



EyeLogic SDK

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Chapter 1

EyeLogic SDK Documentation (C)

1.1 Introduction

1.1.1 About

The EyeLogic Software Development Kit (SDK) is a free software package for building custom applications that use an EyeLogic eye tracking device. It provides the ability to connect to your device from any custom application via an Application Programming Interface (API). The EyeLogic SDK is available in the following programming languages C++, C#, C, and Python. It can also be used with any other programming language that can import dynamic link libraries (DLLs), such as Visual Basic or Matlab.

For each directly supported language, there is a short and simple example program to help you start developing your first EyeLogic application.

This manual describes how to use the EyeLogic API for C and gives a step-by-step introduction on how to start with your own C program.

1.1.2 System Requirements

Please refer to the EyeLogic Server documentation for system requirements and installation instructions.

The SDK has no additional requirements. It is built for Microsoft Windows (32 bit or 64 bit) only. The included sample projects are written for Microsoft Visual Studio 2017 or newer. Other compilers are not supported at this time.

1.2 Installation and Getting Started

1.2.1 Download Software

To use an EyeLogic eye tracking device from within your application, you need the EyeLogic Server and the EyeLogic SDK. Check the download page for the latest version of both packages: <https://www.eyelogicsolutions.com/downloads/>

1.2.1.1 Compatibility

The software is written to support backwards compatibility, i.e. updating the EyeLogic Server software will not break support for your device, regardless of the model. This guide assumes that you are installing the latest version of the EyeLogic Server. Please always update to the latest server version before reporting an error to the EyeLogic Support.

On the other hand, it is not always necessary to update the SDK and API DLLs. Since you as a programmer would have to recompile your application with each SDK update, we have designed the SDK to allow the server to communicate with older API versions. So when you ship your application, simply add the EyeLogic API DLLs of the current version to your package. It will be compatible with both current and newer versions of the server.

See [Shipping Your Application](#) for a tutorial on how to ship your application.

1.2.2 Installing the EyeLogic SDK on Windows

The EyeLogic SDK does not need to be installed. It is shipped as a .zip file that simply needs to be extracted to any directory on your hard drive. Make sure you have user rights to that directory, e.g. any directory within C:\Program Files or similar is problematic as it requires admin rights to access those files every time you start your program. It is recommended to use a local user directory.

Note: The SDK has to be installed on the same computer as the server. Please see the main server manual for help on installing the server.

After extracting the .zip file, the directory contains one subfolder for each supported programming language. Open the c folder, the content should be:

- bin - contains the binary DLLs to link against
- example - contains the sample code
- include - contains the include header files for compilation

1.2.3 Getting Started with the Sample Code

In the directory, into which you unpacked the SDK EyeLogicSDK, navigate to the sub-directory c/example and open the solution file AllDemoClients.sln in Visual Studio. Note, you will need Visual Studio 2017 or newer to open this file.

You may want to choose your destination compile level (Debug/Release) in the drop down list on top of the screen. Set it to "Debug" while developing your app. When your app is finished, set it to "Release" to create an optimized application binary. Then compile from the menu with Build->Build Solution. You should see output similar to the following:

```
1>----- Build started: Project: DemoClient, Configuration: Debug x64 -----
2>----- Build started: Project: DualPC, Configuration: Debug x64 -----
3>----- Build started: Project: Validation, Configuration: Debug x64 -----
1> main_democlient.c
2> dualpc_democlient.c
3> validation_democlient.c
1> DemoClient.vcxproj -> cpp\example\x64\Debug\DemoClient.exe
2> DualPC.vcxproj -> cpp\example\x64\Debug\DualPC.exe
3> Validation.vcxproj -> cpp\example\x64\Debug\Validation.exe
1> Copy dll dependencies for execution
1>      1 File copied.
2> Copy dll dependencies for execution
2>      1 File copied.
3> Copy dll dependencies for execution
3>      1 File copied.
===== Build: 3 succeeded, 0 failed, 0 up-to-date, 0 skipped =====
```


Before running the application check that the EyeLogic Server is running (see the EyeLogic Server manual). If the server is running, there will be an EyeLogic icon in the Windows system tray.

On the left hand side of the Editor you will see a list of all projects/clients. The active one is highlighted in bold (DemoClient). You can make any other demo client active (e.g. DualPC or Validation) by right-clicking on the desired name in the list and setting it as the startup project.

Press F5 to compile and run the application.

Note that your firewall may block the connection between your program and the server. In this case, add a rule to your firewall to allow your application to open TCP/UDP ports to an application on localhost (for Windows Defender, just click "Accept").

If you have reached this point, you have set up your EyeLogic SDK correctly. You are now ready to start developing your own application. See the next section **Concepts** for the basic programming concepts and for a tutorial on how to deploy and ship your application.

1.3 Concepts

1.3.1 Server-Client Setup

The EyeLogic software consists of two main parts: The `server` and the `API`. The `server` is the necessary driver for your eye tracking device. It detects your device and handles the communication. The `API` is part of the EyeLogic Standard Development Kit (SDK). It consists of `.dll` files that can be used by your application to connect to the EyeLogic Server, start tracking and receive eye tracking data.

The `server` is designed to run continuously as a background process on your computer. When not actively tracking, the `server` uses a negligible amount of your computer's resources. Once an EyeLogic eye tracking device is connected, the `Server` application automatically detects it automatically and allows the user to set it up via the `Server` configuration dialogue (see the `Server` icon in the Windows tray bar). If for some reason the `server` background process is not running (the tray icon is missing), you can start the `server` manually from the Windows Start menu.

The `API` is a set of `.dll` files that can be used by any custom program (called a `user application`). These DLLs allow the `user application` to connect to the (running) `server`. Note that the EyeLogic Server can run on the same machine as the `user application`, or they can run on different PCs. See **Dual PC Setup** for how to set up the setup with running the `server` and the `user application` running on different machines.

1.3.2 Set Up a Project for your Application

For an easy start to developing a new application, it is recommended that you copy the existing sample folder to a new location (e.g. `EyeLogic_SDK\c` with all its contents). The sample source file already provides a fully functional implementation. From this sample code, you can easily modify and extend the code to suit your individual experiment.

