EPSON
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MOVERIO
BT-300

Developer's Guide

SEIKO EPSON CORPORATION

Revision history

Revision	Item	Revised contents
R1.0	-	-
R1.1	1.2	Added precaution for creating App for BT-300
	2.5.1	Deleted description of unnecessary setting items for gradle
	3.4.2	Added「Comparison with mute knock function」
	5.1	Added frame rate and precaution for camera release process

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— Contents —

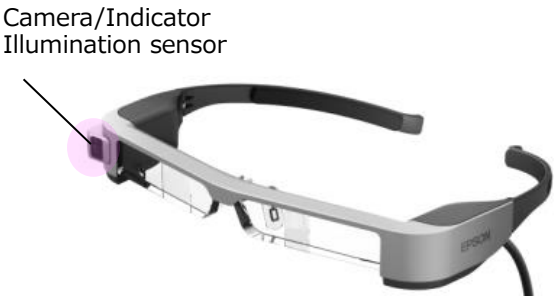
1. Introduction

1.1. Summary

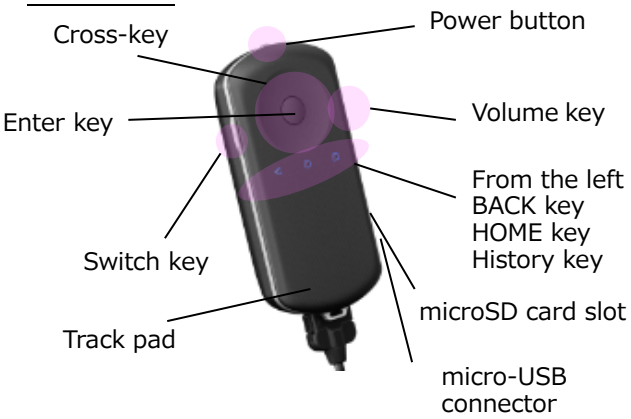
This document explains the technical information necessary to use devices for developing apps for the Moverio BT-300.

Product Appearance and Hardware Configuration

Headset



Controller



1.2. Main System Specifications

Item		Specifications
System	Processor	Intel Cherry Trail, Atom x5, Quad core, 1.44 GHz
	Architecture	x86 (ABI 32-bit)
	Software	Android 5.1 API Level 22
Memory	RAM	2 GB
	Internal storage	16GB
RF	Wi-Fi	IEEE 802.11a/b/g/n/ac, Wi-Fi Direct
		Wi-Fi Miracast Sink/Source w/UIBC
	Bluetooth	Bluetooth 4.1 (Bluetooth Smart Ready certified)
Display	Resolution	1280RGB x720
	Color reproduction	24 bit color
	Screen density	mdpi
	Screen orientation	Fixed at Landscape
Codec	Still image format	BMP, JPEG, PNG, GIF
	Movie format	MP4, VP8
	Audio format	WAV, MP3, AAC
External I/F	USB Type	Micro USB Type-B, USB 2.0 (host/device)
	Vendor ID	0x17EF
	SD card	microSD, microSDHC (MAX 32 GB)
UI	Track pad	Multi-touch supported
	Buttons	Power button, HOME key, BACK key, History key, Volume key, Switch key
	Vibrations	Available
Audio I/O	Output	Stereo earphones
	Input	Microphone
Sensor	Headset	9-axis, ALS
	Controller	9-axis
Camera	Resolution	5 M pixels
GPS		Available

- The basic functions are based on Android.

- Except for when using Wi-Fi or Bluetooth, data communication or telephone calls on 3G and so on are not supported.
- Since Google authentication has not been acquired, you cannot use services that require Google authentication. Example: Positional information services in Google Play and Google

- Model specification information

The following shows the main information items that you can acquire that are specific to the model. Depending on the model, you can use this information to distinguish between models.

Table 1-1 Main Items for Android.os.Build

Item	Contents
MANUFACTURER	EPSON
MODEL	EMBT3C
PRODUCT	embt3c
BRAND	MOVERIO

- Precaution for creating App for BT-300

This product uses a Si-OLED（Organic EL Pane）for display panel. Due to the general characteristic of the Si-OLED, you may notice burn-in or decreasing luminance on the panel. To reduce the burn-in, please note the following points to create Apps.

- Have screen transition that the same screen does not display for long time
- Avoid using high brightness color scheme for character display, marker display and object display that always display at same position
- Countermeasure using sleep function or implementing screen saver process into the App to avoid no operation state for long time

1.3. Functions of SDK

By using the Epson original APIs as well as the standard Android APIs, the BT-300 can use specific functions that are not built-in to the standard Android system.

