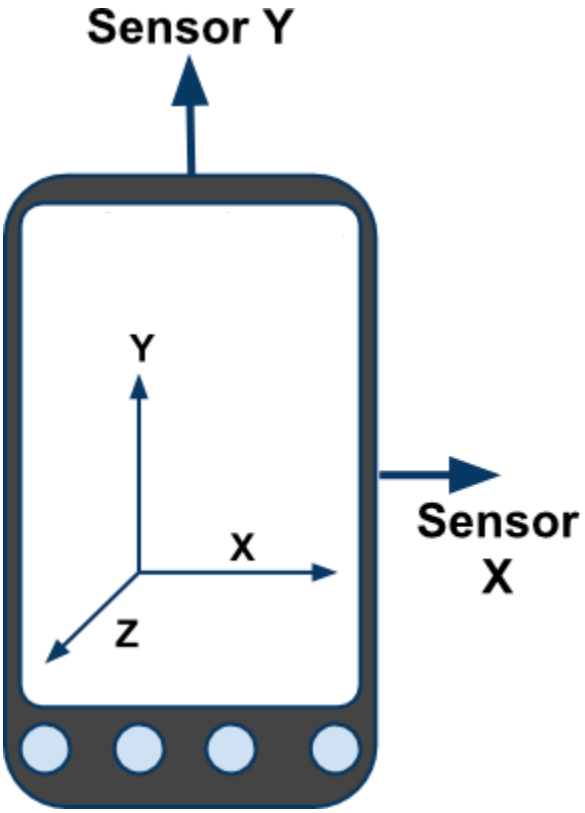
# Android Sensors

Most Android-powered devices have built-in sensors that measure motion, orientation, and various environmental conditions. These sensors are capable of providing 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.




For example, a game might track readings from a device's gravity sensor to infer complex user gestures and motions, such as tilt, shake, rotation, or swing. Likewise, a weather application might use a device's temperature sensor and humidity sensor to calculate and report the dewpoint, or a travel application might use the geomagnetic field sensor and accelerometer to report a compass bearing.

The Android platform supports **three broad categories of sensors**:

- **Motion sensors**

  These sensors measure acceleration forces and rotational forces along three axes. This category includes accelerometers, gravity sensors, gyroscopes, and rotational vector sensors.

- **Environmental sensors**

These sensors measure various environmental parameters, such as ambient air temperature and pressure, illumination, and humidity. This category includes barometers, photometers, and thermometers.

- **Position sensors**

  These sensors measure the physical position of a device. This category includes orientation sensors and magnetometers.

You can access sensors available on the device and acquire raw sensor data by using the Android sensor framework. The sensor framework provides several classes and interfaces that help you perform a wide variety of sensor-related tasks. For example, you can use the sensor framework to do the following:

- Determine which sensors are available on a device.
- Determine an individual sensor's capabilities, such as its maximum range, manufacturer, power requirements, and resolution.
- Acquire raw sensor data and define the minimum rate at which you acquire sensor data.
- Register and unregister sensor event listeners that monitor sensor changes.

# Introduction to Sensors

The Android sensor framework lets you access many types of sensors. Some of these sensors are hardware-based and some are software-based. Hardware-based sensors are physical components built into a handset or tablet device. They derive their data by directly measuring specific environmental properties, such as acceleration, geomagnetic field strength, or angular change. Software-based sensors are not physical devices, although they mimic hardware-based sensors. Software-based sensors derive their data from one or more of the hardware-based sensors and are sometimes called virtual sensors or synthetic sensors. The linear acceleration sensor and the gravity sensor are examples of software-based sensors. Table 1 summarizes the sensors that are supported by the Android platform.

Few Android-powered devices have every type of sensor. For example, most handset devices and tablets have an accelerometer and a magnetometer, but fewer devices have barometers or thermometers. Also, a device can have more than one sensor of a given type. For example, a device can have two gravity sensors, each one having a different range.

**Table 1.** Sensor types supported by the Android platform.

| Sensor | Type | Description | Common Uses |
|---|---|---|---|
| TYPE_ACCELEROMETER | Hardware | Measures the acceleration force in $m/s^2$ that is applied to a device on all three physical axes (x, y, and z), including the force of gravity. | Motion detection (shake, tilt, etc.). |
| TYPE_AMBIENT_TEMPERATURE | Hardware | Measures the ambient room temperature in degrees Celsius (°C). See note below. | Monitoring air temperatures. |
| TYPE_GRAVITY | Software or Hardware | Measures the force of gravity in $m/s^2$ that is applied to a device on all three physical axes (x, y, z). | Motion detection (shake, tilt, etc.). |
| TYPE_GYROSCOPE | Hardware | Measures a device's rate of rotation in rad/s around each of the three physical axes (x, y, and z). | Rotation detection (spin, turn, etc.). |
| TYPE_LIGHT | Hardware | Measures the ambient light level (illumination) in lx. | Controlling screen brightness. |
| TYPE_LINEAR_ACCELERATION | Software or Hardware | Measures the acceleration force in $m/s^2$ that is applied to a device on all three physical axes (x, y, and z), excluding the force of gravity. | Monitoring acceleration along a single axis. |
| TYPE_MAGNETIC_FIELD | Hardware | Measures the ambient geomagnetic field for all three physical axes (x, y, z) in μT. | Creating a compass. |
| TYPE_ORIENTATION | Software | Measures degrees of rotation that a device makes around all three physical axes (x, y, z). As of API level 3 you can obtain the inclination matrix and rotation matrix for a device by using the gravity sensor and the geomagnetic field sensor in conjunction with the **getRotationMatrix()** method. | Determining device position. |
| TYPE_PRESSURE | Hardware | Measures the ambient air pressure in hPa or mbar. | Monitoring air pressure changes. |
| TYPE_PROXIMITY | Hardware | Measures the proximity of an object in cm relative to the view screen of a device. This sensor is typically used to determine whether a handset is being held up to a person's ear. | Phone position during a call. |
| TYPE_RELATIVE_HUMIDITY | Hardware | Measures the relative ambient humidity in percent (%). | Monitoring dewpoint, absolute, and relative humidity. |
| TYPE_ROTATION_VECTOR | Software or Hardware | Measures the orientation of a device by providing the three elements of the device's rotation vector. | Motion detection and rotation detection. |
| TYPE_TEMPERATURE | Hardware | Measures the temperature of the device in degrees Celsius (°C). This sensor implementation varies across devices and this sensor was replaced with the **TYPE_AMBIENT_TEMPERATURE** sensor in API Level 14 | Monitoring temperatures. |