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Improve Performance Wireless Sensor Network Localization Using RSSI and AEMM

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***Abstract* -** Improve wireless sensor network localisation performance using RSSI and an advanced error minimisation method (AEMM). WSNs remain domain-specific and are typically deployed to support a single application. However, as WSN nodes become more powerful, it becomes increasingly important to investigate how multiple applications can share the same WSN infrastructure. Virtualisation is a technology that may allow for this sharing. The issues surrounding wireless sensor node localisation estimation are still being researched. There are a large number of Wireless Sensor Networks (WSNs) with limited computing, sensing, and energy capabilities. Localisation is one of the most important topics in wireless sensor networks (WSNs) because location information is typically useful for many applications. The locations of anchor nodes and the distances between neighbouring nodes are the primary data in a localisation process. The complexity and diversity of current and future wireless detector network operations drive this. Several single schemes have been proposed and studied for position estimation, each with advantages and limitations.

Nonetheless, current methods for evaluating the performance of wireless detector networks are heavily focused on a single private or objective evaluation. Accurate position information in a wireless detector network is critical for colourful arising operations (WSN). It is critical to reducing the goods of noisy distance measures to improve localisation accuracy. Existing works (RSSI) are detailed and critically evaluated, with a higher error rate using a set of scenario requirements. Our proposed method (AEMM) is critical for detecting and dealing with outliers in wireless sensor networks to achieve a low localisation error rate. The proposed method (AEMM) for localisation and positioning nodes in wireless sensor networks supported by IOT and discovering the appropriate position of several nodes addresses all of the issues in WSN.

Keywords: Wireless Sensor Network, Energy Efficiency, Detection, Localization, Internet-of-Things, RSSI, Sensor Node, AOA, AEMM.

I. INTRODUCTION

Wireless Sensor Networks (WSNs) are broadly used in many areas for monitoring and sensing applications in IoT. Since these nodes have energy constraints, adopting an efficient scheduling mechanism for WSNs to save energy and for reliable data collection is imminent. As IoT hosts numerous applications like smart grids, smart homes, and delay-intolerant applications like smart healthcare, the design of scheduling mechanisms is an important task, as shown in the main challenges in the data collection of IoT Networks are there are a massive amount of sensor nodes deployed, scheduling data transmission of these massive number of IoT nodes. A wireless sensor network (WSN) is constituted by spatially distributed autonomous devices communicating wirelessly, gathering information and detecting certain events of significance in physical and environmental conditions. Each of these devices is capable of concurrently sensing, processing and communicating. Having these capabilities on a sensor device offers a vast number of compelling applications, as illustrated. For example, one of the oldest application areas of WSNs is found in environment monitoring, ranging from tracking herds of animals to monitoring hard-to-reach areas. Military battlefields also constitute a potential application of WSNs, especially in inaccessible or hostile territory, where WSNs may be indispensable for detecting snipers and intruders and tracking their activity.

Additionally, deploying WSNs can be very useful for improving logistics, where tackling the challenges in managing goods being transported can preserve their quality by monitoring the temperature of containers, to mention a few [1]. WSNs, as shown in Fig.1, generally consist of one or more sinks (or base stations) and perhaps tens or thousands of sensor nodes scattered in a physical space. Integrating information sensing, computation, and wireless communication allows the sensor nodes to sense physical information, process crude information, and report it to the sink. The sink, in turn, queries the sensor nodes for information. WSNs have several distinctive features. Daily progressive spread in using technologies such as wireless networks and smart devices which are equipped with different sensors, radio frequency identification labels (RFID) and near field communications (NFCs) have led to developing the thought of the new technology concept of the Internet of things (IoT) for daily human's life [1]. The Internet of things describes a world in which everything, including inanimate objects, has a digital identity and lets the smart systems organise and manage them. The idea of the Internet of things promotes the potential for communication, data exchange, aggregation and integration among the objects in our surroundings. Anything in this space has some services which present them to other things or existences and receives its required service [2].

