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DROWSINESS DETECTION USING ARTIFICIAL INTELLIGENCE TECHNIQUES

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ABSTRACT

Driver fatigue is one of the major causes of accidents in the world. Detecting the drowsiness of the driver is one of the surest ways of measuring driver fatigue. In this project we aim to develop drowsiness detection system using Fuzzy Logic and Genetic Algorithm, both in Isolation to detect drowsiness .It uses an nonintrusive technique for judging driver alertness. Alertness is detected on the basis of the degree to which the driver's eyes are open or closed. Viola-Jones algorithm has been developed for face detection which then further used by the fuzzy logic and Genetic Algorithm. Fuzzy logic used to determine level of fatigueness and determine output state. Genetic algorithm has been used to make a good performing combination of good indicators. It calculates the degree (%) of eyes and mouth to detect the state of drowsiness. During the analytical study Genetic Algorithms [22, 23] results were found more accurate as compared to Fuzzy

This paper describes how to find the eyes, and determine the status of the eyes are open or closed. An application of Viola Jones algorithm is used for Face detection and tracking. The Haar like feature is developed, which was a primary objective of the project. Haar like feature is a classifier which is trained with a few hundreds of positive and negative examples that are scaled to the same size. The system deals with using information obtained for the binary version of the image to find the edges of the face, which narrows the area of where the eyes may exist..Taking into account the knowledge that eye regions in the face present in uppermost quadrants, we consider extraction of eyes for calculations. Once the eyes are located, we can use various matlab image processing tool to determine whether the eyes are open or closed.

General Terms

Image Processing, Eye Estimation, Haar like Feature, Fuzzy Logic, Genetic Algorithm

KEYWORDS: Viola-Jones Algorithm, Haar Like Feature, Drowsiness Detection

INTRODUCTION

Driver drowsiness is an important factor in the motoring of vehicle accidents[16,8,2,1]. It was demonstrated that driving performance deteriorates with increased drowsiness with resulting crashes constituting more than 20% of all vehicle accidents. There are various traditional techniques developed to alert the drivers. One set of such techniques places sensors[7,9] in various standard vehicle components a second set of techniques measures the psychological factors of the drivers. Athird set of solutions focuses on computer vision systems that can detect and recognize the facial motion and appearance changes occurring during drowsiness.

The advantage of computer vision techniques is that they are non-invasive, and thus are more amenable to use by

the general public. There are some significant previous studies about drowsiness detection using computer vision techniques. Most of the published research on computer vision approaches to detection of fatigue has been focused on the analysis of blinks. However, in the fatigue detection systems developed to date, drowsiness warning system using image processing has become most widely used because it provides a remote detection. Matlab is used for image processing.

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation.

Typical Uses Include

- Math and computation
- Algorithm development
- Data acquisition Modeling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics
- Application development, including graphical user interface building

MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. This allows you to solve many technical computing problems, especially those with matrix and vector formulations, in a fraction of the time it would take to write a program in a scalar non-interactive language such as C or FORTRAN al.

EARLIER WORKS

Various Algorithms were Proposed Till Date, they Can be Classified

- Biological indicators
- Vehicle behavior
- Face analysis

Some of them are intrusive methods and some are non-intrusive. The intrusive methods includes ECG [13], EOG and Head motion. In some of this type of methods drivers had to wear a head gear while driving[12]. While in other methods they used pulse detectors which were placed in the steering wheel and in the back of the seat. This too were not reliable most of the time.

That is why this techniques was not much adopted for common people. Methods to detect drowsiness on the basis of vehicle behaviors such as vehicle steering activity, vehicle speed and vehicle lateral position were also developed but they were too slow to alert the driver before he fell asleep. These methods alerts driver only after they fell asleep not before they were in the episode of the drowsy state.

