An Effective Utilization of Routing Algorithm for Wireless Sensor Networks Based On Centrality Measures

[1]Raja Ashok Kumar, [2]Kanakasundararao.R
[1]Assistant Professor, Department of Computer Science and Engineering, AITS, Rajampet, Andhra Pradesh-India.
[2]Assistant Professor, Department of Information Technology, Guru Nanak Institute of Technology, Hyderabad, Telangana-India

ABSTRACT:

A routing algorithm for wireless sensor networks with an arbitrary conveyance in an objective perception zone is proposed. Since hubs with enormous nearby betweenness centrality devour vitality all the more rapidly, the system life can be drawn out by redistributing vitality utilization to hubs with littler neighborhood between's centrality. Different measures of centrality are utilized and the network's reaction is assessed with respect to the course chosen by the network's choice when a few nodes come up short. It is shown through reproductions that controlling sensor nodes proficiently with a high proportion of centrality enables a network to oppose node disappointments or assaults. Besides, this gives the network high disappointment resistance. Right now, a routing algorithm that utilizes centrality measures to choose the shortest path (a low-vitality path between the source and goal node) is actualized.

Keywords: ***Graph Theory; routing algorithm; shortest path; low cost; Wireless Sensor Network.***

I. INTRODUCTION

Wireless sensor network (WSN) is broadly considered as one of the most significant advances for the twenty-first century [1]. In the previous decades, it has gotten colossal consideration from both the scholarly world and industry everywhere throughout the world. A WSN commonly comprises of countless low-cost, low-power, and multifunctional wireless sensor nodes, with detecting, wireless correspondences, and calculation capacities [2,3]. These sensor nodes impart over short separations through a wireless medium and work together to achieve a typical errand, for instance, condition observing, military reconnaissance, and modern procedure control [4]. The fundamental way of thinking behind WSNs is that, while the ability of every individual sensor node is restricted, the total intensity of the whole network is adequate for the necessary strategic.

In numerous WSN applications, the organization of sensor nodes is acted in an impromptu manner without cautious arranging and building. Once conveyed, the sensor nodes must have the option to independently compose themselves into a wireless correspondence network. Sensor nodes are battery-fueled and are required to work without participation for a generally significant stretch of time. As a rule, it is troublesome and even difficult to change or

revive batteries for the sensor nodes. WSNs are described by denser degrees of sensor node organization, higher lack of quality of sensor nodes, and cut off the force, calculation, and memory limitations. Along these lines, one of a kind attributes and limitations present numerous new difficulties for the improvement and utilization of WSNs.

Because of the serious vitality limitations of an enormous number of thickly sent sensor nodes, it requires a suite of network conventions to actualize different network control and the executive's capacities, for example, synchronization, node confinement, and network security. The customary routing conventions have a few inadequacies when applied to WSNs, which are chiefly because of the vitality compelled nature of such networks [4]. For instance, flooding is a procedure where a given node communicates information and control bundles that it has gotten to the remainder of the nodes in the network. This procedure rehashes until the goal node is come to. Note that this method doesn't consider the vitality limitation forced by WSNs. Therefore, when utilized for information routing in WSNs, it prompts issues, for example, implosion and cover [9,12]. Given that flooding is a visually impaired method, copied parcels may continue coursing in the network, and subsequently, sensors will get those copied bundles, causing an implosion issue.

Likewise, when two sensors sense a similar district and communicate their detected information simultaneously, their neighbors will get copied parcels. To beat the inadequacies of flooding, another strategy known as tattling can be applied [10]. In tattling, after accepting a bundle, a sensor would choose arbitrarily one of its neighbors and send the parcel to it. A similar procedure rehashes until all sensors get this bundle. Utilizing tattling, a given sensor would get just one duplicate of a bundle being sent. While tattling handles the implosion issue, there is a noteworthy postponement for a parcel to arrive at all sensors in a network. Moreover, these bothers are featured when the number of nodes in the network increments.

II. ENERGY CONSUMPTION CHALLENGES IN WIRELESS SENSOR NETWORKs

Message Delivery

The job of sensor nodes in WSN is detecting nature and conveying information to the base station. Since there are different detecting nodes in WSN to pass the information to the goal node, decency is a significant issue for the scientist. Multi-jump routing deteriorates the bundle misfortune in WSNs, node close to the goal has higher parcel conveyance. In the event that the sensor node has a parcel to send, it must have the option to convey the information at the goal node. Poor information conveyance execution may debase the exhibition of information move and extend vitality utilization. In this way, the conveyance proportion ought to be high [9].

