

Request #: **HUTRR93**
Title: Gesture Sensors
Spec Release: 1.12
Received Date:
Requester: Matthew Williams
Company: Microsoft

Pages Affected: Sensors (0x20)
Values checked: By chair (Matthew Williams)

Current Status: Approved
Priority: Normal

Required Voter: Wacom
Required Voter: Intel
Required Voter: Apple

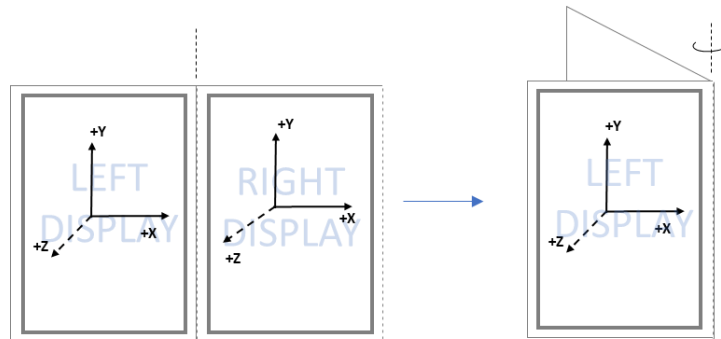
Voting Begins: 14th April 2020
Voting Ends: 21st April 2020
Voting Result: 3-0-0 (Yes/No/Abstain)

Gesture Sensors

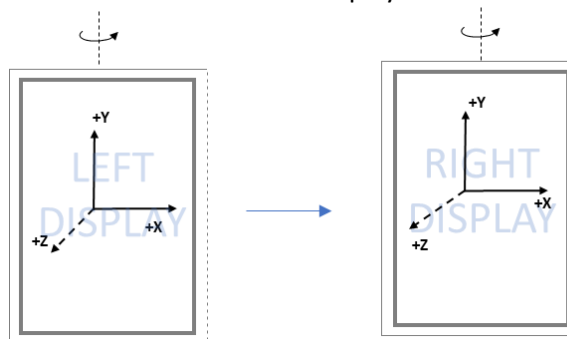
1. Background

Foldable form factors with dual displays allows the user to transition to experiences where only one of the two sides are active. When this happens, the operating system must leave only one of the two displays powered on. Sensors integrated on both sides of the system can be used to provides hints about which display is going to be inactive. This involves detecting gestures shown below:

- User folds panels all the way back. Sensors on both sides can be used to detect this gesture and report panels that contributes to such a gesture. Operating systems can use this gesture as a hint along with other heuristics to determine which display is going to inactive.



- User flips the device around to interact with the other display. Sensors on the system can be used to detect this gesture and report it to the host. Operating systems can use this gesture as a hint along with other heuristics to determine state of displays.



Instead of detecting these gestures inside the operating system (by consuming raw data), it's much more power efficient to have a low power device attached to the host (typically a microcontroller or on SoC sensor hub) process the sensor data and report these gestures.



This document proposes adding HID usages to expose sensor-based gestures from a HID device. Specifically:

- Usage for a new sensor type to expose a gesture sensor that can detect a **Chassis Flip** gesture.
- Usage for a new sensor type to expose a gesture sensor that can detect a **Hinge Fold** gesture.
- Additional usages are also proposed for exposing data associated with such gestures.

2. Usages

Sensor Device Usages

We propose adding the following usages to mark an application or physical collection as exposing hinge angle or a gesture sensor:

Usage ID	Description
0xD1	<p><i>Gesture: Chassis-Flip-Gesture Sensor</i></p> <p>This usage must be used by a device to mark an application or physical collection as exposing a flip gesture sensor</p> <p>A chassis flip gesture shall be reported when the entire device (inclusive of whole chassis) moves around the axis of the hinge by 180 degrees.</p>  <p>Specifics of this gesture like timing characteristics can change from one system to another. For example, a pocketable device can have different timing specifications for when this gesture should be report and that can be different for devices that are larger.</p>
0xD2	<p><i>Gesture: Hinge-Fold-Gesture Sensor</i></p> <p>This usage must be used by a device to mark an application or physical collection exposing a hinge fold gesture sensor.</p> <p>A hinge fold gesture shall be reported when one or both panels attached by a hinge moves at least 90 degrees with respect to each other about the axis of the hinge.</p>  <p>Specifics of this gesture can change from one system to another. For example, a pocketable device can have different timing specifications for when this gesture should be reported and that can be different for form factors that are bigger.</p> <p>There is no limit on speed of this movement as that can vary from one kind of system to another.</p>