Table 1-2 Table of each function and which API to use

Function	Contents	Android Standard API	Epson Original API
3. Display Control	Start/end 3D display in side-by-side, adjust the display brightness, full screen display, display mute		✔
4. UI Control	Key code and track pad control	✔	
5. Camera Control	Take still images/movies	✔	
6. Sensor Control	Acquire values for the controller's built-in sensor, and the BT-300 original sensor	✔	✔
7. Bluetooth	Bluetooth profile support	✔	

The following chapters explain how to use these functions from the app.

2. Developing Apps

2.1. Summary of Developing Apps

The BT-300 has adopted Android as the system software. Therefore, you can develop apps for the BT-300 in the same environment as developing apps for Android smartphones. However, when connecting the BT-300 with the app development computer, or when using functions unique to the BT-300, you need to adjust the computer settings so that they are compatible with the BT-300.

This chapter explains the following procedures necessary to develop apps for the BT-300.

- Introduction to the Android SDK
- USB driver settings
- Connecting the BT-300 to a computer
- Including the SDK provided by Epson

2.2. Introduction to the Android SDK

The introduction to the Android SDK assumes the following steps will be performed in a Windows 7 environment.

2.2.1. Acquiring Android Studio

Download Android Studio from the following Website.
https://developer.android.com/studio/index.html

2.2.2. Acquiring and installing JDK

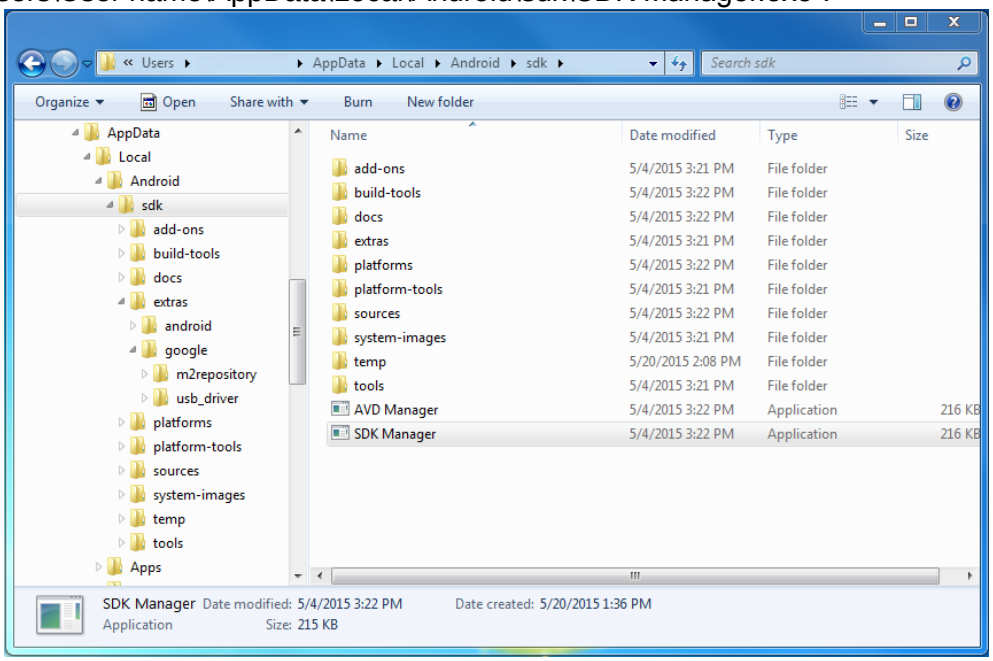
Download the JDK (7 or later) from the following Website, and then install.
http://www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html

2.2.3. Installing Android Studio

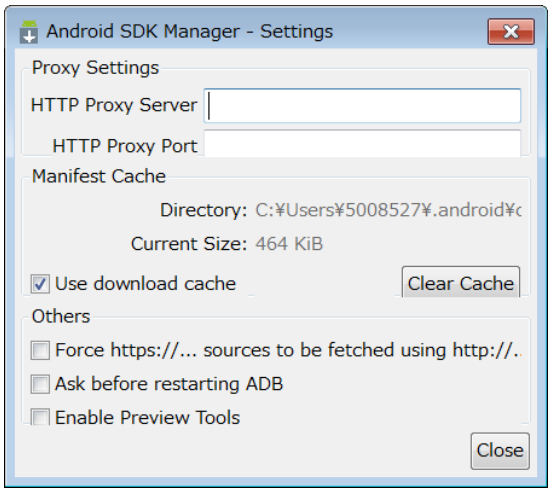
Follow the directions provided by the installer to install Android Studio.
Example) C:\Users\User name\AppData\Local\Android\sdk
* From here on, instructions assume Android Studio is installed in the folder above.

