

# Webcam-based User Interface

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Image Processing Project

EE 371R

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# Overview

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- Project Goals
- Implementation
- Results
- Conclusion
- Questions

# Project Goals

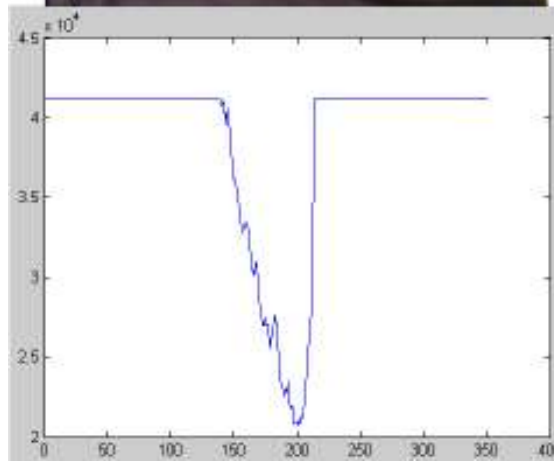
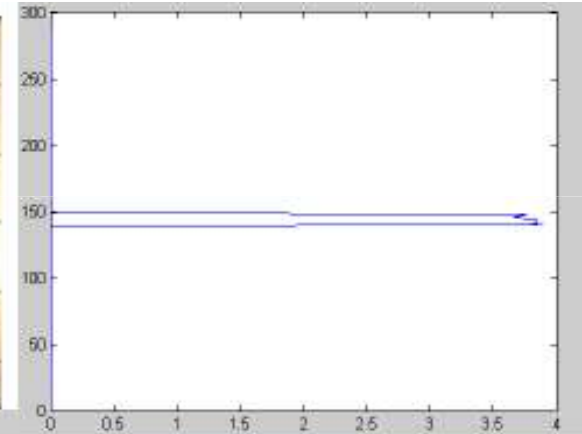
- Implement software to locate the focal point of the user's eyes on the screen using an inexpensive, low-res camera
- Operate in real time ( $> 15$  Frames/sec)

# 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



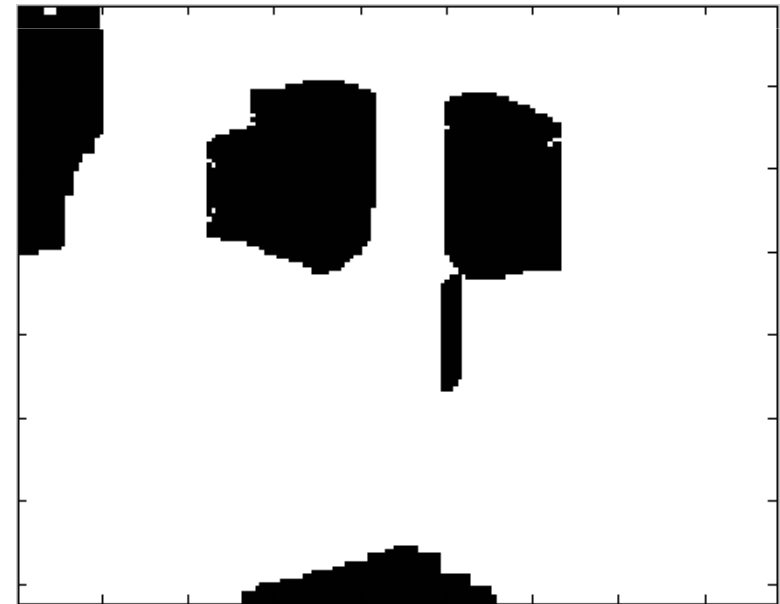
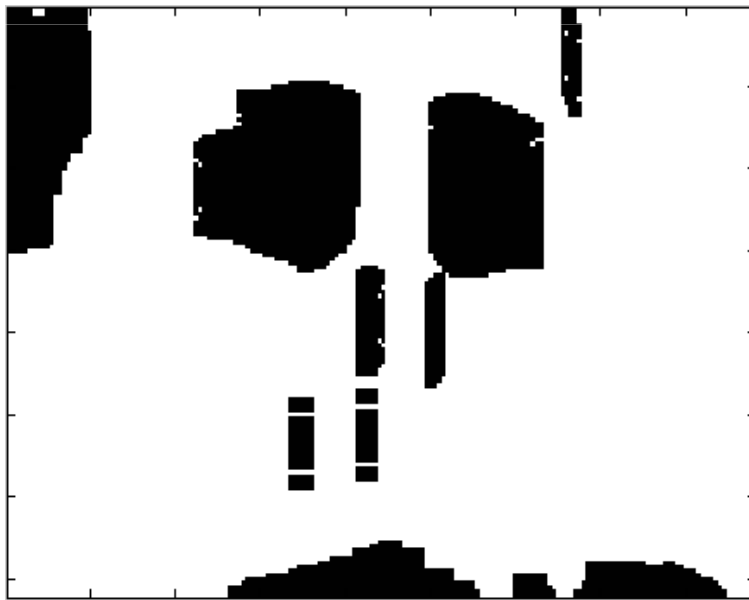
# Implementation