Sensor data field usages: Gesture state

Chassis-Flip/Hinge-Fold Gesture sensors will use the following named array in its input report to notify the host about state of a gesture:

Usage ID	Description
0x05F1	<p>Property exposes gestures from the device. This is a named array that lists the following values:</p> <ul style="list-style-type: none">• Sel - 0x09A0 – Gesture state is unknown• Sel - 0x09A1 – Detected that the gesture has started• Sel - 0x09A2 – Detected that the gesture has completed• Sel - 0x09A3 – Detected that the gesture has been cancelled

Note: For the simple gestures in this document there may not be a need to report states other than completed.

Sensor data field usages: Hinge-Fold-Gesture state

Hinge-Fold-Gesture sensors will report the following additional fields in its input report:

Usage ID	Description
0x05F2	Indicates the initial value of the hinge angle when the gesture started.
0x05F3	Indicates the final value of the hinge angle when the gesture ended
0x5F4	Named array to indicate the panel that contributed to the fold gesture <ul style="list-style-type: none">• Sel – 0x09B0 – Unknown• Sel - 0x09B1 – Panel One contributed most to the fold gesture• Sel - 0x09B2 – Panel Two Contributed most to the fold gesture• Sel - 0x09B3 – Both the panels contributed to the fold gesture
0x05F5	Named array to indicate whether the fold gesture was due to the hinge angle increasing or decreasing (opening or closing of the hinge) <ul style="list-style-type: none">• Sel – 0x09B4 – Unknown• Sel - 0x09B5 – Hinge fold due to increasing angle (opening)• Sel - 0x09B6 – Hinge fold due to decreasing angle (closing)

2.1. Updates

Add the following to section 1.1. in page 23

Gestures: Chassis Flip Gesture Sensor	CA, CP – An application-level or physical collection that identifies a sensor that can detect chassis flip gesture of a system.
Gestures: Hinge Fold Gesture Sensor	CA, CP – An application-level or physical collection that identifies a sensor that can detect a hinge fold gesture

Create a new section “1.1.20” “Gesture sensor field usages” which has the following table

Gesture State	<p>NArY – Indicates the state of the gesture:</p> <ul style="list-style-type: none"> • Sel – Unknown • Sel – Started • Sel – Completed • Sel – Cancelled
Hinge Fold Initial Angle	SV – Indicates the hinge angle when the fold gesture started
Hinge Fold Final Angle	SV – Indicates the hinge angle when the fold gesture is completed
Hinge Fold Type	<p>NArY – Indicates if the fold was because of an increasing or decreasing hinge angle. It can be one of the following values:</p> <ul style="list-style-type: none"> • Sel – Unknown • Sel – Increasing • Sel – Decreasing
Hinge Fold Contributing Panel	<p>NArY – Indicates the panel that contributed to the hinge fold gesture. This can be one of the following values:</p> <ul style="list-style-type: none"> • Sel – Unknown • Sel – Panel1 • Sel – Panel2 • Sel – Both

Update the table in Page 10 with the following values:

	<i>(for Data Fields commonly used with Orientation/Orientation Extended sensors, please look at Usage range 0470 – 048f)</i>		1.13
	<i>(These datafields are used by Gesture sensors)</i>		
D0	Gesture	CA, CP	1.1, 1.20
D1	Gesture: Chassis Flip Gesture	CA, CP	1.1, 1.20
D2	Gesture: Hinge Fold Gesture	CA, CP	1.1, 1.20
D3-DF	Gesture: Reserved		
	<i>(for Datafields commonly used with gesture sensors please look at usage range 0x05d0-0x05d8)</i>		1.1.20
E0	Other	CA, CP	1.1
E1	Other: Custom	CA, CP	1.1,1.16
E2	Other: Generic	CA, CP	1.1,1.17
E3	Other: Generic Enumerator	CA, CP	1.1,1.17
E4-EF	Other: Reserved		
	<i>(for Data Fields commonly used with Custom sensors,</i>		1.16

