



OPEN GAZE API BY GAZEPOINT



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1 Introduction

The Open Gaze Application Programming Interface (API) was first published in 2010 as an open-source alternative to proprietary vendor formats for communicating with eye-tracking devices. The vision is to allow developers a common interface to integrate into their application without having to add customizations for each eye-tracking system on the market.

A key requirement of the API is that it does not require any DLL's, libraries, or any programming language or platform specific components. The API uses a standard TCP/IP socket for communication between a client (the application) and the server (the source of eye-tracking data). The data format uses the extensible markup language (XML) to format the data transmit between the client and server. Since both TCP/IP and XML are open standards, they can be readily implemented in any language or operating system.

2 Basic Structure

A client-server communication session would typically begin with client initiating a connection to the server. The client would then request which data records it is interested in receiving, then commanding the server to begin streaming the data records out. The client then simply listens for the data records packaged in XML formatted strings sent by the server.

2.1 Controlling the Server

A connection to the server is created by opening a TCP/IP socket with the IP address of the server (typically use "127.0.0.1" as the localhost IP address if both client and server are running on the same machine). The server default port value is 4242 although the server software may allow the port number to be modified. The client and server do not need to be on the same computer.

Example code (C#, matlab, python) is provided with the Gazepoint software installer and can be found in the demo folder inside your Gazepoint directory.

C:\Program Files (x86)\Gazepoint\Gazepoint\demo

2.2 Client Commands

The client has two XML tags for communicating with the server, GET and SET. These read and write to data variables on the server. The data variables that may be manipulated are listed in Sections 0 and 4.

An example of the SET command is:

```
CLIENT SEND: <SET ID="CALIBRATE_SHOW" STATE="1" />
SERVER SEND: <ACK ID="CALIBRATE_SHOW" STATE="1" />
```

The '<' and '>' characters identify the start and end of the XML text string respectively. The SET indicates the command is setting a value to a variable. The variable being modified is identified by its ID CALIBRATE_SHOW in this case, and the value set is '1' identified by the STATE parameter. A GET

command is formatted in a similar manner but without the STATE parameter. The server response will be discussed in the following section.

```
CLIENT SEND: <GET ID="CALIBRATE_SHOW" />
SERVER SEND: <ACK ID="CALIBRATE_SHOW" STATE="1" />
```

2.3 Server Commands

The server can send data to the client with four different tags, ACK, NACK, CAL, and REC. The ACK and NACK responses are generated when responding to GET and SET commands. The CAL responses are generated based on the operations the calibration routine is currently performing. The REC strings hold the data record that was transmitted.

In the example above, the client requested the calibration window be shown and the server responded that the variable was set to '1' or TRUE.

```
CLIENT SEND: <SET ID="CALIBRATE_SHOW" STATE="1" />
SERVER SEND: <ACK ID="CALIBRATE_SHOW" STATE="1" />
```

ACK indicates a successful command while NACK would indicate a failure.

The server CAL and REC tags will be described in greater detail in the Sections 3.22 and 0.

2.4 Delimiters

Each XML record is delimited by carriage return ('CR' or '\n') and a line-feed characters ('LF', '\n') one after the other. The actual characters transmit would appear as shown below between the quotes "".

```
CLIENT SEND: "<SET ID="CALIBRATE_SHOW" STATE="1" />\r\n"
SERVER SEND: "<ACK ID="CALIBRATE_SHOW" STATE="1" />\r\n"
```

3 Configuration Commands

The configuration commands are used to set and get configuration settings from the server. The configuration commands are described in the following sections.

3.1 ENABLE_SEND_DATA

Description: Start or stop the streaming of data from the server to client.

Parameter: STATE

Parameter type: Boolean (0 or 1)

Permissions: Read and Writable

Example: '...' the data being sent is described in Section 5

```
CLIENT SEND: <SET ID="ENABLE_SEND_DATA" STATE="1" />
SERVER SEND: <ACK ID="ENABLE_SEND_DATA" STATE="1" />
SERVER SEND: <REC ... />
SERVER SEND: <REC ... />
```

3.2 ENABLE_SEND_???

Each of the data variables generated by the system can be individually selected and added to the API data stream by enabling the particular data stream of interest. A list of the enable commands are shown below. Each of the data variables are described in detail in Section 5 below.

```
ENABLE_SEND_COUNTER
ENABLE_SEND_TIME
ENABLE_SEND_TIME_TICK
ENABLE_SEND_POG_FIX
ENABLE_SEND_POG_LEFT
ENABLE_SEND_POG_RIGHT
ENABLE_SEND_POG_BEST
ENABLE_SEND_POG_AAC
ENABLE_SEND_PUPIL_LEFT
ENABLE_SEND_PUPIL_RIGHT
ENABLE_SEND_EYE_LEFT
ENABLE_SEND_EYE_RIGHT
ENABLE_SEND_CURSOR
ENABLE_SEND_KB
ENABLE_SEND_BLINK
ENABLE_SEND_PUPILMM
ENABLE_SEND_DIAL
ENABLE_SEND_GSR
ENABLE_SEND_HR
ENABLE_SEND_HR_PULSE
ENABLE_SEND_HR_IBI
ENABLE_SEND_TTL
ENABLE_SEND_PIX
ENABLE_SEND_USER_DATA
```

Description: Enable a data record variable in the data record string.

