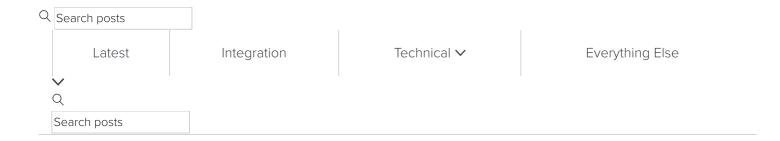
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Applying Low Pass Filter to Android Sensor's Readings

May 28th 2013, Samir Bhide





s is a continuation of the AugmentedRealityView project which was released

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Android sensor framework lets you access many types of sensors. Two very basic types are:

- 1. Hardware Sensors.
- 2. Software Sensors.

Hardware 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.

For example: Sensor.TYPE_ACCELEROMETER" , Sensor.TYPE_MAGNETIC_FIELD

Software 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.

For example: Sensor.TYPE_ORIENTATION , Sensor.TYPE_ROTATION_VECTOR

Best Practices for Accessing and Using Sensors

- 1. Unregister sensor listeners.
- 2. Don't test your code on the emulator.
- 3. Don't block the onSensorChanged() method.
- 4. Avoid using deprecated methods or sensor types.
- 5. Verify sensors before you use them.
- 6. Choose sensor delays carefully.

onSensorChanged()

7. Filter the values received in onsensorChanged(). Allow only those that are needed.

After we register the Sensors, the sensor readings get notified in SensorEventListener

method. However, the rate of change in sensor values is so high that if

we map these small changes a.k.a 'Noise' the values jump within a large range of values.

We can also specify the sensorManager 's delay properties from one of these:

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- 2. SENSOR_DELAY_GAME
- 3. SENSOR_DELAY_UI
- 4. SENSOR_DELAY_NORMAL

This, however, is only a peek into the system. Events may be received faster or slower than the specified rate, but usually events are received faster.

Moral of the story is:

Allow only those values which are useful and discard the unnecessary noise.

The solution for this is to apply a Low-Pass Filter on these values.

A Small Glimpse of Low Pass Filter

A low-pass filter passes low-frequency signals/values and attenuates (reduces the amplitude of) signals/values with frequencies higher than the cutoff frequency.

Take an example of simple signal with values ranging from 0 to 1. Due to an external source (environmental factors such as jerks or vibrations), a considerable amount of noise is added to these signals. These high frequency signals (noise) cause the readings to hop between considerable high and low values.

Programmatically Apply Low Pass Filter

A device's sensor readings contribute noise data due to high sensitivity of its hardware to various factors. For gaming purposes, these highly sensitive values are a boon, but for application hat need smooth readings, these hopping values are a mess.

Lets look at AugmentedRealityView on GitHub, where we have to point markers on



The high sensitivity causes the markers to change positions randomly due to noise.

A Low-Pass Filter concept comes to rescue, because we can omit those high frequencies in the input signal, applying a suitable threshold to the filter output reading

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With this implementation the markers won't hop randomly because we have removed the unwanted high reading values.

Here is the algorithm implementation:

```
<code>for i from 1 to n
y[i] := y[i-1] + α * (x[i] - y[i-1])
</code>
```

Here, α is the cut-off/threshold.

Lets implement it in Android:

```
<code>lowPass(float[] input, float[] output)
</code>
```

The above method filters the input values and applies LPF and outputs the filtered

```
Signals. static final float ALPHA = 0.25f; // if ALPHA = 1 OR 0, no filter applies.
```

```
<code>protected float[] lowPass( float[] input, float[] output ) {
   if ( output == null ) return input;
   for ( int i=0; i<input.length; i++ ) {
      output[i] = output[i] + ALPHA * (input[i] - output[i]);
   }
   return output;
}
</code>
```

Low-Pass Filter is finally applied to sensor values in

onSensorChanged(SensorEvent event)

as

follows:

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```
UIARView.pitch = (float)(((results[1]*180/Math.PI))+90);
UIARView.roll = (float)(((results[2]*180/Math.PI)));
radarMarkerView.postInvalidate();
}
}
</code>
```

Here i have applied low pass filter for

Sensor.TYPE_ACCELEROMETER and

```
Sensor.TYPE_MAGNETIC_FIELD
```

All code in this post and more can be found on GitHub.

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