IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-7, Special Issue-12, May 2019 E-ISSN: 2347-2693

Traffic Surveillance System

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Available online at: www.ijcseonline.org

Abstract— Due to the large number of vehicles in circulation, studies of intelligent traffic systems have increased. Most of studies focus on the detection, tracking and counting of vehicles and on the estimation of traffic parameters. Two wheelers are the most important mode of transport in many countries. The main advantages of motorcycles are their low price and operation cost compared with other vehicles. But the number of accidents involving motorcycles has increased during the last decade and no proper database maintenance is provided. Thus, our paper provides a survey on various techniques into use for improving traffic conditions and for avoiding accidents. It suggests techniques for data collection using various implemented methods.

Keywords—Traffic control, traffic census, traffic statistics, traffic system

I. INTRODUCTION

Now-a-days traffic control is very essential in managing transportation systems. It is common in many modern cities that the road facilities do not raise proportionally in time with increase of population and vehicles. Massive vehicles on roads have brought about a sharp increase of traffic congestion, and further caused a series of social and economic problems [1]. Also, disobey of certain basic rules such as wearing helmet, avoiding triple seat, and driving within a certain limit has increased rates of accidents substantially thus causing a threat to the lives of lakhs of people.

India faces more than 200,000 deaths caused by road accidents and this was recorded by the Global Road Safety Report,2015 "the report states that the Indian road safety laws do not meet the best practice requirements for four out of five risk factors: enforcing speed limits, prevention of drunk driving, safety of children and use of helmets [2].

The accidents ratio is increasing day by day and various precautions are mandatory to be implemented. Smart cities have employed various techniques and methods for safety and emergencies such as helmet detection and automatic chalan generation which is yet not the most effective method in India with a huge crowd at a single signal. For generation of chalan, the camera needs to capture the image of the vehicle's number through which the chalan for the particular vehicle owner is generated and sent to their address. However, the camera captures only the vehicles of the front line and is unable to capture image of the vehicles behind this line. Thus, more improvements are required.

Looking into the accident prone areas in the past decades, one research focus has been urban intelligent transportation systems (ITSs) with the development of intelligent control and computer technology. ITS aims to provide innovative services for different modes of transportation and traffic management, and enable smarter use of transportation systems by individuals with better information and coordination [3].

Database collection for various road accidents occurring in several places all over India is done on a minimal rate. There are various proposed papers for traffic analysis and fall detection rates. Some major accident reports captured over years by traditional techniques gave the following analysis as shown in the figure below:

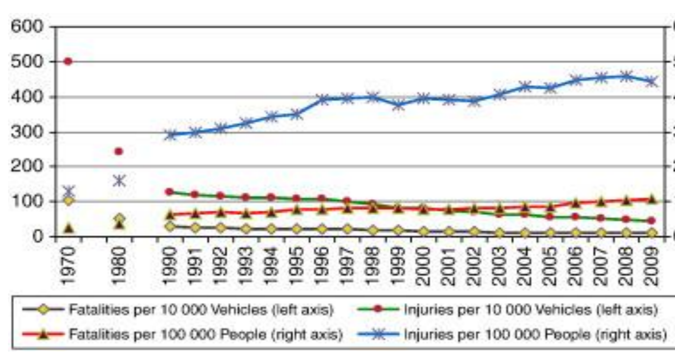

Fig 1.Exposure risk per 10 000 vehicles and 100 000 people [3].

This is a report generated in the state of Andra Pradesh by Reserve Bank of India & Ministry of Shipping, Road Transport & Highways, GoI [3]. These statistics are not accurate and need more improvisation on data maintenance about the entire details of the accident occurrence along with the actual cause so that using that information certain conclusions can be made about the accident prone areas and how to improve the situation in those areas. Also, such information will prove helpful in estimating accidents through the type of vehicle and if it occurred due to alcohol consumption, crash, or due to non-helmet driving.

There is no such single database maintained for purposes such as detection of helmet, occurrences of accidents, triple seat, etc. which can help the government improve road conditions atleast in smart cities where the infrastructure can be borne.

II. RELATED WORK

1. DATA MINING TECHNIQUE:

Sharad Shrestha [4] did Analysis of Road Traffic Fatal Accidents Using Data Mining Techniques in which he followed traditional data analysis steps of data pre-processing, modelling and result analysis.

