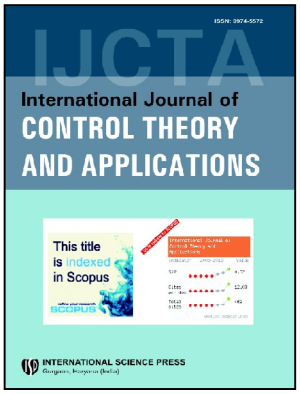

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A Study on Investigating Wi-Fi based Fingerprint indoor localization of Trivial Devices

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Abstract: Localization for trivial devices typically relies on distinct approaches for indoor and outdoor contexts, since the Global Positioning System (GPS), which is typically used for outdoors, does not perform well within buildings. A localization system supporting needs to detect indoor transitions automatically to provide seamless investigation across the different indoor positions. This paper proposes a Wi-Fi based Fingerprint method that combines RSS signal evaluation with a GPS-less sensor-based Localization scheme to provide maximal accuracy, reliability and adaptability a new environment is using Wi-Fi based Fingerprint without unnecessary power consumption.

Keywords: Wi-Fi based Fingerprint; Smart device Positioning; Indoor Positioning; Seamless Transition; Context-aware Computing, Global Positioning System

INTRODUCTION

Indoor Positioning android applications need capabilities for determining the current position of any trivial device. Smart device positioning in outdoor areas typically relies on Global Navigation Satellite Systems (GNSS) such as the Global Positioning System (GPS)[3]. Various indoor solutions have been proposed in the last few years, e.g., hybrid methods that fuse Wi-Fi fingerprinting with sensor-based Pedestrian Dead Reckoning (PDR).

Accurate indoor localization methods typically based on some infrastructure. Wi-Fi based fingerprinting [1], e.g., leverages a radio cellular mapping that contains a large set of locations with associated Radio Signal Strength Indication (RSSI) values for a set of Wi-Fi access points. To determine the current position, the radio cellular mapping is scanned for a location with a signal strength profile like that of the current location.

Other methods utilize the information contained in building models, e.g., the infrastructure, positions of doors, walls, staircases, etc. Whereas most recent research proposes outdoor indoor solutions, the problem with combining indoor and outdoor positioning is pedestrian navigation [2], has deserved far less attention. Larger areas comprising indoor ranges as well as several buildings, e.g., company, will typically be heterogeneous in the sense that a single indoor positioning method [10] which is suitable for one building might not be applicable for another that contained number of levels of stores in a building required infrastructure.

The rest of this paper is organized as follows. Related work in Section II, the Wi-Fi fingerprint-based indoor localization, in Section III. Prototype of indoor localization application In Section IV, we describe the current state of an implementation and the remaining tasks In Section V, Finally, Section VI reviews some benefits and conclusion of the presented approach, open problems, and future research plans.

