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An Eye Gaze Real Time Road Detection System for Driver Assistance

K.Pradeep Reddy
Associate Professor
Department of CSE
Tirumala Engineering College.

M.Uday Kumar
Associate Professor
Department of CSE
Tirumala Engineering College.

B Avinash
M.Tech Student
Department of CSE
Tirumala Engineering College.

Abstract

Automated estimation of the allocation of a driver's visual attention may be a critical component of future Advanced Driver Assistance Systems. In theory, vision-based tracking of the eye can provide a good estimate of gaze location. In practice, eye tracking from video is challenging because of sunglasses, eyeglass reflections, lighting conditions, occlusions, motion blur, and other factors. Estimation of head pose, on the other hand, is robust to many of these effects, but cannot provide as fine-grained of a resolution in localizing the gaze. However, for the purpose of keeping the driver safe, it is sufficient to partition gaze into regions. In this effort, we propose a system that extracts facial features and classifies their spatial configuration into six regions in real-time. Our proposed method achieves an average accuracy of 91.4% at an average decision rate of 11 Hz on a dataset of 50 drivers from an on-road study.

Introduction

Driver distractions are the leading cause of most vehicle crashes and near-crashes. According to a study released by the National Highway Traffic Safety Administration (NHTSA) and the Virginia Tech Transportation Institute (VTTI) 80% of crashes and 65% of near-crashes involve some form of driver distraction. In addition, distractions typically occurred within three seconds before the vehicle crash. Recent reports have shown that from 2011 to 2012, the number of people injured in vehicle crashes related to distracted driving has increased 9%. In 2012 alone, 3328 people were killed due to distracted driving crashes, which is a slight reduction from the 3360 in 2011.

Distracted driving is defined as any activity that could divert a person's attention away from the primary task of driving. Distractions include texting, using a smart phone, eating and drinking, adjusting a CD player, operating a GPS system or talking to passengers.

This is particularly challenging nowadays, where a wide spectrum of technologies have been introduced into the car environment. Consequently, the cognitive load caused by secondary tasks that drivers have to manage has increased over the years, hence increasing distracted driving. According to a survey, performing a high cognitive load task while driving affects driver visual behavior and driving performance. References reported that drivers under high cognitive loads showed a reduction in the time spent examining mirrors, instruments, traffic signals, and areas around intersections. Especially concerning is the use of hand-held phones and other similar devices while driving. NHTSA has reported that texting, browsing, and dialing cause the longest period of drivers taking their Eyes Off the Road (EOR) and increase the risk of crashing by three fold. A recent study shows that these dangerous behaviors are wide-spread among drivers, 54% of motor vehicle drivers usually have a cell phone in their vehicles or carry cell phones when they drive. Result in drastic changes in the facial features (e.g., pupil and eye corners) to be tracked the system must be accurate for a variety of people across multiple ethnicities, genders, and age ranges.

Monitoring driver activities forms the basis of a safety system that can potentially reduce the number of crashes by detecting anomalous situations. Authors showed that a successful vision-based distracted driving detection system is built upon reliable EOR estimation. However, building a real- time EOR detection system for real driving scenarios is very challenging for several reasons: (1) The system must operate during the day and night and under real world illumination conditions; (2) changes in drivers' head pose and eye movements result in drastic changes in the facial features (e.g., pupil and eye corners) to be tracked; (3) the system must be accurate for a variety of people across multiple ethnicities, genders, and age ranges. Moreover, it must be robust to people with different types of glasses. To address these issues, this paper presents a low-cost, accurate, and real-time system to detect EOR. Note that EOR detection is only one component of a system for detecting and alerting distracted drivers.

EXISTING SYSTEM:

The video-based gaze approaches commonly use two types of imaging techniques: infrared imaging and visible imaging. The former needs infrared cameras and infrared light sources to capture the infrared images,while the latter usually utilizes high resolution cameras for images.

Compared with the infrared-imaging approaches, visible imaging methods circumvent the aforementioned problems without the need for the specific infrared devices and infrared light sources. They are not sensitive to the utilization of glasses and the infrared sources in the environment. Visible-imaging methods should work in a natural environment, where the ambient light is uncontrolled and usually results in lower contrast images.

Sugano et al. have presented an online learning algorithm within the incremental learning framework for gaze estimation, which utilized the user's operations (i.e., mouse click) on the PC monitor.

Nguyen first utilized a new training model to detect and track the eye, and then employed the cropped image of the eye to train Gaussian process functions for gaze estimation. In their applications, a user has to stabilize the position of his/her head in front of the camera after the training procedure.

Williams et al. proposed a sparse and semi-supervised Gaussian process model to infer the gaze, which simplified the process of collecting training data.

