Indoor Tracking App

GPS less tracking system

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Plan

- Problematic
- The App solution
- Zoom on inertial principle
- The implementation
- Perspectives

Problematic

Since the 2001, US government has open the Global Positioning System (GPS) military tracking system to the world.

-

People take possession of the technology and intensively use it.

-

Today, we cannot imagine living without GPS !

-

GPS works with satellites and outcomes your position by distance triangulation between you and the satellites.

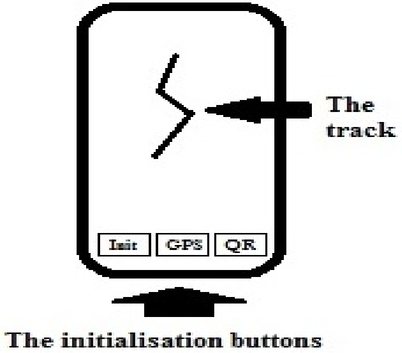
-

But, what's happen inside a building ????

-

GPS does not work.... to keep tracking indoor we must find another way.

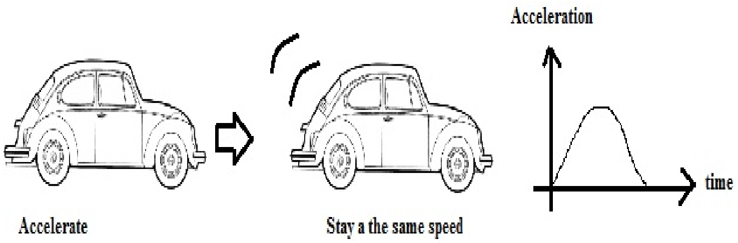
The App Solution



- Init button : reset the displayed track, localize the position in the center of the screen
- GSP button : reset the displayed track and localize the position into a background map
- Button QR ; reset the displayed track and localize the position into a building background map
- The track : the path performed by the user

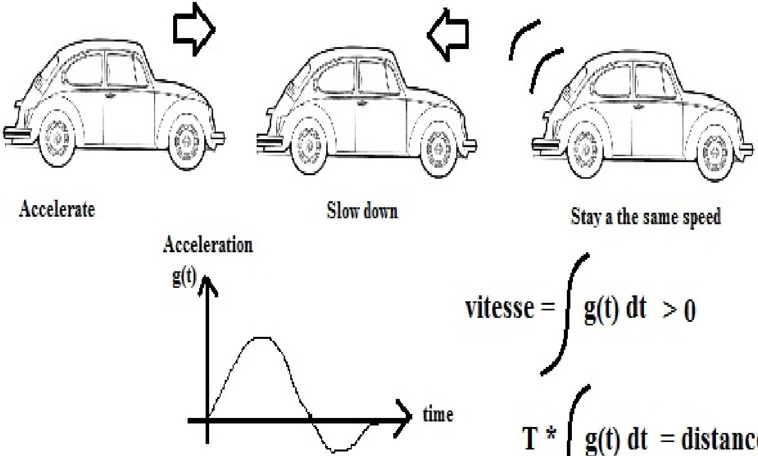
Zoom on inertial principle

- How the position is determined without GPS ?



Zoom on inertial principle

- How the position is determined without GPS ?

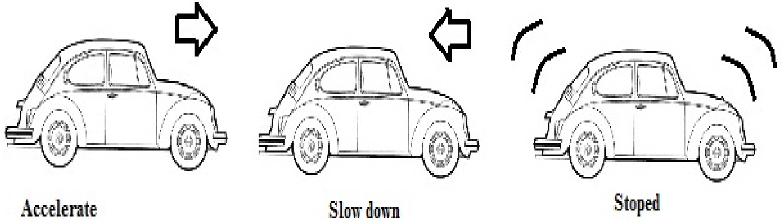


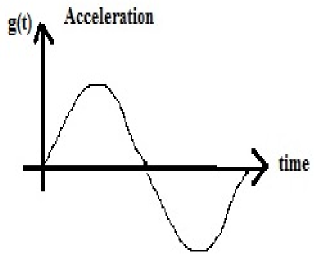
$$\text{vitesse} = \int g(t)\,dt > 0$$

$$T * \int g(t)\,dt = \text{distance}$$

Zoom on inertial principle

- How the position is determined without GPS ?