Alternatively, you can start a new Visual Studio project from scratch. In this case, make sure that the compiler and linker are able to find the EyeLogic include and binary files. To do this, make the following changes to the project properties of your Visual Studio project:

- Under "C/C++", set "Additional Include Directories" to the location of `<Location of your EyeLogic_SDK>\c\include`.
- Under "Linker", set "Additional Library Dependencies" to `<Location of your EyeLogic_SDK>\c\bin`.
- Under "Linker -> Input", add `ELCApi.lib` to "Additional Dependencies" (for Win32-Applications, use `ELCApi32.lib`).

1.3.3 Control Flow between API and server

The usual control flow between the custom application/API and the server is characterised by the following steps:

1. **initialize:** Before calling any other function the API DLLs need initializing.
2. **connect to server:** Establish a connection to the server via TCP.
3. **find eye tracking device:** Obtain the information on connected eye trackers, otherwise wait until an eye tracker is plugged in.
4. **start tracking:** Request tracking. If successful, the device will start tracking and the server sends *Gaze Samples* to the user application, see also [Gaze Samples](#).
5. **perform calibration:** Request a calibration. A calibration point will appear on the screen, animated to move across the screen. The user must fixate on this point until the calibration screen disappears. The system is calibrated and ready for use when this process is successfully completed.
6. **shut down:** At the end of your experiment either stop the tracking or simply shutdown the API.

All information which is passed from the server to the user application is passed via *asynchronous callbacks*. The application must register its own implementations of these callback functions with the API (see [Example Program](#) for a sample implementation).

Note that you need to calibrate to get valid gaze samples (see [Gaze Samples](#)). Any gaze samples reported before the system is calibrated will not contain valid eye data.

1.3.4 Dual PC Setup

The Dual PC Setup is a special setup where the EyeLogic Server runs on a different computer than the user application.

The most common use case for the Dual PC Setup would be the following. Running an experiment with an operator controlling the eye tracking device and a participant performing a task. The participant uses a different PC (which displays the experiment) than the operator (who can control the eye tracker via the EyeLogic Server software).

The operator's computer (called the Operator PC) must have the EyeLogic driver software (the EyeLogic Server) installed and running. The eye tracker is physically attached to a monitor that is connected to the participant's computer (called the Experiment PC). The USB cable of the eye tracker is plugged into the USB port of the Operator PC!

The operator can now use the server to detect the eye tracking device. On the Experiment PC, any custom application that presents an experiment to the participant can use the EyeLogic API to remotely connect to the server. To do this, the application should use the API calls:

1. `elRequestServerList()` to obtain a list of all EyeLogic servers in the local network (LAN/WLAN) which are running and are configured to allow remote connections
2. `elConnectRemote()` to connect to a specific server from that list
3. `elSetActiveScreen()` to set the screen connected to the Experiment PC as the active screen for eye tracking (replacing the default main screen of the Operator PC)

Note, that a server must allow remote connections for it to be found. You can enable this in the settings of the server window.

If the connection is successful, the client can operate as usual as if it were connected to a local server. See the demo application "dualpc" demo application in the SDK for an example.

1.3.5 Example Program

In this section, the code of the C example program is explained in some detail.

The file starts with an include section. It adds

```
#include "elcapi/ELCApi.h"
```

in order to find all necessary definitions of the EyeLogic API.

The next relevant part is the definition of the callback functions which are invoked by the EyeLogic API whenever an event occurs. Declaration of those functions may look like:

```
void onGazeSample( const struct ELCGazeSample* gazeSample );  
void onEvent( enum ELCEvent event );
```

These are the callback functions that will be called by the EyeLogic software whenever an event occurs. These functions are defined in the following lines. The example code simply prints the event to the console, but you can write your own implementation here.

The `main()` method is where the application implements its control flow. It consists of the following code lines:

```
elInitApi( "Demo Client" );
```

Always call `elInitApi` first before calling any other function of the EyeLogic C API. This is necessary to initialise the internal structures. Accordingly, the last command of your program to the EyeLogic API should be

```
elDestroyApi( );
```

The callback functions are registered by:

```
elRegisterEventCallback( onEvent );
```

and (further below):

```
elRegisterGazeSampleCallback( onGazeSample );
```

After initialization the program proceeds with:

```
const enum ReturnConnect retConnect = elConnect( );
```

Connects to the EyeLogic server. Check the return code to see if the connection was established successfully.

```
elGetActiveScreen( &screenConfig );
```

and

```
elGetDeviceConfig( &deviceConfig );
```

are called in order to obtain information about the active screen and the connected eye tracking device. If no device is connected, `deviceConfig.deviceSerial` is set to 0.

```
const enum ReturnStart retStart = elRequestTracking( 0 );
```

Tells the device to start tracking and the Server to begin sample processing. Parameter 0 specifies the frame rate mode. If your device is capable of multiple frame rate modes (60Hz, 120Hz or 250Hz), you can also specify a different number. The list of available frame rate modes is passed to the `onDeviceConnected()` callback, with the first frame rate mode (0) being the default mode, which is usually the fastest available mode on your system.

```
const enum ReturnCalibrate retCalibrate = elCalibrate( 0 );
```

Performs a calibration. This method blocks until the calibration is finished - i.e. completed or cancelled. The parameter 0 indicates the type of calibration. A list of available calibration methods is part of the `DeviceConfig` and can be obtained by calling `getDeviceConfig()`.

The example program waits for 10 seconds and then closes the connection:

```
disconnect( );  
elRegisterGazeSampleCallback( 0 );  
elRegisterEventCallback( 0 );
```

The last two lines unregister the callback functions. Be sure to unregister them before destroying the API object.

```
elDestroyApi( );
```

1.3.6 Gaze Samples

Gaze samples are the most important data which is generated by the eye tracker. The eye tracker provides one gaze sample per frame. Each sample contains information about the time of measurement, the position of the eyes, the pupil radius and the point at which the user is looking on a stimulus plane (usually a computer monitor).

1.3.7 Shipping Your Application

When you want to ship your application, be sure to include all relevant files so that it can run on different computers. The EyeLogic functionality will only work on computers that have the EyeLogic Server installed. The installed server must be at least be of the same version as the supplied API DLLs (a newer server version is acceptable).

In addition to the relevant files of your application, you need to ship the contents of the `bin/` folder of your language (typically including some `.dll` files). Place the contents of the `bin/` folder in the working directory of your application and ship them together.

