Hybrid Energy Efficient Scheme For Wireless Sensor Networks

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ABSTRACT:- Today, Wireless Sensor Network has been widely used in many areas such as battle field surveillance, industry process control, pipeline monitoring, environmental monitoring and control, healthcare and medical research, national defense and military affairs, etc. In all these key application areas, localization plays an important role. Localization in wireless sensor networks is the process of determining the geographical positions of sensors. This consumes the major portion of energy contained by the network. The problem is more serious as sensor nodes have limited computation capability, limited power and small memory size so it is difficult to use the same routing algorithm as used in other adhoc network. This paper, proposed the use of dynamic power management system along with routing algorithm based on Tabu search and Fuzzy Inference System for forming clusters and identifying cluster head. The proposed Tabu search algorithm carries out two neighborhood generating operations in order to determine an optimal path from a source to a destination and minimize algorithm execution time between cluster head (semchedin, Medikoune, & et.al., 2012)***. Meanwhile to identify the cluster Head fuzzy inference system is used. The proposed algorithm is implemented using MATALB software and the reduce energy consumption and increase packet delivery ratio (PDR) shows the edge of proposed algorithm over existing algorithm.***

Keywords:- WSN, TSA, FIS, PDR

I. INTRODUCTION

The recent advancements in the technology and manufacturing of small and low-cost sensors have made application of these sensors technically and economically feasible. These sensor nodes are designed to possess certain sensing, computing and wireless communication capabilities. These sensors sense the required information from surrounding environment and convert it into electrical signal. These signals are further processed to extract intended information. These sensors are interlinked with each other forming a wireless sensor network. Based on the mobility of sensor nodes wireless sensor network (WSN) can be classified as mobile or fixed WSN. A large number of these sensors can be networked in many applications that require unattended operations, hence creating a wireless sensor network (WSN) (Nayak & Vathasavai, 2017). The major advantage of WSNs is their ability to operate in remote areas under inconsiderate surroundings. Some of its applications include: security, surveillance, monitoring, and detection etc. Figure 1 shows a schematic diagram of sensor node components (Wan, Hao, & Li, 2016).

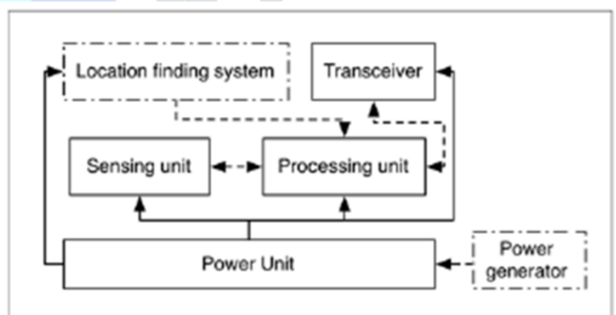


figure 1: functional blocks in a sensor node

Typical Sensor nodes consist of sensing, processing, transmission, and power units with additional option of location identification. Sensor nodes are usually scattered in a sensor field in an area where the monitoring is required. Sensor nodes coordinate among themselves to produce high-quality information about the physical environment. Each sensor node bases its decisions on its mission, the information it currently has, and its knowledge of its computing, communication, and energy resources (Bheemalingaiah & Naidu, 2017). Each of these scattered sensor nodes has the capability to collect and route data either to other sensors or back to an external BS(s). A BS may be a fixed or mobile node capable of connecting the sensor network to an existing communications infrastructure or to the Internet where a user can have access to the reported data. Figure[2] shows the architecture of WSN with flat & hierarchical topology.