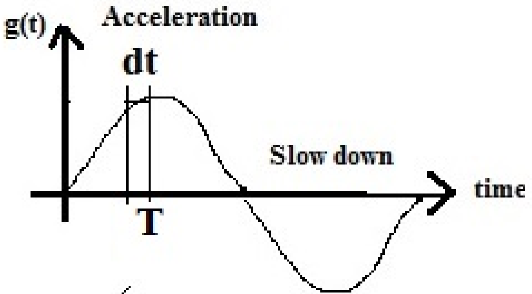


$$\text{vitesse} = \int g(t)\,dt = 0$$

$$T * \int g(t)\,dt = \text{distance} \neq 0$$

Zoom on inertial principle

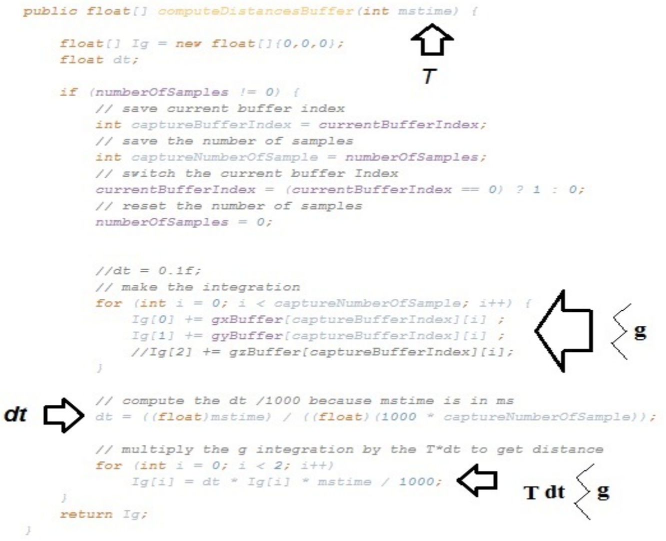
- How the position is determined without GPS ?



$$d = dt * \sum g(t) * dt$$

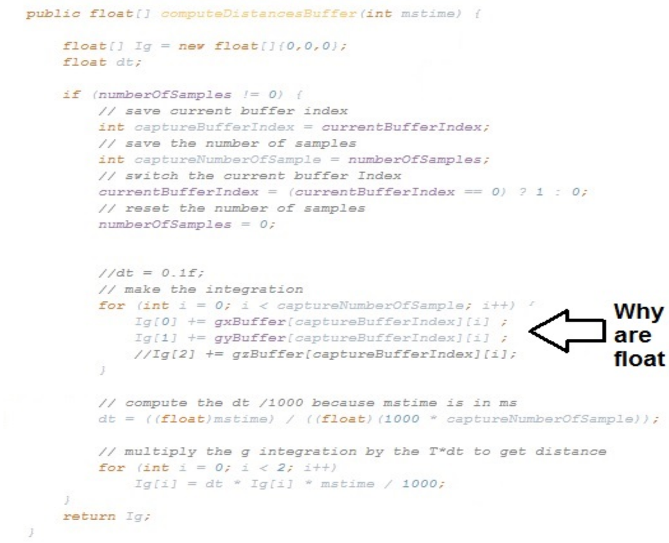
$$D(T) = \sum d = \sum dt \sum g(t) * dt = T\,dt \sum g$$

The implementation



```
public float[] computeDistancesBuffer(int mstime) {

    float[] Ig = new float[]{0,0,0};
    float dt;

    if (numberOfSamples != 0) {
        // save current buffer index
        int captureBufferIndex = currentBufferIndex;
        // save the number of samples
        int captureNumberOfSample = numberOfSamples;
        // switch the current buffer Index
        currentBufferIndex = (currentBufferIndex == 0) ? 1 : 0;
        // reset the number of samples
        numberOfSamples = 0;


        //dt = 0.1f;
        // make the integration
        for (int i = 0; i < captureNumberOfSample; i++) {
            Ig[0] += gxBuffer[captureBufferIndex][i] ;
            Ig[1] += gyBuffer[captureBufferIndex][i] ;
            //Ig[2] += gzBuffer[captureBufferIndex][i];
        }

        // compute the dt /1000 because mstime is in ms
        dt = ((float)mstime) / ((float)(1000 * captureNumberOfSample));

        // multiply the g integration by the T*dt to get distance
        for (int i = 0; i < 2; i++)
            Ig[i] = dt * Ig[i] * mstime / 1000;
    }
    return Ig;
}
```

