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A Survey of WLAN Positioning for Mobile Devices based on Time of Flight

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Abstract: In the modern world computing has become pervasive and has led to expansive usage of resource constraint devices like RFID devices, IoT devices, embedded systems and other smart devices. Though these devices allow us to run a variety of services with ease, there is a lot of sensitive information that is accessed through these resource constraint devices raising security concerns.The traditional cryptographic techniques are too big, too slow or too energy-consuming for efficient use on such devices. In this paper we present a novel technique to address this issue. We propose use of Permutation Parity Machine (Neural cryptographic technique) for key exchange, encryption and hash functions.Subsequently we demonstrate its performance against common types of attacks and the results of testing it against standard NIST test suites.

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INTRODUCTION

Need for location information is increasing day-by-day and has become vast research area be it for outdoor or indoor, outdoor positioning has matured enough compared to indoor. The detailed evaluation of indoor positioning [8] are discussed and presented the different technology since the hunt for location along the history.

Time of Flight (ToF) based WIFI-Positioning techniques are utilized in localizing mobile device and it is wide open for research compared with profound available techniques such as RSSI for positioning. The suggested frameworks can decide the position at runtime without requiring a complex calculation done at offline as case of finger printing. Moreover, ToF is vigorous against environmental and weather parameters as compared to RSSI.

By and large, every current radio technologies for positioning like Ultrasound, FM, RFID, Bluetooth or WIFI can be utilized. Now-a-days WiFi based indoor positioning is gained vital approachesthat is because of IEEE 802.11 standard and thus, is generally utilized everywhere throughout the world. This makes WIFI-based positioning prominent in indoor positioning research field. WiFi equipments like portable PCs, tablets and cell phones largely available for the experiment with open source software's in the market.

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Advantages of WLAN based ToF technique over RSSI are Finger printing of signals are not required as compared,does not require database intensive work of calibration, runtime calculation with precise position estimation calculations by trilateration technique, ToF strategies are stronger against outer obstructions than RSSI techniques w.r.t changes in the environment

Constraints of ToF strategy is that the estimation of definite sign proliferation delay, in any case, is difficult to quantify with today's standard WIFI devices without driver level modification and missing high exactness clocki.e time stamp in nano seconds precession.

TOF-systems indicate high possibilities for indoor positioning with the limitation by adjusting time stamps measurements with prediction and approximation algorithms. Nowadays positioning and localization is drawn to attention because of its demanding applications like context awareness applications in universe. Here we are interested to deal with Wi-Fi based Positioning System (WPS), every moment of our daily life has become context aware with mobile devices because of its importance. WPS delivers a positioning service for indoor environment (building) such as navigation, monitoring or tracking – car tracking in tunnel, robots tracking in warehouse, medical equipment's tracking hospital etc. Generally this called Indoor Positioning System (IPS)

Classification of positioning system is based on application area i.e. outdoor and indoor: well proven devices are available in the market, further it can be classified based on the technology or the generation. Indoor can be active type and passive type base on underlying technology for reception and

transmission of signals. Classification is summarized in the Figure 1. This paper focuses on indoor based on WLAN of active type using off the self-mobile devices.

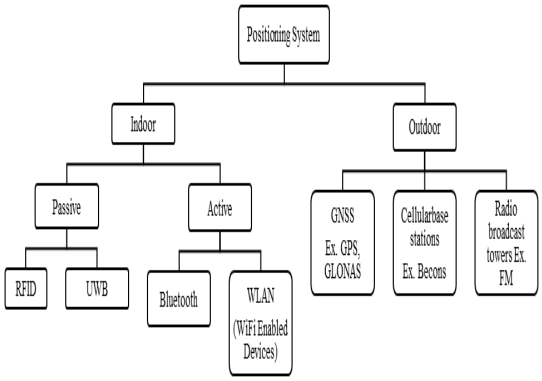

Figure 1: Classification of positioning system

LITERATURE SURVEY

WiFi technique based indoor positioning or ranging systemsutilizes the received signal strength indicator (RSSI) or measurement of Time to derive distance. The paper [1] discusses the advantages and disadvantages of Time of flight technique and compares the accuracies, with the control frame NULL-ACK [1] and implemented with off the self-devices. Ranging accuracy with a mean absolute error of less than 1.33 meters in an ideal scenario is achieved.

