TAGLESS INDOOR POSITIONING AND OBJECT TRACKING USING A WIRELESS SENSOR NETWORK

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INTRODUCTION.

Accurate and reliable positioning technique is becoming popular and more important nowadays with the proliferation of location-aware services. Although global positioning system (GPS) can provide location information quite reliably, it is however limited to outdoor uses due to significant attenuation of satellite signals inside a building. Even for outdoor uses, GPS signals may be blocked by high-rise buildings; to circumvent this problem, other researchers have proposed a geo-location technique in urban environment using signal strength of GSM mobile. Once indoor, other methods of positioning techniques will be needed in order to provide a seamless and ubiquitous coverage of the positioning service.

Therefore, indoor positioning systems have been gaining popularity in recent years and have been designed to provide location information of an object such as a person or device [1]. Some developed concepts included for example RADAR [2] and LANDMARC [3]. Indoor positioning and object tracking using RFID [3, 4] has long been investigated and developed. The technique consists of both active and passive systems. In an active system, the tag is powered up by a built-in battery to regularly transmit communication back to the reader(s), whereas for a passive system, the tag will only be powered up if it comes within the coverage area of the reader(s). A major drawback for both of these systems is that they require a tag to be placed on the object that needs to be tracked. Hence any new object entering the coverage area will not be automatically detected until a tag is placed on it.

MATERIALS AND METHODS.

A new concept in indoor positioning technique and object tracking without using any device or tag is hereby proposed. This tagless positioning and tracking system is based on monitoring the disturbance of electromagnetic wave pattern, in the form of radio frequency (RF) wave, using received signal strength indicator (RSSI) measurement, to locate and track an object. As the system is designed to track a human being, it can therefore be used for surveillance purpose. It is well known that RF wave can be blocked by an object which then results in signal attenuation causing a significant drop in the received signal strength. It has long been a problem for a communication system on how to combat the drop in signal strength due to object blockage. Here, we propose to exploit this fundamental problem and turn it into a new conceptual technique for indoor positioning and object tracking.

This proposed research work is different from [2] and [3] because in [2] the object being tracked needs to carry a mobile device, and [3] uses active RFID tags. In both scenarios, the object is fully aware that it is being tracked, and therefore without first been assigned a mobile device or RFID tags, it is not possible to track the object. For this proposed project, however, the tracking part is 'passive', meaning that the object is not aware that it is being tracked, and any object entering the coverage area can be detected and tracked, making the proposed system suitable for surveillance purpose. The principle of this proposal is based on the changes in attenuation level of RF signal strength when the line-of-sight (LOS) link is blocked directly by an object. Hence when an object is trespassing a grid of such LOS links, it can be detected and its motion tracked within the coverage area.

How can indoor positioning and object tracking using this method be useful? Such a system can be useful in monitoring a human being when a camera cannot be used due to privacy issue, or when poor lighting condition renders the camera images useless. It can also be used to monitor lifeless objects, e.g. detecting when a vehicle has entered a monitored area.

RESULTS AND DISCUSSION.

This is a new project, and we expect to see a drop of 4 – 8 dB of wi-fi signal power when it is blocked by a human, as shown in Table 1.

Table 1: Attenuation level of WiFi signal by different objects. Note a 3 dBm drop is equivalent to a 50% reduction in power.

Object	Dry wall	Hollow wood door	Brick wall	Concrete wall	Refrigerator	Human**
Attenuation (dB)	3	4	6	8	19	4 - 8

*** This is the projected attenuation level that we expect to see.*

CONCLUSIONS.

With the proliferation of wireless sensor network of which the Wi-Fi access points are part of, it is proposed that the project shall look into using the existing backbone infrastructure of Wi-Fi modems to double-function as sensors for the proposed indoor positioning system. To do this, fundamentally the received signal strength of transmitted RF wave needs to be measured and tracked in real time. Relevant hardware needs to be selected and /or designed, and tracking algorithm(s) needs to be designed.

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