A. Data Preparation: Data preparation step was the first step in data analysis where all records with missing value in the chosen attributes were removed. Fatal rate is divided into two categories: high and low. Several variables are calculated from other independent variables. Here are two examples:

• FATAL RATE: This variable denotes the percentage of fatality in a fatal accident computed as FATAL RATE = FATALS/PERSONS, where FATALS this is the number of deaths and PERSONS is the number of people involved in the accident. This is also known as rate in the analysis. • ARRIVAL TIME is the arrival time of emergency staff in minutes, calculated as ARRIV AL TIME = 60× (ARR HOUR − HOUR) +ARR MIN−MINUTE. All records with missing values are removed, and the early morning hours after 12:00 midnight are added by 24 to make it computationally easier.

B. Modelling: They first calculated several statistics from the dataset to show the basic characteristics of the fatal accidents. We then applied association rule mining, clustering, and Naïve Bayes classification to find relationships among the attributes and the patterns.

C. Result Analysis: USA has their results which include number of population along with the class labels and they use clustering algorithms to find the number of fatal accident in their region. They used a data analytic tool Weka to perform this analysis [4].

In their conclusion they stated that according to the statistics of classification and association rule mining, the weather conditions, road surface or light conditions do not contribute much into human fatalities than do human factors like being drunk, collision types, etc.

2. DEEP LEARNING:

Wei Liu and Miaohui Zhang [5] used Deep Learning Method for Vehicle Type Classification on Visual Traffic Surveillance Sensors

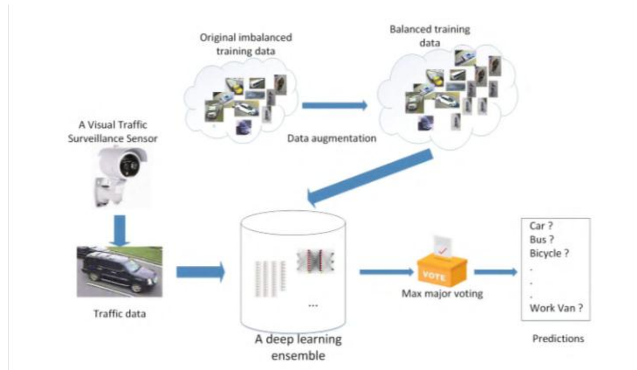

Fig 2. The framework of deep CNN ensemble model [5].

To correctly classify vehicle type on images acquired from visual traffic surveillance sensors, we proposed an image classification scheme based on ensemble deep learning. The proposed vehicle classification scheme consists of two main stages. In the first stage, data augmentation with balanced sampling is applied to alleviate the unbalanced dataset problem. In the second stage, an ensemble of convolutional neural network models with different architectures is constructed with parameters learned on the augmented training dataset. Experiments on the MIO-TCD classification challenge dataset demonstrate that the proposed method is able to increase mean precision to some extent, compared with the baseline algorithms [5].

3. HOUGH TRANSFORM DISCRIPTOR:

Maharsh Desai, Shubham Khandelwal, Lokneesh Singh and Prof. Shilpa Gite kept ways for Automatic Helmet Detection on Public Roads using hough transform descriptor [6].

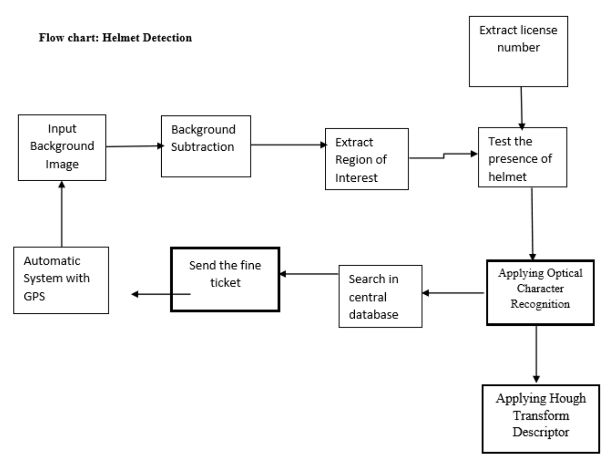

Fig 3. Helmet Detection flow chart [6]

Transform Descriptor. Hough Transform descriptor is basically used for detecting regular curves such as lines, circles etc. They proposed to detect circles here and find whether a person is wearing helmet or not. If a person is not wearing helmet, use back ground subtraction method for extracting the license plate and use optical recognition method, to get license number of the
vehicle. Then look into the database and send the ticket to the matched person [6].

