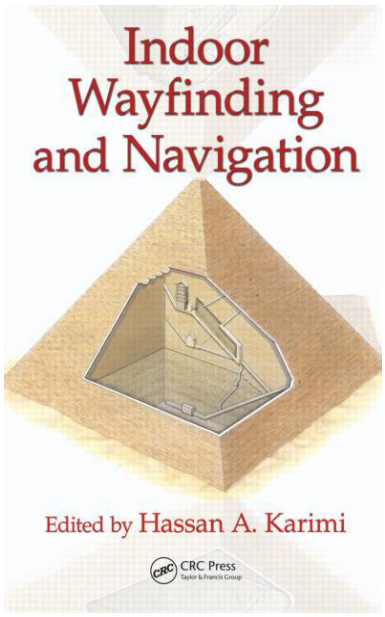

Indoor Wayfinding and Navigation

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Outdoor wayfinding and navigation systems and services mainly rely on ubiquitous signals from Global Navigation Satellite Systems (GNSS). The absence of GNSS signals within indoor and underground/under-water environments makes wayfinding and navigation through such surroundings a more challenging problem. The challenge is also amplified by the freedom of the individuals to move in 3D within an indoor environment in contrast to the restricted 2D motion of pedestrians and vehicles outdoors. This book, which is comprised of eleven chapters, discusses the cognitive, positioning, mapping, and applications aspects of indoor wayfinding and navigation.

The cognitive aspects of wayfinding and navigation are discussed in the first two chapters, where Chapter 1 provides an aggregated view of what makes indoor environment different from outdoor and transitional surroundings with the aim of guiding further research and tools in indoor wayfinding. New virtual reality studies on learning/navigating through indoor spaces using simple or complex routes under motivated and control conditions are presented in Chapter 2. These studies highlight the importance of considering rout complexity in developing built environments.

Chapters 3, 4, and 5 present several localization technologies for indoor and underground environments. Indoor technologies – such as Wi-Fi, Bluetooth, Radio-Frequency Identifier (RFID), dead reckoning, and acoustic technologies – are presented in Chapter 3. To mitigate the signal propagation errors due to attenuation, shadowing, multipath effects, signal delays of electromagnetic waves-based indoor positioning technologies, Chapter 4 presents a magnetic-based positioning system. This proposed technology is motivated by the fact that magnetic signals are able to pass through building material without propagation errors, even in non-line-of-sight scenarios. Chapter 5 presents a research effort for the development of a positioning system for underground tunnel, with particular emphasis on the case of the Large Hadron Collider (LHC) at the European Organization for Nuclear Research (CERN). Chapter 6 highlights the details of how to generate, represent, and use probabilistic maps for indoor localization while relying on inertial sensors.

A unique aspect of this book is dedicating Chapters 7, 8, 9, and 10 to the discussion and analysis of wayfinding and navigation requirements for Blind and Visually Impaired (B/VI) individuals. Using findings from several years of needs' assessment conducted by relevant experts, Chapter 7 outlines the needs and challenges for indoor wayfinding and navigation faced by B/VI individuals. State-of-the-art in assistive technology solutions for enabling B/VI individuals to navigate unfamiliar indoor environments are presented in Chapter 8. The Chapter also identifies the gaps in existing approaches and explores technical challenges in bridging these gaps. Chapter 9 presents the "NavPal" computing technology tools to enhance the safety and independence of B/VI individuals navigating unfamiliar indoor environments. These tools combine a variety of techniques and technologies including robots, crowd-sourcing, advanced path planning, and multimodal interfaces. The last of these chapter series examines several interesting short-term and long-term directions of future research related to wayfinding and navigation tools to assist blind travelers.

The last Chapter of this book introduces the risks and threats related to indoor positioning systems and the state-of-the-art countermeasures to protect against them. The chapter also discusses the technical challenges in applying such protection mechanisms and their applicability in the context of indoor wayfinding and navigation systems.

This book would be of interest to anyone concerned with gaining high-level knowledge related to approaches, sensors, techniques, technologies, and applications for indoor wayfinding and navigation. The book presents interesting discussions related to these aspects with unique emphasis on wayfinding and navigation for B/VI individuals and related privacy issues/challenges. Discussions related to vision-based systems for wayfinding and navigation would have made this book more comprehensive. Gained knowledge through this book will constitute an essential step towards the path of designing indoor wayfinding and navigation systems/services for multiple uses and users.

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