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A Survey on Novel Energy Efficient Sleep Scheduling Routing Protocol for long life Wireless Sensor Network

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Abstract

There have been enormous works that tried to increase the efficiency of Wireless Sensor Network (WSN). Most of the researchers have been using the clustering method in order to prolong the lifetime of sensor nodes in a WSN. The clustering of sensor nodes will result in the distribution of resource management in a WSN. Hence, this can avoid sensor nodes from being overloaded and promotes load distribution among the sensor nodes. In this paper, a number of related works using the clustering methods have been reviewed in depth. We have identified the gaps for each of the strategies used for each method. By using the gaps identified, a new routing protocol is proposed.

Key-words: wireless sensor network, routing protocols, energy efficient.

I. INTRODUCTION

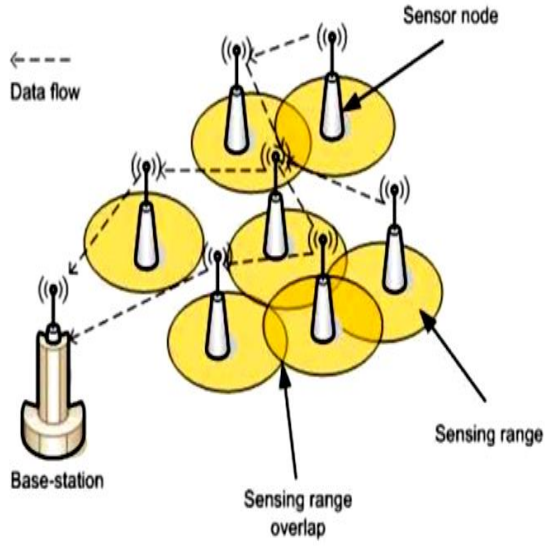
Recent developments in smaller scale electromechanical systems (MEMS) innovation have empowered little yet solid processors and wireless handsets with gentle ranges to be outfitted with sensors used for monitoring purposes. These sensors are used in what is known as a Wireless Sensor Network (WSN) which are used to collect data over a geographic area through physical estimation.

In this world, there are gigantic data that can and should be collected, processed and analyzed in order to produce valuable information for the well-being of the human kind. Some of the data are in the form of light, temperature, seismic waves, type of gasses and numerous others. If using the conventional method to collect these data i.e., manual, a lot of man-hours would be involved. Therefore, the introduction of WSN has simplified the process by using sensor nodes that are scattered over a geographic location to collect these data.

A wireless sensor network can consist of countless of sensor nodes that are randomly or deterministically distributed to dissect and screen the monitored location. A sensor node normally comprises of a icrocontroller, internal and external antenna, and also an intercaing circuit equipped with sensors ((H. LIN et al. 2017).

Sensor nodes are connected and can communicate with one another by multi hopping or by realying the data it want to send to the adjacent node. After the data has been collected, il will then be sent to a special node known as the sink node or base station. Sink nodes will have to be more sophisticated than the ordinary nodes. Normally, sink nodes will be equipped with adequate memory, processing power that will enable it to provide high-range transmission.

Figure 1 – A Typical Wireless Sensor Network



A typical setup of a Wireless Sensor Network is shown in Figure 1. Usually, the network is bi-directional, and it allows the nodes to transmit data to a sink node or also known as base station. Reversely, the sink node or the base station can also send management data to the nodes. Initially, the wireless sensor network was developed to be used by the military in the battle area; but now, such networks are being used in different environment for the public. Some of the examples of such applications are: modern construction, control and monitoring, machine inspection, monitoring of environment, and modern agriculture.

After successfully collected the data, the sensor nodes need to relay the collected data to the sink node. In doing so, finding the right route to relay the information is very important as this will affect the energy consumption of the related nodes involved. The routing process is actually a process of relaying data over the internet from a source to a destination. The problem of discovering effective routing algorithms has been a major research area in the field of data network. There are two essential activities involves in the routing process; the first one is in determining the ideal routing ways, and the other one is moving data packets through the Internet.