The face analysis done till date are mostly non-intrusive and uses camera to detect the facial expressions [4, 11, 16]. It further uses image processing tools to detect the facial expressions. Some methods used the change in intensities in binary images to detect the drowsiness state while others used the facial expressions such as yawning to detect it. These type of methods were found to be more accurate than those mentioned before

PROPOSED METHOD AND SYSTEM

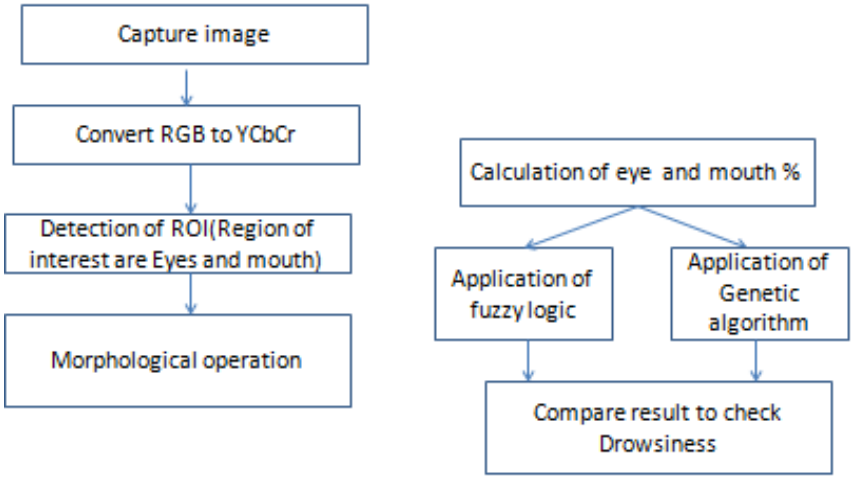

Figure 1: Flowchart of Drowsiness Detection System

Capturing Image

An image which taken inside a vehicle includes the driver's face. Typically a camera takes images within the RGBmodel (Red, Green and Blue). However, the RGB model includes brightness in addition to the colours. When it comes to human‟s eyes, different brightness for the same colour means different colour. When analyzing a human face, RGB model isvery sensitive in image brightness. Therefore, to remove the brightness from the images is second step. We use the YCbCr space since it is widely used in video compression standards .Since the skin-tone colour depends on luminance, we nonlinearly transform the YCbCr colour space to make the skin cluster luma-independent. This also enables robust detection of dark and light skin tone colours. The main advantage of converting the image to the YCbCr domain is that influence of luminosity can be removed during our image processing. In the RGB domain, each component of the picture (red, green and blue) has a different brightness. However, in the YCbCr domain all information about the brightness is given by the Y component, since the Cb (blue) and Cr (red) components are independent from the luminosity. Below figure 2 represents captured image

Figure 2: Captured Image

RGB to YCbCr Conversion

Image captured by camera is in RGB (red green blue) colour space. RGB colour model includes brightness in addition to colours. For human eyes different brightness for the same colour means different colour. When analyzing a human face, RGB model is very sensitive in image brightness. Therefore, to remove the brightness from the images is second step. We use the YCbCr space since it is widely used in video compression standards. Since the skin-tone colour depends on luminance, we nonlinearly transform the YCbCr colour space to make the skin cluster luma-independent. This

also enables robust detection of dark and light skin tone colours. The main advantage of converting the image to the YCbCr domain is that influence of luminosity can be removed during our image processing.

RGB image is first converted to HSV space and then YCbCr space

V = max (R , G, B)

S = V-min (R,G,B)/V

H = G-B/6S, if V = R

H = 1/3 + (B-R/6S), if V =G

H =2/3 + (R-G/S), if V=B

Skin Detection

At the beginning, due to the different brightness, here are variations of skin color in RGB color space. So we have converted it to YCbCr space in above section.

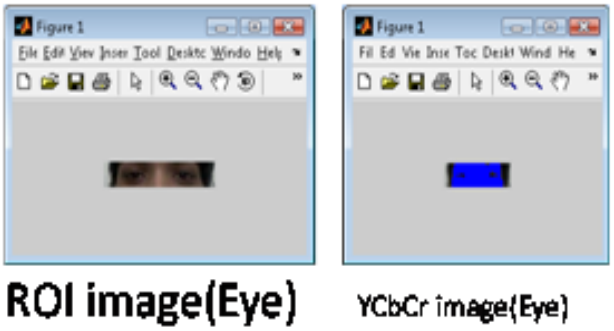

Figure 3: Skin Detection Using YCbCr Image

Now in order to get drivers face location we need to eliminate background from the image. as shown in figure 3.

