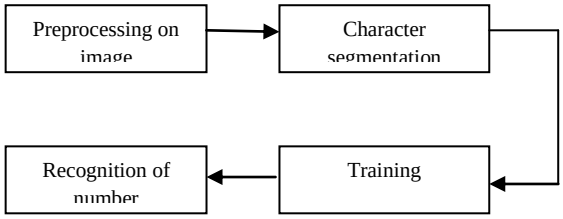


Figure 4: Sub Components of proposed system

4.3.1 Pre-processing of the Image

The first phase in our character recognition system is Thresholding i.e. to convert the text image to
Binary. Binary images are images whose pixels have only two possible intensity values. 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.
Once this is done 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.

4.3.2 Character Segmentation

The character segmentation is done using standard character segmentation algorithm.

4.3.3 Feature Extraction

The feature extraction process involves extracting features like Horizontal line, vertical line, Right slant line, Left slant line, curve and Hole from the thinned image.
Generally the compass operators are used to find out the horizontal, vertical and slant edges in the letter. The problem with this technique is that lines should exactly horizontal (0 degree), vertical (90 degree) and inclined to -45 and 45 degrees. In real scenario such conditions can not be met. So getting exactly horizontal lines, vertical lines and slant lines is difficult.

4.4 Detailed design of Electronic Penalty (EPS) System

EPS system will work as follows

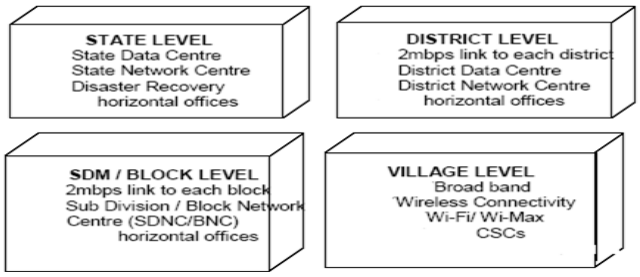
Step1. Extracted registration number received (Example: MH 46 N595) will be matched with the state in which the vehicle belongs to for this purpose the first two character will identify the state. Here MH i.e. Maharashtra

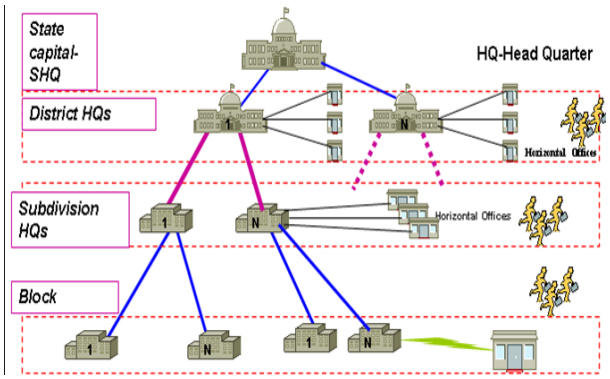
Step2. After identifying the state, next step is identifying the RTO area, for this next two digits are responsible. Example MH 46 then 46 belongs to Kalamboli R.T.O. in Navi Mumbai.

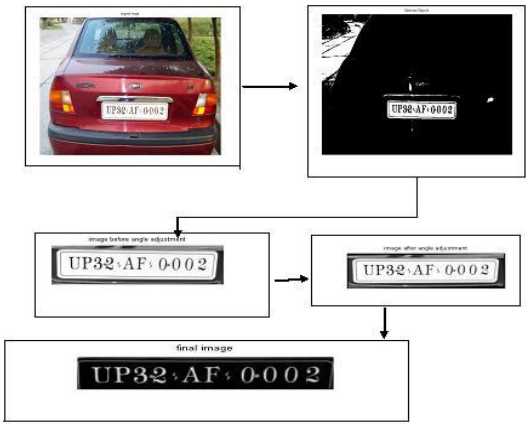
*Step 3.*After this the next numbers are Registration number, here in example N595 will be matched with the registration digitalized data of VAHAN with the help of Registration Certificate (RC)handled by R.T.O.

Step4. After this the owner's detail will be identified and penalty will be deducted from his account or from the Master Card. This could also be mapped with Aadhar Card.

4.5. Architecture for EPS







5. RESULT

For recognition system all methods are implemented in MATLAB. Once all vehicles are identified with the help of RFID so it's easy to recognize the registration plate from vehicle via methods.

Proposed work will be completed in three domains

- Development of LPR system in RGB color space.
- Development of Number plate recognition system using neuro fuzzy system.
- Architectural design of EPS.

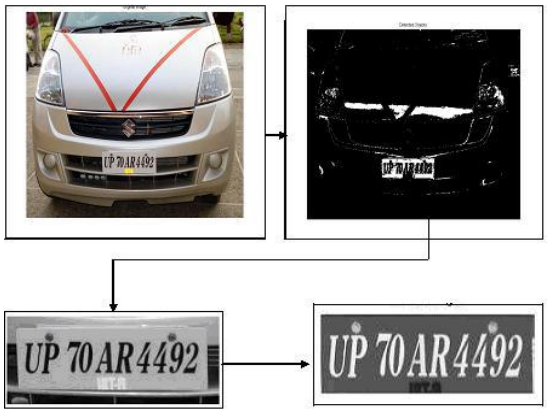
5.1Results of Registration Plate Recognition System and Number Recognition System

