Programming
Handheld Systems
Sensors
Today’s Topics

SensorManager & Sensor
SensorEvent & SensorEventListener
Filtering sensor values
Example applications
SENSORS

HARDWARE DEVICES THAT MEASURE THE PHYSICAL ENVIRONMENT

Motion

Position

Environment
Some Example Sensors

Motion – 3-axis Accelerometer
Position – 3-axis Magnetic Field
Environment – Pressure
SensorManager

System service that manages sensors

Get instance with

getSystemService(
    Context.SENSOR_SERVICE)

Access a specific sensor with

SensorManager.
    getDefaultSensor(int type)
Some Sensor Type Constants

Accelerometer –
  Sensor.TYPE_ACCELEROMETER

Magnetic field –
  Sensor.TYPE_MAGNETIC_FIELD

Pressure –
  Sensor.TYPE_PRESSURE
SensorEventListener

Interface for SensorEvent callbacks
Called when the accuracy of a sensor has changed

void onAccuracyChanged(
    Sensor sensor, int accuracy)
SensorEventListener

Called when sensor values have changed

void onSensorChanged(
    SensorEvent event)
Registering for SensorEvents

Use the SensorManager to register/unregister for SensorEvents
Registering for SensorEvents

To register a SensorEventListener for a given sensor

```java
public boolean registerListener (SensorEventListener listener,
                                 Sensor sensor, int rate)
```
Unregisters a listener for the sensors with which it is registered

public void unregisterListener (SensorEventListener listener, Sensor sensor)
SensorEvent

Represents a Sensor event

Data is sensor-specific

Sensor type

Time-stamp

Accuracy

Measurement data
Sensor Coordinate System

When default orientation is portrait & the device is lying flat, face-up on a table, axes run

- **X** – right to left
- **Y** – top to bottom
- **Z** – up to down
Sensor Coordinate System

Coordinate system does not change when device orientation changes
Sensor Raw Accelerometer

Displays the raw values read from the device's accelerometer
If the device were standing straight up, the accelerometer would ideally report:

\[
X \approx 0 \text{ m/s}^2 \\
Y \approx 9.81 \text{ m/s}^2 \\
Z \approx 0 \text{ m/s}^2
\]
Accelerometer values

But these values will vary due to natural movements, non-flat surfaces, noise, etc.
Filtering Accelerometer Values

Two common transforms
Low-pass filter
High-pass filter
Low-pass filters

Deemphasize transient force changes
Emphasize constant force components
High-pass filters

Emphasize transient force changes
Deemphasisize constant force components
Percussion Instrument
Sensor Filtered Accelerometer

Applies both a low-pass and a high-pass filter to raw accelerometer values

Displays the filtered values
SensorCompass

Uses the device’s accelerometer and magnetometer to orient a compass
Next Time

Maps & Location