Fixed point observation of geomagnetism for dynamic fingerprinting map construction

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Abstract. Fingerprinting requires sensor data map to estimate a user's location by comparing the map with sensor data of the user's device. Although it is assumed that the sensor data does not change, it is considered that the premise is not stable in the geomagnetic fingerprinting near a large electric current flows or an electric device utilizing electromagnetism generating a magnetic field. In this paper, we report the result of fixed point observation of geomagnetism at the place where change is likely to occur in the building of university.

Key words: Fingerprinting, Geomagnetism, Indoor positioning

1 Research background

At indoor, GPS is not available due to the interrupting the satelite radio waves. So, a lot of indoor positioning method for smartphones are investigated. In this research, we focus on a method called fingerprinting. In fingerprinting, a map for specific sensor data is prepared in advance and the current position information is estimated by comparing the value of the map with the actual measurement value. Positioning accuracy depends on the freshness and granularity of the map. It is assumed that the value of sensor data observable at the same point is constant, but its value changes with the passage of long-term time such as environmental change. For this reason, automatic updating by a cyclic robot [2] and a method of coping with change by using difference of sensor data [1] and the like have been proposed. On the other hand, it is thought that sensor data will change even for a short time. In this paper, because the geomagnetism changes due to factors such as large current flow and electronic devices utilizing electromagnetism, we assume that changes are observed near the elevator, near the printer. This paper reports the results of fixed point observation at the places where have such characteristics.

2 Related work

Chenshu Wu et al. [1] pointed out that when positioning is performed using only one time of sensor data, the result becomes unstable. To solve this problem, they

propose to use the difference between sensor data values with neighboring points. As a result, even if the value of a certain point is unstable, improvement can be expected in the case where the entire sensor data fluctuates at the same time. However, it dosen't work when a part of sensor data fluctuates.

Kensaku K et al. [2] periodically update sensor data maps by circulating autonomous robots. Accordingly, it is possible to cope with a change in the surrounding environment such as a change in the installation position of the AP. However, we can not deal with sensor data that changes in a short time, as we will see in this paper.

3 Purpose of research

We assume that causes of the sensor data value changing in a short time are electronic devices that use a large current flow or electromagnetic. Since these are considered to be used periodically, it is necessary to prepare separate sensor data maps when non-use and use, and use them properly according to the situation. In this paper, focusing on the geomagnetism, we observe the fixed point observation to capture the change of the sensor data for a short period of time which is missing by the conventional method and investigate the actual influence assuming the change of the elevator and the printer.

4 Experimental result

We selected two places for fixed point observation in the building of School of Information Science, Nara Institute of Science and Technology. One is neer an elevator entrance, and another is in front of a printer. An observation device was Nexus 7 (2013 model, Android 5.0.) Geomagnetic values are recorded at 20ms intervals into a CSV file. The value to be acquired is the geomagnetic value for the three axes in the x, y, z direction with respect to the Android device.

Fig. 1 shows the measurement results in 1 hour in front of the elevator, Fig. 2 shows the measurement result at 1 m away from the elevator, and Fig. 3 shows the measurement result in front of the printer. The vertical axis of the graph is the norm of three axes. At the start of measurement, the value fluctuation is large due to the influence of the author's body in the vicinity, so it is omitted here. In Fig. 1, the numerical value gradually increases with drifting. Compared with the experiment at the position 1 m away from the elevator, it is conceivable that the error will increase somewhat because the range of change in the value is large, but there is a difference that it is necessary to prepare a plurality of maps absent. Further, in Fig. 3, there is no large change in the value, and it is found that it is considerably more stable than before the elevator.