Every colour in RGB colour space is represented by some pixel value like

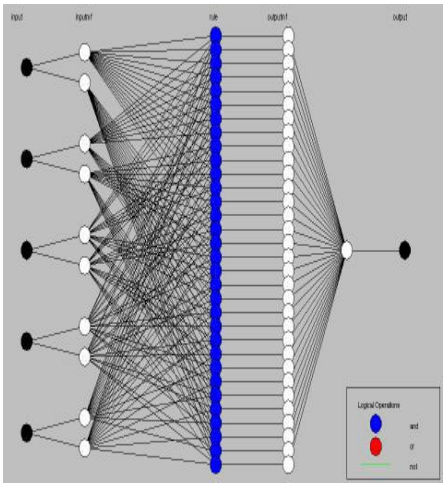
- White has RGB value [255 255 255]
- Red has RGB value [255 0 0]
- Black has [0 0 0]

Initially reference colour is specified with some RGB value and with some deviation. All the objects

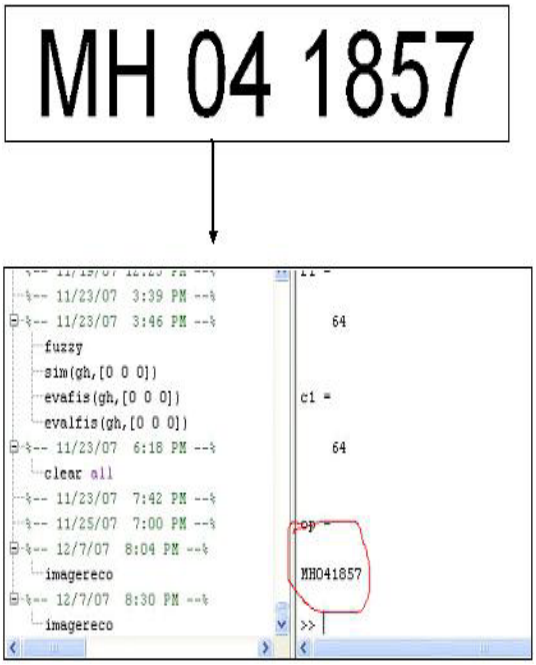
Within this range are extracted. These objects are then tested against region properties in order to extract registration plate. The input to the RPR system is RGB image and output is number plate:



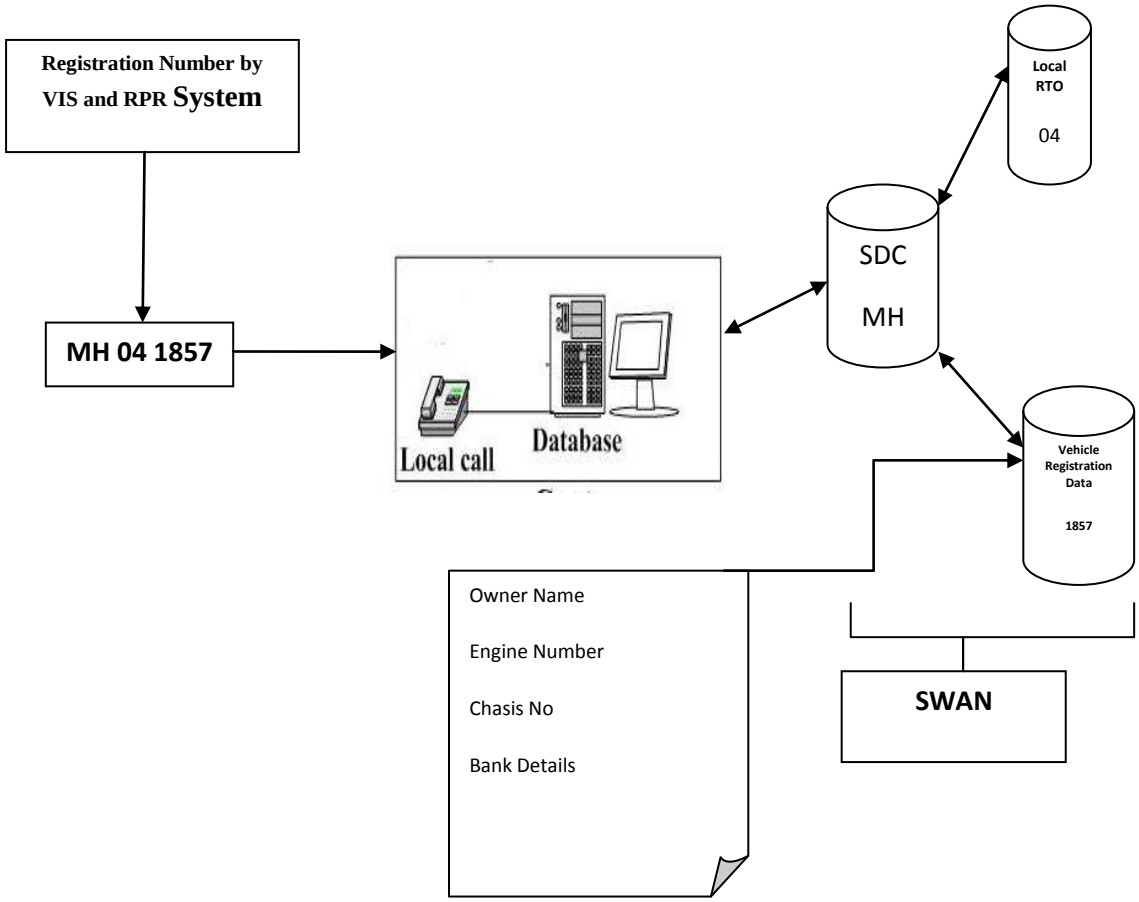
5.2 The Trained Network Is as Follows



This network is used to recognize the number plate



6. FRAMEWORK OF EPS



7. 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 penalised two or more fold the previous amount which is not possible in present scenario manually. 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.

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