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Safeguarding Street Traffic using ANPR and Red Light Violation Detection (RLVD) Systems

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A B S T R A C T

In Mumbai, where annually more than one million people die on the road, Lack of road traffic safety emerged as one of the major problems across the globe, resulting in increasing road accidents chances. Road traffic deaths and injuries have a terrible impact on individuals, communities, and countries. They involve a huge cost to overburden health care systems, occupy scarce hospital beds, consume resources, and end in significant losses of productivity and prosperity, with deep social and economic repercussions.

The presented system would involve multiple CCTV cameras which will be mounted at a certain height, where nice footage can be recorded at various Red Lights across the cities. The designed system mainly focuses on the 'seat belt wearing' parameter of four-wheelers, i.e whether a driver is wearing a seat belt or not. The system will extract relevant images from footage for the image analysis and with the help of the computer vision; the system will determine whether a driver is wearing a seatbelt. Similarly, our aim is to use technology to make the traffic environment more friendly and safe for everyone and every second. Now to make sure that people follow all the rules, we need to tell them their faults and see to it that they pay the fine. This will ensure that the person pays for his/her mistake and does not make them again in the future. Doing so will also increase the knowledge of traffic rules in the community.

Keywords: Computer Vision, E-Challan Generation, Optical Characters recognition, Automated Number Plate Recognition, RLVD, Computer Vision, Seat Belt, Image processing[1]

1. Introduction

The aim of this research paper is to ameliorate the current problems being faced daily. For a better traffic environment for the cities and towns, the situation needs to be dealt with. To do this, technology will play an important role. The ability of technology to change our lives has been observed and is also being observed daily. Today we have the entire world connected with each other through a mobile device that we take for granted. We can access any file stored anywhere in the world in a split second, the technology of the cell phone is a simple example of what great wonders we can achieve. Similarly, our aim is to use technology to make the traffic environment more friendly and safe for everyone ensure that the person pays for his/her mistake and does not make them again in the future. Doing so will also increase the knowledge of traffic rules in the community.

In this research paper, it is explained how an environment can be created where traffic violators are captured with the help of a camera and computer vision application during the violation of rules, and the fine is sent to the violator right that moment. The smart analytics system will use the Automated Number Plate Recognition (ANPR) system, Red Light Violation Detection (RLVD) system. The system will provide assistance in detecting, Violators using a Cell phone while Driving, Absence of helmet, Triple Riding Detection, Data Visualization to name a few. and every second. Now to make sure that people follow all the rules, we need to tell them their faults and see to it that they pay the fine.[1]
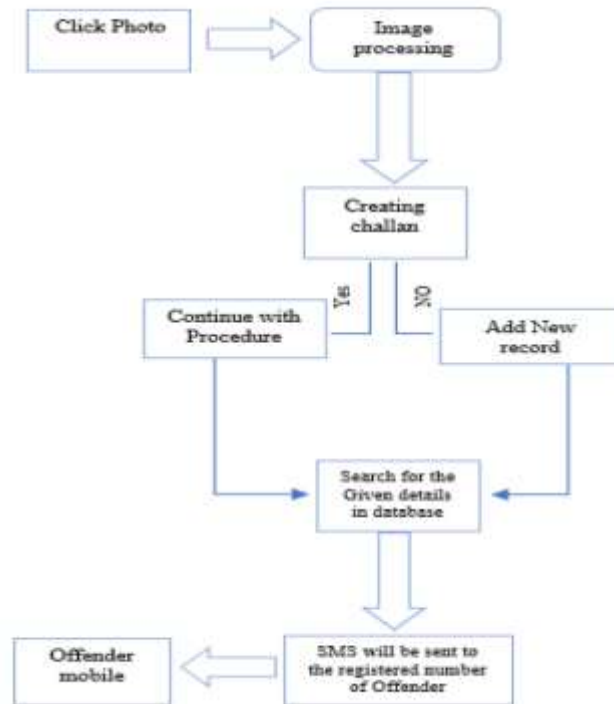
2. Proposed System

An overview of the system can be seen in Fig. 1.1. The system is composed of two subsystems:

1) Automatic Number Plate Recognition

2) Automated Challan Generation System

2.1 Automatic Number Plate Recognition

Number plate recognition is a deterrent for serial traffic offenders. The software helps with reactive security as well, which includes inspections, forensics, investigations, and legal proceedings. No matter from the perspective you look at it, automatic license plate recognition seems like a necessity for ensuring our safety on the road. In fact, it could also be particularly useful when it comes to detecting stolen vehicles. The use of ANPR in this way has proved to be important in the detection of many offences, tackling uninsured vehicle use and uncovering cases of major crime. It also allows officers' attention to be drawn to offending vehicles whilst allowing law-abiding drivers to go about their business unhindered attention to be drawn to offending vehicles.

