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CLUSTERING BASED HYBRID BEST-FIRST SEARCH MULTIPATH ROUTING APPROACH (CHBSMRA) FOR LOAD BALANCING IN WSN

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Abstract – One of the fundamental issues in wireless sensor networks is information collection. How the sensor node can send proficiently the detected information to the sink since their number is exceptionally enormous and their assets are restricted. Clustering enjoys various benefits like it lessens the size of the routing table , conserve communication bandwidth, drag out network lifetime, decline the redundancy of data packets, decreases the pace of energy consumption and so forth . In this paper, we present a Clustering based Hybrid best-first search Multipath routing Approach (CHBSMRA) for Load Balancing in WSN . The reenactments show that the proposed approach is productive regarding energy consumption, amplification of the organization lifetime, data delivery to the sink and scalability.
Keywords: Multipath routing, load balancing, clustering, wireless sensor network,

1. Introduction

A wireless sensor organization (WSN) comprises of conveyed sensors to monitor physical and ecological circumstances which are of independent kind. The wireless sensors were at first utilized in military applications however these days, it is utilized in numerous modern and consumer applications for monitoring and controlling [1]. The WSN has a gathering of nodes going from not many to a few hundred or even thousands. It comprises of little light weighted wireless nodes called sensor nodes. A sensor node differs from the size of a shoebox to a grain of residue. The expense of sensor nodes is goes from a couple to many dollars, contingent upon the complexity of the singular sensor nodes. The size and cost imperatives on sensor nodes brings about changes in limitations on assets like energy, memory, computational speed and bandwidth [19]. The topology of the WSNs can differ from a straightforward star organization to multihop network organization. The proliferation technique between the jumps of the organization can either be routing or flooding. Energy, calculation, memory and restricted communication abilities Dr.R. Ramesh, Associate Professor, Anna University, India. All sensor nodes in the wireless sensor network are connecting with one another or by intermediate sensor nodes.

In this paper we present a useful Load balancing routing framework to extend the existence season of each and every current node in way to get most proficiency from the framework. The current routing algorithms are utilized to pick a negligible work to diminish the transmission time for Wireless Sensor Networks since they don't consider the energy used by nodes for transmission [7]. A little form in transmission time is the fundamental deficiency of existing load balancing directing algorithm.

2. Existing Methodologies

1. Improved Load Balancing

S. Zoican, R. Zoican and D. Galatchi (2015) et.al proposed Improved load balancing and scheduling performance in embedded systems with task migration [19]. The migration mechanism permits load adjusting, better scheduling of the undertakings and permits helpful sign processing at the entire organization and it is valuable in the event of node failures also. This mechanism utilizes the Micrium working framework primitives to choose when the assignment migration will be begun and to control the entire migration process. The correspondence network is given by the Lightweight Internet Protocol (LwIP) protocol. A presentation assessment (load balance, migration time and missed deadlines ratio) is performed. The paper shows the feasible implementation of undertakings migration in implanted frameworks and represents a superior presentation of the heap adjusting and the errands scheduling. The all out time for accomplishing the heap adjusting and move time per task is under the specific threshold of 20 ms specifically for a constant frame task. The missed deadlines ratio will be diminished and the node with no missed deadlines has not changed their missed deadlines ratio.

2. Virtual Grid-Based routing protocol (VGRP)

H. Kareem and H. Jameel (2018) et.al proposed Maintain Load Balancing in Wireless Sensor Networks Using Virtual Grid Based Routing Protocol [8]. In light of the wide assortment of utilizations of wireless sensor networks (WSNs) in various parts of life, research focusing on WSNs has quickly expanded in the new couple of years. Various difficulties abbreviate the operation of sensor node over the designated region for various reasons like risk, inhospitality, and restricted energy assets of the encompassing region. One significant issue is the energy expected to work the singular sensor node which most certainly influences the operation of the whole sensor network. As needs be, energy utilization should be limited as conceivable which requires compromising sensor network exercises as well as network operation. One principal arrangement regularly utilized for limiting the energy utilization in every sensor node is utilizing an energy-effective routing algorithm. The assessment interaction is finished utilizing the CFDASC routing protocol since it addresses the most tantamount and related algorithm among past work. Recreation results demonstrate that the introduced approach outperformance the CFDASC algorithm as far as network stability and burden balancing of the whole network.

