Research Paper

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Mobility Mapping In Indoor User Tracking

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ABSTRACT: The user mobility tracking plays an important role in identifying human activities and providing future user centered location based services (LBS's).Estimating the geographical position of mobile device such as smart phone in an indoor environment is not easy without the use of specific infrastructures. But in this paper, we present a secured and robust adaptive mobility map construction scheme for large scale which does not require any offline fingerprinting efforts.

KEYWORDS: Mobility tracking, WI-Fi, shotgun reads, spectral clustering, Mobility map

I. INTRODUCTION

The location information promises to provide attractive services in ubiquitous computing environments. In an outdoor environment, Global Positioning Systems (GPS) [1] provide precise location of mobile devices with worldwide coverage.GPS, however has a shadow problem and is not available in indoor environment. In indoor environments, radio technologies such as Wi-Fi and cellular signals are used as observations for location estimates and provide a wide coverage especially in urban environments. The widespread availability of wireless networks (Wi-Fi) has created an increased interest in harnessing them for other purposes, such as localizing mobile devices. While outdoor positioning has been well received by the public, its indoor counterpart has been mostly limited to private use due to its higher costs and complexity for setting up the proper environment. In this paper, we use local Wi-Fi network to localize a mobile user in an indoor environment. Wi-Fi (or 802.11 networking) works on the basic principle that data packets are sent using radio waves. These radio waves can be received by any compatible receiver placed in a pc, mobile phone, tablet pc or any other circuit. Through Wi-Fi, one may be able to track objects or people in real time, while adapting to changes in both the environment, and the Wi-Fi network, in a reliable manner. There has long been interest in the ability to determine the physical location of a device given only Wi-Fi signal strength. The data distribution may vary based on changes in temperature and humidity, as well as the position of moving obstacles, such as people walking throughout the building. This uncertainty makes it difficult to generate accurate estimates of signal strength measurements. The Received Signal Strength (RSS) values measured by most radio transceivers can be used to estimate the distance between nodes and implement rangebased localization schemes. Received signal strength indicator (RSSI) is a measurement of the power present in a received radio signal. RSSI is an indication of the power level being received by the antenna. Therefore, the higher the RSSI number (or less negative in some devices), the stronger the signal.

The Received Signal Strength (RSS) values measured by most radio transceivers can be used to estimate the distance between nodes and implement range-based localization schemes. These schemes are popular because no additional hardware is required on the nodes to localize. The Transmitter of the signals is known as an Access point. In computer networking, a wireless access point (AP) is a device that allows wireless devices to connect to a wired network using Wi-Fi, or related standards. The AP usually connects to a router (via a wired network) if it's a standalone device, or is part of a router itself. One successful approach for indoor user tracking is a Wi-Fi based fingerprint [2],[3].But it involve some cumbersome work of fingerprint landmark calibration. Previous works in mobility tracking most often rely on the integrations of assisted GPS (A-GPS). Cell-ID, Bluetooth and Wi-Fi with the use of fingerprints based technologies for indoor [4]-[6]. In contrast to our previous tracking systems which are based on GPS measurements and geometric clustering, the adaptive mobility mapping is designed to adaptively construct a mobility map of environment using randomly selected and unlabelled sequences of Wi-Fi received signal strength (RSS). The RSS sample vectors are recorded by many individuals moving around the environment as they conduct their daily activities. Each signal typically covers only a small part of the coverage area and the idea is to piece their sequences together by treating them like shotgun reads. Shotgun read is a term used in DNA sequencing [7]. The output in DNA sequencing is a set of linear sequences of genomes. The output in the present system is a directed and weighted graph. This graph is

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called the mobility map. It abstracts the environment under coverage into a finite set of unlabelled location point(LP's). After the map is constructed, labelling of location can be done. Although the user can label the place on the map, simple automatic methods can be used to construct semantically meaningful place names from the observed data. The LBS market has grown significantly in the past decade and is expected to reach a size of \$12.7 billion in 2014. In addition to where the user is currently located, it is useful for the system to have knowledge about where the user is expected to go to, what activity the user will do next etc. The location information of a user promises to provide attractive services in ubiquitous computing environments. Over the years, diverse user tracking systems have been developed. In an outdoor environment, Global Positioning Systems (GPS) provide precise locations of mobile devices with world-wide coverage.GPS, however has a shadow problem and is not available in indoor environment. In indoor environments, radio technologies such as Wi-Fi and cellular signals are used as observations for location estimates and provide a wide coverage, especially in urban areas. One successful approach for indoor user tracking is a Wi-Fi fingerprint based method. The technique builds a radio map by measuring the Wi-Fi signals at each reachable calibration point, a priory and tracks a mobile device based on run-time observation of the Wi-Fi signals.

II. SYSTEM DESCRIPTION

The aim of the work is to sporadically collect sequences of Wi-Fi RSS sample vector to create a mobility map. The map is $G=(Vc, E\varphi)$ where CEVc represents a LP.A LP is formed by clustering together of RSS sample vectors with large similarities. The weight of each $\varphi \in E\varphi$ represents the transition matrix between two neighboring LP's.During mobility tracking, the location of a user can be determined by filtering the real time RSS trajectory of user into this mobility map. The RF Signal Tracker is an engineering application for doing impromptu hand-held drive-tests with our Android phone. We can monitor the RF and WiFi signal strength for the device as well as the serving cell locations and hotspots, describe a cell site's zone of coverage, identify changes in technology and handover points, and save and playback that data. While many of the phone stats in the app can be displayed on the phone already (go to Settings -> About -> Status to see them). The advantage of the app is you can then map, record, and analyze, and share that data in a meaningful way. Wi-Fi signal measuring tool is shown below:



Step 1: Objective Function Minimization: For each shotgun read, we construct a weighted graph $\psi l = (Vl, El)$. The weight of an edge represents the similarity between two nearby vertices.

The simplest way to represent the RSS data in a low dimensional space is to map the weighted graph ψ l onto a line while ensuring that any vertices which are nearby will have corresponding mapping points.

III. RESULTS

We conducted experiments in our college campus. The RSS data is recorded by the Android phone at a scanning rate of 1 sample/second. The similarity between the shotgun reads is shown by a cluster gram as shown in figure 4 and the corresponding connecting graph of vectors is shown in figure 5. Then the clustering of sample vectors is done using K-means clustering algorithm as shown in figure 6.

IV. CONCLUSION

The results clearly illustrate the potent of renewable energy option of solar energy in Nigeria as fossil fuels poses great negative environmental impact on the society as such the need to promote investment by the Government to mitigate energy crisis in foreseeable future.

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