Webcam-based User Interface

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Image Processing Project
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Overview

- Project Goals
- Implementation
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Project Goals

- Implement software to locate the focal point of the user’s eyes on the screen using an inexpensive, low-res camera
- Operate in real time (> 15 Frames/sec)
Design Modules

- Read image from a web camera
- Gather meaningful data to find eyes’ focus
- Implement neural network to process data
Implementation

- Step 1 – find the center of the user’s face
  - Use symmetry
Implementation

- Step 2 – reduce the image size
  - Crop around the center of the user’s face
Implementation

- Step 3 – Bandpass and morphological filtering
  - Based on common frequency characteristics of 50 sample images
Implementation

- Step 4 – thresholding, blob coloring and blob rejection
  - Each blob must have a twin
Implementation

- Step 5 – reduce image to 2 eye images
Implementation

- Step 6 - Send eye images and coordinates to neural network (NN)
  - NN feeds back focal point of eyes
Results

- Good results for size of training data
  - Need NN training routine

User moving, but staring at the center of the screen
Results

- Calibration
  - Effected by lighting changes/background
  - Need to recalibrate at least once a day
- Output need low-pass filtering
Results

- Problems
  - Image blur
  - 2 FPS max
  - Long training time
  - Needs constant calibration
Conclusion

- Successful proof-of-concept
  - 2 FPS is slow, but acceptable
  - LPF on output makes it even slower
  - Implemented on an average personal computer for < $30

- Future work
  - Needs NN training algorithm
  - Only find eyes every nth frame
  - Generalized NN
Questions?