ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 8, August 2014

Model of Automated System to Prevent Road Crashes Due to Drunk & Drowsy Driving

Md.Shamsur Rahim[1], Md.Saddam Hossain Mukta[2], M.SaminYasar [3], A.M.Umayer Reza[4]

Lecturer, Department of Computer Science, Bangladesh University, Dhaka, Bangladesh[1]

Assistant Professor, Department of Computer Science, Dhaka,American International University-Bangladesh, Bangladesh[2]

Student, Department of Computer Science, American International University-Bangladesh, Dhaka, Bangladesh[3,4]

Abstract: Now-a-days a significant number of road crashes are occurred due to drunk and drowsy driving which is the vital fact of uncertain death and injuries to numerous people due to any rare system that can detect vulnerability drunk and drowsy at the same time. According to data provided by MADD.ORG 9,878 people are died in USA in 2011. If an automated system can detect whether a person is drowsy or drunk and can alert the driver as well as can take the partial control of the vehicle then the number of uncertain death toll due to road accident can be reduced. The automated system will declare an emergency situation by eliciting a strong signal from human body since body generates different types of symptom when person is fall asleep or drunk. After detecting these symptoms using the facial action coding system (FACS) through a bank of Gabor filters and support vector machine the automated system will declare exigency to the driver and will also alert the nearest police station with the vehicle's current location using GPS. A model is proposed using FACS and extended technology that will take control over the both drunk and drowsy condition and act as a rescuer in urgency.

Keywords: Automobiles, Computer vision, FACS, Drowsiness detection, Drowsy driver detection, Drunk driver detection.

I. INTRODUCTION

Once automated vehicle only existed in fiction or dream, but by the blessing of modern science, automated vehicle is not any more a miracle as On March 28, 2012 Google [11] has successfully tested drive their first driverless car which was a modified version of Toyota Prius [1]. But obviously it will take time to spread over general people as this driverless car's equipment costs a lot, which is around $150,000 [1]. But the matter of fact is every 53 minutes on average; someone is killed in a drunk driving crash (9,878 people in total in 2011). Every 90 seconds, someone is injured because of this entirely preventable mishap. In USA the percentage of traffic deaths in 2011 that were drunk driving related was 31% [2].Statistics from the National Highway Traffic Safety Administration says that every year across the U.S., falling asleep while driving causes at least 100,000 crashes. 1,500 people die and 40,000 are injured in these crashes. It found that drowsiness of drivers was a significant factor in at least 20 percent of all crashes. The researchers estimated that people are four to six times more likely to have a crash or near crash when they are driving drowsy [3]. So, statistic shows that about 51% accidents are occurred because of drunk and drowsy driving.

One can easily imagine that the number of uncertain death due to drunk and drowsy driving will be scary around the world. Most of the countries have laws, enforcement and sanctions to prevent drunk driving but unfortunately people are violating these laws now and often. Statistics shows that 50-75% people drive anyhow even though their lenience is taken [4]. And in case of drowsy driving it is not possible to prevent by any kind of laws or enforcement. There are already many automated system to prevent drowsy and drunk driving separately and only one system that can prevent both.

The aim of this paper is to find out an efficient model of a technology that can detect and prevent drowsy and drunk driving effectively, efficiently, accurately and can be easily installed in any types of vehicle which will help to reduce the death toll of people around the world due to drowsy and drunk driving.

There are several techniques proposed by the researchers around the globe. But to detect the both incidents this paper is proposing to use facial action expression detection using an infra-red camera. [Figure-02] shows an example of FACSexample.

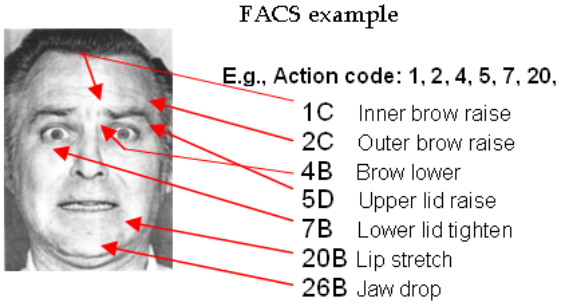

Fig. 02- FACS Example

II. RELATED WORKS

Many researchers have been conducted research to prevent drowsy or drunk driving, but only few have been partially

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 8, August 2014

successful on to prevent both. In this section, we aver few of many systems that can detect drunk or drowsy driving in brief. Minoru Sakairi and Masahito Togami [5] proposed a method of automatically detection of drunk and drowsy driving using breath sensor which is the first device [5] that can detect drunk driving by detecting expired gas based on the principle that water clusters in breath are easily separated into positively and negatively charged ones by using an electric field. For detecting drowsiness they have used breath peaks based on conscious and unconscious breath. It is the first device [5] which can detect both drunk and drowsy driving. In their proposed method they have used a breath-alcohol sensor which is put just behind the steering wheel of car mock-up, around 50cm distance from the operator. As the device is kept away around 50cm, when the windows of the vehicle are opened then it won't be able to detect the water clusters and breathe of the operator properly, since external wind flow will hinder the system execute properly.