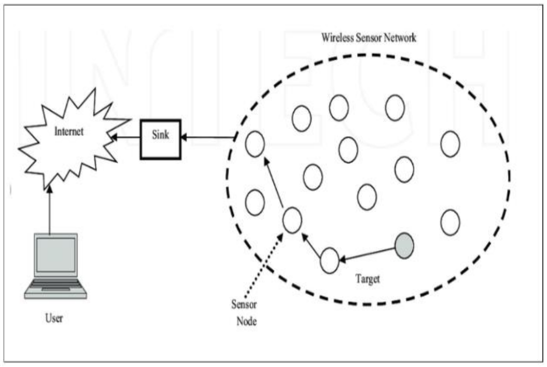

Figure 1 General Structure of wireless sensor network

1.1 Wireless Sensor Network applications

Nowadays, wireless sensor networks are used broadly in our routine life. You can find different sensor usage around your places, be it your home, workplace, mall, hospital etc. Here categorised, the applications into the military, environment, health, home and other commercial areas. It is possible to extend this classification with more categories, such as space exploration, chemical processing, disaster relief, and so on [3].

Environmental Applications:- Another important area of wireless sensor networks is environmental applications which include large-scale earth monitoring and planetary exploration; chemical/biological detection; precision agriculture; biological, earth, and environmental monitoring in marine, soil, and atmospheric contexts; forest fire detection; meteorological or geophysical research; flood detection; bio-complexity mapping of the environment; and pollution study [4].

Military Applications:- Wireless sensor networks can be a part of military command, control, communications, computing, intelligence, surveillance, reconnaissance and targeting systems. The rapid deployment, self-organisation, and fault tolerance characteristics of sensor networks make them promising sensing techniques for military applications. Some of the military applications of sensor networks are monitoring friendly forces, equipment and ammunition; battlefield surveillance; reconnaissance of opposing forces and terrain; targeting; battle damage assessment; and nuclear, biological and chemical attack detection (recently considered as one of the critical types of attacks) and surveillance.

Healthcare Applications:- Some health applications of sensor networks involve providing interfaces for the disabled, integrated patient monitoring, diagnostics, drug administration in hospitals, telemonitoring of human physiological data, and tracking and monitoring doctors and patients inside a hospital. The wireless body area network (WBAN) combines wireless sensors for healthcare applications. In which the sensors have been wearable and implantable on/in the body [5].

II. RELATED WORK

In [6], the significant goal is to measure how accurate and precise is the RSSI model in a remote sensor system to assess the position of an agreeable target. In this work not, another complex location estimation strategy for Wireless Sensor Systems (WSN) has been created. Yet, the proposed research actualises a straightforward confinement plan in light of a solid exploratory examination of Radio Signal Strength (RSS) as a separation estimation method in WSNs over the 433 MHz remote channel. This work's perceptions are categorised into two general classifications: the principal ones depend on an adjustment-based examination, and the second ones depend on a full-fledged plan for position estimation, the k – nearest neighbour match algorithm. In [7], Location estimation of sensor nodes is a key component in many wireless sensor networks (WSN) applications such as target tracking, rescue operations, disaster relief and environmental monitoring. The accuracy of the localisation algorithm is a vital component of the success of the localisation technique. The RSSI ranged-based localisation algorithm is a simple and cost-effective technique that relies on measuring the Receive Signal Strength Indicator (RSSI) for distance estimation. In this paper, we present experimental results that are carried out to analyse the sensitivity of RSSI measurements in an outdoor and indoor environment. A calibration model that characterised the RF radio channel will be derived and used for distance estimation. The validity of the estimated distance will be verified to track the position of a sensor node within an indoor environment. The results of this study reveal the feasibility of an RSSI-based localisation algorithm in designing the correct real-time position monitoring system. In [8], WSNs provide numerous indoor localisation algorithms. The lifetime of the localised node can be expanded by utilising radios which are energy efficient and minimising their busy time of activity.