GPS is well known outdoor technology for positioning. Aided inertial devices are used to adjust the poor or attenuated signals at reception to decide exact estimations with theprecise measurements. Those inertial based on MEMS [2] are used to overcome in dense areas and indoors; in the absence of GPS in indoor scenario whereWi-Fi is one of the most popular radios; the paper [2] discusses the time-based range measurements w.r.t Wi-Fi indoor positioning technology. The paper [2] presents exceptionally precise indoor framework which is basedWi-Fi technology and on MEMS inertial sensors. Short fall of [2] is that determination of direction of movement of finding heading.

There are wired and wireless personal networks exits, especially when comes wireless personal network, finding location or localizing mobile devices rises to location-aware service's needs. Thepaper [3]gives a thorough study of variouswireless personal network, which include both research-orientedsolutionsand commercial products. Assesses systems againstcommercial availability,performance, user preferences,robustness, complexity, cost, security, privacyand limitations.

The paper [4] discusses about triangulation technique to manipulate the position of GPS. Brings out limitation non-line-of-sight (NLOS) wave propagation and climate; which adds to positioning errors significantly.The paper [4] comes up with Wi-Fi network with RSSI and fingerprintingtechnologies for positioning with mobile device with GPS and the proposed methodology achievesnominal positioning error of 3.8 m less than that of GPS. However it is less than [1] methods proposed and techniques.

The timestamping resolution plays vital role in the ToF measurements, the nano seconds level stamping is required to achieve less than 3m accuracies, the paper[6] implement the kernel level functions to open sources drivers to achieves required accuracies. The implementation [6] limits only to the UNIX base system due the driver nativity.

There are plenty of ToF techniques available right now, many manufactures of Wi-Fi chips are in the process of embedding the ToF as part of chips with time stamping of nano seconds compared to present microseconds, so that it is used as service or functions by making the abstraction of localization for mobile devices.

PROPOSED SYSTEM

Wi-Fi devices works in two frequency spectrum bands 2.5GHz and 5GHz, the idea behind the ToF is that Wi-Fi packet including the control/management/data includes certain number of bits, those bits are transferred to AP to Mobile vice versa i.e.

$$d = c*t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where d is distance (range) that Wi-Fi Signal travels with speed of light c at time t. Equation 1 can be rewritten as

$$d= c/2 *(t_{1ToF} + t_{3CONST} + t_{2ToF}) \ldots.. 2$$

Where $t_{1ToF}$is the time taken by the packet travel from AP to Mobile device with fixed payload and $t_{2ToF}$is from Mobile device to AP and t3 CONST is elapsed or process time. Same is illustrated in Figure 2.

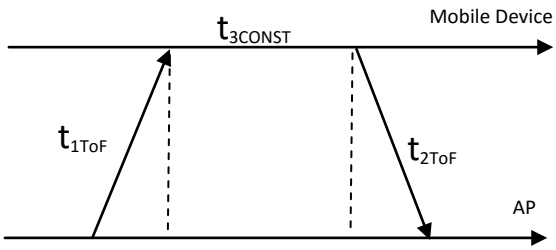

Figure 2: ToF measurement illustration

Challenges Involved in Measuring is that Timestamps, This Calls for the Changes at Driver Level and Const can be Derived Based on Frequency and Modulation Techniques Used at the Physical Layer.

t3 CONST is captured from the kernel level modified drivers for given OS, in windows system NDIS 6.0 package is used and at linux wireshark is used for capturing WLAN 802.11 frames.

Proposed system requires hardware with any Processor (Laptop/Desktop) with embedded wireless standard IEEE 802.11 b/g/n chip. Thus, Equivalent or better configuration with 1GB RAM and 500GB HDD with internet connection and below listed software installed in mobile devices.

Software requirements:

Operating System : Windows /Linux Family.
Language : C# and .Net /C++
Data Bases : MSSQL if required
Front End : Windows Forms
Internet Connection:

To verify location based service if required.

Conclusions and future enhancement

Most the techniques come across are focused on the calculation of RTT and time measurements and apply the statistical methods to achieve the desired goals. The CONST delay can be calculated based precisely i.e layer 2 of OSI information by the probing the hardware information and using packet injection and capturing tools to calculate the ToF. Applying filter or prediction algorithms to track the mobile devices.Kalman and Extended Kalman filter is used for tracking which yields less than 3cm result.

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