Initial Evaluation of ZigLoc: Anchor-Free Sensor Localization System using WiFi Fingerprints

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1. INTRODUCTION

Sensor network plays an important role to retrieve environmental information for IoT (Internet of Things). To minimize deployment cost of large scale indoor sensor networks, we are developing *ZigLoc*, a sensor localization system that requires no anchor deployment. In ZigLoc, sensor location is estimated using WiFi fingerprints, which are collected for a WiFi localization system. This paper briefly describes concepts of ZigLoc as well as our previous works for ZigLoc, and reports an initial experimental result.

2. ZIGLOC

Figure 1 depicts an overview of ZigLoc. WiFi APs are sending periodic beacon signals. Sensor nodes detect the beacon signals from multiple APs and measure their RSS (received signal strength) to generate an RSS vector, which is sent to a localization server. The localization server then performs fingerprinting localization [3] with the RSS vector. The localization server looks up three fingerprints nearest to the RSS vector from a WiFi fingerprint database and calculates a weighted average of the fingerprint locations to estimate sensor location.

Sensor nodes are equipped with ZigBee (IEEE 802.15.4) modules and cannot demodulate WiFi (IEEE 802.11) signals. We therefore developed a cross-technology signal extraction scheme. We have reported a WiFi AP-RSS monitor with AP recognition for sensor nodes [2]. WiFi operating channel estimator have also been developed [1] because APs automatically select their operating channels.

3. INITIAL EVALUATION

We conducted experiments to evaluate the basic performance of ZigLoc. Figure 2 depicts an experiment setup. We installed eight WNDR4300 APs from Netgear Inc. in our laboratory and collected location fingerprints using a WiFi module on MacBook Air in a $4 \times 9\,\mathrm{m}^2$ localization area with 1-meter grid spacing. We then put a sensor node at eight locations in the localization area and collected AP-RSS for one minute to estimate sensor location. ZigLoc localization was performed for 15 times at the each sensor location. As a comparison, the location of a WiFi device, which was put right beside the sensor node, was also estimated by WiFi fingerprinting localization.

Figure 3 shows ECDF (empirical cumulative distribution function) of localization errors for ZigLoc and WiFi localizations. ZigLoc and WiFi localization achieved accuracies of 7.40 m and 2.61 m respectively for 90 % of localizations. Currently, ZigLoc exhibited a low localization accuracy for practical use. The low accuracy was mainly caused by an offset between RSS derived by sensor nodes and by WiFi module due to bandwidth difference and antenna gain. We are now working on accuracy improvement.

4. ACKNOWLEDGMENTS

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5. REFERENCES

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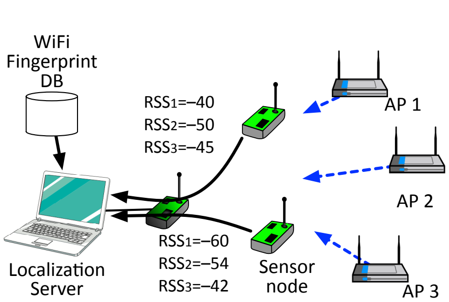

Figure 1: Overview of ZigLoc

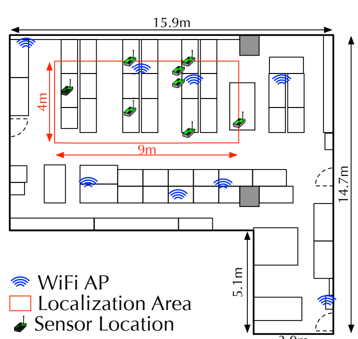

Figure 2: Experiment setup

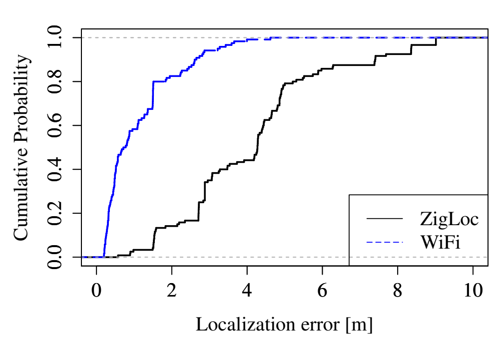

Figure 3: ECDF of localization error