Development of a Transportation Mode Identification Method Using Smart Phone Movement History Information

MATSUSHIMA Toshikazu, Guest Research Engineer
HASHIMOTO Hiroyoshi(Dr. Eng.), Senior Researcher
TAKAMIYA Susumu (Dr. Arts & Science), Head
Road Division, Road Traffic Department

(Key words) Smart phone, traffic behavior survey, transportation mode identification

1. Introduction

The spread of smart phones permits traffic behavior surveys based on smart phone applications (below "smart-phone surveys") to be performed more easily with the agreement of survey participants, and it is now possible to efficiently obtain movement history information. At the data utilization stage, it is necessary to analyze traffic behavior by transportation mode, so a method of identifying transportation mode based on movement history information has been developed.

2. Outline of the transportation mode identification method

This report introduces a method of identifying transportation mode using latitude/longitude and acceleration from among movement history information (GPS etc. sensor information) automatically obtainable by a smart-phone survey.

First, latitude/longitude and acceleration data during movement are resolved in units of 10 seconds. Walking and driving are identified focusing on the characteristics of the acceleration waveform of each unit. As shown by Figure 1, in the case of a high amplitude cyclic waveform, the unit is identified as walking (pedometer mechanism). In a case not identified as walking, but where relatively high frequency shaking is detected, it is identified as cycling.

Next, continuous units that were not identified as walking or cycling are integrated to focus on characteristics of movement path. Based on the degree of turning and conformity with the bus route network or the railway route network, the units are identified as either bus or railway travel (Figure 2 is an example of movement identified as bus travel). If units could not be identified as bus or railway travel, they are identified as driving.

3. Verification using results of a smart phone survey in Tsukuba City

In November 2013, the method was applied to data from the results of a smart phone survey done in cooperation with Tsukuba city and Tsukuba University (history of one day's movement of 1,400 people (workers and students) living in Tsukuba City). As a result, as shown in Table 1, the accuracy rate in the transportation mode identification results based on transportation mode recorded by the participants was about 80%.

4. In Conclusion

We developed a transportation mode identification method and confirmed its usefulness. If it is possible to automatically identify transportation mode, participants in smart-phone surveys do not have to record their transportation mode, contributing to more frequent larger scale surveys. In the future, we will conduct research to improve smart phone surveys by applying the transportation mode identification method for its practical use.

Figure 1 Walking acceleration waveform

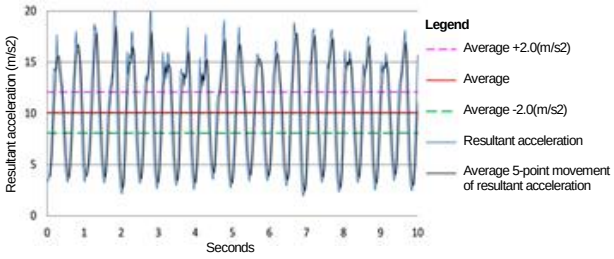

Figure 2 Example of movement identified as bus travel

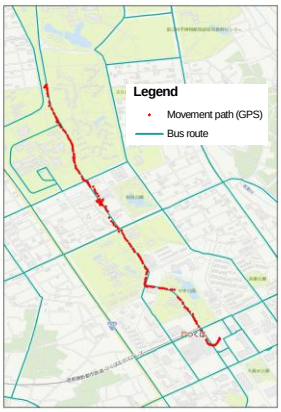

Table 1 Accuracy rate of transportation mode identification

Rate (%)		Movement means identification results					
		Walking	Cycling	Driving	Bus travel	Railway travel	Total
Participants response	Walking	87.4	4.2	3.9	2.1	2.4	100.0
	Cycling	10.1	76.1	11.7	1.9	0.2	100.0
	Driving	3.5	1.0	82.8	12.4	0.4	100.0
	Bus travel	7.4	1.3	34.3	55.7	1.4	100.0
	Railway travel	7.7	0.1	10.9	2.9	78.4	100.0