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Accident Detection in Live Surveillance

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Accident Detection in Live Surveillance

Shrey Gupta[α] & Vandana Choudhary[σ]

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Index Terms: deep learning, heatmap, openCV, ROI, SSD model, tensor flow.

I. Introduction

With the increasing number of vehicles on the road there is a need to develop a system which provides information of vehicles to the driving assistant system in intelligent transportation system. It is an essential building block for traffic monitoring and many other applications. Smart traffic monitoring system is incomplete without the existence of system that is capable of detecting any traffic problems automatically, such as traffic rules violation and traffic jam. Thus, the problems solved by this project are:

a) Accident in India

In our country road accidents is a negative externality associated with expansion in road network, motorization and urbanization in the country. A major public health problem is the road traffic injuries, leading to loss of life and forever sufferings to the family of the victim causing disabilities and hospitalization. In case of India, road injuries is the number one causes of death and health loss among persons of age group 15-29 years. During the calendar year 2016, the total number of road accidents is reported at 4,80,652 causing injuries to 4,94,624 persons and claiming 1,50,785 lives in the country. and their number increases around 10% annually. Rail and coastal shipping account for about 32 per cent and 7 per cent, respectively, while the share of inland waterways transportation and air is less than 1 per cent each. Railways are a relatively cheaper mode of transport and are mainly used for transporting bulk materials over long distances.

b) Deaths due to Over Speeding

Over speeding or dangerous driving is the single largest killer on India's roads. According to data compiled by the Ministry of Road Transport and Highways, in 2015, 44.2 per cent (64,633 out of 1,46,133 deaths) of road accident deaths were a direct consequence of over speeding, while of the total accidents 47.9 per cent (2,40,463 out of 5,01,423 accidents) were linked to this.

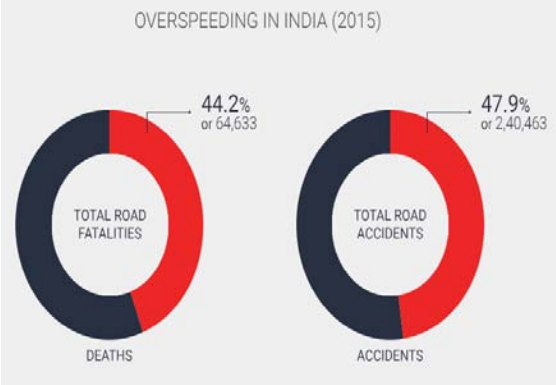

Figure 1

c) Deaths due to Wrong Way Driving

Traffic police study reveals that, almost 30% of road accidents are caused by this dangerous convenience of driving into oncoming traffic. The cops have already booked 1,53,891 drivers till date. According to the Union ministry of road transport and highways, 5,705 people were killed across the country in accidents caused by using the wrong side of the road.

Figure 2

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II. Proposed System

The proposed system will help in developing a smart city transportation system that is capable of sending alert to authorities by detecting the speeds of the car, car moving in wrong direction and collision which can help us in decreasing death caused by road accidents. Traffic jam can also be detected by slow speed and high volume of vehicles, and we can estimate road profile based on it. The road accidents can be reduced by speed detection of a vehicle and wrong direction of moving vehicle thus help to stop the violation of traffic rules to maintain smooth flow to traffic on city roads.

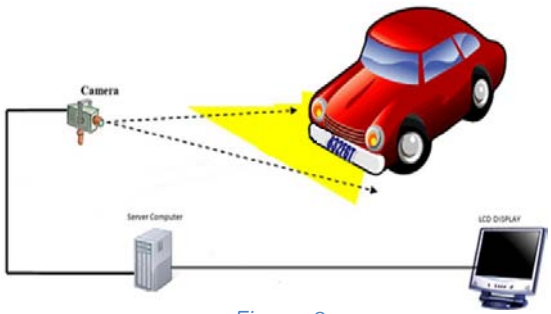

Figure 3

a) Software and Libraries used

The main libraries used in this project to implement different modules together are:

Python 3

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. The other languages use punctuation, but python uses English keywords instead. Python 3.0 is a new version of the language that is incompatible with the 2.x line of releases.

OpenCV

OpenCV (Open Source Computer Vision Library) is a machine learning open source computer vision software library. OpenCV is built to increase the use of machine perception in commercial sector by providing a common infrastructure for new technologies and computer applications. By using this library code can be modified easily and utilized for business.

