AN EFFICIENT APPROACH TO TRAFFIC VIOLATION DETECTION AND FINE GENERATION

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ABSTRACT

Most of the people have been struck in traffic one time or the other. The people that violate the traffic rules are a cause of concern not only by the traffic police of various countries but also for the general public that does follow the traffic rules laid by the government. The increasing number of road accidents can also be tackled if there is a suitable measure that deals with the problems of having less manpower than the number and areas of traffic violators. The procedure for levying fine also consumes a big amount of time. This paper discusses an automated traffic violation detection system that could supplement and support the present traffic monitoring strategies. This system is split into three main parts that comprise of video surveillance processing, database management and violation fine generation.

KEYWORDS: Traffic Violation Detection, Computer vision, Traffic Monitoring, Video Image Processing, Traffic violation fine generation

I. INTRODUCTION

Most of the people have been struck in traffic one time or the other. The increasing number of road accidents is also a major cause of concern for many countries. Since there are so many traffic violations everywhere, more traffic police are needed. The road accidents are happening most often due to the reckless and speedy driving of the vehicles, not obeying or following traffic rules, the attitudes of the “right of the mighty” bigger vehicles toward the smaller vehicles, overburdened or overcapacity hauling of public and transport vehicles, poor maintenance of the vehicles, drunk and driving, driver fatigue, and above all the appalling condition of the already chocked roads with every inch encroached by unauthorized persons and properties[6].

The government is finding it difficult to have enough traffic police personnel as the number of traffic accidents and violations rise day by day.

In addition, computer technology has also revolutionized a lot of fields including traffic monitoring. It has brought many changes to this field ranging from the automatic collection of toll tax of vehicles to the online challan management of traffic violators. Road and traffic surveillance systems are being used in the form of CCTV cameras. But even after utilizing these methods, the violations are not decreasing as there is a lack of proper monitoring and fine generation also.

The quest for better traffic information, and thus, an increasing reliance on traffic surveillance, has resulted in a need for better vehicle detection [2]. In particular, the vision-based approach is promising since it requires no pavement adjustments and has more potential advantages such as a cheaper cost, larger detection areas, and it is also more flexible and suitable for vehicles identification [3]. We argue that the traditional system of traffic surveillance should be supplemented by an automated system of traffic violation detection also, so that there could be an efficient use of traffic monitoring and also to reduce the number of traffic violations.

Vehicle tracking systems using three-dimensional models have been studied by various groups, the most prominent being at Karlsruhe (Koller et al., 1993) [8] and at the University of Reading (Baker and Sullivan, 1992; Sullivan, 1992) [2]. These models focussed on higher accuracy with less number of vehicles.
In region based tracking of vehicles, the process is initialized by the background subtraction technique [3]. A Kalman filter-based adaptive background model (Karmann and Brandt, 1990; Kilger, 1992) [7] allows the background estimate to evolve as the weather and time of day affect lighting conditions. This method works fairly well in less amount of traffic but cannot work well in areas with a dense amount of traffic.

Contour-based methods [5] track the contour of the object using deformable object models (active contours). Feature-based methods [4] track parts of the object (e.g. corners). The advantage of this approach is that even in the presence of partial occlusion, some of the features of the moving objects remain visible [9]. Also, same algorithm can be used under various lighting conditions as it selects the most salient features by itself.

A knowledge-based method was also proposed for vehicle tracking. It involved separation of shadows from vehicles using knowledge including results of edges detection, road direction, date, time, etc [10]. The knowledge was built for a long amount of time.

The challan generation by the traffic police in India has become online, popularly known as e-challan. In the city of Mumbai, automatic challan machine can be spot. It will consist of hand held gadget for spot quality collection and layout printed receipt [1].

Hence, computer technology has a major role to play in the overall development of innovative traffic monitoring and challan generation mechanisms that will have impact on the management of road accidents and traffic rule violations. In most of the countries, traffic monitoring systems are complex and regulated by government or professional bodies. Also, the cost of the generated challans by traffic rule violators is highly dependent on the rule violated and the city or area in which it happened.

The traffic rules vary from area to area and country to country. So, it is difficult to maintain uniform vehicle detection and monitoring system that can be used everywhere.

In the meantime, some confusion is also detected in the literature over which method of vehicle tracking (model based, region based, contour based or feature based) should be used.

On the other hand the literature is also unable to conclusively decide over which one of these methods would give better results as there are different types of vehicles and different density of traffic in various areas. As such, there is a need to explore these issues, so that more valuable arguments could be added into the literature.

II. METHODOLOGY

In this paper, the new system has been developed which is known as Traffic Violation Detection and generation of e-challan. This system has the features for the details of the registered vehicles to be added into the database, monitoring of the real time traffic by CCTV video footage and generation of challan by the traffic police accordingly, if a traffic rule is seen to be violated. Meanwhile the traffic police administration can also use this system to do further analysis, as and when they require, by keeping the records of the violations separated area and city wise. Moreover this system also provides the added advantage of adding as many areas and cities as are required.