Parameter: STATE

Parameter type: boolean (0 or 1)

Permissions: Read and Writable

Example:

```
CLIENT SEND: <SET ID="ENABLE_SEND_COUNTER" STATE="1" />
SERVER SEND: <ACK ID="ENABLE_SEND_COUNTER" STATE="1" />
```

3.3 CALIBRATE_START

Description: Start or stop the calibration process

Parameter: STATE

Parameter type: boolean (0 or 1)

Permissions: Read and Writable

Example:

```
CLIENT SEND: <GET ID="CALIBRATE_START" />
SERVER SEND: <ACK ID="CALIBRATE_START" STATE="0" />

CLIENT SEND: <SET ID="CALIBRATE_START" STATE="1" />
SERVER SEND: <ACK ID="CALIBRATE_START" STATE="1" />
```

3.4 CALIBRATE_SHOW

Description: Show or hide the calibration graphical window

Parameter: STATE

Parameter type: boolean (0 or 1)

Permissions: Read and Writable

Example:

```
CLIENT SEND: <GET ID="CALIBRATE_SHOW" />
SERVER SEND: <ACK ID="CALIBRATE_SHOW" STATE="0" />

CLIENT SEND: <SET ID="CALIBRATE_SHOW" STATE="1" />
SERVER SEND: <ACK ID="CALIBRATE_SHOW" STATE="1" />
```

3.5 CALIBRATE_TIMEOUT

Description: Set or get the duration of the calibration point (not including animation time below)

Parameter: VALUE

Parameter type: float (> 0)

Permissions: Read and Writable

Example:

```
CLIENT SEND: <GET ID="CALIBRATE_TIMEOUT" />
SERVER SEND: <ACK ID="CALIBRATE_TIMEOUT" VALUE="1.25" />

CLIENT SEND: <SET ID="CALIBRATE_TIMEOUT" VALUE="2" />
SERVER SEND: <ACK ID="CALIBRATE_TIMEOUT" VALUE="2" />
```

3.6 CALIBRATE_DELAY

Description: Set or get the duration of the calibration animation (before calibration at a point begins)

Parameter: VALUE

Parameter type: float (>= 0)

Permissions: Read and Writable

Example:

```
CLIENT SEND: <GET ID="CALIBRATE_DELAY" />
SERVER SEND: <ACK ID="CALIBRATE_DELAY" VALUE="0.5" />

CLIENT SEND: <SET ID="CALIBRATE_DELAY" VALUE="1.0" />
SERVER SEND: <ACK ID="CALIBRATE_DELAY" VALUE="1.0" />
```

3.7 CALIBRATE_RESULT_SUMMARY

Description: Get a summary of the calibration results

Parameter: AVE_ERROR (average error over all calibration points in pixels)

Parameter: VALID_POINTS (number of successful calibration points)

Permissions: Read only

Example:

```
CLIENT SEND: <GET ID="CALIBRATE_RESULT_SUMMARY" />
SERVER SEND: <ACK ID="CALIBRATE_RESULT_SUMMARY" AVE_ERROR="19.43"
VALID_POINTS="5" />
```


3.8 CALIBRATE_CLEAR

Description: Clear the internal list of calibration points

Parameter: PTS (number of calibration points returned only)

Permissions: Read/Write

Example:

```
CLIENT SEND: <GET ID="CALIBRATE_CLEAR" />
SERVER SEND: <ACK ID="CALIBRATE_CLEAR" PTS="5" />

CLIENT SEND: <SET ID="CALIBRATE_CLEAR" />
SERVER SEND: <ACK ID="CALIBRATE_CLEAR" PTS="0" />
```

3.9 CALIBRATE_RESET

Description: Reset the internal list of calibration points to the default values

Parameter: PTS (number of calibration points returned only)

Permissions: Read/Write

Example:

```
CLIENT SEND: <GET ID="CALIBRATE_RESET" />
SERVER SEND: <ACK ID="CALIBRATE_RESET" PTS="0" />

CLIENT SEND: <SET ID="CALIBRATE_RESET" />
SERVER SEND: <ACK ID="CALIBRATE_RESET" PTS="5" />
```

3.10 CALIBRATE_ADDPOINT

Description: Add a point to the internal list of calibration points

Parameter: X (calibration point position as percentage of screen width)

Parameter: Y (calibration point position as percentage of screen height)

Parameter type: float

Permissions: Read/Write

Example:

```
CLIENT SEND: <GET ID="CALIBRATE_ADDPOINT" />
SERVER SEND: <ACK ID="CALIBRATE_ADDPOINT" PTS="5" X1="0.50000"
Y1="0.50000" X2="0.85000" Y2="0.15000" X3="0.85000" Y3="0.85000"
X4="0.15000" Y4="0.85000" X5="0.15000" Y5="0.15000" />

CLIENT SEND: <SET ID="CALIBRATE_ADDPOINT" X="0.5" Y="0.1" />
SERVER SEND: <ACK ID="CALIBRATE_ADDPOINT" PTS="6" X1="0.50000"
Y1="0.50000" X2="0.85000" Y2="0.15000" X3="0.85000" Y3="0.85000"
X4="0.15000" Y4="0.85000" X5="0.15000" Y5="0.15000" X6="0.50000"
Y6="0.10000" />
```

3.11 USER_DATA

Description: Set the value of the user data field for embedding custom data into the data stream

Parameter: VALUE (user defined)

Parameter type: string

Parameter: DUR (0 or 1, 0 for continuously changed (default), 1 for a one-time entry)