Ellen M.Ayoob, et al. [6] proposed another method for detecting drowsy driving by using PERCLOS and a user-centered warring system as many drivers feel annoying with the sound of the warning system. In their proposed system driver can adjust the sensitivity of the drowsiness warning to minimize false alarms, select sounds that range from a robust, alerting sound to a gentle advisory tone, and adjust the volume to match the ambient sound environment. The driver can disable the warning system too in the proposed system. Although it is a noble work but it has limitations too. As they have used infra-red camera to measure the PERCLOUS, but that infrared technology for PERCLOS measurement works fairly well in the darkness of night, but not very well at all in daylight, because ambient sun light reflections make it impractical to obtain retinal reflections of infra-red.

EsraVural, et al. [7] another group of researchers proposed facial action classifier to detect drowsiness. They have also developed a multinomial ridge regression (MLR) model where they've described facial expressions that are highly effective to detect drowsiness. It is really a nice approach because, but the problem is it can only detect drowsiness. Jung-hank Yeo, [8] articulated another drowsiness detection system which was patented on Jun.5, 2001. He initiated the mechanism by processing image using a charged coupled device (CCD) camera which makes it possible to detect drowsiness.

But still it won't be able to detect drunk driving. In the paper of Dai, Jiangpeng, et al.[7], they used a program based on mobile phone that calculates acceleration using the sensor reading from mobile phone and match driving pattern with real driving test to detect drunk driving. If there is any evidence of drunk driving is present, the mobile phone will automatically alert the operator or may call the police before any accident actually happens. Murata, Kohji, et al,[10] are developing a noninvasive system to detect individuals driving under the influence of alcohol by measuring biological signals. They used the frequency time series analysis to attempt to distinguish between normal and intoxicated states of a person as the basis of the sensing system. But this system doesn't deal with drowsy detection.

III. PROPOSED APPROACH

Although Researchers are working to detect and prevent drunk and drowsy driving since a long time ago, so Today, in 2014 why there isn't any available system in the market that can detect and prevent drowsy driving? Why only few models of cars have them? [12][13]. Here in this section we discuss about the problems and our proposed approach.

Problem:

- Researchers have proposed different approaches to detect drunk and drowsy driving separately. But there isn't any system that can detect both using common method.
- A system can help a drowsy person by alerting them, but it is impractical to alert a person who is drunk and out of his mind.
- As a drunken person is out of his/her mind so at this situation by alerting them it is impossible to prevent or reduce road accident.
- Previous researches which have used different kinds of Computer Vision techniques may have a higher rate of failure if the driver uses any type of glasses or mask.

Proposed Model:

After researching several methods finally an approach has been found that can be effectively used in both drunk and drowsy driving detection. According to this research outcome, FACS is the best approach to detect the both. There has been a research to detect drowsiness using FACS and their proposed approach obtained 92% correct accuracy for predicting driver drowsiness based on the facial behavior [7]. Till now this is the most accurate outcome to detect drowsiness which is only possible using FACS. They used a full set of action units used for predicting drowsiness.

AU	Name
1	Inner Brow Raise
2	Outer Brow Raise
4	Brow Lowerer
5	Upper Lid Raise
6	Cheek Raise
7	Lids Tight
8	Lip Toward
9	Nose Wrinkle
10	Upper Lip Raiser
11	Nasolabial Furrow Deepener
12	Lip Corner Puller
13	Sharp Lip Puller
14	Dimpler
15	Lip Corner Depressor
16	Lower Lip Depress
17	Chin Raise
18	Lip Pucker

ISSN (Online) : 2278-1021
ISSN (Print) : 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 3, Issue 8, August 2014

19	Tongue show
20	Lip Stretch
22	Lip Funneller
23	Lip Tightener
24	Lip Presser
25	Lips Part
26	Jaw Drop
27	Mouth Stretch
28	Lips Suck
30	Jaw Sideways
32	Bite
38	Nostril Dilate
39	Nostril Compress
45	Blink