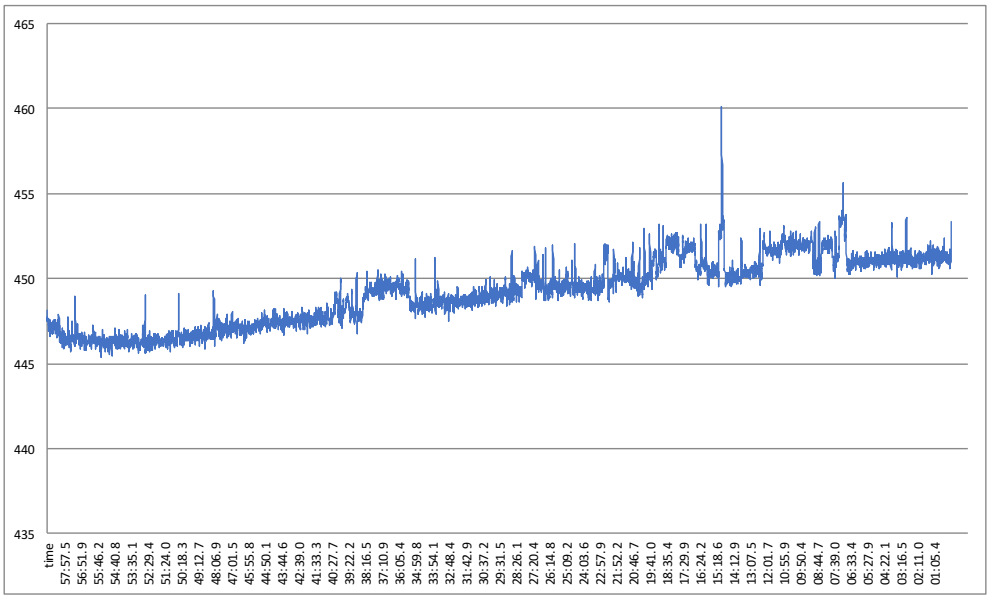

Fig. 1. Geomagnetic norm in front of the elevator

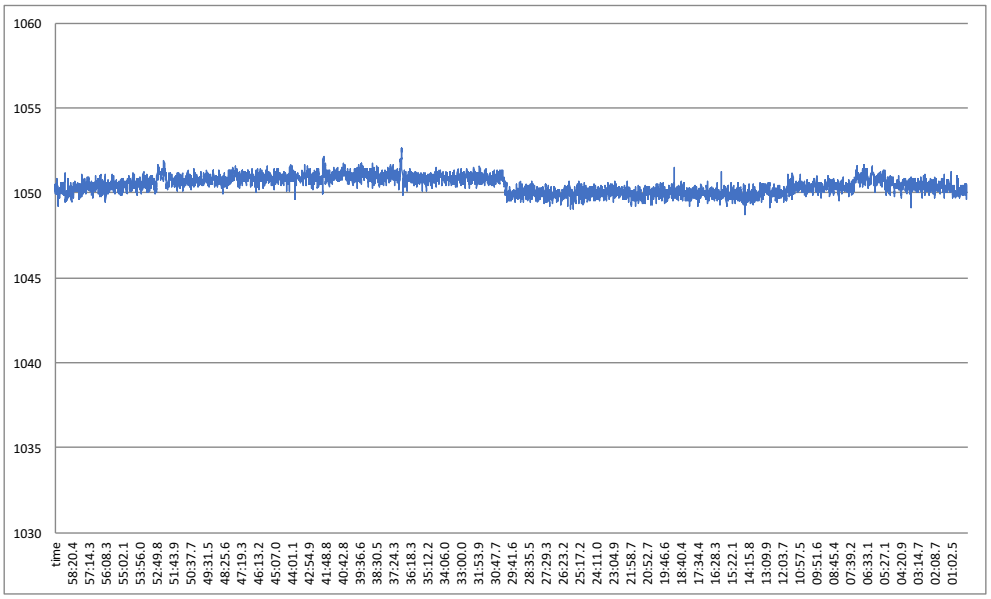

Fig. 2. Geomagnetic norm at 1m away front of the elevator

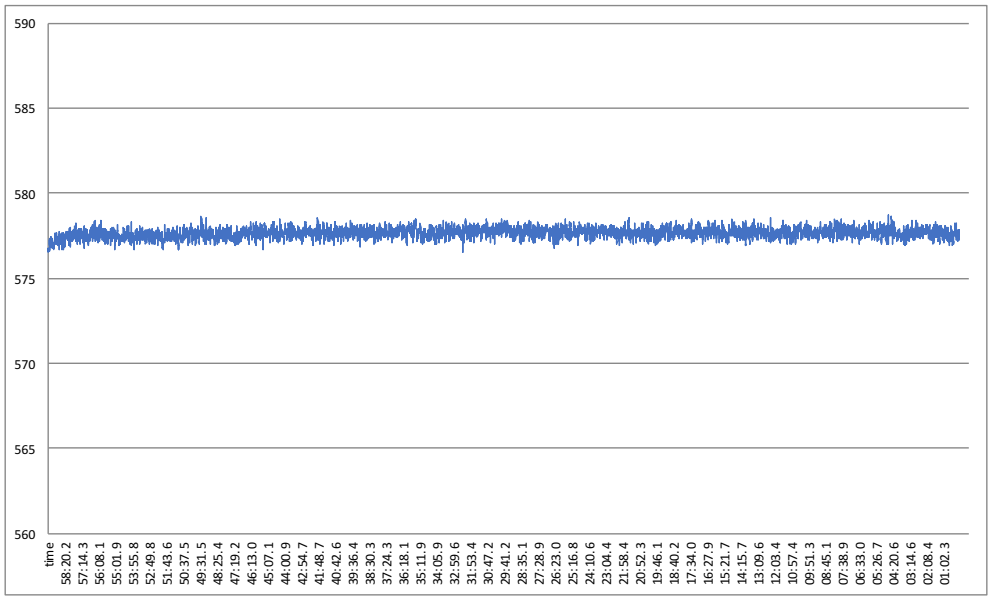

Fig. 3. Geomagnetic norm in front of the printer

5 Summary

Experiments were conducted by considering that the geomagnetic value used in fingerprinting changes in a short time due to external factors. Using the Android device, we acquired geomagnetism for 1 hour in front of the elevator and in front of the printer where short-term changes in geomagnetism are likely to be seen. In areas considered within the university there is no large geomagnetic change and it seems unnecessary to have multiple maps. Since we observe geomagnetic fluctuation in the concourse of the subway in the past, we will investigate the fields that are likely to be more fluctuating in the future.

Acknowledgment

This work was supported by JSPS KAKENHI Grant Number JP16K00147.

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