Automated Pupil Tracking as a Biomarker for Parkinson's Disease

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Abstract

Parkinson's Disease (PD) is a neurodegenerative disorder without a cure that affects 10 million people worldwide. The rate of pupil dilation after a light stimulus is one of the biomarkers for this disease. Ophthalmologists can analyze the pupil dilation rate by shining a light at the eye and recording the resulting dilation. Previously, medical students would spend hours manually finding the radius in each frame.

This program was created to help automate the process. This helps the medical students focus on getting real world experience instead of having to spend their time on tracking the pupil size. In addition, the optometrist can analyze the data and properly diagnose the patient with early onset Parkinson's, leading to preventative treatment for the patient.

Motivation

- Our project will help doctors diagnose Parkinson's disease sooner.
- Aid research in Parkinson's Disease.
- We will gain experience working with pre-existing code.
- Experience working on larger scale project with a group.

Project Overview

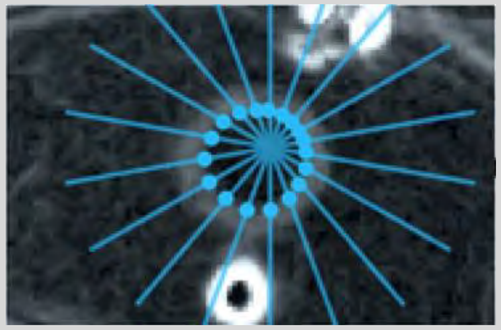
Parkinson's disease can be indicated by an abnormal response of patient's pupil to a light stimulus, the sustained pupil constriction after the cessation of the stimulus can be an indication of Parkinson's disease.
This program automates the process of finding the size of the pupil over the duration of the test, and potentially will analyze the relevant data automatically.

Features

There are three core features of the program that allow it to function.

- Frame Extraction
  - A video will be split into individual frames
- Ellipse Fitting
  - The size of the pupil is measured in each frame
- Data Collection
  - The size of each frame and its number is saved in a csv file

Functionality



When a new video is uploaded, the program extracts each frame as an image.

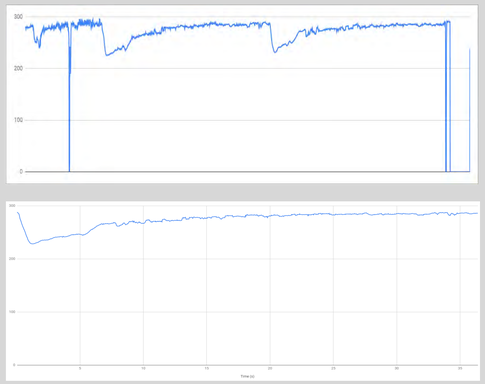
User clicks on a region inside the pupil to get its center point to make a reference frame for ellipse fitting.

Then, it fits an ellipse on each frame image to track the pupil's size.

Pupil fitting is done by tracing radial lines from the center point every 30 degrees around a circle.

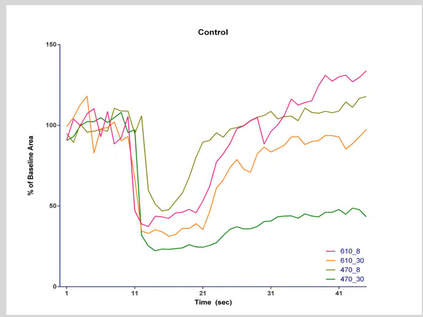
Generates a best fit ellipse around the edge points.

Graph Plotting

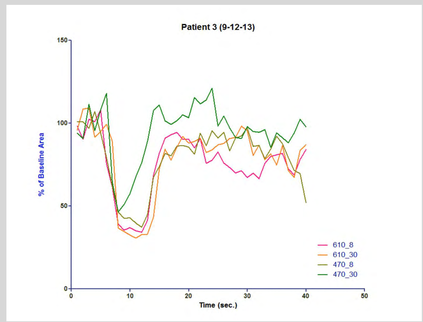


After collecting the data from the program and storing it in a csv file, the user can use it to plot a graph and analyze the dilation rate of the pupil.

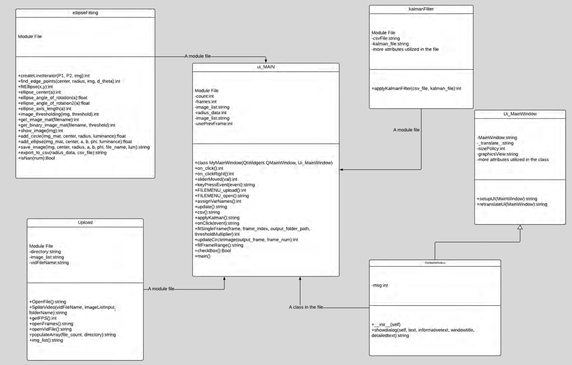
Control Data



Parkinson's Data



Designs



The image above shows the diagram for the program.

We want the User Interface to be as simple as possible so only essential components are implemented. This includes:

- Uploading videos
- Opening existing frames
- Saving data
- Custom range ellipse fitting

The program was written using:

- Python
- PyQt5 for the Graphical User Interface

References and Acknowledgements

The code we inherited:
https://github.com/tingxiao/Pupil-Dilation-Tracking
https://github.com/j-adamski/Pupil-Dilation-Tracking-GUI

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