RELATED WORK

Using received Signal Strength (RSS)[8] signal strength changes as an indicator for Indoor detection. Alternatively, the signal-to-noise ratio (SNR) of the received Signal Strength signal can be observed. However, continuously searching for RSS within buildings will drain the battery quickly. Moreover, the method might be unreliable and inaccurate if the signal is weak, in indoors, e.g., near a building gates. The Wi-Fi-based Fingerprint positioning technology has a very promising application prospect mainly because of the ubiquitous and inexpensive nature of Wi-Fi infrastructure. Also, Wi-Fi is widely used and integrated in various electronic devices. Thus, the Wi-Fi based Fingerprint positioning systems can also reuse these mobile devices as tracking targets to locate users, which is a less invasive way to provide location aware and position tracking services. To save power and energy, other approaches try to avoid RSS usage and rely on a restricted set of less power consuming Smartphone sensors e.g., for ambient light, cell signal, or magnetic field, battery drain considerations., IO detection [2] according to Zhou et al. is based on checking the sensor values cross empirically determined fixed thresholds. Show that an Auto-supervised machine learning approach provides a much better adaptability to different environments. Various indoor localization detection techniques have been proposed recently to meet the intensive demand for location-based tracking services. Wi-Fi Based Fingerprint- approach is one of most popular and inexpensive solution. To construct the Fingerprint database, there must be a synchronized measurement for indoor space and Fingerprint space, by this way the Fingerprints database is established. It is the indoor space measurement for the usability of Wi-Fi based fingerprint localization system. In this work, a sensor-free calibration ensign's indoor localization scheme, protocol. The main contribution of our protocol is that we don't need Indoor space measurement. Floor plan and RSS samples temporal sequence is the only requirement. The core of our method is a graph matching based manifold alignment process, which automatically finds the best correspondence between floor plan and wireless fingerprint transition structure. Without using indoor space measurement, the system deployment complexity and cost are significantly reduced. This paper proposes Wi-Fi based Fingerprint positioning systems and deploy it in a 2000m2 office environments. The evaluation has shown that our proposal can handle complex environment mapping and achieve high localization & tracking accuracy. The increase of mobile computing has projection extensive interests in location-based services, leading to an urgent need for fine-grained location. The past researches have witnessed the conceptualization and development of various wireless indoor localization techniques, including Wi-Fi RFID [12] acoustic signals ultrasound etc. Due to the wide deployment and availability of Wi-Fi infrastructure, Wi-Fi based Fingerprint indoor localization has become one of the most attractive localization techniques. Roughly speaking, a Fingerprint-based scheme consists of two stages: i). Location survey and ii). Fingerprint matching. During Location survey calibration received signal strengths (RSS) from multiple Wi-Fi access points (APs) are recorded at known locations to construct a fingerprint database. To locate a trivial device, Localization algorithms [11] are required RSS measurements against the pre-labelled records and estimate device location to be the one with the best fingerprint there is generally a trade-off between accuracy, ubiquity, and cost in designing a pervasive indoor localization system. Accuracy is being the primary challenge especially in mobile environments. Even schemes that have been reported to have very high accuracy in some instances. To investigate the root cause of limited localization accuracy. This paper proposes extensive ideas and uncovers the following characteristics of Wi-Fi fingerprint-based localization: 1) APs have different discriminatory capabilities to fingerprint a specific location since RSS changes are inversely proportional to the physical distance, subject to radio signal propagation laws. Far away APs may lead to large location estimation errors while close ones can help mitigate the location uncertainty. 2) Biased RSS measurements caused by signal fluctuation and human body blockage may present themselves as outliers in fingerprint matching. Human body blockage to Smartphone can remove line-of-sight and weaken the received signal by up to 10dB, thus greatly exaggerating the discrepancies of fingerprints measured from the same location. 3) RSS measurements may be outdated because of hardware and software limitations of commodity wireless devices. In other words, latest reported RSS values could be duplicates of previous scans performed several seconds ago. Considering device mobility, the outdated RSS could in fact be measurements done at a previous location, resulting in outdated fingerprints consisting of RSS measurements from multiple locations. In overlooking such outdated information, previous works directly compare the outdated fingerprints with those collected at a single location, incurring frequent fingerprint mismatches. The above are key reasons behind location errors of fingerprint based schemes, especially in mobile environments; yet unpredictably they have not been adequately addressed in existing works.

I. Wi-Fi based Fingerprint indoor localization

This section describes an advanced Indoor localization system that is expected to provide fast and reliable device localization without unnecessary power consumption. In the multi-scheme approach a three-level positioning architecture is described, where the top-level algorithm, called Wi-Fi based Fingerprint Indoor Localization In Wi-Fi based fingerprint based indoor localization, a well-known method of estimating device location is to find the nearest reference point using Euclidean distance in signal space. However, this paper shows that Euclidean distance is prone to error, and proposes a new method for selecting the nearest neighbor which penalizes signals from unstable access points and compensates for RSSI shifts due to various reasons. Experiments with real measurements show that the new method reduces mean error distance compared to the Euclidean distance method. The future growth in indoor location-based services (ILBS)[9] has spurred recent development of many indoor positioning techniques. Due to the absence of Global Positioning System (GPS) signal, many other signals have been proposed for indoor usage. Among them, Wi-Fi emerges as a promising one due to the pervasive deployment of wireless LANs (WLANs)[13]. Wi-Fi fingerprinting has been given much attention recently because it does not require line-of-sight measurement of access points (APs) and achieves wide range of applicability in complex indoor environment. This survey overviews recent advances on two major areas of Wi-Fi based fingerprint localization: advanced localization techniques and efficient system deployment. Regarding advanced techniques to localize device, this paper presents how to make use of temporal or spatial signal patterns, device collaboration, and motion sensors. Regarding efficient system deployment, this paper discusses recent advances on reducing offline labor-intensive survey, adapting to fingerprint changes, calibrating heterogeneous devices for signal collection, and achieving energy efficiency for smart phones. This study and compare the approaches through our deployment experiences, and discuss some future directions. Wi-Fi-based indoor localization has focused more interest recently, because buildings are getting equipped with Wi-Fi access points for connectivity. Using these access points as location indicators removes the need for additional infrastructure cost. A widely-used technique is called the Wi-Fi based Finger Print localization when using the fingerprint-based method, a commonly used method of estimating device location is to find the nearest reference point, using the Euclidean distance in signal space. The difficulty with Euclidean distance method is that it is prone to error, especially when Wi-Fi access points are unstable: Some access points may be active when generating radio map and not active when the device estimates its location. The situation could be the other way around. Even if an access point is active, the device may not receive signal due to some difficulties such as collisions. When the signal strengths from unstable access points are fed into the standard estimation algorithm, they can lead to serious estimation difficulties. Also, an observation is made that RSSIs from access points can be shifted due to various reasons such as user device height and way of holding the Smart phones. Thus, we need location estimation techniques that penalize unstable access points, and compensates for RSSI signals. In this paper, a new estimation method is designed under these criteria, and is shown to provide higher accuracy compared to the original Euclidean distance-based algorithm.

