**Report on “Mobile sensors support in Android platform”**

**Ahmed Ashraf Hamza 20166001**

**Ahmed Osama Gomaa 20156017**

What is sensor?

**Sensor** is a device, module, or subsystem whose purpose is to detect events or changes in its environment and send the information to other electronics, frequently a computer processor. A sensor is always used with other electronics, whether as simple as a light or as complex as a computer.

Sensors in Mobile Devices:

These sensors can provide raw data with high precision and accuracy, and are useful if you want to monitor three-dimensional device movement or positioning, or you want to monitor changes in the ambient environment near a device.

Android sensor framework:

* You can access these sensors and acquire raw sensor data by using the Android sensor framework. The sensor framework is part of the android.hardware package.
* The Android sensor framework provides several methods that make it easy for you to determine at runtime which sensors are on a device. The API also provides methods that let you determine the capabilities of each sensor, such as its maximum range, its resolution, and its power requirements.
* The Android sensor framework lets you access many types of sensors:

|  |  |
| --- | --- |
| Hardware-based | Software-based |
| Physical components built into a handset or tablet device | Not physical devices, although are near hardware-based sensors |
| They derive their data by directly measuring specific environmental properties | Derive their data from one or more of the hardware-based sensors and are sometimes called virtual sensors or synthetic sensors. |
| Acceleration, Geomagnetic field strength, or Angular change | The linear acceleration sensor and the gravity sensor |

Some of Sensor types supported by the Android platform:

Some Classes in these Frameworks:

1. Sensor Manager:

You can use this class to create an instance of the sensor service. This class provides various methods for accessing and listing sensors, registering and unregistering sensor event listeners, and acquiring orientation information. This class also provides several sensor constants that are used to report sensor accuracy, set data acquisition rates, and calibrate sensors.

1. Sensor:

You can use this class to create an instance of a specific sensor. This class provides various methods that let you determine a sensor's capabilities.

1. Sensor Event:

The system uses this class to create a sensor event object, which provides information about a sensor event. A sensor event object includes the following information: the raw sensor data, the type of sensor that generated the event, the accuracy of the data, and the timestamp for the event.

1. Sensor Event Listener:

You can use this interface to create two callback methods that receive notifications (sensor events) when sensor values change or when sensor accuracy changes.

Sensors Availability:

While sensor availability varies from device to device, it can also vary between Android versions. This is because the Android sensors have been introduced over the course of several platform releases. For example, many sensors were introduced in Android 1.5 (API Level 3), but some were not implemented and were not available for use until Android 2.3 (API Level 9).

1-Motion Sensors

Motion sensors are useful for monitoring device movement, such as tilt, shake, rotation, or swing.

Motion sensors by themselves are not typically used to monitor device position, but they can be used with other sensors.

Different Cases:

First Case: a user is steering a car in a game or a user is controlling a ball in a game (In this case: you are monitoring motion relative to the device's frame of reference or your application's frame of reference).

Second Case: moving with you while you drive your car (in this case: you are monitoring motion relative to the world's frame of reference).

Return type of these Sensors

All the motion sensors return multi-dimensional arrays of sensor values for each Sensor Event.

Most Used Motion Sensors

The rotation vector sensor and the gravity sensor are the most frequently used sensors for motion detection and monitoring. The rotational vector sensor is particularly versatile and can be used for a wide range of motion-related tasks, such as detecting gestures, monitoring angular change, and monitoring relative orientation changes.

Some Sensors

|  |  |
| --- | --- |
| Sensors | Desc. |
| Gravity sensor | Used to determine the device's relative orientation in space |
| Linear accelerometer | Representing acceleration along each device axis, excluding gravity. |
| Rotation vector sensor | Represents the orientation of the device as a combination of an angle and an axis |
| Significant motion | Motion that might lead to a change in the user's location; for example walking, biking, or sitting in a moving car. |

2-Position Sensors

\*Useful for determining device's physical position.

\*Hardware-based sensors.

|  |  |  |
| --- | --- | --- |
| Sensor | Description | Example |
| Geomagnetic field sensor | Measures earth's magnetic field Strength (in micro-tesla unit) along 3D coordinator. | BMM150 device (has low power and low noise, used for compass apps). |
| Accelerometers sensor | Are integrated circuits or modules used to measure the acceleration of an object to which they are attached. | Vehicle dynamics image stability, tilt and anti-theft devices. |
| Proximity sensor | How close the face of device to an object. | Use with mobile telephones and tablet computers like: Anti-aircraft warfare and Parking sensors. |
| Velocity sensor | Measures consecutive position measurements at known time intervals. | 1) Tachometer (is an instrument device that employed in a motor (ex: cars) to calculate rotation speed of a shaft/disk in RPM (Revolutions Per Minute) shows it in an analog device.  2) LSV (Laser Surface Velocimeter) is an optical sensor measuring velocity and length on moving surfaces based on “Doppler effect”. |

3)

To measure Velocity without velocity sensor:

Using Accelerometers sensor

Assuming constant acceleration, the formula is extremely simple:

a = (V1-V0)/t. So, knowing the time and the acceleration,

and assuming V0 = 0, then V1 = a\*t

In a more real world, you probably won't have a constant acceleration, so you should calculate Delta V for each measurement, and adding all those changes in velocity to get the final velocity. Always consider that you won't have a continuous acceleration data, so this is the most feasible way.

