Request #:	HUTRR74
Title:	Creation of an Eye Tracker Usage Page
Spec Release:	1.12
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Required Voter:	Tobii
Required Voter:	EyeTech DS
Required Voter:	Intel
Required Voter:	Microsoft

Summary:

This request is to establish a new Usage Page for eye trackers and head trackers for desktop interaction. Currently these trackers are controllers using proprietary interfaces. This document proposes to standardize interfaces to these devices.

Background:

An eye tracker is a device designed to measure gaze point and eye position. When calibrated against a display device, an eye tracker is capable of returning coordinates on the screen the user is looking at. Using these coordinates it is possible to define mechanisms to interact with applications using eyes.

A head tracker performs a similar role, except it tracks the orientation of the head against the calibrated screen and returns the corresponding coordinate. An eye tracker may be capable of tracking both head and eyes.

This proposal aims to specify eye and head tracking for general application interaction. The Proposal defines a page with facilities to discover, control and read data from eye trackers and head trackers mounted on the monitor (also referred to as remote trackers). The trackers definition will be contained within an Application Collection(CA).

In order to protect end-user privacy, the proposed standardized eye tracking CA should only be used for interactive use cases. This means that a host that implements this interface must not transfer gaze point data to any other device, nor store gaze point data for later transfer to any other device. This applies both to raw gaze point data, as well as any aggregate of this.

Proposal:

Add the following to Table 1: Usage Page Summary:

Page ID = 0x12
Page Name = Eye and Head Trackers
Section or Document = (next available per technical editor)

Edit the appropriate Reserved range in Table 1 in which the Page 0x12 ID lies to not include Page 0x12

Create a new section for the Eye and Head Tracker page, with usage table and add the following to it. Section and table numbering are at technical editor discretion

Table (x): Eye and Head Tracking Page

Usage ID	Name	Type	Section
0x0000	Reserved		
0x0001	Eye Tracker	CA	
0x0002	Head Tracker	CA	
0x0003-0x000F	Reserved		
0x0010	Tracking Data	CP	
0x0011	Capabilities	CL	
0x0012	Configuration	CL	
0x0013	Status	CL	
0x0014	Control	CL	
0x0015-0x001F	Reserved		
0x0020	Sensor Timestamp	DV	
0x0021	Position X	DV	
0x0022	Position Y	DV	
0x0023	Position Z	DV	
0x0024	Gaze Point	CP	
0x0025	Left Eye Position	CP	
0x0026	Right Eye Position	CP	
0x0027	Head Position	CP	
0x0028	Head Direction Point	CP	
0x0029	Rotation about X axis	DV	
0x002A	Rotation about Y axis	DV	
0x002B	Rotation about Z axis	DV	
0x002C-0x00FF	Reserved		
0x0100	Tracker Quality	SV	
0x0101	Minimum Tracking Distance	SV	
0x0102	Optimum Tracking Distance	SV	
0x0103	Maximum Tracking Distance	SV	
0x0104	Maximum Screen Plane Width	SV	
0x0105	Maximum Screen Plane Height	SV	
0x0106-0x01FF	Reserved		
0x0200	Display Manufacturer ID	SV	
0x0201	Display Product ID	SV	
0x0202	Display Serial Number	SV	
0x0203	Display Manufacturer Date	SV	
0x0204	Calibrated Screen Width	SV	

0x0205	Calibrated Screen Height	SV	
0x0206 – 0x02FF	Reserved		
0x0300	Sampling Frequency	DV	
0x0301	Configuration Status	DV	
0x0302 – 0x03FF	Reserved		
0X0400	Device Mode Request	DV	
0x0401 – 0xFFFF	Reserved		

Add to a new description section (per technical editor) after the Usage Page table with the following text:

Usage Definitions

Timestamp

Sensor Timestamp	DV	0x0020	Sensor timestamp of the applicable physical collection

Sensor timestamp is a 64–bit integer. Since HID does not support 64–bit values natively and supports only signed 32–bit integers, this field is represented as an 8–byte blob.

Default units are microseconds.

