

A Webcam Based Face-Tracking Game

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Summary

In this project, we use the open-source OpenCV library with a webcam to create a game where the player can use his or her face position to play a Tic-Tac-Toe game with the computer.

Webcams are inexpensive and commonly found on laptops and can be used to implement face-tracking technology with three degrees of freedom tracking. Tracking includes finding the relative position of the users' face to the camera.

Using webcams and existing object detection techniques such as the OpenCV library makes it possible to quickly implement a simple and affordable tracking system.

In the future we plan to add expression recognition and explore ways of extending face tracking to other applications. Please see the "Future Work" section for more information.

Play The Game

- Uses standard Tic-Tac-Toe rules
- User plays against computer
- Watch play on game board (upper right)
- Click 'S' key to begin
- Move face in webcam to move face square
- Surround a game square with face square
- Click the 'C' key to select square
- Game board will update with black circle
- Computer will counter move with red squares

Face-Tracking Technology

Face-tracking determines the locations and sizes of human faces in an image or a video. Face-tracking often uses machine learning (ML) algorithms to train the machine to recognize human faces. The most popular ML algorithm for face-tracking is AdaBoost which was proposed by Viola and Jones in 2001.

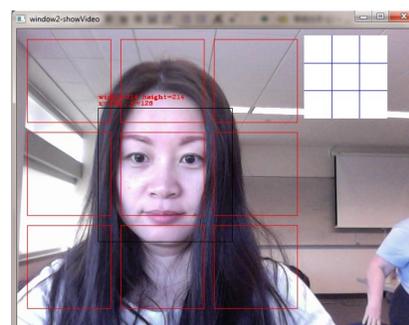
OpenCV is an open source computer vision library providing 500 functions spanning many areas in vision, such as camera calibration, stereo vision, robotics, and user interface.

We use a cascade of classifiers provided by OpenCV trained by Adaboost for face detection.

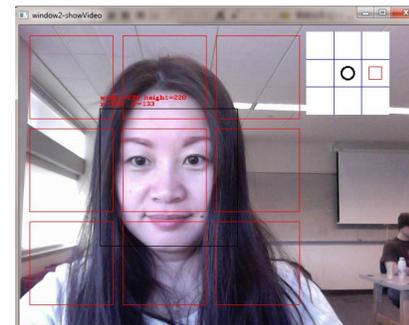
Video Sequence from the Game



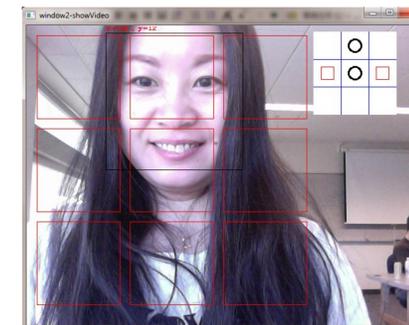
1. Face detection



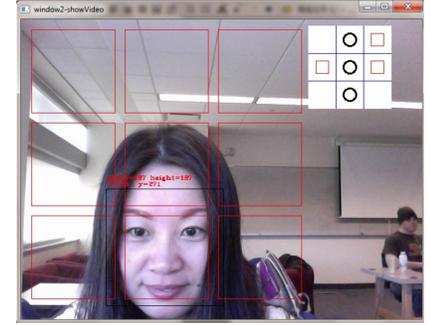
2. Show anchors



3. Use face-tracking to choose center square



4. Use face-tracking to choose the top-center square



5. Use face-tracking to choose the bottom-center square

References

- Machine learning tutorial.
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OpenCV machine learning reference
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http://www.cognotics.com/opencv/docs/1.0/ref/opencvref_ml.htm
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Three papers related to adaBoost
Y. Freund, A more robust boosting algorithm. May 2009. URL:
<http://arxiv.org/abs/0905.2138>
Y. Freund and R. E. Schapire, Experiments with a new boosting algorithm. In Machine Learning: Proceedings of the Thirteenth International Conference, pages 148-156, 1996
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Acknowledgments

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Now Try Our Demonstration

Future Work

We intend to add facial expression recognition as another part of the game using a "haartrain" model to train the machine to recognize 6 basic human facial expressions, including anger, surprise, disgust, fear, sadness, and joy. We began work on this using the Cohn-Kanade AU-Coded Facial Expression Database but found the AI training requires thousands of training images, not just a few. Expression recognition would be fun for the game but also could serve a practical purpose as a complementary input device, for example for ambient data visualization systems or to control internet browsing.

Other future work includes the possibility of tracking the users' face to control the users' view of a 3-dimensional desktop virtual environment system. For example, as the user moves their face, their viewpoint into the virtual world adjusts automatically. Besides gaming and other applications, this would be more natural than mouse and keyboard input and could possibly be used for more general tracking of natural movement within a larger virtual environment.