2.2.4. Platform-tools and SDK Platform

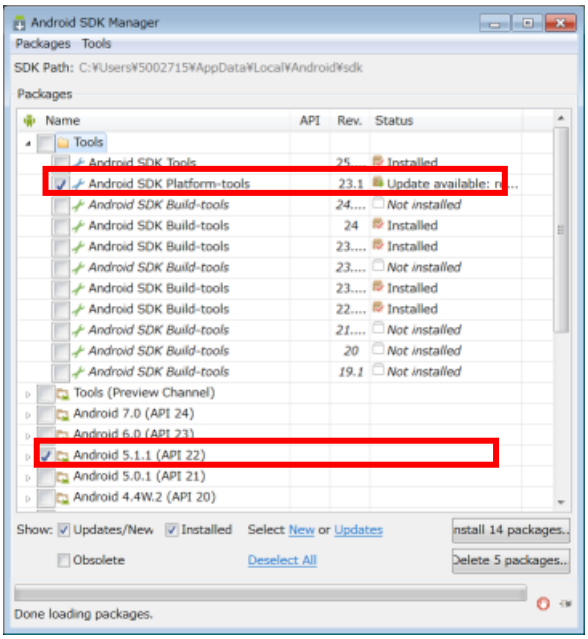
Execute “C:\Users\User name\AppData\Local\Android\sdk\SDK Manager.exe”.



* When you start SDK Manager, the dialog "No packages found" may be displayed.
  This occurs when the proxy is not set correctly, and information cannot be updated.
  Close all dialogs except for "Android SDK Manager", and then set the proxy in [Tools] -[Options].
  If you do not know the Proxy settings, contact your network administrator for details on “Connecting method to external network using Proxy”.

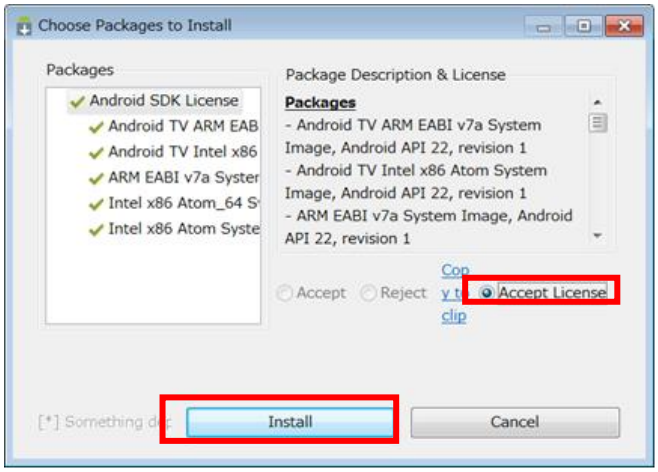


Select the following necessary files in the SDK Manager, and then install.



- [Tools] - [Android SDK Platform-tools]
- [Android 5.1.1] - [SDK Platform]

Select the above, click [Install], and then select “Accept all”.



This completes the introduction to the Android SDK.
Next, we will explain how to connect Moverio to the app development computer, and setup the ADB driver.

2.3. USB driver settings

2.3.1. When Using Windows

Connect Moverio to the app development computer, and setup the USB driver.
Install the USB driver from the following site.
https://software.intel.com/en-us/android/articles/installation-instructions-for-intel-android-usb-driver

2.3.2. When Using Mac OS/Linux

You do not need to install the USB driver.

2.4. Connecting the BT-300 to a computer

This section explains how to connect the BT-300 to a computer after the ADB settings are complete.

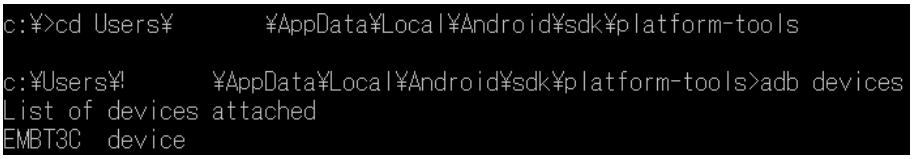
2.4.1. BT-300 settings

- Follow the steps below to enable USB debugging.

1) Tap "Settings" - "About Device" to open the screen.
2) "Developer options" is displayed when you tap "Build number" seven times.
3) Open "Settings" - "Developer options", and then select "USB debugging".

2.4.2. Checking the connection

You can check if the computer and the BT-300 are connected by using the ADB check command.
Start the command prompt, run "cd C:\Users\<User name>\AppData\Local\Android\sdk\platform-tools", and move the folder. * It is useful to maintain the environment variable path mentioned above.
When you execute "adb devices" and the device name is displayed in the list, ADB connection is complete.



