Driver Distraction Supervision

[1]Pradeep N. Fale, [2]Rohit M. Butale, [3]Shrey R. Khadilkar, [4]Vaibhav R. Hedau, [5]Ankur S. Aglawe

[1]Professor, Department of Information Technology, Priyadarshini College of Engineering, Nagpur, India
[2,3,4,5] Students, Department of Information Technology, Priyadarshini College of Engineering, Nagpur, India

Abstract—**Distraction and Drowsiness of the drivers is the primary reason for accidents within the global. Because of lack of sleep and tiredness, drowsiness can occur while using. The nice manner to keep away from injuries caused by the driver's distraction is to locate the drowsiness of the motive force and warn them earlier than falling asleep. To come across drowsiness and distraction many techniques like eye retina detection, facial characteristic popularity, and yawning detection were used. Right here in this project, we propose a method of detecting driving force drowsiness with the usage of eye retina detection, face distraction detection, and yawning detection of the driver. As soon as the motive force is discovered drowsy or distracted an alert can be generated and a message might be printed on the display screen with the alarm for you to alert the driver quickly.**

Keywords— **OpenCV, Python, SciPy, dlib, Neural Networks.**

I. INTRODUCTION

Drowsiness is surely described as “a country of near-sleep due to fatigue”. It’s far technically distinct from fatigue, which has been defined as a “disinclination to keep appearing the assignment at hand”. The outcomes of sleepiness and fatigue are very much identical. Fatigue affects mental alertness, decreasing an individual’s capability to function in a car effectively and increasing the danger of human errors that would result in fatalities and accidents. Sleepiness slows reaction time, decreases consciousness, and impairs judgment. Fatigue and sleep deprivation impact all transportation operators (for example airline pilots, truck drivers, and railroad engineers).In each situation, the driver can’t attend on the number one mission of riding which may additionally beautify the likelihood of crash occurrence. The interplay between driver and vehicle such as monitoring and assisting each other is one of the vital answers for maintaining ourselves safe in the cars. Although energetic safety structures in motors have contributed to the lower variety of deaths happening in visitor’s injuries, the quantity of visitor’s injuries continues to be growing consistent with to be had statistical Information, over 1.3 million humans die each year on the road and 20 to 50 million human beings suffer non-deadly injuries because of road injuries. Exhausted drivers who fall asleep on the wheel are accountable for approximately 40% of road accidents, says a take a look at through the crucial road studies Institute (CRRI) at the three hundred-km Agra-Lucknow limited-access highway [1].

Driver drowsiness and Distraction is a chief issue which results into numerous vehicle accidents. Growing and maintaining technologies that may correctly hit upon or prevent drowsiness at the wheel and alert the driving force before a mishap is a first-rate mission inside the area of twist of fate prevention systems. Because of the dangers that drowsiness can cause on the roads some strategies want to be developed for preventing counteracting its consequences. With the appearance of a present-day era and actual-time scanning structures the use of cameras we will prevent predominant mishaps on the road by using alerting car motive force who is feeling drowsy via a drowsiness detection device

The point of this venture is to accumulate a prototype drowsiness and distraction detection machine. The spotlight could be placed on making plans a framework so that it will exactly display the open or shut condition of the driving force's eyes continuously. By tracking the eyes, it miles believed that the signs and symptoms of motive force fatigue may be detected early enough to avoid a car twist of fate. Detection of fatigue entails the remark of eye actions and blink patterns in a sequence of pictures of a face.

II. LITERATURE SURVEY

In August 2014, García et. al. [9] described ‘driver monitoring based totally on Low-cost three-D Sensors’. They proposed an answer for motive force monitoring and event detection based on three-D facts from a variety of digital cameras is presented. The system combines 2-D and three-D strategies to provide head pose estimation and areas-of-hobby identification. Based totally on at the captured cloud of three-D points from the sensor and analyzing the two-D projection, the points similar to the top

are determined and extracted for in additional analysis. Later, head pose estimation with 3 levels of freedom (Euler angles) is envisioned based totally on the iterative closest points set of rules. Eventually, relevant regions of the face are recognized and used for in addition evaluation, e.g., event detection and conduct analysis. The ensuing utility is a 3-D motive force monitoring gadget based totally on low-value sensors. It represents a thrilling device for human thing research studies, permitting computerized study of specific factors and the detection of unique occasion associated with the motive force, e.g., driving force drowsiness, inattention, or head pose.

