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AN INDOOR LOCALIZATION MECHANISM BASED ON FINGERPRINTING AND IOT IN SMART BUILDINGS

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Abstract— Location service is one of the first services in sensible automated systems of internet of Things (IoT). For varied location-based services, accurate localization has become a key issue. Recently, analysis on IoT localization systems for smart buildings has been attracting increasing attention. During this paper, we tend to propose a completely unique localization approach that utilizes the neighbor relative received signal strength to build the fingerprint info and adopts a Markov-chain prediction model to help positioning. The approach is termed the novel localization technique (LNM) in brief. Within the proposed LNM scheme, the history data of the pedestrian's locations are analyzed to additional lower the unpredictable signal fluctuations during a smart building environment, meanwhile enabling calibration-free positioning for numerous devices. The performance analysis conducted during a realistic setting shows that the presented method demonstrates superior localization performance compared with well-known existing schemes, particularly once the issues of device no uniformity and Wi-Fi signals fluctuation exist.

INTRODUCTION

Location plays an important role in many context-aware applications. For many different services that can be offered in a smart building it is usually needed information about the number and location of residents. Their identities are also relevant, since one of the aims of smart buildings is to deploy personalized services. Depending on the service requirements, a different localization scheme would be required, varying the number of needed sensors, the algorithms used and assuring a tradeoff between comfort and energy efficiency. In recent years, there has been a large technological progress on indoor localization systems, but most of them present problems such as the time required in the calibration process, poor robustness or a high installation and equipment costs [4]. In addition, the user privacy is a key issue, and some sensors cannot be installed in Ambient Intelligent Environments (AIE) if current laws want to be obeyed. For instance, video cameras could not be used in offices. These problems cause localization systems to be unsuitable to be used in AIEs, where it is needed to have non intrusive, ubiquitous and cheap systems which do not need the installation of expensive hardware equipment. Furthermore, intelligent buildings would need that localization systems provide information about the identity of users, so that AIE can learn and manages to be adaptive towards the residents.

Localization using the existing wireless communication infrastructure is regarded as an effective method with great potential. Recently, received signal strength (RSS) fingerprint approaches based on WiFi have gained popularity [6]. However, there are several glaring problems for traditional RSS fingerprint approaches. First, real RSS fingerprints at any locations always change with time. Besides, considering the hardware differences of mobile devices (e.g., smartphones, tablets, mobile robots, mobile smart objects), different mobile devices may get different measurement data, even for the exactly same RSS value. The noisy characteristics cause the measured samples to greatly deviate from those stored in the radio map. Second, in the process of matching, the localization system need to access the RSS fingerprint database storing a great amount of data, which will take plenty of time. Although some systems adopt Clustering of map locations to reduce

the computational requirements, clustering algorithm also introduces error and extra complexity. Moreover, localization matching requires Wi-Fi scanning, regarded as an energy-intensive process. Since mobile devices are energy-constrained, it is critical to reduce the Wi-Fi scanning process. Finally, building the fingerprint map requires an extensive and thorough site-survey process. To address the issues of labor-intensive and time consuming calibration, the signal wave propagation model based techniques are proposed to estimate the RSS values at given locations. The main focus of these solutions is to build mathematical or theoretic models instead of manually tagging to calculate the RSS values of given locations.

LITERARTURE SURVEY

There are a lot of developed methods to solve the location problem. These can be classified into RF-based techniques and non RF-based techniques. The latter include audio, visual, ultrasonic, infrared, and laser sensors, whereas the RF-based localization techniques are mainly based on GPS, wireless local area network (WLAN), and RFID localization. By nature, the RF signals have certain advantages over non RF signals, as it is collected in [5]. Depending on the accuracy need by the final application, a different technological solution should be chosen. For example, for small scenarios where a location system with a room accuracy is enough, it could be used the Received Signal Strength Indication (RSSI) of RF sensors. However, in emergency situations, for example in evacuation planning in case of fire, it would be necessary a positioning system that provides an accuracy lower than 1.5 meters. Since each location algorithm has its advantages and its disadvantages in terms of accuracy, cost and complexity, the integration of several of these algorithms should improve the overall system performance. Due to this, and given that our system provides various services with different requirements in terms of accuracy, this paper researches on a hybrid present solution that includes location information from different sources and uses smart data fusion algorithms to process it.
a novel localization mechanism that integrates RFID (Radio-Frequency Identification) and IR (Infra-Red) data to solve technical drawbacks of RF and non RF-based localization techniques [5], so our solution meets the accuracy, cost and complexity requirements given our localization problem. It also solves the non-intrusive identification problem by using cheap technologies.