1.4 Appendix

1.4.1 License Agreement and Warranty for SDK

IMPORTANT – PLEASE READ CAREFULLY:

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1.5 About EyeLogic

EyeLogic is a manufacturer of high precision and high quality eye tracking devices, mainly for scientific and research use cases. EyeLogic GmbH is a spin-off of the Free University of Berlin, faculty of mathematics and computer science and has a vast experience in image processing and computer vision.

1.5.1 Contact and Support

For technical support questions contact us via mail at: support@eyelogicsolutions.com

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 Schlesische Str. 28
 10997 Berlin Germany
 www: <https://www.eyelogicsolutions.com>

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Chapter 2

Class Index

2.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

ELCDeviceConfig	
Device configuration	13
ELCDeviceGeometry	
Geometric position of the device related to the active monitor	14
ELCEyeImage	
Image of the eyes captured by the device	14
ELCFixationStart	
Information about a fixation start	14
ELCFixationStop	
Information about a fixation end	15
ELCGazeSample	
All information about the state of the eyes at a specific time	15
ELCScreenConfig	
Screen configuration	18
ELCServerInfo	
Connection information for an EyeLogic server	19
ELCValidationPointResult	
ValidationPointResult holds the results of the validation (total deviation between true point position and calculated POR of the left and right eye POR in [px] and [deg]) of the validation point at position (validationPointPxX, validationPointPxY) [px]	19
ELCValidationResult	
ValidationResult contains one ValidationPointResult struct per validation stimulus point of the performed validation	20

Chapter 3

File Index

3.1 File List

Here is a list of all documented files with brief descriptions:

ELCApi.h	The file contains the C prototype declaration for all functions which are necessary to control the EyeLogic software from an API client	21
ELCGazeEvent.h	The file specifies the C++ container for a gaze event	35
ELCGazeSample.h	The file specifies the C container for a gaze sample	36

Chapter 4

Class Documentation

4.1 ELCDeviceConfig Struct Reference

Device configuration.

```
#include "ELCApi.h"
```

Public Attributes

- uint64_t **deviceSerial**
serial number of the device as unsigned 64-bit int for a verbose format, print it as 8-digit hex number
- char **deviceName** [32]
name of the device, 0-terminated string
- char **brandedName** [64]
name of the license owner, 0-terminated string
- bool **isDemoDevice**
whether the device is for DEMO use only, not for public sale
- int32_t **numFrameRates**
number of available framerates
- uint8_t **frameRates** [16]
array of available framerates [Hz], use only the entries frameRates[0] ... frameRates[numFrameRates-1]
- int32_t **numCalibrationMethods**
number of available calibration methods
- uint8_t **calibrationMethods** [16]
array of available calibration methods [number of calibration points], use only the entries calibrationMethods[0] ... calibrationMethods[numCalibrationMethods-1]

4.1.1 Detailed Description

Device configuration.

4.2 ELCDeviceGeometry Struct Reference

Geometric position of the device related to the active monitor.

```
#include "ELCApi.h"
```

Public Attributes

- double **mmBelowScreen**
vertical distance between the lowest pixel on the display and the upper edge of the eye tracker
- double **mmTrackerInFrontOfScreen**
horizontal distance between the front of the screen and the front edge of the eye tracker

4.2.1 Detailed Description

Geometric position of the device related to the active monitor.

4.3 ELCEyeImage Struct Reference

contains an image of the eyes captured by the device

```
#include "ELCEyeImage.h"
```

Public Attributes

- uint8_t **data** [300 * 90 * 3]
image buffer, stores all pixels as RGB value (3 bytes per pixel)

4.3.1 Detailed Description

contains an image of the eyes captured by the device

4.4 ELCFixationStart Struct Reference

information about a fixation start

```
#include "ELCGazeEvent.h"
```

Public Attributes

- `int64_t timestampMicroSec`
timepoint when the fixation started in microseconds after EPOCH
- `int32_t index`
index of the corresponding GazeSample at which the fixation started
- `double porX`
X coordinate of binocular point of regard on the stimulus plane at when the fixation started.
- `double porY`
Y coordinate of binocular point of regard on the stimulus plane at when the fixation started.

4.4.1 Detailed Description

information about a fixation start

4.5 ELCFixationStop Struct Reference

information about a fixation end

```
#include "ELCGazeEvent.h"
```

Public Attributes

- `int64_t timestampMicroSec`
timepoint when the fixation ended in microseconds after EPOCH
- `int64_t timestampStartMicroSec`
timepoint when the fixation started in microseconds after EPOCH
- `int32_t index`
index of the corresponding GazeSample at which the fixation ended
- `int32_t indexStart`
index of the corresponding GazeSample at which the fixation started
- `double porX`
X coordinate of binocular point of regard on the stimulus plane of the overal fixation (average over the whole fixation period)
- `double porY`
Y coordinate of binocular point of regard on the stimulus plane of the overal fixation (average over the whole fixation period)

4.5.1 Detailed Description

information about a fixation end

4.6 ELCGazeSample Struct Reference

contains all information about the state of the eyes at a specific time

```
#include "ELCGazeSample.h"
```

Public Attributes

- `int64_t timestampMicroSec`
timepoint when data was acquired in microseconds after EPOCH
- `int32_t index`
increasing GazeSample index
- `double porRawX`
X coordinate of binocular point of regard on the stimulus plane, check `porRawX != InvalidValue` before using it.
- `double porRawY`
Y coordinate of binocular point of regard on the stimulus plane, also check `porRawX != InvalidValue` before using `porRawY`.
- `double porFilteredX`
X coordinate of filtered binocular point of regard on the stimulus plane, check `porFilteredX != InvalidValue` before using it.
- `double porFilteredY`
Y coordinate of filtered binocular point of regard on the stimulus plane, also check `porFilteredX != InvalidValue` before using `porFilteredY`.
- `double porLeftX`
X coordinate of monocular point of regard of the left eye, check `porLeftX != InvalidValue` before using it.
- `double porLeftY`
Y coordinate of monocular point of regard of the left eye, also check `porLeftX != InvalidValue` before using `porLeftY`.
- `double eyePositionLeftX`
position of the left eye in device coordinates, unit is mm
- `double eyePositionLeftY`
position of the left eye in device coordinates, unit is mm
- `double eyePositionLeftZ`
position of the left eye in device coordinates, unit is mm
- `double pupilRadiusLeft`
radius of the left pupil in mm or `InvalidValue` if eye was not found
- `double porRightX`
X coordinate of monocular point of regard of the right eye, check `porRightX != InvalidValue` before using it.
- `double porRightY`
Y coordinate of monocular point of regard of the right eye, check `porRightX != InvalidValue` before using `porRightY`.
- `double eyePositionRightX`
position of the right eye in device coordinates, unit is mm:
- `double eyePositionRightY`
position of the right eye in device coordinates, unit is mm:
- `double eyePositionRightZ`
position of the right eye in device coordinates, unit is mm:
- `double pupilRadiusRight`
radius of the right pupil in mm or `InvalidValue` if eye was not found

