WiFi Based Indoor Localization System by Using Weighted Path Loss and Extreme Learning Machine

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1. WIFI BASED INDOOR LOCALIZATION SYSTEM

The methodology of our WiFi based indoor localization system is built upon passive cooperation of occupants only which does not interrupt the daily lives of them. Instead of modifying the hardware or software of occupants' mobile devices, we upgrade the software of the existing commercial WiFi access points (APs) in the indoor environment to WiFi sniffers, which can detect the received signal strength (RSS) of each mobile device. The RSS and MAC addresses of mobile devices are then sent to a location processor. The location processor will leverage on appropriate localization algorithms to figure out the position of each mobile device and thus its user. Based on our experimental results, our system can provide around 2m localization accuracy consistently in different indoor scenarios.

The deployment components of our system are only numbers of software upgraded WiFi APs which can cover the entire competition testbed, and a laptop as the location processor.

2. LOCALIZATION ALGORITHMS

We proposed the Weighted Path Loss (WPL) approach in [1], which can be classified as a centralized model-based localization algorithm. WPL works as follows: The distance between the mobile device and each WiFi AP is calculated based on a modified indoor path loss model in the first place. Then the estimated location of each mobile device is obtained as the summation of each WiFi AP's weighting factor (reciprocal of the distance between the mobile device and each WiFi AP) multiplied by its physical location, provided all the physical locations of the WiFi APs are known. As shown in [1], WPL approach can provide higher localization accuracy, faster estimation and more robustness than other model-based approaches. It is suitable to deliver indoor positioning services with high localization accuracy in large open indoor environment.

Besides the model-based approach, another category of localization algorithm is fingerprinting-based approach. We also proposed a fingerprinting-based localization algorithm which is based on Extreme Learning Machine (ELM) in [1]. ELM is a kind of machine learning algorithm based on a Single-hidden Layer Feedforward neural Network architecture. It has been proved to provide good generalization performance at an extremely fast learning speed. It consists of two phases: offline calibration phase and online localization phase. During the offline calibration phase, WiFi RSS fingerprints are collected at several known locations in the first place. Then, these WiFi RSS fingerprints and their physical locations are adopted as training inputs and training targets respectively to build up an ELM model for online localization. During the online localization phase, after feeding the current measured WiFi RSS data of each mobile device into the ELM model, the output given by ELM is the estimated location of each mobile device. As shown in [1], ELM has tremendous advantages in offline training time and online localization accuracy. Moreover, it can provide outstanding localization accuracy in complex indoor environment.

Appropriate localization algorithms will be integrated and leveraged to adapt various indoor scenarios during the competition.

3. REFERENCES

[1] H. Zou, H. Wang, L. Xie, and Q.-S. Jia, "An RFID indoor positioning system by using weighted path loss and extreme learning machine," in Cyber-Physical Systems, Networks, and Applications (CPSNA), 2013 IEEE International Conference on, 2013.