Nonetheless, the minimal effort and low-control radios exclude Received Signal Strength Indicator (RSSI) based functionality that generally utilised RF-based estimations for localisations. In [9], It is a 3D localisation algorithm in which every sensor node measures the distance by utilising the mobile beacon. Mobile beacons are aware of their location by utilising GPS; every beacon contains the current location of each mobile beacon. This algorithm presents a range base methodology so mobile beacons can utilise the UBW signal. It provides an efficient resolution for time and is quite useful for multipath execution. For high accuracy, it utilises TOA systems. Finally, SDI is proposed for determining the 3D position of the beacon node. In [10], Accurate location information is essential for various emerging applications in wireless sensor networks (WSN). Reducing the effects of noisy distance measurements is paramount to improving localisation accuracy. This paper proposes an anchor node selection scheme for Received Signal Strength (RSS) based localisation in WSN. In the proposed approach, the nodes are sorted firstly to select anchor nodes reasonably, and to further reduce the influence of range error, the weight is assigned to each selected anchor node. Finally, an effective modified cuckoo search algorithm is used to compute the coordinates of unknown nodes. Extensive experiments are conducted to study the effects of anchor node ratio, ranging error factor and node density on the localisation accuracy performance of the proposed method. The experimental results demonstrate that the proposed method improves localisation accuracy better than the localisation technique without a special anchor selection scheme which selects all anchors' information received. The localisation technique selects the nearest anchors. Authors [11] introduced an improved anchor selection strategy that selects the three anchors nearest to the target for the generation of the training test and during the testing phase. The method is evaluated using real measurements acquired in office rooms. The results show that the proposed method provides an increased accuracy compared to the localisation algorithm using a standard regression tree. To our knowledge, challenges still exist in the research for RSS-based localisation. This paper mainly analyses the problems of RSS-based localisation and proposes a novel anchor selection scheme. Cheng et al. [12] designed a reliable selection strategy for anchor nodes. These factors are considered to conduct the fitness function, such as the localisation accuracy, communication overhead, and energy consumption. Then, the particle swarm algorithm is used to iterate to get the optimal anchor combination. The results show that the proposed strategy brings small calculation, fast convergence and positioning accuracy. Authors [13] various traffic requirements in wireless sensor networks depend mostly on specific application types: event-driven, continuous, and query-driven. In these applications, real-time delivery is one of the important research challenges. However, due to the harsh networking environment around a node, many researchers usually take a different approach from conventional networks. In order to discuss and analyse the advantages or disadvantages of these approaches, some comprehensive surveys kinds of literature were published; however, they are either outdated or compiled for communication protocols on a single layer. Based on this deficiency, we present up-to-date research approaches and discuss the important features of real-time communications in wireless sensor networks in this paper. As for grouping, we categorise the approaches into hard, soft, and firm real-time models. Furthermore, in all these categories, research has focused on MAC and scheduling and routing according to the second-level research area or objective. Finally, the article also suggests potential directions for future research in the field. Authors [14] proposed a general formulation to the anchor node selection problem and then relaxed the optimisation problem by deriving an upper bound of the objective function. Finally, the anchor node is selected based on the connectivity information. The experiments indicated that the proposed method is robust to improve network topology inference and routing performance. The above anchor node selection strategies are based on network connectivity, whereas they ignore range measurement techniques. The range-based RSS localisation can achieve high localisation accuracy; however, it is very susceptible to noise and obstacles, particularly in the indoor environment. Several algorithms exist in the following literature, which depends on optimising anchor selection to overcome the problem. The authors [15] use wireless sensor networks (WSNs), which are associated with the Internet of Things (IoT), and represent useful networks in assisting in monitoring, tracking and sensing different environmental activities. Sensors play an essential role in designing and applying any WSN.Due to the vast advances in communication and networking technology, there is a need to develop, build and apply various smart or intelligent service networks. IoT refers to equipping real objects with communication and computing facilities that enable collaboration with each other in real-life applications. IoT inclines toward the process of controlling, communicating, cost-saving and automation. This era will be the IoT era due to its numerous vital applications. This paper aims to review the status of the IoT and its application requirements. It also aims to survey the role of the sensors in this context. The paper provides a good overview of the important characteristics and applications of WSNs and IoT. This work is a practical guide for researchers interested in such a field. In [16] this project, the sensor-related information will be transmitted to the user by avoiding the collision of IoT. The Internet of Things is the software, things embedded with electronics, sensors and network connectivity. Most workers will die in industries because of no safety cautions or alarm indications. For example, an alarm indicates the emergency of high temperatures and humidity in the work area. This sometimes results in damage to types of machinery too. This project solves the situation by providing an alarm/Buzzer indication whenever temperature or humidity increases in the work area. System users are frequently notified with sensor data. If any high temperature/humidity values arise, an alarm or buzzer will indicate or caution the workers to be more alert in the work area. Some works in the industry should follow the temperature and humidity values in a certain range for reliable output. The buzzer will blow the horn if temperature and humidity sensor values exceed. The main advantage of IOT-based IWSN is data transmission without collision, safety and security.