The role of ANPR is the key to ensuring that the violators pay fine and do not continue without doing so. Its use will give an easy way for the police to find the people who might abscond from the law. ANPR is an invaluable tool in the campaign to make our traffic environment smoother and safer. As ANPR has become established, equipment costs have dropped and technology improved which has allowed ANPR to be adopted by the Police.

Fig 1.1 Proposed system overview

Automatic Number Plate Recognition (ANPR) is important for modern traffic enforcement and safeguarding public road safety in an ever-increasing road traffic volume. Automatic Number Plate Recognition systems identify unique vehicle number plates and generate vital traffic statistics to help government agencies to better monitor, maintain, and manage traffic situations, also as road system design and development.

2.2 Automated Challan Generation System

An automatic E-challan generation for a traffic rule violation is an IoT based project module that will automatically detect violating vehicles and punish them accordingly. This module is designed to reduce the work of traffic police officers so that they can focus on other violations like illegal parking, driving on the wrong side, and drunk & driving. This module will work in order to reduce the violations and make the city a better and safe place for pedestrians and vehicles. The need for automation is increasing due to the growing number of vehicles on the road every day.

3. Implementation

The presented system uses the captured images of the 4 wheelers for analyses. The developed software checks the seat belt parameter from the images. If a violation is found then the system moves for Automated Number Recognition process, where the captured images of the car are scanned, and the number plate is identified. The vehicle number is used as a key pointer and searches for all the data related to the vehicle's information such as the registration number, owner's name, type, etc.

3.1 Image Analysis

When images are to be utilized in different areas of image analysis like visual perception, it's important to scale back the quantity of knowledge within the image while preserving the important, characteristic, structural information. For achieving better results, Hough Line Probabilistic Transformation is applied to the digital images. A line is often represented as y = mx + c or in parametric form, as Where ρ is the perpendicular distance from origin to the line, and θ is the angle formed by this perpendicular line and horizontal axis measured counter-clockwise.

$\rho = x\cos\theta + y\sin\theta$

3.1.1 Pre-processing

For the present system pre-processing involves two processes: Resize – The image size from the given input image. It is to be resized to a feasible aspect ratio. Normally, these images will be in RGB mode, with three channels (red, green, and blue). The number of channels defines the amount of color information available on the image. The image has to be converted to grayscale.

3.1.2 Localization

For the present system pre-processing involves two processes: Resize – The image size from the given input image. It's to be resized to a feasible ratio. Normally, these images are going to be in RGB mode, with three channels (red, green, and blue). The number of channels defines the amount of color information available on the image. The image has to be converted to grayscale.

Localization is done by using an image processing technique called Thresholding. The pixels of the image are truncated to two values depending upon the value of the threshold. Thresholding requires pre-image analysis for identifying the suitable threshold value. The adaptive thresholding technique determines a local threshold value for every image pixel so as to avoid the matter originating from non-uniform illumination.

3.1.3 Character Recognition

Finally, the selected blobs are sent to an Optical Character Recognition (OCR) Engine, which returns the ASCII of the license number. The optical character recognition (OCR) aspect of the process can be seen in the following figure 3.1.3.[3]
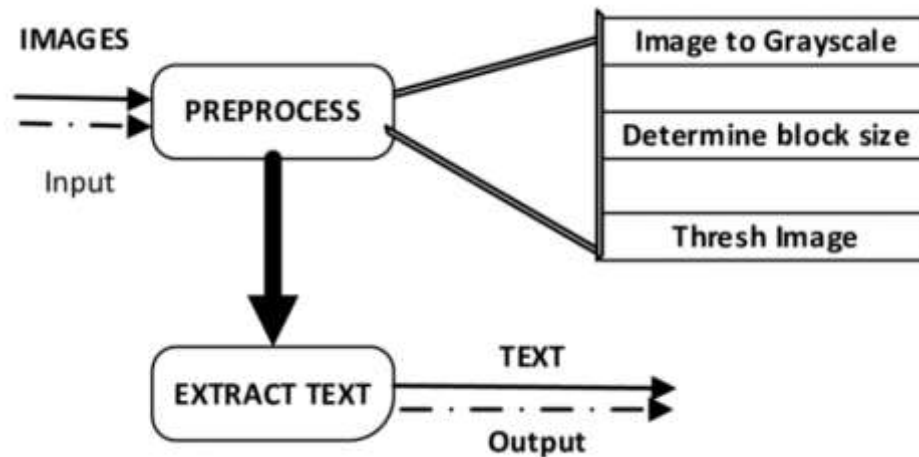

Fig 3.1.3 OCR Process Flow Chart

This database will then be used for Automated Challan Generation System and the violator is fined right at the moment.

