IJCSE International Journal of Computer Sciences and Engineering Open Access
Survey Paper Vol.-7, Issue-3, March 2019 E-ISSN: 2347-2693

Intelligent Driver Assistant System: A survey

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DOI: https://doi.org/10.26438/ijcse/v7i3.848853 | Available online at: www.ijcseonline.org

Accepted: 06/Mar/2019, Published: 31/Mar/2019

***Abstract*—** India is home to one of the most underpaid yet overworking drivers. Transporters expect them to work at least twenty hours straight without any consideration to their health. Due to this the drivers are often tired and often on the verge of fatigue. This leads them to have bursts of micro-sleep: a temporary episode of sleepiness which may last for a smidgen of a second or up to thirty seconds, where the victim fails to react to some stimulus from the environment and becomes unconscious. As a result of this, road accidents have become a common occurrence in India. One solution to this problem is to enhance the vehicles to an extent, so that it's possible to find out the level of drowsiness of the driver in real time. In this paper, we conduct a survey to find various methods for detecting driver's drowsiness condition.

***Keywords*—** *Driver Assistant System, Road Accident, Drowsiness, micro-sleep, Image Processing, driver yawning*

I. INTRODUCTION

In India, sixteen people die per hour. Global Road Safety Report 2015 states that road accidents has caused a total of 1 41,526 deaths and around five lakh injuries to people in India. Moreover, this estimation is not accurate since all accidents are not recorded by the police.

Vehicles, that were once considered to be a luxury, has now become a necessity in every man's life. When people drive for long hours or at odd times, they tend to get tired and feel drowsy, but still, keep on driving to reach their destination as soon as possible. This habit tends to make the driver overexert themselves. Driving in a state of sleepiness is a really dangerous task. If the driver falls asleep, then there is no one controlling the vehicle, which will lead to a road accident.

Driving is a tedious task which requires driver's attention at all time, but in recent years, drivers live with a lot of stress and have to go through a lot of exhausting situations that may reduce their ability to control the vehicles that they are driving.

The drivers have agreed that some sort of assistance system is required to prevent them from getting sleepy or in drowsy state which will help them in avoiding road accidents. This has led to the development of driver assisting systems, which helps in keeping the driver attentive at all times during the journey.

There are a lot of parameters that could contribute to a driver's drowsiness. Some predominant parameters include mental or physical fatigue, inadequate sleep, and consumption of drugs. The divers are actually aware that their capabilities have reduced due to them being in a state of drowsiness.

The driver assisting systems have many benefits, among them, one of the important benefit is the promotion of safety. Whenever the driver falls asleep, it is detected by the assisting system and a warning is generated to bring back the driver into a state of being aware of their surroundings. There a lot of technologies that are made to detect the current state of driver drowsiness or record driver's condition in real time, and each of these technologies have their own strong points and limitations.

The organization of the survey paper is as follows, Section I contains the introduction of the driver assistant systems, Section II contain the related work of existing driver assistant systems, Section III concludes the research work with discussion of gaps identified in existing works and Section IV cites the references that are discussed in the survey paper.

II. RELATED WORK

In Table 1 below, various research papers related to drowsiness of drivers and its detection have been surveyed in order to determine the methods used to solve the underlying problem. After their determination, their limitation or gaps have been identified.

Table 1. Driver Assistant System in Literature

S.No.	Author	Title	Methods	Parameters	Conclusion
1.	Srijayathi, K., & Vedachary, M.	Implementation of the Driver Drowsiness Detection System	Driver drowsiness measured through sensor mounted on steering wheel	Driver fatigue, sleep deprivation, sleep disorders	The speed of the car is decreased when driver is in fatigue condition and when the driver blinks, a buzzer beeps to alert the driver.
2.	Vural, E., Çetin, M., Erçil, A., Littlewort, G., Bartlett, M., & Movellan, J.	Automated drowsiness detection for improved driving safety	Sleep and crash episodes are measured using machine learning	Blink rate, eye closure, yawning and some facial movements	The association between head roll and driver drowsiness, and the driver yawns less before falling asleep.
3.	De Charette, R., & Nashashibi, F.	Traffic light recognition using image processing compared to learning processes	Detection phase is carried out in grayscale along with reduction in spot light, and templates have been used for recognition	Traffic-light in grayscale	The apparatus was examined in real-time in a prototype. The majority of test cases were correctly recognized, yet there were some false test cases.
4.	Al-Rahayfeh, A., & Faezipour, M.	Enhanced frame rate for real-time eye tracking using circular Hough transform	Image processing to identify circular pattern	Eye trailing, eye detection	The improvement offered in this paper indicates that not all captured live video frames are required to be processed for eye detection due to the fact that the same eye movement will be taken on various next video frames.
5.	Jha, S., & Busso, C.	Analysing the relationship among the driver's head pose and gaze to model his/her visual attention	Head pose recognition algorithm applied to natural driving recordings, which then are compared to ground truth estimations	Head pose and gaze	The paper evaluated the overall performance of a brand new head pose estimation algorithm presenting that 24.5% of the frames are incorrectly processed, suggesting open demanding situations in creating computer vision algorithms that are sturdy in real traffic environment.
6.	Rani, P. S., Subhashree, P., & Devi, N. S.	Computer vision based gaze tracking for accident prevention	Image processing tool to get the facial geometry primarily based on eye part detection	Road traffic, eye blinking and eye closure	As the primary reasons of car accidents had been related to human errors, they might be categorized in one of the foremost driver's disarray categories.
7.	Constantin, L., Fosalau, C., Zet, C., & Petrisor, D.	Driver Monitoring Using Face Detection and Facial Landmarks	There are two methods: the first one is for the detection of the eyes of the driver, and the second one is to trace the facial expressions	Detection of eyes, facial features, and the orientation and location of the face of the driver	The algorithm monitors driver awareness and facial landmarks in real world scenes with low error and short processing time.
8.	Garg, R., Gupta, V., & Agrawal, V.	A Drowsy Driver Detection and security system	To minimize the security aspect of the problem, they proposed iris scan which is based on biometric technology which will enable authorization To	Iris scan system, detection of drowsy driver and signalling system	Their method is reliable and robust for automobile safety and security as confirmed by experimental results.