Gaze Point, Eye Position, Head Direction Point and Head Position

Position X	DV	0x0021	X coordinate of the applicable physical collection
Position Y	DV	0x0022	Y coordinate of the applicable physical collection
Position Z	DV	0x0023	Z coordinate of the applicable physical collection
Gaze Point	CP	0x0024	The location on the display the user is looking at
Left Eye Position	CP	0x0025	The center of eyeball position of the left eye in 3D space relative to the defined eye position origin.
Right Eye Position	CP	0x0026	The center of eye ball position of the right eye in 3D space relative to the defined eye position origin.
Head Position	CP	0x0027	The position and rotation of the head relative to the defined head position origin
Head Direction Point	CP	0x0028	The location on the display the user is pointing his face to
Rotation X	DV	0x0029	Rotation about the X axis of the applicable physical collection
Rotation Y	DV	0x002A	Rotation about the Y axis of the applicable physical collection
Rotation Z	DV	0x002B	Rotation about the Z axis of the applicable physical collection

Gaze Point is a physical collection that contains the [X, Y] coordinates on the screen where the user is gazing. Head Direction Point is a physical collection that contains the [X, Y] coordinates on the screen where the vector, originating from the [X, Y, Z] Head Position coordinates while being orthogonal to the users face, intersects with the screen. Eye Position and Head Position are physical collections that contain the [X, Y, Z] coordinates of the eye or head with respect to the screen. The [X, Y, Z] coordinates of the head is the mid point on a straight line between the users eyes. The head position collection also includes the orientation of the head, thus extending the physical collection with [Rx, Ry, Rz] in extrinsic Euler angles, applied in Rx, Ry, Rz order.

An eye tracker reports eye position and eye gaze point, and a head tracker reports the head direction point and head position. Default units are in micrometers for distances, and radians with five decimals for rotations.

The origin of the coordinate system sits in the top left corner of the screen, x values increases in the right direction, y values increases downwards, and z values increases when moving outwards from the display facing the user.

Capabilities Collection

This collection contains the capabilities of the sensor.

Tracker Quality

Tracker Quality	SV	0x0100	This field provides guidance regarding the quality of the tracker. It is an enumeration whose values are described below.

Tracking quality is defined in two levels based on their suitability for various general use cases.

The columns in the following table represents the values that a tracker will report for each quality level, and the expectations from that level. An eye tracker needs to report a quality level to be usable, and head tracker does not require a specific quality level and should set the quality level to N/A.

Eye Tracker Quality Level	Value
N/A	0
Fine gaze	1

All other values are reserved for future use.

The definitions of the quality level for eye tracking are:

Fine gaze: At least 95% of the Population has an Average Accuracy of < 2°.

Average Accuracy is defined as the average Accuracy over a Screen under Normal Conditions. If more than two of the twelve measurement points are non valid, the average accuracy is defined to be “Infinity”.

Population is defined as:
A user group of at least 600 participants, distribution as follows:
Ages: 10–60, uniformly distributed.
Gender: uniformly distributed.
Eye color: light and dark, at least 40% of each category.
Makeup: yes/no. At least 25% in each category.
Sight correction: None, glasses (at least 20%), lenses (at least 5%).
Glasses: Shall be uniformly distributed across nearsighted/farsighted. Diopters uniformly distributed at least up to +/-5.

Normal Conditions are defined as: Measured at 200–500 lux, user calibrated close to center of tracked volume, and where testing is done at a user position moved 10 cm from the calibrated position in a randomized direction (in X Y Z).

Screen. The screen is divided in a 4 by 3 grid, with one measurement point randomized in each of the 12 areas. Screen dimensions must be the largest screen size supported by the tracker at the specified quality level. The screen background color during calibration must be grey and during testing it must be black or white, selected randomly for each participant (at least 40% of each).

Accuracy is defined as offset between (1) measurement point and (2) average of all collected gaze data over 1000ms. It must be at least one collected gaze data for the measurement point to be considered valid.

Tracking Distance

These three fields with define the working distance of the eye or head tracker.

Minimum Tracking Distance	SV	0x0101	A read-only field specifying the least distance from the sensor that the sensor can accurately track the user
Optimum Tracking Distance	SV	0x0102	A read-only field specifying the distance at which the sensor gives the most accurate tracking data
Maximum Tracking Distance	SV	0x0103	A read-only field specifying the maximum distance, beyond which the sensor cannot track the user

Default units are in micrometers.

Maximum Screen Plane [Width, Height]

Max Screen Plane Width	SV	0x0104	A read-only field specifying the width of the largest surface that can be tracked at the optimal distance from the sensor
Max Screen Plane Height	SV	0x0105	A read-only field specifying the height of the largest surface that can be tracked at the optimal distance from the sensor

Default units are in micrometers.