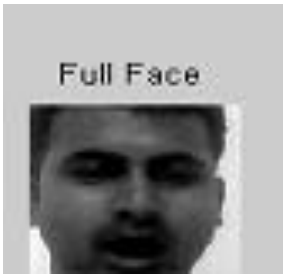

Figure 4: Image with Background Separation

Haar like features are used to detect face and eye of the driver. A Haar like feature is a classifier which is trained with a few hundreds of positive and negative examples that are scaled to the same size. Here positive examples refer to the images of an object which is to be detected and negative examples indicate images of anything other than the desired object. A feature based system works faster than a pixel based system.

Face Detection Using Haar like Features

As we are going to work on the facial expressions background in an image is of no use to us. In this step we remove the background from an image and only the region containing face is given as output. Automatic face detection is very complex task in the world of image processing, Many methods exist to solve this Viola-Jones algorithm [14] has been developed with face detection

Figure 5: Image with Haar-Feature

Phases

- Face Localization.
- Eye Location.

Captured Faces are stored in xml database. Viola and Jones adapted the idea of using Haar wavelets and developed the so called Haar-like features. A Haar-like feature shown in figure 6.considers adjacent rectangular regions at a specific location in a detection window, sums up the pixel intensities in each region and calculates the difference between these sums. Haar like features are used to detect face and eye of the driver. A Haar like feature is a classifier which is trained with a few hundreds of positive and negative examples that are scaled to the same size. Here positive examples refer to the images of an object which is to be detected and negative examples indicate images of anything other than the desired object. A feature based system works faster than a pixel based system.

ROI Detection (Techniques to Detect Drowsiness)

Various technique has been used to detect drowsiness. In this project, we had used a Fuzzy Logic and Genetic algorithm to detect drowsiness. Face region is separated from captured image next step is to detect ROI. As our main motive is to analyze eye and yawning movement, we need to detect eye and mouth region as these are two most visual cues to detect drowsiness of a person. We divided the face into quadrants, the region of eyes and mouth will be uppermost and lowermost quadrant of the face. Therefore, calculation will be based on eye and mouth to estimate drowsiness. By taking these assumptions, the search for the eye and mouth will be limited to the area this limited area will make the search more efficient

Fuzzy Logic to Detect Drowsiness

After ROI, Fuzzy logic is applied to estimate the drowsiness. The concept of fuzzy logic has gained wide acceptance in recent years and have found numerous applications in expert systems and artificial intelligence applications. Fatigue is a type of fuzzy bodily state.

It cannot be quantified objectively. Thus, we use computers

To apply the fuzzy logic and determine the level of fatigueness. The variable used by the drowsiness detection system encompasses the eye and the mouth state. The risk factor is Calculated based on rule-table decision. The eye and And mouth is taken as the input variables. The physical state of the eye and mouth is the output variable.

Establishing the Grade

The variable is changed according to the driver‟s physical conditions. For example, when the driver is tired, his eyes will involuntarily extend the mean of the eye. When the driver is alert, his standard deviation is low and his mean of the eye will also be low.

However, when the driver is exhausted, his standard deviation is high and his mean of the eye will also be higher. Therefore, based on standard deviation and mean of the eye, nine rule base of the fuzzy logic is defined as follows

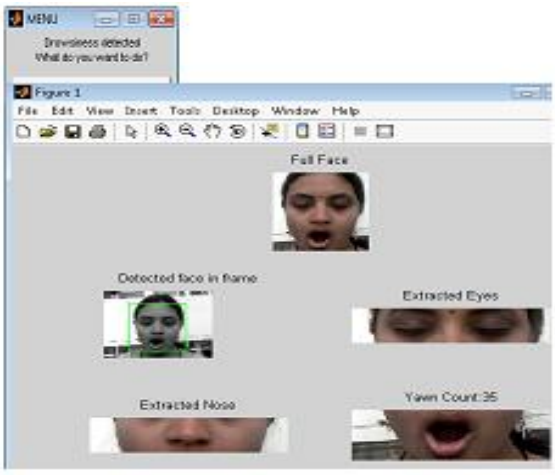

Figure 6: Drowsiness Detection Using Fuzzy Logic

The eye count and mouth (yawn) count is calculated to estimate the drowsiness. The Fuzzy Logic controller is used, decision is calculated to estimate the Drowsiness state IF Eyes are open and mouth count <threshold and decision < 0.5 then No Drowsiness Else person is drowsy

Genetic Algorithm to Detect Drowsiness

Genetic algorithm, image is captured using webcam.[17] Facial features are extracted such as Eyes and Mouth from the image, using VJ algorithm, to calculate the actual degree of percentage of eyes and mouth.

