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GAILoc: Improving Fingerprinting-Based Localization System Using Generative Artificial Intelligence

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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 novel semi-supervised deep convolutional generative adversarial network (S-DCGAN)-based radio map construction method for real-time device localization. We 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 39 cm, and more than 90% of the errors are less than 82 cm. That is, numerical results proved that, in comparison to traditional methods, the proposed SRCLoc method can significantly improve positioning performance and reduce radio map construction costs.

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