Table1: Full set of action units used for predicting drowsiness. (Source: [7])

In our proposed model, we decided to use Gabor filter [15] & support vector machine for each of the facial expression that are related with drowsiness and drunkenness. Gabor filter is linear filter that is used to detect edge. The Gabor filter can be defined as:

$$\psi(x,y,\varpi,\theta)=\frac{1}{2\pi\sigma^2}e^{-\left(\frac{x'^2+y'^2}{2\sigma^2}\right)}\left[e^{i\varpi x'}-e^{-\frac{\varpi^2\sigma^2}{2}}\right] \quad (17)$$

$$x'=x\cos\theta+y\sin\theta, y'=-x\sin\theta+y\cos\theta$$

where (x, y)is the pixel position in the spatial domain, ω the radial center frequency, θ the orientation of Gabor filter, and the standard deviation of the round Gaussian function along the x- and y-axes. In addition, the second term of the Gabor filter, compensates for the DC value because the cosine component has nonzero mean while the sine component has zero mean.[17]

When the operator starts the engine of the vehicle, the system will try to detect whether the operator is drunk or not. If the operator is found as drunk then the vehicle will stop and send an alert to nearest Police station with License number of the vehicle and its current location using GPS reading. If the driver is not drunk the vehicle will start moving. In other scenario, operator may become drunk/drowsy while driving.

So to detect and prevent these sorts of situation our proposed model of the system will always analyze the facial expression of the operator using an infra-red camera and the image will be processed through a bank of Gabor filter [15] and one trained Support Vector Machine for each of the facial expression that are related with drowsiness and drunkenness.

The effectiveness of these methods are proven by EsraVural, et al. [7] for detecting only drowsiness. If the system can find that the operator is drowsy it'll alert and limit the speed of the vehicle until the operator is not enough conscious to drive. In case of drunk driving detection, the system will also limit the speed of the vehicle at a safe limit and alert the nearest police station like the previous scenario. The model is given below:

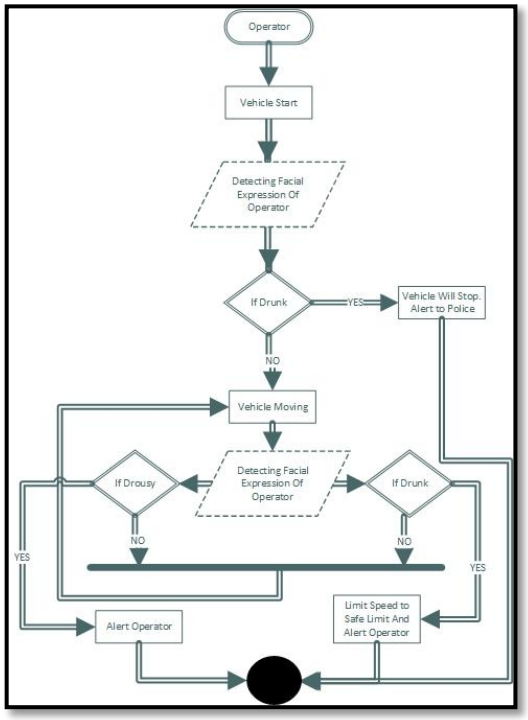

Figure 01 – Proposed model to detect drunk and drowsy driving

IV. DISCUSSION

FACS is defined as internationally recognized, sophisticated research tool that precisely measures the entire spectrum of human facial expressions[14]. So in this model it has been proposed to use FACS to detect and alert drunk & drowsy driving. In most of the cases FACS has predicted patterns related to deception at about 80% accuracy [14]. EsraVural, et al. [7] found an accuracy rate of 92% using FACS to detect drowsy driving. So it is theoretically proved that this proposed model will also have better accuracy rate than any other system existing at the present. The objective of this research was to find out a model of a system that would be able to detect drunk and drowsy driving meanwhile would also be able to play a vital role by itself to reduce the road accidents due to these reasons. The authors are satisfied with their model and have confidence in accuracy of detection of drunk and drowsy driving to reduce road accidents by a large percentage.

V. CONCLUSION

Although there has been many researches done before our research to reduce the massive death of people due to drunk and drowsy driving, but in our practical life people don't see the existence of these research's output. There are many possibilities why these research output does only exist in pen and paper, not in real world. The possibilities or reasons may include: the system is not cost efficient, the system's accuracy rate is not enough to cope up with the practical environment. But we believe that our approach is with cost efficiency, highly accuracy rate can fit with the real world outside of the research work as it's only required a simple infra-red Camera & a GPS. So it's time to reduce the uncertain death due to drowsy and drunk driving using an automated system.