In an ideal routing, finding the best route are determined using various measurements. A measurement is a standard of estimation utilized by routing algorithms to determine ideal route to assess which route will be the best for a packet to travel. There are some challenges faced in routing data in a WSN as mentioned by A. Karmaker et al. (2016). There are a number of challenges faced by routing protocol, and some of them are as follows:

a) Scalability:

The upgrading of sensor nodes will leads to the enhancement of the network as a whole. Therefore, the Routing Protocol should be able to handle the scalability of the network size without affecting the performance of the network.

b) Fault Tolerance:

The operation of the network relies heavilty on the operability of the sensor nodes. The nodes could stop working due to the depletion of energy. However, the inoperability of few nodes will not affect the network performance as a whole, and this is known as Fault Tolerance. Fault tolerance is the trait that is designed into a framework to accomplish a specific design objective. Similarly, as a design must meet numerous useful and performance objectives, it should likewise fulfil various other design necessities. The most noticeable of the additional necessities are reliability, accessibility, wellbeing, performability, viability, and testability; fault tolerance is a one-framework trait fit for satisfying such prerequisites. Fault tolerance is accomplished in systems utilizing two methods to be specific design diversity and excess.

c) Production Cost:

In order to ensure that the network can be commercially used, the cost of the sensor nodes should be kept low. The manufacturer should concentrate on specific applications barring undesirable attributes and ought not to influence the nature of the nodes.

There have been numerous of applications for Wireless sensor network, and some of them will be presented here:

a) ***Area Monitoring:***

One of the common usage for WSN is in the area monitoring. The WSN can be dispatched to monitor certain activities over a designated area. Normally, various of sensors will be used.

Some of them are like heat, weight, and movement sensors. These sensors will be used to collect data in the designated area and will relay the collected data to the base stations or sink nodes. The data can be collected at a regular interval or in the event of changes of the data being monitored (for example, movement of people in a designated area).

b) ***Earth Monitoring/ Environmental:***

WSN is also widely used in monitoring the environment. It is widely used to the extent that a special network called Environmental Sensor Networks was introduced. The networks are being used to monitor changes in the environment such as volcano activities, gas released, area clearing due to logging and many more.

c) ***Forest Fire Detection:***

Detecting fire in a forest can also use WSN. Due to the vast area to monitor, WSN is a suitable candidate to be used as monitoring tool. Normally, heat and gas sensors will be used to detect forest fire. Eraly detection is crucial to avoid a major catastrophe.

d) ***Agriculture:***

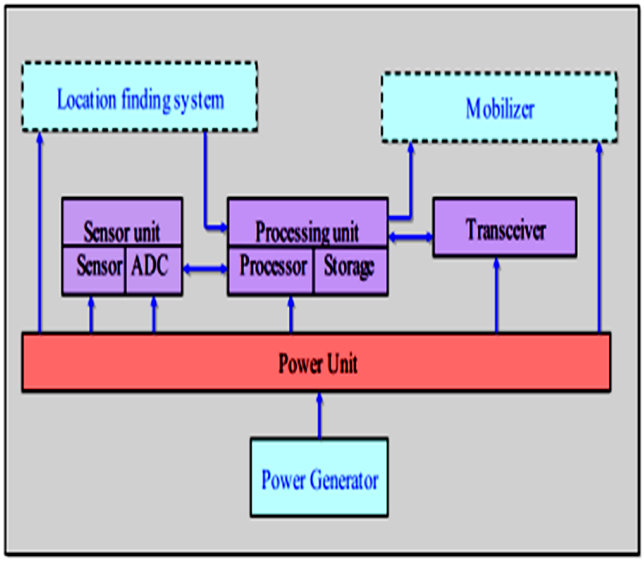
Wireless sensor networks are also being used in agriculture, or in a more sophisticated words, it is known as Smart Agriculture. This is the way forward for future agriculture. Sensor nodes are used to collect data such as the moistureness of the soil and this will normally link to the irrigation system.

