Glaucoma classification with eye-tracking data

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1 Introduction

Glaucoma is a group of eye diseases which affects harmfully the optic nerve and leads to vision loss. About 6 to 67 million people have glaucoma globally. It occurs more commonly among older people. [1]

Screening for glaucoma is usually performed as part of a standard eye examination performed by optometrists and ophthalmologists. Testing for glaucoma should include measurements of the intraocular pressure via tonometry, anterior chamber angle examination or gonioscopy, and examination of the optic nerve to look for any visible damage to it, or change in the cup-to-disc ratio and also rim appearance and vascular change. A formal visual field test should be performed.

If this disease treated early it is possible to slow or stop the progression of disease with several medicine techniques. In order to make diagnosis procedure easier and convenient we propose to test and use machine learning techniques, which will allow us to reduce amount of tests in glaucoma diagnosis, especially on early stages, find new biomarkers for glaucoma diagnosis.

Eye movements of glaucoma patients have been shown to differ fromage-similar control groups when performing everyday tasks, such as reading, visual search, face recognition, driving,and viewing static images. [1]

2 Objectives

Our purpose is to solve binary classification task using different methods and approaches.
Firstly, we will generate features from eye-tracking data, what can be done in several ways:

1. **Event detection.**

   Fixation and Saccade points analyze. [2] Working directly with eye-tracking time series. [3]

2. **Trajectory based classification.**

   Building trajectories and based on Fixation and Saccade points. Here we can extract characteristics of trajectories, like length, regions of interest, and so on.[4] Or working with images directly and try detecting some patterns, which characterize some particular class. Building maps (Heat maps, Fixation/Saccade maps and so on) also could be useful in this case. [5]

Next target will be testing different methods and approaches to solve classification task on obtained datasets. Here we want to try usual machine learning techniques and also build neural networks.[4], [5]
At the final step we are planning to analyze the results, perform feature extraction to confirm or disprove recent theories connected to glaucoma, find potential biomarkers for illness diagnosis.

3 Dataset

In our project, we are going to use an open public dataset [1], which consists of data from 76 people: 44 glaucoma patients and 32 healthy ones. For everyone there were several test, from which data executed: each participant watched three video clips, for approximately 16 min in total, and completed standard clinical tests of visual function (visual acuity, contrast sensitivity, visual field examination). The dataset contains raw gaze data, processed eye movement data, clinical vision test results, and basic demographic information (age, sex). This dataset [1] was already used for classification in [5], what confirms the informativeness of data. Solution of our colleagues consists of one way feature generation method (Saccade mapping), one dimension reduction method and one classifier. We are going to try all popular and useful methods of eye-tracking feature generation and machine learning, which are written above, in order to improve result of our colleagues.

References

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