AttentiRobot: Attentive Vision for Landmark Detection and Tracking

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The potential of the visual attention mechanism for visual robot navigation is investigated. Available visual attention algorithms are used to automatically select representative landmarks of a navigation environment, which can be used by the robot to achieve navigation tasks.

Visual attention refers to the ability of a vision system to rapidly detect the most salient parts of a given scene. On the other hand, robustly detecting and tracking visual landmarks of an environment is an essential faculty of autonomous robots in order to accomplish navigation tasks. This work investigates the potential of the visual attention mechanism to provide pre-attentive scene information to a robot navigation system. Fig. 1 shows the Pelé robot and its environment.

Figure 1: The Pelé robot with a color web camera mounted (left) and the navigation environment (right)

The most conspicuous locations of the navigation environment are automatically detected by means of a real-time visual attention system recently developed[1]. Taking advantage of the pre-attentive information provided by the multi-scale, multi-cue visual attention model, the detected scene parts are tracked over time[2]. Robustly detected and tracked scene locations can be selected as landmarks in the environment, which the robot can use in feature-based localization and mapping.

Classical visual attention algorithms detect salient scene parts —spots of attention—according to features like color, intensity, and orientation. However, corners represent an important feature for building reliable tracking solutions, especially in an indoor environment. Thus, the classical model of visual attention has been extended to consider also corner features. This extension clearly improved the behavior of the detection module by stabilizing the detected spots of attention over time.

Once detected, the spots of attention are characterized by certain features in order to facilitate their tracking later. Four different features (two chromatic, intensity, and corners) have been used in this work to characterize the detected spots, as shown in Fig. 2. The characteristic feature vector indicates the contribution of each of the considered features to the saliency of the detected spot.

Pre-attentive information from the visual attention model is efficiently used to track detected spots of attention over time. Each tracked spot is associated with a trajectory that stores its spatial and temporal evolution. Fig. 3 gives an example of tracked spots of attention in a sequence of about 90 frames.

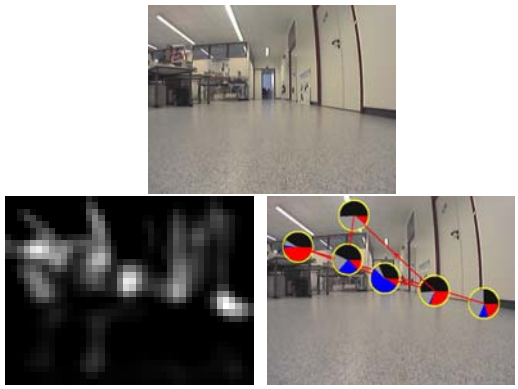

Figure 2: Detection and characterization of spots of attention. Top: original image. Bottom left: corresponding saliency map. Bottom right: detected spots of attention and their corresponding characteristic feature vectors.

The length of the trajectories is an indicator of the persistency and robustness of the tracked features[3]. In future work, the robustly tracked features will be used to build a feature map of the robot's environment.

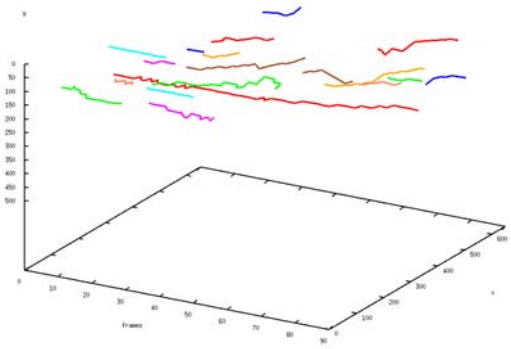

Figure 3: Trajectories of a variety of tracked spots of attention for 90 frames. Longer lines mean more robust features for navigation.

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[1] N.Ouerhani and H. Hugli, "A Real-time Implementation of Visual Attention on a SIMD Architecture", International Journal of Real Time Imaging, Vol. 9, pp. 189-196, 2003.

[2] N. Ouerhani and H. Hugli. "A Model of Dynamic Visual Attention for Object Tracking in Natural Image Sequences", Lecture Notes in Comp. Sci. (LNCS) 2686, Springer Verlag, pp. 702-709, 2003.

[3] N. Ouerhani, H. Hugli, G. Gruener, "Attention-based Landmark Detection and Tracking for Visual Robot Navigation", submitted to the Intl. Conference on Pattern Recognition, UK, August 2004.