			minimize road accidents aspect of the problem, they proposed drowsiness detection and an alerting system which is made by a monitoring device for the drivers' eyes as well as a thermal sensor to monitor heat.		
9.	Chien, J. C., Lee, J. D., & Liu, L. C.	A fuzzy rules-based driver assistance system	This system consists of four cameras, which specializes on the driver for predicting the driver's viewing angle of the road ahead for detection of road condition.	Driver's viewing angle, detection of road condition	The system utilizes fuzzy-rules for the evaluation of interactions among the driver's gaze, that whether there is traffic ahead, and in the side lanes to calculate if the present driving condition should be of any worry to the driver and if any danger present, issue one of the three type of warnings, from safe to dangerous.
10.	Mehrubeoglu, M., Pham, L. M., Le, H. T., Muddu, R., & Ryu, D.	Real-time eye Tracking using a smart camera	The proposed algorithms in this paper are tested through applications such as: eye detection, tracking under various separate conditions such as different angles of a person's body, rotation speed and eye movement	eye detection, several angles of the head, and body motion speed	This paper shows the implemented algorithms and performance output of these. Various tools mentioned in the explanation below are also used.
11.	Venkateswarlu, R.	Eye gaze estimation from a single image of one eye	A unique algorithm is introduced for measuring the eye vision through a single image	Noticing that the eye contour is in the shape of a circle, the paper calculates the common direction of the iris contour	The two key contributions are that this paper shows the probability of getting an antique eye vision way from a single image.
12.	Model, D., & Eizenman, M.	An automatic personal calibration procedure for advanced gaze estimation systems	Advance gaze systems doesn't need any calibration to estimate the axis of the eye. But, they need a single point of calibration to calculate the angle between the two axes, viz. Optical and visual	Point-of-gaze, optical axis, visual axis	This method is carried out while the subjects watch something like a video clip. They conducted the experiment on four people and found the output to be within 0.5 degrees of root mean square error.

Srijayathi, K. et al. showed interest in the development of smart and responsive cars that may assist a driver under necessary conditions. These systems could be used to extract sensitive information of real-time situations which could help in various scenarios, such as rescue operations or helping investigators. They infer that lack of sleep and disorders related to sleep that cause driver fatigue are an essential factor in increasing the recent road accidents. They propose a safety prototype that operates in real-time to control the speed of the vehicle when it finds a driver in fatigue. The purpose behind their efforts is to minimize road accidents by detecting the symptoms of fatigue in driver's behavior and controlling the speed of the vehicle when it is necessary. A sensing element is mounted on the vehicle and whenever the driver loses consciousness, then it alerts them through the buzzer to stop the vehicle from causing an accident. We have understood the reason to work on sleepiness in self-driving car from this paper [1].

Vural, E. et al. mentioned that there have been several proposals in the area of detection as well as prediction of a driver's drowsiness. These proposals vary greatly, such as finding rhythms in sleep patterns, measuring the

performance of vehicles, etc. The use of computer vision in this area has become essential due to its ability to predict drowsiness. They have studied previous proposals and found out that some common factors for detection is blink rate, closing of eye, and yawning. They propose a machine learning algorithm that detects episodes of driver's drowsiness in real time. Preprocessing of 30 facial expressions was done to generate a separate database for spontaneous expressions. Some of the important factors include yawning and blinking of eyes, along with some other facial expressions. Furthermore, head motion was detected using the unique combination of an accelerometer and an eye tracking device. This algorithm yielded 96% accuracy within people and 90% accuracy across people in predicting the crash and drowsiness episodes, when run through a computer game based on driving. We learn the importance of machine learning to train data sets for the purpose of detection of these symptoms [2].