4.6.1 Detailed Description

contains all information about the state of the eyes at a specific time

4.6.2 Member Data Documentation

4.6.2.1 eyePositionLeftX

```
double eyePositionLeftX
```

position of the left eye in device coordinates, unit is mm

- (0, 0, 0) is in the center of the device
- x-coordinate: positive towards the right side of the screen

check eyePositionLeftX != InvalidValue before using it

4.6.2.2 eyePositionLeftY

```
double eyePositionLeftY
```

position of the left eye in device coordinates, unit is mm

- (0, 0, 0) is in the center of the device
- y-coordinate: positive towards the top of the screen

check eyePositionLeftX != InvalidValue before using eyePositionLeftY

4.6.2.3 eyePositionLeftZ

```
double eyePositionLeftZ
```

position of the left eye in device coordinates, unit is mm

- (0, 0, 0) is in the center of the device
- z-coordinate: distance in front of the screen

check eyePositionLeftX != InvalidValue before using eyePositionLeftZ

4.6.2.4 eyePositionRightX

```
double eyePositionRightX
```

position of the right eye in device coordinates, unit is mm:

- (0, 0, 0) is in the center of the device
- x-coordinate: positive towards the right side of the screen

check eyePositionRightX != InvalidValue before using it

4.6.2.5 eyePositionRightY

```
double eyePositionRightY
```

position of the right eye in device coordinates, unit is mm:

- (0, 0, 0) is in the center of the device
- y-coordinate: positive towards the top of the screen

check eyePositionRightX != InvalidValue before using it

4.6.2.6 eyePositionRightZ

```
double eyePositionRightZ
```

position of the right eye in device coordinates, unit is mm:

- (0, 0, 0) is in the center of the device
- z-coordinate: distance in front of the screen

check eyePositionRightX != InvalidValue before using it

4.7 ELCScreenConfig Struct Reference

Screen configuration.

```
#include "ELCApi.h"
```

Public Attributes

- bool **localMachine**
whether the screen is connected to the this machine
 - char **id** [32]
identifier name of the screen (0-terminated string)
 - char **name** [32]
descriptive name of the screen (0-terminated string)
 - int32_t **resolutionX**
screen X resolution [px]
 - int32_t **resolutionY**
screen Y resolution [px]
 - double **physicalSizeX_mm**
horizontal physical dimension of the screen [mm]
 - double **physicalSizeY_mm**
vertical physical dimension of the screen [mm]
-

4.7.1 Detailed Description

Screen configuration.

4.8 ELCServerInfo Struct Reference

connection information for an EyeLogic server

```
#include "ELCApi.h"
```

Public Attributes

- char **ip** [16]
IP address of server as 0-terminated string.
- uint16_t **port**
port of server

4.8.1 Detailed Description

connection information for an EyeLogic server

4.9 ELCValidationPointResult Struct Reference

ValidationPointResult holds the results of the validation (total deviation between true point position and calculated POR of the left and right eye POR in [px] and [deg]) of the validation point at position (validationPointPxX, validationPointPxY) [px].

```
#include "ELCApi.h"
```

Public Attributes

- double **validationPointPxX**
ELCInvalidValue or x-coordinate of stimulus point position.
 - double **validationPointPxY**
ELCInvalidValue or y-coordinate of stimulus point position.
 - double **meanDeviationLeftPx**
ELCInvalidValue or mean deviation between left eye POR and stimulus position in [px] in the stimulus plane.
 - double **meanDeviationLeftDeg**
ELCInvalidValue or mean deviation of left eye gaze direction in [deg] in the 3-D world system.
 - double **meanDeviationRightPx**
ELCInvalidValue or mean deviation between right eye POR and stimulus position in [px] in the stimulus plane.
 - double **meanDeviationRightDeg**
ELCInvalidValue or mean deviation of right eye gaze direction in [deg] in the 3-D world system.
-

4.9.1 Detailed Description

ValidationPointResult holds the results of the validation (total deviation between true point position and calculated POR of the left and right eye POR in [px] and [deg]) of the validation point at position (validationPointPxX, validationPointPxY) [px].

The stimulus point position and deviation [px] are given in the 2D stimulus coordinate system originating in the top left corner of the stimulus.

The deviation [deg] corresponds to the total angular deviation between the measured gaze direction from the ground truth gaze direction as determined according to the measured eye position.

Note: All data fields may be ELCInvalidValue. All pairs validationPointPxX/-Y, meanDeviationLeftDeg/-Px and meanDeviationRightDeg/-Px are always either both valid or both ELCInvalidValue.

4.10 ELCValidationResult Struct Reference

ValidationResult contains one ValidationPointResult struct per validation stimulus point of the performed validation.

```
#include "ELCApi.h"
```

Public Attributes

- struct **ELCValidationPointResult** **pointsData** [4]

4.10.1 Detailed Description

ValidationResult contains one ValidationPointResult struct per validation stimulus point of the performed validation.

Chapter 5

File Documentation

5.1 ELCApi.h File Reference

The file contains the C prototype declaration for all functions which are necessary to control the EyeLogic software from an API client.

```
#include "ELCGazeSample.h"
#include "ELCEyeImage.h"
#include "ELCGazeEvent.h"
```

Classes

- struct **ELCServerInfo**
connection information for an EyeLogic server
- struct **ELCScreenConfig**
Screen configuration.
- struct **ELCDeviceGeometry**
Geometric position of the device related to the active monitor.
- struct **ELCDeviceConfig**
Device configuration.
- struct **ELCValidationPointResult**
ValidationPointResult holds the results of the validation (total deviation between true point position and calculated POR of the left and right eye POR in [px] and [deg]) of the validation point at position (validationPointPxX, validationPointPxY) [px].
- struct **ELCValidationResult**
ValidationResult contains one ValidationPointResult struct per validation stimulus point of the performed validation.