Network Lifetime

In wireless sensor networks, vitality utilization is one of the significant issues in view of battery-worked sensor nodes as well as because of its critical effect on

green figuring. In wireless sensor networks, the Clustering approach assumes a significant job. The grouping approach expands network lifetime, improved data transfer capacity use and furthermore diminishes inefficient vitality utilization in this way decreasing overhead. In any case, the grouping approach has certain restrictions as follows:

Throughput

To guarantee the dependability in the wireless sensor networks certain degree of throughput is required to satisfy the nature of administrations to the end-client of the network. In WSN meddling issues happens when the channel sharing for higher information transmission. Other than different issues of WSN impacts of impedances is likewise enormous significant during synchronous transmission of information so as to upgrade the WSN limit. In such a situation high throughput and low postponement are hard to accomplish.

The throughput of wireless sensor networks influenced by different factors, for example, impact shirking, control overhead, channel use, and dormancy. Throughput amplification is a crucial issue in WSNs. Accordingly, we need productive coordination among throughput and force utilization [7].

Vitality Efficient Design

In WSNs, vitality utilization and drawing out the life of the network are two basic issues. WSNs nodes are low fueled battery gadgets, the substitution of battery or revive of the battery is a troublesome undertaking in a threatening situation. The parts of the sensor node expend a lot of vitality either in dynamic mode or inactive mode. In this way, there is a requirement for a force the executives plan to spare vitality out of gear mode by turning off the segments that don't take an interest in a specific occurrence of time [8].

Vitality sparing in an impedance situation

The conduct of WSNs is incredibly influenced by the arrangement condition in wireless correspondence is eccentric in various situations. Sensors are generally sent thickly in wireless sensor networks. Because of this thick condition, it can endure critical impedance which extraordinarily disables network execution. In this manner, to find various systems for diminishing force utilization within the sight of obstruction and shadowing conditions are likewise significant [9].

The successful bunching approach lessens the vitality level in intra-group and between-group correspondence because of this builds network lifetime. The vitality utilization in wireless sensor networks is as yet testing in the modern and research field [10].

Constrained Energy

Nodes of wireless sensor networks have a low controlled battery and little in size with the goal that sensor nodes have constrained vitality stockpiling for working in the network. So there is a requirement for a proficient methodology for use of this restricted vitality. A legitimate bunching plan can decrease the

general vitality expended in the network [11].

Versatility

In WSN the vast majority of the sensor nodes sent because of foundationless property. The node of the sensor network has a restricted inclusion go. For such situations, proficient routing conventions are required for dealing with a tremendous measure of sensor nodes. WSN comprises of an assortment of an enormous number of little nodes; it is difficult to safeguard the worldwide data of the network for every node in the sensor networks [12].

Information conglomeration

Information conglomeration is a method for taking out excess information transmission in WSNs. Information total is the key strategy for sparing vitality. Information accumulation is a procedure to assemble and total information with the goal that the network lifetime is improved. A large portion of the occasions every sensor node copies detected information to its sink node called base station lead repetition at the base station [13]-16].

II. ROUTING IN WSN

Routing techniques are required for moving information between the sensor nodes and the base station [1] [2]. Routing in WSN is not the same as customary IP network routing in light of the fact that it shows various exceptional attributes all things being equal unreasonable to assemble a worldwide tending to plot for an enormous number of sensor nodes, besides instead of standard correspondence frameworks all usage of sensor frameworks require the flood of identified data from various sources to a particular BS [8]. Diverse routing strategies are proposed for remote sensor network and these shows can be named per various parameters. The characterization of routing techniques is appeared in figure 1.2[1].