II. PROTOTYPE OF INDOOR LOCALIZATION PPLICATION

To perform this work, a prototype of an indoor positioning system is designed that works entirely on the user’s device (without requirement to have a back-end server). The software allows determining the position of the

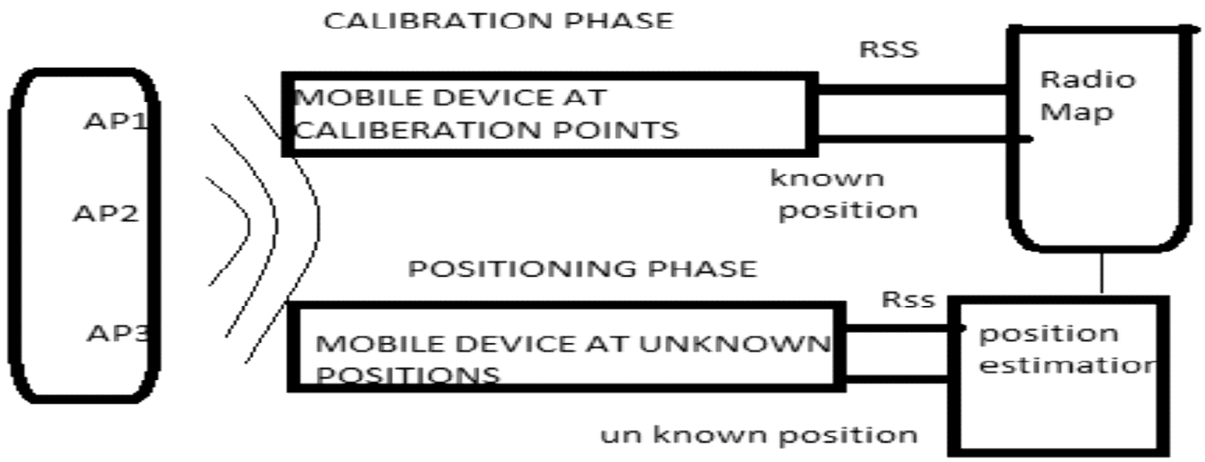

Figure 1: The two phases of location fingerprinting

device using a prepared radio map and device built-in Wi-Fi chipset. The proposed software works in the two location fingerprinting phases – calibration phase and positioning phase[3].

In calibration phase, the proposed application has the following functionality: 1) load and view map of the building; 2) Show the list of all available APs and their current RSS in the current position; 3) perform fingerprinting by tapping on the current position in the map. Functionality in the positioning phase: 1) load and view map of the building; 2) estimate position: in form of coordinates as well as a point on the loaded map and positioning algorithm is required.

III. STATUS AND REMAINING TASKS

After several researches and development, location-aware services have gradually emerged into real life. They assist human activities in a wide range of applications, from productivity and goal fulfillment to social networking and entertainment. Conventional, location-aware applications have been confined to outdoor environments. Relatively less research has explored the potential applicability of similar services for indoor settings. However, in large indoor environments such as huge buildings, airports, libraries, railway stations or shopping malls, location-awareness can increase the quality of service provided by these facilities. Large scale fulfillment of indoor location-awareness is much more difficult due to two technical challenges. First, GPS cannot be applicable for indoor use because GPS signals cannot reach indoor receivers. Second and more importantly, due to different indoor environments such as building geometries, the movement of people, and the random effects of signal propagation, triangulation based approaches are much less effective. In addition, intrusion and noise from other devices can also delimit the accuracy of positioning. On the other hand, these challenges provide researchers with great opportunities for innovative indoor positioning methods. Some early indoor positioning technologies used infrared, laser, and/or ultrasonic range finders, yielding good system performance in field tests. The disadvantages of such an approach are its size, complexity, and cost, which render it infeasible for mobile devices. Several researchers have been working on using Wi-Fi infrastructure for indoor positioning, even though it was not specifically designed for this purpose. Due to the infeasibility of indoor Triangulation, most of these systems use a fingerprinting approach based on the Received Signal Strength (RSS) transmitted by nearby Wi-Fi access points. Typically, such an approach consists of a training phase and a positioning phase. In the Location phase, each survey position is characterized by location-related Wi-Fi RSS properties called Wi-Fi RSS fingerprints. During the positioning phase, the position likelihood is calculated based on the current Wi-Fi RSS [11] measurements. For Wi-Fi fingerprinting, fine-grained system training is normally required to achieve high accuracy and resolution. This results in significant costs in terms of initial configuration and ongoing maintenance to continuously adapt to environmental changes and Wi-Fi infrastructure alterations. Such alterations are not uncommon due to system Malfunctions, equipment upgrades, or simply turning on and off Wi-Fi access points controlled by individual users. A great deal of effort has been made by researchers to reduce such costs. A potentially effective way.