III. MATLAB SOFTWARE USED

Here wireless network configuration simulation on MATLAB software using MATLAB function and tool. This thesis's performance analysis of the implementation tool for information mining implementation provides processor-optimised libraries for fast execution and computation on input cancer datasets. Its JIT (just in time) compilation technology provides execution speeds that rival ancient programming languages. It should also use multicore and computer computers, as the implementation tool provides numerous multi-row mathematics and numerical functions. These functions execute on multiple procedure threads in a single implementation tool, allowing them to run faster on multicourse computers. All inflated economic data retrieval results in this thesis were performed in an implementation tool. The high-level language and interactive environment many engineers and scientists use worldwide is an implementation tool. It enables users to explore and visualise ideas and collaborate across disciplines using signal and image methods, communication, and result computation. Implementation tool provides tools to collect, evaluate, and display information, allowing you to gain insight into your data in a fraction of the time it would take using spreadsheets or traditional programming languages.

IV. RESULT ANALYSIS

In the field in WSN, find a maximum error in RSSI in base paper main problem more error rate but overcome through the proposed method and improving performance and minimisation error localisation in WSN.

Table 1 Network configuration using initiate input parameter values in WSN, then Simulation.

Parameter Name	Parameter Values
Length (m) x Height (m) x Width(m)	101x101x101
Approximate Distance Calc.	5
Approximate Angle Cale.	5
Population Size	62
Maximum Iterations	80
Number of Nodes	13,23,30

(I) Experimentation on 13 nodes and using initiate set WSN configuration: Error Analysis

According to figure 2, they concluded that the overall error rate of the RSSI method is the highest. Still, second, our proposed method's (AEMM) overall error rate is low, also called the error minimisation comparison between the proposed method (AEMM) and the existing (RSSI) method. Find the proposed method (AEMM) are nodes position analysis very accurate and also called another word error are minimisation as better describe the local ignorance in the results compared to First, the (RSSI) method.

(II) Experimentation on 13 nodes and using initiate set WSN configuration: Execution Time Analysis

Figure 3 concluded that the overall execution time analysis of the RSSI method is less, but the second proposed method (AEMM) overall execution time analysis average comparison between the proposed method (AEMM) and the existing (RSSI) method. Find the proposed method (AEMM) is used to nodes position and analysis the execution time average to better describe the local ignorance in the results compared to First, the (RSSI) method.