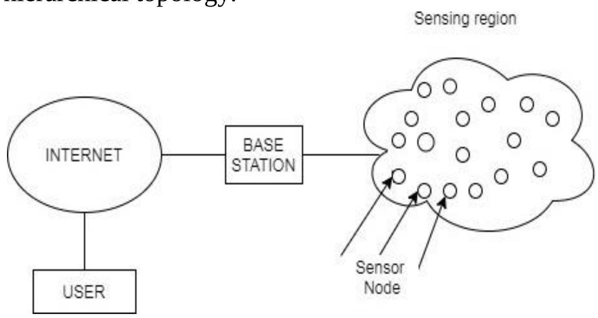


figure 2: architecture and operation of wsn

II. LITERATURE SURVEY

Padmalaya Nayak et al. (Nayak & Vathasavai, 2017)Proposed the use of type 2 fuzzy logic (T2FL) model to improve the energy efficiency of the system. The T2FL algorithm is known for better uncertain decision handling capability than T1FL. in this paper, we come up with an idea of fuzzy logic (FL), which is applied in WSN for decision making. These algorithm improves the efficiency of CH and make it adaptable, flexible and intelligent enough to distribute the load among the sensor nodes that can enhance the network lifetime. This paper, highlights a bunching calculation based on interim type 2 fuzzy logic display, that deal with uncertain decision of any WSN network.

Chang and Ju [14], has proposed a scheme for conserving the energy in wireless sensor network by utilizing the clustering scheme without peers. In this scheme for data aggregation cluster head is selected on the basis of distance between node and remained energy. After every twenty rounds of data aggregation cluster head has been selected. The advantage of this scheme is that not any particular node is overburden thus increases the life of nodes. The proposed algorithm was developed in C#.net. Finally the results are compared with other state-of-art on the basis of energy remained with the increased round to find its higher effectiveness.

Dogan Yildiz et al. (D, S, & et.al., 2015), In this paper authors proposed the two dimensional localization method based on Parametric-equation of the hyperbola, to identify the location of target node in wireless sensor networks. As the number of nodes is increased with the range the localization performance of the proposed algorithm generally increases for all distributions. But when the number of nodes decreases the performance matrices goes down. This paper is implemented on MATLAB and is based on following assumptions that there is no obstacle in surroundings, nodes are identical and stationary this hinder the practical applicability of the proposed work.

Alexandros Ladas et al. (Ladas, Pavlatos, & et.al., 2016), This paper presents Multipath-ChaMeLeon (MCML) which utilizes the attributes of the proactive Optimized Link State Protocol (OLSR) to implement a multipath routing approach based on the Expected Transmission Count (ETX). The use of ETX forced the need to integrate some more redundant information within the generated control messages which indulge the normalized routing load. The use of multipath approach creates the multiple duplicate messages which increases the burden of network. More to the point M-CML routing approach combined with an intelligent link metric such as the ETX reduces the effects of link instabilities and enhances the network performance which reflects in terms of resiliency and scalability. Increase in the redundant information and multiple path transmission of message consequences the need of large storage and increased computational cost .

Anjali Bharti et al. (Bharti, Devi, & Bhatia, 2015), In this paper, the authors suggested a passive blind estimation of time-delays for uncorrelated interference source signals for wireless sensor networks. The proposed work is based on the estimation of the time differences of arrival (TDOAs) between multipath signals for passive source localization. The benefit of this is interference signal can be recovered effectively, avoiding the effect of the co-frequency mixed communication signal. Simulations prove that the TDOA passive estimation performance of the interference signal in a co-frequency mixed environment has improved effectively. The proposed algorithm is based on Blind source separation and secondary interference signal.. The received signals at the sensors are modeled as unknown linear combinations of the differently delayed versions of multipath interference signal.

Abdul Razaque et al. (Abdul, Musbah, & Joshi, 2014), This paper has presented a centralized clustering techniques based on a tabu search method to solve clustering problems for a wireless sensor network with unfixed cluster head and indefinite nodes. Since the network has indefinite nodes the tabu search allow reassigning nodes to clusters, selecting cluster heads, and removing existing clusters. The performance of this novel approach was evaluated with different network sizes and topologies and has better performance in terms of cluster cost and execution time. Furthermore, it behaves well with network extensibility. The major drawback of this proposed algorithm Due to centralized approach and transfer of redundant data this scheme suffers from over burden on network and faces optimization problem.