A sample of the data collected is shown in table 3.1.

Table 3.1 Violating Vehicle data retrieved by Number plate Analysis (RegNo, ChasisNo, EngineNo Redacted for confidentiality)

Sr.	District	Police Station	CRNO	Reg Date	RegNo	Chasis No	Engin No	Make	Model	Color	Manufacture Year
1	MUMBAI CITY	DINDOSHI	72/2019	13/02/2019	MH01BA****	DSVBLK****	DSVBLK****	BAJAJ	DISCOVER DTSI	ORANGE	
2	MUMBAI CITY	VILE PARLE	53/2019	13/02/2019	MH02HA****	****	****	HERO HONDA	SPLENDOR	SILVER	
3	MUMBAI CITY	CHUNABHATTI	28/2019	13/02/2019	MH03AQ****	MD2DSJBZZRWF****	JAMBRF****	BAJAJ	BAJAJ TEMPO		2008
4	MUMBAI CITY	M.R.A. MARG	44/2019	13/02/2019	MH01BJ****	MD2836FZ5CCG****	JLZCCG****	BAJAJ	PULSAR	YELLOW LIGHT	
5	MUMBAI CITY	M.R.A. MARG	47/2019	14/02/2019	MH01XA****	MD2DHDH22NCC****	DHGBNC****	BAJAJ	PULSAR	BLACK	
6	MUMBAI CITY	VILE PARLE	55/2019	15/02/2019	MH02DM****	****	****	HONDA	ACTIVA		
7	MUMBAI CITY	B.K.C.	32/2019	16/02/2019	MH43S****	ME4KC098D7****	KC09E4****	HONDA	UNICORN	RED	2007
8	MUMBAI CITY	CHARKOP	59/2019	15/02/2019	MH02VA****	****	****	BAJAJ	AUTO RICKSHAW	BLACK AND YELLOW	
9	MUMBAI CITY	POWAI	74/2019	15/02/2019	MH02EY****	MB8DP11AHJ****	AF21****	SUZUKI	ACCESS 125	BLACK	2018
10	MUMBAI CITY	R A K MARG	34/2019	14/02/2019	MH46AA****	ME4KC09CBE****		HONDA	UNICORN	BLACK	
11	MUMBAI CITY	R A K MARG	35/2019	15/02/2019	MH01BA****	DSGBL****	DSVBLL****	BAJAJ	DISCOVER DTSI	RED	2005
12	MUMBAI CITY	MALVANI	182/2019	17/02/2019	MH02CE****			TATA	TEMPO		
13	MUMBAI CITY	R A K MARG	40/2019	17/02/2019	MH01AU****			BAJAJ	PULSAR	RED	
14	MUMBAI CITY	DHARAVI	60/2019	17/02/2019	MH01BN****	ME4KC09CHD****	KC09E8655****	HONDA	UNICORN		
15	MUMBAI CITY	MALVANI	184/2019	18/02/2019	MH47D****	****	****	BAJAJ	AUTO RICKSHAW		
16	MUMBAI CITY	KURLA	90/2019	19/02/2019	MH03CM****	MA3ERLF1S00****		MARUTI SUZUKI EECO		WHITE	

