Chapter 9
Design and Implementation of Vehicle Navigation Systems

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ABSTRACT

Vehicle Navigation System (VNS) is a complicated and integrated system. A reliable vehicle navigation system should integrate the wireless communication technologies, positioning technologies, embedded computer, geographic information database, and so on. The major purpose of the chapter is to help understanding the architecture of vehicle navigation system. This chapter first introduces the system requirements and system analysis, and show the system platform of vehicle navigation system. The system platform can be divided into six components. There are the digital map database, positioning devices, map-matching process, route planning process, route guidance process, human-machine interface, and wireless communication interface. The design issues and system communication of these components are detail illustrated in the chapter. Finally, the authors also present some vehicle navigation systems proposed in the past few years, and show the difference of these systems. The aim of vehicle navigation system is to guide the vehicle along the optimal path from the starting point to destination. A reliable vehicle navigation system can reduce the traffic chaos in the city and improve the transportation delay. In order to achieve reliable vehicle navigation system, the detail system requirements, system analysis, and system architecture are shown in the chapter. Each component of vehicle navigation system is briefly illustrated, and the system communication is also described. The authors also present the architecture of the proposed vehicle navigation system, and show the difference of these systems. Therefore this chapter helps understanding the architecture of vehicle navigation system.

INTRODUCTION

The aim of navigation system is to detect the position of the vehicle, track the vehicle and control the movement of the vehicle from one place to another. The location techniques and the map are two important components in the navigation system. In Age of Exploration, the shipman records their position on the chart and pilots their courses according the compass, sextant, and chronometer. After World War II, the radar technique is implemented to identify the range, altitude, direction, or speed of both moving and fixed objects. The radar technique is also involved in the modem navigation system in order to improve the correctness of the vehicle position, and sailing safety. In recent years, with the development of global positioning technology, electronic technology, and wireless communication technology, the size of navigation system becomes smaller and can be carried on a bus, truck or car. Thus, the automotive navigation system had been proposed to guide vehicles in its location using digital map display. Moreover, with rapid increment of automotives, the urban traffic becomes much more crowed and the traffic chaos is a serious problem in many cities. Therefore, how to design a vehicle navigation system in order to reduce the traffic chaos and improve the transportation delay is a critical problem. In the chapter, the detail architecture of vehicle navigation system is illustrated.

THE DESIGN OF VEHICLE NAVIGATION SYSTEMS

The development process of an information system should involve the system requirements, system analysis, system design, system construction, system testing, and system maintenance tasks. This chapter will focus on the system analysis, system requirements, and system design of the vehicle navigation system.

System Requirements

Let's consider a scenario that a visitor is driving in a strange city, how can he know his position and plan the driving path to the targeted place based on his tourist map? Getting lost is a nightmare for each visitor. Thus, the system requirements for the tourist and the strange driver are shown as below (Zhao, 1997):

a. Shows the correct position of the current vehicle or destination on the digital map;
b. Plans the shortest/fastest route from the current position to the destination and show on the digital map;
c. Guides the drivers along the planned route;
d. Tracks the vehicle on the digital map;
e. Easy and safety to use;
f. Shows the real-time traffic information (emergency or congestion) on the monitor;
g. Re-plan routers based on emergency information or congestion information. Moreover, more system requirements shown as below had been proposed in the investigation results for the Taiwanese drivers .
h. Shows the warning message of the speed traps or the over speed limit;
i. Shows the park area and the gas station on the digital map;
j. Shows the shopping/restaurant information on the digital map;
k. Shows the tourist information on the digital map;
l. Shows the Road-Side service;
m. Reports the traffic accident; Summarize these system requirements, the basic system requirements can be shown as the following:
n. The function to show the location of the current vehicle or destination on the digital map;

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