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A Centralized System Approach to Indoor Navigation for the Visually Impaired

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People who are Blind or Visually Impaired (BVI) have one goal in common: navigate through unfamiliar indoor environments without the intervention of a human guide. The number of blind people in the world is not accurately known at the present, however, based on the 2010 Global Data on Visual Impairments, World Health Organization, approximately 285 million people are estimated to be visually impaired worldwide: 39 million are blind and 246 have low vision, 90% in developing countries, with 82% of blind people aged 50 and above. Available extrapolated statistics about blindness in some countries in the Middle East show ~102,618 in Iraq, ~5,358 in Gaza strip, ~22,692 in Jordan, ~9,129 in Kuwait, ~104,321 in Saudi Arabia, and ~10,207 in the United Arab Emirates. These statistics reveal the importance of developing a useful, accurate, and easy to use navigation system to help this large population of disabled people in their everyday lives. Various commercial products are available to navigate BVI people in outdoor environments based on the Global Positioning System (GPS) where the receiver must has a clear view of the sky. Indoor geo-location, on the other hand, is much more challenging because objects surrounding the user can block or interfere with the GPS signal.

In this paper, we present a centralized wireless indoor navigation system to aid the BVI. The system is designed not only to accurately locate, track, and navigate the user, but to also find the safest travel path and easily communicate with the BVI. A centralized approach is adopted because of the lack of research in this area. Some proposed navigation systems require users to inconveniently carry heavy navigation devices; some require administrators to install a complex network of sensors throughout a building; and others are simply impractical in practice. The system consists of four major components: 1) Wireless Positioning Subsystem, 2) Visual Indoor Modeling Interface, 3) Guidance and Navigation Subsystem, and 4) Path-Finding Subsystem. The system is designed not only to accurately locate, track, and navigate the user, but to also find the safest travel path and easily communicate with the BVI. A significant part of the navigation system is the virtual modeling of the building and the design of the path-finding algorithms, which will be the main focus of this research. Ultimately, the proposed system provides the design and building blocks for a fully functional package that can be used to build a complete centralized indoor navigation system, from creating the virtual models for buildings to tracking and interacting with BVI users over the network.

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