

INDOOR LOCALIZATION BASED ON RECEIVED SIGNAL
STRENGTH INDICATOR (RSSI) IN WIRELESS SENSOR
NETWORK (WSN)

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Computer Science (Networking)

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Lokalisasi digunakan secara meluas dalam Rangkaian Sensor Tanpa Wayar (WSN) untuk mengenal pasti lokasi semasa nod sensor. WSN terdiri daripada beribu-ribu nod yang menjadikan pemasangan GPS pada setiap nod sensor mahal dan lebih-lebih lagi GPS tidak dapat memberikan hasil penyetempatan tepat dalam persekitaran tertutup. Penyetempatan adalah salah satu cabaran yang paling penting dalam WSN, memandangkan ia memainkan peranan penting dalam banyak aplikasi. Penyetempatan node melibatkan aktiviti pemantauan peristiwa, perbincangan kumpulan antara sensor yang berdekatan, mengarahkan maklumat yang diperlukan ke destinasi dengan memastikan liputan rangkaian di cek. Dalam makalah penyelidikan ini, algoritma pengurusan berdasarkan Penerima Kekuatan Isyarat yang Diterima (RSSI) dicadangkan untuk menyetempatan nod sink dalam rangkaian dengan ralat penyetempatan minimum. Koordinat kedudukan nod sink adalah dianggarkan berdasarkan anggaran jarak dan koordinat posisi sepadan nod jangkar yang ada di rangkaian. Kerja-kerja ini dilakukan di Contiki-OS dengan bantuan simulator terbina dalam COOJA.

ABSTRACT

Localization is widely used in Wireless Sensor Networks (WSNs) to identify the current location of the sensor nodes. A WSN consist of thousands of nodes that make the installation of GPS on each sensor node expensive and moreover GPS may not provide exact localization results in an indoor environment. Localization is one of the most important challenges in WSNs, in view of the fact that it plays a significant part in many applications. Localization of node involves the activity of monitoring events, group discussion between the nearby sensors, routing the necessary information to the destination by keeping network coverage in check. In this research paper, Received Signal Strength Indicator (RSSI) based trilateration algorithm is proposed for localizing a sink node present in the network with minimal localization error. The position coordinates of the sink node is estimated based on the distance estimates and corresponding position coordinates of the anchor nodes present in the network. This work was performed in Contiki-OS with the help of built-in simulator COOJA.

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LIST OF SYMBOLS

M	Meter
dBm	Decibel-milliwatts
C	Constant value
n	Range of environment (2-4)
Ptx	Power measured
d	Distance

LIST OF ABBREVIATIONS

ABBREVIATION	TITLE
Wi-Fi	Wireless fidelity
GPS	Global Position System
RFID	Radio Frequency Identification
RF	Radio Frequency
RSSI	Received Signal Strength Indicator
IEEE	Institute of Electrical and Electronics Engineers
TOF	Time-of-Flight
TDOA	Time difference of arrival
AOA	Angle of arrival
WSN	Wireless Sensor Network

CHAPTER 1

INTRODUCTION

1.1 Background Study

The wireless sensor network (WSN) concept was first emerged in early 1980s (Bekcibasi & Tenruh, 2014). WSN consists of sensor nodes which are densely deployed where every node has sensor, processor, transmitter and receiver units (Farrag Mohammed, Abo-Zahhad Mohammed, Doss M.M., 2016). WSN had gained much popularity in today rapidly advancing technology world (Gupta, 2015). Many people area as comfortable of wireless technology as it does not need maximum supervision on the specific location.

Now, as the world is increasing with people, everyone is searching for a system that could easily locate a person location using WSN especially indoors of a large building. Besides, the advance technology using GPS, WSN aims toward more of tracking within indoors where a building which is too huge to locate a person is a short period of time (Brena et al., 2017). Firstly, the sensors of WSN are used to measure the signal that related to parameters, like time and angle of the signal. Secondly, the sensor will calculate the actual position of the target (“81-92.pdf,” n.d.). Thirdly, the sensor node of the WSN detects the presence of the target nodes.

Furthermore, usage of WSN had gained much popularity in indoor localization especially in building area caused in building area; Global Position System (GPS) does not work well in indoors. Due to the GPS signal is a satellite based positioning system which is designed for outdoor environment (Ozsoy, Bozkurt, & Tekin, n.d.). The GPS

signal is easily blocked by most construction materials and hence making it useless for indoor positioning (Ting, Kwok, Tsang, & Ho, 2011).

Recently, localization algorithms is widely used in WSN to determine the current coordinate of the sensor nodes (Kuriakose, Amruth, & Nandhini, 2014). Localization is the issue of locating the geometrical location of the sensor node in the network (Singh, Tripathi, & Singh, 2011). Localization techniques in sensor networks make use of small number of anchor nodes. Where whose others locations are known in prior and others nodes estimate their coordinate position from the messages they receive from the anchor nodes (Science & Kumar, 2014).

In most of the localization techniques, localization is carried out with the help of neighboring nodes (Kuriakose et al., 2014). Localization techniques can be categorized into the range-free and range-based techniques (Pal & Sharma, 2015) , this localization technique can be used in WSN to identify the location of people and to calculate positions for randomly deployed sensor nodes (Journal, Science, Technology, & Science, 2016). The range-based technique typically achieves high accuracy compared to the range-free technique and it is better to use in indoor localization (Paul & Sato, 2017).

Range-based localization technique consists of several techniques such as received signal strength indication (RSSI), angle of arrival (AOA), time difference of arrival (TDOA), and time of arrival (TOA) (Du, 2018) . Among these techniques, the RSSI-based technique is relatively simple, less demanding on the hardware, and with low cost. So RSSI-based technique will be study more. Most of the researches enhance the localization accuracy through the use of various optimization techniques or combining a variety of localization algorithms (Qi, Liu, & Liu, 2018), with little regard to the real environment.

This study focuses on the suitable localization technique for indoor localization. A new RSSI localization technique is proposed without any additional hardware support and with low cost (Zhu & Feng, 2013). RSSI is a radio frequency that

is the most popular technique for indoor and outdoor environment which is mainly used for distance measurement between transmitter and receiver (Sadowski & Member, 2018).

1.2 Problem Statement

The main problem in WSN is localization. The localization technique based on range-based has higher accuracy. But it also requires additional hardware on sensor nodes. Therefore, there are many ways that can be used to measure location of nodes in the network but these techniques require high costs and require specific hardware. In this research, RSSI Techniques can be used because of its low cost and is easy to implement compared to previous techniques. RSSI technique used for nodes location in WSN compared with various range-based location techniques.

Although, RSSI technique does need additional hardware but it low in-term of accuracy due to RF signals influenced by the environment. Thus, the exact distance between the nodes cannot obtain by using RSSI, so the localization accuracy of nodes is not high.

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