	<i>please look at Usage range 0540 – 055f)</i>		
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Update the table in Page 17 with the following values:

05A6-05AF	<i>Property: Personal Activity Reserved</i>		
	<i>(These datafields are used by gesture sensors)</i>		
05F0	Data Field: Gesture Sensor	SV	1.1.20
05F1	Data Field: Gesture State	NArY	1.1.20
09A0	Gesture State: Unknown	Sel	1.1.20
09A1	Gesture State: Started	Sel	1.1.20
09A2	Gesture State: Completed	Sel	1.1.20
09A3	Gesture State: Cancelled	Sel	1.1.20
09A4-09AF	Reserved for use as Selection Values		
05F2	Data Field: Hinge Fold Initial Angle	SV	1.1.20
05F3	Data Field: Hinge Fold Final Angle	SV	1.1.20
05F4	Data Field: Hinge Fold Contributing Panel	NArY	1.1.20
09B0	Sel: Unknown	Sel	1.1.20
09B1	Sel: Panel1	Sel	1.1.20
09B2	Sel: Panel2	Sel	1.1.20
09B3	Sel: Both	Sel	1.1.20
05F5	Data Field: Hinge Fold Type	NArY	1.1.20
09B4	Sel: Unknown	Sel	1.1.20
09B5	Sel: Increasing	Sel	1.1.20
09B6	Sel: Decreasing	Sel	1.1.20
05F6-05FF	Data Field: Gesture Sensor Reserved		
	<i>(These Data Fields are commonly used by Generic sensors)</i>		

Add the usages highlighted in red to Section 4.1, page 72

```

// sensor category gesture
#define HID_DRIVER_USAGE_SENSOR_CATEGORY_GESTURE          0x09,0xD0
#define HID_DRIVER_USAGE_SENSOR_TYPE_GESTURE_CHASSIS_FLIP 0x09,0xD1
#define HID_DRIVER_USAGE_SENSOR_TYPE_GESTURE_HINGE_FOLD   0x09,0xD2
//sensor category other
#define HID_DRIVER_USAGE_SENSOR_CATEGORY_OTHER            0x09,0xE0
#define HID_DRIVER_USAGE_SENSOR_TYPE_OTHER_CUSTOM        0x00,0xE1
#define HID_DRIVER_USAGE_SENSOR_TYPE_OTHER_GENERIC       0x09,0xE2
#define HID_DRIVER_USAGE_SENSOR_TYPE_OTHER_GENERIC_ENUMERATOR 0x09,0xE3

```

Add the usages highlighted in red to Section 4.1, page 76

```

// data type sensor gestures
#define HID_USAGE_SENSOR_DATA_GESTURE                    0x0A,0xF0,0x05
#define HID_USAGE_SENSOR_DATA_GESTURE_STATE              0x0A,0xF1,0x05 // NArY
//begin gesture state selectors
#define HID_USAGE_SENSOR_DATA_GESTURE_UNKNOWN            0x0A,0xA0,0x09 // Sel
#define HID_USAGE_SENSOR_DATA_GESTURE_STARTED            0x0A,0xA1,0x09 // Sel
#define HID_USAGE_SENSOR_DATA_GESTURE_COMPLETED          0x0A,0xA2,0x09 // Sel
#define HID_USAGE_SENSOR_DATA_GESTURE_CANCELLED          0x0A,0xA3,0x09 // Sel
//end gesture state selectors
#define HID_USAGE_SENSOR_DATA_GESTURE_HINGE_FOLD_INITIAL_ANGLE 0x0A,0xF2,0x05
#define HID_USAGE_SENSOR_DATA_GESTURE_HINGE_FOLD_FINAL_ANGLE 0x0A,0xF3,0x05
#define HID_USAGE_SENSOR_DATA_GESTURE_HINGE_FOLD_CONTRIBUTING_PANEL 0x0A,0xF4,0x05 //NArY
//begin contributing panel selectors
#define HID_USAGE_SENSOR_DATA_GESTURE_CONTRIBUTING_PANEL_UNKNOWN 0x0A,0xB0,0x09 // Sel