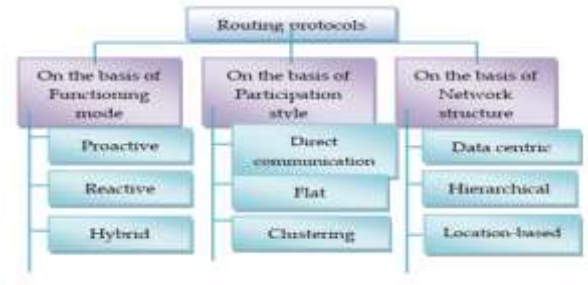

Fig 1. Classification of routing protocols

3.1 ENERGY EFFICIENT ROUTING PROTOCOLS IN WSN

The vitality productivity of a network is a noteworthy worry in wireless sensor networks (WSN). Nowadays networks are getting huge, so data assembled is getting significantly bigger, which all devour a lot of vitality bringing about an early passing of a node. Consequently, numerous vitality proficient conventions are created to decrease the force utilized in information testing and assortment to expand the lifetime of a network. Following are some vitality productive routing conventions:

- LEACH "Low-Energy Adaptive Clustering Hierarchy" In
- PEGASIS "Force Efficient Gathering in Sensor Information Systems"

- TEEN "Limit touchy Energy Efficient sensor Network convention" The TEEN is a various leveled convention intended for the conditions like unexpected changes in the detected characteristics, for example, temperature.

- APTEEN "Versatile Threshold touchy Energy Efficient Sensor Network"

- Directed Diffusion Directed dispersion is information-driven routing convention for gathering and distributing the data in WSNs [15

- Energy-Efficient Sensor Routing (EESR) EESR is a level routing algorithm [16] proposed especially to diminish the force use and information inactivity and to give versatility in the WSN. Chiefly, it comprises of Gateway, Base Station, Manager Nodes.

III. LITERATURE REVIEW

Ahmad, A., Latif, K. Javaid N. Khan et. al. (2013) [20] explored bunching methodology which is the most all-around perceived coordinating procedure in WSNs. In light of the contrasting needs of WSN application, profitable essentialness use in coordinating shows is as yet a potential field of research. The creators exhibited new vitality effective coordinating procedures right now. This procedure is used to vanquish the essential difficulty of a vitality gap and inclusion opening. In their technique, they have controlled these issues by displaying a thickness controlled uniform course of center points and settled a perfect number of Cluster Heads in each round.

Lohan, P. what's more, Chauhan, R. et. al. (2012) [21] exhibited the Geography-Informed Sleep Scheduling and Chaining Based Routing (GSSC) algorithm in a wireless sensor network. As locator nodes are power limitations, the framework lifetime improved by using the vitality of nodes capably. GSSC spares power by finding the same nodes from a routing point of view by utilizing their topographical data, it faculties almost comparative data and afterward killing unnecessary nodes to dispense with information excess. This fastening based routing can reduce the vitality going through of information moving with the assistance of a multi-jump routing procedure. Their reenactment result (utilizing MATLAB) show that GSSC accomplished extensive addition in-network life expectancy than LEACH and PEGASIS.

Seongsoo Jang, Ho-Yeon Kim and Nam-Uk Kim et. al. (2011) [22] dealt with the improvement of the Wireless Sensor Network innovation, omnipresent innovation goes to the fore as the center innovation later on. In the WSN, the vitality effectiveness of the entire network is key trouble that must be illuminated. Grouping is one of routing strategies to improve vitality proficiency. The creator recommends another strategy, "Vitality Efficient Clustering plan with Concentric Hierarchy (EECCH)," a brought together bunching plan proposed at beating inadequacies of LEACH and LEACH-C both. By drawing hovers with the base station as its inside, the base point isolates network nodes into certain levels. The bunches have various quantities of its part

nodes to wipe out the disparity in vitality dispersal through this procedure; it gets conceivable to improve vitality productivity.

Saravana Kumar R., Susila S.G. furthermore, Raja J. et. al (2010) [23] have done research chip away at WSN. It comprising of an enormous number of sensors and as the sensor works on a restricted force source, it is trying to structure a vitality productive routing convention that can decrease the deferral while giving high-vitality proficiency and expanded network lifetime. Creator investigates the central disseminated grouping routing convention Low Energy Adaptive Clustering Hierarchy, likewise proposed a novel routing technique and information collection strategy in which the sensor nodes structure the bunch and the group head picked dependent on the rest of the intensity of the individual node count without re-bunching and the node planning plan is embraced in each bunch of the WSN. Results utilizing MATLAB shows that the proposed routing convention impressively lessens vitality use and upgrade the all-out life expectancy of the wireless sensor network contrasted with the LEACH convention.