3. Energy Efficient and Load Balancing Clustering Scheme (EELBCS)

Yousif KhalidYousif, R Badlishah, N. Yaakob , A Amir (2017) et.al proposed An Energy Efficient and Load Balancing Clustering Scheme for Wireless Sensor Network (WSN) Based on Distributed Approach [18]. One of the most basic issues and difficulties in Wireless Sensor Networks (WSNs) is to diminish energy utilization to drag out the network lifetime of WSNs. The grouping method is one of the procedures which have been utilized to give energy

efficiency. Notwithstanding, the vast majority of the grouping plans select the bunch head either haphazardly disregarding significant boundaries or based on an incorporated methodology by using the base station which can influence the network versatility. Moreover, single-hop correspondence is utilized by CHs to advance their detected information to the CH which prompts the expanded energy utilization of CHs in a huge scope network. This makes the node with more remaining energy and has a serious level of neighbor node in the network can possibly be chosen as group heads. In the information transmission stage, multi-hop information transmission is utilized between CHs to keep away from direct correspondence among CHs and the base station.

4. Load balancing mechanism based on SDWSN

Xin Cui 1, Xiaohong Huang, Yan Ma and Qingke Meng (2019) et.al proposed A Load Balancing Routing Mechanism Based on SDWSN in Smart City [3]. In the wireless sensor network framework of savvy urban communities, whether the network traffic is adjusted will straightforwardly influence the help nature of the network. Due to the traditional WSN (wireless sensor network) architecture, load balancing innovation is hard to meet the necessities of versatility and high adaptability. This paper proposes a heap balancing mechanism based on SDWSN (software-characterized wireless sensor network). This mechanism uses the benefits of a brought together control SDN (software-characterized network) and adaptable traffic scheduling. The Open Flow protocol is utilized to screen the running status and connection load data of the network progressively. As per the transmission capacity prerequisite of the data flow, the superior burden adjusted routing is gotten by an Elman brain network. The recreation results show that the heap balancing algorithm proposed in this paper can further develop the typical data transmission usage and lessen the connection load jitter of the network, hence working on the exhibition of the whole network.

3. Proposed Methodologies

In the first part of this method, load balancing among the cluster head and cluster part is achieved through the revelation of multipath courses. The primary goal of our approach is to cluster sensor network productively around not many high-energy door nodes [6]. Clustering works with network scalability to colossal number of sensors and further develops the organization lifetime by permitting the sensors to conserve energy through communication with closer nodes and by balancing the load among the entryway nodes. Gateways partner cost to speak with every sensor in the organization. Clusters are shaped in view of the expense of communication and the load on the gateways. The organization course of action is achieved by two phases that incorporates, bootstrapping and clustering.

Construction of Multipath routing

Multiple paths are found from cluster head to cluster individuals. To expand the data forwarding, paths are picked in view of least interference to stay away from collision. The traffic is directed once the paths are found. Primary way is picked in view of least energy consumption, least interference and more data forwarding rate.

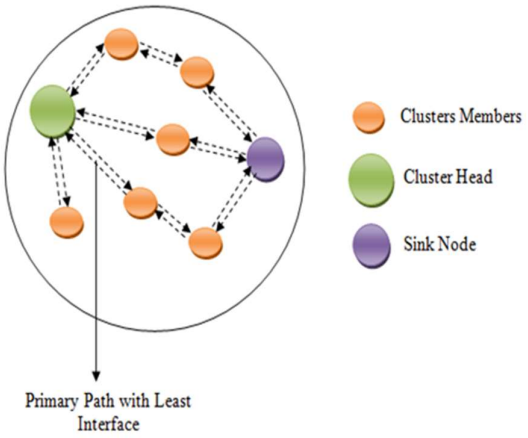

Figure 1. Multipath construction

Packets are sent through primary way to destination by means of cluster individuals. Cluster head is answerable for choosing way determination to course the packets. On the off chance that any way goes past the bundle lost level, the way will be given as second need. Utilizing way re-initialization procedure way is introduced with greater security with least interference.