In June 2010, Bin Yang et. al. [27] described 'Camera-based Drowsiness Reference for driving force state class below actual riding situations'. They proposed that measures of the motive force's eyes are capable to discover drowsiness below simulator or test situations. The overall performance of the latest eye monitoring based totally in-car fatigue prediction measures is evaluated. These measures are assessed statistically and through a category technique based on a huge dataset of ninety hours of actual road drives. The outcomes display that eye-monitoring drowsiness detection works well for some drivers as long as the blink detection works nicely. In spite of some proposed enhancements, but, there are still issues with terrible mild situations and for men and women sporting glasses. To a precise, the camera-based totally sleepiness measures provide a valuable contribution for a drowsiness reference, however are not dependable enough to be the only reference.

In 2013, G. Kong et. al. [11] defined 'visual evaluation of Eye state and Head Pose for motive force Alertness monitoring'. They offered visual evaluation of eye nation and head pose (HP) for continuous monitoring of alertness of an automobile driver. Most existing procedures to visual detection of non-alert driving styles rely both on eye closure or head nodding angles to determine the driving force drowsiness or distraction degree. The proposed schemes makes use of visual functions consisting of eye index (EI), student interest (PA), and HP to extract critical information on non-alertness of a vehicle driver. A support vector system (SVM) classifies a sequence of video segments into alert or non-alert using activities. Experimental consequences show that the proposed scheme offers excessive type accuracy with acceptably low mistakes and fake alarms for human beings of diverse ethnicity and gender in actual avenue driving situations.

In June, 2012, A. Cheng et. al. [19] described 'driver Drowsiness recognition based totally on computer vision technology'. They presented a nonintrusive drowsiness recognition approach the use of eye-monitoring and photo processing. A robust eye detection algorithm is introduced to address the problems as a result of adjustments in illumination and motive force posture. Six measures are calculated with percentage of eyelid closure, maximum closure period, and blink frequency, common starting degree of the eyes, opening speed of the eyes, and final speed of the eyes. These measures are combined the usage of Fisher's linear discriminated capabilities using a stepwise method to reduce the correlations and extract an independent index. Effects with six individuals in driving simulator experiments exhibit the feasibility of this video-based drowsiness recognition method that provided 86% accuracy.

In 2011, M.J. Flores et. al. [22] defined 'driver drowsiness detection gadget under infrared illumination for an clever vehicle'. They proposed that to lessen the quantity of such fatalities, a module for a complicated driver help gadget, which caters for computerized motive force drowsiness detection and also driving force distraction, is provided. Artificial intelligence algorithms are used to technique the visible data that allows you to locate music and analyze both the driver's face and eyes to compute the drowsiness and distraction indexes. This real-time machine works in the course of nocturnal situations because of a close to-infrared lighting fixtures system

In June, 2014, Eyosiyas et. al. [8] defined 'motive force Drowsiness Detection via HMM based totally Dynamic Modeling'. They proposed a new technique of reading the facial features of the driver via Hidden Markov version (HMM) based dynamic modeling to come across drowsiness. They have got applied the algorithm the use of a simulated driving setup. Experimental outcomes demonstrated the effectiveness of the proposed approach.

III. METHODOLGY

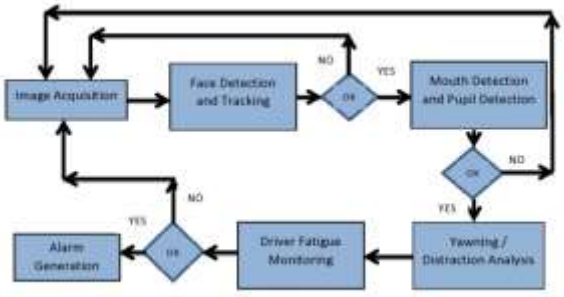


Fig.1. Flow chart

The flowchart of the proposed machine has been proven inside the above discern. The digital camera captures the picture and sends it to the processor of the pc which consists of a 32-bit memory card installed with Open CV which facilitates image processing. If the signal crosses the threshold of a set of continuous frames with EAR much less than the threshold fee, it will automatically make the alarm beep and the velocity of the automobile receives reduced. In any other case, that signal is rejected and the subsequent signal is processed.