II. DESIGN OF WIRELESS SENSOR NETWORK

The fundamental pieces of every sensor node are four components. They are preparing, detecting, the wellspring of energy, and handset. Some of them have discretionary parts, for example, energy source, framework GPS and versatility screen (JEON, B. et al. 2012).

Figure 2 shows the architecture of a sensor network, namely: sensor unit, handling unit, handset unit and energy unit. It might likewise have additional parts that are reliant on the usage, for example, location finding scheme (GPS), power generator and mobilizer. Ordinarily, sensor units comprise of two sub-units: sensors and analogue to digital converters (ADCs).

Figure 2 – Architecture of Sensor Network



III. ROUTING IN WIRELESS SENSOR NETWORK

In the wireless sensor network, a routing strategy assumes a pivotal job. Relegating overall ids to a major number of conveyed sensor nodes is exceedingly hard. In this way, traditional protocols may not have any significant bearing to WSN. WSN has natural highlights instead of standard wireless communication networks (MANET, cell network, and so on.). It is an amazingly dynamic and application-explicit network and has confined limit concerning power, stockpiling, and handling. These highlights make building up a routing protocol an extremely harder. Multiple sources are required as a rule to send their data to a particular base station.

One of the biggest limitation of the WSN is the energy consumption. Due to the nature of its nodes which runs on batteries, energy conservation is the most upmost issue for a WSN. Just imagine in a situation where sensor nodes are planted over a mass area for collecting data, replacing the batteries would be a daunting task (SUBRAMANIAN, G. et al. 2012). The most energy consumption lies in routing the data after it has been collected.

Therefore, it is important to have an efficient routing protocol.

There are also instances whereby the sensor nodes would be sending repetitive data. As mentioned earlier, the activities of routing the data will consume energy. So, this will leads to the energy depletion more quickly. Moreover, the network is also dynamic. Therefore, a good routing protocol is needed to address this feature.

Portability is another issue that a routing protocol has to faced. Due to the nature of the network which is dynamic, there would be cases where the topology of the network would change. The sensor nodes might be static, but the sink nodes would not be so. One of the way of obtaining the information of the designated area for a WSN is by using Global Positioning System (GPS). But this would need a lot of energy. Therefore, it is not feasible. As a result, a routing protocol needs to exploit other techniques like triangulation (TRAN-DANG, H. et al. 2014).

IV. LITERATURE SURVEY

Table 1 shows the summary of literature survey conducted for this research thus far.

Table 1 – Literature Survey on WSN

No.	*Title*	*Author*	*Year*	*Approach*
1	Density, distance and energy based clustering algorithm for data aggregation -in wireless sensor networks	H. Lin, R. Xie and L. Wei	2017	In this research, a new clustering method has been proposed. The proposed method considers the density of a WSN in prolonging the lifetime of a WSN.
2	Preserving data and key privacy in Data Aggregation for Wireless Sensor Networks	V. Akila and T. Sheela	2017	In this research, the security of data in a WSN using data aggregation has been considered.
3	A Data Aggregation Scheme Based on Compressive Sensing in Wireless Sensor Network	C. Ma, X. Jin and Z. Ma	2016	In this research, a data aggregation scheme was proposed which based on compressive sensing. Through the method, some measuremenr based on the energy utilization was used.
4	An efficient cluster head strategy for provisioning fairness in wireless sensor networks	A. Karmaker, M. M. Hasan, S. S. Moni and M. S. Alam,	2016	In this paper, a novel method to select a cluster head fairly for a cross layer protocol was proposed.
5	A Clustering Algorithm for WSN to Optimize the Network Lifetime Using Type-2 Fuzzy Logic Model	D. V. Pushpalathaand P. Nayak	2015	In this research, another method of selecting a cluster head was proposed. The method uses fuzzy logic. The selection criteria includes, remaining battery power, concentration and also the distant to the base station.
6	Localization algorithms based on hop counting for Wireless Nano-Sensor networks	H. Tran-Dang, N. Krommenacker and P. Charpentier	2014	In this paper, two methods have been proposed to prolong the lifetime of WNSN. The first method uses flooding mechanism in forwarding kacket, while the second method