Network arrangement using bootstrapping

In the period of bootstrapping, gateways decides the nodes which are arranged inside the range of transmission. Gateways broadcast a message demonstrating the beginning of clustering. It is accepted that receivers of sensors are open all through the clustering system. Every gateway shapes the clustering at an alternate occurrence of time to stay away from collisions. In answer the sensors likewise broadcast a message with their most extreme transmission power demonstrating their location and energy hold in this message. The nodes still up in the air during this stage are remembered for the per-gateway range set. At the hour of cycle of bootstrapping, each sensor node and gateways are dispensed with distinctive IDs. All sensor nodes report their location and IDs to the gateways inside communication range of one another. In this way, the separation from a sensor node to each gateway is assessed inside its range.

Network arrangement using clustering

In the phase of clustering, gateways evaluate the communication cost with every node in the range set. This information is then exchanged between all the gateways. By acquiring the data from all gateways, every gateway inaugurates the grouping of nodes depends on the cost of transmission and the current load on its cluster. In clustering phase, sink executes the clustering algorithm. Once the clusters are organized, every sensor conveys regarding its ID of the gateway which it related with, based on the range of communication in between the sensor nodes and gateways.

When the clustering is over, all the sensors are informed about the ID of the cluster they belong to. As the gateways distribute the general information at the time of grouping, every sensor node is selected by just one gateway. For inter-cluster communication all the traffic is routed through the gateways. [9] The proposed algorithm is presented in which it first describe all the assumption about the WSN model that are used along with the associated terminology. It considers two kinds of nodes in the system; sensor nodes and less-energy-constrained gateway or CH. All communications are over wireless links. A wireless link is organized in

between two nodes only in the case of they are within range of each other. Gateways are capable of long-haul communication compared to the sensor nodes. All nodes are assumed to be aware of their position through GPS. Network setup is performed in two phases; bootstrapping and clustering.

Hybrid best-first search algorithm

Hybrid best-first search algorithm called as Iterative Deepening A-star (IDA-star) Algorithm is the graphical search algorithm for tracking down the minimal expense between the source and the destination. It is a more productive algorithm contrasted with other search algorithms. It tends to be utilized to decrease the memory use and furthermore it prolongs the organization lifetime in light of the fact that a less measure of memory is required for transmission. The assessed capacity of IDA-star is as per the following

$$f_{cost}(node) = g_{socost}(node) + h_{decost}(node) \quad (6.2)$$

Where $f_{cost}(node)$ is the total cost of the path and g_socost is the source node cost (first node) and h_decost is the cost of the destination node (end node). The above evaluated function evaluated above is very useful for finding the optimal path to transmit the data.

In generally, the IDA-Star algorithm is completely founded on the profundity first search techniques and it is to finds the ideal way precisely and it takes the extremely less memory utilization contrasted with A-star algorithms. The primary contrast from IDS is that it utilizes the f-costs (g + h) as far as possible and in addition to an iterated profundity. In the accompanying algorithm, h is the heuristic capacity that gauges the way from a node to the objective. This algorithm fundamentally determines two nodes, one is a starting node and other one is a destination node. At first, IDA-Star algorithm plays out the profundity first searches in chronic way .It is utilized for various regions like Artificial Intelligence and Fuzzy Logics and so on [7]. IDA-star is to track down the ideal in the middle of between the arrangements of nodes.

IDA-Star algorithm can be implemented as follows

Begin:
Star node S
Declare f-cost=L
Initialize the cost for each node L=h(S)
L=∝
Loop
P=It contains only S
Cost limit= (0, S, P) //It performs IDA-star for g
L=L
Repeat the steps
$ returns (solution-sequence or none,new cost limit)
D=DFS (initial cost, path, end node cost)
If D>k, then k=minimum (K, D)
If P is the last node

LOAD BALANCING THROUGH MULTIPATH ROUTING (LBTMR)

In this proposed multipath routing, shortest path is laid out at first and afterward packets are sent from Cluster Head (CH) to cluster part [5]. To stay away from such interference, a section is shaped and the distance between two paths is orthogonal to CH to cluster part nodes. Optimal

path is picked by IDA * algorithm. IDA-star algorithm is utilized to track down the optimal path from the every node to the cluster head. IDA-star algorithm makes a tree structure to search the optimal routing path from a given node to the cluster head .The node can be assessed by the accompanying function,

$$\boldsymbol{F(n) = N_{cost}(n) + CH^{-1}(n)}$$

As a result, the largest values of F (n) can be chosen as an optimal node.