Parameter type: int

Permissions: Read/Write

Example:

```
CLIENT SEND: <GET ID="USER_DATA" />
SERVER SEND: <ACK ID="USER_DATA" VALUE="0" />

CLIENT SEND: <SET ID="USER_DATA" VALUE="TEST1" />
SERVER SEND: <ACK ID="USER_DATA" VALUE="TEST1" />
```

3.12 TRACKER_DISPLAY

Description: Show or hide the eye-tracker display window

Parameter: STATE

Parameter type: boolean (0 or 1)

Parameter: TRAY

Parameter type: boolean (0 or 1, 0 for normal operation, 1 for minimize to system tray)

Permissions: Read/Write

Example:

```
CLIENT SEND: <GET ID="TRACKER_DISPLAY" />
SERVER SEND: <ACK ID="TRACKER_DISPLAY" STATE="1" />

CLIENT SEND: <SET ID="TRACKER_DISPLAY" STATE ="0" />
SERVER SEND: <ACK ID="TRACKER_DISPLAY" STATE ="0" />
```

3.13 TIME_TICK_FREQUENCY

Description: Get the time-tick frequency to convert the TIME_TICK variable to seconds

Parameter: FREQ

Parameter type: long long

Permissions: Read only

Example:

```
CLIENT SEND: <GET ID="TIME_TICK_FREQUENCY" />
SERVER SEND: <ACK ID="TIME_TICK_FREQUENCY" FREQ="4704405731611246592"
/>
```

3.14 SCREEN_SIZE

Description: Get the gaze tracking screen position and size or set the screen on which the gaze tracking is to be performed. Provides the ability to work with multi-monitor systems.

Parameter: X (screen X position in pixels)

Parameter: Y (screen Y position in pixels)

Parameter: WIDTH (screen width in pixels)

Parameter: HEIGHT (screen height in pixels)

Parameter type: integer

Permissions: Read/Write

Example:

```
CLIENT SEND: <GET ID="SCREEN_SIZE" />
```

```
SERVER SEND: <ACK ID="SCREEN_SIZE" X="0" Y="0" WIDTH="1920"  
HEIGHT="1080" />
```

```
CLIENT SEND: <SET ID="SCREEN_SIZE" X="-1920" Y="0" WIDTH="1920"  
HEIGHT="1080"/>
```

```
SERVER SEND: <ACK ID="SCREEN_SIZE" X="-1920" Y="0" WIDTH="1920"  
HEIGHT="1080" />
```

3.15 CAMERA_SIZE

Description: Get the size of the camera sensor in pixels

Parameter: WIDTH (camera width in pixels)

Parameter: HEIGHT (camera height in pixels)

Parameter type: integer

Permissions: Read only

Example:

```
CLIENT SEND: <GET ID="CAMERA_SIZE" />
```

```
SERVER SEND: <ACK ID="CAMERA_SIZE" WIDTH="752" HEIGHT="480" />
```

3.16 PRODUCT_ID

Description: Get the identifier of the current eye-tracker being used

Parameter: VALUE (product name GP3 or GP3HD)

Parameter type: string

Permissions: Read only

Parameter: BUS (connection bus USB2 or USB3)

Parameter type: string

Permissions: Read only

Parameter: RATE (system update rate, 60 or 150 fps)

Parameter type: string

Permissions: Read only

Example:

```
CLIENT SEND: <GET ID="PRODUCT_ID" />
SERVER SEND: <ACK ID="PRODUCT_ID" VALUE="GP3" BUS="USB2" RATE="60" />
```

3.17 SERIAL_ID

Description: Get the serial number of the eye-tracker

Parameter: VALUE (serial number)

Parameter type: string

Permissions: Read only

Example:

```
CLIENT SEND: <GET ID="SERIAL_ID" />
SERVER SEND: <ACK ID="SERIAL_ID" VALUE="123456789" />
```

3.18 COMPANY_ID

Description: Get the identifier of the eye-tracker manufacturer

Parameter: VALUE (company name)

Parameter type: string

Permissions: Read only

Example:

```
CLIENT SEND: <GET ID="COMPANY_ID" />
SERVER SEND: <ACK ID="COMPANY_ID" VALUE="GAZEPOINT" />
```

3.19 API_ID

Description: Get the API version number

Parameter: VALUE (API version)

Parameter type: string

Permissions: Read only

Example:

```
CLIENT SEND: <GET ID="API_ID" />
SERVER SEND: <ACK ID="API_ID" VALUE="2.4" />
```

3.20 TRACKER_ID

Description: Set/Get eye-tracker type and id information

Parameter: ACTIVE_ID (ID number of current active eye-tracker)

Parameter type: integer

Permissions: Read/Write

Parameter: MAX_ID (Maximum number of connected eye-trackers)

Parameter type: integer

Permissions: Read only (ignored when written by a SET command)

Parameter: SEARCH (Automatic eye-tracker search algorithm: NONE=no search, SIMPLE=move to next eye-tracker if both eyes lost, CURSOR=move to eye-tracker on screen with current mouse cursor, GAZE=move to eye-tracker on screen currently targeted by the users gaze).

Parameter type: string

Permissions: Read/Write

Example:

```
CLIENT SEND: <GET ID="TRACKER_ID" />
SERVER SEND: <ACK ID="TRACKER_ID" ACTIVE_ID="1" MAX_ID="2" SEARCH="NONE" />
```

3.21 MARKER_PIX

Description: Set the size of the marker in millimeters and turn on or off marker tracking.

Parameter: VALUE (size of marker in millimeters, print one from below and measure one side of the marker square, larger squares are more easily tracked but are more intrusive).

