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A Review on: A Novel Approach to Detect and Identify the Abnormal Driving Behavior

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Abstract
Driving behavior analysis is also a popular direction of Smartphone-based vehicular applications. However, existing works on driving behaviors detection using dataset camera videos can only provide a coarse-grained result using thresholds, i.e. distinguishing abnormal driving behaviors from normal ones. Since thresholds may be affected by car type and sensors' sensitivity, they cannot accurately distinguish the differences in various driving behavioral patterns. The fine-grained abnormal driving behaviors monitoring is able to improve drivers' awareness of their driving habits as most of the drivers are over-confident and not aware of their reckless driving habits. There are many problems; the first problem is the new and challenging real-world Problem raised from the auto insurance industry, called driver number estimation and the second problem is the classical driver identification problem, measured by the classification accuracy on unseen …trips of seen drivers. These problems are resolved with KNN, Hidden Markov Model and NN for Abnormal Driving Behaviors Detection and Identification. The work is implemented on Smartphones with MATLAB Smart app in MATLAB toolbox.

Keywords: KNN, NN, Driver behavior, Smartphone etc

Introduction
(WHO), traffic accidents became one in every of the highest ten leading causes of death within the world. Specifically, traffic accidents claimed nearly 3500 lives on a daily basis in 2014. Studies show that the majority traffic accidents square measure caused by human factors, e.g. drivers' abnormal driving behaviors. Therefore, it's necessary to find drivers' abnormal driving behaviors to alert the drivers or report Transportation Bureau to record them. though there has been works [1] on abnormal driving behaviors detection, the main focus is on detective work driver's standing supported pre-deployed infrastructure, like alcohol sensing element, infrared sensing element and cameras, that incur high installation value. Since dataset camera videos have received increasing popularities over the recent years and blending into our daily lives, a lot of and a lot of dataset camera video-based transport applications square measure developed in intelligent facility. Driving behavior analysis is additionally a well-liked direction of Smartphone-based transport applications. However, existing works [2] on driving behaviors detection victimization dataset camera videos will solely give coarse-grained result victimization thresholds, i.e. identifying abnormal driving behaviors from traditional ones. Since a threshold is also stricken by automotive sort and sensors' sensitivity, they cannot accurately distinguish the variations in varied driving behavioral patterns. Therefore, those solutions cannot give Fine-grained identification that is distinguishing specific sorts of driving behaviors. Moving on this direction, we'd like to contemplate a fine grained abnormal driving behaviors observation approach, which uses Smartphone sensors to not solely find abnormal driving behaviors however additionally determine specific sorts of the driving behaviors while not requiring any extra hardware's. The fine-grained abnormal driving behaviors observation is in a position to boost drivers' awareness of their driving habits as most of the drivers square measure over-confident and not responsive to their reckless driving habits. to boot, some abnormal driving behaviors square measure unobvious and simple to be unnoticed by

drivers. If we will determine drivers' abnormal driving behaviors mechanically, the drivers is responsive to their unhealthy driving habits, in order that they'll correct them, serving to forestall potential automotive accidents. In line with [3], there square measure six sorts of abnormal driving behaviors outlined, and that they square measure illustrated in Fig.1. Weaving(Figure one.1(a)) is driving alternately toward one facet of the lane and so the opposite, i.e. curved driving or driving in Shape; swerve (Figure one.1(b)) is creating associate degree abrupt redirection once driving on a usually straight course; facet slipping(Figure one.1(c)) is once driving in an exceedingly usually line, however deviating from the conventional driving direction; quick U-turn(Figure one.1(d)) may be a quick redeeming U-shape, i.e. turning round(180 degrees) quickly and so driving on the alternative direction; Turning with a large radius is popping cross associate degree intersection at such a particularly high speed that the automotive would drive on a curve with an enormous radius, and also the vehicle typically seems to drift outside of the lane, or into another line; sudden braking is once the driving force slams on the brake and also the vehicle's speed falls down sharply in a very short amount of your time. This work uses Smartphone sensing and machine learning techniques. By extracting distinctive options from the readings of Smartphone sensors, we will find and determine the six sorts of abnormal driving behaviors to understand a fine-grained abnormal driving behaviors detection and identification; we tend to face the subsequent nice challenges. First, patterns of driving behaviors got to be known from readings of Smartphone sensors. Second, the noise of dataset camera video sensors' readings ought to be removed. Finally, the answer ought to be light-weight and process possible on dataset camera videos. [4]

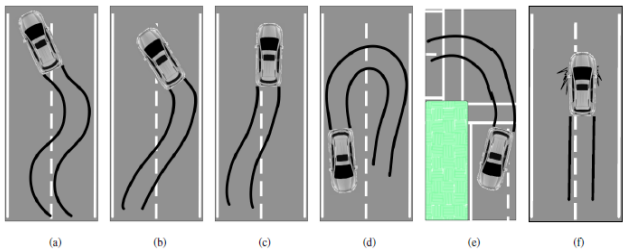

Fig. 1: Six types of abnormal driving behaviors: (a) Weaving, (b) Swerving, (c) Side slipping, (d) Fast U-turn, (e) Turning with a wide radius, (f) Sudden braking [1].

