Novel Velocity Update Applied for IMU-based Wearable Device to Estimate the Vertical Distance

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Abstract:
The demand for indoor localization that does not rely on the presence of any external infrastructure had been increasing. In general, an indoor localization system was required to be precise, highly accurate and reliable. In this paper, we presented and analyzed an indoor localization wearable device that was capable of positioning people while riding in an elevator. The inertial measurement unit (IMU) was utilized with an embedded system on the device. Current approaches involving IMU mounted on a pedestrian's body generally estimated the displacement on the ground only (in two dimensions). Thinking of a wearable device to estimate the vertical distance for elevator riding and with the fact that there are different levels of height for different buildings, a new algorithm was proposed to estimate distance in vertical direction when people riding in an elevator. The proposed algorithm was based on the double integrating process from global acceleration with gravity removal in which the velocity and distance are updated in periods that the vertical acceleration oscillates around Zero level. Experiments with a wearable device which was designed based on the IMU model MPU9150, Arduino board and wireless Xbee took place for riding in an elevator. Experimental results contained device's attitude, vertical distance and time stamp. They were recorded online wirelessly via Xbee devices into an *txt file. Experiments in this work include riding up and down in an elevator. They were repeated to collect data for evaluation by root mean square error (RMSE) computation based on the ground-truth. The experimental results demonstrated RMSE of 0.77%, 0.88%, 1.66% riding in an elevator through one floor only, riding in an elevator through multiple floors while stopping at each floor, riding in an elevator through 40 floors, respectively.

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