4. CELL TRANSMISSION MODEL:

Pengfei Shao, Lei Wang [7] developed a distributed traffic control strategy based on cell-transmission model for optimal network performance. Through the analysis to the evolution of traffic flow between intersections and study of the cell transmission model, we propose a simplified model on the basis of cell-transmission model to better describe the evolution of traffic flow. At the same time, the model avoids the drawbacks of cell-transmission model. A series of rules is designed with help of the sub gradient descent method to update the status of intersections. The relaxed problem is distributed solved by a sub gradient descent algorithm after appropriate reformulation and decomposition of the problem in both space and time. Then, the resulting solution is exploited to attain traffic signal timing plans through distributed rounding. The simulation studying on different situations shows the proposed method works better than the benchmarked one. Extending the developed method to different traffic models and transportation problems will be our future work [7]

Table 1 COMPARISON TABLE

Published on	Technique	Author	Key features
12 November 2018	Typical milestone nets, data augmentation methods, transfer technology and supervised learning	Ping Wang; Wenbang Hao; Zhu Sun; Saisai wang; Erlong Tan; Li Li	Traffic detection, weather conditions
7 June 2017	Data mining Technique, Apriori algorithm	Liling Li, Sharad Shrestha, Gongzhu Hu	Analysis of Road Traffic
5 May 2016	Hough transform descriptor, Background subtraction	Maharsh Desai, Shubham Khandelwal, Lokneesh Singh	Helmet detection, Fall detection
25 October 2015	Deep neural network with balanced sampling	Wei Liu; Miaohui Zhang; Zhiming Luo; Yuanzheng Cai	Vehicle type classification

Here we have compared authors of various publications along with the techniques they have used for factors like helmet detection, monitoring vehicular type, fall detection and traffic detection.

III. METHODOLOGY

We studied about various algorithms in implementation for monitoring various aspects of traffic in circulation. However, we feel there is still less accuracy on object detection and recognition especially in high traffic areas where distinguishing objects is a tedious task. For that purpose, we introduce to use YOLOv3 algorithm for object detection and bring all aspects including fall detection, distinguishing vehicular types, helmet detection and triple seat detection under one platform. This will make it easier to maintain and compare databases.

About YOLOV3:

YOLOV3 is a new approach to object detection. Previous work on object detection and image recognition repurposes classifiers to perform detection. Instead, they did frame object detection as a regression problem to spatially separated bounding boxes and associated class probabilities. A single neural network predicts bounding boxes and class probabilities directly from full images in one evaluation.

Our unified architecture is extremely fast. Our base
YOLOV3 model processes images in real-time at a speed of 45 frames per second. A smaller version of the network, Fast YOLOV3, processes an astounding at a speed of 155 frames per second while still achieving double the mAP of other real-time detectors.

When compared to state-of-the-art detection systems, YOLOV3 is known for making more localization errors but is less likely to predict false positives on background. Finally, YOLOV3 learns very general representations of objects. It outperforms other detection methods, including DPM and R-CNN, when generalizing from natural images to other domains like artwork.

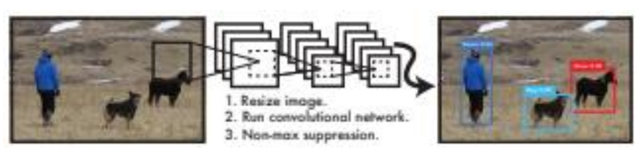

Fig 4: The YOLOV3 Detection System. Processing images with YOLOV3 is simple and straightforward. Our system (1) resizes the input image to 448 × 448, (2) runs a single convolutional network on the image, and (3) thresholds the resulting detections by the model's confidence. [8].

Unified Detection: In a single neural network object in single neural network are unified .feature from entire unique box are used to predict bounding box. Bounding boxes across all classes for an image are predicted. This means our network reasons globally about the full image simultaneously, and all the objects in the image.

End to end training and real time speed are maintained by using YOLOV3 design.
And the input image is divide into S × S grid by the system itself.
If the centre of an object falls into a grid cell, that grid cell is responsible for detecting that object.

