

Finger Counter: A Human-Computer Interface

Stephen C. Crampton and Margrit Betke

Computer Science Department, Boston University,
Boston, MA 02215, USA
stevec@cs.bu.edu, betke@cs.bu.edu

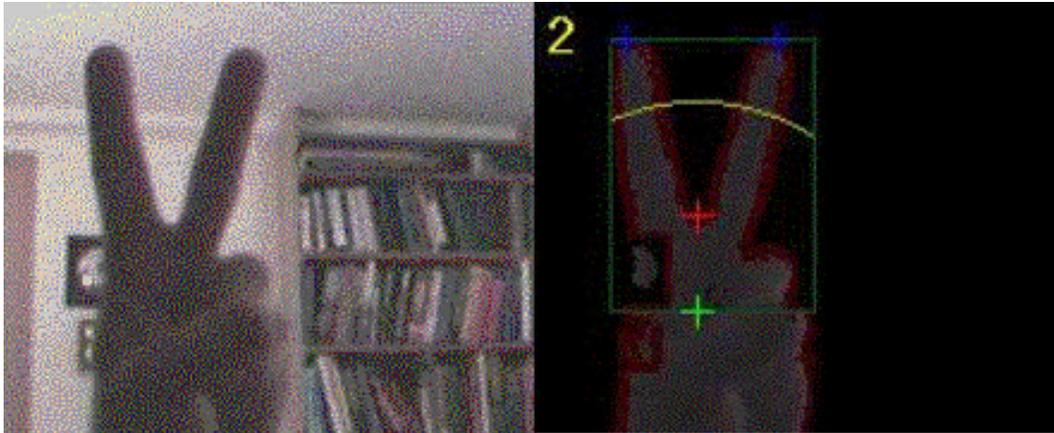


Fig. 1. The video input and one of the output windows of *Finger Counter*.

Extended Abstract

Finger Counter is a computer-vision system that counts the numbers of fingers held up in front of a video camera in real time. The system is designed as a simple and universal human-computer interface: potential applications include educational tools for young children and supplemental input devices, particularly for persons with disabilities. The interface is language independent and requires minimal education and computer literacy.

Finger Counter uses background differencing and edge detection to locate the outline of the hand. The system then processes the polar-coordinate representation of the pixels on the outline to identify and count fingers: fingers are recognized as protrusions that meet particular threshold requirements. The system also logs the frequency of different inputs over a given time interval.

We implemented the *Finger Counter* interface under Linux using Video4Linux and also under Microsoft Windows™ as a DirectShow™ filter. The system was tested extensively under various lighting and background conditions. During testing, the system successfully counted the fingers of numerous subjects with disparate hand shapes and sizes and skin color. In ongoing experiments, more than a dozen test subjects were able to get the system to recognize how many fingers they were holding up within a few seconds.

Finally, we incorporated the *Finger Counter* interface into a children's game for learning and entertainment. The game asks children to hold up a certain number of fingers, and then tells the children, through text and audio, how many fingers it counts.

Ongoing research and development directions are as follows: (1) motion detection to enhance the segmentation process; (2) statistical analysis of tracking information to enhance reliability of finger finding; and (3) music and visual additions to the application game.

A live demonstration of *Finger Counter*, implemented on a laptop with a webcam, will be provided at the UI4All Conference.

Acknowledgements

Financial support by the National Science Foundation (IIS 0093367 and EIS 0202067) and the Office of Naval Research is gratefully acknowledged.

References

1. Birchfield, S. (1986). Elliptical head tracking using intensity gradients and color histograms. *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, Santa Barbara, CA, June 1998, pp. 232-237.
2. Imagawa, K., Lu, S., and Igi, S. (1998). Color-based hands tracking system for sign language recognition. *Proceedings of the 3rd International Conference on Automatic Face and Gesture Recognition*, Nara, Japan, April 1998, pp. 462-467.
3. Jennings, C. (1999). Robust finger tracking with multiple cameras. Presented at the *IEEE Workshop on Recognition, Analysis and Tracking of Faces and Gestures in Real-Time Systems*, Corfu, Greece, September 1999, <http://www.cs.ubc.ca/spider/jennings/ratfg-rt99/cj99.html>.
4. Shimada, N., Shirai, Y., Kuno, Y., and Miura, J. (1998). Hand gesture estimation and model refinement using monocular camera—ambiguity limitation by inequality constraints, *Proceedings of the 3rd International Conference on Automatic Face and Gesture Recognition*, Nara, Japan, April 1998, pp. 268-273.