* If this is not displayed, reconnect the BT-300 to the USB port, and rerun the "adb devices" command.

2.5. Including the SDK provided by Epson

2.5.1. How to use the SDK provided by Epson

The following procedures assume app development in Android Studios.

1) Display the Project View in Android Studio, and then create a “libs” folder from [File]-[New]-[Directory].

2) C:\Users\<user name>\AndroidStudioProjects\<application name>\app\libs is created; put BT300Ctrl.jar in this folder.
(When the created project folder is C:\Users\<user name>\AndroidStudioProjects)
*Explanations from now on are based on the assumption that the project is at C:\Users\<user name>\AndroidStudioProjects\<application name>.

3) Press the Sync Project with Gradle Files button above Android Studio to apply the Gradle change to the project.

3. Display Control

3.1. Display control summary

The BT-300 is smart glass that features an optical see-through system. You can overlay information on the display using an optical technique that provides clear images, without disturbing the view of the user's surroundings. It is also possible to project more information since the device uses a see-through system allowing images to be projected for both eyes, as opposed to the single image monocular type.

<Summary of functions>

- Full screen display
- Switch between 2D/3D display
- Display brightness control
- Mute control

3.2. Full screen display function

When displaying in full screen, mount using the following method.
Full screen display is available for the BT-300 by using the standard Android functions.
In the BT-200, since full screen display was not available using the standard Android functions, the Epson original API was used.

- Executing full screen in applications
  Execute the following process in onCreate() for each Activity.

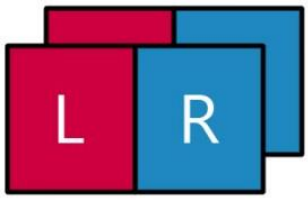
```
View view = this.getWindow().getDecorView();
view.setSystemUiVisibility(View.SYSTEM_UI_FLAG_HIDE_NAVIGATION   |
View.SYSTEM_UI_FLAG_FULLSCREEN | View.SYSTEM_UI_FLAG_IMMERSIVE);
```

* The above is an example only. See the following URL for details.
  https://developer.android.com/training/system-ui/immersive.html

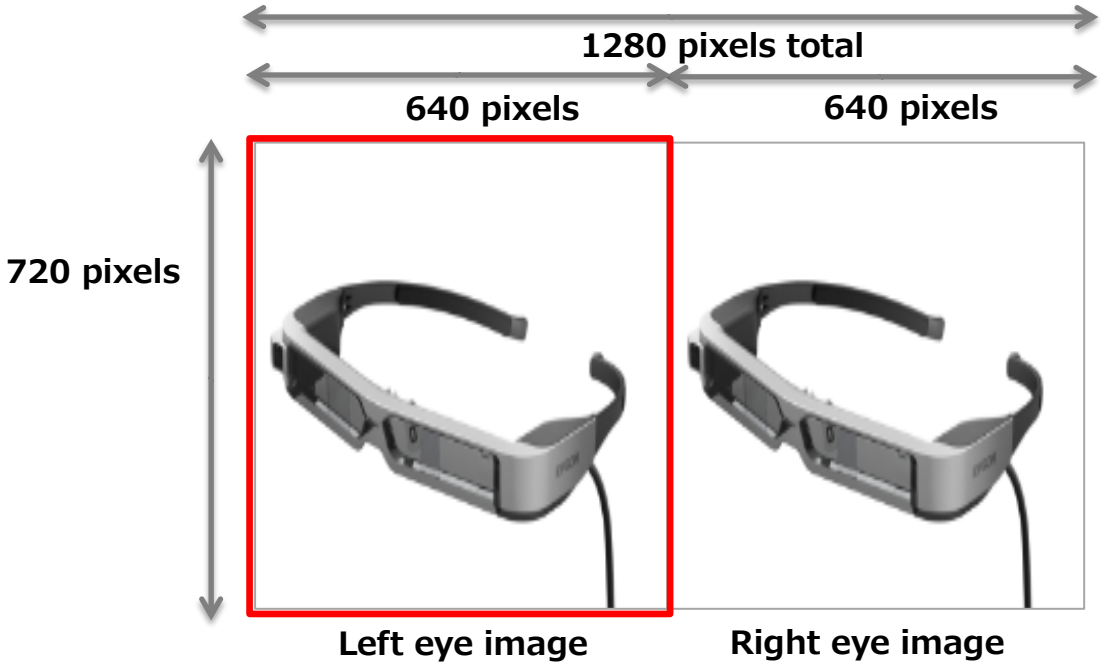
Depending on the method mentioned above, you may be able to hide the action bar and the navigation bar.