```

```
#define HID_USAGE_SENSOR_DATA_GESTURE_CONTRIBUTING_PANEL_PANEL1 0x0A,0xB1,0x09 // Sel
#define HID_USAGE_SENSOR_DATA_GESTURE_CONTRIBUTING_PANEL_PANEL2 0x0A,0xB2,0x09 // Sel
#define HID_USAGE_SENSOR_DATA_GESTURE_CONTRIBUTING_PANEL_BOTH 0x0A,0xB3,0x09 // Sel
//end contributing panel selectors
#define HID_USAGE_SENSOR_DATA_GESTURE_HINGE_FOLD_TYPE 0x0A,0xF5,0x05 // NArY
//begin fold type selectors
#define HID_USAGE_SENSOR_DATA_GESTURE_FOLD_TYPE_UNKNOWN 0x0A,0xB4,0x09 // Sel
#define HID_USAGE_SENSOR_DATA_GESTURE_FOLD_TYPE_INCREASING 0x0A,0xB5,0x09 // Sel
#define HID_USAGE_SENSOR_DATA_GESTURE_FOLD_TYPE DECREASING 0x0A,0xB6,0x09 // Sel
```


3. Illustrative Examples

3.1. Gesture Sensor - Flip

```
// For reference: Complete HID report descriptor
// Sensor based gesture
const unsigned char report_descriptor[] = {
    HID_USAGE_PAGE_SENSOR,
    HID_USAGE_SENSOR_TYPE_COLLECTION,
    HID_COLLECTION(Application),

    HID_REPORT_ID(1),
    HID_USAGE_PAGE_SENSOR,
    HID_DRIVER_USAGE_SENSOR_TYPE_GESTURE_CHASSIS_FLIP,
    HID_COLLECTION(Physical),

    //feature reports (xmit/receive)
    HID_USAGE_PAGE_SENSOR,
    HID_USAGE_SENSOR_PROPERTY_SENSOR_CONNECTION_TYPE, // NAry
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_8(2),
    HID_REPORT_SIZE(8),
    HID_REPORT_COUNT(1),
    HID_COLLECTION(Logical),
        HID_USAGE_SENSOR_PROPERTY_CONNECTION_TYPE_PC_INTEGRATED,
        HID_USAGE_SENSOR_PROPERTY_CONNECTION_TYPE_PC_ATTACHED,
        HID_USAGE_SENSOR_PROPERTY_CONNECTION_TYPE_PC_EXTERNAL,
    HID_FEATURE(Data_Arr_Abs),
    HID_END_COLLECTION,
    HID_USAGE_SENSOR_PROPERTY_REPORTING_STATE,
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_8(5),
    HID_REPORT_SIZE(8),
    HID_REPORT_COUNT(1),
    HID_COLLECTION(Logical),
        HID_USAGE_SENSOR_PROPERTY_REPORTING_STATE_NO_EVENTS,
        HID_USAGE_SENSOR_PROPERTY_REPORTING_STATE_ALL_EVENTS,
        HID_USAGE_SENSOR_PROPERTY_REPORTING_STATE_NO_EVENTS_WAKE,
        HID_USAGE_SENSOR_PROPERTY_REPORTING_STATE_ALL_EVENTS_WAKE,
    HID_FEATURE(Data_Arr_Abs),
    HID_END_COLLECTION,
    HID_USAGE_SENSOR_PROPERTY_POWER_STATE,
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_8(5),
    HID_REPORT_SIZE(8),
    HID_REPORT_COUNT(1),
    HID_COLLECTION(Logical),
        HID_USAGE_SENSOR_PROPERTY_POWER_STATE_UNDEFINED,
        HID_USAGE_SENSOR_PROPERTY_POWER_STATE_D0_FULL_POWER,