H. Lin, et. Al. (2017) has proposed a clustering strategy called Density, Distance and Energy based Clustering (DDEC) to improve the performance of a WSN. By using the clustering method, the nodes in a WSN is grouped into clusters using the part number to regulate the load in the network. It also proposes an algorithm to select a cluster head based using the distribution, width and also the remaining energy of a candidate. The method has managed to reduce the intra-communication cost and prolong the lifetime of the network. From the experiment conducted, it shows that DDEC out-perform the DDCHS.

Another isssue related to WSN is the security and data aggregation. Akila, V. (2017) has proposed a method that can protect the security of data in a WSN using data aggregation. The existing method requires an extensive computing power and also introduces overhead for the communicating nodes. But with the proposed method, all these issues have been resolved. In addition, the proposed method provides the data security.

SUN, B. et. al. (2016) has proposed a layered data aggregation technique which can reduce the data transmission and thus would consume less energy in a WSN. In the proposed method, the sensor nodes are arranged using multistage clusters. The clusters will then compressed its data before forwarding it to the adjacent node which will then forward it to another adjacet nodes until it reaches the sink nodes. From the experiment conducted, it showed that the proposed method provides better energy consumption for a WSN.

Authors (A. KARMAKER et al. 2016) has proposed a novel plan to select reasonable and adjusted cluster head for a cross-layer protocol in the wireless sensor network. Since LEACH-C and it's the greater part of the variations select cluster head by thinking about energy and distance as an essential parameter, it can diminish energy utilization of nodes however neglect to make an adjusted cluster. As per the prerequisite of reasonable CH choice, we think about remaining energy, number of neighbour nodes and one-hop neighbour data. The proposed algorithm spares a huge measure of energy as well as spread each locale of the detecting area reasonably. We assess our proposed protocol with two ongoing clustering approaches, one is appropriated and another is a unified methodology. MATLAB simulation result demonstrates that the critical performance improvement over the related plans accomplished by the proposed protocol in terms of First Node Death (FND), Last Node Death (LND) and energy utilization.

In the past few years, the use of Wireless Sensor Networks (WSNs) is expanding hugely in various applications (H. TRAN-DANG et al. 2014 and MOHAMAD ZAIN et al. 2018), for example, catastrophe the executives, security observation, outskirt insurance, battlefield surveillance and so forth. Sensors are relied upon to convey remotely in enormous numbers and arrange with one another where human orderly isn't practical. These small sensor nodes are operated by battery power and the battery-operated sensor node can't be revived or supplanted in all respects effectively. Therefore, the energy utilization is a very significant issue to prolong the network lifetime.

To address this issue, the clustering method can be used whereby the sensor nodes are grouped into cluster. Each cluster will be headed by a node called the Cluster Head (CH). All the information collected by the sensor nodes will be sent to this CH which will then forward it to the base station or the sink node. Selecting an appropriate CH is crucial in reducing the energy consumption. Therefore, an algorithm was also proposed. The algorithm uses Type-2 Fuzzy Logic. The algorithm takes into consideration of the remaining battery power, and also the distance to the base station in selecting the CH.

