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Poster

System for Body Motion Capture While Moving in Large Area

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Abstract

Previous motion capture device such as OptiTrack has actively used. However, it is suitable to measure in a narrow space. We proposed a system to measure the body motion while walking in a large area. In the system we attached OptiTrack, Depth sensor and 9-axis sensor to a mobile vehicle. This paper reports the potential of our system.

CCS Concepts

• ***Hardware*** →Communication hardware, interfaces and storage→Sensor applications and deployments;
•***Human-centered computing*** → Visualization → Visualization systems and tools → Visualization toolkits;

1. Introduction

Some outdoor training such as walking or running requires a large space for body movement. For the purpose of skill transfer or motion analysis, it is required to measure the body motion during the training. However, the motion capture device such as OptiTrack or ARToolkit cannot measure in large space due to the camera can clearly capture the marker in a limitation distance.

In our study, we proposed and developed a system to measure walking motion while walking in a large space. Three sensors: OptiTrack, depth sensor (RealSense) and 9-axis sensor were attached to a vehicle that run following a walker. OptiTrack is moved closed to the walker, therefore it can capture the makers clearly. However, due to the movement of the OptiTrack's camera, it required other sensors to compensate the change of position and orientation of the camera. Hence, we used RealSense and 9-axis sensor. This paper introduces our system and reports its potential during outdoor walking.

2. A Motion Tracking System for a person during walking

Figure 1 shows the overview of our system during the measurement of an outdoor walking. Figure 2 shows the configuration of the mobile measurement system that we proposed in this study. Three sensors that we attached the vehicle (Segway, i2 SE Cargo) are maker-capture device (Optitrack V120: Duo (resolution 640 × 480,120 fps)), depth sensors (Intel RealSense Depth Camera D435 (depth sensor resolution 640 × 480,60 fps)), and 9-axis sensor (TSND151 (maximum sampling 1000 Hz. This 9-axis sensor refers to 3-axis of three sensors: acceleration, angular velocity and geomagnetism sensor.

Figure 1: *Overview of our system during the measurement of an outdoor walking.*

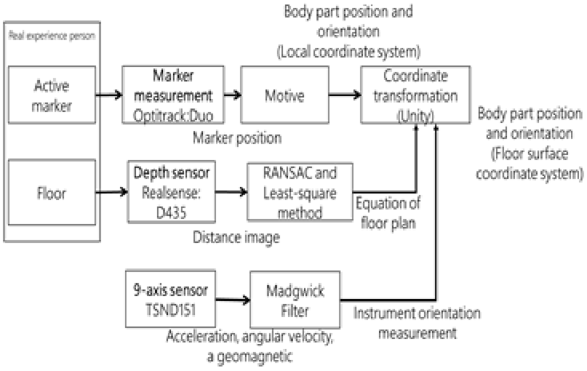

Figure 2: *System configuration.*

OptiTrack:

It is used to measure the distance between the makers and the Segway. For body motion measurement, we attached six

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set of makers to the head, both elbows, both knees and hip of a walker.

Depth sensor (RealSense):

To measure the floor surface that the Segway running on. The normal vector of the floor plane can be found by measuring the distance of each point of the floor plane to the Segway. Outliers that were included in the point cloud data were excluded by the RANSAC (RANdom SAmple Consensus) [FB81].

9-axis sensor:

To measure the orientation of the Segway. We used Madgwick Filter to estimate the position of the Segway [Seb10]. Each sensor value (acceleration, angular velocity and geomagnetism) were used for this estimation.

3. Walking Measurement

3.1 Objective

To investigate to potential of our system by measuring the walking motion. We evaluated whether the body parts have been properly measured with respect to the floor surface.

3.2 Participants and Procedures

One male university student with the height of 169 cm partcipated this measurement. We set the makers to six loctaions of his body.

There were two conditions: walking on the flat surface and inclined surface, for this measurement. Participant walked in a straight line for about 1.4 s of stepping period for both condtions. The angle of inclined surface was about 3.5 degrees in maximum for both uphill and downhill.

3.3 Result

Figure 3 and 4 show the result of walking on a flat surface inclined surface, respectively. The blue line shows the height of the marker attached the left knee and orange line represents the time displacement of the inclination of the floor surface.

The blue lines in both fingures showed that the period was about 1.4 s. It was the step period of walking. This result indicated that our system can measure the movement of leg during walking. The average value of red line in figure 3 was 0.140 ± 0.180 degrees. It indicated that the floor surface what participant walked on was horizontal.

Figure 4 shows that, the duration walking on uphill surface was 10 ~ 17 s, and 17~ 23 s for downhill. The average value of the inclination of the uplink was 2.649 ± 1.018 degrees, and the downlink was -2.795 ± 0.740 degrees. It had about 1 degree error. We considered that the error was caused by the distance image acquired in the boundary plane and the slope contained two planes.

4. Conclusion

In this study, we developed a mobile body motion measurement system based on the floor surface measurement. This system was able to measure the motion of a person walking on a flat surface and inclined surface.

In our future work, we measure other training motion such as running with verious makers to the feet and other location of the body.

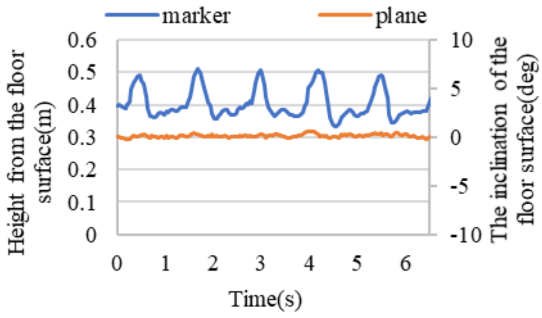

Figure 3: *Walking on the flat surface.*

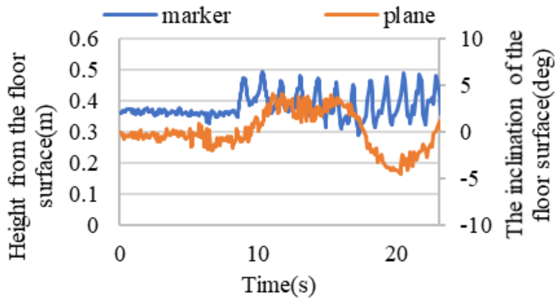

Figure 4: *Walking on the inclined surface.*

5. Acknowledgements

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