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



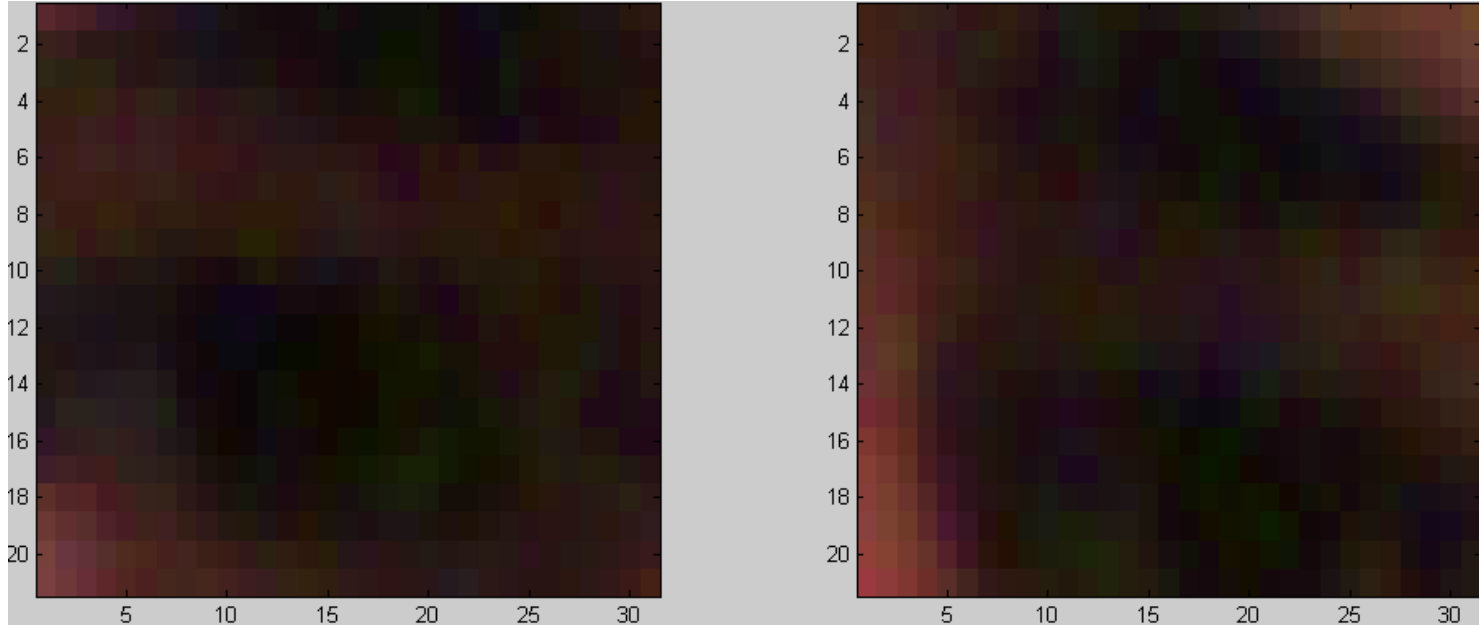
# Implementation

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



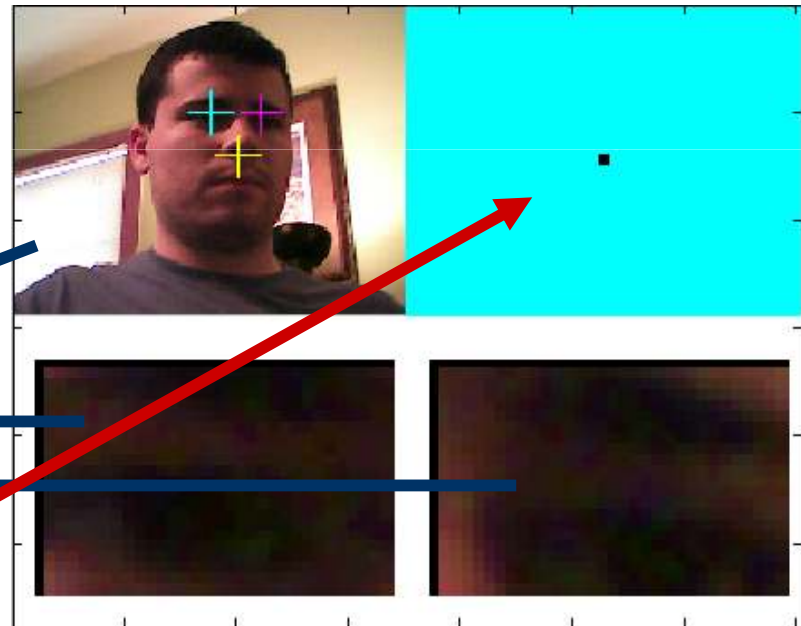