Gurbinder Singh Brar et. al., (2016) [24] proposed PDORP convention which is a transmission-based vitality mindful routing convention. The proposed convention PDORP has the qualities of both force effective get-together sensor data frameworks (PEGASIS) and DSR routing conventions. Hybridization of hereditary algorithm and bacterial searching streamlining is related to the proposed routing system to recognize vitality capable perfect ways. The execution assessment, relationship through a hybridization approach of the proposed routing show, gives improved outcomes including less piece botch rate, a lesser measure of deferment, diminished vitality utilization, and improved throughput, which prompts to upgraded QoS and hauls out the lifetime of the framework.

S. Lindsey, C. Raghavendra et. al. (2002) [19] proposed the Power-Efficient Gathering in Sensor Information Systems (PEGASIS), which maintains a strategic distance from the supposition of direct correspondence and lessens the moderately huge overhead of the LEACH convention. In PEGASIS, the nodes structure a chain, and every node stores in its routing table the addresses of an upstream and a downstream node. The information assortment process is started at the most distant finish of the chain. Each middle of the road node totals the got information with its nearby information before transmitting the outcome to its upstream neighbor. The last node in the chain is liable for transmitting to the sink node.

Liu Wenjun and Yu Jiguo et. al. (2009) [6]recommended that as opposed to allowing the nodes to transmit straightforwardly to the base station, a novel plan of bunching was proposed. Grouping gives asset usage and limits vitality utilization in WSNs by lessening the number of sensor nodes that include in the long-separation correspondence. They utilized a vitality productive grouping and routing plan for wireless sensor networks (EECR) which incorporates disseminated nodes bunching, dynamic bunch head revolution, and between bunch routing choice. In the grouping stage, they utilized a lopsided bunching component in which

group heads (CHs) which are nearer to the base station (BS) have littler group sizes than those more distant from BS, along these lines they can ration some power for between bunch information sending. For the dynamic bunch head pivot instrument, the sensor centers perform group head work thus which adjusts power utilization well among CHs.

Gherbi Chirihane and Aliouat Zibouda et al. (2015) [25] proposed an appropriated vitality effective versatile grouping convention with Data Gathering for WSN diminishes the vitality utilization and network lifetime is broadened. The bunching methods are utilized productively with circulated group heads. The node's proportion is killed for a fixed timeframe and rest control laws are intended to decrease the cost work. The situation shows the irregular arrangement of nodes and the all-out reenactment time is decayed utilizing asset reservation. The system circulated vitality productive versatile bunching convention with Data Gathering (DEACP) decreased the general network vitality utilization, balance the vitality utilization among the sensors and expand the lifetime of the network by making the grouping proficient in multifaceted nature of message and time, well-conveying the group heads over the network, the heap adjusting progressed nicely and thus transmission intensity of the node is diminish which in this manner lessens the vitality utilization.

IV. CENTRALITY BASED RELATED WORK IN WIRELESS SENSOR NETWORKS

Group head determination utilizing fluffy rationale for wireless sensor networks [12]; right now head political decision depends on node vitality, node (degree centrality) and node's closeness centrality. It has been demonstrated that the proposed strategy is performing more vitality productive when contrasted with the plans which are not utilizing centrality measure. CFGA [13], additionally has utilized node degree as one of the determination parameters for group head choice. In [14] Parth H. Pathak and Rudra Dutta have utilized the idea of betweenness centrality to accomplish a suitable harmony between the hand-off weight of nodes and their capacity levels. Numerical outcomes exhibited by them affirm that centrality based burden adjusting fundamentally improves the network lifetime of sensor networks. L. Sitanayah [15] has utilized a variety of crossing over centrality for Fault-Tolerant Relay node Deployment. They named their centrality measure as Rerouting.