Table 2 – Literature Survey on WSN

Paper	***Alive Node(500 Rounds)***	***Energy Consumption***	***Residual Energy***	***Remaining Battery Power***
H. Lin *et al.*	146	-	0.141J	-
V. Akila *et al.*	-	700J	-	-

B. Sun *et al.*	-	2400J	-	-
A. Karmaker *et al.*	90	-	12.5J	-
D. V. Pushpalatha *et al.*	-	-	-	High
H. Tran-Dang *et al.*	-	-	0.45J	-

According to H. Tran-Dang, N. Krommenacker and P. Charpentier (2014) Wireless Nano-Sensor networks (WNSN) comprise of Nano-sensors outfitted with Nano handsets and Nano antennas to operate in Terahertz frequency band (0.1-10THz). Such bandwidth will result in short range communication and is susceptible to interference. As a result, this will restrict the abilities of the Nano-nodes. Therefore, in this research, an algorithm based on hop-checking techniques is proposed. The algorithm will measure the distance of the nodes and will forward the data collected using the flooding technique. In order to overcome the problem of high overhead, duplication of data and high energy utilization, the algorithm also uses clustering. The data collected by the sensor nodes will be sent to the Cluster Head before being forwarded to the sink node. In doing so, the routing protocol will consider the distance using hops count. From the experiment conducted, it was found that the proposed protocol can increase the performance of a WNSN.

V. PROBLEM IDENTIFICATION

Energy depletion is the most important issue in a WSN. Due to its nature that uses batteries, energy conservation is vital. On the other hand, routing of data consumes most energy in a WSN. As a result, an efficient routing protocol is needed to ensure that the relaying of information would consume less energy. This is evident in many applications where WSNs are used, for example in the military, smart agriculture and environment monitoring. Therefore, it s safe to conclude that energy constraint is the most important thing that need to be adressed by WSN in order to ensure that the network can operate longer.

The density of an area is one of the main considerations need to be taken care of by any routing algorithm. Unfortunately, most clustering algorithms did not address this feature. Khamiss. Aet. al. (2014), has proposed a routing protocol which takes into consideration the density of an area. In addition, the protocol also uses fuzzy clustering technique during the cluster formation which relies on intra and inter-communication distances, apart form the residual energy.

Meanwhile, Hai Lin. et.al. (2017) has proposed a new clustering method called Density, Distance and Energy based Clustering (DDEC). The proposed method can improve the network performance by analyzing on the number of alive nodes, along with the residual energy using Density, Distance and Energy Clustering.

In another work, An Yan et. Al. (2017) also mentioned that the sensor nodes in a WSN have limited energy resources. As a result, it is very important to come up with methods that can reduce the nergy consumption for such networks so that the network lifetime can be prolonged. In addition, there are also other issues which need attention, such as, the reliability of the storage, security, data aggregation and processing power of the nodes which also contribute to the longevity of a WSN network.

There is a direct linkage between the size of a WSN with its bandwidth and also energy depletion. In order to deal with this issue, V. Akila et. Al. (2017) has proposed a method that uses data aggregation and at the same time offers security to the data. In the proposed method, the base station would identify the suspicious groups which are related to the set of group aggregates. The data retransmission will only done for the abnormal data sensing intermediate nodes.

Meanwhile, Bin Sum et. Al. (2016) has proposed an efficient data aggregation method based on compressed domain. The proposed method can resolve the issue of high data

transmission which in return would consume a lot of energy in a WSN.

In another work, Basavaraj G.N et.al. (2017) has proposed a method using residual energy for the nodes using the average distance between the cluster head and the sink node. Unfortunately, this method only provides little improvement to the existing performance of the WSN.

VI. PROPOSED TENTATIVE METHODOLOGY

Wireless Sensor Networks (WSN) proposed algorithmic procedural flow chart. Figure 4 shows the tentative flow of the proposed algorithm with all the possible modules in the network. The main modules will the initialization of network, clustering module, and cluster head election module etc. The implementation and simulation of proposed work will be performed in MATLAB Simulation environment.

The steps of simulation of proposed idea shown in Figure 3. Primary and secondary cluster heads (CHs) will equitably disperse all through the system and number of CHs framed in each round will be relatively uniform.