        HID_USAGE_SENSOR_PROPERTY_POWER_STATE_D1_LOW_POWER,
        HID_USAGE_SENSOR_PROPERTY_POWER_STATE_D4_POWER_OFF,
    HID_FEATURE(Data_Arr_Abs),
    HID_END_COLLECTION,
    HID_USAGE_SENSOR_STATE,
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_8(6),
    HID_REPORT_SIZE(8),
    HID_REPORT_COUNT(1),
    HID_COLLECTION(Logical),
        HID_USAGE_SENSOR_STATE_UNKNOWN,
        HID_USAGE_SENSOR_STATE_READY,
        HID_USAGE_SENSOR_STATE_NOT_AVAILABLE,
```

```

        HID_USAGE_SENSOR_STATE_NO_DATA,
        HID_USAGE_SENSOR_STATE_INITIALIZING,
        HID_USAGE_SENSOR_STATE_ACCESS_DENIED,
        HID_USAGE_SENSOR_STATE_ERROR,
    HID_FEATURE(Data_Arr_Abs),
    HID_END_COLLECTION,
    HID_USAGE_SENSOR_PROPERTY_REPORT_INTERVAL,
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_32(0xFF, 0xFF, 0xFF, 0xFF),
    HID_REPORT_SIZE(32),
    HID_REPORT_COUNT(1),
    HID_UNIT_EXPONENT(0),
    HID_FEATURE(Data_Var_Abs),

    //input reports (transmit)
    HID_USAGE_PAGE_SENSOR,
    HID_USAGE_SENSOR_STATE,
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_8(6),
    HID_REPORT_SIZE(8),
    HID_REPORT_COUNT(1),
    HID_COLLECTION(Logical),
        HID_USAGE_SENSOR_STATE_UNKNOWN,
        HID_USAGE_SENSOR_STATE_READY,
        HID_USAGE_SENSOR_STATE_NOT_AVAILABLE,
        HID_USAGE_SENSOR_STATE_NO_DATA,
        HID_USAGE_SENSOR_STATE_INITIALIZING,
        HID_USAGE_SENSOR_STATE_ACCESS_DENIED,
        HID_USAGE_SENSOR_STATE_ERROR,
    HID_INPUT(Data_Arr_Abs),
    HID_END_COLLECTION,
    HID_USAGE_SENSOR_EVENT,
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_8(5),
    HID_REPORT_SIZE(8),
    HID_REPORT_COUNT(1),
    HID_COLLECTION(Logical),
        HID_USAGE_SENSOR_EVENT_UNKNOWN,
        HID_USAGE_SENSOR_EVENT_STATE_CHANGED,
        HID_USAGE_SENSOR_EVENT_PROPERTY_CHANGED,
        HID_USAGE_SENSOR_EVENT_DATA_UPDATED,
        HID_USAGE_SENSOR_EVENT_POLL_RESPONSE,
    HID_INPUT(Data_Arr_Abs),
    HID_END_COLLECTION,
    HID_USAGE_GESTURE_STATE,
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_8(1),
    HID_REPORT_SIZE(8),
    HID_REPORT_COUNT(1),
    HID_COLLECTION(Logical),
        HID_USAGE_SENSOR_DATA_GESTURE_UNKNOWN,
        HID_USAGE_SENSOR_DATA_GESTURE_STARTED,
        HID_USAGE_SENSOR_DATA_GESTURE_COMPLETED,
        HID_USAGE_SENSOR_DATA_GESTURE_CANCELLED,
    HID_INPUT(Data_Arr_Abs),
    HID_END_COLLECTION,

    HID_END_COLLECTION
}