III. METHODOLOGY

Each sensor node in WSNs works on limited energy, and the lifetime of the network depends on the number of alive nodes, which are able to communicate to serve the purpose of the sensor network (Ladas, Pavlatos, & et.al., 2016). The deployed sensor nodes require some techniques that make our network energy-efficient. Most of the work in this field either utilizes clustering techniques or routing technique for making the network energy efficient or sequentially improves the life time of WSN. Beside this certain paper found in literature works on power management (PM) techniques also. Energy efficiency is one of the most important concerns.

For an energy efficient operation (Heinzelman, R., & et, 2000), optimal cluster formation is necessary to ensure that energy is consumed at a balanced rate. The operation of cluster based WSNs is broken into rounds. Each round is made up of cluster head selection, cluster formation and data transmission. For this purpose a fuzzy inference system is used for cluster formation and cluster head selection. For this 3 input parameter, energy level of the CH, distance between the CH and the BS and the density of nodes are used. This parameter is further categorized as low medium and high values which generate 27 chance values.

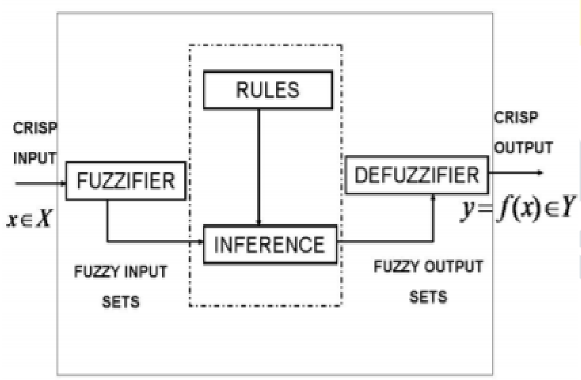


figure 3: the structure of a fuzzy logic system

Figure 3 shows the basic structure of Fuzzy inference system Another important factor that is highlighted in this paper is, in most of the WSN applications, a sensor node follows low duty cycle and low-event arrival rate at the input of sensor node so it may be beneficiary if we implement Dynamic Power Management (DPM) scheme for the network. In DPM the operating state of system components when the workload varies and making components *off* or *idle* when not in use. But the drawback is that some nodes may miss to sense data during transition condition. For this purpose DPM scheme is implemented for CH only. CH will be active only during data aggregation mode or during the process of clustering.

The principle behind the tabu search (Ghaboosi, Haghighat, & et.al., 147-166) is that for problem solving to qualify as intelligent, it must incorporate responsive exploration Computation of routing schedule is done dynamically with the consideration of current level of some criteria of each node. For this, normally it may require the nodes to report their criteria periodically to the base station. The base station can then determine the routing schedule based on this updated information. The proposed method assumes that: 1) all sensor nodes are randomly distributed in the area and every sensor node is assumed to know its own position as well as that of its neighbors and the sink; 2) all sensor nodes have the same maximum transmission range and the same amount of initial energy.

. It is proposed here that a number of metrics will be combined into a single decision thereby optimizing a routing protocol over a number of metrics and making it more robust. The link cost will be determined via a fuzzy logic system with the caching parameters being applied to a fuzzifier that translates them into fuzzy sets. The fuzzy sets are used to appraise each constraint as being Low, Medium or High, assigning each a value

It derives from the fact that in a system based on memory, a bad strategic choice can yield more information than a good random one. Since, randomization creates a situation where it is difficult to discover differences between good and bad. For this purpose during the search the entire neighborhood is explored and all feasible moves instead of examining some random ones on a given iteration are evaluated. After establishment of all the neighborhood solutions, one of them must be chosen as the next initial node. These evaluations are passed to a fuzzy inference engine that applies a set of fuzzy rules that determines if a route is apt for caching or not. If a route is deemed suitable a route reply is generated and sent to the initiator of the route request by reversing the path stored in the route record. Flow chart of implemented Tabu search with fuzzy inference system algorithm is shown in figure 4. The path from source to destination node is established in the create allowed shortest path with the help of cache rule. Cache rule select the best solution and update shortest path. Update shortest path gives the information in fuzzy inference system (FIS) then FIS check all the cache rule, if the condition is true then route information stored in cache otherwise ignore route.

