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Survey on Speed Detection of Moving Objects

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ABSTRACT-

Manual and legacy technology is used to detect over speeding in developing countries like India. This process can be easily automated by leveraging the powers of image processing and machine learning. Moving object detection is one of the crucial tasks in image processing because of its important role in many real-world applications. Vehicle speed detection can be achieved by employing image and video processing methods to determine vehicular speed. Given that India is now moving towards automated solutions to curb traffic violations and road accidents, we focus our efforts on characterizing these violations in Indian cities. The conclusion of our research comprises of which technique is much better choice and why it not yet implemented in all over India.

Keyword: Visual Average Speed Computer and Recorder (VASCAR), Blob Detection Algorithm and e-challan

Introduction

In 2004, fatal injuries from road accidents were predicted to become one amongst top 10 leading cause of death by the end of 2021, and the trend shows that middle-income developing countries (like India) are going to get the hardest hit. The number of disastrous road accidents also increased from 450 in 2020 to 498 in 2021, a jump of 9-10%. While fatal road accidents killed 375 people in 2020, some 409 people died last year. [1][2].
Previous research in the field of behavior studies regarding traffic rule violations has shown that in more than 70% cases, the role of human behavior is one of the causes [3]. Most of these accidents can be prevented if the traffic rules are properly followed. In India, the traffic police across states have started adopting the automated traffic management systems to promote adherence to traffic rules [4]. Such automated systems vary in their functioning and usage across the states. Some systems are capable of tasks like capturing violations and issuance of e-challan without any human intervention. At the same time, others can also generate challans along with photo evidence and send it to violators through SMS [5].

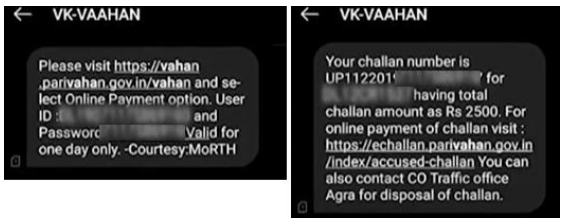

Figure 1: A sample e-challan SMS

Literature Review

This paper is on an experiment in which four morphological operations are working to reduce the noise from the gray scale image and thereby enhancing the quality of the image.
In the literal [10], authors introduce the first step towards developing the Speed Detection Radar, where he explains "Adaptive Background Subtraction"
Rad A. G. et al. [11] developed a system in which they used video and image processing toolbox which calculates the speed of vehicle. It resulted in average error of speed . This system could operate on images with various resolutions and different video sequences.
Leite A.V. et al. [12] determined a way for estimation of speed in induction motor with sensor less control. Extended kalman filter was used as speed detection technique.

Problem Definition

Vehicle speed detection is the process of locating a moving vehicle using a camera. capture vehicle in video sequence from surveillance camera is demanding application to improve tracking performance. This technology is increasing the number of applications such as traffic control, traffic monitoring, traffic flow, security etc. The estimated cost using this technology will be very less. Video and image processing has been used for traffic surveillance, analysis and monitoring of traffic conditions in many cities and urban areas. Various methods for speed estimation are proposed in recent years. All approaches attempt to increase accuracy and decrease cost of hardware implementation. The aim is to build an automatic system that can accurately localise and track the speed of any vehicles that appear in aerial video frames.

Objective

In this research work a real time technique for vehicle speed detection and automated number plate recognition using image processing is presented old methods for speed detection techniques include radar- or laser based devices to measure speed of vehicles such techniques are comparatively more costlier than a still camera. In this image is captured of moving vehicle and is used for estimating its speed as well as for automated number plate recognition. When the moving object is running on road because of the relative motion of the camera and moving vehicle / object in the camera exposure time causes motion blur in moving region of image. This system aims at provide visual solution for speed estimation of object in motion. It detects number plate automatically by capturing the frame of an object in motion.

