# Eye Tracking Data Analysis Software Documentation

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# Contents

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# 1   Abstract

The purpose of this codebase is to provide an eye gaze analysis tool that utilizes machine learning algorithms to provide insight into how individuals process and interact with visual information and to identify any potential trends or patterns that may be relevant to various research or practical applications. The codebase is compatible with Gazepoint's GP3 Desktop and GP3HD V2 eyetrackers and uses the WEKA software collection for its data mining procedures.

# 2   System Requirements

This software has been tested on machines running Windows 10, Windows 11, and mac OS 13 Users will need to have a Java SDE installed.

# 3   Setup

## 3.1   Program Requirements

Ensure that you have all the required libraries installed. These libraries are necessary for the program to run properly, and they should be located in the "libs" folder. If for some reason they are not present, you will need to download them and attach them to the program manually.

Required libraries:

- arpack_combined.jar

- common-lang3.jar

- commons-math3-3.6.1.jar

- core.jar

- mt.jar

- opencsv-5.7.0.jar

- weka.jar

## 3.2   Configuration requirements

Please be advised that the program's main.java file contains a hard-coded screen size. It is necessary to change the code to reflect the right screen size of the monitor used for the experiment. Failure to do so may result in incorrect calculations.

## 3.3   How To Use the Repository

1. Clone the repository to your local machine using git or your preferred version control system.

2. Ensure that you have all the required libraries installed and run the program
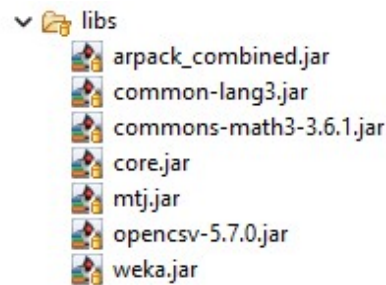


3. Upon launching the program, the Data Analysis Page will initialize. Users can navigate through the various tabs located in the top left corner to access the desired analysis features. The program will prompt the user to input the gaze and fixation files, specify the desired location for the output files, and provide the participant's name for the output folder naming convention.
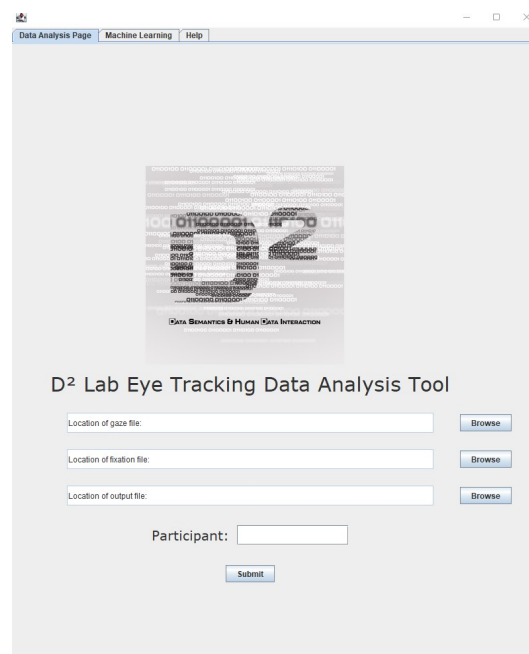
4. Upon submission of the required information, the program will display a blank screen as it processes the data. After the data has been buffered, the program will then display a new screen where the user will have the option to select specific windows for the output. If the user chooses not to select a window, they can simply select the "Exit" option and submit, and the program will automatically terminate. However, if the user wishes to select a window, they can choose from the various options provided. For added convenience, hovering over the different options will reveal a hint describing the function of each option, providing guidance for those who may be unsure of which option to select.
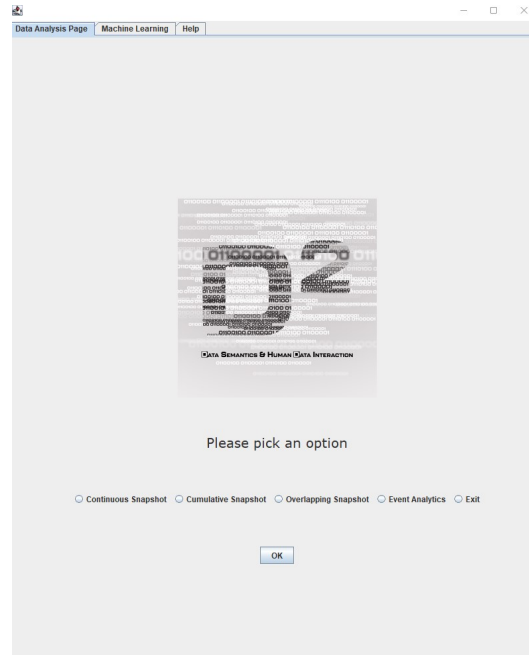


5. Depending on the option selected, the program will prompt the user to provide additional parameters specific to that window. After the user has provided the necessary information and submitted it, the program will automatically terminate. The outputted files will be saved in the location specified, within a folder named after the participant.