Stage 1: Multiple paths are laid in the middle between CH (Cluster Head) and cluster individuals to achieve the productive load balancing in the organization.

Stage 2: Cluster Head sends the Route Query (RQ) packets to cluster individuals to track down ideal route.

Stage 3: Cluster part gathers the situation with path determination and send the report in terms of Route Reply (RREP) packets to Cluster Head (CH) every one of the reports are accumulated in the CH. In these control packets, just the situation with path information will be gathered.

Stage 4: If any node doesn't reply to CH, the path might be viewed as broken and it tends to be additionally recuperated in light of the Path Re-Initialization procedure. In this procedure, the rate of packet lost will be estimated and furthermore it assesses the path passed time.

Stage 5: Construct the path with least interference rate and least energy consumption.

Stage 6: Choose the optimal path by IDA * algorithm

In the proposed cluster multipath routing, cluster individuals convey to CH by means of multipath routes. In every single route revelation process, CH records the situation with link dependability, Link Expiry Rate (LER) and Energy Consumption Rate (ECR). For data forwarding process, CH will pick just reliable links in view of the above said parameters.

4. Experimental Result

4.1 Energy consumption

Energy consumption for packet transmission from source to destination is determined by the average energy that is spent to deliver a packet successfully from a source node to the destination. If every hop along a path have same energy level and same energy consumption for sending and receiving the key then it is essential to consider hop- per-delivery to determine the energy consumption.

No of Nodes	VGRP	EELBCS	Proposed CHBSMRA
500	450	600	200
800	590	800	280
1000	730	900	400
1200	920	1100	460
1500	1070	1300	530

Table 1. Comparison table for Energy consumption

The Comparison table 1 of Energy consumption Values explains the different values of existing VGRP, EELBCS and proposed CHBSMRA. While comparing the Existing algorithm and proposed CHBSMRA, provides the better results. The existing algorithm values start from 450 to 1070, 600 to 1300 and proposed CHBSMRA values starts from 200 to 530. The proposed

method provides the great results.

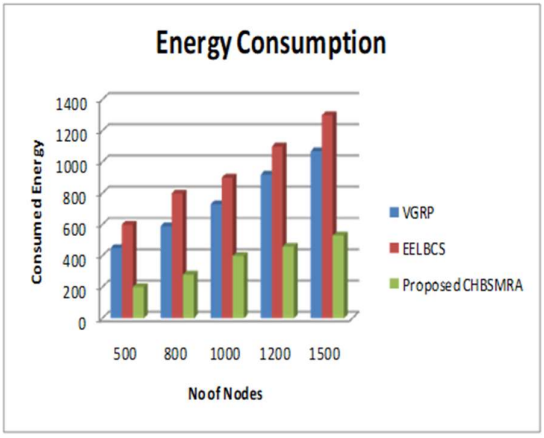

Figure 2. Comparison Figure for Energy consumption

The Figure 2 Shows the comparison chart of Energy consumption demonstrates the existing VGRP, EELBCS and proposed CHBSMRA. X axis denote the No of Nodes and y axis denotes the Consumed energy. The proposed CHBSMRA values are better than the existing algorithm. The existing algorithm values start from 450 to 1070, 600 to 1300 and proposed CHBSMRA values starts from 200 to 530. The proposed method provides the great results.

4.2 End-to-end Delay

End-to-end Delay is the average time taken by a data packet to arrive in the destination. It also includes the delay caused by route discovery process and the queue in data packet transmission. Only the data packets that successfully delivered to destinations that counted.

$$\sum(arrive\ time - send\ time)/\sum Number\ of\ connection$$

No of Nodes	VGRP	EELBCS	Proposed CHBSMRA
500	1.03	0.46	0.23
800	1.08	0.59	0.35
1000	1.23	0.64	0.48
1200	1.35	0.77	0.56
1500	1.59	1.01	0.68

Table 2. Comparison table for End to end delay

The Comparison table 2 of End to end delay Values explains the different values of existing VGRP, EELBCS and proposed CHBSMRA. While comparing the Existing algorithm and proposed CHBSMRA, provides the better results. The existing algorithm values start from 1.03 to 1.59, 0.46 to 1.01 and proposed CHBSMRA values starts from 0.23 to 0.68. The proposed method provides the great results.