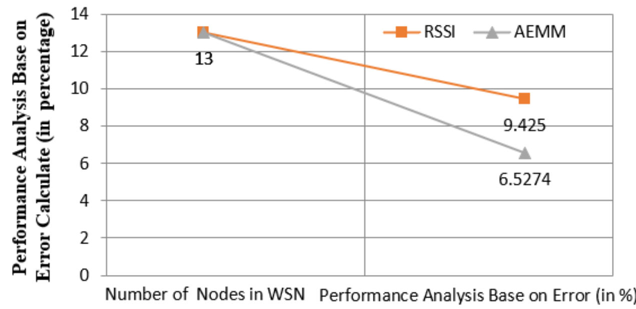

Figure 2 Experimentation on 13 nodes-based error analysis graphs in WSN

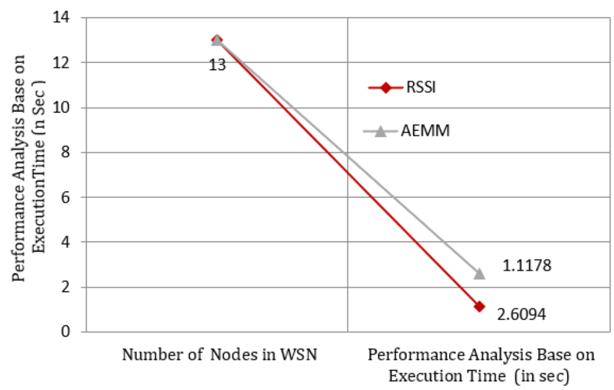

Figure 3 Experimentation on 13 nodes-based execution time analysis graphs in WSN

V. CONCLUSION

Improve wireless sensor network localisation performance using RSSI and an advanced error minimisation method (AEMM). WSNs remain domain-specific and are typically deployed to support a single application. However, as WSN nodes become more powerful, it is becoming increasingly important to investigate how multiple applications can share the same WSN infrastructure. WSN research on range-based systems. A cost-effective alternative to range-based methods is proposed: range-free methods (RSSI). They are dependent on the connectivity of nodes and anchors. Furthermore, range-free methods avoid using expensive hardware by estimating node locations using inter-node communication and the sensing range of the node. Wireless sensors positively impact IoT because they are cooperative devices that sense certain conditions. Sensors are regarded as the foundation of such intelligent networks. This paper provides an excellent overview of the most common IoT applications and structures. The approach first uses the difference between the maximum and minimum RSS from anchors to determine whether an unknown node is a boundary node; additionally, each selected anchor node is assigned a different weight based on the size of distance measurements between the unknown node and anchors in the selected anchor node-set. This paper proposes a method for improving performance and minimising error localisation in WSN using some nodes. Our proposed method (AEMM) analyses results based on estimated information, estimates node position in the localisation area and reduces the wireless error rate.

REFERENCES

[1]. Matin, Mohammad Abdul, and M. M. Islam. "Overview of the wireless sensor network." Wireless sensor networks-technology and protocols 1, no. 3,2012.

[2]. Yorke, Peter, Tim Wark, Raja Jurdak, Wen Hu, Philip Valencia, and Darren Moore. "Environmental wireless sensor networks." Proceedings of the IEEE 98, no. 11 (2010): 1903-1917.

[3]. García-Hernández, Carlos F., Pablo H. Ibarguengoytia-Gonzalez, Joaquín García-Hernández, and Jesús A. Pérez-Díaz. "Wireless sensor networks and applications: a survey." IJCSNS International Journal of Computer Science and Network Security 7, no. 3 (2007): 264-273.

[4]. Al-Turjman, Fadi M., Hossam S. Hassanein, and Mohamed Ibnkahla. "Optimised relay repositioning for wireless sensor networks applied in environmental applications." In 2011 7th International Wireless Communications and Mobile Computing Conference, pp. 1860-1864. IEEE, 2011.

[5]. Kashyap, Ramgopal. "Applications of wireless sensor networks in healthcare." In IoT and WSN applications for modern agricultural advancements: Emerging research and opportunities, pp. 8-40. IGI Global, 2020.

[6]. Saxena, Mohit, Puneet Gupta, and Bijendra Nath Jain. "Experimental analysis of RSSI-based location estimation in wireless sensor networks." In 2008 3rd International Conference on Communication Systems Software and Middleware and Workshops (COMSWARE'08), pp. 503-510. IEEE, 2008.

