Anomaly Detection for Road Traffic: A Visual Analytic Framework by using SVM and HMM

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Abstract—Traffic control is one of the fastest developing technologies in the world. In India, numbers of vehicles are growing very fast which leads to accidents, traffic jam issues. Traffic analysis becomes a challenging problem. The analysis of large amount of multidimensional road traffic data for anomaly detection is a complex task. Visual analytic helps in detecting anomalous behavior in road traffic. In this project author try to explore the multidimensional road traffic data, detect anomalous events and explain the anomalous event. In this project author try to find out the probability of vehicles which meet to accident in future, it also used to avoid traffic congestion and improve safe driving.

Key words: Multidimensional, Visual Analytic, Road Traffic, Anomalous, Congestion

I. INTRODUCTION

In today's life we have to face many problems one of which is traffic congestion and accident which become more serious day by day. We know that population of city increases and numbers of vehicles increasing rapidly which leads to inappropriate discipline regarding driving and traffic rules that directly increase the ratio of accident. The collection and analysis of road traffic information with the help of intelligent transport system can be used to avoid traffic congestion, minimize the disadvantageous effect of heavy traffic on environment and prevent accidents and close to accident. Detection and prediction of accident or near-accident is a complex task that require the analysis and integration of large amount of multidimensional and heterogeneous data. The data include sensor data from vehicles and traffic conditions, driver behavior etc. To improve the safety and for measure road traffic accidents we can use old road data to form statistical models that show the normal activity and by eliminate models that represent the anomalous activity. We can say that not all abnormal road traffic activity are accidents or close to accident but finding these activities reduces the time for searching and give the possible result of interest which can be the accidents and near-accidents.

Data mining is very useful for detection of abnormalities in road traffic. Normally anomaly detection is a complex and not well define task therefor automated data mining technique not work well. Many time data analysis is done by experts that require powerful tools which combine their abilities with the machine strength. Human expert knowledge is useful for analysis and detection of anomalies.

The aim of this work is to explore large volumes of multidimensional road traffic data for the improvement of safe driving. It helps used to optimize traffic flow, avoid traffic congestion, minimize the adverse effects of heavy traffic on the environment and prevent accident.

In this project we analyze the road traffic for vehicle detection, we find the speed of vehicle, determine the lane of vehicle in which it drive and pattern of driving. The design of VA framework incorporate classical interactive temporal and map interface and an innovative visual metaphor for visualizing multidimensional features and anomalies. In this project we use SVM and HMM algorithm for detection of abnormal behavior of driver.

Fig. 1: Traffic congestion

This paper include the Literature survey, existing methodologies, proposed work, techniques and modules, possible result and conclusion. Last part of the work are the references which are used in the project.

II. LITERATURE REVIEW

Many researches and works have been done on road traffic. The main paper of this research is by Maria Riveiro et al. [1] has proposed an approach to find the anomaly for road traffic. It analyses the vehicles on road, measure speed. Frames are used for vehicle detection. It uses the SOM and GMM algorithm for anomaly detection.

Alisha janrao et al. [2] has proposed system for counting traffic density. This paper totally focuses on development of smart traffic control system. The main aim is to coordinate the traffic by keeping check of its density form all side and controlling the traffic signals intelligently.

Bharthi Sharma et al. [3] has proposed automated vehicle detection focus on average filter to reduce the noise effects. It discussed the morphological closing profile for vehicle segmentation. Thresholding value is applied to remove unnecessary objects.

Meru, A.V et al. [4] outline different vehicle detection techniques. In this paper foreground is vehicles and background is road, it give better out than optical flow method and frame differing method.
Trupti A. Chopkar et al. [5] proposed the optical flow method in background subtraction. Optical flow method calculate the image optical flow field And clustering is done according to the optical flow distribution characteristics of image. We get the complete movement information and detect the moving object from the background.

Heba A. Kurdi et al. [6] has proposed review of the close circuit television technique for vehicle traffic management in this she explain CCTV’s can lessen the traffic problem treating video images having parameters of traffic , necessary information is noted like traffic composition and speed, breaking traffic rules and accidents etc.

Prutha Y M and Anuradha S G [7] proposed real time vehicle detection technique based on background differencing, morphological operations and edge detection. Threshold techniques are applied to calculate traffic parameters i.e. counting the number of vehicles and speed of the cars.

Chandrasekhar. et al. [8] presents a traffic control method using edge detection. The images captured are compared with a reference image. Edge based matching is the process in which two representatives of the same objects are paired together and any edge or its representation on one image is compared and evaluated against all the edges on the other image.

Kavya. P Walad. et.al.[9] proposed the existing traffic light control system, their drawback and image processing techniques. Many edge detection techniques have developed for extracting edges from a digital image. There are two different edge detection operators in image processing. Gradient based classical operators like Robert, Prewitt operator and Laplacian based operators like canny detection. Edge detection technique addresses the problem of image enhancement. The canny edge detection algorithm gives best performance even in noise condition compare to other first order edge detection.