Percentage of Eyes(Le)=[100-(L/26*100)]

Similarly Percentage of Mouth(Lm)=(L/108*100)]. Now this Percentage of Eyes and mouth are given input to Genetic algorithm to determine the percentage of Drowsiness state[18] Result is calculated to check the % of Drowsiness

Result > 40 -------Drowsy

Else Result <40 -------Non- Drowsy

Result is calculated by combination of Eyes and Mouth as an input to Genetic algorithm and result (output) is produced as actual percentage of Drowsiness.

Crossover rate is defined as 0.95%

Mutation rate is defined as 0.05%

Figure 7: Drowsiness Detection Using Genetic Algorithm

RESULTS

It shows the percentage of Drowsiness and Compared the Result of Genetic algorithm with that of Fuzzy in Figure 8.

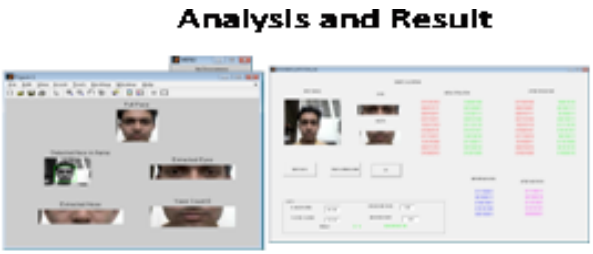

Figure 8: Analytical Study of Fuzzy and Genetic

In the following Figure 9, Genetic algorithm results are compared with Fuzzy Logic and it proves that Genetic algorithm [19] results are more accurate interms of Percentage of Drowsiness,

	FUZZY					GENETIC					ERROR IN ABRUPT MOV OF HEAD
Image	% of Drowsiness (Accuracy)	Processing time (sec)	Fuzzy State	Actual	Accuracy in terms of State	% of Drowsiness (Accuracy)	Processing time (sec)	GA State	Actual	Accuracy in terms of State	
a25(A1)	55	2.217426	Droway	Droway	YES	62	0.154697	Droway	Droway	YES	
a22(A2)	22	5.124017	Droway	Droway	YES	56	0.126099	Droway	Droway	YES	
a14(A3)	11	1.245673	Droway	Droway	YES	66	0.100419	Droway	Droway	YES	
a17(A4)	22	2.562255	Non Droway	Non Droway	YES	22	0.102665	Non Droway	Non Droway	YES	
a26(A5)	0	5.090757	Non Droway	Non Droway	YES	16	0.095740	Non Droway	Non Droway	YES	
a9(A6)	0	5.553166	Non Droway	Droway	NO	66	0.097602	Droway	Droway	YES	NO

Figure 9: Comparative Study of Fuzzy and Genetic

Estimation (Processing) time required is less compared to Fuzzy

Actual state is compared with the processed output which shows more correct result with Genetic than Fuzzy.

CONCLUSIONS

This paper presented a non-intrusive system to detect the status of the eyes. The paper mainly describes the percentage of Drowsiness detection using Fuzzy and Genetic algorithm both in isolation. The exact facial region and the eye region are detected using various matlab algorithms. Haar like features is developed by Viola and Jones, to detect face and eye of the driver. Detecting facial region before eye region improves the accuracy to a great extent. Previous approaches focused on assumptions about behaviors that might be predictive of drowsiness. An advantage is feature based system works faster than a pixel based system. Result shows that Genetic algorithm is more accurate than Fuzzy as it applies the real life scenario of Crossover and mutation

REFERENCES

1. Azim Eskandarian, Member, IEEE and Ali Mortazavi (2007).“Evaluation of a Smart Algorithm for Comme-rcial Vehicle Driver Drowsiness Detection.” IEEE Intelligent Vehicles Symposium Istanbul, Turkey, June 13-15
2. Eriksson, M and Papanikolopoulos, N.P(1997) “Eye- Tracking for Detection of Driver Fatigue”, IEEE Intelligent Transport System Proceedings, 314-319..
3. Ibrahiem M. M. El Emary, “On the Application of Artificial Neural Networks in Analyzing and Classifying the Human Chromosomes”, *Journal of Computer Science*, vol.2(1), 2006, pp.72-75.