Enumerations

- enum `ELCDeviceEvent` {
`EVENT_SCREEN_CHANGED`, `EVENT_CONNECTION_CLOSED`, `EVENT_DEVICE_CONNECTED`,
`EVENT_DEVICE_DISCONNECTED`,
`EVENT_TRACKING_STOPPED` }
EyeLogic events.
- enum `ELCReturnInit` { `INIT_SUCCESS`, `INIT_ALREADY_INITED` }
return values of `elInitApi()`
- enum `ELCReturnConnect` { `CONNECT_SUCCESS`, `CONNECT_NOT_INITED`, `CONNECT_VERSION_MISMATCH`,
`CONNECT_FAILURE` }
return values of `elConnect()`
- enum `ELCReturnActiveScreen` { `ACTIVESCREEN_SUCCESS`, `ACTIVESCREEN_NOT_INITED`, `ACTIVESCREEN_NOT_FOU`,
`ACTIVESCREEN_FAILURE` }
return values of `setActiveScreen()`
- enum `ELCReturnStreamEyeImages` { `EYEIMAGES_SUCCESS`, `EYEIMAGES_NOT_CONNECTED`,
`EYEIMAGES_REMOTE_CONNECTION`, `EYEIMAGES_FAILURE` }
Return values of the `elStreamEyeImages()` function.
- enum `ELCReturnNextData` {
`NEXTDATA_SUCCESS`, `NEXTDATA_PTR_IS_NULL`, `NEXTDATA_NOT_INITED`, `NEXTDATA_TIMEOUT`,
`NEXTDATA_CONNECTION_CLOSED` }
Return values of the `getNextEvent/getNextGazeSample` functions.
- enum `ELCReturnStart` {
`START_SUCCESS`, `START_NOT_CONNECTED`, `START_DEVICE_MISSING`, `START_INVALID_FRAMERATE_MODE`,
`START_ALREADY_RUNNING_DIFFERENT_FRAMERATE`, `START_FAILURE` }
return values of `elRequestTracking()`
- enum `ELCReturnCalibrate` {
`CALIB_SUCCESS`, `CALIB_NOT_CONNECTED`, `CALIB_NOT_TRACKING`, `CALIB_INVALID_CALIBRATION_MODE`,
`CALIB_ALREADY_BUSY`, `CALIB_FAILURE` }
return values of `elCalibrate()`
- enum `ELCReturnValidate` {
`VALID_SUCCESS`, `VALID_NOT_CONNECTED`, `VALID_NOT_TRACKING`, `VALID_NOT_CALIBRATED`,
`VALID_ALREADY_BUSY`, `VALID_PTR_IS_NULL`, `VALID_FAILURE` }
return values of `elValidate()`

Functions

- typedef `void` (STDCALL `*GazeSampleCallback`)(const struct `ELCGazeSample` *sample)
callback function type, new gaze sample
- EXTERNC ELC_EXPORT enum `ELCReturnInit` STDCALL `elInitApi` (const char *clientName)
initialize the ELCapi.
- EXTERNC ELC_EXPORT `void` STDCALL `elDestroyApi` ()
destroys the ELCapi. Call this once before shutting down. Be sure to unregister all callbacks before calling this method.
- EXTERNC ELC_EXPORT `void` STDCALL `elRegisterDeviceEventCallback` (DeviceEventCallback event↔
Callback)
registers the callback receiver for events. Ensure that all callbacks are unregistered before destruction.
- EXTERNC ELC_EXPORT `void` STDCALL `elRegisterGazeSampleCallback` (GazeSampleCallback sample↔
Callback)
registers the callback receiver for gaze samples. Ensure that all callbacks are unregistered before destruction.
- EXTERNC ELC_EXPORT `void` STDCALL `elRegisterEyeImageCallback` (EyeImageCallback eyeImage↔
Callback)
registers the callback receiver for eye images. Ensure that all callbacks are unregistered before destruction.

- EXTERNC ELC_EXPORT void STDCALL **elRegisterGazeEventCallback** (FixationStartCallback fixationStartCallback, FixationStopCallback fixationStopCallback)
registers the callback receiver for gaze events. Ensure that all callbacks are unregistered before destruction.
- EXTERNC ELC_EXPORT enum **ELCReturnConnect** STDCALL **elConnect** ()
*return values of **elConnect**()*
- EXTERNC ELC_EXPORT enum **ELCReturnConnect** STDCALL **elConnectRemote** (struct **ELCServerInfo** server)
initialize connection to a remote server (method is blocking until connection established)
- EXTERNC ELC_EXPORT int32_t STDCALL **elRequestServerList** (int32_t blockingDurationMS, struct **ELCServerInfo** *serverList, int32_t serverListLength)
Ping all running EyeLogic servers in the local network and wait some time for their response.
- EXTERNC ELC_EXPORT void STDCALL **elDisconnect** ()
closes connection to the server
- EXTERNC ELC_EXPORT bool STDCALL **elIsConnected** ()
whether a connection to the server is established
- EXTERNC ELC_EXPORT bool STDCALL **elGetActiveScreen** (struct **ELCScreenConfig** *screenConfig)
obtain configuration of active screen
- EXTERNC ELC_EXPORT int32_t STDCALL **elGetAvailableScreens** (struct **ELCScreenConfig** *screenConfig, int32_t numScreenConfigs)
Get a list of screens connected to the local machine. If there are more screens than 'numScreenConfigs' found, then only the first 'numScreenConfigs' ones are filled.
- EXTERNC ELC_EXPORT enum **ELCReturnActiveScreen** STDCALL **elSetActiveScreen** (char *screenID, struct **ELCDeviceGeometry** deviceGeometry)
Make a screen connected to this machine to the active screen.
- EXTERNC ELC_EXPORT bool STDCALL **elGetDeviceConfig** (struct **ELCDeviceConfig** *deviceConfig)
obtain configuration of active device
- EXTERNC ELC_EXPORT enum **ELCReturnStreamEyeImages** STDCALL **elStreamEyeImages** (bool enable)
Enabled/disables eye image stream. If enabled, eye images are received from eye image listeners..
- EXTERNC ELC_EXPORT enum **ELCReturnNextData** STDCALL **elGetNextDeviceEvent** (enum **ELCDeviceEvent** *event, int32_t timeoutMillis)
Obtains the next unread event or blocks until a new event occurs or the given timeout is reached.
- EXTERNC ELC_EXPORT enum **ELCReturnNextData** STDCALL **elGetNextGazeSample** (struct **ELCGazeSample** *gazeSample, int32_t timeoutMillis)
Obtains the next unread gazeSample or blocks until a new GazeSample is received or the given timeout is reached.
- EXTERNC ELC_EXPORT enum **ELCReturnNextData** STDCALL **elGetNextEyeImage** (struct **ELCEyeImage** *eyeImage, int32_t timeoutMillis)
Obtains the next unread eye image or blocks until a new eye image is received or the given timeout is reached.
- EXTERNC ELC_EXPORT enum **ELCReturnStart** STDCALL **elRequestTracking** (int32_t frameRateModelInd)
request tracking
- EXTERNC ELC_EXPORT void STDCALL **elUnrequestTracking** ()
unrequest tracking
- EXTERNC ELC_EXPORT enum **ELCReturnCalibrate** STDCALL **elCalibrate** (int32_t calibrationModelInd)
perform calibration (method is blocking until calibration finished)
- EXTERNC ELC_EXPORT void STDCALL **elAbortCalibValidation** ()
abort a running calibration / validation
- EXTERNC ELC_EXPORT enum **ELCReturnValidate** STDCALL **elValidate** (struct **ELCValidationResult** *validationResult)
perform validation (method is blocking until validation finished) - calibration must be performed prior