Nipjyoti et al. [10] present the traffic data analysis which define maximum and minimum detection widths for vehicles, optimum trap length for reducing the occlusion effects, vehicle speed and placements from median across road width.

The search for anomalous event is a challenging task. The approach in our study most anomaly detection techniques compare the online data with characterization of the normalcy model previously construct from set of data. Many paper present anomaly detection techniques for road traffic Deublein et al.[11] present methodology for prediction of occurrence of road accident it utilize a combination techniques like regression analysis.

Liu et al.[12] present correlation –based clustering , adaptive parameter free detection method to retrieve anomaly in city traffic.

Kinoshita et al.[13] give a method for detecting incidents form probe-cars data by identifying abnormal events that distinguish incidents form unpredicated congestion.

P. Rheingans et al.[14] describe set of visualization method which helps users to understand and analyze behavior of learned models. The visualizations correspond to the model characteristics: class probability, decision boundary and meta attribute.

Manavoglu et al.[15] describe the approach to learn individualized behavior models for web users. In this visualization is used to identify different behavioral among users.

T . Muhlbacher et al.[16] describe a complete frame work for building and validating regression models that allow the incorporation of expert domain knowledge in the process.

Pratishtha Gupta et al.[17] present a model to count the traffic load with the help of parameters such as edge detection, histogram equalization and removing the noise with the help of median filter. To get smooth image and sharp boundaries she proposed median filter.

Keerthana Gunasekaran et al. [18] proposed the techniques used in the night time vehicle detection. White Top Hat Transform method used to modify the contrast of the image. Multilevel Thresholding has determined the optimal threshold by the maximizing the class variance of dark and bright regions. To identify the vehicle for further analysis, methods such as support vector machine classification and symmetric based identification are used.

Zhushao-Ping and Fan Xiao-Ping [19] presented an approach for detecting and tracking moving vehicles in night time traffic. They extracted SIFT features using SIFT feature extraction algorithm, the algorithm is used to characterize moving vehicles in night time.

S. Liu et al.[20] analysis the spatio-temporal data in city traffic where hot spots in urban areas are identified through the use of mobility based clustering method.

The approach implemented to find anomalies in a work uses a clustering technique to group normal and abnormal behaviors of driver. Cao et al.[21] present a technique for an interactive cluster visualization which evaluated using multidimensional data.

### III. EXISTING METHODOLOGY

Existing work investigate how to support expert analyst who analyze the big volume of multidimensional road traffic data for improvement of safe driving and prevent accident. Therefor they select process that uses a large amount of database of road data. In order to find which analytic task need support they carried out a formative user study with expert analysts. To support all these task and taking into account the expert would have a transparent system. They propose a framework that combine computational methods and interactive visualization approaches. They uses the TripMiner a combination of various data mining methods for the detection of anomaly.

They select the combination of method which creates a models and outputs which analyst easily interpret. They uses clustering methods and a statical method for affiliation to the normal cluster or to anomalous behavior. They used a clustering algorithm, SOM (self-organizing map), GMM (gaussian mixture models) for anomaly detection. They implemented a data-driven statistical parametric method with the combination of clustering method (K-means) and GMM. In order to establish number of cluster they used Silhouette measurement of closeness for a cluster.

Anomaly detection method is based on two assumption , first anomalous behavior have to be sufficiently
different from normal events in order to be detectable and second the training set should be free of anomalous events.

- Silhouette estimation and K-means clustering: To establish number of clusters they used silhouette coefficient. The silhouette width show the difference between the within cluster tightness and separation from the rest. After testing the different number of cluster, optimal number of cluster show. Once the number of cluster determine using classical k-mean algorithm they group the training data.

- Statistical characterization of clusters using GMMs: A GMM is a statistical model. In this model the overall probability distribution is synthesized from weighted sum of individual Gaussian distribution.

- Markov chain and state diagram: To account for the temporal variation of the data and the transaction between the different clusters found, they use a Markov chain model.

In this paper VA framework is presented. The framework show a schematic overview and anomaly detection process that include online and off-line procedure. The frame work shows the driving behavior before a crash or near to crash, many group of driving behavior is also show.

In this analyst analyze the traffic by zooming in and out, and find the anomalous behavior of the vehicles.

In the existing study they use GMM algorithm for the detection of anomaly in which the detection rate are slow and the accuracy was not proper. It gives the result but the result are not proper or accurate to overcome this drawback we use the advance version of algorithm HMM and also uses the support vector machine which improve the accuracy and detection rate. It prevent the accident rate and also improve the weather conditions. It also help to improve the traffic flow, traffic congestion.