The main objective of Traffic Violation Detection and generation of e-challan System is to provide convenience to road traffic monitoring administration and the general public, increase accuracy of the detection of traffic rule violations recorded by the video surveillance cameras.

This system will concentrate on the management of three main parts that are video surveillance processing, database management and violation fine generation.

In the first part, processing of the video obtained from the CCTV camera will take place. The various methods such as Gaussian blur, thresholding etc. can be used for this.

In the second part, the details of all the registered vehicles and the drivers can be added to the database. The details of contacting the driver (in case a challan has to be issued against him or her) should also be present. The data recorded in this phase should also be backed up properly, in order to be protected by an unforeseen situation. The various traffic rules and the fine for violating them should also be recorded in this phase. Due to
the presence of a variety of traffic rules and regulations and different combinations of fines, this data is to be added into the database area wise. The database has high chances of a huge number of insertions and deletions from it, so it should be maintained flexibly but consistently.

The third part consists of fine or challan generation. The captured video or image of the traffic rule violator can serve as the basis of the levied fine. The challans and fines should also be added into the database in textual or visual form. The generated challan can be sent to the violator based on his or her recorded details from the database. This step is to be carried out only by a government official or by a person of required authority. The flow chart of the system as shown in figure 1 shows the integration of the three parts.

The main weaknesses of the current traffic monitoring system are in terms of time wasted by the traffic police administration. The amount of time spent on monitoring the traffic manually and physically should be replaced by an automated computer system. The automated system could also check corruption and wrong fines levied to the drivers.

There is a large amount of hassle involved in monitoring the traffic manually due to the changing weather conditions and the road management. There is a lack of traffic police in remote and urban areas so there is a strong need to monitor the traffic by the available resources and with the help of existing policemen only. And, lastly, manual file keeping is also being a major barrier of the current system. There are still police records that use manual system including the file keeping. Since the files are kept using the clip files or the paper files and are placed on the shelves, it is a problem for someone who wants to do the inserting, deleting and retrieving data. The files which are kept for a long time might be very tedious to read because the content might become blur or being destroyed by insects. The files might get lost too. This cause problem for keeping old data.

The researcher has developed the new idea of Traffic Violation Detection System after considering current and similar system. The vehicles can be monitored using computer vision and if they are found to be parked in a ‘no parking’ area, then by Optical Character Recognition (OCR) the violator can be fined. The challan or ticket can also be sent to the violator on his mobile phone by retrieving his or her details from the database. If a vehicle is violating a red light, the snapshot can be captured of the monitoring screen. Then, the violator can be fined either manually or by using OCR to detect the license registration number of the vehicle. Hence, this system is automated, better and more efficient than the present system.
III. MODELING AND ANALYSIS

The author has concentrated on Traffic Violation Detection System (TVDS) based on the previous research and analyses. This system uses computer vision, to automate the monotonous, cumbersome and time consuming task of traffic police monitoring. This system uses computer vision to detect vehicles. This method is useful and convenient because after training the model on vehicle images, it is able to detect most of the images of passing vehicles. Hence, it is able to automate the tasks requiring manpower easily and efficiently. The other reason for using computer vision is to easily record the violating vehicles. The vehicles, if found to be illegally parked could not only be fined but also, their online record can be kept while detecting them. So, it facilitates the convenient method of online record keeping also.

This traffic rule violation detection system holds the possibility to reduce the traffic rule violations drastically. Many times it happens that when the challan of a violator is being made, then in the meantime the other violators go away. Also, people who don’t have a driving license or insurance flee as soon as they see that the fines are being levied by the police. In such cases, the records of the violators are not made and the fine is also not levied. This gives rise to the traffic rule violations. The increasing number of traffic rule violations also adds to the increase of road accidents. The people losing their lives in road accidents are often those people that have become habitual of breaking the traffic rules and getting away with it without being fined. In most of the countries, CCTV cameras are installed to monitor the traffic and check the violations. In India also, the concept of e-challan is making impact. In India, this challan is generated by the traffic police manually. The picture of the violating vehicle is captured by the police, which contains the proven evidence against the violating vehicle. Then, a fine is generated against the violator and sent to his or her mobile via a SMS. Despite being efficient, this system lacks the efficiency of automatic detection of violators. By using computer vision a satisfactory portion of the violators can be detected conveniently, thus saving the precious time and efforts of the traffic police.

The major advantage that the Traffic Violation Detection System (TVDS) has is the proper management of the database of the general public. The database has to be managed by the government, so the new records can be added using vehicle registration numbers also. The information can be added with the purchase of every new vehicle. So, it eases the searching, insertion, updation of users’ records.