DISADVANTAGES OF EXISTING SYSTEM:

- The iris center detection will become more difficult than the pupil center detection because the iris is usually partially occluded by the upper eyelid.
- The construction of the classifier needs a large number of training samples, which consist of the eye images from subjects looking at different positions on the screen under the different conditions.
- They are sensitive to head motion and light changes, as well as the number of training samples.
- They are not tolerant to head movement

PROPOSED SYSTEM:

In this paper, we concentrate on visible-imaging and present an approach to the eye gaze tracking using a web camera in a desktop environment. First, we track the human face in a real time video sequence to extract the eye region. Then, we combine intensity energy and edge strength to locate the iris center and utilize the piecewise eye corner detector to detect the eye corner. Finally, eye gaze tracking is performed by the integration of the eye vector and head movement information.

Our three-phase feature-based eye gaze tracking approach uses eye features and head pose information to enhance the accuracy of the gaze point estimation.

In Phase 1, we extract the eye region that contains the eye movement information. Then, we detect the iris center and eye corner to form the eye vector.

Phase 2 obtains the parameters for the mapping function, which describes the relationship between the

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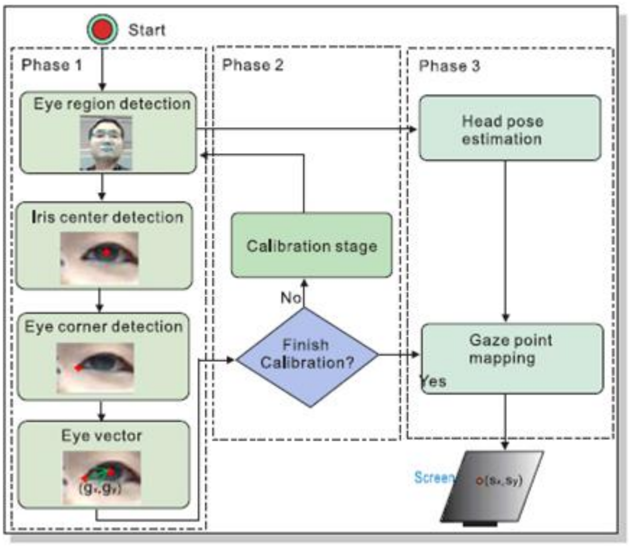
eye vector and the gaze point on the screen. In Phases 1 and 2, a calibration process computes the mapping from the eye vector to the coordinates of the monitor screen.

Phase 3 entails the head pose estimation and gaze point mapping. It combines the eye vector and head pose information to obtain the gaze point.

ADVANTAGES OF PROPOSED SYSTEM:

- The proposed approach can tolerate illumination changes and robustly extract the eye region, and provides an accurate method for the detection of the iris center and eye corner.
- A novel weighted adaptive algorithm for pose estimation is proposed to address pose estimation error; thus, improving the accuracy of gaze tracking.

SYSTEM ARCHITECTURE:



Facial Feature Detection and Trackin

Parameterized Appearance Models (PAMs), such as Active Appearance Models and Morphable Models are popular statistical techniques for face tracking. They build an object appearance and shape representation by computing Principal Component Analysis (PCA) on a set of manually labeled data.

PAMs typically optimize many parameters (about 50–60), which makes them very prone to local minima. Second, PAMs work very well for person-specific subjects but do not generalize well to other untrained subjects because they use a linear model of shape and appearance. Third, the shape model typically cannot model asymmetric expressions (e.g., one eye open and another closed, or an asymmetric smile). This is due to the fact that in most training datasets, these expressions do not occur.

To address the limitations of PAMs, Xiong and Dela Torre proposed the Supervised Descent Method (SDM) , which is a discriminative method for fitting PAMs. There are two main differences from the traditional PAMs. First, it uses a non-parametric shape model that is better able to generalize to untrained situations (e.g., asymmetric facial gestures). Second, SDM uses a more complex representation. This provides a more robust representation against illumination, which is crucial for detecting and tracking faces in driving scenarios.

Head Pose Estimation

In real driving scenarios, drivers change their head pose and facial expression while driving. Accurately estimating driver's head pose in complex situations is a challenging problem. In this section, a 3D head pose estimation system is proposed to decouple rigid and non-rigid head motion.

Gaze Estimation

The driver's gaze direction provides crucial information as to whether the driver is distracted or not. Gaze estimation has been a long standing problem in computer vision .Most existing work follows a model-based approach to gaze estimation that assumes a 3D eye model, where the eye center is the origin of the gaze ray. In this paper, we used a similar model.

We make three main assumptions: First, the eyeball is spherical and thus the eye center is at a fixed point (rigid point) relative to the head model; Second, all the eye points, including the pupil, are detected using the SDM tracker. Third, the eye is open and therefore all the eye contour points can be considered rigid. Our algorithm has two main parts: (1) Estimate the 3D position of the pupil from the rigid eye contour points, and (2) estimate the 3D gaze direction from the pupil position and the eye center.