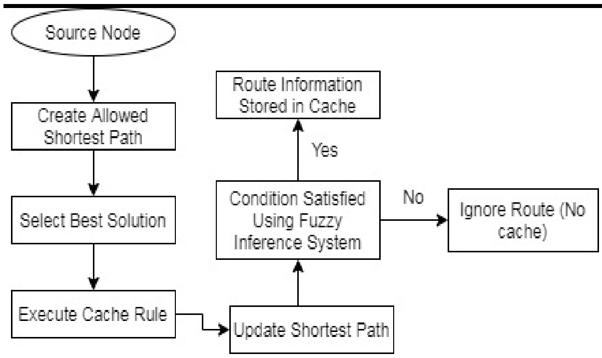


figure 4 : flow chart of implemented algorithm

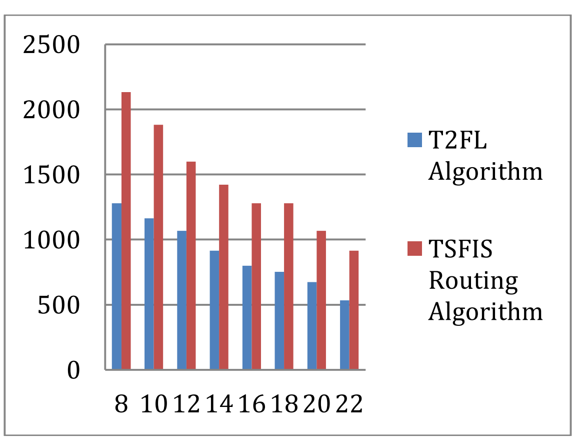
V. RESULT

The proposed algorithm is simulated in MATLAB under following assumption

1. All the nodes in WSNs are identical in terms of hardware, energy consumption , and computation capabilities.
2. The nodes are placed randomly in the field
3. All the nodes have the equal initial energy.
4. The base station position is located outside of the WSNs.

Table 1 shows the comparison between throughput (kbps) of previous and proposed model. Throughput defines the number of packets per second received at the destination the increased value of this parameter indicates the suitability of tabu search and FIS scheme. Bar graph shows that the proposed algorithm has an edge over the previous one.

Throughput (Kbps)			
Number of Node	Type2FL Algorithm	TSFIS Algorithm	% Improvement of Previous Algorithm
8	1280.00	2133.33	39.99%
10	1163.63	1882.35	38.18%
12	1066.66	1600.00	33.33%
14	914.28	1422.22	35.71%
16	800.00	1280.00	40.00%
18	752.94	1280.00	41.17%
20	673.68	1066.66	36.84%
22	533.33	914.28	41.66%



To study the performance of proposed algorithm three parameter Network delay , Throughput and Packet delivery ratio, are used for system optimization two inputs (distance, degree) and one output (priority) fuzzy inference system. System optimization depends on the priority of the system. Suppose distance is low and degree is high then priority is medium. Priority depends on the medium value of the distance and degree.