IV. RESULTS AND DISCUSSION

The new developed system, Traffic Violation Detection System (TVDS) will be explained in terms of three modules such as video surveillance processing, database management and violator fine generation. The vehicles are detected based on the contour method, which gives a high rate of accuracy. The developed system is able to support and supplement the current traffic monitoring system. It can easily be integrated with just an initial set up of adding cameras, areas, database and traffic rule violation information.

While, the two major aspects of feasibility such as technical and operation in feasibility assessment also will be attempted. This system will be initiated by identification of the problems that happen or requirements that are needed in a certain area. Therefore, a system which can add variable number of cameras, violations and users should be initiated. It is also initiated due to the fact that people frequently violate traffic rules if they had not got caught for the violation earlier and were able to get away with it.

The system must also be able to keep information of the user and their registered number of vehicles, the license plate registration numbers and their contact information for reference by the user of the system (which is the traffic police). Through the system, the captured snapshots of the violating vehicles can be added to the database and the fine can be generated against the vehicle.

Processing of the traffic footage is the first part in Traffic Violation Detection System (TVDS). There will be multiple users of the system. The users of the system will be the verified traffic police only so that the generated fine can be authentic. Also, the database will include the details of a large portion of the country’s population. Hence, backing up and careful handling of the data is also needed. By integrating database from the various sources of the government departments, such as new licenses generated in the country, new vehicles bought by
the users, etc. data insertion and updation can be more easily done in this system. The system has been designed using advance and intelligent techniques that are already in use to help the system to produce the best solution. The system provides the ability to add in increments and to modify application quickly and simply via an intelligent user interfaces. It provides a wealth of possibilities to define field attributes including controls for missing data, data entry restrictions, code lists, data validation rules and many more.

The second part is known as database management. In this part there will be addition and deletion of users’ records. Various validation rules can be applied to check integrity, consistency and authenticity of the database. For example, age of a person cannot be negative, License plate number should have the initial letters as capital, the contact information of the user should be available in at least one form and should not be null. These type of validation rules can be used, improved and applied based on requirements of each and every area, as and when required. The database user can add as many information as the memory of his or her system’s memory persists.

Ideally, the database should be stored and backed up in multiple physical locations to ensure data availability even if an unforeseen calamity or disaster occurs, natural or otherwise.

And, the last part is about violator fine generation. This is the most important part of the system. If the CCTV is installed in such a way that the license plate numbers of the vehicles can be monitored easily, then it will become convenient for the user of the system to generate the fine.

The E-challan can be generated in the method as described in Figure 2 [1]. This part can be carried out in the comfort of the traffic police station also. The challans can also be added to the database (for future references) in a separate folder called ‘tickets’. If the vehicle is illegally parked, then the challan can be directly generated by the system also.

V. CONCLUSION

The Traffic Violation Detection system is a system that helps the traffic police to generate, detect and track the vehicles that have violated the traffic rules conveniently. This system is developed completely in Python language. The database is developed using SQLite. Researchers feel contentment due to the fact that the developed system will be beneficial for the traffic police and the general public and also due to building a system with skill that was not being learnt or learnt a little. Some machine learning terms have also been learnt in the process of building this system and also the knowledge of computer vision and vehicle detecting is also improved as well as the knowledge of Information Technology field.

In terms of implementation, the subsystems were put together to make sure that it is in working order. Fine tuning of the system is also done as some of the sub system could not be link together at first. The implementation is used to check if it is easy to be used by other people. The purposes are to test and compare its functionalities with almost similar system out in the current scenario. Also information can be gathered about the system so that the minor adjustment or subsystem that was missing can be build and implemented in to the system again. The system is built by developing an easy-to-use Graphical User Interface (GUI) to facilitate easy
access to the system. The developed system is highly flexible and scalable, as the information can be added and removed by the users of the system easily. The cameras, violations, camera groups can be added by the system user with just a click. It can also be used in various variants, if the area needs different types of traffic rules violations check.

The system adopts user-friendly control interface and the usage of easy words makes the user to operate the system without doubts and difficulties. The openness of the source codes and documentations will make future enhancements and improvements to be done easier. To avoid the waste of time and effort, schedule is planned tightly. Each task was done before the schedule deadline to enable necessary corrections and debugging. Backup copies of the system were made varied by time and stored in different places in order to recover from any defects or data loss. As the system was tested matching the desired input with the desired output thus the system has a certain level of reliability. The system also gives the facility of using it in dark or white theme, so that the user doesn’t feel bored with the provided interface.

When thinking about future research directions it becomes apparent that the goal needs to be a real integration and use of the developed system. This implies a number of changes in the ways that research is done at the moment. It will become more important to devise faster and newer ways to automate the daily and monotonous tasks of the traffic police. Also, there is a need to do further research to increase the accuracy of the current system. The future holds definite possibilities in the field of accurate and definite detection of traffic rule violators being done completely automatically, utilizing the techniques and efforts of machine learning and computer vision.

VI. REFERENCES