These two values specify the surface area within which the tracker can perform accurate tracking. These two values may define a surface larger than that of the current calibrated screen, thus indicating that the tracker can recognize gaze coordinates outside of the monitor. The tracker may also return data for gaze point outside this range. But the values outside of this range are likely to be less accurate.

Configuration Collection

This collection returns the EDID Information of the calibrated monitor. First four usages in this collection correspond to the layout of the Display Product Identification of the EDID[1]. The next two usages contain the width and height of the calibrated display.

Display Manufacturer ID	SV	0x0200	The manufacturer ID of the calibrated display. This is two bytes in size. It is the manufacturer's 3-letter EISA PNP ID, currently managed and assigned by UEFI.org. The encoding of the three-letter ID is the same as in the EDID header version 1.3.
Display Product ID Code	SV	0x0201	This is a two-byte value that contains the Product ID code of the calibrated display
Display serial Number	SV	0x0202	A four-byte value that has the serial number of the display
Display Manufacturer Date	SV	0x0203	A two-byte value that contains the manufacturer assigned date for the display. The lower order byte contains the week of manufacture, and the higher order byte contains the year of manufacture, less 1990 for years from 1990-2245. If week=255, it is the model year instead.
Calibrated Display Width	SV	0x0204	Width of the calibrated display in physical units. Default units are micrometers.
Calibrated Display Height	SV	0x0205	Height of the calibrated display in physical units. Default units are micrometers.

[1] VESA Enhanced EDID Standard (PDF), Video Electronics Standards Association, 2000-02-09, p. 32, retrieved 2011-11-19

The monitor information identifies the calibrated display in case of multimonitor scenarios. The width and height are used to scale the returned tracking data coordinates to logical pixels for application consumption. The data in this collection needs to be re-queried whenever the configuration status changes.

Status Collection

This collection contains the current status of the device.

Sensor Sampling Frequency

Sensor Sampling Frequency	DV	0x0300	An integer that specifies the current sampling frequency of the sensor. Default units are Hz.

Configuration Status

Configuration Status	DV	0x0301	An enumeration specifying the configuration status of the device.

Possible values are:

Name	Description	Value
Reserved		0
Ready	The device is configured and ready for use	1
Configuring	The device is undergoing configuration	2
Screen Setup Needed	Screen plane setup has not been performed on the device.	3
User Calibration Needed	The user needs to perform a calibration to make the device usable	4

When the configuration status changes, the device should send an input report notifying the OS.

All other values are reserved for future use.

Control Collection

This collection contains ways to control the device. The allowed operations are to activate or inactivate disable gaze point, eye position or head position measurements.

Device Mode Request

Device Mode Request	DV	0x0400	This is an enumeration specifying the requested mode for the tracker.

Possible values for the mode request are:

Name	Description	Value
Enable Gaze Point	Request device to provide gaze point data	1
Enable Eye Position	Request device to provide eye position data	2
Enable Head Position	Request device to provide head position data	4

All other bitfields are reserved for future use.

