Project Proposal for Webcam-based User Interface

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Introduction

This spring, the image processing project that I propose is a user interface that uses a low-resolution, inexpensive camera to replace the functionality of a mouse on a personal computer. By tracking the eye movements and deflections of the user, this algorithm will determine the location of the user's focus on the screen, and will manipulate the cursor accordingly.

Design Approach

By implementing efficient, simple image processing techniques, the algorithm will find the location of the user's face in the image. After approximating the distance between the camera and the user, the program will discard the useless image data surrounding the face, and search for the user's eyes in the face image (see figure 1). Once found, the location of each eye will be recorded, and a small amount of pertinent image data surrounding each eye will be passed, together with the recorded locations of the face and eyes, into a neural network.

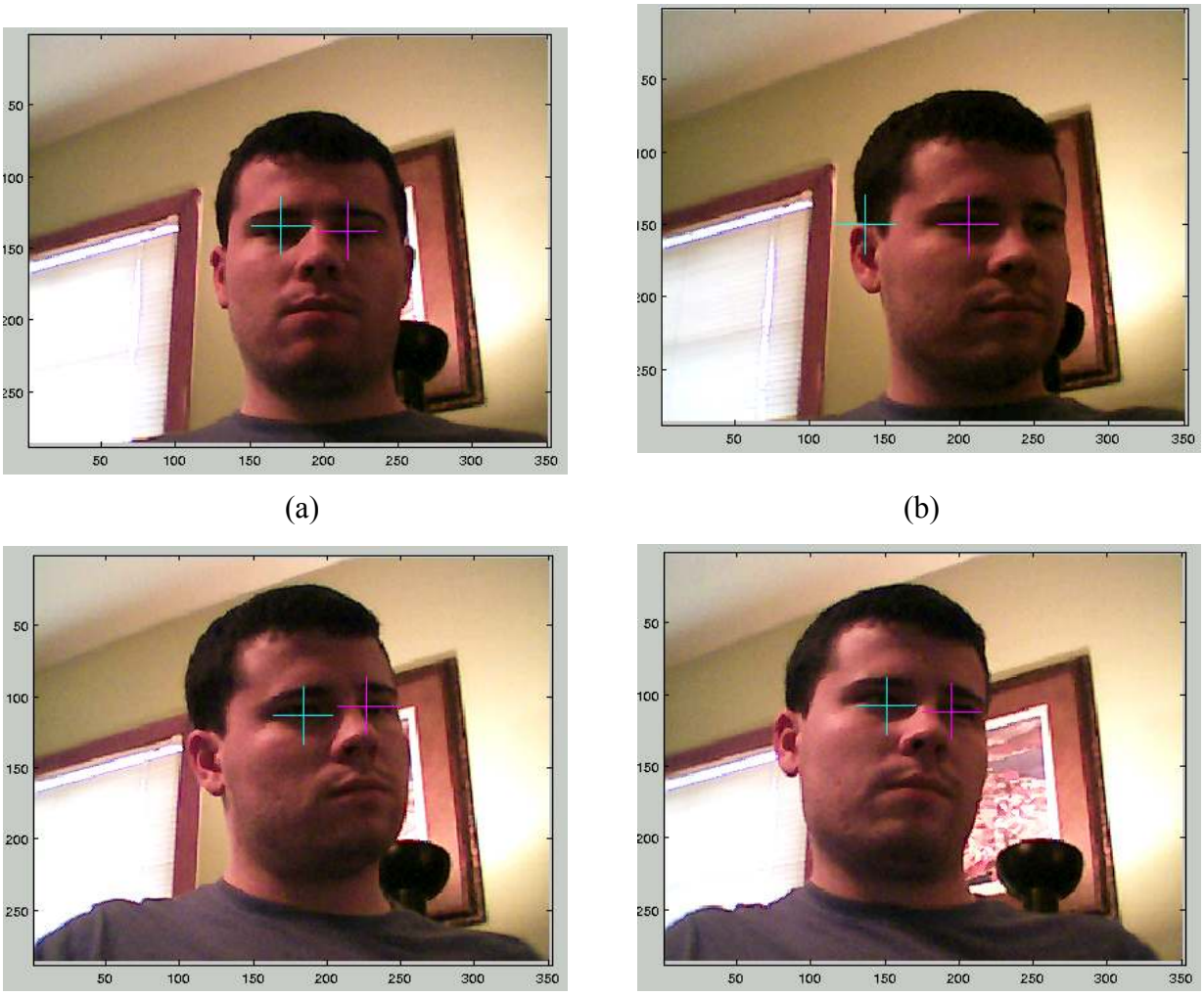
Because each face is so different, and because the position or orientation of the user may change over time, a neural network must be trained to adapt to the unique circumstances at the beginning of each session. This training should involve a short eye-following exercise during which the user simply watches a moving icon as it traces over the screen. The neural network will be trained to associate the pertinent location and image data from the image processing algorithm with the correct screen coordinates. Extended blinking will optionally be trained to generate a select function at this stage. Once this training session has completed, the program will be able to accurately locate the user's focus on the screen and manipulate the cursor appropriately. The program will scan for changes in the location of the face and eyes at about 2Hz.

Project Considerations

Because am I working alone on this project, I will need to spend a significant amount of time on the design stage early in the semester. I have already completed several elements of the image processing algorithm, and I plan to finish most of the design over spring break. I will also need to specifically design the interface to work with several diverse sample users in order to avoid overtraining on my own image.

Conclusion

The development of a webcam-based user interface adds useful functionality to a product that is already accessible to consumers and can be easily implemented on a variety of platforms. The design of this interface is a worthwhile image processing semester project.



(a) (b)

(c) (d)

Figure 1: Sampled results of eye-location algorithm already designed. The algorithm is currently accurate on 70% of a test set of 50 images. Improved design will reduce errors (b).