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Sensing Vehicle Conditions for Detecting Driving Behaviors

Springer

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Preface

As more vehicles take part in the transportation system in recent years, driving or taking vehicles has become an inseparable part of our daily life. However, the increasing number of vehicles on the roads brings more traffic issues including crashes and congestions, which make it necessary to sense vehicle conditions and detect driving behaviors for both drivers and other participants in the transportation system. For example, sensing lane information of vehicles in real time can be assisted with the navigators to avoid unnecessary detours, and acquiring instant vehicle speed is desirable to many important vehicular applications, such as vehicle localization, and building intelligent transportation systems. Moreover, if the driving behaviors of drivers, such as inattentive and drunk driving, can be detected and warned in time, a large part of traffic accidents can be prevented. In addition, vehicle dynamics and driving behaviors can also be applied in the way of crowd sensing to help the traffic planers analyze the traffic conditions and make proper decisions.

For sensing vehicle dynamics and detecting driving behaviors, traditional approaches are grounded on the built-in infrastructure in vehicles, such as infrared sensors and radars, or additional hardware like EEG devices and alcohol sensors. However, currently, only the high-end vehicles are equipped with such a built-in infrastructure, and the implementation of additional devices could be less convenient and costly. With the tremendous development of mobile devices in recent years, this book provides a different approach by utilizing the built-in sensors of smartphones to sense vehicle dynamics and detect driving behaviors.

The book begins by introducing the concept of smartphone sensing, and also presenting the motivation behind the book and summarizing our contributions to the book. After that, in Chap. 2, we propose approaches utilizing built-in sensors in smartphones for sensing vehicle dynamics. In this chapter, we begin with sensor data processing including coordinate alignment and data filtering, then the sensing data are exploited to detect various vehicle dynamics, including moving, driving on uneven road, turning, changing lanes, and the instant speed of vehicles. In Chap. 3, we discuss the detection of abnormal driving behavior by sensing vehicle dynamics. Specifically, we propose a fine-grained abnormal *D*riving behavior *D*etection and i*D*entification system, D^3, to perform real-time high-accurate abnormal driving

behaviors monitoring using the built-in motion sensors in smartphones. D^3 system is evaluated in real driving environments with multiple drivers driving for months. In Chap. 4, we exploit the feasibility to recognize abnormal driving events of drivers at early stage. In real driving environment, providing detection results after an abnormal driving behavior is finished is not sufficient for alerting the driver and avoiding car accidents. Thus, early recognition of inattentive driving is the key to improve driving safety and reduce the possibility of car accidents. Specifically, we developed an *E*arly *R*ecognition system, ER, which recognizes inattentive driving events at an early stage and provides timely alerts to drivers, leveraging built-in audio devices on smartphones. ER system is evaluated in real driving environments with multiple drivers driving for months. In Chap. 5, we provide an overview of the state-of-the-art researches. Finally, conclusions and future directions are presented in Chap. 6.

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