Detection Using Smartphone Sensors

To eliminate the requirement of pre-deployed infrastructures and extra hardware, recent studies think about exploitation smartphones to notice abnormal driving behaviors. Specially, [4] uses accelerometers, magnetometers and GPS sensors to work out whether or not bad motorbike maneuvers or accidents occur. [5] Uses accelerometers, gyroscopes and magnetometers to estimate a driver's driving vogue as Safe or Unsafe. [6] Use accelerometers to notice drunk driving and unexpected driving maneuver, severally. The works square measure similar therein they perform a coarse-grained driving behavior detection that uses some thresholds to seek out abnormal driving behaviors. All the same, thresholds perhaps full of automobile sort and sensors' sensitivity in order that they cannot accurately distinguish the variations in numerous driving activity patterns. Therefore, none of existing works will understand fine-grained identification. Our work uses Smartphone sensing and machine learning techniques to appreciate a fine-grained abnormal driving behaviors detection and identification. Though machine learning technique already is employed to some activity recognition work [5], our work is 1st to spot driving activities exploitation machine learning technique. In [7], since activities square measure instant, pattern of activities is easy. Thus options of activities' pattern would be known simply. However, in real driving environments, since the time period of some driving behavior is long, not instant, like Weaving, the system have to be compelled to verify the start and ending of the driving behavior 1st. Extracting and choosing effective options of every sort of abnormal driving behavior would be a lot of complicated.

Driving Behavior Characterization

In this, we have a tendency to 1st describe the info assortment method for driving behavior samples from real driving environments. Then we have a tendency to analyze patterns of every sort of driving behavior from Smartphone sensors' readings.

Collecting knowledge from Smartphone Sensors

We develop associate degree App to gather readings from the 3-axis measuring system and therefore the 3-axis orientation detector. We have a tendency to align the 2 coordinate systems within the Smartphone and within the vehicle by creating the accelerometers coordinate axis on the moving direction of the vehicle. Therefore, we have a tendency to might monitor the vehicle's acceleration and orientation by retrieving readings from the Dataset camera video measuring system and orientation detector. [8]

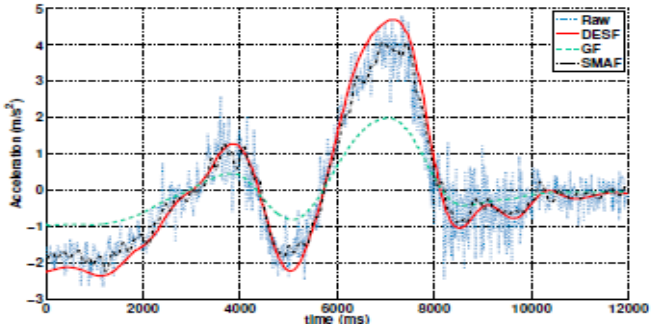

Fig. 2: Accelerometer vs. Time Graph

Smart Phone Sensors

This describes the brief description of various types of sensors present in Smartphone which are currently being used in analyzing driver behaviour.

a) Accelerometer An accelerometer is an electromechanical device that will measure acceleration forces. These forces may be static (z axis), like the constant force of gravity pulling at your feet, or they could be dynamic (x, y axis) caused by moving or vibrating the accelerometer [2]. An accelerometer is a sensor which measures the tilting motion and orientation of a mobile phone. Instead, the accelerometer sees the acceleration associated with the phenomenon of weight experienced by any test mass at rest in the frame of reference of the accelerometer device. For example, an accelerometer on the surface of the earth will be at rest so measure an acceleration

force of g= 9.81 m/s^2 straight upwards, because of its weight. By contrast, accelerometers in free fall or at rest in outer space will measure zero [3]. We can also say accelerometer measure g-force acceleration. Its unit is m/s^2[9].

b) **Gyroscope** detects the current orientation of the device, or changes in the orientation of the device. Orientation can be computed from the angular rate that is detected by the gyroscope. It basically works on the principle of angular momentum [4]. It is expressed in rad/s on 3rd axis [10].

c) **Magnetometer** Magnetometers are measurement instruments used for two general purposes-to measure the magnetization of a magnetic material like a ferromagnetic, or to measure the magnetic strength and the direction of the magnetic field at a point in space [5]. It senses orientation relative to the Earth's magnetic field using the Hall Effect.

d) **Global Positioning System (GPS)** GPS is a satellite based Navigation tracking [8], often with a map showing where you have been. It gives us the value of longitude and latitude which determines the point of location on earth.[11]

e) **Camera** is a device used to capture images. In Smartphone, camera can be both used to capture images and video chat. In detecting various human behaviour camera plays a vital role as it captures the live image of a human.

f) **Microphone** is a device used to detect the sound. The various patterns of sound are collected for research purpose and trained. Examples from the frequency of sound, it can be determined whether sound pattern is of horn or indicator [12].