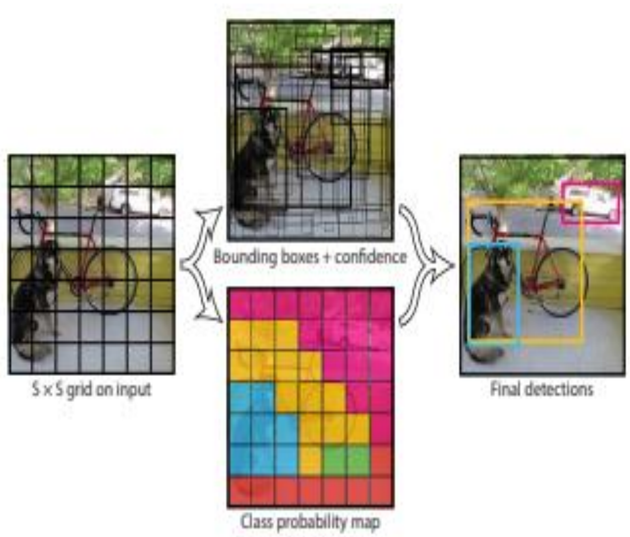

Fig 5: The Model. Our system models detection as a regression problem. It divides the image into an S × S grid and for each grid cell predicts B bounding boxes, confidence for those boxes, and C class probabilities. These predictions are encoded as an
$S \times S \times (B * 5 + C)$ tensor [8].

Real-Time Detection of image and objects in the wild: YOLOV3 has proved itself as a fast and accurate object detector, making it ideal for computer vision applications. We connect YOLOV3 to a webcam and verify that it maintains real-time performance, including the time to fetch images from the camera and display the detections.

The resulting system is interactive and engaging. While
It functions like a tracking system when attached to a web cam and has individual object processing, detecting objects as they move around and change in appearance.

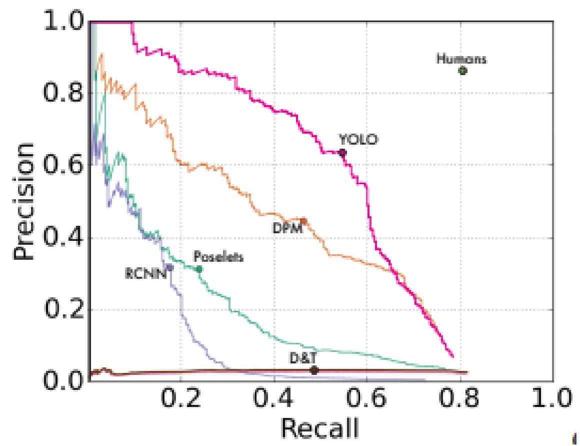

Fig 6.1: Picasso Dataset precision-recall curves [9].

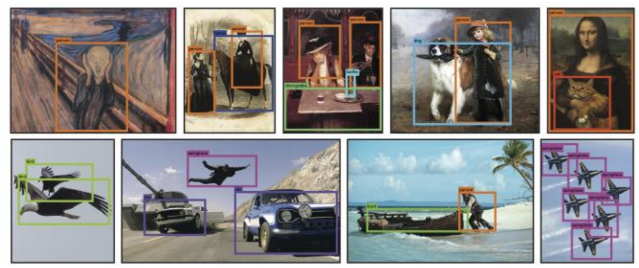

Figure 6.2: Qualitative Results. YOLOV3 running on sample artwork and natural images from the internet. It is mostly accurate although it does think one person is an airplane [9].

IV. Results and Discussion

We compared various studies and implementations involving image processing and object detection. However, we felt the need of a more advanced and efficient technique to detect objects. Thus, we proposed to use YOLOv3 for object detection which works faster and thus gives better results in comparison to other technologies.

V. Conclusion and Future Scope

We studied various algorithms in implementation for traffic surveillance that are used in several sectors of the world. Data mining and Apriori algorithm is used for analysis of road traffic, supervised learning for traffic detection and weather conditions, Hough transform descriptor for helmet detection and deep neural network for vehicle type classification.

We proposed to use YOLOV3v2 which is a deep neural network object detection algorithm for detecting objects and thus making tasks such as helmet detection, fall detection, classification of vehicles to be achieved under a single platform. YOLOv3, a state-of-the-art, real-time object detection system that can detect over 9000 object categories.

This will increase accuracy in places with huge traffic like cities in India.

Fast YOLOV3 is the fastest general-purpose object detector in the literature and YOLOV3 pushes the state-of-the-art in real-time object detection. YOLOV3 also generalizes well to new domains making it ideal for applications that rely on fast, robust object detection.

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