Parameter type: float

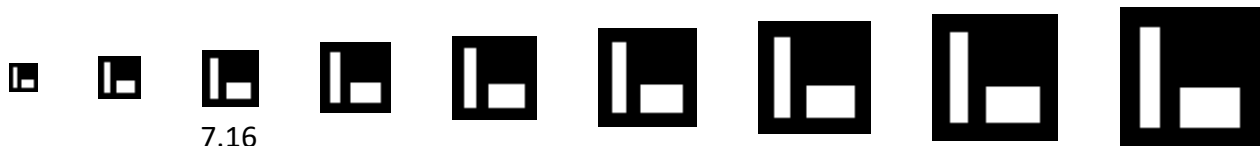
Parameter: STATE (camera height in pixels)

Parameter type: boolean

Permissions: Read/Write

Example:

```
CLIENT SEND: <SET ID="MARKER_PIX" VALUE="7.16" STATE="1" />
SERVER SEND: <ACK ID="MARKER_PIX" VALUE="7.16" STATE="1" />
```



3.22 AAC_FILTER

Description: Set/Get the AAC moving window average filter length

Parameter: VALUE (length of moving window average)

Parameter type: integer

Permissions: Read/Write

Example:

```
CLIENT SEND: <SET ID="AAC_FILTER" VALUE="15" />
SERVER SEND: <ACK ID="AAC_FILTER" VALUE="15" />
```

3.23 TTL_WRITE

Description: Set/Get the direction (input or output) and write to the state of the TTL ports if output

Parameter: CHANNEL (channel number of the TTL port 0,1,2,3,4,5,6)

Parameter type: integer

Permissions: Read/Write

Parameter: VALUE (-1 if channel is input, 0 or 1 if channel is output), ignored if a Get command

Parameter type: integer

Permissions: Read/Write

Example:

```
CLIENT SEND: <SET ID="TTL_WRITE" CHANNEL="1" VALUE="0" />
SERVER SEND: <ACK ID="TTL_WRITE" CHANNEL="1" VALUE="0" />
```

4 Calibration Records

When the user calibration takes place, a sequence of calibration specific data is sent from the server to the client, identified with the <CAL /> tag. This data includes the timing of when calibration points are shown and move to the next point, as well as the final result of the calibration process. To begin calibration through the API the following commands would be used:

```
CLIENT SEND: <SET ID="CALIBRATE_SHOW" STATE="1" />
SERVER SEND: <ACK ID="CALIBRATE_SHOW" STATE="1" />
CLIENT SEND: <SET ID="CALIBRATE_START" STATE="1" />
SERVER SEND: <ACK ID="CALIBRATE_START" STATE="1" />
```

As calibration proceeds, the following data will be sent from the server:

```
SERVER SEND: <CAL ID="CALIB_START_PT" PT="1" CALX="0.5000" CALY="0.5000" />
SERVER SEND: <CAL ID="CALIB_RESULT_PT" PT="1" CALX="0.5000" CALY="0.5000" />
SERVER SEND: <CAL ID="CALIB_START_PT" PT="2" CALX="0.8500" CALY="0.1500" />
SERVER SEND: <CAL ID="CALIB_RESULT_PT" PT="2" CALX="0.8500" CALY="0.1500" />
SERVER SEND: <CAL ID="CALIB_START_PT" PT="3" CALX="0.8500" CALY="0.8500" />
SERVER SEND: <CAL ID="CALIB_RESULT_PT" PT="3" CALX="0.8500" CALY="0.8500" />
SERVER SEND: <CAL ID="CALIB_START_PT" PT="4" CALX="0.1500" CALY="0.8500" />
SERVER SEND: <CAL ID="CALIB_RESULT_PT" PT="4" CALX="0.1500" CALY="0.8500" />
SERVER SEND: <CAL ID="CALIB_START_PT" PT="5" CALX="0.1500" CALY="0.1500" />
SERVER SEND: <CAL ID="CALIB_RESULT_PT" PT="5" CALX="0.1500" CALY="0.1500" />
SERVER SEND: <CAL ID="CALIB_RESULT" CALX1="0.50000" CALY1="0.50000"
LX1="0.50229" LY1="0.50279 LV1="1" RX1="0.51467" RY1="0.50870 RV1="1"
CALX2="0.85000" CALY2="0.15000" LX2="0.84943" LY2="0.14930 LV2="1"
RX2="0.84600" RY2="0.14763 RV2="1" CALX3="0.85000" CALY3="0.85000"
LX3="0.84942" LY3="0.84929 LV3="1" RX3="0.84627" RY3="0.84779 RV3="1"
CALX4="0.15000" CALY4="0.85000" LX4="0.14943" LY4="0.84930 LV4="1"
RX4="0.14616" RY4="0.84772 RV4="1" CALX5="0.15000" CALY5="0.15000"
LX5="0.14944" LY5="0.14931 LV5="1" RX5="0.14689" RY5="0.14815 RV5="1" />
```

4.1 CALIB_START_PT

Description: Sent at the start of the specified calibration point. Each calibration point has an animation time and then a calibration time. The CALIB_START_PT is sent at the beginning of the animation time.

Parameter: PT (point number 1 to N)

Parameter type: integer

Parameter: CALX, CALY (X- and Y- coordinates of the calibration point)

Parameter type: float

Example:

```
SERVER SEND: <CAL ID="CALIB_START_PT" PT="1" CALX="0.5000"
CALY="0.5000" />
```

4.2 CALIB_RESULT_PT

Description: Sent at the end of the specified calibration point. The CALIB_RESULT_PT is sent at the end of the calibration time.

