WiFiGenius: An Accurate and Reliable WiFi-based Indoor Localization and Navigation System

Han Zou[1], Hao Jiang[1], Xiaoxuan Lu[1], Zhenghua Chen[1], Jing Chen[1], Jianjie Zhu[1], Yiwen Luo[1], Lihua Xie[1], Yeng Chai Soh[1], Ming Jin[2], and Costas Spanos[2]
[1]Nanyang Technological University, Singapore
[2]University of California, Berkeley, CA, USA
{zouhan, jiangh, xlu010, chen0832, n1308722e, jjzhu, yluo006, eycsoh, elhxie}@ntu.edu.sg, {jinming, spanos}@berkeley.edu

1. WIFIGENIUS

Our WiFi based Indoor Positioning System (IPS) – WiFiGenius, leverage the WiFi received signal strength (RSS) of mobile device mainly to achieve accurate and reliable indoor localization. We upgrade the firmware of the existing commercial WiFi access points (APs) to allow them to collect WiFi RSS of each mobile device. The RSS and MAC addresses of mobile devices are then sent to a location server. The location server will employ on appropriate localization algorithms we proposed [1,2] to figure out the position of each mobile device and thus its user.

The deployment requirements of our system are only numbers of upgraded commercial WiFi APs which can cover the entire competition testbed, a laptop as the location server and a mobile device as the testing device. A light offline site survey will be conducted in order to construct the WiFi RSS database. Other Inertial Measurement Unit (IMU) sensors of mobile device, i.e. accelerometer, gyroscope and magnetometer, will be employed to assist and improve the performance of WiFiGenius in some particular indoor scenarios.

2. LOCALIZATION ALGORITHMS

WiFiGenius leverage four localization algorithms we have proposed, namely Weighted Path Loss (WPL), Extreme Learning Machine (ELM), integrated WPL-ELM and Online Sequential Extreme Learning Machine (OS-ELM) [1, 2].

WPL is a centralized model-based localization algorithm. It can provide higher localization accuracy, faster estimation and more robustness than other model-based approaches [1]. It is suitable to deliver indoor positioning services with high localization accuracy in large open indoor environment. ELM is a fingerprinting-based machine learning algorithm. It has tremendous advantages in offline training time and online localization accuracy. Moreover, it can provide outstanding localization accuracy in complex indoor environment as shown in [1]. WPL-ELM integrates the fast estimation of WPL and the high localization accuracy of ELM together [1].

Furthermore, we proposed OS-ELM to address the two challenging problems of the existing WiFi based IPS: the intensive costs on manpower and time for offline site survey and the inflexibility to environmental dynamics [2]. The fast learning speed of OS-ELM can reduce the time and manpower costs for the offline site survey. In the meanwhile, its online sequential learning ability enables the proposed localization algorithm to adapt in a timely manner to environmental dynamics. Based on our experimental results [2], OS-ELM can provide high localization accuracy with a fast online sequential learning speed under various environmental changes, and achieved superior performance to the existing approaches.

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

3. REFERENCES

[1] H. Zou, L. Xie, Q.-S. Jia, and H. Wang, "Platform and Algorithm Development for a RFID-Based Indoor Positioning System," *Unmanned Systems*, vol. 2, pp. 279-291, 2014.

[2] H. Zou, X. Lu, H. Jiang, and L. Xie, "A Fast and Precise Indoor Localization Algorithm Based on an Online Sequential Extreme Learning Machine", *Sensors*, vol. 15, pp. 1804-1824, 2015.