Indoor Positioning Sytem Using Geomagnetic Anomalies for Smartphones

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ABSTRACT

In this paper, we propose an indoor positioning system using smartphones. To localize the position of target that is pedestrian in usual indoors, we make use of perturbations of the geomagnetic field caused by structural steel elements in a building. The systems based on magnetic field do not need any physical infrastructure, so it is possible to be realized with low cost, but other systems have to be equipped with infrastructure overheads, such as WLAN APs, beacon, Bluetooth and so on, for broadcasting signals inside buildings which require additional costs. To estimate the target's position using the geomagnetic anomaly, the proposed system measure the magnetic field on its own position using a magnetometer embedded in smartphones and compare the sensor measurement with the magnetic map that has been built for the building in advance. There are many ways to build the map introduced by several papers, so finding the most effective way is one of the challenges for this approach. The estimated position is calculated by a stochastic system based on the particle filter. To calculate control inputs for the particle filter, such as moving distance and direction, we exploit an inertial measurement unit (IMU) that is composed of 3-axis accelerometer and gyroscope built in the smartphone. Using the IMU we also compensate a measurement error of the magnetometer induced by a pose change of the smartphone. The experimental results show that accuracy is within 3 meter in two buildings. These results imply the potential to locate people in the buildings that have geomagnetic map built in advance at the meter scale using only smartphone embedded sensors.

KEYWORDS: Indoor positioning, magnetic fingerprinting, particle filter, inertial measurement