3.3. Switch between 2D/3D display

The BT-300 allows you to display 3D content using side by side.
The side by side method places images on the left and right of the screen.



When using the side by side system with an HD size screen, you need to arrange images from left to right by reducing 1280 x 720 by half (640 x 720 pixels) to create one frame of an image.



You can use the following interface to separate images for the left and right eyes in the side by side system, and output each display.

- **Import module**
  com.epson.moverio.btcontrol.DisplayControl
- **Constructor**
  DisplayControl(Context context)
- **Interface**
  - **Switch 2D/3D display**
    int setMode(int DisplayMode, boolean toast)
  - **Parameters**

  DisplayMode: 2D/3Dmode situation
  2D Mode : DisplayControl.DISPLAY_MODE_2D
  3D Mode : DisplayControl. DISPLAY_MODE_3D
  toast : Switch between show/hide for the OSD for 2D/3D
  Show : true
  Hide : false
  - **Return value**
    Execution results: 0 (success), -1 (failure)

  - **Acquire current 2D/3D display setting**
    int getMode()
  - **Parameters**

  None
  - **Return value**
  2D Mode : DisplayControl.DISPLAY_MODE_2D Constant value 0
  3D Mode : DisplayControl. DISPLAY_MODE_3D Constant value 1

3.3.1. Adjust display brightness

When changing the brightness of display built-into the headset, you can change the transparency of the displayed image. When the brightness is low, the image is more transparent, and when the brightness is high, the image is more opaque.

- **Import file**
  com.epson.moverio.btcontrol.DisplayControl
- **Constructor**
  DisplayControl(Context context)
- **Interface**
  - **Display brightness settings**
    int setBacklight(int backlight)
  - **Parameters**
    backlight: Brightness level 0 (dark) to 20 (bright)
  - **Return value**
    Execution results: 0 (success), -1 (failure)

  - **Acquire display brightness**
    int getBacklight()
  - **Parameters**
    None
  - **Return value**
    Current brightness setting (0 to 20)

3.4. Mute function

3.4.1. Display mute

You can use the mute function to temporarily stop displaying images. For example, you can use this to clear your view if you feel there is any possibility of danger in your immediate surroundings.

Use the following interface to activate and then deactivate mute.

- **Import file**
  com.epson.moverio.btcontrol.DisplayControl
- **Constructor**
  DisplayControl(Context context)
- **Interface**
  - **Set mute status**
    int setMute(boolean mute)
    - **Parameters**
      Mute: Mute ON (true)/ OFF (false)
    - **Return value**
      Execution results: 0 (normal value), Others (error)

  - **Acquire the mute status**
    boolean getMute()
    - **Parameters**
      None
    - **Return value**
      Execution results: true (mute ON), false (mute OFF)

3.4.2. Comparison of mute knock function

For similar function, there is a system standard function of BT-300 called mute knock to temporary stop video and sound. Comparisons to display mute using API are shown as below.

Item		Display mute API	Mute knock
How to use		Call DisplayControl#setMute()	By turning "Tap mute" in setting App ON, tap headset twice lightly. To return, perform the following operation Tap headset twice lightly Press either function key, volume key or power button *When auto sleep operate during mute, sleep function have priority and will be in sleep mode. After returning from sleep mode, mute will be cancelled.
Video motion	**When mute**	Display turns off	Display turns off（Same as left column） KEYCODE_MEDIA_PAUSE will be issued from system to AudioManager to pause video play
	When return	Display turns on	Display turns on(Same as left column) KEYCODE_MEDIA_PLAY will be issued from system to AudioManager to restart video play
Sound motion	**When mute**	No Change	KEYCODE_MEDIA_PAUSE will be issued from system to AudioManager to pause music play
	When return	-	KEYCODE_MEDIA_PLAY will be issued from system to AudioManager to restart music play
Remarks		To know current mute situation, call DisplayControl#getMute()	No notification to App for mute knock ON and OFF

3.5. Creating images for the see-through function

MOVERIO is a device that uses projection technology. This system provides the user with an image projected onto a half-mirror via a light-guided panel, creating a half-mirror version (whereby not all the pixels are needed) allowing images to be arranged over a real-life scene giving a sense of transparency, and creating a more vivid augmented reality experience.

To create this transparent background effect, so visual elements (text, graphics...) stand out vividly, the background will need to be set to black when drawing on the projection, so you display the target section overlapping with the actual images.

The following steps allow you to create images making use of the see-through function.

1) Execute full screen display.