4. N. Senthilkumaran and R. Rajesh, "A Study on Edge Detection Methods for Image Segmentation", *Proceedings of the International Conference on Mathematics and Computer Science (ICMCS-2009),* 2009,Vol. I, pp.255-259.
5. Mantas Paulinas and Andrius Usinskas, "A Survey of Genetic Algorithms Applicatons for Image Enhancement and Segmentation", *Information Technology and Control*, Vol.36, No.3, 2007, pp.278-284.
6. Xian Bin Wen, Hua Zhang and Ze Tao Jiang, "Multiscale Unsupervised Segmentation of SAR Imagery Using the Genetic Algorithm", *Sensors*, vol.8, 2008, pp.1704-1711.
7. K. Harimast (2002) "Human Maehinc. Intedae in an Intelligent vehicle" SAU.vol.56, 4-7.
8. L. Barr, H. Howrah, S. Popkin, RJ. Carrol l(2009) " A review and evaluation of emerging driver fatigue detection, measures and technologies", A Report of US department of transportation Washington DC.
9. Lin, S. H., Kung, S. Y., & Lin, L. J. (1997). "Face recognition/detection by probabilistic decision-based neural network."IEEE Transactions on Neural Networks,
10. Paul Stephen Rau, "Drowsy Driver Detection and Warning System for Commercial Vehicle Drivers: Field Operational Test Design, Data Analyses and Progress".
11. Nikhil R Pal, Chien-Yao Chuang, Li-Wei Ko, Chih-Feng Chao, Tzyy- Ping Jung, Sheng-Fu Lieng, Chin-Teng Lin, EEG-Based Subject- and Session-independent Drowsiness Detection: An Unsupervised Approach".
12. Gabriela Dorfman Furman, Armanda Baharav, "Investigation of Drowsiness while Driving Utilizing Analysis of Heart Rate Fluctuations".
13. Paul Viola, Michael J. Jones, "Robust Real-Time Face Detection".
14. Metin Kaya, "Image Clustering and Compression Using an Annealed Fuzzy Hopfield Neural Network",
15. Sugiyama, K., Nakano, T., Yamamoto, S., Ishihara, T., Fujii, H., & Akutsu, E. (1996). "Method of detecting drowsiness level by utilizing blinking duration". JSAE Paper 9630273.
16. "Eye Location Using Genetic Algorithm "Jeffrey Huang and Harry Wechsler, Department of Computer Science, George
17. ason University, Fairfax, VA 22030,2nd International Conference on Audio and Video-Based Biometric Person Authentication (AVBPA), Washington, DC, 1999.
18. "Driver Fatigue Detection using Genetic Algorithm.", S. Jin, S.-Y. Park J.J.Lee, 11th International Symposium on Artificial Life and Robotics, Oita, Japan, January 23–25, 2006
19. J. Bala, K. DeJong, J. Huang, H. Vafaie, H. Wechsler, "Visual routine for eye detection using hybrid genetic architectures," International Conference on Pattern Recognition, vol. 3, pp. 606-610, 1996.
20. S. Rajasekaran, G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic, and Genetic Algorithm (Synthesis and Applications)," Prentice Hall India, 2003
21. Michalewicz, Zbigniew, "Genetic Algorithms + Data Structures = Evolution Programs," Springer-Verlag, 1999.
22. Schmitt, M. Lothar, "Theory of Genetic Algorithms," Theoretical Computer Science (259), pp. 1-61, 2001.
23. D. Whitley, "A genetic algorithm tutorial. Statistics and Computing," pp. 65–85, 1994.