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Investigation of the various driver recognition techniques and its behavioural characterization

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Abstract— As an element of IOT, IOV is a promising technology for connected vehicles.IOV involves the concept of smart driving which will be enabled only with the help of recognition of various drivers. There are various ways to predict the driver behavior. In this paper, an extensive literature review of various driver recognition mechanisms has been done. In doing so, we have classified the driving behavior according to different parameters. Some open issues and challenges have been computed so that work can be carried out on these issues.

Keywords—IoT,SIoVIoV,Driving Behavior.

I. BACKGROUND

Internet of Things (IoT) [1] is supporting all the intelligent devices to be attached to a global system where the individual device will be ready to provide services from separate coupled devices. This transformation of information is similar to the social communication of human being that is presently expressed by online social systems. Social Internet of Things (SIoT) [2] is directing this new model of machine-to-machine social networks. SIoV system utilizes the common system components specified in the Vehicular Ad-hoc Networks (VANETs) [3] and align again them as per the designs created in the IoT-Architecture. There were numerous issues with the driving conduct in dealing with the activity of keen cities. There is a need of characterization of conduct of drivers in order to separate great drivers, awful drivers , rash drivers and so on. Extensive Literature Survey has been done about the IOV and driver behaviour. Behavioural Classification of the Drivers has done on the basis of various parameters. Section I of this paper gives the background of the IOV , problems regarding the traffic management which are caused due to the driver behaviour . Section II presents the literature review of the various driving recognition mechanisms. Section III concludes the classification of driver behaviour. Section IV formulated the open issues and challenges we obtained from the literature survey before the paper is finally concluded in section V.

II. LITERATURE REVIEW

Jiayin Cen et al. (2016) presented a system design for analysis and assessment of driving behaviour. There are several developments have been made in big data technologies and Internet of Things (IoT). These technologies have provided several solutions in order improve the traffic efficiency and safety. This research proposed a system architecture which combines the driver driving data and driver background data in order to evaluate and analyze the driving behaviour of a driver. In this research, the logistic regression was used to analyze the drive background data. This research also applied the entropy weight technique and analytic hierarchy process to access driving data and output scores are used in order to indicate the good or bad driving patterns.

The important applications of the proposed system are that it provides the drivers with feedback which improve their driving behavior, active safety applications and offer references to personalize the vehicle insurance in IoV systems. The system architecture is described in this research by using the three algorithms for the analysis process. The system is implemented for testing on three drivers for understanding the working of the system. The result indicated that proposed system provides meaningful and constructive results in several aspects. The authors also described some imperfect steps that need to be improved in future. Some weights and thresholds also combine the scores through validation that helps in improving the performance of the whole system.

Zhang et al. (2017)described detection of the online driving anomaly from large scale vehicle data for improving the driving safety; it is essential to determine the driving anomalies. The Internet of the vehicle (IOV) plays an important role in finding the driving anomalies and to acquire the big data from big data and multiple vehicle sensors. The current developed approaches are based on rules or supervised learning. These approaches required the labeled data which is not available in big data scenarios. The driving behaviour is totally different from vehicles statuses in order to preciously model the driving behaviour needs and to fuse the several sources of sensor data. this research proposed SafeDrive which is a status-aware and online approach to solve this issue. SafeDrive derives state graph from historical data set as a behavior model.

The SafeDrive splits the online data stream into some segments and compares each of the segment with SG. The SafeDrive is used to determine the segment which deviates from SG as an anomaly. This research has evaluated the SafeDrive on a cloud- platform with around 29,000 real connected vehicles. The result indicated that SafeDrive is suitable for identifying the various driving anomalies efficiently from the large scale vehicle data stream. It provides 93% accuracy for determining anomalies that are used to alert the drivers so that they can correct their driving behaviour.

Bucchiet al. (2012)presented the traffic psychology and driver behavior. The driving style is described as the way in which a driver selects to drive. It also depends upon the physical and emotional conditions of the driver during their driving. This research analyzed the interaction of human factors and road-safety in order to determine the attitude, personality, ability,and reliability of a driver. he characteristics of drivers are considered as exogenous and driving style is considered as an endogenous latent construct. The driving style is referred as the judgment that is expressed by the driver on a large scale from aggressiveness to cautions.

The driving style can be determined by measuring the kinematic parameters. In this research, the authors investigated the construction process of driver personality by using the psychology methods. The results indicated that it is possible to detect the behavior of the driver and its performance from their personality. It also helps in detecting the trends that result in minimizing the driving risks. This research provides the useful indications for designing of safe roads for drivers. It is very important to have a new rule during the road management and design. The main purpose of this research is to investigate the issues of the driver’s aptitude on determining the driving operations. This research indicated that the driver’s psychology is essential for verified for safe driving.