To reduce the feeling of being in a screen, remove everything except for the necessary image (status bar and so on).

2) Make the background black.

Make everything black except for the object you want to display ([R,G,B] = [0,0,0]).

In theory, the black section should keep out external light.

4. UI Control

4.1. UI control summary

4.1.1. Hardware button types and functions

The BT-300 comes with the hardware buttons shown in the following figure. The key event for each key is shown in Table 4-1 Key Code List.

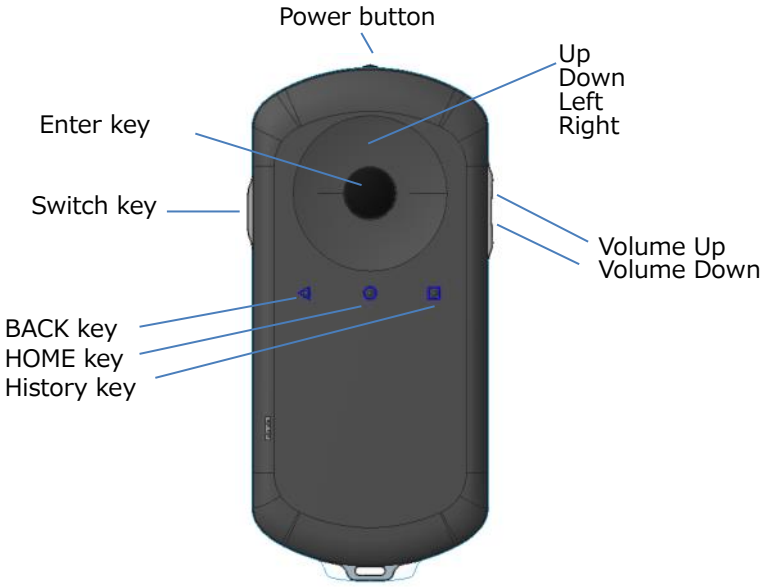


Table 4-1 Key Code List

Name	Key code*	Device type
Power button	(KEYCODE_POWER)	Physical switch
HOME key	(KEYCODE_HOME)	Touch Sensor
BACK key	KEYCODE_BACK	Touch Sensor
History key (Recent key)	(KEYCODE_RECENT)	Touch Sensor
Switch key	(KEYCODE_MULTIFUNCTION)	Physical switch
Volume Up	KEYCODE_VOLUME_UP	Physical switch
Volume Down	KEYCODE_VOLUME_DOWN	Physical switch
Up	KEYCODE_DPAD_UP	Touch Sensor
Down	KEYCODE_DPAD_DOWN	Touch Sensor
Left	KEYCODE_DPAD_LEFT	Touch Sensor
Right	KEYCODE_DPAD_RIGHT	Touch Sensor
Enter key	KEYCODE_DPAD_CENTER	Physical switch

*When there are parenthesis, events are not notified in the app.

4.1.2. Events that can be acquired by the app during track pad operations

The following table indicates whether or not an event occurs for each method when the track pad is operated for relative coordinates mode and absolute coordinates mode.

✔ : Event occurs

Class	Method	Operation	Event
View	onTouchEvent		✔
	dispatchTouchEvent		✔
GestureDetector.OnGestureListener	onDoubleTap		✔
	onDoubleTapEvent		✔
	onSingleTapConfirmed		✔
GestureDetector.OnDoubleTapListener	onDown		✔
	onFling		✔
	onLongPress		✔
	onScroll		✔
	onShowPress		✔
	onSingleTapUp		✔
MotionEvent	getAction	ACTION_UP	✔
		ACTION_DOWN	✔
		ACTION_MOVE	✔
		ACTION_CANCEL	✔
		ACTION_HOVER_ENTER	✔
		ACTION_HOVER_EXIT	✔
		ACTION_HOVER_MOVE	✔
	getToolType	TOOL_TYPE_FINGER	
		TOOL_TYPE_MOUSE	✔
		TOOL_TYPE_STYLUS	
		TOOL_TYPE_UNKNOWN	
	getX		✔
	getY		✔
	getDownTime		✔
	getPointerCount		✔
	getPointerId		✔
	getSize		
	getToolMajor		
	getToolMinor		
	getTouchMajor		
	getTouchMinor		
	getEventTime		✔
	getPressure		

5. Camera Control

5.1. Camera control summary

The BT-300 has a camera built into the headset. As well as standard photography, you can also use it to recognize markers.