The driver's face is monitored at some stage in using a video or net digital camera. To discover the drowsiness the first step is to stumble on the face the usage of the set of frames taken via the camera. Then the vicinity of the eyes is detected and the retina of the attention is continuously monitored. The captured image is sent to the processor for photo processing. It converts the acquired image to virtual sign the usage of Open CV. If the signal crosses the brink fee of the EAR for a given quantity of frames, then the alarm beeps and the velocity of the vehicle is automatically decreased.

A. Image sequences input and face detection

OpenCV changed into developed retaining image processing in thoughts. Each feature and data structure of OpenCV worries itself with an image processing library. Comparatively, Matlab is high of commonplace use & gradual. Any usefulness can be achieved through strategies for tool kits in OpenCV, it is probably cash-associated device compartments or explicit DNA device stash. Additionally, the dlib library comes with oriented gradients primarily based on a face detector histogram a facial landmark predictor that comes bundled inside the library. Facial landmarks generated by way of dlib are an index able list as defined in the underneath image.

The dlib library serves us with a facial landmark detector as well as a facial landmark predictor. Beneath are the facial landmarks that can be produced by using the library. Now from these landmarks, it just churns out the attention areas efficiently.

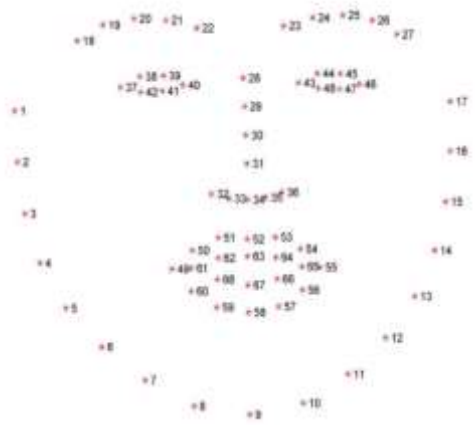


Fig.2. Facial landmarks set by dlib

B. Eye detection

$$EAR = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

Fig.3. Eye aspect ratio equation

This equation reflects this relation referred to as Eye Aspect Ratio (EAR). Where p1… p6 are 2d facial landmark regions. The numerator of this equation computes the space among the vertical eye landmarks which the denominator computes the space among horizontal eye landmarks, weighting the denominator appropriately due to the fact there's handiest one set of horizontal points but two sets of vertical points.

Now for calculating the eye-element ratio we need to compute the Euclidean distance among the facial landmarks factors which in turn wishes SciPy bundle in python. (It, not a strict requirement however SciPy is needed if paintings associated with laptop imaginative and prescient or photo processing is intended). Also, the package named utils is wanted for photo processing and laptop vision capabilities to assist the operating with OpenCV.

The thread class is imported so that we can beep the alarm in a special thread from a foremost thread so that it is ensured that our script doesn’t prevent/pause executing whilst the alarm beeps. So that you can play a file of the wav or mp3 format, we want to play sound library. For detecting and localizing facial landmarks we can require the dlib library hence we import it. Eye aspect ratio function is defined to calculate the gap between the attention landmarks taken vertically and distances between the eye landmarks taken horizontally.

So, while the eye is open, the price again for the eye aspect ratio could be constant approximately. Then the cost will hastily lower accomplish 0 in case of an eye fixed blink. When the eye is closed, eye element ratio once more procedures to an approximate consistent fee which may be very smaller in comparison to that when the attention is open. Therefore, the dip within the component ratio suggests a blink of the eyes.

C. Mouth and Yawn detection

Yawning is characterized by utilizing an extensively opened mouth. Like the ocular perceiver closure detection, the facial landmarks are acclimated to locate an open mouth shown in fig 2. Lip distance is the parameter used to decide if the situation's mouth is open. If the lip distance calculated from the frame is above the lip distance threshold, the difficulty is resolute to be yawning. An alarm is raised if the situation has yawned greater than the set boundary price consecutively. Minuscule apertures that in authenticity are construed due to verbalizing, orally eating are not noted as shown in fig 4.

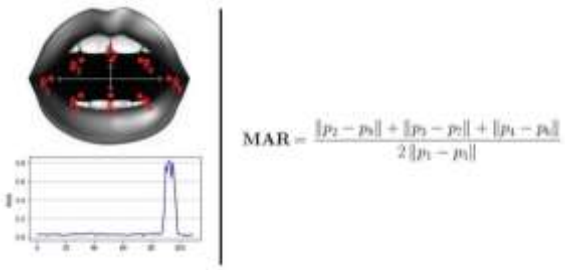


Fig.4. Mouth and Yawning detection.