Chenget al. (2013) presented a design of a system for safe driving. The proposed system is based on the Fusion of Multi-Aspects Information and the Internet of Vehicles. The proposed system guarantees the security of the drivers during their driving in order to tension with the growing transportation safety. The proposed system has to main functions. The first function is to prevent the potential risks from the adjacent vehicles. The other function is to remind the drivers about their dangerous driving behavior of analyzing the performance of drivers based on a large number of statistics in order to regulate the habits of drivers. The proposed system uses the Internet of Vehicle and Multi-aspects information fusion in order to prevent the drivers from dangers and for providing the efficiency in order to ensure the safe driving. The result indicated that the proposed system also helps in minimizing the expenditure of personnel and fund.

Devare, et al. (2016) presented a survey on the Internet of Things for Smart Vehicles. By using the various approaches, we can minimize the emergency services arrival time during accidents and also avoid the traffic jams. Traffic density is the main factor in distributing traffic in a suitable manner. The proposed method is estimating the vehicular density in urban with the help of communication capabilities betweenRSUs and vehicles. This research determined the social structures of IoV components, their interactions types,and their relationships. In this research, the authors also mapped the components of VANET’s into the architecture reference model of IoT in order to provide the better integration of IoV with IoT domains. This research also provided the experimental study and implementation details in order to demonstrate the efficiency of the proposed system and different application scenarios for practical deployment and user groups of the proposed system. This research envisions that IoV is an integral part of the intelligent transport systems in creating the future smart cities.

Eboli, L., Mazzulla, G., & Pungillo (2017) describes the information about the driving style that concern the physical and emotional condition, and the way driver use while driving. The research focussed on determining the relationship between the driving characteristics and driving styles. The driving characteristics that were focussed include behavioral, emotional and somatic conditions. These include sleepiness, gloom, worry, anger, boredom, sickness tiredness, sleepiness,and nervousness. To determine the relationship between the driving characteristics and behavior, Structural Equation Modelling (SEM) was proposed.To perform the research, a questionnaire was provided to the driver to collect information about different conditions in which they drive the vehicle. The drivers filled the questionnaire form on different days and different paths. In this way, the changes in the driver behaviorwere determined.

Maglaraset al. (2016) described that vehicles had become an active member of smart cities because of the evolution of new sensing and communication capabilities which have become possible due to many advancements in digital technology. Today, vehicles possess the capability to interact with the public network as well as each other. There are certain networks which have made this possible. These include Vehicle-to-infrastructure, vehicle-to-vehicle and vehicle-to-pedestrian interactions. These networks allow to collect and share real-time information about the behavior of the driver as well as the condition of the road. SIoV abbreviated form of Social Internet of Things demonstrate the relationship among different objects such as motorbikes, cars, trucks, etc. thus, both the drivers and the vehicles now have the capability to interact with each other with the help of SIoV. This paper focussed on discussing different components as well as technologies associated with Social Internet of Things. Apart from this, several applications and privacy and security issues associated with this technology are also explained.

Angkititrakul, Miyajima, & Takeda (2011) focussed on determining the bad behavior of drivers with the help of Gaussian mixture model. The proposed model was developed to determine the car-following behavior in response to the observable driving signals and pedal control operations. Apart from this, there are chances of improvement to determine the driving behavior of the driver with the help of new adaption scheme.

Previously, numerous approaches and techniques have been proposed and applied to determine eth driving behavior. These approaches mostly consider the assumptions and interpretations. But no model significantly represent the exact scenario of how drivers behave. Therefore, there are significant deviations in the designed drive models when compared with the real-world conditions. Therefore, this research focussed on using the model adaption scheme. It is capable of adaptive, different parameters sop that any unseen driving characteristics can be easily supported to assure efficient and flexible advanced vehicle control system. Promising results were obtained with the proposed model by applying the validation and comparison of realistic car-following data.

Yanget al. (2014) presented ideas about the internet of Vehicles (IoV). A number of companies, as well as researches, are focussing on IoV because of the rapid development of communication technology and its commercial interest. The research focussed on providing an abstract network model of IoV. Different technologies to build IoV and its applications are discussed in detail. Apart from this, there are many challenges also discussed that are prevalent in IoV at present. VANET covers only small network model. The proposed model incorporates several factors that include road network, traffic jams,and bad driver behavior. Driver behavior is a very important factor that needs to be considered in such research to determine the challenges then provide possible solutions accurately.