The 3D position of the pupil is computed as follows: Triangulate the eye contour points in 2D and determine which triangle mesh contains the pupil. See Fig

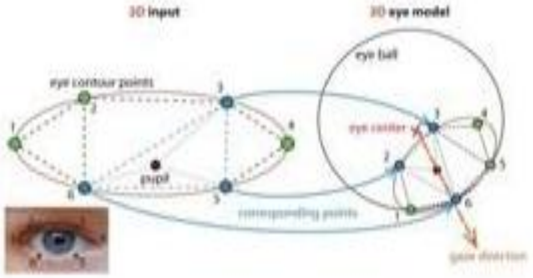


Fig: 3D Gaze estimation

Compute the bar centric coordinates of the pupil inside the triangle mesh that contains the pupil.

Apply the bar centric coordinates to the corresponding eye contour points in 3D to get the 3D position of pupil.

After we obtain the 3D position of the pupil, the gaze direction can be simply estimated as the ray that goes through the 3D eye center and the 3D pupil. We can thus obtain the gaze angles.

Eyes off the Road Detection

The EOR estimation is based on a 3D ray tracing method that uses the geometry of the scene as described in Fig... Our EOR estimation algorithm computes the point where the driver’s 3D gaze line, vgaze in Fig. , intersects the car windshield plane Π. If the intersection point lies outside of the defined on-the- road area, an alarm is triggered. In our approach, we only used the gaze from the driver’s left eye since it suffers from less occlusion (only short head movements to check the driver mirror) than the right eye.

To compute the 3D gaze vector, we need the 3D position of the eye and the gaze direction (gaze yaw and pitch angles).

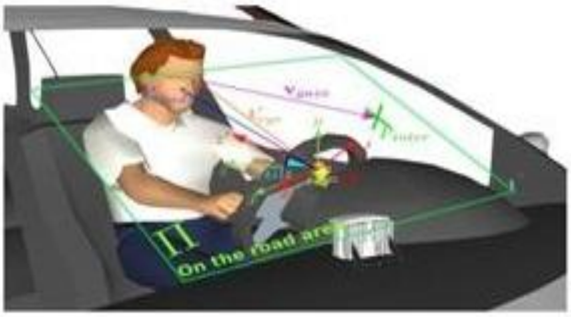


Fig: Geometric analysis for EOR estimation.

CONCLUSION AND FUTURE SCOPE

This paper describes a real-time EOR system using the video from a monocular camera installed on steering wheel column. Three are the main novelties of the proposed sys- tem: (1) Robust face landmark tracker based on the Super- vised Descent Method, (2) accurate estimation of 3D driver pose, position, and gaze direction robust to non-rigid facial deformations, (3) 3D analysis of car/driver geometry for EOR prediction. The proposed system is able to detect EOR at day and night, and under a wide range of driver’s characteristics. The system does not require specific calibration or manual initialization. More importantly, no major re-calibration is necessary if the camera position is changed or if we re-define a new on- the-road area.

This is due to the explicit use of 3D geometric reasoning. Hence, the installation of the system in different car models does not require any additional theoretical development. Our experiments showed that our head pose estimation algorithm is robust to extreme facial deformations.

In future improving the facial feature detection in challenging situations (e.g. faces with glasses with thick frames) and improving the pupil detection using Hough transform-based techniques to further improve the gaze estimation will boost the performance of our system.

References

1. Yiu-ming Cheung, Senior Member, IEEE, and Qinmu Peng, Member, IEEE, “Eye Gaze Tracking With a Web Camera in a Desktop Environment”, IEEE TRANSACTIONS ON HUMAN-MACHINE SYSTEMS 2015.

2. M. L. Cascia, S. Sclaroff, and V. Athitsos, "Quick, solid head following under differing brightening: An approach in light of enlistment of surface mapped 3D models," IEEE Trans. Design Anal. Mach. Intell., vol. 22, no. 6, pp. 322–336, Apr. 2000.

3. Y. Dong, Z. Hu, K. Uchimura, and N. Murayama, "Driver distractedness checking framework for smart vehicles: A survey," IEEE Trans. Intell. Transp. Syst., vol. 12, no. 2, pp. 596–614, Jun. 2011.

4. E. Murphy-Chutorian, A. Doshi, and M. M. Trivedi, "Head posture es-timation for driver help frameworks: A strong calculation and exper-imental assessment," in Proc. IEEE Intell. Transp. Syst. Conf., 2007, pp. 709–714.

5. D. W. Hansen and Q. Ji, "subjective depending on each person's preferences: An overview of models for eyes and look," IEEE Trans. Design Anal. Mach. Intell., vol. 32, no. 3, pp. 478–500, Mar. 2010.

6. D. Vlasic, M. Mark, H. Pfister, and J. Popovic', "Confront exchange with multilinear models," ACM Trans. Chart., vol. 24, no. 3, pp. 426–433, Jul. 2005.

7. A. Nabo, "Driver consideration—Dealing with languor and diversion," Smart Eye, Gothenburg, Sweden, Tech. Rep., 2009.

8. C. Cao, Y. Weng, S. Zhou, Y. Tong, and K. Zhou, "Faceware-house: A 3D outward appearance database for visual figuring," IEEE Trans. Vis. Comput. Illustrations, vol. 20, no. 3, pp. 413–425, Mar. 2014.