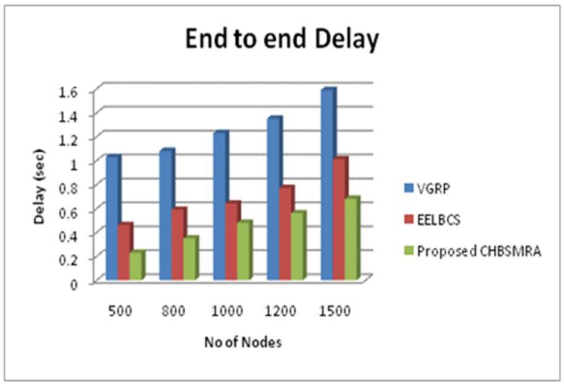

Figure 3. Comparison Chart for End to end delay

The Figure 3 Shows the comparison chart of End to end delay demonstrates the existing VGRP, EELBCS and proposed LBTMR algorithm. X axis denote the No of Nodes and y axis denotes the Delay in seconds. The proposed CHBSMRA values are better than the existing algorithm. The existing algorithm values start from 1.03 to 1.59, 0.46 to 1.01 and proposed CHBSMRA algorithm values starts from 0.23 to 0.68. The proposed method provides the great results.

4.3 Packet Lost

Packet Lost is the total number of packets dropped during the simulation.

$$Packet\ lost = Number\ of\ packet\ send - Number\ of\ packet\ received$$

No of Nodes	VGRP	EELBCS	Proposed CHBSMRA
500	35	21	08
800	38	26	09
1000	41	34	11
1200	47	42	14
1500	55	48	17

Table 3. Comparison table for Packet Loss

The Comparison table 3 of Packet Loss Values explains the different values of existing VGRP, EELBCS and proposed CHBSMRA. While comparing the Existing algorithm and proposed CHBSMRA, provides the better results. The existing algorithm values start from 35 to 55, 21 to 48 and proposed CHBSMRA values starts from 08 to 17. The proposed method provides the great results.

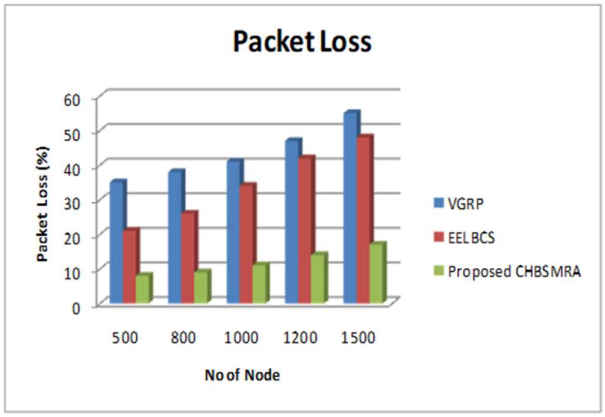

Figure 4. Comparison Chart for Packet Loss

The Figure 4 Shows the comparison chart of Packet Loss demonstrates the existing VGRP, EELBCS and proposed CHBSMRA. X axis denote the No of Nodes and y axis denotes

the Packet loss in percentage. The proposed CHBSMRA values are better than the existing algorithm. The existing algorithm values start from 35 to 55, 21 to 48 and proposed CHBSMRA values starts from 08 to 17. The proposed method provides the great results.

5. Conclusion

This paper proposed a Clustering based Hybrid best-first search Multipath routing Approach (CHBSMRA) for Load Balancing in WSN. The relocating mechanism is based on the estimation of the node loading and missed deadlines ratio and is upheld by the proposed clustering based hybrid best-first search multipath routing approach. To keep away from the upward correspondence in the network (which exists on account of a simply distributed algorithm), a unified moving algorithm is picked. The fundamental objective of this algorithm is to lessen the missed cutoff time ratio.

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