IV. CONCLUSION AND FUTURE WORK

The In indoor localization system, the location estimation algorithm should not only produce lowerror answers, but also be resilient to real-life events such as unstable access points. The Euclidean distance-based nearest neighbor selection method is prone to error when unstable access points are present. Also, RSSI signals can occur due to various reasons such as how users hold the Smartphone. We propose location estimation techniques that penalize unstable access points, as well as compensates for RSSI signals. The performance evaluation from real measurements shows that the proposed algorithm reduces localization errors compared to the original Euclidean distance-based algorithm. While Wi-Fi fingerprint-based localization acts as the dominant scheme in indoor localization, the accuracy challenge remains a primary concern. In this paper, we identify several crucial causes of localization errors in fingerprint-based schemes. These observations then lead us to the design of a new Wi-Fi finger printing scheme which successfully reduces the mean and 95th percentile location errors to 2 meters and 5.5 meters, without degrading ubiquity or increasing the costs. Our approach marks a significant progress in RSS finger print based indoor localization, especially for smart phones, and sheds lights on practical deployment in the real world.

REFERENCES

[1] M. Jager,¨ S. Suß,¨ and N. Becker, "Multi-scheme smartphone localization with autoadaptive dead reckoning," International Journal on Advances in Systems and Measurements, vol. 8, no. 3 / 4, pp. 255–267, 2015.

[2] R. Hansen, R. Wind, C. S. Jensen, and B. Thomsen, "Seamless indoor/outdoor positioning handover for location-based services in streamspin," in 2009 Tenth International Conferences.

[3] Y. Kim, S. Lee, S. Lee, and H. Cha, "A GPS sensing strategy for accurate and energyefficient outdoor-to-indoor handover in seamless localization systems," Mobile Information Systems, vol. 8, no. 4, pp. 315–332, 2012.

[4] P. Zhou, Y. Zheng, Z. Li, M. Li, and G. Shen, "Iodetector: A generic service for indoor outdoor detection," in Proceedings of the 10th

[5] V. Radu, P. Katsikouli, R. Sarkar, and M. K. Marina, "A semi-supervised learning approach for robust indoor-outdoor detection with smartphones," in Proceedings of the 12th ACM Conference.

[6] M. Wu, P. H. Pathak, and P. Mohapatra, "Monitoring building door events using barometer sensor in smartphones," in Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing. New York, NY, USA: ACM, 2015, pp. 319–323.

[7] A. Overeem *et al.*, "Crowdsourcing urban air temperatures from smartphone battery temperatures," Geophysical Research Letters, vol. 40, no. 15, pp. 4081–4085, 2013.

[8] P. Bahl and V. N. Padmanabhan, "RADAR: an in-building RF-based user location and tracking system," in Proceedings of IEEE INFOCOM, 2000, pp. 775–784.

[9] L. M. Ni, Y. Liu, Y. C. Lau, and A. P. Patil, "LANDMARC: indoor location sensing using active RFID," Wireless Networks, vol. 10, no. 6,pp. 701–710, 2004.

[10] S. P. Tarzia, P. A. Dinda, R. P. Dick, and G. Memik, "Indoor localization without infrastructure using the acoustic background spectrum," in Proceedings of ACM MobiSys, 2011, pp. 155–168.

[11] K. Liu, X. Liu, and X. Li, "Guoguo: Enabling fine-grained indoor localization via smartphone," in Proceedings of ACM MobiSys, 2013.

[12] N. B. Priyantha, A. Chakraborty, and H. Balakrishnan, "The cricket locationsupport system," in Proceedings of ACM MobiCom, 2000, pp.32–43.

[13] Z. Yang, C. Wu, and Y. Liu, "Locating in fingerprint space: wireless indoor localization with little human intervention," in Proceedings ofACM MobiCom, 2012, pp. 269–280.