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Estimation of Depth Information Using Orientation Sensor and Shake Gesture Application

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Abstract. By optimizing the output of the orientation sensor on smart phone, this paper estimates and generates depth information depending on slope. To verify effectiveness of the generated depth information, we produce game and express the depth information by applying it to the object in game space. We filter the orientation sensor data which is composed of acceleration and magnetic sensors through Kalman filter which has excellent optimizing capability. For stable data input, we use pre-processing through which the data are input at regular intervals. The slope information of the preprocessed data is input into the object-size-transforming formula to generate the depth information according to each different slope. By using this depth information, we can modify the size of the object and output the result. The generated output result has been verified for its performance through experiments. This paper also proposes 'Shake' application in which the shake size for each direction is detected when the user shakes the smart phone, and realizes explosion considering the shake direction in response.

Keywords: orientation sensor, depth information, Kalman filter, shake

1 Introduction

Smart phone has various interfaces to transmit communication through user's intuitive maneuvering. Among these, the most widely used inputting methods for mobile devices are 'touch screen' and 'button'. Touch screen has shortcomings in that the screen size is small, and the screen is hindered from sight during touch. Buttons are also limited in number, so it requires additional interface. On the other hand, gesture recognition utilizing information from gyro sensor or acceleration sensor can provide intuitive and natural interface for the user since the screen is clear for sight, and various inputting signals can be generated.[1-7]

Devices based on Android OS have sensors which can measure motions, directions, and various environmental elements. These sensors can provide data with high precision and accuracy. They can also monitor three-dimensional motions or directions and tell relative environmental changes in the vicinity of the device. For example, we can infer complex motions or movements of the user(tilt, shake, rotation, and swing) from the weight sensor. In addition, with the weather application, we can

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calculate and output dew point using temperature and humidity sensors of the device. With the travel application using geomagnetic sensor and acceleration sensor, we can output three-dimensional directions just like the compass, or get information on the surroundings by linking up with camera image information.[2-5]

This paper uses the orientation sensor which is composed of acceleration sensor and magnetic sensor to detect movement and directional information. Also, the detected slope information has been analyzed and applied to be transformed into depth information. To verify the effectiveness of the proposed method, we made 'third-person, top-view game' and applied depth information to the object in game space and then experimented with its movements.

2 Proposed Algorithm

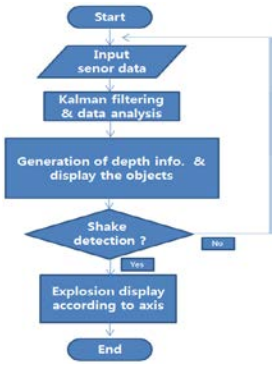

Fig. 1. Flow chart of proposed algorithm

Sensor data are characterized as being irregular and highly variable. Therefore, to be used as data, preprocessing through filtering is necessary. In addition, for stable data input, data inputting should be done at regular intervals. This paper used Kalman filter for data filtering on x, y, and z axis since it is highly competent in optimization compared with other filters. After filtering of data on each axis, threshold has been assigned to distinguish significant data. In particular, by using the output value on x coordinate of the orientation sensor using acceleration and magnetic sensor, the proposed formula has been used to generate depth information(refer to Formula(1)), which is applied to the object in game space and images are output depending on movements.

$$Ori\_xdata[x]/const + scale\_tuning\_factor = SCALE \quad (1)$$

(Ori_xdata[x]: x axis data of orientation sensor, const: constant value,
scale_tuning_factor: auxiliary value for tuning, SCALE: scale value of the object)

Also, by analyzing the size and directional information, we judge 'shake gesture'. Through several experiments, if the sensor sum data is greater than the threshold value, we judge the shake information for each axis. We determine the explosion in the direction which shows the largest data on x, y, and z axis. As counter reaction, we output explosion image in the direction of shake in the surroundings of the object. For application in game, we display the explosion image on the y axis for the x axis so that the user can recognize the shake direction. In the same way, for the y axis, the explosion image is realized on the x axis to give the sense of reality.

4 Experiment

4.1 Experiment 1

(a) (b)

Fig. 2. Image of game object after inference of depth information

With the x-axis data gotten when the user moved the gadget, we apply the proposed method to transform it into depth information. For validation, we applied it to the moving object in game we had produced. There are two objects flying in game space in figure (a). The flying object on the left is the one to which the proposed algorithm has been applied. And the flying object on the right is the one which shows no change in size(1:1) no matter where it is located. The result of the experiment shows that the flying object on the left in game space gets larger and rotates, which means the user rotated the device in counter clockwise direction and the distance got closer between the user and the gadget. Because of this, the flying object in the bottom part of the device, which is closer to the user, got larger. Through this, we could verify that the depth information can well express the object in game space. In figure (b), the rotation is in the clockwise direction, and the upper part of the device got distant from the user. The size of the object in the upper part is expressed smaller as in the left. Through experiment (a) and (b) in experiment 1, we could see the potential for expressing the object existing in two dimension as being in three dimension by using the slope information of the orientation sensor and applying the proposed algorithm.

4.2 Experiment 2

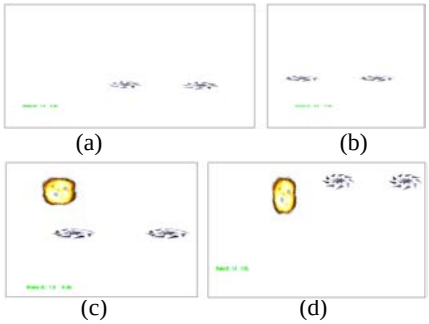

Fig. 3. Output image of the shake direction and the explosion image

In experiment 2, we detected shake gesture information and analyzed it to realize explosion at certain location of the object in game space by distinguishing the axis which outputs the greatest value on each sensor coordinate axis. Figure(a) is the image of the detection of the largest value in the clockwise direction on x axis after shake detection. Figure (b) is the detection image of the largest value in the counter clockwise direction on the y axis after shake detection. As counter reaction of the game, in figure(c), in the y axis game direction from the user, and in figure(d), in the x axis direction from the user, the explosion has been output.

5 Conclusion

Smart phone has been recognized as the key content for IoT(internet of things) and healthcare thanks to innovation in sensor technology. Since smart phone has various sensors, we can realize various applications. In this paper, we optimized the output of the orientation sensor which is composed of acceleration sensor and magnetic sensor, and used it for input data. This paper also proposes the method to generate depth information utilizing slope information in the clockwise and counter clockwise direction on the x axis among the preprocessed data on the x, y, and z axis. To verify the validity of the proposed method, we made a simple game and experimented with the moving object in game space. As result of the experiments, we could effectively realize the game reality with the object size changing naturally. In addition, we detected the size and direction of shake by the user, and in reaction to it, we realized the explosion considering the shake information (direction and size information), proposing yet another shake application. The proposed algorithm may be used for sensor applications.

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