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Seamless Indoor-Outdoor Transitioning of Pedestrian Platforms

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The interest in indoor positioning systems has been rising in the last couple of decades. This interest was further accelerated by the availability of signals of opportunity. The introduction of signals of opportunity into the indoor environments has meant that these widely available technologies can be utilised to achieve higher levels of accuracy and precision for positioning in parking garages, airports, underground locations, large office buildings, and shopping centres. Indoor positioning can also be utilised for emergency services or for Building Information Models (BIM) for purposes such as construction sites or hospital building management. In addition to the need for indoor and outdoor positioning, there is a need to ensure seamless transitions in and out of these different environments. For example, building information from BIM could be utilised for navigation of BIM users that considers the architectural barriers (e.g., for wheelchairs, baby strollers, and transport of large equipment within the facility). For this, a positioning system capable of seamlessly transitioning in and out of buildings is needed. This paper proposes a multi-sensor and cooperative positioning method of seamless environment transition and presents the first architecture concept. For this purpose, Global Navigation Satellite System (GNSS) data are planned to be fused with Ultra Wide-Band (UWB), Inertial Measurement Unit (IMU), Wireless-Fidelity (Wi-Fi), visual camera and LiDAR (Light Detection and Ranging) data. All sensors required for such a positioning system, are already available on modern smartphones commonly used as low-cost platforms for pedestrian navigation and localisation. Newer smartphones are also equipped with LiDAR and UWB chips, which are a future signal of opportunity, just like Wi-Fi currently is. The transition to different environments will be determined based on the UWB anchors called identical anchors that will be used to transition from the global coordinate system for the outdoor environment to the local building environment for positioning in indoor environments. The proposed multi-sensor and cooperative positioning system is expected to be able to achieve decimetre-level accuracy.