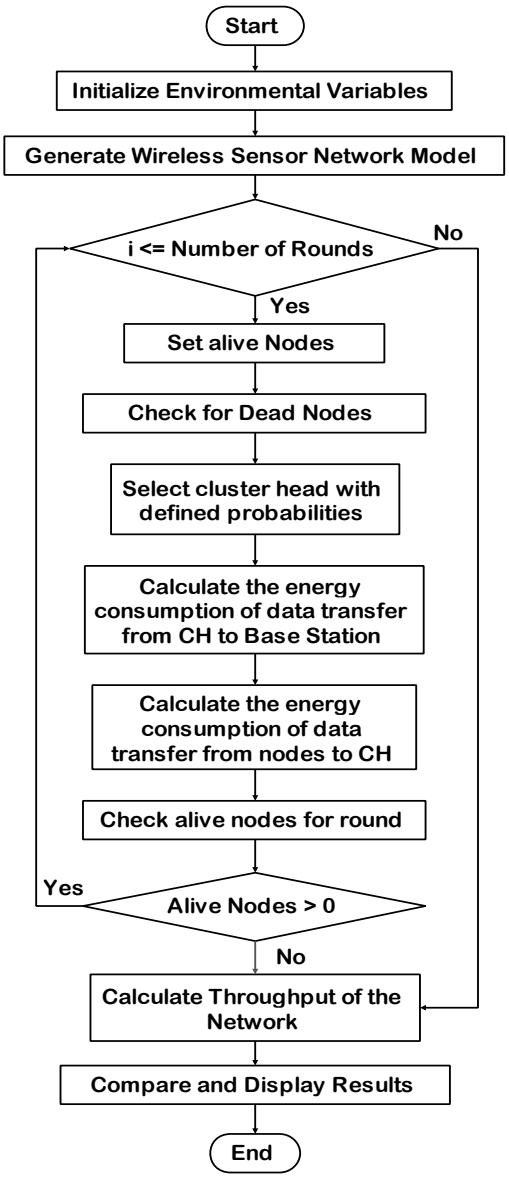


Figure 3 –Flow Chart of Proposed Methodology.

VII. EXPECTED OUTCOMES

After going through different research work in the literature survey. Authors have tried different dimensions of clustering to group up the whole nodes spread across the network. The idea of handling data transfer from node to base station by grouping(clusters) them either by considering density od nodes, the distance between nodes, or minimum energy [1], has shown a potential increase in the network lifetime and increase in the residual energy of the network.

A method (O. ABOUELKHAIR et al. 2014) was motivated to keep privacy of the

information secure by adding keys which add significant energy consumption to the network. Data aggregation proposed by (B. SUN, et al. 2016) worked by working on the data being collected and transferred to upper layers in the network hierarchy to conserve energy.

All those have motivated to keep the idea of clustering to make strong routing from end node to base station and data aggregation pattern will significantly add value to the clustering for improvement of overall energy consumption and network lifetime.

To make more strong path with equal opportunity to transfer data from all the corners of the network and in parallel with data aggregation and more residual energy a time constraint should be added to get more efficient results.

This would save network nodes to die faster and live longer and add life to the network, and simultaneously capable to save much power in batteries. So that network lives more than 500 rounds, the average energy of nodes more than 0.14J after 500 rounds and base station throughput more than 1.5x104.

VIII. . CONCLUSION AND FUTURE SCOPE

Wireless Sensor Networks (WSN) is a promising innovation for monitoring the environment especially in the situation where human involvement is not feasible or required. Some of the application of WSN can be seen in VANET and IoT as stated in Ramli, et. al (2020), Mohamed Rawi, et. al (2014) and Salleh, et. al (2017). There have been many methods used in managing the sensor nodes and clustering is the most widely used due to its adaptability, robustness, versatility and energy effectiveness. Having said that, these clustering methods ought to be implemented carefully in order to accomplish energy adjusting and energy protection which are the most prevalent design issue faced by WSN. In future, further research in WSN will need to carefully implement hypothetical strategies so that the main objective of such methods can be achieved. For that reason, we are also proposing a new routing protocol that uses clustering methods and hope that it can overcome all the gaps identified.

