

Preface

Have you ever wondered why navigation systems have become so popular over the past several years? Do you know why navigation services are becoming commonplace on mobile devices, particularly smartphones? The answer to these questions is that with advanced technologies, no one has to get lost while travelling from one location to another.

Mobility, or navigation, is a daily activity for all people everywhere, regardless of geographic location, mode of travel, time and duration of travel, travel needs, or travel purposes. Navigation can be a daunting task as transportation networks have become very large and complex over time. Large transportation networks mean increased ambiguities and difficult decisions to be made while in transit. Navigation could be further exacerbated when travelers are unfamiliar with their traveling environments. Ambiguities and navigation decisions, which may involve the whereabouts of an individual at any time during a trip or the step-by-step directions to be followed during a trip, have produced a need for navigation devices to provide navigation assistance.

Devices to assist with navigation have been around for decades and over that period, a wide range of technologies such as geo-positioning sensors, mobile computing, and wireless communications have evolved. Of these technologies, the Global Positioning System (GPS) mainly due to its pervasive nature, has had the most impact on navigation systems and services. This impact has been so profound that GPS has become synonymous with navigation, while in reality, it is only one of several components within a navigation system. Today, there are devices for outdoor navigation assistance such as in-car navigation systems (offered as an extra in some vehicles), portable navigation systems (mobile devices assisting drivers), and navigation services (provided on cell phones and smartphones). While early navigation systems and services provided navigation assistance only for those in vehicles, there are emerging outdoor navigation systems and services to assist pedestrians with their navigation needs. In addition, we have seen the introduction of navigation systems and services to assist people in indoor wayfinding. While navigation systems and services for outdoors and indoors are conceptually and operationally similar, they are dissimilar with respect to the type of technologies and map databases they need to operate. For example, outdoor navigation systems and services

are predominantly based on GPS for positioning cars and people, but GPS is not available or effective for indoor navigation systems and services; instead WiFi, one common geo-positioning sensor for indoor navigation, is used.

In this book, the current trends and future directions in navigation technology aimed at providing navigation assistance are discussed and analyzed. The book contains eight chapters covering topics on and related to navigation technology and navigation trends, research directions, issues, and challenges.

Chapter 1 discusses navigation technology from its early development to contemporary systems and services. The chapter starts with a historical perspective, providing an overview of the evolution of navigation technology, and discusses the specific characteristics of navigation environments, technological advances, and the challenges facing navigation technology in terms of indoor/outdoor travel and information sources. In particular, the similarities and differences between outdoor and indoor navigation systems and services are compared and analyzed. The chapter also discusses the shortcomings of current navigation systems and services, and briefly presents the concept of universal navigation and its potential to overcome those shortcomings.

Chapter 2 discusses outdoor navigation in detail. It starts by describing the information flow in outdoor navigation systems and highlighting the main components of navigation systems including geo-positioning, map matching, geocoding, mapping, routing, and directions. The three main technologies, i.e., geo-positioning, wireless communication, and database, supporting outdoor navigation systems are examined. This is followed by descriptions of the typical functions performed in these systems. The chapter ends with a discussion of usability in outdoor navigation systems.

Chapter 3 provides an in-depth exploration of indoor navigation, including the three primary technologies, i.e., geo-positioning, wireless communication, and database, of indoor navigation systems. This chapter goes on to describe the typical functions performed in these systems and concludes with a discussion of usability in indoor navigation systems.

Chapter 4 presents the concept and technologies of Universal NAVigation Technology (UNAVIT), which can provide navigation assistance anywhere, anytime, and for any user. The chapter discusses the UNAVIT's capabilities, as well as an ontology. The features of UNAVIT, assistance for travel anywhere, anytime, by any user, in any mode of travel automatically and adaptively, are discussed. A possible architecture for UNAVIT is described, outlining the various components of such a system. The chapter also looks at information flow in UNAVIT for smartphones (Android and iPhone) and Web Mapping Services (e.g., Google Maps, Bing Maps, Yahoo Maps).

Chapter 5 details the anywhere feature of UNAVIT. It begins with an ontology highlighting the concepts of anywhere navigation and the relationships among those concepts. Then, the different categories of anywhere navigation are analyzed: indoor navigation, outdoor navigation, indoor-outdoor navigation, outdoor-indoor navigation, and indoor-outdoor-indoor navigation. Two algorithms, one for naviga-

tion from outdoor to indoor and another for navigation from indoor to outdoor, are described and analyzed.

Chapter 6 examines the anytime feature of UNAVIT, discussing how navigation assistance could be affected by time of day, day of week, and the season. An ontology to highlight the concepts in anytime navigation and the relationships among them is presented. The chapter also describes an algorithm that addresses navigation assistance based on different times and situations.

Chapter 7 discusses the anyuser feature of UNAVIT at a deeper level. The categories of users (general population, mobility-impaired, visually-impaired, cognitively-impaired, elderly) are discussed. The chapter presents an ontology to highlight the different needs and preferences of each category of users and describes an algorithm to address the needs and preferences of each of those users.

Chapter 8 presents social navigation networks (SoNavNets) as a new method for providing navigation assistance. The chapter starts by defining location-based social networks, a new approach to providing location-based services through social networks. An ontology for SoNavNets, along with algorithms for request and recommendation, are outlined. To better understand the components and capabilities of this new approach, a social navigation network (SoNavNet) system, developed by the author in the Geoinformatics Laboratory of the School of Information Sciences at the University of Pittsburgh, is presented. The chapter discusses and analyzes the differences between the model-centric navigation assistance (the current computing approach) and the experience-centric navigation assistance (the SoNavNet approach) where members share navigation experiences with others.



<http://www.springer.com/978-1-4419-7740-3>

Universal Navigation on Smartphones

Karimi, H.A.

2011, X, 157 p., Hardcover

ISBN: 978-1-4419-7740-3