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Detection of Movement and Shake Information using Android Sensor

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Abstract. With the accelerator sensor on a smart phone, this paper tries to sense movement information on the x, y, and z axis on the space coordinate, and to detect shake information. First, we analyze the sensor output information to get the movement information on each three-dimensional axis. Then, we integrate the resulting information to suggest the algorithm for judging the shake gesture. We use Kalman filter for stable and accurate detection of the sensor data. We measure the data at certain intervals to see if the smartphone moved, or if it did, to which direction. We could verify the effectiveness of the suggested method through experiments. The suggested method is effective as interface in contents such as games and also as information for reacting to emergencies.

Keywords: accelerator sensor, shake, Kalman filter, interface

1 Introduction

"Touch technology" on the smartphone is very convenient and has contributed greatly to the widespread use of the smartphone with its user-friendly interface. Also, new types of human-device interactive technology are expected to become in full bloom, thanks to LTE(Long Term Evolution/ the new high-speed wireless data technology), high-performance computing calculation capabilities in a smartphone, and various other sensor technologies.[1-12] Smartphones are equipped with many kinds of different interfaces which the user controls on intuition for communication. Among these, 'touch screen' and 'button' are the most commonly used input technologies for mobile devices. However, the touch screen has its own inconveniencies; the screen is small and the user cannot see the screen while he/she is touching on the screen. Buttons are also limited in number, so we need additional interfaces.

On the other hand, 'gesture recognition', which uses gyro or accelerator sensors, can provide intuitive and natural interfaces for the user, since it is able to generate various input signals without hiding the screen.[2-4]

In this paper, we analyze and then apply the sensor data on the android smartphone to detect and output movement directions on the x, y, and z axis in space. After analyzing the data on the three axes, we try to detect "Shake". The accelerator used for this purpose is prone to great data variations and noise per hour. So, we need to stabilize processing of the sensor data through the Kalman filter.[7-11]

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2 Android sensors and Kalman filter

These days Android devices come with several built-in sensors like Accelerometer, Gyroscope, Magnetometer, Proximity, Pressure sensors etc.[1-12] We used 3-Axis Accelerometer sensor gives us the acceleration measurements in m / s^2 along each of X; Y;Z axes. It can be used to recognize the motion activities. The most important source of error of an accelerometer is the bias. The bias of an accelerometer is the offset of its output signal from the true value. It is possible to estimate the bias by measuring the long term average of the accelerometers output when it is not undergoing any acceleration.[4][12] We can reduce the noises of accelerator sensors using Kalman filer[7-11]. Kalman filter is the optimal inference method which uses the probability model of the subject system along with the measurement value to find the state variable of the system[7-8] The algorithm works in a two-step process. In the prediction step, the Kalman filter produces estimates of the current state variables, along with their uncertainties. Once the outcome of the next measurement (necessarily corrupted with some amount of error, including random noise) is observed, these estimates are updated using a weighted average, with more weight being given to estimates with higher certainty. Because of the algorithm's recursive nature, it can run in real time using only the present input measurements and the previously calculated state and its uncertainty matrix; no additional past information is required.[9-10]

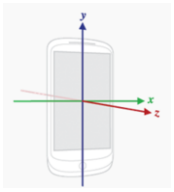


Fig. 1. Sensor Coordinate System

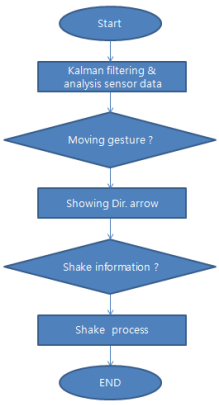


Fig. 2. Flowchart of proposed algorithm

3 Proposed Algorithm

The raw sensor data from the x, y, and z axes are analyzed and used to check the presence of movements. Here, we stabilize the sensor data values by filtering each value from the x, y, and z axes through the Kalman filter. The resulting values are compared with the pre-selected Threshold value to judge the presence of movements on each axis. The highest value among the judged values is the directional value for the gesture. Then, we see if there is shake by integrating data values on each axis. We

need to set up interval timings for measurements and also need to determine the threshold value to judge movements as well as shake information.(confer Fig. 2)

4 Experiment

In the experiment, the accelerator sensor on the Android detects the movement information on the x, y, and z axes. The resulting sensor output data are integrated to suggest the algorithm for sensing the shake movement by the user. The proposed algorithm is verified through experiments.