```

3.2 Gesture Sensor - Fold

```
// For reference: Complete HID report descriptor
// Sensor based gesture
const unsigned char report_descriptor[] = {
    HID_USAGE_PAGE_SENSOR,
    HID_USAGE_SENSOR_TYPE_COLLECTION,
    HID_COLLECTION(Application),

    HID_REPORT_ID(1),
    HID_USAGE_PAGE_SENSOR,
    HID_DRIVER_USAGE_SENSOR_TYPE_GESTURE_HINGE_FOLD,
    HID_COLLECTION(Physical),

    //feature reports (xmit/receive)
    HID_USAGE_PAGE_SENSOR,
    HID_USAGE_SENSOR_PROPERTY_SENSOR_CONNECTION_TYPE, // NArY
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_8(2),
    HID_REPORT_SIZE(8),
    HID_REPORT_COUNT(1),
    HID_COLLECTION(Logical),
        HID_USAGE_SENSOR_PROPERTY_CONNECTION_TYPE_PC_INTEGRATED,
        HID_USAGE_SENSOR_PROPERTY_CONNECTION_TYPE_PC_ATTACHED,
        HID_USAGE_SENSOR_PROPERTY_CONNECTION_TYPE_PC_EXTERNAL,
    HID_FEATURE(Data_Arr_Abs),
    HID_END_COLLECTION,
    HID_USAGE_SENSOR_PROPERTY_REPORTING_STATE,
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_8(5),
    HID_REPORT_SIZE(8),
    HID_REPORT_COUNT(1),
    HID_COLLECTION(Logical),
        HID_USAGE_SENSOR_PROPERTY_REPORTING_STATE_NO_EVENTS,
        HID_USAGE_SENSOR_PROPERTY_REPORTING_STATE_ALL_EVENTS,
        HID_USAGE_SENSOR_PROPERTY_REPORTING_STATE_NO_EVENTS_WAKE,
        HID_USAGE_SENSOR_PROPERTY_REPORTING_STATE_ALL_EVENTS_WAKE,
    HID_FEATURE(Data_Arr_Abs),
    HID_END_COLLECTION,
    HID_USAGE_SENSOR_PROPERTY_POWER_STATE,
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_8(5),
    HID_REPORT_SIZE(8),
    HID_REPORT_COUNT(1),
    HID_COLLECTION(Logical),
        HID_USAGE_SENSOR_PROPERTY_POWER_STATE_UNDEFINED,
        HID_USAGE_SENSOR_PROPERTY_POWER_STATE_D0_FULL_POWER,
        HID_USAGE_SENSOR_PROPERTY_POWER_STATE_D1_LOW_POWER,
        HID_USAGE_SENSOR_PROPERTY_POWER_STATE_D4_POWER_OFF,
    HID_FEATURE(Data_Arr_Abs),
    HID_END_COLLECTION,
    HID_USAGE_SENSOR_STATE,
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_8(6),
    HID_REPORT_SIZE(8),
    HID_REPORT_COUNT(1),
    HID_COLLECTION(Logical),
        HID_USAGE_SENSOR_STATE_UNKNOWN,
        HID_USAGE_SENSOR_STATE_READY,
        HID_USAGE_SENSOR_STATE_NOT_AVAILABLE,
        HID_USAGE_SENSOR_STATE_NO_DATA,
```

```

        HID_USAGE_SENSOR_STATE_INITIALIZING,
        HID_USAGE_SENSOR_STATE_ACCESS_DENIED,
        HID_USAGE_SENSOR_STATE_ERROR,
    HID_FEATURE(Data_Arr_Abs),
    HID_END_COLLECTION,
    HID_USAGE_SENSOR_PROPERTY_REPORT_INTERVAL,
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_32(0xFF, 0xFF, 0xFF, 0xFF),
    HID_REPORT_SIZE(32),
    HID_REPORT_COUNT(1),
    HID_UNIT_EXPONENT(0),
    HID_FEATURE(Data_Var_Abs),

//input reports (transmit)
HID_USAGE_PAGE_SENSOR,
HID_USAGE_SENSOR_STATE,
HID_LOGICAL_MIN_8(0),
HID_LOGICAL_MAX_8(6),
HID_REPORT_SIZE(8),
HID_REPORT_COUNT(1),
HID_COLLECTION(Logical),
    HID_USAGE_SENSOR_STATE_UNKNOWN,
    HID_USAGE_SENSOR_STATE_READY,
    HID_USAGE_SENSOR_STATE_NOT_AVAILABLE,
    HID_USAGE_SENSOR_STATE_NO_DATA,
    HID_USAGE_SENSOR_STATE_INITIALIZING,
    HID_USAGE_SENSOR_STATE_ACCESS_DENIED,
    HID_USAGE_SENSOR_STATE_ERROR,
    HID_INPUT(Data_Arr_Abs),
    HID_END_COLLECTION,
    HID_USAGE_SENSOR_EVENT,
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_8(5),
    HID_REPORT_SIZE(8),
    HID_REPORT_COUNT(1),
    HID_COLLECTION(Logical),
        HID_USAGE_SENSOR_EVENT_UNKNOWN,
        HID_USAGE_SENSOR_EVENT_STATE_CHANGED,
        HID_USAGE_SENSOR_EVENT_PROPERTY_CHANGED,
        HID_USAGE_SENSOR_EVENT_DATA_UPDATED,
        HID_USAGE_SENSOR_EVENT_POLL_RESPONSE,
    HID_INPUT(Data_Arr_Abs),
    HID_END_COLLECTION,
    HID_USAGE_GESTURE_TYPE,
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_8(1),
    HID_REPORT_SIZE(8),
    HID_REPORT_COUNT(1),
    HID_END_COLLECTION,
    HID_USAGE_GESTURE_STATE,
    HID_LOGICAL_MIN_8(0),
    HID_LOGICAL_MAX_8(1),
    HID_REPORT_SIZE(8),
    HID_REPORT_COUNT(1),
    HID_COLLECTION(Logical),
        HID_USAGE_SENSOR_DATA_GESTURE_UNKNOWN,
        HID_USAGE_SENSOR_DATA_GESTURE_STARTED,
        HID_USAGE_SENSOR_DATA_GESTURE_COMPLETED,
        HID_USAGE_SENSOR_DATA_GESTURE_CANCELLED,
    HID_INPUT(Data_Arr_Abs),
    HID_END_COLLECTION,