System topology control gives a proficient way to deal with tending to such difficulties in the WSN [5]. Topology control is characterized as a lot of strategies or techniques that can change a fundamental system structure in an effective way, accordingly augmenting framework execution or lessening transmission cost [6]. A few methods of topology control have been proposed for WSNs; notwithstanding, bunching has demonstrated to be the most proficient and broadly utilized plan for overseeing system structure. In addition, bunch based directing components have been displayed in the Refs. [5,6,7]; these components include two stages: the set-up stage and the consistent state stage. In the set-up stage, all the sensor hubs are sorted out as groups. In each group, a bunch head (CH) choice calculation is executed to choose a hub as

the pioneer of the comparing group and perform related errands. Along these lines, each group comprises of part hubs and a CH. After the CH choice, the consistent state stage begins and the CH totals the information got from encompassing part hubs and transmits it to the BS straightforwardly (single-bounce correspondence) or through other CH hubs (multi-jump correspondence) as outlined in Figure 2.

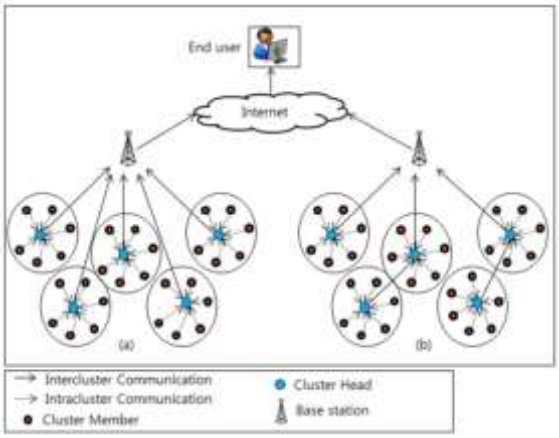

Figure 2. Cluster-based wireless sensor network (WSN) with different data communication scenarios: (**a**) single-hop communication and (**b**) multi-hop communication from sensor nodes to the end user through base station (BS).

Centrality. They utilized this centrality record to focus on the most significant nodes (the nodes with high centrality), and send extra hand-off nodes to give elective paths around these nodes and subsequently upgraded the network lifetime. EBC [16] depends on the idea of betweenness centrality and measures the "significance" of every node in the network. This data is accustomed to distinguishing various jobs among the nodes (e.g., agents, anomalies), accordingly controlling data flow, message conveyance, inertness, and vitality dissemination among nodes. In the paper the creators select the most significant edges, vitality savvy, to spread messages. Sink Betweenness (SBet) centrality metric considers just the shortest paths that incorporate the sink as a terminal node. This work means to utilize centrality data in the plan of tree-based circulated routing algorithms for Wireless Sensor Networks (WSNs).

V. PROPOSED ALGORITHM

Dijkstra's algorithm lies in Bellman's Principle of Optimality, and the two algorithms depend on an advancement strategy called dynamic programming. Dijkstra's algorithm is utilized to process the base cost or shortest path between one node and every single other node when the vertices of the graph speak to nodes and path costs are spoken to by path separates between sets of nodes associated by an immediate connection. The proposed algorithm figures the shortest path between two nodes. It utilizes a graph comprising nodes and edges. The cost of every node is determined from the source by summarizing the cost up to that node. For a given source vertex (for example node), the algorithm turns out all paths and figures the path with the lowest cost, (for example the shortest separation between the source node and some other node) [15], [16].

This algorithm offers another technique for figuring the costs of the shortest paths from a solitary source node to a solitary goal node. The objective of the two algorithms, the proposed algorithm, and Dijkstra's algorithm, is to choose the nodes in the shortest path issue. The principle contrast in the algorithms is that Dijkstra conveys the general data of the network and each node is included, while

the proposed algorithm manages the closest node, and not all nodes are included as in Djikstra's algorithm [17], [18], [19].

Algorithm 1

```
Initialization: C(S) =0
                C(i)=∞; where belongs to active nodes set
                Previous (S)=S
                Visited_nodes=[S]
While (CH doesnt belong to Visited_nodes)
      For each i belongs to active nodes set
         If C(S)+P(S,i)< C(i)
            C(i)= P(S,i)+ C(S)
            Previous(i)=S
            Visited_nodes=[Visited_nodes, i]
         End if
            Update S=i
      End for
End while
```

Figure 3 proposed algorithm

Figure 3 shows a delineates the means performed by the proposed routing algorithm from beginning to end. Initially, the algorithm recognizes the source and goal nodes, signified R1 and R2, individually, and a cost of 0 is doled out to the source node. Therefore, another node is chosen and named as P (or lasting node). This node at that point turns into a conditional node and another node near it is chosen and named as P. This method is rehashed until the goal node is come to [20].