Literature Survey

Nidhi Kalra et al. [2014] have studied that in today's life, everyone seems to be in hurry to achieve their destination as quickly as doable. Therefore individuals advisedly or accidentally take harsh driving events like unforeseen acceleration, unforeseen turns or unforeseen brakes that more lead them to accidents or maybe loss of their lives. And it's a typical belief that if person behaviour was being monitored, it might be comparatively safer. To watch driver behaviour numerous sensors were getting used either deployed within the automotive, wayside or inherent in Smartphone. This paper provides a survey of varied ways for analyzing driver behaviour appeared in literature survey. This paper conjointly provides some analysis directions that numerous researchers will explore. [1]

Prarna Dhar et al. [2014] have studied the Unsafe driving primarily includes driving either headlong or driving below the Influence (DUI) of alcohol, may be a major reason for traffic accidents throughout the planet. During this paper, we advise an extremely economical system that helps at early detection and alert of dangerous vehicle manoeuvres usually associated with rash driving. The complete system needs solely an itinerant which can be placed in vehicle and with its inherent measuring system and orientation sensing element. When putting in a program on the itinerant, it'll cypher accelerations supported sensing element readings and compares them with typical unsafe driving patterns extracted from real driving tests. [2]

Rachana Daigavane et al. [2015] has studied and discovers the most causes of accidents and so provides risk assessments. pursuit dangerous driving behaviour will facilitate raise drivers awareness of their driving habits and associated risks, thus, serving to cut back careless driving and enforce safe driving practices. Showing determination behaviour and energetic pursuit of your ends was presently a causal agency of traffic in an urban centre. Awareness and encourage driver safety square measure the measures that square measure further, we have a tendency to square measure shall propose a decent arrangement that uses detection system and management of the vehicle. For the foremost half, drivers aren't aware that they offer disposition to behave sharply activity found within the normal course of events. Among the factors concerned in driving, particularly the motive force, the vehicle, and also the surroundings, the human issue is that the most relevant and most troublesome to characterize. This project wasn't solely helpful for the motive force's behaviour detection however conjointly offer reconstruction and investigation of accidents and during this thanks to cut back the risks and dangers for the driver. [3]

J. Engelbrecht et al. [2015] have studied a Road crashes square measure a growing concern of governments and is rising to become one amongst the leading preventable causes of death, particularly in developing countries. The ever present presence of smartphones provides a brand new platform on that to implement sensing element networks and driver help systems, further as different ITS applications. During this paper, existing approaches of exploitation smartphones for ITS applications square measure analyzed and compared. Specific focus is on vehicle-based observance systems, like driving behaviour and elegance recognition, accident detection and road condition observance systems. More opportunities to be used of smartphones in ITS systems were highlighted, and remaining challenges during this rising field of analysis square measure known. [4]

Zhongyang Chen et al. [2015] have studied a period of time abnormal driving behaviours observance was a corner stone to up driving safety. Existing works on driving behaviours observance exploitation Smartphone solely offer a rough grained result, i.e. characteristic abnormal driving behaviours from traditional ones. to enhance drivers' awareness of their driving habits therefore on forestall potential automotive accidents, we want to think about a fine-grained observance approach, that not solely detects abnormal driving behaviours however conjointly identifies specific varieties of abnormal driving behaviours, i.e. Weaving, Swerving, facet slippery, quick turnaround, Turning with a large radius and unforeseen braking. Through empirical studies of the 6-month driving traces collected from real driving environments, we discover that each one of the six varieties of driving behaviours had their distinctive patterns on acceleration and orientation [5].

Eshed Ohn-Bar et al. [2016] have studied the highlights the role of humans within the next generation of driver help and intelligent vehicles. Understanding, modelling and predicting human agents were mentioned in 3 domains wherever humans and extremely machine-driven or self-driving vehicles interact: 1) within the vehicle cabin, 2) round the vehicle, and 3) within encompassing vehicles. Efforts inside every domain, integrative frameworks across domains, and scientific tools needed for future developments square measure mentioned to supply a humanistic perspective on analysis in intelligent vehicles[6].