IV. RESULT

Following is the table representing four test instances which are too encountered even as doing this venture that issues with the drowsiness of the driver.

Test Cases	Eyes Detected	Eye Closure	Result
Case1	NO	NO	NO RESULT
Case1	NO	NO	NO RESULT
Case1	YES	NO	NO ALARM
Case1	YES	YES	ALARM BEEPS

Fig.5. Test Instances

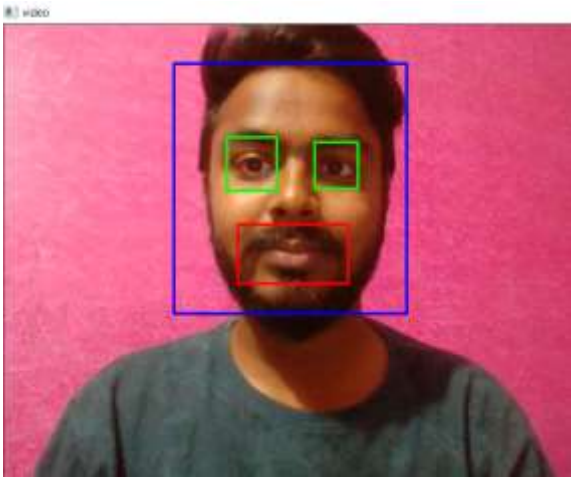
On the factor, while the eyes are closing for greater than the positive degree of edges then we find that the driver is feeling tired. Henceforth these instances are prominent is and a caution sounded. To get the final results a large no. of images were taken and their accuracy in deciding eye glints and drowsiness was tried.

For this assignment, we utilized a five-megapixel webcam associated with the pc. The webcam had built-in white LEDs connected to it to reveal it is running. In a real-time scenario, infrared LEDs should be utilized rather than white LEDs with the intention that the framework is non-meddling. An inbuilt speaker is applied to supply sound output to awaken the driving force while drowsiness is detected.

The framework turned into tried for numerous individuals in diverse surrounding lighting situations (daytime and evening time). At the factor when the webcam backdrop illumination turned into turned ON and the face is stored at a super distance, at that factor, the framework can become aware of blinks and drowsiness with over 95% accuracy.

This is a respectable final result and can be achieved through real-time systems as well. Pattern outputs for diverse conditions in one-of-a-kind pix are given beneath. Three images were taken; one in which simply the eyes have been diagnosed and the opposite in which they had been no longer and another in which drowsiness is detected.

A. Sample Images



B. Accuracy

For accuracy detection of Eye Detection and Drowsiness Detection is as follows:

Formula for Eye Detection Accuracy-

Eye Detection Accuracy = total quantity of instances eyes detected / (general no. of eyes detected+ overall no of times eyes no longer detected)

Formula for Drowsiness Detection Accuracy-

Drowsiness and Distraction Detection Accuracy = Total no. of times alarm sounds / (general no. of instances alarm sounds + overall no of times alarm didn't sound)

INPUT	Eyes Detection Accuracy	Drowsiness and Distraction Accuracy
Sample 1	100%	87.5%
Sample 2	95%	100%
Sample 3	80%	62.5%
Sample 4	100%	87.5%
Sample 5	100%	100%
TOTAL	**95%**	**87.5%**

Fig.6. Accuracy of Drowsiness/ Distraction Detection.

CONCLUSION

An accurate and efficient Driver Drowsiness and Distraction system have been developed which achieves comparable metrics with the existing state-of-the-art system. This project is using recent globally known techniques in the field of computer vision and deep learning. This system is efficiently designed and evolved partial implementation of the driving force Drowsiness and Distraction Detector the use of Python and OpenCV together with the cam to detect the face. The device to be developed is to be tested and barriers are diagnosed. The relaxation of the work can be finished under what is deliberate already.

REFERENCES

[1] The Article "40% of highway accidents occur due to drivers dozing off" https://www.financialexpress.com/india-news/40-of-highway-accidents-occur-due-to-drivers-dozing-off/1659901/.

[2] Wang, Q., Yang, J., Ren, M., Zheng, Y.: Driver fatigue detection: a survey. In: Proceedings of the World Congress on Intelligent Control (2019).