BIBLIOGRAPHY

1. KHAMISS, A.; CHAI, S.; ZHANG, B.; LUAN, J.; LI, Q. (2014). An energy-efficient and density -aware clustering for WSNs, Proceedings of the 33rd Chinese Control Conference, Nanjing, pp. 377-382.
2. KARMAKER, A.; HASAN, M. M.; MONI, S. S.; ALAM, M. S. (2016). An efficient cluster head selection strategy for provisioning fairness in wireless sensor networks, 2016 IEEE International WIE Conference on Electrical and Computer Engineering (WIECON-ECE), Pune, pp. 217-220.
3. JEON, B.K.; PARK, S. (2012) Design and implementation of high event density area centred clustering-based routing, 2012 International Conference on Computing, Networking and Communications (ICNC), Maui, HI, pp. 247-251.
4. SUN, C. M; JIN, X.; MA, Z. (2016). Data Aggregation Scheme Based on Compressive Sensing in Wireless Sensor Network, 2016 9th International Symposium on Computational Intelligence and Design (ISCID), Hangzhou, pp. 453-456.
5. PUSHPALATHA, V.; NAYAK, P. A. (2015). Clustering Algorithm for WSN to Optimize the Network Lifetime Using Type-2 Fuzzy Logic Model, 2015 3rd International Conference on Artificial Intelligence, Modelling and Simulation (AIMS), Kota Kinabalu, pp. 53-58.
6. SUBRAMANIAN; AMUTHA, R. (2012). Efficient and secure routing protocol for wireless sensor networks using mine detection an extension of triple umpiring system for WSN, 2012 8th International Conference on Computing Technology and

Information Management (NCM and ICNIT), Seoul, pp. 141-145.
7. LIN, H.; XIE, R.; WEI, L. (2017). Density, distance and energy-based clustering algorithm for data aggregation in wireless sensor networks, 2017 IEEE/CIC International Conference on Communications in China (ICCC), Qingdao, pp. 1-5.
8. TRAN-DANG, N.; KROMMENACKER; CHARPENTIER, P. (2014). Localization algorithms based on hop counting for Wireless Nano-Sensor networks, 2014 International Conference on Indoor Positioning and Indoor Navigation (IPIN), Busan, pp. 300-306.
9. ABOUELKHAIR; ELSAADNY, A. (2014). Multipath Adaptive Periodic Threshold-Sensitive Energy Efficient Protocol for Wireless Sensor Networks, 2014 Sixth International Conference on Computational Intelligence, Communication Systems and Networks, Tetova, pp. 33-37.
10. AKILA; SHEELA, T. (2017). Preserving data and key privacy in Data Aggregation for Wireless Sensor Networks, 2017 2nd International Conference on Computing and Communications Technologies (ICCCT), Chennai, pp. 282-287.
11. MOHAMAD ZAIN, J.; MUHAMMAD, N. (2018). Conceptual Framework for Lightweight Ciphertext Policy-attribute based Encryption Scheme for Internet of Thing Devices, 3rd International Conference of Computer, Environment, Agriculture, Social Science, Health Science, Engineering and Technology (ICEST 2018), Bulharia, pp. 379-383.
12. RAMLI, N. I.; MOHAMED RAWI, M. I. (2020). An overview of traffic congestion detection and classification techniques in VANET, Indonesian Journal of Electrical Engineering and Computer Science, Vol 20(1), pp. 437-444.
13. MOHAMED RAWI, M. I.; RAMLI, N. I. (2014). Enabling intelligent wireless sensor networks for passive house, 2014 IEEE Conference on Wireless Sensors (ICWiSE), Subang Jaya, Malaysia, pp. 100-105.
14. SALLEH, A.; MAMAT, K.; DARUS, M. Y. (2017). Integration of wireless sensor network and Web of Things: Security perspective, 2017 IEEE 8th Control and System Graduate Research Colloquium (ICSGRC), Shah Alam, pp. 138-143.