Parameter: PT (point number 1 to N)

Parameter type: integer

Parameter: CALX, CALY (X- and Y- coordinates of the calibration point)

Parameter type: float

Example:

```
SERVER SEND: <CAL ID="CALIB_RESULT_PT" PT="1" CALX="0.5000"
CALY="0.5000" />
```

4.3 CALIB_RESULT

Description: Sent at the end of the entire calibration process and lists the estimated point-of-gaze at each of the calibration points for both the left and right eyes, as well as a valid flag indicating if the calibration for a particular eye was successful or not at a particular calibration point.

Parameter: CALX?, CALY? (X- and Y- coordinates of the calibration point number ?)

Parameter type: float

Parameter: LX?, LY? (X- and Y- coordinates of the left eye point-of-gaze at calibration point ?)

Parameter type: float

Parameter: LV? (valid flag for left eye at calibration point ?)

Parameter type: boolean

Parameter: RX?, RY? (X- and Y- coordinates of the right eye point-of-gaze at calibration point ?)

Parameter type: float

Parameter: RV? (valid flag for right eye at calibration point ?)

Parameter type: boolean

Example:

```
SERVER SEND: <CAL ID="CALIB_RESULT" CALX1="0.50000" CALY1="0.50000"
LX1="0.50229" LY1="0.50279 LV1="1" RX1="0.51467" RY1="0.50870 RV1="1"
CALX2="0.85000" CALY2="0.15000" LX2="0.84943" LY2="0.14930 LV2="1"
RX2="0.84600" RY2="0.14763 RV2="1" CALX3="0.85000" CALY3="0.85000"
LX3="0.84942" LY3="0.84929 LV3="1" RX3="0.84627" RY3="0.84779 RV3="1"
CALX4="0.15000" CALY4="0.85000" LX4="0.14943" LY4="0.84930 LV4="1"
RX4="0.14616" RY4="0.84772 RV4="1" CALX5="0.15000" CALY5="0.15000"
LX5="0.14944" LY5="0.14931 LV5="1" RX5="0.14689" RY5="0.14815 RV5="1" />
```


5 Data Records

Data is transmit from the server to the client in a sequence of records formatted as XML strings. A data record is identified with the <REC /> tag. An example for the data record counter would look as follows:

```
<REC CNT="1484" />
```

In this example there is one data field CNT with a value of 1484. Each data field is described below.

5.1 Counter

Description: The counter data variable is incremented by 1 for each data record sent by the server. Useful to determine if any data packets are missed by the client.

Parameter ID: CNT

Parameter type: int

Enable: ENABLE_SEND_COUNTER

Example:

```
<REC CNT="1484" />
```

```
<REC CNT="1485" />
```

```
<REC CNT="1486" />
```

```
<REC CNT="1487" />
```

5.2 Time

Description: The time elapsed in seconds since the last system initialization or calibration. The time stamp is recorded at the end of the transmission of the image from camera to computer. Useful for synchronization and to determine if the server computer is processing the images at the full frame rate. For a 60 Hz camera, the TIME value should increment by 1/60 seconds.

Parameter ID: TIME

Parameter type: float

Enable: ENABLE_SEND_TIME

Example:

```
<REC TIME="4.99716" />
```

```
<REC TIME="5.01366" />
```

```
<REC TIME="5.02991" />
```

```
<REC TIME="5.04653" />
```

5.3 Time Tick

Description: This is a signed 64-bit integer which indicates the number of CPU time ticks for high precision synchronization with other data collected on the same CPU. The time tick is from the OpenCV library: https://docs.opencv.org/master/db/de0/group_core_utils.html#gae73f58000611a1af25dd36d496bf4487

Parameter ID: TIME_TICK
Parameter type: LONGLONG
Enable: ENABLE_SEND_TIME_TICK
Example:

```
<REC TIME_TICK="2096547271623" />  
<REC TIME_TICK="2096547490186" />  
<REC TIME_TICK="2096547654197" />
```

5.4 Fixation POG

Description: The Fixation POG data provides the user's point-of-gaze as determined by the internal fixation filter.

Parameter ID: FPOGX, FPOGY
Parameter type: float

Parameter description: The X- and Y-coordinates of the fixation POG, as a fraction of the screen size. (0,0) is top left, (0.5,0.5) is the screen center, and (1.0,1.0) is bottom right.

Parameter ID: FPOGS
Parameter type: float

Parameter description: The starting time of the fixation POG in seconds since the system initialization or calibration.

Parameter ID: FPOGD
Parameter type: float

Parameter description: The duration of the fixation POG in seconds.

Parameter ID: FPOGID
Parameter type: integer

Parameter description: The fixation POG ID number

Parameter ID: FPOGV
Parameter type: boolean

Parameter description: The valid flag with value of 1 (TRUE) if the fixation POG data is valid, and 0 (FALSE) if it is not. FPOGV valid is TRUE ONLY when either one, or both, of the eyes are detected AND a fixation is detected. FPOGV is FALSE all other times, for example when the subject blinks, when there is no face in the field of view, when the eyes move to the next fixation (i.e. a saccade).

Enable: ENABLE_SEND_POG_FIX

Example:

```
<REC FPOGX="0.48439" FPOGY="0.50313" FPOGS="1891.86768"  
FPOGD="0.49280" FPOGID="1599" FPOGV="1" />
```

5.5 Left Eye POG

Description: The POG data for the user's left eye.

