Color-based Tracking of Human Body Parts

The Computational Vision and Robotics Laboratory of FORTH-ICS have developed a method for tracking multiple skin colored objects in images acquired by a possibly moving camera. The proposed method encompasses a collection of techniques that enable the modeling and detection of skin-colored objects as well as their temporal association in image sequences. Skin-colored objects are detected with a Bayesian classifier which is bootstrapped with a small set of training data. Tracking over time is realized through a novel technique which can handle multiple skin-colored objects. Such objects may move in complex trajectories and occlude each other in the field of view of a possibly moving camera. Moreover, the number of tracked objects may vary in time. A prototype implementation of the developed system operates on 320x240 live video in real time (30Hz) on a conventional Pentium 4 processor.

The proposed 2D tracker has formed a basic building block for tracking multiple skin colored regions in 3D. More specifically, we have developed a method which is able to report the 3D position of all skin-colored regions in the field of view of a potentially moving stereoscopic camera system. The prototype implementation of the 3D version of the tracker also operates at 30 fps.

On top of this functionality, the tracker is able to deliver 3D contours of all skin colored regions; this is performed at a rate of 22 fps.One of the very important aspects of the developed tracker is that it can be trained to any desired color distribution, which can be subsequently tracked efficiently and robustly with high tolerance in illumination changes.

Due to its robustness and efficiency, the proposed tracker(s) have already been used as important building blocks in a number of diverse applications.

More specifically, the 2D tracker has been employed for:

- Tracking the hands of a person for human computer interaction. Simple gesture recognition techniques applied on top of the outcome of the skin-colored regions tracker has resulted in a system that controls the mouse of a computer based on the visual interpretation of hand gestures. These gesture recognition techniques are based on finger detection in skin-colored regions corresponding to human hands. The developed demonstrator has successfully been employed in real-world situations where a human controls the computer during MS PowerPoint presentations.

- Hand tracking in the framework of a cognitive vision system whose goal is the automatic interpretation of the activities of people handling tools.
- Tracking color blobs in vision-based robot navigation experiments.

A preliminary version of the proposed tracker has been successfully presented in the ECCV'04 demonstrations session (http://cmp.felk.cvut.cz/eccv2004/).
More details and video demonstrations can be found at:
www.ics.forth.gr/~argyros/research/colortracking.htm
www.ics.forth.gr/~argyros/research/fingerdetection.htm
www.ics.forth.gr/~argyros/research/virtualmouse.htm

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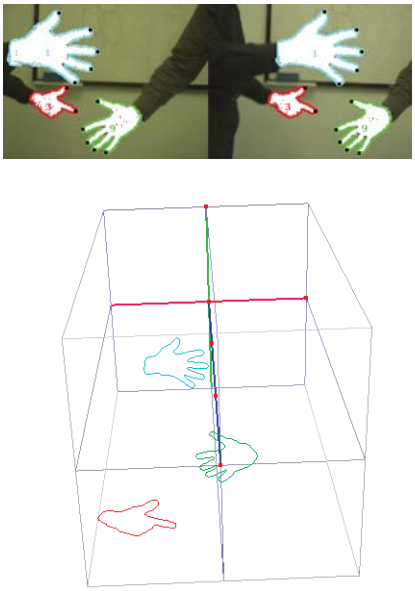

Stereoscopic view of tracked hands and 3D reconstruction of their silhouettes

COMPUTATIONAL VISION AND ROBOTICS LABORATORY (CVRL)

The Computational Vision and Robotics Laboratory (CVRL) of FORTH-ICS was established in 1985. The research and development efforts at CVRL focus on the areas of computational vision and autonomous mobile robots that perceive their environment and exhibit intelligent behaviours.

Research in this field has theoretical interest because it leads to the computational and mathematical modelling of perception and action, and contributes to a better understanding of the mechanisms involved in the corresponding capabilities of biological organisms. Furthermore, this research is of practical interest because it forms the basis for the development of interesting and often significant robotic systems, such as robotic wheelchairs for people with disability, tour-guide robots in museums and other exhibitions, robots performing routine tasks such as cleaning and surveillance. Moreover, by-products of this research prove extremely useful in other application areas that are not directly related to robotics, such as virtual and augmented reality, 3D modelling and environmental monitoring, event detection, and content-based image retrieval. Efforts at CVRL are balanced between basic and applied research, resulting in the construction of robust vision and robotic systems for various application domains.

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