Categorizing Gaze in a Natural Decision Making Environment with Computer Vision

David Brenes, Xingyu Chen, David Yang, Nikki Sullivan, Jonathan Winkle

Introduction

Mobile Eye Tracking

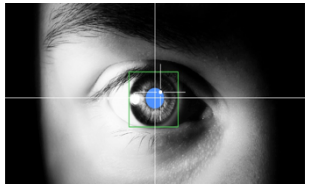
- Expanding rapidly
- Implemented widely, such as in advertising, medicine, and scientific research
- Eye movements can reliably indicate certain thought processes

Current methods

- Time-consuming and onerous
- Require researchers to manually inspect each frame of the video
- to determine fixation points

Goals of the project

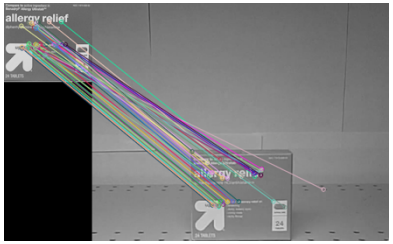
- Develop imaging algorithms capable of detecting objects in a dynamically changing scene.
- Improve existing computer vision packages to develop tools to automatically identify objects in an environment.



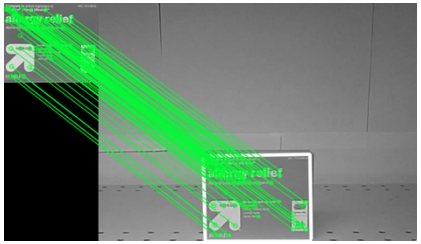
What have we done?

- A toolkit to help researcher to process Eye tracking data
- A fast and robust object identification algorithm
- A system analyzing the result

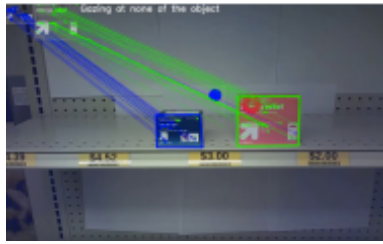
Multiple Object Identification



Original SIFT with Brute-Force matching



SIFT feature with Flann-Based matching



Accurately detect multiple objects and feature points

Blackout Method – Multiple Occurrences Object Detection

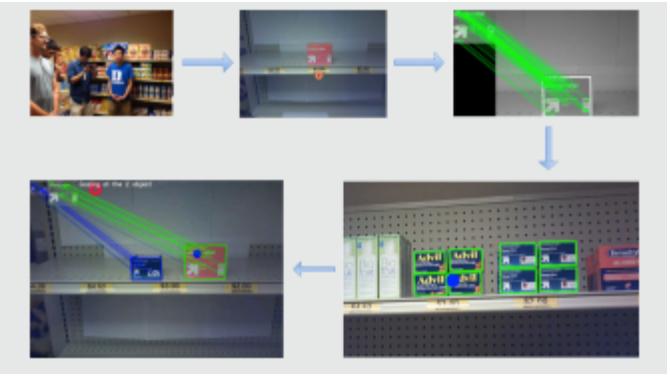
Erratic boundaries: multiple object occurrences

Black-out method to improve object detection

Accurately detect multiple occurrences of objects

Equipment and Data Collection

- SMI Eye Tracking Glasses were used
- Data generated are videos with subject gaze points overlaid
- Created image processing software using OpenCV, Python, and Python libraries
- OpenCV gave us access to many computer vision algorithms
- Algorithms used to analyze eye tracking videos include Scale Invariant Feature Transform (SIFT) and Fast Approximate Nearest Neighbor Search Library (FLANN)



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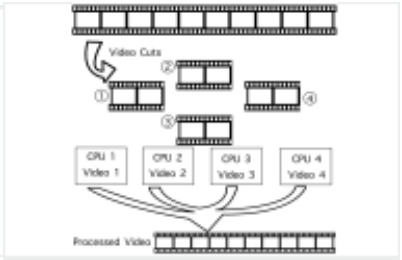
https://bit.ly/2ajvu0W

https://github.com/dy46/Eye-Tracking

Multiple Processing

```
real    93m8.800s
user    93m1.809s
sys     93m0.347s
```

Runtime for a 40s video is around 90 minutes

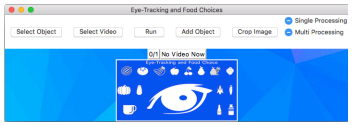


Divide video into separate CPU processes

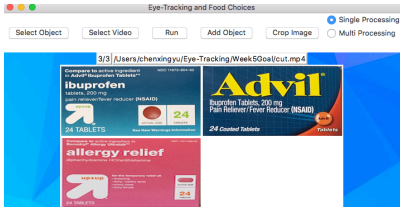
```
real    23m7.694s
user    23m1.213s
sys     23m0.476s
```

Reduced runtime proportional to number of processes

Graphical User Interface



Create a robust, interactive GUI for easier use



Select multiple reference images and processing methods

Drag and select reference image from the GUI interface

Future Projects

- Create a structure to hold metadata about each frame
- Use previous frames as templates for subsequent frames
- Create a lightweight, initial processing run to mark frame differences to determine discrepancies between frames and optimizeprocessing

Contact: dy46@duke.edu, xc77@duke.edu, db240@duke.edu, njs28@duke.edu, jaw69@duke.edu