TensorFlow

TensorFlow™ is a high-performance numerical computation open source software library. The TensorFlow Object Detection API is built on top of TensorFlow open source frame work that makes it object detection models easy to construct, train and deploy on the projects.

III. Working of Proposed System

The proposed system consists of 3 different modules. These are explained below:

Car Speed Module detects the speed of the car ensuring the road safety and reduce in the number of road accidents caused due to overspeeding.

Collision Prevention Module detects distance between car and object and help to pre-charge the brakes in conjunction with an automatic braking or emergency brake assist system.

Wrong Way Detection Module detects car moving in wrong direction by mainly the two causes- overtaking and lazy/reckless driving

Accident Detection Module detects accident caused due to overspeeding, wrong way driving. Also, it sends alert to authorities so that on time help can be provided to the road accident victim.

a) Module 1: Car Speed

In this the vehicle is detected by frames using OpenCV and then with the help of the tensorflow detection api these frames are processed and vehicle is detected. After the Vehicle is detected its image is stored and then check for the direction of the vehicle by using the approach defined in car count module.

The main area of interest for us is when the car crosses the ROI line area. The pixel length is calculated by subtracting the bottom position with the bottom position of the detected car. After that the real scale length is calculated by multiplying pixel length with 44 to convert the pixel length in meter.

Total time passed is also calculated by subtracting the current frame number at which the car is detected from the current frame number detected lists. To know the scale of the total time elapsed for a vehicle to pass through ROI area (24 = fps) the Total time passed is multiplied with 24.

Finally, the speed can be computed by:

- speed = real_length / real_time_passed / constant

To get the vehicle speed in kilometer units, compute the following mathematical calculation:

- speed = speed / 6 * 40

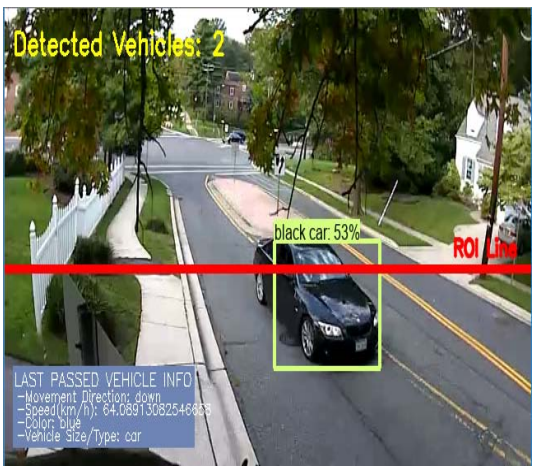

Figure 4

b) Module 2: Collision Prevention

A collision Detection system, also known as a precrash system, forward collision warning system, or collision mitigating system, is an automobile safety system designed to prevent or reduce the severity of a collision.

The camera on the dashboard detect he object by using TensorFlow object detection api and then calculate the distance relative to object from camera. If the distance is less than 0.5 m then the warning is issued on the car dashboard with the alarming sound in the speakers of the car.

Having analyzed the results the loss of speed after impact depends on the initial speed of a car and the angle of collision. The bigger collision angles the higher speed loss is after the hit. From the car movement trajectories after the modeled accident it is observed that the character of the trajectory depends on: the angle of collision, the car speed before the impact. The bigger the angle between the movement direction and the road fencing, the bigger the deflection of the trajectory appears.

Figure 5

c) Module 3: Wrong Way Detection

Wrong way driving crashes occur infrequently, accounting for almost 3 percent of all crashes, but they have a very high likelihood of resulting in fatal or serious-injury crashes. The causes associated with wrong-way crashes tend to make them spatially concentrated to particular stretches of roads, making it important to identify and monitor such high-risk locations. The detail about two popular scenarios of people driving in wrong direction are as follows:

Scenario 1 (Overtaking):

IDEAL: According to the traffic rules of India, there should be no overtaking when there is a single lane for both the directions of traffic as shown in the figure 6.