In the event that the user has any questions regarding the use of the program, they can refer to the help page which provides a detailed, step-by-step guide on how to use the program, troubleshoot common errors, and understand the limitations of the program. This page serves as a useful resource for ensuring a smooth and efficient experience with the program.
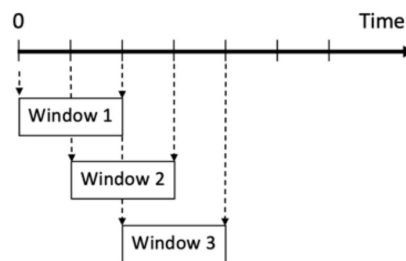
- Continuous Snapshot: This option generates gaze data in a series of fixed, non-overlapping windows.
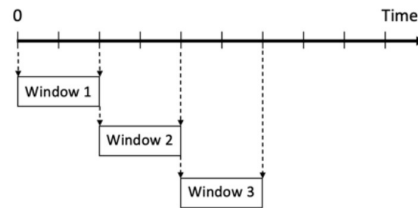


- Cumulative Snapshot: This option generates gaze data in a series of expanding windows that increases with every interval.
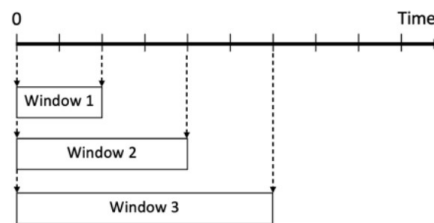


- Overlapping Snapshot: This option generates gaze data in a series of fixed and overlapping windows.



- Event Analytic: This option generates a baseline file based on the first two minutes of the gaze data, and then compares it to the rest of the file. If the data exceeds the baseline value, it will be counted as an event, and the program will continue to search for the next event within a specified time period. If no event is found, the program will close at a specific period. If another event is found, the session window will continue searching.
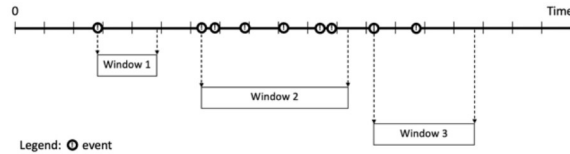
6. Depending on the option you choose, the program will ask for different input. For the first three options, the program will ask you to select the window size and/or overlapping amount (both in terms of time in seconds).

7. If you choose the last option, Event Analytic, the program will ask you which gaze or fixation file you would like to analyze. The program will create a baseline file based on the first two minutes and then ask you to pick a baseline value and a value from the file you inputted to compare to each other, as well as a maximum duration of an event.

# 4  Analysis

## 4.1  Input

{participant}_all_gaze.csv and {participant}_fixation.csv data files exported from Gazepoint Analysis

## 4.2  Output

1. FXD analysis

   - total number of fixations
   - sum of all fixation duration
   - mean duration
   - median duration
   - StDev of durations
   - Min. duration
   - Max. duration
   - total number of saccades
   - sum of all saccade length
   - mean saccade length
   - median saccade length
   - StDev of saccade lengths
   - min saccade length
   - max saccade length

- sum of all saccade durations
- mean saccade duration
- median saccade duration
- StDev of saccade durations
- Min. saccade duration
- Max. saccade duration
- scanpath duration
- fixation to saccade ratio
- sum of all absolute degrees
- mean absolute degree
- median absolute degree
- StDev of absolute degrees
- min absolute degree
- max absolute degree
- sum of all relative degrees
- mean relative degree
- median relative degree
- StDev of relative degrees
- min relative degree
- max relative degree
- 

2. EVD analysis

- total number of L mouse clicks

3. GZD analysis

- average pupil size of left eye
- average pupil size of right eye
- average pupil size of both eyes

4. AOIResults: Outputs for each defined AOI

- Convex Hull Area
- Fixation Count
- Total Duration
- Mean Duration

- Median Duration
- StDev of Duration
- Min Duration
- Max Duration
- total number of saccades
- sum of all saccade length
- mean saccade length
- median saccade length
- StDev of saccade lengths
- min saccade length
- max saccade length
- sum of all saccade durations
- mean saccade duration
- median saccade duration
- StDev of saccade durations
- Min. saccade duration
- Max. saccade duration
- scanpath duration
- fixation to saccade ratio
- sum of all absolute degrees
- mean absolute degree
- median absolute degree
- StDev of absolute degrees
- min absolute degree
- max absolute degree
- sum of all relative degrees
- mean relative degree
- median relative degree
- StDev of relative degrees
- min relative degree
- max relative degree

5. System Log

   a text file that outlines what was successfully created or any errors that were encountered

6. InputFiles Folder: Modified Fixation and Gaze file

Provides a modified version of both .csv input files which removes all invalid data and appends two additional calculated columns, "SACCADE_PV" (saccade peak velocity) and "SACCADE_AMPL" (saccade amplitude). Data rows are considered invalid if they are off-screen, both pupils do not have a validity value of 1, or if pupil size/difference exceeds a reasonable amount.

7. Snapshot Folder (If yes was selected)

contains all the snapshot files

# 5 Limitations

- Several sections of the codebase rely on the existence of data columns in the raw data files. To ensure that the program functions correctly, select all the possible columns when exporting data from the Gazepoint Analysis software.

- Note that the program will create a folder for the participant regardless of the success of the program execution.

- Please be aware that if the names and locations selected for the files match those of an existing file, the existing file will be automatically overwritten

# 6 References