Parameter ID: LPOGX, LPOGY

Parameter type: float

Parameter description: The X- and Y-coordinates of the left eye POG, as a fraction of the screen size.

Parameter ID: LPOGV

Parameter type: boolean

Parameter description: The valid flag with value of 1 if the data is valid, and 0 if it is not.

Enable: ENABLE_SEND_POG_LEFT

Example:

```
<REC LPOGX="0.21336" LPOGY="0.44548" LPOGV="1" />
```

5.6 Right Eye POG

Description: The POG data for the user's right eye.

Parameter ID: RPOGX, RPOGY

Parameter type: float

Parameter description: The X- and Y-coordinates of the right eye POG, as a fraction of the screen size.

Parameter ID: RPOGV

Parameter type: boolean

Parameter description: The valid flag with value of 1 if the data is valid, and 0 if it is not.

Enable: ENABLE_SEND_POG_RIGHT

Example:

```
<REC LPOGX="0.43623" LPOGY="0.53243" RPOGV="1" />
```

5.7 Best POG

Description: The 'best' of the left/right eye POG data, which is the average of the left eye and right eye POG if both are available, or if not, then of either the left or right eye, depending on which one is valid. For most applications, use the FPOG which includes fixation filtering of the BPOG data.

Parameter ID: BPOGX, BPOGY

Parameter type: float

Parameter description: The X- and Y-coordinates of the best eye POG, as a fraction of the screen size.

Parameter ID: BPOGV

Parameter type: boolean

Parameter description: The valid flag with value of 1 if the data is valid, and 0 if it is not.

Enable: ENABLE_SEND_POG_BEST

Example:

```
<REC BPOGX="0.47175" BPOGY="0.43360" BPOGV="1" />
```

5.8 Assistive Communication POG

Description: The AAC POG is a moving window average of the FPOG data. The length of the moving window may be controlled with the API. This filtering reduces jitter and makes targeting with the eyes easier to accomplish for eye-typing and other assistive applications. The filter length can be set using the AAC_FILTER API command.

Parameter ID: APOGX, APOGY

Parameter type: float

Parameter description: The X- and Y-coordinates of the AAC POG, as a fraction of the screen size.

Parameter ID: APOGV

Parameter type: boolean

Parameter description: The valid flag with value of 1 if the data is valid, and 0 if it is not.

Enable: ENABLE_SEND_POG_AAC

Example:

```
<REC APOGX="0.47175" APOGY="0.43360" APOGV="1" />
```

5.9 Left Eye Pupil

Description: The image data relating to the left eye.

Parameter ID: LPCX, LPCY

Parameter type: float

Parameter description: The X- and Y-coordinates of the left eye pupil in the camera image, as a fraction of the camera image size.

Parameter ID: LPD

Parameter type: float

Parameter description: The diameter of the left eye pupil in pixels.

Parameter ID: LPS

Parameter type: float

Parameter description: The scale factor of the left eye pupil (unitless). Value equals 1 at calibration depth, is less than 1 when user is closer to the eye tracker and greater than 1 when user is further away.

Parameter ID: LPV

Parameter type: boolean

Parameter description: The valid flag with value of 1 if the data is valid, and 0 if it is not.

Enable: ENABLE_SEND_PUPIL_LEFT

Example:

```
<REC LPCX="0.40525" LPCY="0.32822" LPD="15.23866" LPS="1.04834"  
LPV="1" />
```

5.10 Right Eye Pupil

Description: The image data relating to the right eye.

Parameter ID: RPCX, RPCY

Parameter type: float

Parameter description: The X- and Y-coordinates of the right eye pupil in the camera image, as a fraction of the camera image size.

Parameter ID: RPD

Parameter type: float

Parameter description: The diameter of the right eye pupil in pixels.

Parameter ID: RPS

Parameter type: float

Parameter description: The scale factor of the right eye pupil (unitless). Value equals 1 at calibration depth, is less than 1 when user is closer to the eye tracker and greater than 1 when user is further away.

Parameter ID: RPV

Parameter type: boolean

Parameter description: The valid flag with value of 1 if the data is valid, and 0 if it is not.

Enable: ENABLE_SEND_PUPIL_RIGHT

Example:

```
<REC RPCX="0.79375" RPCY="0.54131" RPD="12.69461" RPS="1.12750"  
RPV="1" />
```

5.11 Left Eye 3D Data

Description: The computed 3D data for the left eye position.

Parameter ID: LEYEX, LEYEV, LEYEZ

Parameter type: float

Parameter description: The X-, Y- and Z-coordinates of the left eye with 3D space with respect to the camera focal point, in units of meters.

Parameter ID: LPUPILD Same as LPMM below.

Parameter type: float

Parameter description: The diameter of the left eye pupil in units of meters.

Parameter ID: LPUPILV

Parameter type: boolean

Parameter description: The valid flag with value of 1 if the data is valid, and 0 if it is not.

Enable: ENABLE_SEND_EYE_LEFT

Example:

```
<REC LEYEX="-0.04796" LEYEV="0.00305" LEYEZ="0.69235"  
LPUPILD="0.00210" LPUPILV="1" />
```

5.12 Right Eye 3D Data

Description: The computed 3D data for the right eye position.

Parameter ID: REYEX, REYEV, REYEZ

Parameter type: float

Parameter description: The X-, Y- and Z-coordinates of the right eye with 3D space with respect to the camera focal point, in units of meters.