```

```
HID_USAGE_SENSOR_DATA_GESTURE_HINGE_FOLD_INITIAL_ANGLE,  
HID_LOGICAL_MIN_8(0),  
HID_LOGICAL_MAX_32(0xFF, 0xFF, 0xFF, 0xFF),  
HID_REPORT_SIZE(32),  
HID_REPORT_COUNT(1),  
HID_UNIT_EXPONENT(0x0),  
HID_INPUT(Data_Var_Abs),  
HID_USAGE_SENSOR_DATA_GESTURE_HINGE_FOLD_FINAL_ANGLE,  
HID_LOGICAL_MIN_8(0),  
HID_LOGICAL_MAX_32(0xFF, 0xFF, 0xFF, 0xFF),  
HID_REPORT_SIZE(32),  
HID_REPORT_COUNT(1),  
HID_UNIT_EXPONENT(0x0),  
HID_INPUT(Data_Var_Abs),  
HID_USAGE_SENSOR_DATA_GESTURE_HINGE_FOLD_CONTRIBUTING_PANEL,  
HID_LOGICAL_MIN_8(0),  
HID_LOGICAL_MAX_8(1),  
HID_REPORT_SIZE(8),  
HID_REPORT_COUNT(1),  
HID_COLLECTION(Logical),  
    HID_USAGE_SENSOR_DATA_GESTURE_CONTRIBUTING_PANEL_UNKNOWN,  
    HID_USAGE_SENSOR_DATA_GESTURE_CONTRIBUTING_PANEL_PANEL1,  
    HID_USAGE_SENSOR_DATA_GESTURE_CONTRIBUTING_PANEL_PANEL2,  
    HID_USAGE_SENSOR_DATA_GESTURE_CONTRIBUTING_PANEL_BOTH,  
HID_INPUT(Data_Arr_Abs),  
HID_USAGE_SENSOR_DATA_GESTURE_HINGE_FOLD_TYPE,  
HID_LOGICAL_MIN_8(0),  
HID_LOGICAL_MAX_8(1),  
HID_REPORT_SIZE(8),  
HID_REPORT_COUNT(1),  
HID_COLLECTION(Logical),  
    HID_USAGE_SENSOR_DATA_GESTURE_FOLD_TYPE_UNKNOWN,  
    HID_USAGE_SENSOR_DATA_GESTURE_FOLD_TYPE_INCREASING,  
    HID_USAGE_SENSOR_DATA_GESTURE_FOLD_TYPE_DECREASING,  
HID_INPUT(Data_Arr_Abs),  
HID_END_COLLECTION,
```

```
HID_END_COLLECTION
```

```
}
```