Weishan Dong et al. [2017] driving vogue representations from automobile GPS trip knowledge. we have a tendency to propose a unique motor vehicle encoder regular deep neural Network (ARNet) and a visit encryption framework trip2vec to find out drivers' driving designs directly from GPS records, by combining supervised and unsupervised feature learning in a very unified design. Experiments on a difficult driver variety estimation downside and also the driver identification downside show that ARNet will learn a decent generalized driving vogue representation: It considerably outperforms existing ways and different architectures by reaching the smallest amount estimation error on the average (0.68, but one driver) and also the highest identification accuracy (by a minimum of third improvement) compared with ancient supervised learning ways [7]

Research Gap

In this research work the different researchers studied different techniques. Some of them studied Auto encoder Regularized deep neural Network, ITS and different classifier methods, but they have not got the maximum accuracy of their research work. They have faced the different problems, the first problem was the new and challenging real-world problem raised from the auto insurance industry, called driver number estimation and there was more problems and that problems are discussed in our research problem formulation. It is resolved with the help of KNN, Hidden Markov Model and NN for Abnormal Driving Behaviors Detection and Identification and to get maximum accuracy.

Problem Formulation

In the research work abnormal behavior detection I have studied the different problems that are given below:

- The first problem is the new and challenging real-world Problem raised from the auto insurance industry, called driver number estimation.
- The second problem is the classical driver identification problem, measured by the classification accuracy on unseen trips of seen drivers.
- Other problems such as to early detect abnormal driving status (e.g., drunk, fatigue, and drowsy) and those representation learning problems in other domains.
- The problem pertains to detecting braking events.
- Another category is related to lane positioning problems such as drifting and swerving. The second category is related to speed control problems such as sudden acceleration or erratic braking.
- Another is judgment and vigilance problems: such as driving with tires on center or lane marker, driving on the other side of the road, following too closely, driving without headlights at night, and slow response to traffic signals. These are also cues which indicate rash driving.
- 0% false negative and 2.39% false positive rate for speed control problems.

Methodology

We present the design of our proposed system, D3, which detects abnormal driving behaviors from normal ones and identify different abnormal types using Smartphone sensors. D3 does not depend on any redeployed infrastructures and additional hardware if required.

In our system, D3, abnormal driving behaviors could be detected and identified by Smartphone's according to readings from accelerometers and orientation sensors. Fig.4 shows the architecture of D3. The whole system is separated into offline part-Modeling Driving Behaviors and online part Monitoring Driving Behaviors. In the online part, Modeling Driving Behaviors, D3 trains a classifier model using machine learning techniques based on the collected data, which could identifies the specific types of driving behaviors. In the Feature Extracting, effective features are extracted from the specific types of driving behavioral patterns on acceleration and orientation. Afterwards, the features are trained in the Training and a classifier model would be generated which can realize Fine-grained identification for various types of driving behaviors. Finally, the classifier model is output and stored to Model Database.

Feature Extraction

When machine learning algorithms are processed, representative tuple of features rather than raw data is a more effective input. Thus, it is necessary to extract effective features from driving behavioral patterns.

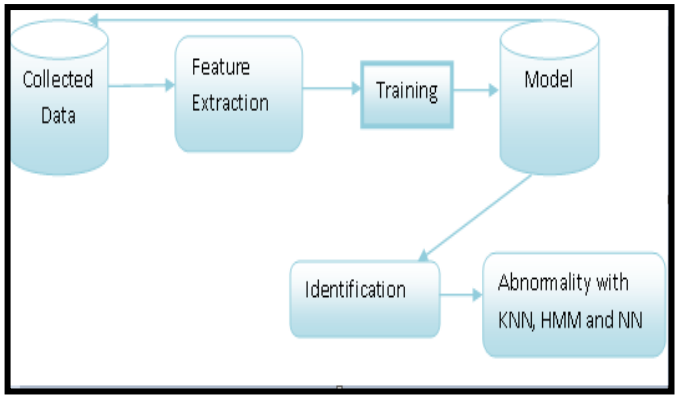

Fig. 3: System Design

Conclusion

In this paper, we address the problem of performing abnormal driving behaviors detection (coarse-grained) and identification (fine-grained) to improve driving safety. In this different problems are reviewed from the existing work on smart phone driver behavior detection. Some problems are like to early detect abnormal driving status (e.g., drunk, fatigue, and drowsy) and those representation learning problems. Another problem is the lane positioning problems such as drifting and swerving. The second category is related to speed control problems such as sudden acceleration or erratic braking. All these problems are resolved win the future with the help of KNN, NN and SVM to improve the results.

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