5.1.1 Detailed Description

The file contains the C prototype declaration for all functions which are necessary to control the EyeLogic software from an API client.

5.1.2 Enumeration Type Documentation

5.1.2.1 ELCDeviceEvent

enum `ELCDeviceEvent`

EyeLogic events.

Enumerator

EVENT_SCREEN_CHANGED	a new screen has been set as active
EVENT_CONNECTION_CLOSED	connection to EyeLogic Server has closed
EVENT_DEVICE_CONNECTED	a new device has connected
EVENT_DEVICE_DISCONNECTED	device disconnected
EVENT_TRACKING_STOPPED	tracking has stopped

5.1.2.2 ELCTurnActiveScreen

enum `ELCTurnActiveScreen`

return values of `setActiveScreen()`

Enumerator

ACTIVESCREEN_SUCCESS	active screen was set
ACTIVESCREEN_NOT_INITED	library needs to be initialized first, See also <code>eInitApi</code>
ACTIVESCREEN_NOT_FOUND	specified screen name was not found as a name of an available monitor
ACTIVESCREEN_FAILURE	active screen could not be changed

5.1.2.3 ELCTurnCalibrate

enum `ELCTurnCalibrate`

return values of `eCalibrate()`

Enumerator

CALIB_SUCCESS	calibration successful
---------------	------------------------

Enumerator

CALIB_NOT_CONNECTED	cannot calibrate: not connected to the server
CALIB_NOT_TRACKING	cannot calibrate: no device found or tracking not started
CALIB_INVALID_CALIBRATION_MODE	cannot start calibration: calibration mode is invalid or not supported
CALIB_ALREADY_BUSY	cannot start calibration: calibration or validation is already in progress
CALIB_FAILURE	calibration was not successful or aborted

5.1.2.4 ELCReturnConnect

enum `ELCReturnConnect`

return values of `elConnect()`

Enumerator

CONNECT_SUCCESS	connection successfully established
CONNECT_NOT_INITED	connection failed: library needs to be initialized first, See also <code>elInitApi</code>
CONNECT_VERSION_MISMATCH	connection failed: API is build on a newer version than the server. Update the EyeLogicServer to the newest version.
CONNECT_FAILURE	connection failed: the server can not be found or is not responding

5.1.2.5 ELCReturnInit

enum `ELCReturnInit`

return values of `elInitApi()`

Enumerator

INIT_SUCCESS	initialization was successful
INIT_ALREADY_INITED	initialization was not successful: was already initialized before

5.1.2.6 ELCReturnNextData

enum `ELCReturnNextData`

Return values of the `getNextEvent/getNextGazeSample` functions.

Enumerator

NEXTDATA_SUCCESS	new event or new GazeSample received
NEXTDATA_PTR_IS_NULL	input ptr is nullptr
NEXTDATA_NOT_INITED	library needs to be initialized first, See also eIInitApi
NEXTDATA_TIMEOUT	timeout reached, no new event/GazeSample received
NEXTDATA_CONNECTION_CLOSED	connection to server closed, no new event/GazeSample received

5.1.2.7 ELCReturnStart

enum [ELCReturnStart](#)

return values of [eIRequestTracking\(\)](#)

Enumerator

START_SUCCESS	start tracking successful
START_NOT_CONNECTED	not connected to the server
START_DEVICE_MISSING	cannot start tracking: no device found
START_INVALID_FRAMERATE_MODE	cannot start tracking: framerate mode is invalid or not supported
START_ALREADY_RUNNING_DIFFERENT_FRAMERATE	tracking already ongoing, but frame rate mode is different
START_FAILURE	some general failure occurred

5.1.2.8 ELCReturnStreamEyeImages

enum [ELCReturnStreamEyeImages](#)

Return values of the [eIStreamEyeImages\(\)](#) function.

Enumerator

EYEIMAGES_SUCCESS	setting streaming of eye images was successful
EYEIMAGES_NOT_CONNECTED	failed, not connected to the server
EYEIMAGES_REMOTE_CONNECTION	cannot stream eye images when connection to the server is a remote connection
EYEIMAGES_FAILURE	failure when trying to set eye image stream

5.1.2.9 ELCReturnValidate

enum `ELCReturnValidate`

return values of `elValidate()`

Enumerator

<code>VALID_SUCCESS</code>	start validation successful
<code>VALID_NOT_CONNECTED</code>	cannot validate: not connected to the server
<code>VALID_NOT_TRACKING</code>	cannot validate: no device found or tracking not started
<code>VALID_NOT_CALIBRATED</code>	cannot start validation: validation mode is invalid or not supported
<code>VALID_ALREADY_BUSY</code>	cannot start validation: calibration or validation is already in progress
<code>VALID_PTR_IS_NULL</code>	input is nullptr
<code>VALID_FAILURE</code>	validation failure

5.1.3 Function Documentation

5.1.3.1 elCalibrate()

```
EXTERNC ELC_EXPORT enum ELCReturnCalibrate STDCALL elCalibrate (
    int32_t calibrationModeInd )
```

perform calibration (method is blocking until calibration finished)

Returns

success state

5.1.3.2 elConnect()

```
EXTERNC ELC_EXPORT enum ELCReturnConnect STDCALL elConnect ( )
```

return values of `elConnect()`

initialize connection to the server (method is blocking until connection established). The connection is only established for a local server (running on this machine). For connections to a remote server,

Returns

success state

See also

`elConnectRemote()`.