Parameter ID: RPUPILD Same as RPMM below.

Parameter type: float

Parameter description: The diameter of the right eye pupil in units of meters.

Parameter ID: RPUPILV

Parameter type: boolean

Parameter description: The valid flag with value of 1 if the data is valid, and 0 if it is not.

Enable: ENABLE_SEND_EYE_RIGHT

Example:

```
<REC REYEX="0.04321" REYEV="0.00213" REYEZ="0.66543" RPUPILD="0.00240"  
RPUPILV="1" />
```

5.13 Cursor position

Description: The position of the mouse cursor.

Parameter ID: CX, CY

Parameter type: float

Parameter description: The X- and Y-coordinates of the mouse cursor, as percentage of the screen size.

Parameter ID: CS (0 for idle, 1 for left mouse button down, 2 for right button down, 3 for left button up, 4 for right button up).

Parameter type: integer

Parameter description: Mouse cursor state, 0 for IDLE, 1 for left button DOWN, 2 for right button DOWN, 3 for left button UP, 4 for right button UP.

Enable: ENABLE_SEND_CURSOR

Example:

```
<REC CX="0.12500" CY="0.32500" CS="0" />
<REC CX="0.12500" CY="0.32500" CS="1" />
<REC CX="0.12500" CY="0.32500" CS="0" />
<REC CX="0.12500" CY="0.32500" CS="3" />
<REC CX="0.12500" CY="0.32500" CS="0" />
```

5.14 Keyboard Input

Description: The keyboard keystroke inputs.

Parameter ID: KB

Parameter type: string

Parameter description: The keyboard key pressed, 0-9, A-Z, along with a few special keys such as LEFT, RIGHT, SPACE, and RETURN. Note the ‘,’ character is changed to COMMA to prevent distortion of the CSV export file. Any key pressed that is not recognized will be listed as OTHER.

Parameter ID: KBS (0=IDLE, 1=KEY DOWN (pressed), 2=KEY UP (released))

Parameter type: integer

Parameter description: State of the key press, IDLE is no action, while DOWN and UP are pressed and released keys. Note that when typing quickly Windows may report a key release and subsequent key press out of order depending on press-and-hold settings in Windows. A key press-and-hold results in a down, delay, then multiple down status commands, which is behavior configured through Windows settings. An IDLE KBS state corresponds with a blank (space) in the KB data field to simplify parsing. Gazepoint Analysis export of the KB data field clears this value to an empty string when KBS is IDLE.

Enable: ENABLE_SEND_KB

Example:

```
<REC KB="A" KBS="1" />
<REC KB=" " KBS="0" />
<REC KB="A" KBS="2" />
<REC KB="SPACE" KBS="1" />
<REC KB=" " KBS="0" />
<REC KB="SPACE" KBS="2" />
```

5.15 Blink Data

Description: The rolling user blink rate (blinks / minute), blink duration and blink ID.

Parameter ID: BKID

Parameter type: integer

Parameter description: Each blink is assigned an ID value and incremented by one. The BKID value equals 0 for every record where no blink has been detected.

Parameter ID: BKDUR

Parameter type: float

Parameter description: The duration of the preceding blink in seconds.

Parameter ID: BKPMIN

Parameter type: integer

Parameter description: The number of blinks in the previous 60 second period of time.

Enable: ENABLE_SEND_BLINK

Example:

```
<REC BKID="0" BKDUR="0.00000" BKPMIN="0" />
<REC BKID="1" BKDUR="0.00000" BKPMIN="1" />
<REC BKID="0" BKDUR="0.01600" BKPMIN="1" />
```

5.16 Pupil Diameter (millimeters)

Description: The left and right eye pupil diameter in millimeters.

Parameter ID: LPMM

Parameter type: float

Parameter description: The diameter of the left eye pupil in millimeters.

Parameter ID: LPMMV

Parameter type: boolean

Parameter description: The valid flag with value of 1 if the data is valid, and 0 if it is not.

Parameter ID: RPMM

Parameter type: float

Parameter description: The diameter of the right eye pupil in millimeters.

Parameter ID: RPMMV

Parameter type: boolean

Parameter description: The valid flag with value of 1 if the data is valid, and 0 if it is not.

Enable: ENABLE_SEND_PUPILMM

Example:

```
<REC LPMM="3.30703" LPMMV="1" RPMM="3.44451" RPMMV="1" />
```


5.17 Dial

Description: The biometrics analog self-reporting dial value as a percentage 0 to 100%.

Parameter ID: DIAL

Parameter type: float

Parameter description: The dial value from 0 to 1.

Parameter ID: DIALV

Parameter type: boolean

Parameter description: The valid flag with value of 1 if the data is valid, and 0 if it is not.

Enable: ENABLE_SEND_DIAL

Example:

```
<REC DIAL="0.40270" DIALV="1" />
```

5.18 Galvanic Skin Response (GSR)

Description: The biometrics galvanic skin response resistance (measured in ohms).

Parameter ID: GSR

Parameter type: int

Parameter description: The skin resistance in ohms (typically from 10 kΩ to 2 MΩ).

Parameter ID: GSRV

Parameter type: boolean

Parameter description: The valid flag with value of 1 if the data is valid, and 0 if it is not. Note the device must be plugged in for an accurate reading, if the sensor block is not plugged in the system measures internal resistances and may report measured values which do not correspond to a valid signal.