IV. PROPOSED WORK

The aim of this work is to explore large volumes of multidimensional road traffic data for the improvement of safe driving. It helps used to optimize traffic flow, avoid traffic congestion, minimize the adverse effects of heavy traffic on the environment and prevent accident.

The project helps in detecting vehicles, speed of vehicles, lane in which vehicle is running, vehicles driving pattern. All these data recorded by using cctv cameras and this data is send to the algorithm which analyzes and gives the probability of the accident for particular vehicle.

In the project we use SVM and HMM algorithm for better result. We calculate the probability of vehicle accident and if the probability is greater than threshold value than it is possible that vehicle will meet the accident.

- HMM (Hidden Markov Model): It is the generalization of a mixture model where the hidden variables are used. It is use for the probability calculation. We use this algorithm because the result of this algorithm is more accurate than the existing system.

- SVM (support vector machine): It is use for analyze the data. It is the supervised learning model use for classification and analysis. It perform the mapping their inputs into high dimensional feature spaces.

A. Flowchart

The below flowchart describe that we start the program by taking the input from cctv camera the data will giving to the vehicle detection part, after the detection of vehicle the speed of vehicle is find after that lane of vehicle is detected and then driving pattern will detected. By completing every part we check the probability with threshold value if probability is greater then threshold value anomaly will detected and if probability is less then we conclude that vehicle derive properly.

Following is the Flowchart of the proposed work.

![Flowchart](image)

**Fig. 2: Flowchart**

The above flowchart describe that we start the program by taking the input from cctv camera the data will giving to the vehicle detection part, after the detection of vehicle the speed of vehicle is find after that lane of vehicle is detected and then driving pattern will detected. By completing every part we check the probability with threshold value if probability is greater then threshold value anomaly will detected and if probability is less then we conclude that vehicle derive properly.

B. Algorithm

1) Collected data
2) vehicle detection
3) speed detection
4) lane detection
5) finding driving pattern
6) calculate probability
7) if probability>threshold then
8) anomaly detected
9) else drive correctly
10) end;

C. Data flow diagram

Flowing represent a DFD of the project:
Fig. 3: Data flow diagram

The above figure shows the data flow diagram, in this the CCTV data are giving to the vehicle detection module, the detected vehicle are giving to the speed detection area in that speed of the vehicle are find, the previous two module information are giving to the lane detection module. Lane detection module find the lane of vehicle and the out of the lane detection module is the input of driving pattern module. The driving pattern module find the pattern of the driving the calculate the probability of the vehicle accident, this probability is compare with the threshold value and if the probability is greater than threshold than the anomaly is detected otherwise the driving pattern of the vehicle is as per the direction of traffic department.

D. Architecture

Fig. 4: Architecture of anomaly detection

The above figure represent the architecture of the anomaly detection. In this the first step is to view the vehicle with the help of video frame. In the second step the vehicles are detected by giving the video frames as a input to the image processing program. The program for detection of vehicle find all the vehicles. The third step is based on finding the speed and lane of the vehicle, speed of vehicle are measured and check the lane in which vehicle drive. After all the checking process the last step is based on anomaly detection in which the anomaly is detected and information of the anomaly is giving so that we can prevent the accident in advance.

V. PROPOSED METHODOLOGY

A. Techniques/Tool required

In the project the analysts have mainly two means to analyzing the data. Matlab R2013bis use as a programming language.

B. Module Distribution

In the project we have four module. The are as follow.

1) Vehicle Detection:

In this author detect the vehicle running on the road. Author analyze the video frame and with the help of morphological operation vehicles are detected. Filter operations are perform for noise and background filtering.

2) Speed Detection:

In this module we finding the speed of the vehicle. Author measure the speed of any moving vehicle within the road segment. The speed of car is compare with the known speed.

3) Vehicle lane Detection:

In which lane vehicles are driving is detected here. This module separate the part of the road where vehicle are moving in one direction. This process is necessary because to simplify an information processing extracted from more than one frame.

4) Vehicle driving Pattern:

How the driver are driving the car is he follow the traffic rules or not are detected here. Pattern of the vehicle driving are detected than we calculate the probability of the accident, the probability will be compare to the threshold value after the comparison the result will show the result which is the accident or near to accident.

VI. OUTCOME POSSIBLE RESULT

In the project after taking the input data from CCTV camera, several technique and algorithm applied on it which give the anomaly who is responsible for accident or near-accident.

The result show the abnormal behavior of the driver, who is not driving properly and did not follow the traffic rule. These driver may be meet to the accident in future. All the anomaly information are show in the result.

VII. CONCLUSION

Data mining methods only work satisfactorily for well-defined and specific problem. In many domains a close collaboration of human machine is needed in order to extract valuable knowledge form large multidimensional and heterogeneous database. We give the information about the vehicle which are nearly to accident and also control traffic congestion.

REFERENCES