De Charette, R. et al. proposed a traffic signal recognition apparatus for smart vehicles that would work in real-time. They have used just image processing to achieve the results. The detection phase is carried out in grayscale along with reduction in spot light, and templates have been used for recognition. The apparatus is designed in such a way that it able work with different inputs and rules, which enables it to recognize signal from various countries. For the sake of comparison, they also developed a lot of traffic signal recognition apparatus on various learning platforms, one among them was cascade classifiers. The apparatus was examined in real-time in a prototype. The majority of test cases were correctly recognized, yet there were some false test cases. This paper deals with traffic light recognition apparatus. We learn the method to use image recognition and machine learning to recognize traffic lights and implement this in the interface [3].

Al-Rahayfeh et al. introduced Eye-gaze sensing and trailing. It's been widely researched and bestowed as some sort of unorthodox human pc interaction. This space has provided comfort to several areas of sensible uses, like helpful programs and technology for the individuals who have disabilities, computer games, and driver assistance and observation systems. Several strategies for eye gaze following are focused in this literature paper. During this research paper, a time period eye trailing software is bestowed. For detection of iris of the driver within the taken video frames, the software accomplishes this with the Circular Hough remodel algorithm that helps to detect circular patterns in a photo. The software takes help of the circular Hough rework to detect the eye. This is done to achieve high CPU speed that's required to complete the work of eye recognition, and the selection of lowest video frame speed that's ok to discover all the attention motions in the taken video are investigated. Two frame per second are enough to discover the attention motions for less speed eye movement. However up to four frames per second are required for high speed eye movements. Also it is notices that decreasing the numbers of the processed frames reduces the desired CPU interval considerably [4].

Jha S et al. Proposed that studying driver behavior is very important within the style of improved driver assistance systems that may discover driver faulty actions, and provide them with the required warnings once not aware of driving tasks. The visual attention span of a driver is a critical factor to consider about, as most driving work needs visual attention. The past work has researched algorithms to discover driver optical attention by pursuing the eye movement. Whereas pursuit pupil will provide associate degree correct way of optical attention, predicting gaze on vehicle surroundings may be a difficult drawback thanks to the constantly changing brightness, body rotations and occlusions. Whereas, this paper studies the use of the pinnacle created as an approximate of the driver's optical focus span. The main problems are the unimportant dependency among head and eye motions whereas looking to a target object that needs the driving force, the psychological factors underneath and therefore the surroundings. At last, the paper analyzed the partiality introduced by eye motions through look actions that will increase once the subjects are driving. The robust dependency among head cause and therefore the visual detection is utilized to predict the optical span of the motive force with varied confidence level reckoning in the case [5].
Rani et al. proposed that driving inattentively is one in all the most causes of auto accidents in Bharat. By watching a driver's actions concludes the premise of associate vehicle safety system which will probably cut back the quantity of causalities by calculating the driver's attention span. Self-propelled vehicles are more associated being loaded with accident dodging and alert systems for avoiding the possible collision with an outside object, like some other automobile or even a person. This paper describes a time period gaze following system victimization the video from a single lens camera put in on the column. The projected system is ready to observe at any time, and even works under various driver's behavior patterns. The system doesn't need specific standardization or manual data format. Additional significantly, no major recalibration is critical even in the event of camera's position being changed. This is often thanks to the express the use of three dimension geometric reasoning. Thus the system used in this scenario in the different vehicle systems doesn't require any separate development in theory. Therefore, once situating the camera, to the catching accuracy to maximize the amount of difference amongst the open and closed eyes pictures of the person. Finally, considering from the clinical atmosphere point of view this way provides associate in nursing unassertive different. The experiments in the paper showed

that the head estimation rule is powerful to extreme figure distortions. The system produced Associate in nursing accuracy on top of ninety looking forward to all of the eventualities evaluated [6].

Constantin, L. et al. researched the impact that driver's fatigue had on road accidents by browsing through several research papers, and this led them to understand the tough situations that are faced by drivers daily. Their research concluded that around 10 to 25 percent of the road accidents caused are due to driver fatigue. Also, they found out that professional drivers are more likely to engage in a road accident due to fatigue. Till now they thought that amateur drivers were more likely to engage in a road accident. They found that the road accidents are caused due to the carelessness of drivers. They propose that a driver should be monitored using face recognition system. Their system is validated in real world scenarios and yields accurate results even in varying illumination and even when drivers' not looking directly at the system [7].

