Internet Of Things
Project Report

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Introduction :

The objective of this project is to find the user's orientation with respect to his / her mobile using accelerometer data. It consists of an algorithm for finding the phone's orientation with respect to ground using raw accelerometer data. We also wanted to find the user's distance (whether the user is far or near) from the phone but we couldn't complete it.

Process:

Collection of data

Data is collected from an Android phone using Phyphox Application from RWTH Aachen University, Germany. We collected the data for three experiments

Algorithm

- The algorithm takes in accelerometer data from the phone using the phyphox app and gives the orientation of the mobile in terms of 3 angles. ϕ, θ, ψ These angles are shown in the picture below:

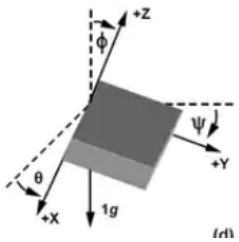


Figure 1: Darker surface is assumed to be screen of the phone for reference

- The 3 angles are calculated using the accelerometer values in x, y and z directions as follows:

$$\theta = \tan^{-1}\left(\frac{A_{X,OUT}}{\sqrt{A_{Y,OUT}^2 + A_{Z,OUT}^2}}\right) \quad (11)$$

$$\psi = \tan^{-1}\left(\frac{A_{Y,OUT}}{\sqrt{A_{X,OUT}^2 + A_{Z,OUT}^2}}\right) \quad (12)$$

$$\phi = \tan^{-1}\left(\frac{\sqrt{A_{X,OUT}^2 + A_{Y,OUT}^2}}{A_{Z,OUT}}\right) \quad (13)$$

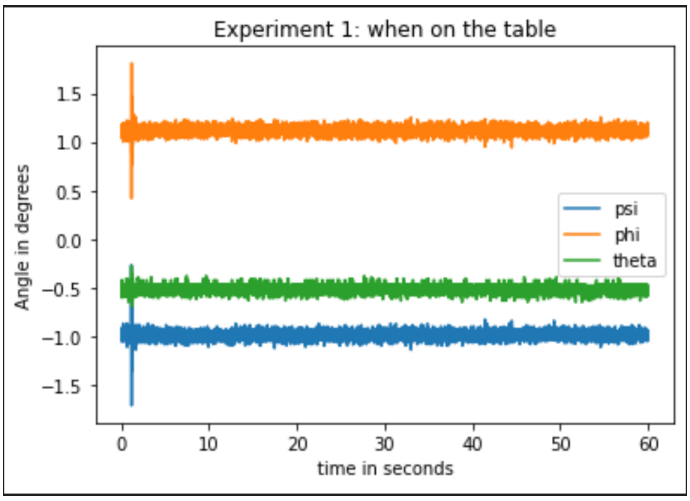
Algorithm for finding Angles:

```
def calculation(data):
    data['theta'] = 0.0
    data['psi'] = 0.0
    data['phi'] = 0.0
    data['theta'] = np.arctan(data['Acceleration x (m/s^2)']/np.sqrt
(np.square(data['Acceleration y (m/s^2)'])+np.square(data
['Acceleration z (m/s^2)'])))
    data['theta'] = (180/math.pi)*data['theta']
    data['psi'] = np.arctan(data['Acceleration y (m/s^2)']/np.sqrt
(np.square(data['Acceleration x (m/s^2)'])+np.square(data
['Acceleration z (m/s^2)'])))
    data['psi'] = (180/math.pi)*data['psi']
    data['phi'] = np.arctan(np.sqrt(np.square(data['Acceleration x
(m/s^2)'])+np.square(data['Acceleration y (m/s^2)']))/data
['Acceleration z (m/s^2)'])
    data['phi'] = (180/math.pi)*data['phi']
```

Experiments:

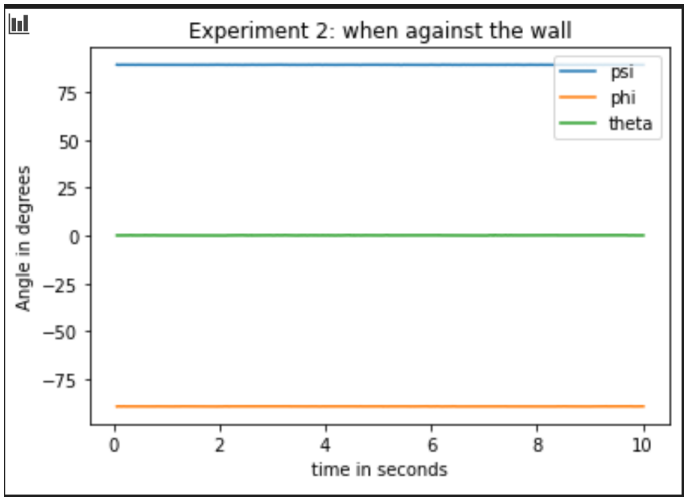
Experiment 1:

phone is laid on the ground.



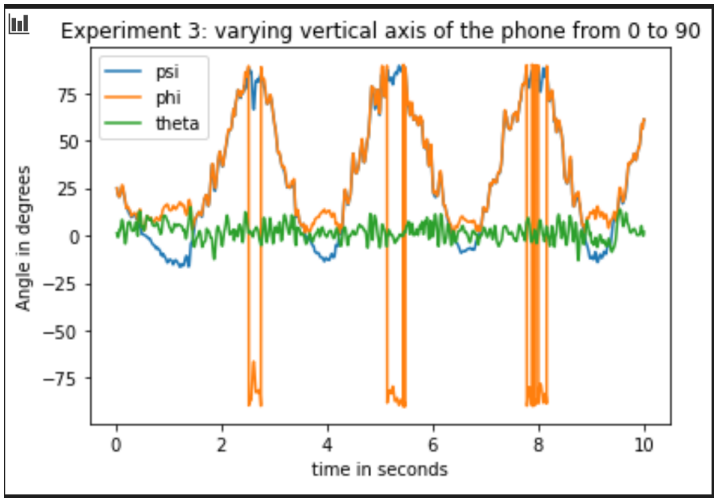
Experiment 2:

The phone is is attached to the wall



Experiment 3:

Phone is only allowed to move vertically from 0 degrees as if on a ground to a 90 degrees as in the second experiment and vice versa during experiment 3.



Uses:

The orientation angles which are found through are algorithm can be used in various places like

- stabilization of cameras while taking videos to take the videos better.
- using these angles to perform screen rotations (landscape, portrait) in mobiles.
- as a control input for car games on a mobile.
- as an input for the VR mode (or 360 degree view) for change in direction of the image/video on screen.

References:

Using An Accelerometer for Inclination Sensing