Returns

success state

5.1.3.3 elConnectRemote()

```
EXTERNC ELC_EXPORT enum ELCReturnConnect STDCALL elConnectRemote (
    struct ELCServerInfo server )
```

initialize connection to a remote server (method is blocking until connection established)

Parameters

<i>server</i>	Server to connect to
---------------	----------------------

Returns

success state

See also

`elAcquireServerList()` to obtain IP address and port of a remote server

5.1.3.4 elDestroyApi()

```
EXTERNC ELC_EXPORT void STDCALL elDestroyApi ( )
```

destroys the ELCapi. Call this once before shutting down. Be sure to unregister all callbacks before calling this method.

See also

`elRegisterDeviceEventCallback()`
`elRegisterGazeSampleCallback()`
`elRegisterEyeImageCallback()`
`elRegisterGazeEventCallback()`

5.1.3.5 elGetActiveScreen()

```
EXTERNC ELC_EXPORT bool STDCALL elGetActiveScreen (
    struct ELCScreenConfig * screenConfig )
```

obtain configuration of active screen

Parameters

<i>screenConfig</i>	is set to the config state upon success, set to 0-initialized struct if library is not initialized
---------------------	--

Returns

true upon successfull config recovery, false upon uninitialized library or screenConfig == nullptr

5.1.3.6 elGetAvailableScreens()

```
EXTERNC ELC_EXPORT int32_t STDCALL elGetAvailableScreens (
    struct ELCScreenConfig * screenConfig,
    int32_t numScreenConfigs )
```

Get a list of screens connected to the local machine. If there are more screens than 'numScreenConfigs' found, then only the first 'numScreenConfigs' ones are filled.

Parameters

<i>screenConfig</i>	pre-allocated array, will be filled with screen configurations
<i>numScreenConfigs</i>	number of entries of screenConfig

Returns

number of filled screen configurations. will be <= numScreenConfigs

5.1.3.7 elGetDeviceConfig()

```
EXTERNC ELC_EXPORT bool STDCALL elGetDeviceConfig (
    struct ELCDeviceConfig * deviceConfig )
```

obtain configuration of active device

Parameters

<i>deviceConfig</i>	is set to the config state upon success, set to 0-initialized struct if library is not initialized
---------------------	--

Returns

true upon successfull config recovery, false upon uninitialized library or screenConfig == nullptr

5.1.3.8 elGetNextDeviceEvent()

```
EXTERNC ELC_EXPORT enum ELCReturnNextData STDCALL elGetNextDeviceEvent (
    enum ELCDeviceEvent * event,
    int32_t timeoutMillis )
```

Obtains the next unread event or blocks until a new event occurs or the given timeout is reached.

The last incoming event is buffered internally and can be obtained by calling this method in a consecutive order. If there is no new event, the method blocks until an event occurs or the given timeout is reached. The method returns SUCCESS if and only if a new event is provided which was not returned before. Therefore, by checking the return value, you can assure to not handle any event twice.

If you want to catch events in a loop, be careful to not wait too long between the calls to this method. Otherwise, you may miss events. If you want to be 100% sure to not miss any event, consider to use the ELEventCallback mechanism.

See also

registerDeviceEventListener

Parameters

<i>event</i>	If this method returns SUCCESS, this data structure is filled with the new (yet unhandled) event. In all other cases, this data structure is filled with the event which was returned last.
<i>timeoutMillis</i>	duration in milliseconds, method returns at the latest after this time. May be 0 if the method should return immediatly.

Returns

whether an event was received (SUCCESS) or the method terminated without a new event

5.1.3.9 elGetNextEyeImage()

```
EXTERNC ELC_EXPORT enum ELCReturnNextData STDCALL elGetNextEyeImage (
    struct ELCEyeImage * eyeImage,
    int32_t timeoutMillis )
```

Obtains the next unread eye image or blocks until a new eye image is received or the given timeout is reached.

The last incoming eye image is buffered internally and can be obtained by calling this method in a consecutive order. If there is no new eye image, the method blocks until an eye image is received or the given timeout is reached. The method returns SUCCESS if and only if a new eye image is provided which was not returned before. Therefore, by checking the return value, you can assure to not handle any eye image twice.

Parameters

<i>eyeImage</i>	If this method returns SUCCESS, this data structure is filled with the new (yet unhandled) eye image. In all other cases, this data structure is filled with the eye image which was returned last.
<i>timeoutMillis</i>	duration in milliseconds, method returns at the latest after this time. May be 0 if the method should return immediatly.

Returns

whether an eye iage was received (SUCCESS)

5.1.3.10 elGetNextGazeSample()

```
EXTERNC ELC_EXPORT enum ELCReturnNextData STDCALL elGetNextGazeSample (
    struct ELCGazeSample * gazeSample,
    int32_t timeoutMillis )
```

Obtains the next unread gazeSample or blocks until a new GazeSample is received or the given timeout is reached.

The last incoming GazeSample is buffered internally and can be obtained by calling this method in a consecutive order. If there is no new GazeSample, the method blocks until a GazeSample arrives or the given timeout is reached. The method returns SUCCESS if and only if a new GazeSample is provided which was not returned before. Therefore, by checking the return value, you can assure to not handle any GazeSample twice.

If you want to catch GazeSamples in a loop, be careful to not wait too long between the calls to this method (at least once per frame). Otherwise, you may miss GazeSamples. If you want to be 100% sure to not miss any GazeSample, consider to use the ELGazeSampleCallback mechanism.

See also

registerGazeSampleListener

Parameters

<i>gazeSample</i>	If this method returns SUCCESS, this data structure is filled with the new (yet unhandled) GazeSample. In all other cases, this data structure is filled with the GazeSample which was returned last.
<i>timeoutMillis</i>	duration in milliseconds, method returns at the latest after this time. May be 0 if the method should return immediatly.