[7]. Al Alawi, Raida. "RSSI based location estimation in wireless sensors networks." In 2011 17th IEEE International Conference on Networks, pp. 118-122. IEEE, 2011.

[8]. Stella, M., Russo, M., & Begušić, D. (2012). RF Localization in Indoor Environments. Radio engineering, 21(2). International Journal of Advanced Smart Sensor Network Systems (IJASSN), Vol 12, No.1/2/3, July 2022

[9]. Ahmad, T., Li, X. J., Wenchao, J., & Ghaffar, A. (2020, September). Frugal Sensing: A Novel Approach of Mobile Sensor Network Localization based on Fuzzy-Logic. In Proceedings of the ACM MobiArch 2020 The 15th Workshop on Mobility in the Evolving Internet Architecture (pp. 8-15),2020.

[10]. Jing Cheng, Ya Li, and Qingyuan Xu. "An Anchor Node Selection Scheme for Improving RSS-Based Localisation in Wireless Sensor Network", Hindawi Mobile Information Systems Volume 2022, Article ID 2611329, 12 pages,2022.

[11]. H. Ahmadi, F. Viani, A. Polo, and R. Bouallegue, "An improved anchor selection strategy for wireless localisation of WSN nodes" in Proceedings of the IEEE Symposium on Computers and Communication (ISCC), Messina, Italy, 2016.

[12]. E. Cheng, L. Wu, F. Yuan, C. Gao, and J. Yi, "Node selection algorithm for underwater acoustic sensor network based on particle swarm optimisation", IEEE Access, vol. 7, pp. 164429 –164443, 2019.

[13]. Beom-Su Kim,1 HoSung Park,1 Kyong Hoon Kim,1 Daniel Godfrey,2 and Ki-Il Kim2, "A Survey on Real-Time Communications in Wireless Sensor Network", Hindawi Wireless Communications and Mobile Computing Volume 2017, Article ID 1864847, 14 pages, 2017.

[14]. T. Bouchoucha and Z. Ding, "Anchor selection for topology inference and routing in wireless sensor networks", Journal of Communications and Information Networks, vol. 5, no. 3, pp. 318 –323, 2020.

[15]. Mahdi, Muhammed Abaid, and Saad Talib Hasson. "A Contribution to the Role of the Wireless Sensors in the IoT Era." Journal of Telecommunication, Electronic and Computer Engineering (JTEC) 9, no. 2-11, 1-6,2017.

[16]. S. V. R. K. Rao, 2M.Saritha Devi, 3A.R.Kishore, 4Praveen Kuma, "Wireless sensor Network based Industrial Automation using Internet of Things (IoT)", International Journal of Advanced Trends in Computer Science and Engineering, Volume 7, No.6, November - December 2018.

[17]. A. Bahillo, S. Mazuelas, R. M. Lorenzo, P. Fernández, J. Prieto, R. J. Durán, and E. J. Abril, ''Hybrid RSS-RTT localisation scheme for indoor wireless networks,'' EURASIP J. Adv. Signal Process., vol. 2010, no. 1, pp. 1–12, Dec. 2010.

[18]. M. W. Khan, N. Salman, A. H. Kemp, and L. Mihaylova, ''Localisation of sensor nodes with hybrid measurements in wireless sensor networks,'' Sensors, vol. 16, no. 7, pp. 1–16, Jul. 2016.

[19]. K. Yu, ''3-D localisation error analysis in wireless networks,'' IEEE Trans. Wireless Commun., vol. 6, no. 10, pp. 3472–3481, Oct. 2007.

[20]. Y. Sun, Z.-P. Zhou, S.-L. Tang, X. K. Ding, J. Yin, and Q. Wan, ''3D hybrid TOA-AOA source localisation using an active and a passive station,'' in Proc. IEEE 13th Int. Conf. Signal Process. (ICSP), Nov, pp. 257–2602016.