CATCH Indoor Positioning System

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Abstract—**In many scenarios of everyday life and especially in warehousing, manufacturing and logistics, it is highly desirable to locate objects or persons quickly and accurately. Nowadays, fingerprinting based Wi-Fi positioning system provides enterprises the ability to track their various resources more efficiently and effectively. Main idea behind fingerprinting is to build signal strength database of target area prior to location estimation. This process is called calibration and the positioning accuracy highly depends on calibration intensity. Unfortunately, calibration procedure requires huge amount of time and effort, and makes large-scale deployments of Wi-Fi based indoor positioning systems non-trivial.**

I. Extended abstract

Our team presents a new indoor positioning system (IPS) with hybrid approach of constructing RSSI fingerprints database using Chebyshev wavelets. The conventional method for collecting RSSI fingerprint DB is very straightforward. An operator with wireless handheld device makes RSSI measurements at several reference points (RPs), and after some processing the data is stored in the database. Location accuracy highly depends on the number of RPs, and for an average building the number of RPs may reach up to several hundred per floor. Our approach is to create an accurate and complete RSSI DB from a limited number of on-site measurements using Chebyshev wavelet transforms. Therefore, the cost of time consuming surveys can be reduced.

Wavelet transforms is one of the relatively new techniques which being used for signal coding, to represent a discrete signal in a more redundant form, often as a preconditioning for data compression. In recent years, wavelets received considerable attention by researchers in different fields of science and engineering. Hence, its practical applications can be found in signal processing, digital communications, data analysis, image processing and many others. The main characteristic of wavelet functions is the ability to perform local analysis. Wavelet analysis is able to reveal signal aspects that other methods are missing, such as trends, breakdown points, discontinuities etc. All of these facts gave us impact to use wavelets to construct received signal strength database for IPS. Although, there are many different types of wavelets, in our research, we will consider Chebyshev wavelets due to several reasons: The ability of Chebyshev polynomials to approximate any continuous function, to any desired accuracy, over a prescribed interval; Good representation of piecewise functions. We construct Chebyshev wavelet transform coefficients using system of linear equations, although, in many papers devoted to discrete Wavelet transforms, the coefficients are produced using an inner product.

We carefully evaluated our system through real-world experiments in one of the largest shopping malls in Malaysia (Mines Shopping Mall). Both, field tests and computer simulations, demonstrated the effectiveness of the system and significant reduction in calibration time, while providing comparable location accuracy to that of the traditional calibration-based approach, as well as, previously proposed methods.

II. System requirements

Our system uses existing Wi-Fi signals and does not require any updates to WLAN infrastructure. We have special calibration and positioning applications running on Android smartphones. Collected signal fingerprint DB will be stored on a cloud server. Cloud based positioning engine is responsible for RSSI approximation, as well as, the positioning.