4.1 Experiment 1

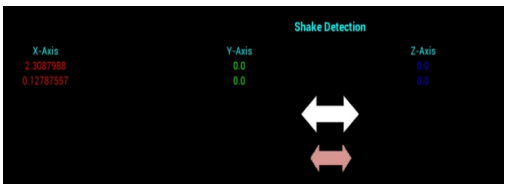
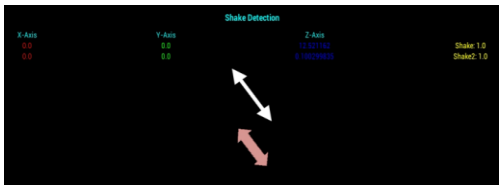


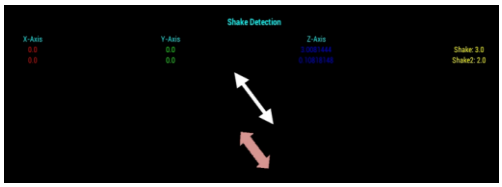
Fig. 3. Experiment on detection of movement information on x axis

In Experiment 1, the user of the Android phone moves to the left or the right. The left or right direction shows the movement information output by the sensor on the x axis. So, only the x axis generates the data. That is to say, the figure applies to the detection of the movement on the x axis direction. Here, the data on y and z axes are marked 0 because the basic threshold value has been set for data processing. The first data on the x axis is the sensor data value. The second data is the output value after having been processed through the proposed Kalman filter. Each value is processed through the proposed algorithm and judged for significance based on the pre-determined threshold value, and the results are generated. In the Experiment 1, the sensor detected movement on the x axis(output 1), and the proposed algorithm also detected movement on the x axis(output 2). The results were simultaneously output. In the Experiment 1, the proposed algorithm was very stable in detecting the sensor movement data. Detection was also possible through the conventional method.

4.2 Experiment 2



(a)



(b)

Fig. 4. Experiment of shake detection

In the Experiment 2, we conduct the shake detection twice on the z axis by using the proposed algorithm. When we measure the accelerator sensor data on the x, y, and z axes, we can detect shake on the z axis with great data variations on the z axis. In the Experiment (a) for shake detection, the detection occurs once for either case. In the second experiment (Experiment (b)), the correct detection occurred three times for the conventional method, and two times for the proposed algorithm. The Experiment 5 shows the conventional method is better at detection than the proposed algorithm.

5 Conclusion

Smartphone has various sensors which can meet user needs as well as convenient input functions such as touch screen or button. The accelerator sensor is especially useful in detecting movement information by using the sensor output data on the x, y, and z axes in space. However, the detection information has some problems of 'drift' or 'noise'. So, this paper proposes Kalman filter for stable detection of the movement information. We also propose the algorithm which can detect gesture information such as 'shake' after integrating and then analyzing 3D movement information on x, y, and z axis. Experiments verify the effectiveness of the proposed algorithm. In particular, Kalman filter and the data collection based on interval measurements are effective for processing sensor data.

References

1.Young Jae Lee, "New Interface Design Using Accelerator Sensor for Smart Phone",

International Journal of Smart Home, Vol. 9, No. 1 (2015), pp. 1-12
2. Yong-Cheol Lee, "Gesture Recognition using Smartphone Sensor", Master Thesis, Jeon Nam Univ.,(2012)
3. Jun Won Lee, Android Sensor Story, Freelec Press, (2014)
4. http://developer.android.com/guide/topics/sensors/sensors_overview.html
5. http://www.techrepublic.com/blog/software-engineer/a-quick-tutorial-on-coding-androids-accelerometer/
6. https://software.intel.com/en-us/android/articles/intel-for-android-developers-learning-series-4-android-tablet-sensors
7. http://homepages.inf.ed.ac.uk/rbf/CVonline/LOCAL_COPIES/WELCH/kalman.1.html#12922
8. http://blog.naver.com/hms4913?Redirect=Log&logNo=30166486895
9. http://en.wikipedia.org/wiki/Kalman_Filter
10. http://blog.naver.com/msnayana/80106682874
11. http://gyjmobile.tistory.com/
12. Shahid Ayub, Alireza Bahraminasab, Bahram Honary, "A Sensor Fusion Method for Smart phone Orientation Estimation",13th Annual Post Graduate Symposium on the Convergence of Telecommunications, Networking and Broadcasting, Liverpool, (2012)