REFERENCE

[1] Google Driverless Car, See at: http://en.wikipedia.org/wiki/Google_driverless_car
[2] Drunk Driving Fatalities by State, See at: http://www.madd.org/blog/2012/december/2011-State-data.html
[3] Drowsy Driving Statistics See at: http://school.sleepeducation.com/drowsydrivingstats.aspx
[4] Borsch-Supan, Axel, ed. Life-cycle savings and public policy: a cross-national study of six countries. Academic Press, 2003.
[5] Sakairi, Minoru, and Masahito Togami. "Use of water cluster detector for preventing drunk and drowsy driving."Sensors, 2010 IEEE.IEEE, 2010.
[6] Ayoob, Ellen M., Richard Grace, and Aaron Steinfeld. "A user-centered drowsy-driver detection and warning system."Designing For User Experiences: Proceedings of the 2003 conference on Designing for user experiences.Vol.6.No. 07. 2003.
[7] Vural, Esra, et al. "Automated drowsiness detection for improved driving safety." (2008).
[8] Yeo, Jung-hack. "Driver's drowsiness detection method of drowsy driving warning system." U.S. Patent No. 6,243,015. 5 Jun. 2001.
[9] Dai, Jiangpeng, et al. "Mobile phone based drunk driving detection." Pervasive Computing Technologies for Healthcare (PervasiveHealth), 2010 4th International Conference on-NO PERMISSIONS.IEEE, 2010.
[10] Murata, Kohji, et al. "Noninvasive biological sensor system for detection of drunk driving." Information Technology in Biomedicine, IEEE Transactions on 15.1 (2011): 19-25.
[11] Google. See at: http://en.wikipedia.org/wiki/Google.
[12] Driver Monitoring System. See at: http://en.wikipedia.org/wiki/Driver_Monitoring_System
[13] Volvo Car Group, Press Release, ID:12130https://www.media.volvocars.com/global/enhanced/en-gb/Media/Preview.aspx?mediaid=12130
[14] Facial Action Coding System, See at: http://www.facscodinggroup.com/about/facs
[15] Gabor Filter, See at: http://en.wikipedia.org/wiki/Gabor_filter
[16] Donato, Gianluca, et al. "Classifying facial actions." Pattern Analysis and Machine Intelligence, IEEE Transactions on 21.10 (1999): 974-989.
[17] Deng, Hong-Bo, et al. "A new facial expression recognition method based on local gabor filter bank and pca plus lda." International Journal of Information Technology 11.11 (2005): 86-96.
[18] The Facial Action Coding , See at: Systemhttp://mplab.ucsd.edu/grants/project1/research/face-detection.htm

BIOGRAPHIES

Md. Shamsur Rahim received his B.Sc in Computer Science & Software Engineering degree from American International University-Bangladesh, Dhaka, Bangladesh 2014. He has been awarded Summa Cum Laude for his outstading acamedic achievement. His research interests include data mining, human computer interaction, artificial intelligence.At this moment he is involved in Teaching at Bangladesh University, Dhaka, Bangladesh And preparing for himself to pursue for higher study.

Md. Saddam Hossain Mukta obtained his M.sc degree in Computer science from University of Trento, Italy where he was receiving Opera University Scholarship and earned a B.Sc degree in Computer Science and Information Technology from Islamic University of Technology (IUT), Gazipur, Bangladesh in 2006. His research interest is mainly focused on Semantic web, Social computing, Software Engineering, HCI, Image processing, Web Mining and Data & knowledge management. Currently he is an Assistant Professor in American International University-Bangladesh (AIUB) in the department of CS.

M. Samin Yasar received his bachelor degree from American International University (AIUB), Dhaka, Bangladesh, in 2013.He joined CAFFE (Computers Are Free Foe Everyone- An UK based organization), Dhaka, Bangladesh, in 2013. In the 2013 he enrolled in Research based Master's degree program at AIUB. He achieved Leadership Award for his outstanding extra-curricular activities, in the 13th convocation ceremony of AIUB. He is the founding member and President of AIUB Computer Club–ACC. His main areas of research interest are Computer Vision, Micro simulation, and Human Computer Interaction (HCI) and Artificial Intelligence systems.

A. M. Umayer Reza earned Bachelor of Science in Computer Science & Engineering in 2014 from American International University – Bangladesh. His areas of interest in research are Artificial Intelligence, Human-Computer Interaction, Database and Data Mining. He is the youngest son of Dr. Md. Rezaul Karim and Dilruba Karim.