The implementation



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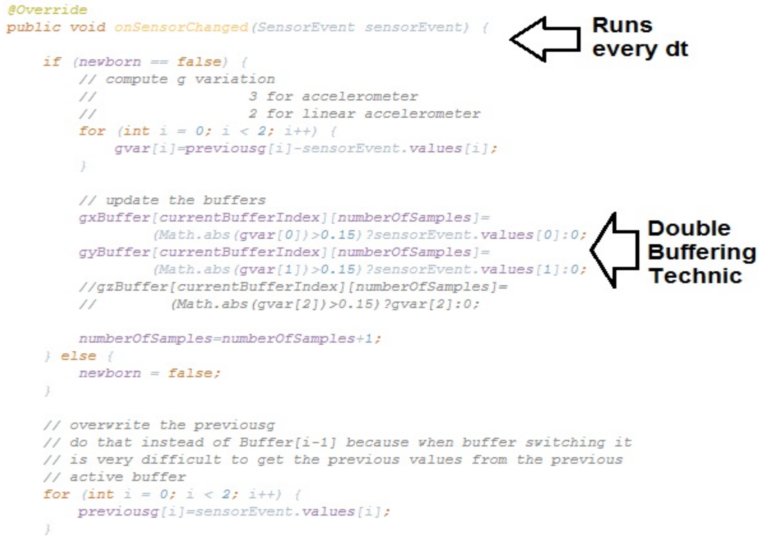
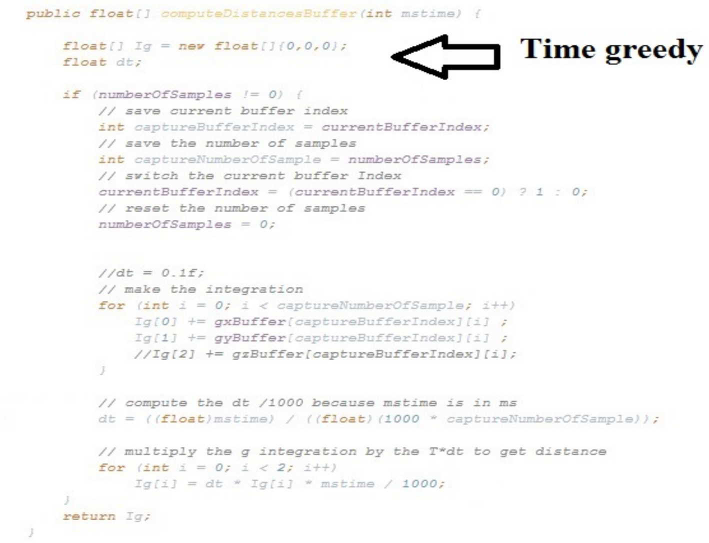
Why gBuffers are float [2][i] ?

The implementation



```
@Override
public void onSensorChanged(SensorEvent sensorEvent) {

    if (newborn == false) {
        // compute g variation
        //                  3 for accelerometer
        //                  2 for linear accelerometer
        for (int i = 0; i < 2; i++) {
            gvar[i]=previousg[i]-sensorEvent.values[i];
        }

        // update the buffers
        gxBuffer[currentBufferIndex][numberOfSamples]=
                (Math.abs(gvar[0])>0.15)?sensorEvent.values[0]:0;
        gyBuffer[currentBufferIndex][numberOfSamples]=
                (Math.abs(gvar[1])>0.15)?sensorEvent.values[1]:0;
        //gzBuffer[currentBufferIndex][numberOfSamples]=
        //          (Math.abs(gvar[2])>0.15)?gvar[2]:0;

        numberOfSamples=numberOfSamples+1;
    } else {
        newborn = false;
    }

    // overwrite the previousg
    // do that instead of Buffer[i-1] because when buffer switching it
    // is very difficult to get the previous values from the previous
    // active buffer
    for (int i = 0; i < 2; i++) {
        previousg[i]=sensorEvent.values[i];
    }
```

Perspectives



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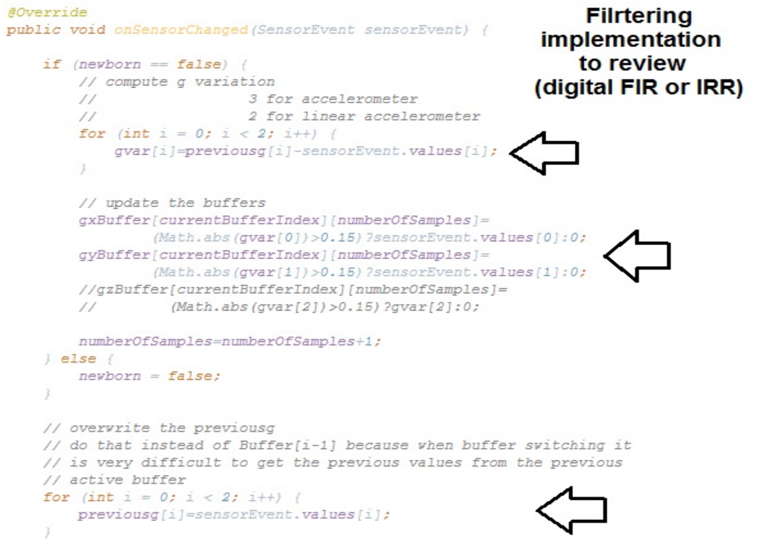
Perspectives



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Filrtering implementation to review (digital FIR or IRR)

Conclusion

- Accelerometer very sensitive
- Sensor driver implementation must be meticulous
- Embedded software is a real trade
- GUI Design too !

Thank you (Q&A ?)