Research Methodology

(1) VASCAR Speed Detection

Visual Average Speed Computer and Recorder (VASCAR) is a method for calculating the speed of vehicles — it does not rely on RADAR or LIDAR, but it borrows from those acronyms. Instead, VASCAR is a simple timing device relying on the following equation:

Speed = Distance / Time

Figure 2: Speed Detection by VASCAR

Police use VASCAR where RADAR and LIDAR is illegal or when they don't want to be detected by RADAR/LIDAR detectors.[6]

In order to utilize the VASCAR method, police must know the distance between two fixed points on the road (such as signs, lines, trees, bridges, or other reference points) [6]

When a vehicle passes the first reference point, they press a button to start the timer. When the vehicle passes the second point, the timer is stopped. The speed is automatically computed as the computer already knows the distance.[6]

(2) Blob Detection Algorithm

Blob detection algorithm is a technique which can track the motion of non-stationary objects in the frame. [7]

A blob is defined as a collection of pixels which are identified as an object. This algorithm determines the location of the blob in consecutive frames of images. [7]

Pixels with similar intensity values or color codes are clubbed to determine the blob. The algorithm is capable to detect multiple blobs in the same image and differentiate their speed and motion. This method has to estimate factors like size, location and color to determine if the new blob shows resemblance to the previous blob such that the blob has the same label name.[7]

```
for each pixel in the image matrix
{
        if pixel is blob color
        {
                label pixel = 1
        }
        else
        {
                label pixel = 0
        }
        repeat loop for all pixels
}
```

Research Questions

The existence of large scale digital data such as traffic violations in a city can be utilized to derive a lot of information and characterize such violations in detail. Law enforcement agencies can get valuable insights from the distribution of violation types in a city. Moreover, an analysis of user behavior towards paying a violation penalty could be useful in drafting future legislation. Thus, we address our first research question:

RQ1:*How can e-challan data be used to characterize the distribution of traffic violations and e-challan payment patterns as well?*

We are also interested in analyzing the spatial and temporal patterns in traffic violations across cities. It can help in designing more robust and effective intervention measures for traffic regulatory bodies.

For example, the variation of traffic violations across different areas and localities would allow law enforcement agencies and policymakers to design more violation-specific intervention measures for each region. Similarly, the temporal patterns in traffic violations across the days of the year can be used to deploy surveillance resources effectively.

RQ2: *What happens if traffic e-challan not paid?*

When an e-challan is issued to you, you need to pay the fine amount within 60 days of receipt. If you fail to do so, a police constable can knock your door anytime soon and the case will be registered against the traffic offender under section 187 of Motor Vehicle Act. Also in the worst case, the matter reaches the court and your driving license could also get canceled. [8]

RQ3:*In How many states has e-challan system implemented across India ?*

E-challan System has been implemented in Bihar, Chandigarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand, Jammu & Kashmir, Punjab and Puducherry at present. [9]

RQ4:*Why AI Speed detection is implemented in major cities and not everywhere across India?*

AI Speed Detection devices requires maintenance which is easily possible in major cities. But in rural areas the security to such devices comes under risk and people might damage the device and if security is provided to such devices in rural areas, the cost of maintenance is more than the device cost and hence only in major cities these devices are installed.

But the Traffic Police Department has come up with a device which is installed in cars named “AI Interceptors”. This help to keep traffic violations under control.

Limitations & Future Scope

Every development has some drawback or lack of necessary feature that emerges with the usage and need. The project can be developed even more by adding vehicle detection wireless sensing networks and implementing a wireless sensor network will be another interesting which will open up much more application areas. Advanced image processing algorithms and libraries could be used so that the system can be used efficiently even during unfavourable lighting conditions and during the night time as well.

Conclusion

As time progresses, the number of vehicles on road in addition to traffic violations in metropolitan cities of India rises, but by using e-challan we can limit the time spent on manual challan’s and also have maximum cases using this AI Speed Detection.

Our report helps in understanding VASCAR Speed Detection and why AI Speed cameras are implemented only in major cities.

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