17	MUMBAI CITY	DINDOSHI	86/2019	19/02/2019	MH47AK****	MD62****	EG4LJ11F****	TVS	JUPITER	BLACK	
18	MUMBAI CITY	DINDOSHI	87/2019	20/02/2019	MH03DB****	ME4JC65BH***	JC65E7226****	HONDA	SHINE	GREY	2018
19	MUMBAI CITY	R A K MARG	43/2019	18/02/2019	MH01AT****	MA3EVB11S0****	F8BIN429****	MARUTI SUZUKI	OMNI	BLACK AND YELLOW	2010
20	MUMBAI CITY	SAMTANAGAR	69/2019	19/02/2019	MH02CT****	****	2****	BAJAJ	AUTO RICKSHAW	BLACK AND YELLOW	
21	MUMBAI CITY	SAMTANAGAR	69/2019	19/02/2019	MH02TA****			BAJAJ	AUTO RICKSHAW	BLACK AND YELLOW	
22	MUMBAI CITY	M.H.B COLONY	77/2019	18/02/2019	MH02BF****	MBLHA10EL8GA****	HA10EB8GA3***	HERO HONDA	PASSION		
23	MUMBAI CITY	PARK SITE	82/2019	17/02/2019	MH03BR****	ME4KC09CDE***	KC09E8671****	HONDA	UNICORN		2014
24	MUMBAI CITY	DINDOSHI	89/2019	20/02/2019	MH01CG****	ME4JF505CGT2****	JF50ET325****	HONDA	ACTIVA	GREY	2016
25	MUMBAI CITY	MAHIM	55/2019	19/02/2019	MH01BQ****	MBLIA12ACDGM****	JA12ABDGM2***	HERO HONDA	PASSION	BLUE	
26	MUMBAI CITY	MALVANI	187/2019	19/02/2019	MH02DE****			HONDA	SHINE		
27	MUMBAI CITY	NIRMAL NAGAR	60/2019	20/02/2019	MH04D****			HONDA	ACTIVA		
28	MUMBAI CITY	MAHIM	51/2019	16/02/2019	MH08T****	ME4JC366L8***	JC36E928****	HONDA	SHINE	GREY	2000

4. System Screenshots and Output Fig 4.2 Challan by Traffic Police
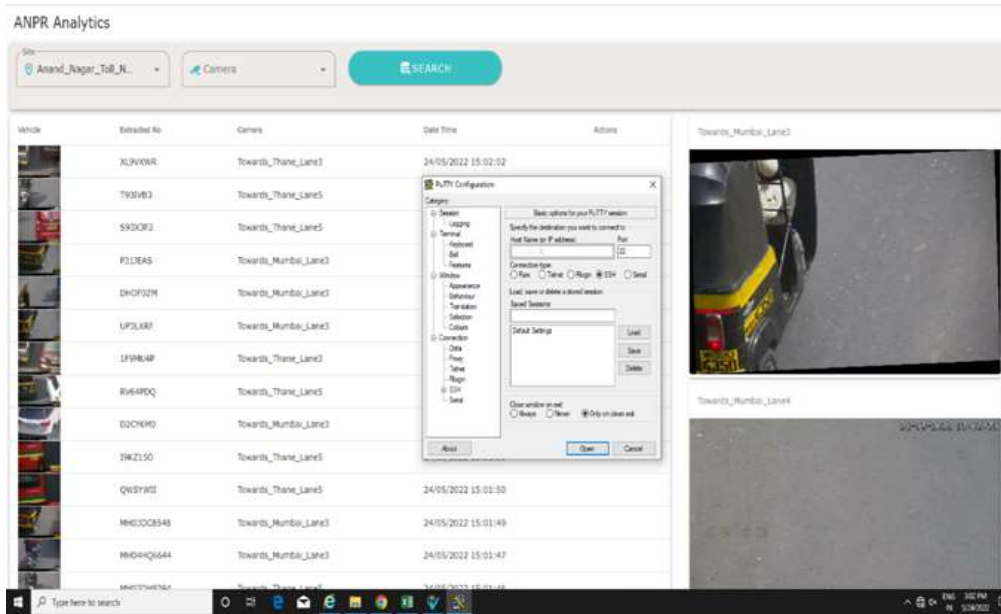

Fig. 4.1 Application for Number Plate recognition and live video

Figure 4.1 shows the user interface of the system[4]. Figure 4.2 shows the challan generated by the system[2].

Challan Details

Challan No :	MTPCCC180019354		
Offense Date :	2018-10-04		
Offense Time :	16:58:00		
License No :	NA		
Vehicle No :	MH47K1135		
Offender Mobile No :	NA		
Payment Status :	Pending		
Compounding Fees :	1000		
Offences	**Sections**	**Offenses**	**Fine Amount**
	51/177 MVA	Fancy Number Plate	1000
Evidences			
Impounded Document	No Impound		

5. Conclusion and Future Research

In this research paper, our focus was to make a safer traffic environment. But in the future, this video analytics system can be integrated into other places as well. For example, the system can be used to secure a particular residential society or secure an airport by identifying threats with the help of AI. Using cameras, sensors and powerful algorithms coupled with Artificial Intelligence holds a lot of potential in the future. This combination is what the next generation will be leveraging in their everyday life. It is our time to develop technologies that would benefit future generations and see to it that simultaneously a safer environment is also achieved.

References

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[4] https://www.lntecc.com/smart-world-solutions/surveillance-infrastructure-companies-lnt-construction-mumbai-surveillance-project/