Summary of reported work related to the IOV has been tabulated below :

Author's Name	**Year**	**Contribution**	**Results**
Cen, J., Wang, Z., Wang, C., & Liu, F.	2016	This research proposed a system architecture which combines the driver driving data and driver background data in order to evaluate and analyze the driving behavior of a driver.	The result indicated that proposed system provides meaningful and constructive results in several aspects.
Zhang, M., Chen, C., Wo, T., Xie, T., Bhuiyan, M. Z., & Lin, X	2017	This research proposed Safe Drive, which is a status-aware and online approach to solve this issue. SafeDrive derives state graph from historical data set as a behavior model.	The results provides 93% accuracy for determining anomalies that are used to alert the drivers so that they can correct their driving behavior.
Bucchi, A., Sangiorgi, C., & Vignali, V	2012	This research analyzed the interaction of human factors and road-safety in order to determine the attitude, personality, ability, and reliability of a driver.	The main purpose of this research is to investigate the issues of the driver's aptitude on determining the driving operations
Cheng, C., & Zongxin, W.	2013	The proposed system guarantees the security of the drivers during their driving in order to tension with the growing transportation safety.	The result indicated that the proposed system also helps in minimizing the expenditure of personnel and fund.
Maglaras, L., Al-Bayatti, A., He, Y., Wagner, I., & Janicke, H.	2016	This paper focussed on discussing different components as	Several applications and privacy and security issues

		well as technologies associated with Social Internet of Things.	associated with this technology are also explained.
Angkititrakul, P., Miyajima, C., & Takeda, K.	2011	The proposed model was developed to determine the car-following behavior in response to the observable driving signals and pedal control operations.	Promising results were obtained with the proposed model by applying the validation and comparison of realistic car-following data.
Eboli, L., Mazzulla, G., & Pungillo, G.	2017	This research also integrated the fog computing into IoT to extend storage, computing, and network resources.	The security and privacy threats are also presented for IoT applications.
Yang, F., Wang, S., Li, J., Liu, Z., & Sun, Q.	2014	The research focused on providing an abstract network model of IoV. Different technologies to build IoV and its applications are discussed in detail.	The proposed model incorporates several factors that include road network, traffic jams, and bad driver behavior.
J. Ni, K. Zhang, X. Lin, and X. S. Shen,	2018	This research reviewed the features and architectures of the fog computing and role of fog nodes which includes transient storage, real-time services, decentralized computation and data dissemination.	It also examined the fog-assisted IoT applications that are based on the applications of IoT on different roles of fog nodes.

III. CLASSIFICATION OF DRIVER BEHAVIOR

Driving behaviour is a critical problem for the design and estimation of in-vehicle driving support systems for increasing traffic safety, energy effectiveness and traffic harmonization. To design an effective SIoV system it is necessary to learn about the behaviour of driver. The classification can be done in following ways[9].

- On the basis of velocity of vehicle
- Steering wheel angle
- Revolution per minutes (r.p.m)
- Break frequency
- Velocity map position
- Linear acceleration
- Linear velocity

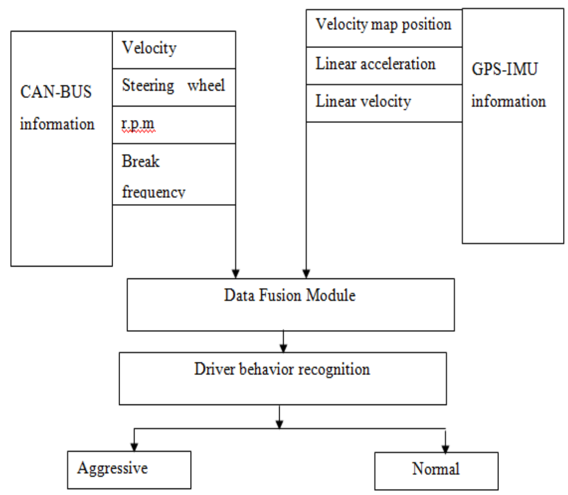

Figure 1: Classification of driving behaviour

The above figure describes that the information such as velocity, steering wheel angle, r.m.p and break frequency are received by using sensing devices that is again connected to the Controller area network Bus (CAN-BUS) decoder. At the same time the information such as positioning of the vehicle, acceleration and velocity are collected by using GPS. The information collected from the CAN-BUS module and Global positioning system-Inertial measurement unit (GPS-IMU) module are integrated in to the fusion module and the behavior of driver is recognized as an aggressive and normal[10].

IV. OPEN ISSUES AND CHALLENGES

Based on the comprehensive survey done in the previous sections,various solutios has been provided for road safety but still, we can use the machine learning techniques and IT infrastructure for more safer and secure network. Here we present some issues and challenges –

- Some suitable machine learning techniques needs to be devised.

- **Authentication** of the drivers should be there .for ex- Biometric Authentication, Facial Recognition etc.
- Delay of Data Transfer between source and sink nodes.
- Latency , Throughput and PDR have to be improved.
- Performance Degradation factors to be identified

V. CONCLUSION

This work reviews the state-of-the-art in driver behaviour models in Social Internet of Vehicles. Form the survey; we have concluded that the driver behavior is characterized by using an appropriate classification technique and by maintaining the discipline in drivers. This survey outlines an integrated model framework for the unwanted movement of drivers that is the potential to capture better efficiency of in Social Internet of Vehicles System.

VI. FUTURE SCOPE

For smart cities, a smart architecture should be used. There should be some method of identifying the authentic drivers, good and bad drivers using fog computing and ANN based approaches.

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