Tabu search works on two neighborhood generating operations to determine the optimal path and it creates a tabu list with the help of short memory which helps to avoid repetition thus reducing the delay time. In table 2 and table 3 the better packet delivery ratio and less delay shows the better performance of proposed scheme over previous one.

table 2:comparison of packet delivery ratio

Packet Delivery Ratio (%)			
Number of Node	Type2FL Algorithm	TSFIS Algorithm	% Improvement of Previous Algorithm
8	96.8%	98.7%	1.9%
10	95.9%	98.3%	2.4%
12	96.7%	98.1%	1.4%
14	96.0%	98.0%	2.0%
16	96.0%	97.9%	1.9%
18	95.5%	97.6%	2.1%
20	95.4%	97.4%	2.0%
22	95.1%	97.2%	2.1%

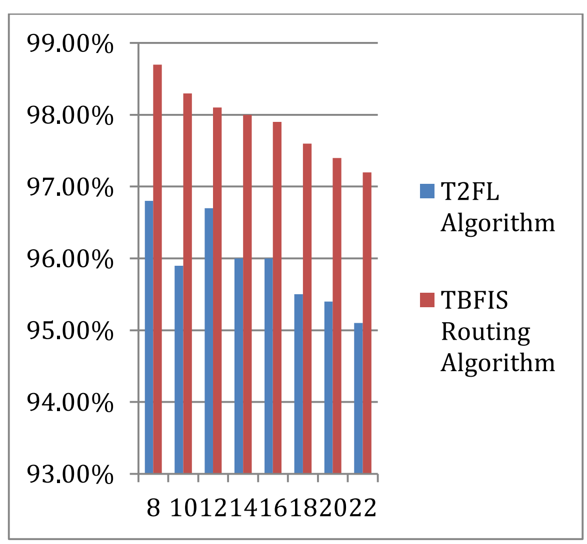
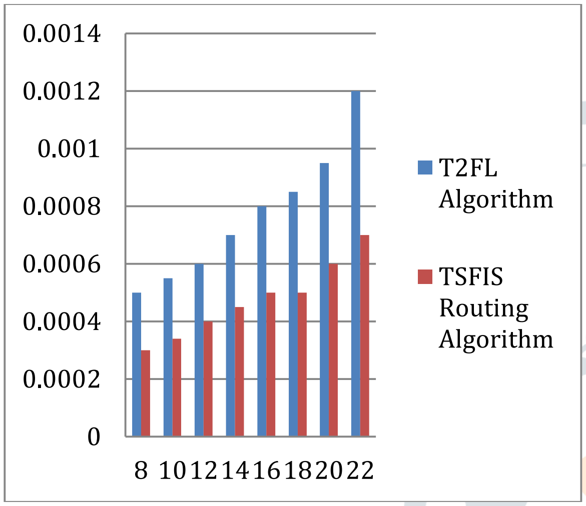


table 3:comparison of delay(sec)

Delay (Sec)			
Number of Node	Type2 FL Algorithm	TSFIS Routing Algorithm	% Improvement of Previou Algorithm
8	0.0005	0.0003	40.00%
10	0.00055	0.00034	38.18%
12	0.0006	0.0004	33.33%
14	0.0007	0.00045	35.71%
16	0.0008	0.0005	37.50%
18	0.00085	0.0005	41.17%
20	0.00095	0.0006	36.84%
22	0.00120	0.0007	41.66%



VI. CONCLUSION

The proposed hybrid protocol works in three different directions for optimization of WSN. The cluster head selection and forming of cluster done by FIS utilizing three different parameter such as node density, residual energy of nodes and distance between cluster and BS is used. Dynamic power management scheme is used for CH to minimize the energy consumption of CH and finally, The use of tabu list for routing is done. This tabu list is updated whenever CH is changed unlike every round as used in previously proposed work. The Tabu search algorithm tries to balance the energy consumptions and ensure that the total energy dissipation is divided equally among all the network nodes. The proposed algorithm gives a higher packet delivery ratio 98.7% for N=8 Sensor node as compared with 96.8% for previous algorithm. The proposed algorithm gives a lower delay 0.0003 for N=8 sensor node as compared with 0.0005 for previous algorithm. The proposed algorithm gives a higher throughput 2133.33 for N=8 Sensor node as compared with 1280.00 for previous algorithm.

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