IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 7, July 2017

Enhanced Fingerprinting and Trajectory Prediction for IoT Localization in Smart Buildings

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Abstract: Location service is the primary services in smart automated systems of Internet of Things (IOT). So accurate localization has become a key issue. A novel localization utilizes the neighbor relative received signal strength(NRSS) to build the fingerprint database and adopts a Markov chain prediction model to assist positioning called as novel localization method (LNM) .In the LNM, the history data of the pedestrian's locations are analyzed to further lower the unpredictable signal fluctuations in a smart building environment, meanwhile enabling calibration-free positioning for various devices The performance evaluation conducted in a realistic environment demonstrates superior localization performance compared with existing schemes, when the problems of device heterogeneity and WiFi signals fluctuation exist.

Keywords: Internet of Things (IOT), Novel localization method (LNM), Location Base Services (LBS).

I. INTRODUCTION

It is inter-networking of physical devices, vehicles (referred "connected devices" and "smart devices"), buildings and other items embedded with electronics, software, sensors, actuators and network connectivity that enable these objects to collect and exchange data. Opening tremendous opportunities for novel applications that promise to improve the quality of our lives. According Location services use device or human location sense by mean of devices like GPS, Wi-Fi, and Bluetooth to provide simplicity in daily activity and personalize offering and services to users. With the development of IOT, LBS has become increasingly important and extensively used.

A Passive method: In it, the tracked person does not carry any electronic device and actively participate in the positioning process.

Active method: In it, tracked person carries a physical electronic device, which can collect and process some information and send the results to a localization server for further processing. Any structure that uses automated processes to automatically control the building's operations including visitor management, personal assistance, heating, ventilation, air conditioning, lighting, security and other system. Defines an intelligent building as "one which provides a productive and cost-effective environment through optimization of four basic elements: structure, systems, services and management, and the interrelationship between them.

Humans are not good with reasoning in systems with limited or conflicting information. Consider a web search engine where the user type in a query and the system provides a list of results which web page is more relevant to this specific user? Now, consider a medical diagnosis system, in which a patient has some, but not all, of the symptoms of a disease. It would be handy if we have something to manage all this limited/conflicting information. So, here is why we need them: BN is a framework for uncertainty management.

II. CONCEPT

The Humans are not good with reasoning in systems with limited or conflicting information. Consider a web search engine where the user type in a query and the system provides a list of results. Which web page is more relevant to this specific user? Now, consider a medical diagnosis system, in which a patient has some, but not all, of the symptoms of a disease. It would be handy if we have something to manage all this limited/conflicting information. So, here is why we need BN is a framework for uncertainty management.

The following diagram shows a directed acyclic graph for six Boolean variables.

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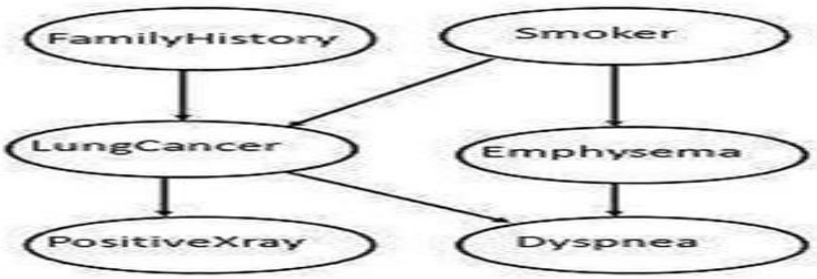

Figure 1. Directed acyclic graph

III. LOOP FUSION METHODS

Conditional Probability Table:
The arc in the diagram allows representation of causal knowledge. For example, lung cancer is influenced by a person's family history of lung cancer, as well as whether or not the person is a smoker. It is worth noting that the variable Positive X-ray is independent of whether the patient has a family history of lung cancer or that the patient is a smoker, given that we know the patient has lung cancer.

IV. METHODOLOGY

Proposed system has Markov-chain model, each object's movement is modeled as a Markov process, and the probability of each movement only depends on the object's current position. The building map is modeled as a cellular structure and is equally divided into hexagonal cells. xzxxThe object is located at a cell, represented as v0 at time 0, . At time 1, it will either stay where it is or move to one of the six neighbours, v1, v2, v3, v4, v5, and v6.At time 2, it will also stand or move to one of the current location's six neighbours. This procedure is then iterated at times 3, 4, . . . , t. The first number in parenthesis is the sequence number and the second is the orientation index, namely, the object's movement state. The process continues until enough history data are collected at time i.

V. ARCHITECTURE

To address the issues of labour intensive and time consuming calibration, the signal wave propagation model based techniques are proposed to estimate the RSS values at given locations which used to build mathematical or theoretic models to calculate the RSS values of given locations.

