Using Human-Computer Interfaces for Purposes beyond Rehabilitation

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ABSTRACT

So far, much research has gone into the field of technology for those disabled or otherwise ill-equipped to fully utilize modern-day computer systems. Technically speaking, this is significantly easier to accomplish as when one is paraplegic (for example) the full potential of the brain is not being reached as it would for non-paraplegic individuals that can control the various appendages to the body. This paper tests the use of a consumer grade web camera to allow control of the mouse cursor through tracking the visual focus of the user.

KEYWORDS: HCI, Webcam, gaze-tracking

1. INTRODUCTION

The desire of many to see all people able to use a computer, especially those disabled, has introduced many new and fascinating concepts to the computer world to aid those who cannot use a computer. A portion of these include the idea to use a video camera of some sort to track the gaze of users unable to move a standard tracking device (e.g., mice, pointing devices, etc) [4].

One of the major reasons that there is so much success in subjects tested with this sort of assistive technology is the simple fact that in many cases, the lack of brain usage devoted to appendage movement allows for a larger amount of the brain free to control an attached or otherwise linked peripheral device. [5] In a non-disabled individual, however, this is not the case, and thus it is preferred to pursue an extra-peripheral option.

2. METHODOLOGY

Initially, the type of movement to be tracked was decided to be eye movement with the iris/pupil being the focus and overall head movement kept to a minimum. After sufficient testing, this method of tracking was rejected, due to need for very high resolution images to keep track of the edge of the iris/pupil, and the complexity required to filter out the iris/pupil from the rest of the image at said resolution.

It was then decided to vie for tracking movement of the head by keeping track of the iris/pupil. This is accomplished by filtering the image to render only the eye visible or at least easily differentiable from the rest of the face (Fig. 1).

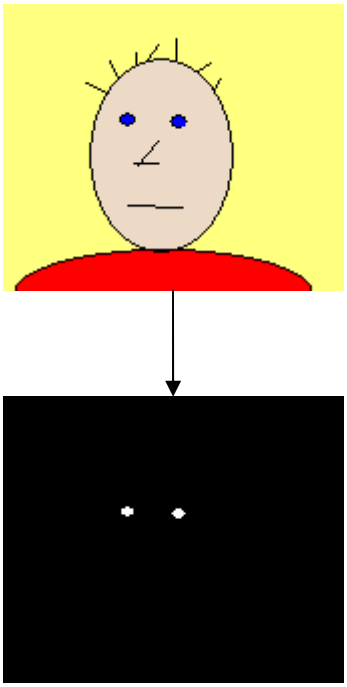

Figure 1: *Example of what needs to be done to track head movement*

After processing the image, it is given to the program to locate the white patches, which it overlays with white squares. The center of each square is recorded, and compared to the previous measurement. If only one position has changed or changed significantly more than the other, the head has turned, and the mouse is moved left or right accordingly. If both positions have changed, then the head has changed pitch, and the cursor moves up or down accordingly (Fig. 2).

