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Improving Fingerprinting-Based Localization System Using Generative AI

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Abstract : A precise localization system is crucial for many artificial intelligence Internet of Things (AI-IoT) applications in the era of smart cities. Their applications include traffic monitoring, emergency alarming, environmental monitoring, location-based advertising, intelligent transportation, and smart health care. The most common method for providing continuous positioning services in outdoor environments is by using a global navigation satellite system (GNSS). Due to nonline-of-sight, multipath, and weather conditions, GNSS systems do not perform well in dense urban, urban, and suburban areas.This paper proposes a generative AI-based positioning scheme for large-scale wireless settings using fingerprinting techniques. In this article, we presented a semi-supervised deep convolutional generative adversarial network (S-DCGAN)-based radio map construction method for real-time device localization. It also employed a reliable signal fingerprint feature extraction method with t-distributed stochastic neighbor embedding (t-SNE), which extracts dominant features while eliminating noise from hybrid WLAN and long-term evolution (LTE) fingerprints. The proposed scheme reduced the workload of site surveying required to build the fingerprint database by up to 78.5% and significantly improved positioning accuracy. The results show that the average positioning error of GAILoc is less than 0.39 m, and more than 90% of the errors are less than 0.82 m. According to numerical results, SRCLoc improves positioning performance and reduces radio map construction costs significantly compared to traditional methods.

Keywords : location-aware services, feature extraction technique, generative adversarial network, long short-term memory, support vector machine
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