[3] Wierwille, W.W., Ellsworth, L.A., Wreggit, S.S., Fairbanks, R.J., Kirn, C.L.: Research on vehicle-based driver status/performance monitoring: development, validation, and refinement of algorithms for detection of driver drowsiness.

[4] National Highway Traffic Safety Administration, Washington, D.C., USA (2018).

[5] Kircher, A., Uddman, M., Sandin, J.: Vehicle control and drowsiness. Swedish National Road and Transport Research Institute, Linköping, Sweden (2017).

[6] Ueno, H., Kaneda, M., Tsukino, M.: Development of drowsiness detection system. In: Proceedings of the Vehicle Navigation and Information Systems Conference(2016).

[7] T. Liu, Y. Yang, G.-B. Huang and Z. Lin, "Detection of drivers distraction using semi-supervised extreme learning machine" in Proc. ELM-2014 Volume 2, Cham, Switzerland:Springer-Verlag, vol. 4, pp. 379-387, 2015.

[8] Eyosiyas Tadesse, Weihua Sheng, Meiqin Liu," Driver Drowsiness Detection through HMM based Dynamic Modeling." 2014 IEEE International Conference on Robotics & Automation (ICRA) Hong Kong Convention and Exhibition Center May 31 - June 7, 2014. Hong Kong, China.

[9] Gustavo A. Peláez C., Fernando García, Arturo de la Escalera, and José María Armingol," Driver Monitoring Based on Low-Cost 3-D Sensors." IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 15, NO. 4, Page(s): 1855 - 1860 AUGUST 2014.

[10] R. Oyini Mbouna, S. G. Kong and M.-G. Chun, "Visual analysis of eye state and head pose for driver alertness monitoring", IEEE Trans. Intell. Transp. Syst., vol. 14, no. 3, pp. 1462-1469, Sep. 2013.

[11] Ralph Oyini Mbouna, Seong G. Kong, Senior Member, IEEE, and Myung-Geun Chun," Visual Analysis of Eye State and Head Pose for Driver Alertness Monitoring." IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 14, NO. 3, SEPTEMBER 2013.

[12] V. Garla, C. Taylor and C. Brandt, "Semi-supervised clinical text classification with Laplacian SVMs: An application to cancer case management", J. Biomed. Informat., vol. 46, no. 5, pp. 869-875, Oct. 2013.

[13] Forsman P.M., Vila B.J., Short R.A., Mott C.G., van Dongen H.P.A. Efficient driver drowsiness detection at moderate levels of drowsiness. Accid. Anal. Prevent. 2012 in press.

[14] Kobayashi H. EMG/ECG acquisition system with online adjustable parameters using zigbee wireless technology. IEEE Trans. Electron. Inform. Syst. 2012;132:632–639.