5.1.1. Main specifications of the built-in camera

Table 5-1 Main specifications of the built-in camera

Item		Contents
Resolution	Picture size	2560x1920/ 1920x1080/ 1280x720/ 640x480/
	Preview size	1920x1080/ 1280x720/ 640x480/
	Video size	1920x1080/ 1280x720/ 640x480/
Exposure compensation	Maximum, minimum	max: +5, min: -5
White balance		auto/ incandescent/ fluorescent/ warm-fluorescent/ daylight/ cloudy-daylight/ shade/ twilight
Scene mode		auto/ action/ portrait/ night/ / barcode

5.1.2. Externally connected camera

- The BT-300 allows you to connect a UVC 1.0 supported camera to the micro-USB connector.
- The image resolution and frame rate for shooting images depends on the camera being used.
- Note that we cannot guarantee operation for all UVC supported cameras.

5.1.3. Precaution for camera releae process

When camera is open and user press HOME key, App will evacuate to background. Please be sure to do the camera release process in that situation. In details, please write camera release process in onPause method. Especially for external camera, while in the situation of not doing release process, be careful it may not be in right connected situation when detaching.

6. Sensor Control

6.1. Sensor control summary

This section provides a list of the sensors available in the BT-300. You can acquire the values for each sensor in the same way as for a general sensor by using the standard Android API.

When you can not use sensor type, you can also specify the value of sensor ID column directly.

6.1.1. Sensor list

Table 6-1 Sensor list

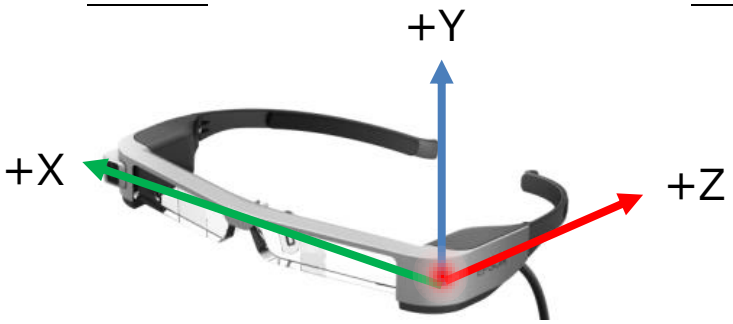
Sensor type	Sensor ID (Hex)	Contents	Built-in location	Android Standard
TYPE_ACCELEROMETER	0x00000001	Accelerometer	Headset	✔
TYPE_MAGNETIC_FIELD	0x00000002	Geomagnetic sensor	Headset	✔
TYPE_ORIENTATION	0x00000003	Azimuth detection	Headset	✔
TYPE_GYROSCOPE	0x00000004	Gyroscope sensor	Headset	✔
TYPE_LIGHT	0x00000005	Illumination sensor	Headset	✔
TYPE_TEMPERATURE	0x00000007	Temperature sensor	Headset	✔
TYPE_GRAVITY	0x00000009	Gravity sensor	Headset	✔
TYPE_LINEAR_ACCELERATION	0x0000000a	Linear acceleration sensor	Headset	✔
TYPE_ROTATION_VECTOR	0x0000000b	Rotation vector sensor	Headset	✔
TYPE_MAGNETIC_FIELD_UNCALIBRATED	0x0000000e	Geomagnetic sensor	Headset	✔
TYPE_HEADSET_TAP	0x00002001	Tap detector	Headset	
TYPE_CONTROLLER_ACCELEROMETER	0x00100001	Accelerometer	Controller	
TYPE_CONTROLLER_MAGNETIC_FIELD	0x00100002	Geomagnetic sensor	Controller	
TYPE_CONTROLLER_GYROSCOPE	0x00100004	Gyroscope sensor	Controller	
TYPE_CONTROLLER_ROTATION_VECTOR	0x0010000b	Rotation vector sensor	Controller	

* You can use the sensors in the headset and the controller at the same time. There is no real limit to the number of sensors that can be used at the same time, but we recommend that the listener only registers necessary sensors to prevent a decline in performance.

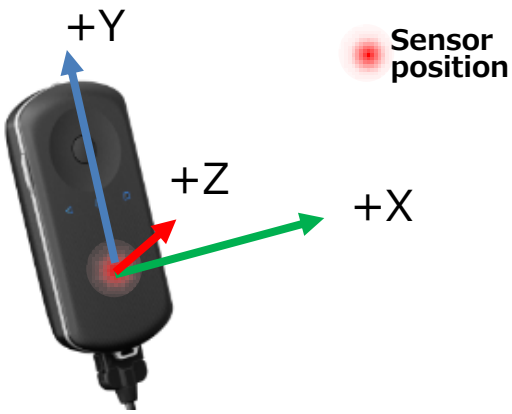
6.1.2. Coordinations axis for each sensor

From the sensors built into the headset and controller, a sensor value is output for each sensor with an X, Y, Z axis according to the coordinate axis shown in the following figure.