VI. Result analysis

A correlation between the running (for example execution) times of Dijkstra and the proposed algorithm appears in Table 1. Every algorithm is executed multiple times. The algorithm was likewise executed multiple times and the outcomes were seen as factually like multiple times. Just the outcomes for 10 executions have appeared here on the grounds that it's simpler to picture. The execution times in seconds for the two algorithms have appeared in Table 2, where the execution time for the proposed algorithm (PA) is 0.000118017196655 and the execution time for Dijkstra is 0.000144004821777 for the principal execution. The outcomes show that there is a distinction in the execution times and the proposed algorithm is quicker concerning the normal execution time.

Figure 3 shows all the more away from the information from Table 1 utilizing a bar-stacked graph. It obviously shows that in general, the proposed algorithm executes quicker than Dijkstra.

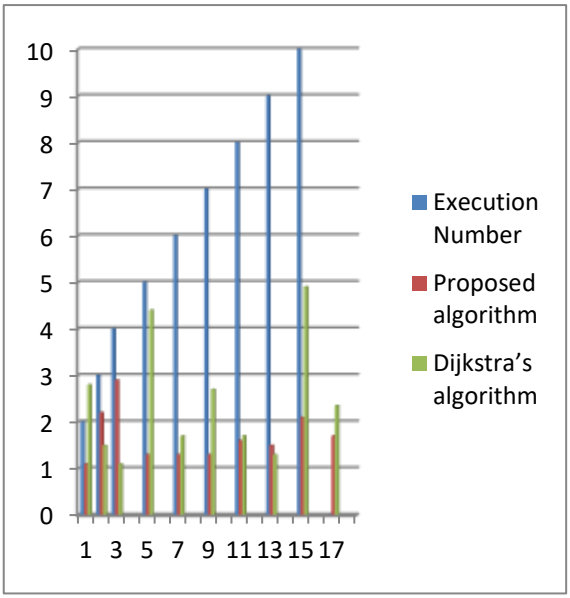

Figure 4 Time response comparison for the bar-stacked chart

Figures 4 shows the execution times for the two algorithms for more than 10 executions. It is seen that the most pessimistic scenario execution time for Dijkstra's algorithm is 4.67 and for the proposed algorithm it is 2.6, demonstrating that the proposed algorithm is to be sure quicker.

It has additionally been demonstrated that the proposed algorithm reliably picks shorter paths between nodes than Dijkstra. This is credited to the utilization of centrality measures.

CONCLUSION

A study on routing using centrality measures has been conducted. been led. been led. The investigation empowered us to break down how data is spread over a network, from the source node to closest nodes lastly to the base station by means of the shortest path. The network's presentation can be assessed by using the degree, closeness and betweenness centrality measures, just as the shortest path conveying information starting with one node then onto the next until the sink nodes came to. We directed an investigation on specific qualities of sensor networks to address various difficulties experienced in a network. These incorporate dependability, disappointment resilience, and power. These three qualities empower the network to perform better. Every one of the attributes has a task to carry out, particularly disappointment resilience. Disappointment resistance is vital if a network needs to continue settling on network choices that are steady in any event, when a few nodes are separated. Right now, centrality measures are utilized for some applications in sensor networks. One of these applications is finding a routing path inside a sensor network. Right now, an algorithm that finds a routing path with the shortest separation between nodes is actualized. The proposed algorithm lowers the vitality utilization and along these lines builds the network's lifetime. While considering a routing algorithm for sensor networks, flexibility against assaults or disappointment is significant. Utilizing reenactments, the effect of nodes on the network's presentation through centrality measures has appeared. It was seen that the proposed algorithm is quicker than Dijkstra's algorithm as far as execution time. The outcomes show that the proposed routing algorithm dependent on centrality measures beats Dijkstra's algorithm as far as network, and centrality measures (for example Degree, Closeness and Betweenness) can be utilized for routing in sensor networks, with the Betweenness centrality measure outflanking the centrality measures. The work displayed right now be stretched out by changing some recreation parameters, for example, the number of reenactment redundancies so as to broaden the outcomes. Also, this work can be stretched out by considering different measurements, for example, parcel conveyance proportion and clog level in the network.

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