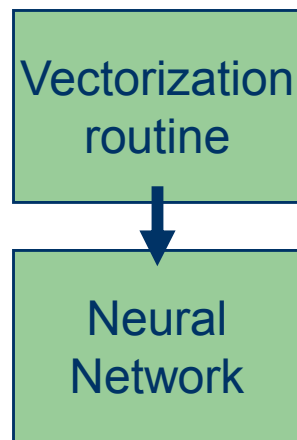
# Implementation

- 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

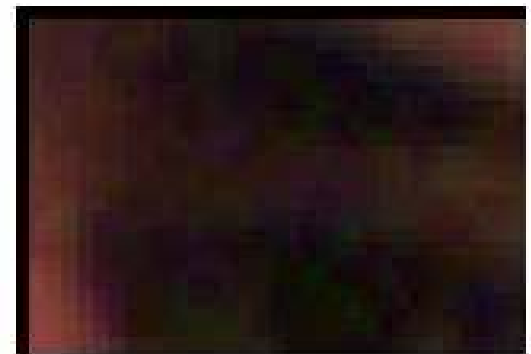
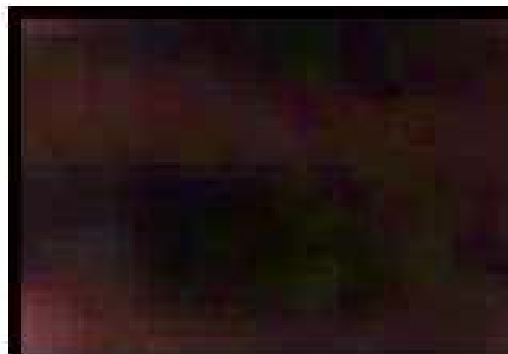