Types:

Position Sensor in Android platform:

1) The geomagnetic field and accelerometer sensors return a multi-dimensional array of sensor values for each “[SensorEvent](https://developer.android.com/reference/android/hardware/SensorEvent.html)”.

2) Position sensors that are supported on the Android platform:

A) **“**[**TYPE\_GAME\_ROTATION\_VECTOR**](https://developer.android.com/reference/android/hardware/Sensor.html#TYPE_GAME_ROTATION_VECTOR)**”**.

B) **“**[**TYPE\_MAGNETIC\_FIELD**](https://developer.android.com/reference/android/hardware/Sensor.html#TYPE_MAGNETIC_FIELD)**”.**

C) **“**[**TYPE\_GEOMAGNETIC\_ROTATION\_VECTOR**](https://developer.android.com/reference/android/hardware/Sensor.html#TYPE_GEOMAGNETIC_ROTATION_VECTOR)**”.**

D) **“**[**TYPE\_ORIENTATION**](https://developer.android.com/reference/android/hardware/Sensor.html#TYPE_ORIENTATION)**”**.

E) **“**[**TYPE\_PROXIMITY**](https://developer.android.com/reference/android/hardware/Sensor.html#TYPE_PROXIMITY)**”.**

3-Environment Sensors

\*Provides sensors that let you monitor various environmental properties which we can use it to monitor humidity, pressure and temperature near an Android device.

\*Hardware-based.

Most common types:

|  |  |  |  |
| --- | --- | --- | --- |
| **Sensor** | **Description** | **Examples** | **Cons** |
| **Light sensors** | Controlling screen brightness. | 1) Increase the screen light when phone’s screen faces the sun.  2) When your mobile shows a green light when its battery is fully charged. | Affected by shocks (if your mobile fall down it could be destroyed). |
| **Temperature sensors** | Monitors temperature of battery, CPU and air's temperature (ambient temperature). | Any temperature application from play store. | Hard to get an accurate air temperature because it has to be instill far away from CPU's temperature sensor. |
| **Pressure sensors** | Measures barometric air pressure. | Was built-in on old android devices like”Galaxy Nexus”. | Not provided built-in in mobile devices. |
| **Humidity sensors** | Measures air humidity by using humidity meter (barometer). | "Sensors: Temp and Humidity" app on play store. | Not provided built-in in mobile devices. |

Environment sensors in Android platform:  
1) Unlike most motion sensors and position sensors, which return a multi-dimensional array of sensor values for each “[SensorEvent](https://developer.android.com/reference/android/hardware/SensorEvent.html)”, environment sensors return a single sensor value for each data event.

2) Environment sensors that are supported on the Android platform:

A) **“**[**TYPE\_AMBIENT\_TEMPERATURE**](https://developer.android.com/reference/android/hardware/Sensor.html#TYPE_AMBIENT_TEMPERATURE)**”.**

**B) “**[**TYPE\_LIGHT**](https://developer.android.com/reference/android/hardware/Sensor.html#TYPE_LIGHT)**”.**

**C) “**[**TYPE\_PRESSURE**](https://developer.android.com/reference/android/hardware/Sensor.html#TYPE_PRESSURE)**”.**

**D) “**[**TYPE\_RELATIVE\_HUMIDITY**](https://developer.android.com/reference/android/hardware/Sensor.html#TYPE_RELATIVE_HUMIDITY)**”.**

**E) “**[**TYPE\_TEMPERATURE**](https://developer.android.com/reference/android/hardware/Sensor.html#TYPE_TEMPERATURE)**”.**

* Resources:
* 1- <https://developer.android.com/guide/topics/sensors/> .
* 2- Wikipedia.
* 3- <http://webcusp.com/a-few-android-phones-that-have-temperature-sensor/> .
* 4- <https://android.stackexchange.com/questions/1894/what-does-the-pressure-sensor-measure> .
* 5- <https://www.bosch-sensortec.com/bst/products/motion/geomagnetic_sensor/overview_geomagneticsensors> .
* 6- <https://www.slideshare.net/Manishd94/velocity-sensors-inrobotics>.
* 7- <https://stackoverflow.com/questions/6085583/how-can-i-find-the-velocity-using-accelerometers-only>