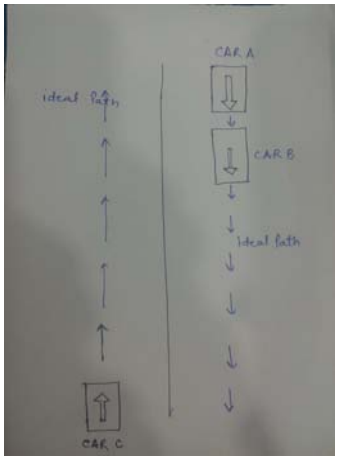

Figure 6: Shows the ideal way of driving without overtaking vehicles

REALITY: Most of them do not adhere to that rule and overtake the vehicles by moving onto other lane (opposite traffic lane) as shown in figure 2. There is a very high probability that the overtaking car (Car A), the car being overtaken (Car B) and the car travelling on the opposite lane (Car C) can meet with an accident.

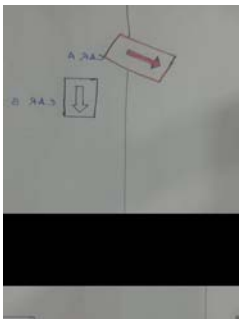

Figure 7(i)

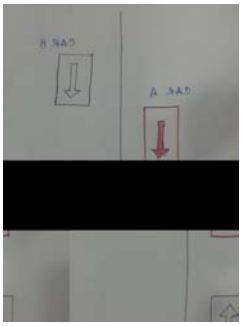

Figure 7(ii)

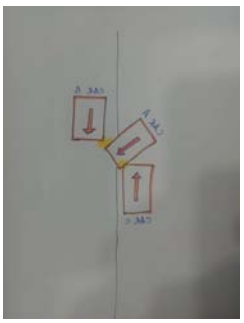

Figure 7(iii)

Figure 7(i),(ii),(iii): Shows overtaking of a vehicle by driving in the wrong direction

Scenario 2 (Lazy/Reckless Driving)

IDEAL: As shown in the figure 8, the Car A should cross over to the right lane and then cross into the desired street.

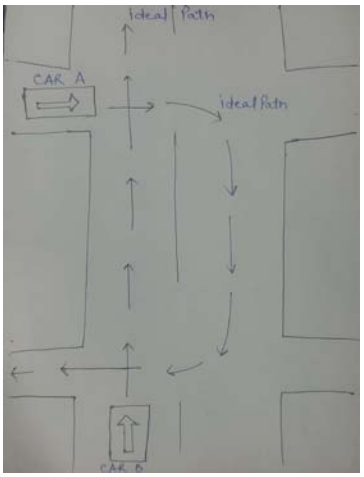

Figure 8: Shows the ideal way of driving of vehicles.

REALITY: Lazy or reckless driving is one of the most common practices by common man used for saving fuel and time. As shown in figure 4, the Car A travels in the left lane (wrong lane) and tries to sneak into the adjacent lane. This can cause an accident if at the same time there is another car like Car B which travels in the right direction but ends up in an accident.

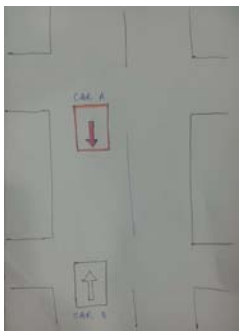

Figure 9 (i)

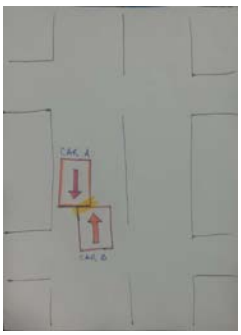

Figure 9(ii)

Figure 9(i) & 9(ii): illustrating the reckless driving by driving in wrong direction to save fuel and time

Design of solution

As a solution for the above stated problem by setting up a device which consist of an SBC (Single-Board Computer) like Raspberry Pi, a siren, a red LED light. The raspberry pi can handle the computer vision processing work and give inputs to siren and LED lights to function appropriately.

The solution model will consist of two blocks:

- *First Block:* Intelligence to detect whether there is any vehicle driving in wrong direction using Computer Vision.
- *Second Block:* Using the output generated from the first block, the second block can be used to ring the siren and glow the red LED light whenever wrong direction driving vehicle is detected on either/both sides of the road.

By implementing the above solution model, we can alert the vehicles on either side of the road to be extra careful. In this project, we will only deal with the first block (computer vision part) of the above-mentioned model.