# Results

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

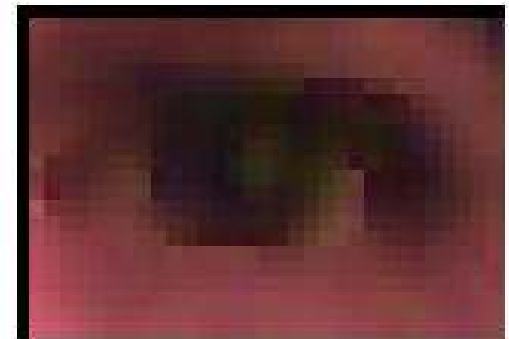
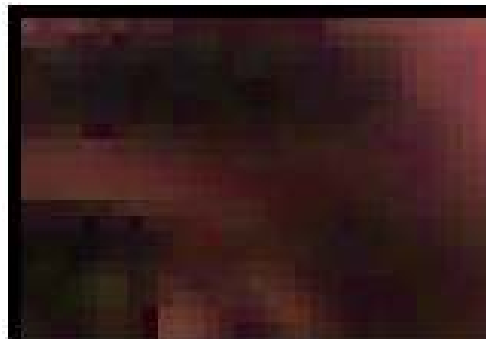
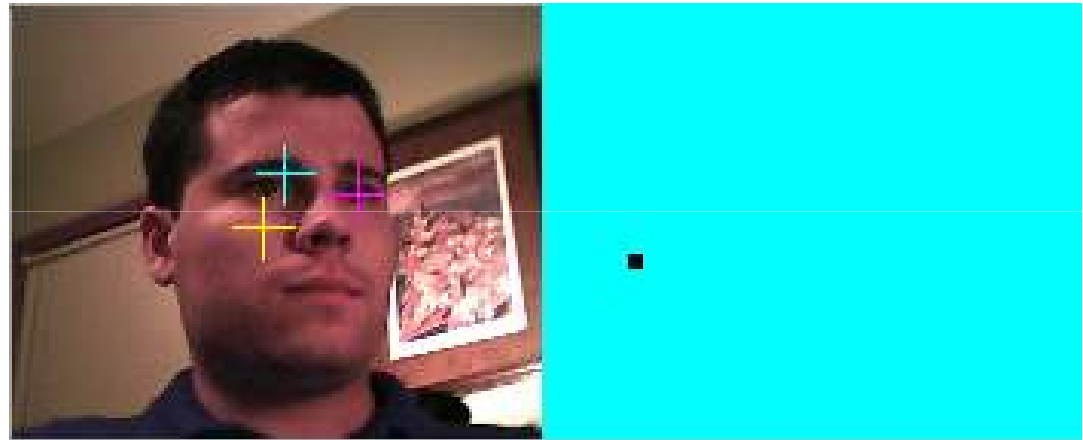


**User moving, but staring at the center of the screen**



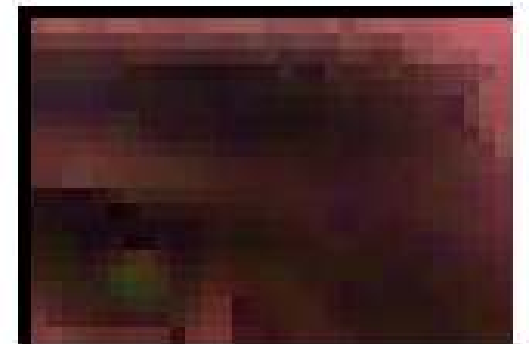
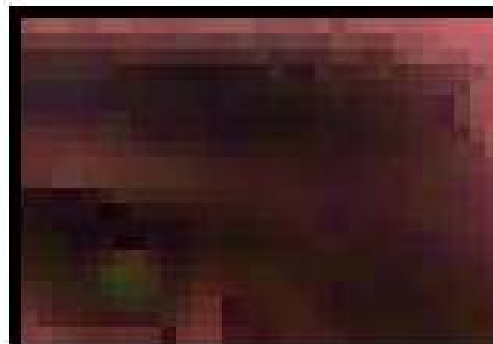
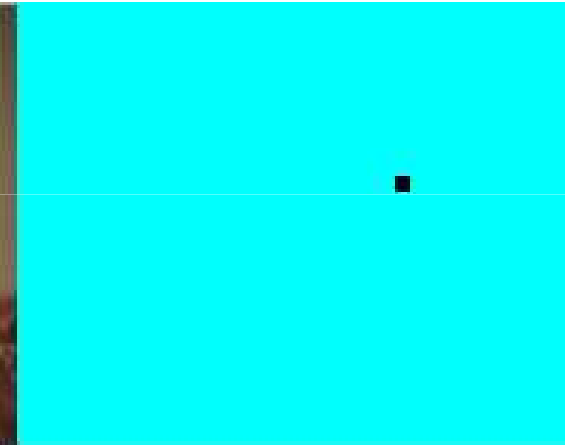
# Results

- Calibration
  - Effected by lighting changes/backg round
  - 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?