Headset



Controller



6.2. Using the sensors

The sensors use the standard Android API, SensorEventListener.

6.2.1. Import module

To use the sensors, import the following modules.

android.hardware.Sensor
android.hardware.SensorEvent
android.hardware.SensorEventListener

6.2.2. Using SensorEventListener

It is necessary to implement SensorEventListener for sensors using Activity or Service.

Example) Implementing SensorEventListener in Activity

```
public class SampleActivity extends Activity implements SensorEventListener
```

6.2.3. Registering sensors being used

When using a sensor, you need to register a sensor listener.

Example) Registering an accelerometer

```
//System sensor service acquisition
SensorManager sm = (SensorManager)getSystemService(SENSOR_SERVICE);
//Registering an accelerometer (TYPE_ACCELEROMETER)
Sensor s = sm.getDefaultSensor(Sensor.TYPE_ACCELEROMETER);
sm.registerListener(this, s, SensorManager.SENSOR_DELAY_NORMAL);
```

6.2.4. Acquiring a sensor value

You can use the sensor value by acquiring a sensor event in onSensorChanged for SensorEventListener.

Example) Acquiring a sensor value for the accelerometer

```
@Override
public void onSensorChanged(SensorEvent event) {
  //Acquiring the accelerometer value (display log)
  if(event.sensor.getType() == Sensor.TYPE_ACCELEROMETER){
    Log.d("Sample","ax="+event.values[0]+",ay="+event.values[1]+",az="+event.values[2]);
  }
}
```

The sensor value that can be received by onSensorChanged differs depending on the sensor type being used. The SensorEvent array element numbers that support each sensor type are shown below.

Table 6-2 Sensor values acquired with Epson original sensor

Sensor type	Unit	SensorEvent Array element numbers	Sensor value
TYPE_HEADSET_TAP	-	0	2: Tap from the left or right
TYPE_CONTROLLER_ACCELEROMETER	m/s^2	0	X axis
		1	Y axis
		2	Z axis
TYPE_CONTROLLER_MAGNETIC_FIELD	rad/s	0	X axis
		1	Y axis
		2	Z axis
TYPE_CONTROLLER_GYROSCOPE	uT	0	X axis
		1	Y axis
		2	Z axis
TYPE_CONTROLLER_ROTATION_VECTOR	-	0	X axis
		1	Y axis
		2	Z axis

* For standard Android sensor types, these values are omitted to conform to the Android standard.

6.3. Sample Code

When using sensor type TYPE_HEADSET_TAP, Toast is displayed in the sample code when a tap is detected.

```
package com.epson.moverio.sample.TapSample;

import android.app.Activity;
import android.hardware.Sensor;
import android.hardware.SensorEvent;
import android.hardware.SensorEventListener;
import android.hardware.SensorManager;
import android.os.Bundle;
import android.widget.Toast;

public class MainActivity extends Activity implements SensorEventListener {
	@Override
	protected void onCreate(Bundle savedInstanceState) {
		super.onCreate(savedInstanceState);
		setContentView(R.layout.activity_main);

		SensorManager sm = (SensorManager)getSystemService(SENSOR_SERVICE);
		Sensor sensor = sm.getDefaultSensor(Sensor.TYPE_HEADSET_TAP);
		sm.registerListener(this, sensor, SensorManager.SENSOR_DELAY_NORMAL);
	}
	@Override
	public void onSensorChanged(SensorEvent event) {
		if(event.sensor.getType() == Sensor.TYPE_HEADSET_TAP){
			//if tap event occurs, show Toast
			Toast.makeText(this, "tap event!", Toast.LENGTH_SHORT).show();
		}
	@Override
	protected void onPause() {
	    super.onPause();
		SensorManager sm = (SensorManager)getSystemService(SENSOR_SERVICE);
		if (sm != null) {
			sm.unregisterListener(this);
		}
	}
	@Override
	public void onAccuracyChanged(Sensor sensor, int accuracy) {
	}
```

7. **Bluetooth**

7.1. Bluetooth summary

7.1.1. Supported specifications

This describes the Bluetooth specifications for the BT-300.

Table 7-1 Bluetooth profile support

Profile	Role
Headset Profile (HSP)	Audio Gateway
Advanced Audio Distribution Profile (A2DP)	Source
Audio/Video Remote Control Profile (AVRCP)	Target
Human Interface Device (HID)	Host
Object Push Profile (OPP)	Client/Server
Personal Area Network (PAN)	NAP/PANU