PROPOSED METHODOLOGY

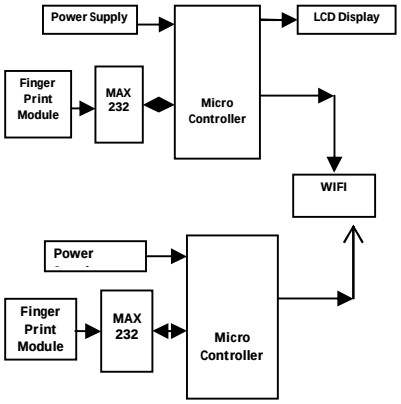

Fig 1: Block diagram

Micro controller: This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.
ARM7TDMI: ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.
Liquid-crystal display (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.
WIFI:

Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections. A

common misconception is that the term Wi-Fi is short for "*wireless fidelity*," however this is not the case. Wi-Fi is simply a trademarked phrase that means *IEEE 802.11x*. Wi-Fi works with no physical wired connection between sender and receiver by using radio frequency (RF) technology, a frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current is supplied to an antenna, an electromagnetic field is created that then is able to propagate through space.

The cornerstone of any wireless network is an access point (AP). The primary job of an access point is to broadcast a wireless signal that computers can detect and "tune" into. In order to connect to an access point and join a wireless network, computers and devices must be equipped with wireless network adapters Wi-Fi is supported by many applications and devices including video game consoles, home networks, PDAs, mobile phones, major operating systems, and other types of consumer electronics. Any products that are tested and approved as "Wi-Fi Certified" (a registered trademark) by the Wi-Fi Alliance are certified as interoperable with each other, even if they are from different manufacturers. For example, a user with a Wi-Fi Certified product can use any brand of access point with any other brand of client hardware that also is also "Wi-Fi Certified". Products that pass this certification are required to carry an identifying seal on their packaging that states "Wi-Fi Certified" and indicates the radio frequency band used (2.5GHz for 802.11b, 802.11g, or 802.11n, and 5GHz for 802.11a).

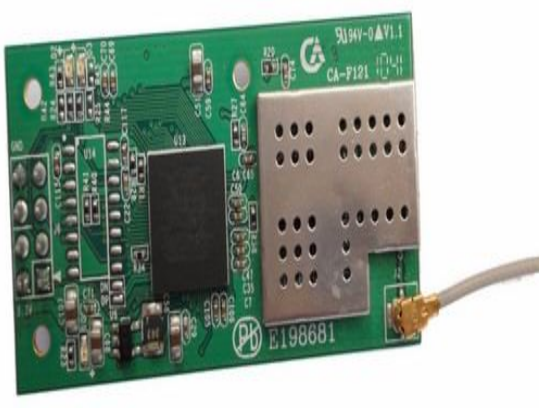

Fig2: WIFI Module

VSD03 is the new third-generation embedded Uart-Wifi modules studied by VSD TECH. Uart-Wif is an embedded module based on the Uart serial,according with the WiFi wireless WLAN standards, It accords with IEEE802.11 protocol stack and TCP / IP protocol stack，and it enables the data conversion between the user serial and the wireless network module. through the Uart-Wifi module, the traditional serial devices can easily access to the wireless network. VSD03 does a comprehensive hardware and software upgrades based on the products

Its main features include:

Interface:

- 2*4 pins of Interface: HDR254M-2X4
- The range of baud rate: 1200~115200bps
- RTS / CTS Hardware flow control
- single 3.3V power supply

Wireless

- support IEEE802.11b / g wireless standards
- support the range of frequency: 2.412~2.484 GHz
- support two types of wireless networks:
  - Ad hoc and Infrastructure
- support multiple security authentication mechanisms:
  - WEP64/WEP128/ TKIP/CCMP(AES)
  - WEP/WPA-PSK/WPA2-PSK
- support quick networking
- support wireless roam

Max 232:

MAX232 converts from RS232 voltage levels to TTL voltage levels, and vice versa. One advantage of the MAX232 chip is that it uses a +5V power source which, is the same as the source voltage for the 8051. In the other words, with a single +5V power supply we can power both the 8051 and MAX232, with no need for the power supplies. The MAX232 has two sets of line drivers for transferring and receiving data. The line drivers used for TXD are called T1 and T2, while the line drivers for RXD are designated as R1 and R2. In many applications only one of each is used.

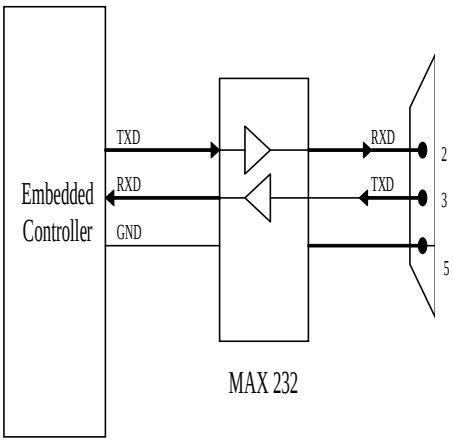

Fig3: Communication via Max 232

Fingerprint module:

A fingerprint sensor is an electronic device used to capture a digital image of the fingerprint pattern. The captured image is called a live scan. This live scan is digitally processed to create a biometric template (a collection of extracted features) which is stored and used for matching. FIM 30 has functions of fingerprint enrollment, identification, partial and entire deletion and reset in a single board, it does not require connection with a separate PC, thereby offering convenient development environment.

Features

- On-line and off-line fingerprint identification incorporated
- Identification rate 1:1 and 1:N; FAR: 1/100.000 y FRR: 1/1.000
- Algorithm and high hardness optical sensor
- It provides high recognition ratio even to small size, wet, dry, calloused fingerprint.
- Fast acquisition of difficult finger types under virtually any condition.
- Memory capacity for 100 fingerprints
- Memory events: up to 2,000 authentications
- Access host can be protected by fingerprint or password
- It offers convenient development environment.
- Two communication ports: RS-232 or host (on-line applications)
- ASCII protocol
- Supply voltage: 5V
- Small size and robust durability, it has longer life span.

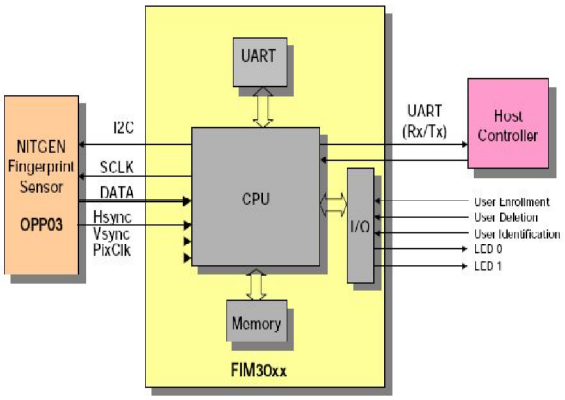

Fig4: Finger print module

CONCLUSION

In this paper, we have proposed and evaluated a novel method, named LNM, which uses NR signal fingerprint and Markov chain for localizing in smart building environment. The proposed 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. Experiments using heterogeneous smart phones have confirmed that LNM is feasible and reliable. LNM can achieve high localization accuracy with about 1.5 m error on the average.

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