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Development of an Indoor Positioning and Navigation System using Wi-Fi network and BLE beacons for the Smart Campus: A case study

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Nowadays, powerful hand-held devices, like smartphones, tablets and smartwatches, are ordinary things, which many people take anywhere they go. One of the major advantages of this technology is the ability to locate its user by means of GNSS or cellular positioning. Paired with popular, free mobile mapping applications, it greatly simplifies the problem of finding oneself in the unknown place, calculating the best route to one's destination by various means of transport or tracking one's movement. For this reason, outdoor navigation is a well-established and widespread technology. The problem arises, when positioning and wayfinding are needed in a GNSS-denied environment, e.g. a building or a mine. In a complex, large or multi-floor constructions modern techniques for easing the navigation through them are rarely applied. Recent years brought numerous new, promising approaches and algorithms for solving a problem of indoor positioning and navigation, but many of them can't be easily implemented on a typical smartphone or conveniently used. This includes Simultaneous Localization and Mapping (SLAM) and algorithms based on Augmented Reality (AR). It seems that the most feasible and cost-efficient methods are those based on Wi-Fi Access Point (AP), low-cost Bluetooth Low Energy (BLE) or Ultra-Wideband (UWB) beacons. This research aims to describe the process of developing such an Indoor Positioning and Navigation System in one of the buildings, located on the campus of the Wroclaw University of Science and Technology, and identify the main challenges that have to be overcome during this process. Feasibility of available GIS software solutions for this application is analyzed. Directions for future research and development are discussed.