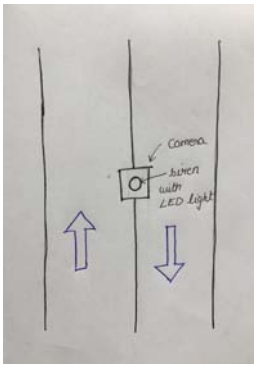

Figure 10(i)

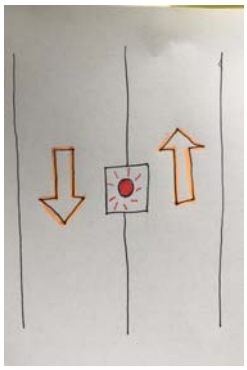

Figure 10 (ii)

Figure 10(i) & 10(ii): Shows that whenever the camera detects vehicle in wrong direction, the siren rings and the red LED light glows

d) Module 4: Accident Detection

In this the vehicle is detected by reading frames at multiple instances from webcam to different variable frames using OpenCV and then with the help of the tensorflow detection api these frames are processed and vehicle is detected. After the Vehicle is detected its image is stored in different frame. And reading of frames at multiple instances from camera and then these frames are stored at different variables.

The difference in frames is calculated. And calling of the difference function occur with the opening of histogram of the two main images store.

When the accident occurs the two-image frame gets overlapped with other rms value of the two images opened before is calculated. If the RMS value of the images is less than 250, then there is a similarity between images. i.e., Scene similar to an accident is found and alert to authorities is send and frame is updated.

Finally, the RMS can be computed by:

RMS= math.sqrt(lambda a,b: (a-b)**2, h1, h2))/len(h1))

h1: Image 1st histogram

h2: Image 2nd histogram

Figure 11

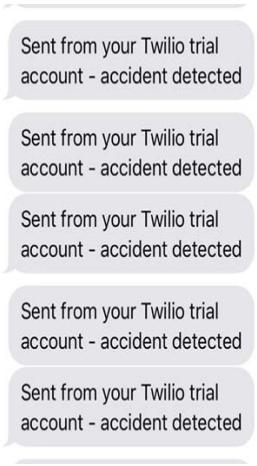

Figure 12

IV. Future Scope

a) Car Speed

Speed estimation process will give an idea to build a smart system for traffic monitoring that is capable of detecting, counting, classifying, and estimating speed of vehicle object from video data.

This will help us to automatically generate over speeding ticket which will reduces the number of traffic police officers needed to deploy in the real field for checking speeding vehicles.

b) Collision Prevention

The collision Detection system can be used pre-charge the brakes in conjunction with an automatic braking or emergency brake assist system.. That can provide the driver with a substantial amount of braking power the moment he depresses the pedal, which may effectively reduce the severity of an accident.

This can helps the driver be more attentive to the road, react sooner to dangerous situations, and have added peace of mind while operating a vehicle, especially at high speeds. Also, it will function reliably in any weather conditions, making driving in fog or rain less risky.

c) Wrong Way Detection

Upon installation, if a wrong-way vehicle entry is detected, the system would immediately alert the wrong-way driver of the error and notify the Authority. Once the wrong-way entry is confirmed, law enforcement would receive immediate notification of the exact entry point. They then could use their protocols and procedures to stop the wrong- way vehicle prior to a crash. While the system aims to notify a driver of their mistake, the focus is to enable law enforcement and Authority to track a wrong-way vehicle on the highway system in real time. The chances of successfully stopping a wrong-way vehicle before a collision become greater when officers know where the vehicle is and where it might be headed.

d) Accident Detection

Accident Detection can enable us to send alert to the authorities on time so that help can be given to the road accident victim and decrease the death caused due to road accidents. Also this system can be interfaced with vehicle airbag system that prevents vehicle occupants from striking interior objects such as the steering wheel or window. This can be also be developed by interconnecting a camera to the photograph of the accident spot makes the tracking easier.

V. Conclusion

This system is capable to detect speed of the car, collision prevention, wrong way direction and accident detection together. The system detects different causes of accidents and send alert to the authorities. It detects the speed of the car by capturing the image detected by the camera. The main aim of this project is to decrease the chances of loss of lives in accident occurring because over speeding, wrong way detection and collision detection and hence improve public safety and also a better system for the managing the traffic on the roads. The system is cost-effective, scalable, fast, at a distance measuring system that can be easily housed in present live surveillance. Apart from this, it also gives an opportunity for transportation engineers and decision makers to plan building of road and can be helpful both in case of personal as well as business purpose, to improves safety and security of the person on road.

Acknowledgment

I am highly indebted to my project guide, Mrs. Vandana Choudhary for her constant supervision as well as for providing necessary information regarding the projects & also for their support in completing the project. The co-operation is much indeed appreciated.

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