InPoTra: Indoor Positioning and Tracking

Special Session at ICWMC 2016, The Twelfth International Conference on Wireless and Mobile Communications

November 13 - 17, 2016 - Barcelona, Spain

http://www.iaria.org/conferences2016/ICWMC16.html

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***Abstract*—Many research based on indoor positioning and tracking systems have been developed due to growing interest in location-aware services. Nevertheless, satisfying solutions have not been found with the considerations of both accuracy and system complexity. In fact, an indoor localization system highly accurate, low energy, widely available, and easily deployed has not yet been developed. Hence, there are still open issues on indoor environments. InPoTra session involves four papers using new methodologies and parameters estimation for indoor positioning.**

Keywords-Indoor Positioning; Tracking; Wireless Localization Techniques; Radio Frequency; Visible Light Communication.

I. INTRODUCTION

Location estimation has been a term of growing interest for years [1]. With the development in mobile computing devices and the advances in wireless technologies many applications need some notion of the current position. This includes applications related to navigation guidance, security, robotic industry, health, entertainment and several other applications.

The Global Positioning System (GPS) is the best system for positioning. Unfortunately, GPS information is not suitable in indoor environments. Hence, many developments in sensor technology and methodologies for indoor positioning have been published to solve this challenge.

Traditionally, indoor positioning research has been widely developed using technologies based on radiofrequency systems, such as WLAN, Bluetooth and UWB [2]. Although these techniques are likely to give an acceptable accuracy, the instability of radio signals does not usually allow to obtain an accuracy better than two meters. In recent years, the widespread introduction of white LEDs for illumination has provided a visible light communication (VLC) based positioning [3]. In fact, VLC is used on three papers in this special session. VLC can offer a higher positioning accuracy because this kind of networks is not affected by electromagnetic interferences and the received signal strength (RSS) is more stable than radio signals and can be accurately known.

II. OVERVIEW OF THE SESSION PAPERS

This special session consists of four papers providing new methodologies and parameters estimation for indoor positioning.

In the first paper entitled “Distance Measurement System Based on Visible Light Communications and Ultrasound Emitters”, the authors propose a new VLC distance-measurement scheme based on the Cricket’s Time Difference of Arrival (TDoA) paradigm. They use an optical signal instead of the Cricket’s radiofrequency one in order to avoid the radio signal problems such as multipath propagation. This approach can be used by indoor positioning systems where the target environment is not suitable for radiofrequency technology, such as underwater scenarios. The system uses a transmitter node formed by an ultrasound transmitter, an optical transmitter and an optical receiver. The receiver node makes use of an ultrasound receiver, an optical receiver and an optical transmitter. Thus, a single acoustic link and two optical links are established. Therefore, both transmitter and receiver can estimate the distance each other. A prototype was implemented and experimental results demonstrated a high accuracy, about 2% of error.

On the other hand, the precision of time synchronization is the key factor for localization based on time of arrival. Thus, in the second paper entitled “Time Synchronization Method Using Visible Light Communication for Smartphone Localization”, the authors examine the feasibility of using VLC for localization time synchronization. In this work, a transmitter module that consists of loudspeakers and an LED is used. The loudspeakers emit short bursts of sound which are synchronized to the beginning of each LED modulation cycle. The LED is modulated for VLC. Bursts are registered by a smartphone and the emission time is estimated when VLC codes are received. Then, the smartphone calculates the time of flight (ToF) of each burst. Experimental results show a time synchronization precision equivalent to 1.0 cm for an airborne acoustic wave.

In the third paper entitled "CAPTURE – "Widening the Net" – Indoor Positioning using Cooperative Techniques", the authors propose a technique to provide better coverage for indoor positioning systems (IPS). The aim of this work is that mobile devices at the boundaries of IPSs, who have themselves been located by an IPS, can assist in a cooperative approach to locate mobile devices beyond the range of the IPS but within range of the cooperating devices. RSS from Bluetooth LE and Wi-Fi radio signals is used to estimate range. Experimental results show the error bounds using this implementation are very high. Nevertheless, the concept presented in this paper can be prominent because a device that is in range with another device can help in positioning it.

In the last paper entitled "Indoor Location Estimation based on IEEE 802.15.7 Visible Light Communication and Decision Trees", the authors propose a fingerprinting indoor location estimation methodology based on an ensemble model of decision trees. The approach use RSS values obtained by simulation making use of the IEEE 802.15.7 standard. Experimental results yielded a 93% accuracy, with an average error distance for misclassified instances of 37 centimeters.

III. Conclusion

The collection of papers included in this special session on Indoor Positioning and Tracking can be useful piece of information for other researchers. In InPoTra session new methodologies and parameters estimation for indoor positioning are described. Nevertheless, despite years of substantial efforts in the research and development of indoor positioning and tracking, there are still open issues because developed systems are not: highly accurate, low energy, widely available, and easily deployed. In addition, most works in the literature do not take in account tracking capability. Therefore, indoor tracking is also still an open issue.

References

[1] P. Bahl and V.N. Padmanabhan, "RADAR: An In-building RF-based User Location and Tracking System", Proceedings of the IEEE 19th INFOCOM, pp. 775-784, 2000.

[2] H. Liu, H. Darabi, P. Banerjee, and J. Liu, "Survey of wireless indoor positioning techniques and systems", IEEE Transactions on Systems, Man, and Cybernetics, 37(6), 1067-1080, 2007.

[3] J. Armstrong, Y. A. Sekercioglu, and A. Neild, "Visible light positioning: a roadmap for international standardization", IEEE Communications Magazine, 51(12), pp. 68-73, 2013.