Enable: ENABLE_SEND_GSR

Example:

```
<REC GSR="67296" GSRV="1" />
```

5.19 Heart Rate

Description: The biometrics heart rate in beats per minute. The value reported is averaged over 3 samples to reduce the effect of artifacts due to possible finger motion.

Parameter ID: HR

Parameter type: float

Parameter description: The heart rate in BPM.

Parameter ID: HRV

Parameter type: boolean

Parameter description: The valid flag with value of 1 if the data is valid, and 0 if it is not.

Enable: ENABLE_SEND_HR

Example:

```
<REC HR="53.00000" HRV="1" />
```

5.20 Heart Rate Pulse

Description: The biometrics heart rate pulse signal used to determine HR in BPM.

Parameter ID: HRP

Parameter type: int

Parameter description: The heart rate pulse signal is unitless but proportional to an ECG signal. The waveform primarily displays the large R pulse signal of the cardiac cycle. The signal is susceptible to noise from finger movement.

Enable: ENABLE_SEND_HR_PULSE

Example:

```
<REC HRP="53" />
```

5.21 Heart Rate Interbeat Interval

Description: The biometrics heart rate interbeat interval. The interbeat interval is the time in seconds between heart beats, also known as the beat to beat interval or RR interval. There is no filtering of this signal and it may be susceptible to noise from finger movement.

Parameter ID: HRIBI

Parameter type: float

Parameter description: The time in seconds between heart beats (R-R) pulse time.

Enable: ENABLE_SEND_HR_IBI

Example:

```
<REC HRIBI="0.781" />
```

5.22 TTL Input/Output

Description: The biometrics analog (TTL0) and digital (TTL1) Input/Output values. Use the TTL_WRITE command to change from input to output and to write output values. Note the analog channel TTL0 can only output a digital 0 or 1.

Parameter ID: TTL0

Parameter type: int

Parameter description: The analog value of channel 0 (0-1023).

Parameter ID: TTL1

Parameter type: binary string of 6 boolean values

Parameter description: The digital value of channel 1,2,3,4,5,6 as concatenated characters.

Parameter ID: TTLV

Parameter type: boolean

Parameter description: The valid flag with value of 1, as of the V2.0 release of the Biometrics system this is always 1.

Enable: ENABLE_SEND_TTL

Example:

```
<REC TTL0="1015" TTL1="111111" TTLV="1" />
```

5.23 Pixel Conversion Factor

Description: If a marker of is worn by the user, the marker position can be tracked in the camera image, and if the size of the marker is known (using MARKER_PIX command) the scaling factor to convert from pixels to millimeters can be determined precisely.

Parameter ID: PIXX, PIXY

Parameter type: float

Parameter description: The X- and Y-coordinates of the marker in the camera image, as a fraction of the camera image size.

Parameter ID: PIXS

Parameter type: float

Parameter description: The scale conversion factor to convert from pixels (such as pupil size) to millimetres. Multiply the value in pixels by PIXS to convert to millimeters.

Parameter ID: PIXV

Parameter type: boolean

Parameter description: The valid flag with value of 1 if the data is valid, and 0 if it is not.

Enable: ENABLE_SEND_PIX

Example:

```
<REC PIXX="0.39185" PIXY="0.49825" PIXS="0.18972" PIXV="1" />
```

5.24 User data

Description: A custom data field that may be set by the user to contain any desired information such as synchronization markers.

Parameter ID: USER

Parameter type: string

Parameter description: A user defined value.

Enable: ENABLE_SEND_USER_DATA

Example:

```
<REC USER="TRIG1" />
```

6 Multiple Eye-trackers

The Gazeport system can be used on multi-display systems with multiple eye-trackers connected to the same computer. Each eye-tracker should be placed below its respective screen and calibrated on that screen by the user. Use the TRACKER_ID API command to control which tracker is active or enable one of the automatic switching algorithms. When the system switches the active eye-tracker, an update data record will be sent to all connected clients with the `<UPDATE />` tag. The tag provides the ID of the now active eye-tracker (ACTIVE_ID), the maximum number of eye-trackers (MAX_ID) and the current screen position and size of the now active eye-tracker (X, Y, WIDTH, HEIGHT).

Example:

```
<UPDATE ACTIVE_ID="1" MAX_ID="2" X="0" Y="0" WIDTH="1920" HEIGHT="1080" >
```

7 API Version 2 Revisions

2.0 Revisions

- Replaced GPI with simpler USER data field
- Added CALIBRATE_CLEAR, CALIBRATE_ADDPOINT, CALIBRATE_RESET
- Removed CALIBRATE_FAST
- Removed TRACK_WINDOW
- Removed MFG_ID from API_ID result

2.1 Revisions

- Added blink tracking fields

2.2 Revisions

- Updated mouse button tracking states.

2.3 Revisions

- Added multi-tracker API commands.

2.4 Revisions

- Updated USER_DATA to enable changing a USER field for a single data record.
- Added biometrics system, pupil in mm, dial, heart rate, gsr and marker tracking.

2.5 Revisions

- Updated TRACKER_DISPLAY to enable minimizing to the system tray.

2.6 Revisions

- Added heart rate pulse signal.
- GSR and HR data type changed from float to int.

2.7 Revisions

- Added APOG for filtered FPOG use in Assistive Communication (i.e. Microsoft Eye-Control).

2.8 Revisions

- Changed HR from int to float.
- Added HRIBI to the biometrics data stream.
- Updated TTL1 to contain 6 digital states in one data record
- Added TTL_WRITE to enable digital write on the TTL port
- Added keyboard keystroke tracking