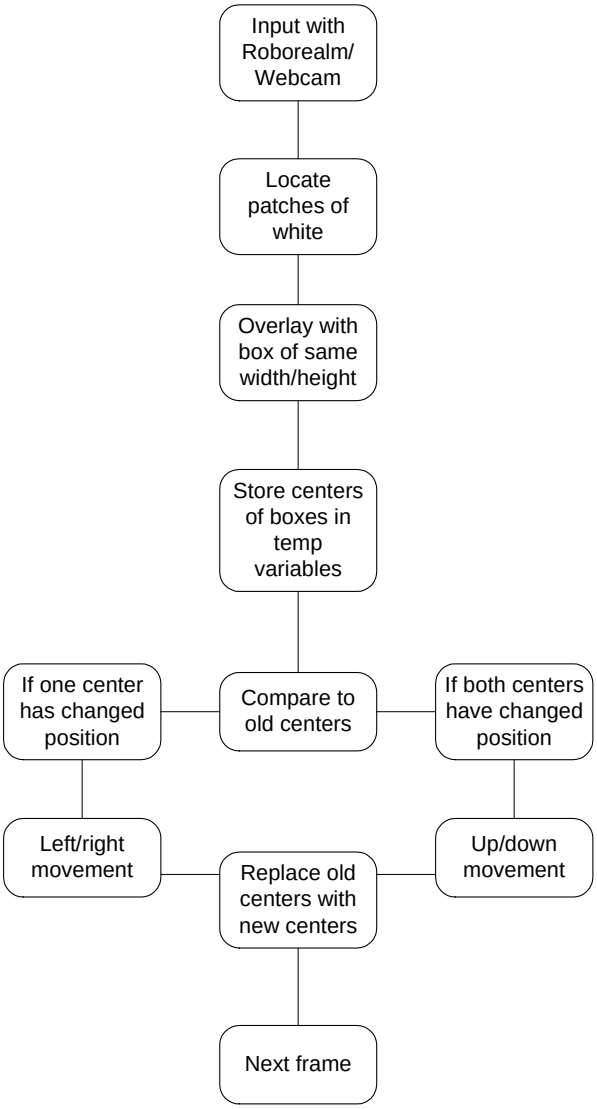

Figure 2: *Algorithm for moving the mouse based on head movement.*

3. DESIGN

Initial testing used RoboRealm software for filtering the image and passing the new image to a Java program. Filtering worked, and a desirable image was produced (Fig. 3).

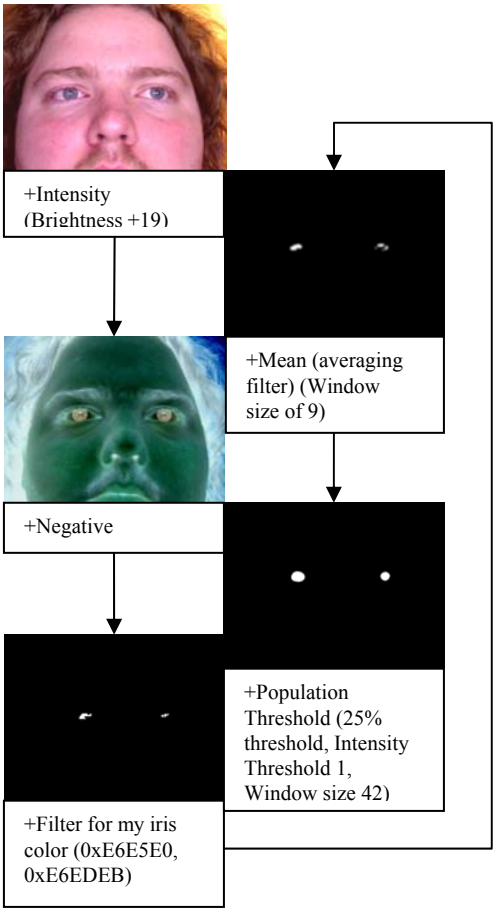

Figure 3: *Transition from a picture of my face to black and white where iris/pupil is located*

However, attempts to interface with the software with Java were arduous at best, due to lack of documentation and mediocre performance, and it was decided that a different piece of software should be used.

Another computer vision library available, OpenCV, was then implemented. Although lacking a GUI, this was preferable, as I intended the end product to run as a background process in the system. In addition, it is open source and has a large community support base.

4. CONCLUSION

As computers have become further and further integrated into society, the need for alternative methods for using a computer has dramatically increased. The choice for computer vision implementation as an alternative is becoming more widespread, and allows control of a computer system in an environment where the user is disabled or simply wants different means of accessing a computer. In the case of eye tracking, as has been seen, the filtering process provided in this research can be used with an algorithm to adjust the mouse position based on alteration in eye position, and thus can be an implementation of this input method.

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