Garg, R. et al. proposed a novel method for the security and safety of an automobile. There are three parameters that are researched and implemented by them, viz. Iris scan system, detection of drowsy driver and signaling system. The thefts of vehicles and road accidents due to fatigue are growing in recent times. To minimize the security aspect of the problem, they proposed iris scan which is based on biometric technology which will enable authorization to minimize road accidents aspect of the problem, they proposed drowsiness detection and an alerting system which is made by a monitoring device for the drivers' eyes as well as a thermal sensor to monitor heat. There is also an option added to ask for help from police whenever the driver is in distress without disclosing it to others around the driver. They combine three aspects of science, viz. Computer vision, and optics as well as image recognition. Their algorithm for detection of eyes is up to 90 percent efficient [8].

Chien et al. proposed a view-based driver help system victimization which uses fuzzy regulations to work out if or not warnings are required is bestowed. This technique is made up of four cameras: one in every of that focuses towards the driving force for calculating the driver's vision angle, while another focuses towards the road in front for the checking of road situation ahead, and therefore the remaining two cameras are at either side of the automobile which is faced towards the back, for the aim of determinant whether or not neighboring lanes contains automobiles hidden within the less visible spots. The system makes use of fuzzy-regulations for the investigation of relations amongst the driver's focused vision, whether or not if there are automobiles ahead, and within the neighboring lines to work out if or not this driving situation ought to be of any issue to the driving force and problems one in every of 3 stages of warnings, from secure to unsecure. In summary, this paper given a fuzzy-rules-based driver-assistance system that analyses the interactions between the driving force, the vehicle, and its encompassing and problems timely alerts that may keep the driving force from going in dangerous traffic things. Additionally, the blind-spot connected modules would alert the driving force once the vehicle deviates toward a neighboring already occupied by a vehicle. Lastly, it's conjointly intentionally that this technique consists of loosely integrated modules, thus it'll be able to accommodate inclusion of further modules within the future delicately [9].

Mehrubeoglu et al. proposed real-World eye and iris pursuit is vital for automated vision-mode positive identification input, instrument management by paralyzed patients, net user research, still as police Security implementations. During this work, one wise camera that is LabVIEW and computer code tools (vision) are used to come up with eye recognition and pursuit strategies. The derived results discovered that eye pursuit consistency decreases with the increase in frame speeds. Specially, gaze at associate degree points while occlusion made a call in no-hit spotting rates that were notifiable below the perfect input situations. The stopping issue that has an effect on the rate of the formula is that the time required to transfer center points by the sensible camera to a program in laptop that is that is used for the testing. A quicker laptop is anticipated to considerably cut back the info send and receive time. As an alternative, transferring the info once every session rather than once every datum will be thought-about. Information transfer is for very old information assortment only; all of the info process is the result of the sensible camera [10].

Venkateswarlu et al. proposed a completely unique approach, known as the one-circle algorithmic program, for measurement the attention gaze employing a monocular photo that focuses in only 1 eye of an individual. Perceptive that the iris border may be a circle, therefore we tend to predict the conventional side of the said iris circle, thought-about because the eye focus, from the elliptical picture produced from it. From common descriptive geometry, associate degree conic is re-projected in the house onto 2 circles of various orientations. However, by victimization associate degree measuring property of the eyeball, the proper answer is disambiguated. This permits America to get the next high quality picture of the iris through the help of a zoom-in camera and thus producing higher accuracies within the calculated figure. This attention gaze methodology on top of is combined with a head because calculated part and along can supply nice potential particularly in these provided applications. But, the most noticeable about this paper is that the methodology is non-invasive, quick and sturdy [11].

Model, D. et al. researched that some methods of calibration are used by gaze calculating systems to find out the specific factors that are required for the calculation of point of gaze for each subject. During this procedures, the subjects are said to fix their gaze on a single point or some points at varying time interval. They found that advance gaze systems do not need any calibration to estimate the axis of the eye for each subject. But, they need a single point of calibration to calculate the angle between the two axes, viz. Optical and visual. They propose a new method for calibration which would not require any user involvement. This method is carried out while the subjects watch something like a video clip. They conducted the experiment on four people and found the output to be within 0.5 degrees of root mean square error. This paper deals with the method to find the eye gaze of a person which can be utilized to estimate the alertness of a driver while driving [12].

III. CONCLUSION

This paper presents a survey on driver assistance systems design and technologies. As per the research paper reviewed, it stands clear that there is a great need for such smart systems by government agencies, or private businessmen for their employee safety. A prime reason for interest in this area increasing is due to the growth in the number of road accidents caused due to fatigue, carelessness or inattention of the driver due to stretched working hours or drunk driving. However the technologies discussed in these papers lack in several ways such as the practical implementation of their design, not able to detect driver on call, driver yawning or simply, no single paper seems to give all the solutions to this behemoth problem.

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