Proceedings of the 8th European Conference for Visual Media Production, London, 16-17 November 2011, paper number sp-1.

ADAPTIVE OBJECT PLACEMENT FOR AUGMENTED REALITY USE IN DRIVER ASSISTANCE SYSTEMS

Lucie Bordes, Toby P. Breckon, Ioannis Katramados, Alireza Kheyrollahi
School of Engineering, Cranfield University, UK.

Abstract
We present an approach for adaptive object placement for Augmented Reality (AR) use in driver assistance systems. Combined vanishing point and road surface detection enable the real-time adaptive emplacement of AR objects within a drivers' natural field of view for on-road information display. This work combines both automotive vision and multimedia production aspects of real-time visual engineering.

Keywords: automotive vision, augmented reality.

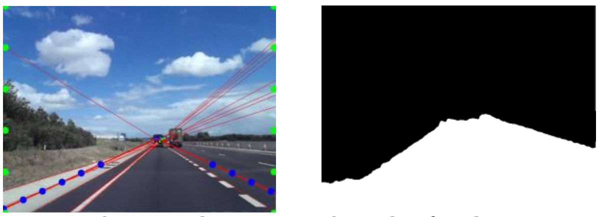
1 Introduction

Recent advances in vehicle technology embed a range of different sensors for road environment monitoring and additionally employ computer vision techniques to extract road information from onboard cameras [1, 2, 3]. The accumulation of this data presented to the driver, in addition to existing satellite navigation, can distract the drivers from their natural road view. This work aims at using combined vanishing point and road surface detection to enable the adaptive emplacement of such information, on the road surface, within the driver's natural field of view. Augmented Reality (AR) could be used in this context for the presentation of both navigation, vehicle status and environment sensed information. Specifically, this work investigates the use of intelligent placement techniques to avoid other environment objects present on the road surface.

2 Road surface detection

In an initial calibration stage, we determine the vanishing point of the road scene using the approach of [1]. This approach uses temporal averaging of an initial calibration sequence to calculate the RANSAC-based intersection of straight lines within the scene. This one time calibration facilitates the recovery of the scene vanishing point from which the road plane homography can be recovered (see Figure 1a).

Subsequently, we have to identify the available space within the defined road area. This is performed using a histogram analysis technique on the saturation channel of the HSL colour transform of the original road image using the technique of [4]. Histogram back-projection is then used to create a probability map of road surface colour occurrence. This is averaged over 10 frames from which a segmented available road surface area (free of other vehicles and environment clutter) is identified. An example is shown in Figure 1b of the identified available road surface area from the original Figure 1a road image.

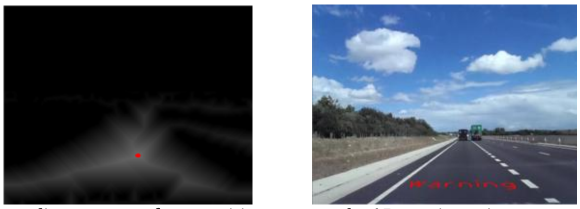


a: vanishing point detection *b: road surface detection*

Figure 1: Road area estimation using [1, 4]

3 Adaptive object placement

The AR information should be presented without interfering with existing objects present in the road environment. A distance transform is used to identify the central point of the segmented road area (Figure 1b) which is maximally distant from the usable road area edges for object emplacement. An inverse perspective mapping using the recovered homography transforms the road surface to a bird eye view upon which an AR marker can be placed. An AR marker and text are rendered onto this view before inverse perspective mapping. The output of the distance transform upon a segmented road image represents the distance to the nearest boundary of the usable (free) road area (Figure 2a). The maximum which is the most central space within the usable road surface is suitable for AR object placement (Figure 2b).



a: distance transform position *b: AR text insertion*

Figure 2: Position identification and emplacement of AR text in road scene

The approach of [5] is used to place AR text and 3D objects upon the road surface at the identified position (Figure 2b).

4 Results

Overall the usable road area detection approach is successful but can be somewhat dependent on the video image quality. A range of different road examples with AR display is shown in Figure 3 where we see adaptation to a number of road occupancy conditions.

Figure 3: Adaptive AR object placement on road scenes

5 Conclusions

The combination of vanishing point detection [1] and road surface detection [4] enables the adaptive emplacement of AR objects within a dynamic road environment suitable for a driver assistance system. Future work could investigate improved road area detection using feature-based or adaptive machine learning techniques.

[1] Kheyrollahi, A. and Breckon, T. P. (2010), "Automatic real-time road marking recognition using a feature driven approach", Machine Vision and Applications, pp. 1-11.

[2] Eichner, M. L. and Breckon, T. P. (2008), "Integrated speed limit detection and recognition from real-time video", IEEE Intel. Vehicles Symp., pp. 626-631.

[3] Tang, I. and Breckon, T. P. (2011), "Automatic road environment classification", IEEE T. on Intel. Trans. Sys., vol. 12, no. 2, pp. 476-484.

[4] Katramados, I., Crumpler, S. and Breckon, T. P. (2009), "Real-time traversable surface detection by colour space fusion and temporal analysis", Proc. Int. Conf. on Computer Vision Systems, pp. 265-274.

[5] Kato, H., Billinghurst, M., Poupyrev, I., Imamoto, K. and Tachibana, K. (2000), "Virtual object manipulation on a table-top AR environment", Proc. Int. Symp. on Augmented Reality, pp. 111-119.

Adaptive object placement for augmented reality use in driver assistance systems

Bordes, Lucie

2011-11-17T00:00:00Z