Returns

whether a GazeSample was received (SUCCESS) or the method terminated without a new GazeSample

5.1.3.11 elInitApi()

```
EXTERNC ELC_EXPORT enum ELCReturnInit STDCALL elInitApi (
    const char * clientName )
```

initialize the ELCapi.

Call this once before calling any other function from this library.

Parameters

<i>clientName</i>	string identifier of the client (shown in the server tool window)
-------------------	---

5.1.3.12 elRegisterDeviceEventCallback()

```
EXTERNC ELC_EXPORT void STDCALL elRegisterDeviceEventCallback (
    DeviceEventCallback eventCallback )
```

registers the callback receiver for events. Ensure that all callbacks are unregistered before destruction.

Parameters

<i>eventCallback</i>	this callback function is called on new events, may be null to unregister
----------------------	---

5.1.3.13 elRegisterEyeImageCallback()

```
EXTERNC ELC_EXPORT void STDCALL elRegisterEyeImageCallback (
    EyeImageCallback eyeImageCallback )
```

registers the callback receiver for eye images. Ensure that all callbacks are unregistered before destruction.

Parameters

<i>eyeImageCallback</i>	this callback function is called on new eye images, may be null to unregister
-------------------------	---

5.1.3.14 elRegisterGazeEventCallback()

```
EXTERNC ELC_EXPORT void STDCALL elRegisterGazeEventCallback (
    FixationStartCallback fixationStartCallback,
    FixationStopCallback fixationStopCallback )
```

registers the callback receiver for gaze events. Ensure that all callbacks are unregistered before destruction.

Parameters

<i>fixationStartCallback</i>	called when the start of a fixation is detected, may be null to unregister
<i>fixationStopCallback</i>	called when the end of a fixation is detected, may be null to unregister

5.1.3.15 elRegisterGazeSampleCallback()

```
EXTERNC ELC_EXPORT void STDCALL elRegisterGazeSampleCallback (
    GazeSampleCallback sampleCallback )
```

registers the callback receiver for gaze samples. Ensure that all callbacks are unregistered before destruction.

Parameters

<i>sampleCallback</i>	this callback function is called on new gaze samples, may be null to unregister
-----------------------	---

5.1.3.16 elRequestServerList()

```
EXTERNC ELC_EXPORT int32_t STDCALL elRequestServerList (
    int32_t blockingDurationMS,
    struct ELCServerInfo * serverList,
    int32_t serverListLength )
```

Ping all running EyeLogic servers in the local network and wait some time for their response.

Parameters

<i>blockingDurationMS</i>	waiting duration in milliseconds. Method returns after this time, or if 'serverListLength' many servers responded.
<i>serverList</i>	pre-allocated array of length 'serverListLength'. Will be filled with responding EyeLogic servers.
<i>serverListLength</i>	Length of pre-allocated serverList array

Returns

number of entries, written to the server list

5.1.3.17 elRequestTracking()

```
EXTERNC ELC_EXPORT enum ELCReturnStart STDCALL elRequestTracking (
    int32_t frameRateModeInd )
```

request tracking

If tracking is not yet ongoing, tracking is started in the device. If tracking is already running (e.g. started from another client) with the same frame-rate as requested, all gaze samples are reported to this client as well.

Parameters

<i>frameRateModeInd</i>	index of the requested frame rate mode (0 .. #frameRateModes-1)
-------------------------	---

Returns

success state

5.1.3.18 elSetActiveScreen()

```
EXTERNC ELC_EXPORT enum ELCTReturnActiveScreen STDCALL elSetActiveScreen (
    char * screenID,
    struct ELCTDeviceGeometry deviceGeometry )
```

Make a screen connected to this machine to the active screen.

Recording is from now on performed on the new active screen. Remember to perform a calibration on the new screen, otherwise it remains in an uncalibrated state.

Parameters

<i>screenID</i>	ID of the new active screen on <i>this</i> machine (even works if the connection to the server is remote). If null, the primary screen of this machine is set as active.
<i>deviceGeometry</i>	Geometry of the device which is mounted to the screen.

Returns

success/error code

5.1.3.19 elStreamEyeImages()

```
EXTERNC ELC_EXPORT enum ELCTReturnStreamEyeImages STDCALL elStreamEyeImages (
    bool enable )
```

Enabled/disables eye image stream. If enabled, eye images are received from eye image listeners,.

See also

registerEyeImageListener() and getNextEyeImage(). Note, that enabling eye images can lead to noticable CPU load and a loss of gaze samples. Always disable it before running your experiment. Eye images can not be received via remote connections.

5.1.3.20 elUnrequestTracking()

```
EXTERNC ELC_EXPORT void STDCALL elUnrequestTracking ( )
```

unrequest tracking

Note that the tracking device may continue if other processes still request tracking. Check the EyeLogic server window to observe the actual state.

5.1.3.21 elValidate()

```
EXTERNC ELC_EXPORT enum ELCTReturnValidate STDCALL elValidate (
    struct ELCTValidationResult * validationResult )
```

perform validation (method is blocking until validation finished) - calibration must be performed prior

Parameters

<i>validationResult</i>	upon ReturnValidate::SUCCESS this struct will be filled with the validation results - may contain ELCInvalidValues. Contains all ELCInvalidValue for all other return values - unless return value is VALID_NOT_CONNECTED, in that case validationResult will be set to all-zeros.
-------------------------	--

Returns

success state

5.1.3.22 void()

```
typedef void (
    STDCALL * GazeSampleCallback ) const
```

callback function type, new gaze sample

callback function type, fixation stopped

callback function type, new fixation started

callback function type, new device event occurred

callback function type, new eye image

5.2 ELCGazeEvent.h File Reference

The file specifies the C++ container for a gaze event.

```
#include "ELCExports.hpp"
#include <stdint.h>
```

Classes

- struct **ELCFixationStart**
information about a fixation start
- struct **ELCFixationStop**
information about a fixation end

5.2.1 Detailed Description

The file specifies the C++ container for a gaze event.

5.3 ELCGazeSample.h File Reference

The file specifies the C container for a gaze sample.

```
#include "ELCExports.hpp"  
#include <stdint.h>  
#include <stdbool.h>
```

Classes

- struct **ELCGazeSample**
contains all information about the state of the eyes at a specific time

Variables

- EXTERNC ELC_EXPORT const double **ELCInvalidValue**
marker for an invalid double value

5.3.1 Detailed Description

The file specifies the C container for a gaze sample.

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