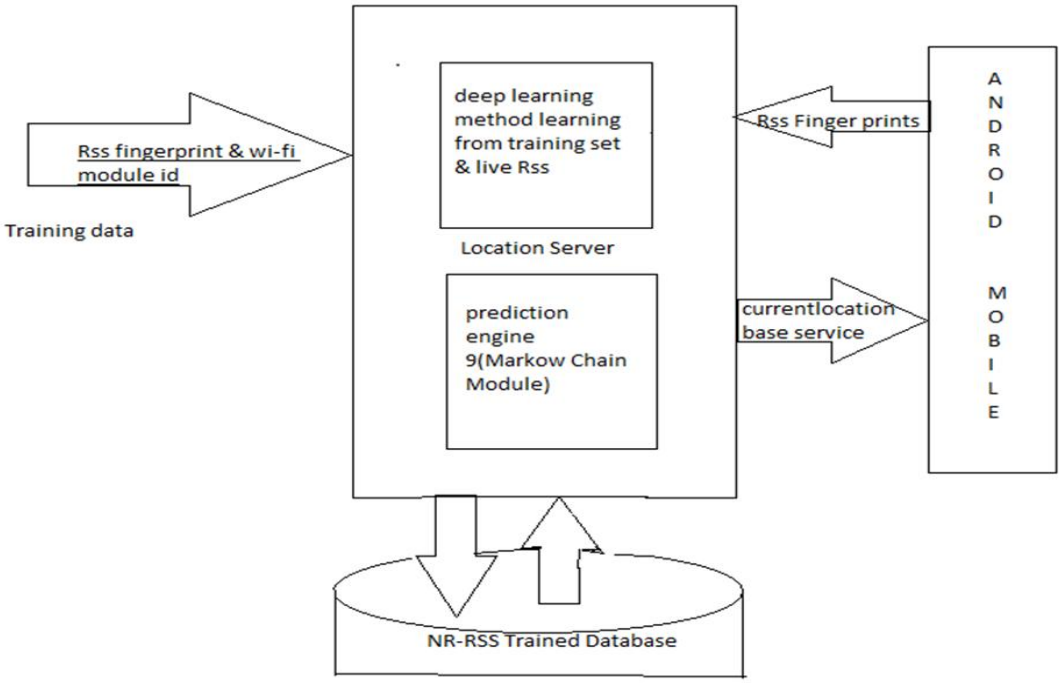

Figure 2. Architecture of System

DOI10.17148/IJARCCE.2017.6766

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A novel localization method (LNM) based on neighbor relative RSS (NRRSS) and Markov-chain prediction algorithm, which mainly utilizes fingerprint-based technology and Markov-chain model to provide higher accuracy of localization with lower calibration requirement. The NR-RSS, the difference of RSS between neighboring locations, compared with the absolute RSS (ARSS) values, is more robust to device heterogeneity and environmental dynamics. Therefore, we adopt NR-RSS instead of ARSS as fingerprint to build the radio map. To demonstrate the system, we implement the solution for large corporate companies having multiple buildings in campus. The tracking of employee in campus is important for company to increase the productive hours. So we demonstrate system for smart corporate office.

Our proposedsystem have evaluated a novel method, named LNM, which uses NR signal fingerprint and Markov chain for localizing in smart building environment .The fingerprint radio map building and localization techniques are based on the neighbor relationship. Our techniques provide robust and stable localization accuracy against device heterogeneity and environmental dynamics, which ensures the efficiency of localization which is feasible and reliable. For future work, we will evaluate other mobile devices such as aero terrestrial drones (e.g., WiFi Bot and Parrot) in complex buildings, as such smart objects will be used in the future smart buildings for supporting many activities (cleaning, emergency, disabled people support, and so on).

VI. CONCLUSION

We haveproposed a novel method, named LNM, which uses NR signal fingerprint and Markov chain for localizing in smart building environment .The fingerprint radio map building and localization techniques are based on the neighbor relationship. Our techniques provide robust and stable localization accuracy against device heterogeneity and environmental dynamics, which ensures the efficiency of localization which is feasible and reliable.
For future work, we will evaluate other mobile devices such as aero terrestrial drones (e.g., WiFiBot and Parrot) in complex buildings, as such smart objects will be used in the future smart buildings for supporting many activities (cleaning, emergency, disabled people support, and so on).

VII. FUTURE WORK

To demonstrate the proposed system, we will implement the solution for large corporate companies having multiple buildings in campus. The tracking of employee in campus is very important for company to increase the productive hours. So will demonstrate proposed system for smart corporate office.

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