[15] Cheng B., Zhang W., Lin Y., Feng R., Zhang X. Driver drowsiness detection based on multisource information. Hum. Factors Ergon. Manuf. Serv. Indust. 2012;22:450–467.
[16] Lee B.-G., Chung W.-Y. Multi-classifier for highly reliable driver drowsiness detection in Android platform. Biomed. Eng. Appl. Basis Commun. 2012;24:147–154.
[17] Bella F. Driver perception of roadside configurations on two-lane rural roads: Effects on speed and lateral placement. Accid. Anal. Prevent. 2012 in press.
[18] Auberlet J.-M., Rosey F., Anceaux F., Aubin S., Briand P., Pacaux M.-P., Plainchault P. The impact of perceptual treatments on driver's behavior: From driving simulator studies to field tests—First results. Accid. Anal. Prevent. 2012;45:91–98.
[19] Zhang, Wei; Cheng, Bo; Lin, Yingzi," Driver drowsiness recognition based on computer vision technology." Published in: Tsinghua Science and Technology (Volume: 17, Issue: 3) Page(s):354 - 362 Date of Publication: June 2012
[20] Brodbeck V., Kuhn A., von Wegner F., Morzelewski A., Tagliazucchi E., Borisov S., Michel C.M., Laufs H. EEG microstates of wakefulness and NREM sleep. NeuroImage. 2012;62:2129–2139.
[21] Johnson M.J., Chahal T., Stinchcombe A., Mullen N., Weaver B., Bédard M. Physiological responses to simulated and on-road driving. Int. J. Psychophysiol. 2011;81:203–208.
[22] M.J. Flores J. Ma Armingol A. de la Escalera, "Driver drowsiness detection system under infrared illumination for an intelligent vehicle" Published in IET Intelligent Transport Systems Received on 13th October 2009 Revised on 1st April 2011.
[23] Drivers Beware Getting Enough Sleep Can Save Your Life This Memorial Day. National Sleep Foundation (NSF); Arlington, VA, USA: 2010.
[24] Guosheng Y., Yingzi L., Prabir B. A driver fatigue recognition model based on information fusion and dynamic Bayesian network. Inform. Sci. 2010;180:1942–1954.
[25] Tremaine R., Dorrian J., Lack L., Lovato N., Ferguson S., Zhou X., Roach G. The relationship between subjective and objective sleepiness and performance during a simulated night-shift with a nap countermeasure. Appl. Ergon. 2010;42:52–61.
[26] De Rosario H., Solaz J.S., Rodri X., Guez N., Bergasa L.M. Controlled inducement and measurement of drowsiness in a driving simulator. Intell. Trans. Syst. IET. 2010;4:280–288.
[27] Fabian Friedrichs and Bin Yang, "Camera-based Drowsiness Reference for Driver State Classification under Real Driving Conditions" 2010 IEEE Intelligent Vehicles Symposium University of California, San Diego, CA, USA June 21-24, 2010
[28] Liu J., Zhang C., Zheng C. EEG-based estimation of mental fatigue by using KPCA-HMM and complexity parameters. Biomed. Signal Process. Contr. 2010;5:124–130.
[29] Sommer D., Golz M., Trutschel U., Edwards D. Agents and Artificial Intelligence. Vol. 67. Springer; Berlin, Germany: 2010. Biosignal based discrimination between slight and strong driver hypovigilance by support-vector machines; pp. 177–187.
[30] Global Status Report on Road Safety 2009. World Health Organisation (WHO); Geneva, Switzerland: 2009.
[31] Ruijia F., Guangyuan Z., Bo C. An on-Board System for Detecting Driver Drowsiness Based on Multi-Sensor Data Fusion Using Dempster-Shafer Theory. Proceedings of the International Conference on Networking, Sensing and Control; Okayama, Japan. 26–29 March 2009; pp. 897–902.
[32] Rosey F., Auberlet J.-M., Moisan O., Dupre G. Impact of narrower lane width: Comparison between fixed-base simulator and real data. Transport. Res. Rec. J. Transport. Res. Board. 2009;2138:112–119.
[33] Xiao F., Bao C.Y., Yan F.S. Yawning detection based on gabor wavelets and LDA. J. Beijing Univ. Technol. 2009;35:409–413.
[34] Liu C.C., Hosking S.G., Lenné M.G. Predicting driver drowsiness using vehicle measures: Recent insights and future challenges. J. Saf. Res. 2009;40:239–245.
[35] Kokonozi A.K., Michail E.M., Chouvarda I.C., Maglaveras N.M. A Study of Heart Rate and Brain System Complexity and Their Interaction in Sleep-Deprived Subjects. Proceedings of the Conference Computers in Cardiology; Bologna, Italy. 14–17 September 2008; pp. 969–971.
[36] Hong Su and Gangtie Zheng, "A Partial Least Squares Regression-Based Fusion Model for Predicting the Trend in Drowsiness" IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS—PART A: SYSTEMS AND HUMANS, VOL. 38, NO. 5, SEPTEMBER 2008.
[37] Portouli E., Bekiaris E., Papakostopoulos V., Maglaveras N. On-road experiment for collecting driving behavioural data of sleepy drivers. Somnology. 2007;11:259–267.
[38] Bergasa L.M., Nuevo J., Sotelo M.A., Barea R., Lopez M.E. Real-time system for monitoring driver vigilance. IEEE Trans. Intell. Transport. Syst. 2006;7:63–77.
[39] Rau P. Drowsy Driver Detection and Warning System for Commercial Vehicle Drivers: Field Operational Test Design, Analysis, and Progress. National Highway Traffic Safety Administration; Washington, DC, USA: 2005.
[40] Smith P., Shah M., Vitoria L.N. Determining driver visual attention with one camera. IEEE Trans. Intell. Transport. Syst. 2003;4:205–21.