Sample Report Descriptor – Eye Tracker

```
Usage Page (12h),                           ; 12h, reserved
Usage (01h),
Collection (Application),
    Usage (10h),
    Collection (Logical),
        Report ID (1),
        Logical Minimum (0),
        Logical Maximum (255),
        Report Size (8),
        Report Count (7),
        Input (Constant, Variable),
        Usage (20h),
        Unit (Seconds),
        Unit Exponent (10),
        Report Count (8),
        Input (Variable),
        Report Count (1),
        Report Size (32),
        Unit (Centimeter),
        Unit Exponent (12),
        Logical Minimum (-2000000),
        Logical Maximum (2000000),
        Usage (24h),
        Collection (Physical),
            Report Count (2),
            Usage (21h),
            Usage (22h),
            Input (Constant, Variable),
        End Collection,
        Usage (25h),
        Collection (Physical),
            Report Count (3),
            Usage (21h),
            Usage (22h),
            Usage (23h),
            Input (Constant, Variable),
        End Collection,
        Usage (26h),
        Collection (Physical),
            Usage (21h),
            Usage (22h),
            Usage (23h),
            Input (Constant, Variable),
        End Collection,
    End Collection,
    Usage (11h),
    Collection (Logical),
        Report ID (2),
        Report Size (8),
        Report Count (1),
```

```
    Usage (0100h),
    Logical Minimum (0),
    Logical Maximum (1),
    Unit (None),
    Unit Exponent (0),
    Feature (Constant, Variable),
    Report Count (1),
    Report Size (16),
    Logical Maximum (65535),
    Feature (Constant, Variable),
    Collection (Physical),
        Report Count (5),
        Report Size (32),
        Logical Minimum (-2000000),
        Logical Maximum (2000000),
        Unit (Centimeter),
        Unit Exponent (12),
        Usage (0101h),
        Usage (0102h),
        Usage (0103h),
        Usage (0104h),
        Usage (0105h),
        Feature (Constant, Variable),
    End Collection,
End Collection,
Usage (12h),
Collection (Logical),
    Report ID (3),
    Report Size (8),
    Logical Minimum (0),
    Logical Maximum (255),
    Report Count (1),
    Feature (Constant, Variable),
    Report Size (16),
    Logical Maximum (65535),
    Unit (None),
    Unit Exponent (0),
    Usage (0200h),
    Feature (Constant, Variable),
    Usage (0201h),
    Feature (Constant, Variable),
    Report Size (32),
    Logical Maximum (2147483647),
    Usage (0202h),
    Feature (Constant, Variable),
    Report Size (16),
    Logical Maximum (65535),
    Usage (0203h),
    Feature (Constant, Variable),
    Collection (Physical),
        Unit (Centimeter),
        Unit Exponent (12),
```

```
            Logical Maximum (2147483647),
            Report Size (32),
            Usage (0204h),
            Feature (Constant, Variable),
            Usage (0205h),
            Feature (Constant, Variable),
        End Collection,
    End Collection,
    Usage (13h),
    Collection (Logical),
        Report ID (4),
        Report Size (8),
        Unit (None),
        Unit Exponent (0),
        Logical Maximum (4),
        Usage (0301h),
        Feature (Variable),
        Report Size (16),
        Logical Maximum (65535),
        Unit (Seconds^-1),
        Unit Exponent (0),
        Usage (0300h),
        Feature (Variable),
    End Collection,
    Usage (13h),
    Collection (Logical),
        Report ID (4),
        Report Size (8),
        Logical Maximum (4),
        Usage (0301h),
        Input (Variable),
        Report Size (16),
        Logical Maximum (65535),
        Unit (Seconds^-1),
        Unit Exponent (0),
        Usage (0300h),
        Input (Variable),
    End Collection,
    Usage (14h),
    Collection (Logical),
        Report ID (5),
        Report Size (8),
        Logical Maximum (7),
        Unit (None),
        Unit Exponent (0),
        Usage (0400h),
        Feature (Variable),
    End Collection,
End Collection
```

Response:

<Added by HID Chair upon closing the Request>

Notes on Approval Procedure:

HID WG On Line Voting Procedures
1. Votes are on a per company basis.

2. Each Review Request shall have attached a Required Voter List that is the result of recruiting by the HID Chair and submitter of members of the USB IF. Required Voter List must include the HID Chair plus 2 companies (other than the submitter) plus any others designated by the HID Chair at the Chair's discretion. The Required Voter List ensures that a quorum is available to approve the Request.

3. Impose a 7-calendar-day posting time limit for new Review Requests. HID Chair or designate must post the RR within 7 calendar days. HID Chair or designate must work with the submitter to make sure the request is valid prior to posting. Valid review request must include all fields marked as required in the template. A new template will be adopted that requires at least the following fields: Change Text, Required Voter List, Review Period End Date and Voting End Date, Submittal Date, Submitter, Review Request Title and RR Number.

4. If a RR approval process stalls, the HID Chair may call a face-to-face meeting or conference call to decide the issue. Submitter may request that this take place.

5. Impose a minimum 15-calendar-day review period on a posted RR prior to the voting period. At HID Chair discretion, changes to the RR may require this review period to restart.

6. The Chair will accept votes via documentable means such as mail or e-mail during the 7 calendar days after the close of the review period. If a Required Voter does not vote during the period, then there is no quorum and the Chair may pursue the absent required voter and extend the voting period. The Chair may designate a substitute for the absent voter and extend the voting period if necessary.