A Research on Clustering Based Optimized Routing Protocols in Wireless Sensor Network

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Abstract: ***Routing in wireless sensor network environment plays a critical role where it might be affected by various factors which would lead to data transmission failure/corruption. Energy is the most concerned factor which affects the routing task mostly due to their limited availability. Thus routers require most efficient routing protocol which can perform data communication with less energy consumption. This routing protocol should be capable of adapting critical conditions happening on routers. Another problem that is mostly found on routing task is security. The security issues created by the hackers would corrupt/steal the data when it is being transmitted to the destination nodes. The routing protocol should also capable of tolerating the security issues and needs to ensure the successful data transmission. In this analysis work, various hierarchical clustering algorithms that are proposed for grouping the wireless sensor nodes those is present in the environment is discussed. The clustering that can be applied on both heterogeneous and homogeneous wireless network environment is discussed. The operation and functionality of each clustering algorithms are given in depth to understand the routing skill of each nodes. The merits and demerits that are present in the every clustering algorithm are presented to find the better clustering approach. The experimental analysis of every algorithm are done and compared in terms of various performance measures to find the better clustering approach that can be utilized for further scenario.***

Keywords: ***Sensor nodes, Clustering, Energy, hierarchical manner, Homogeneous, Heterogeneous***

I. INTRODUCTION

In this computerized age, we can't envision the world without communication [1]. The people need to trade data for different purposes. Securing the communication is a tremendous test because of the raising dangers and assaults against network security [2]. The interoperability and interconnection of system gives a helpful intends to individuals to share data, in this manner turning into an immense repository of information. At present, the system has turned into a basic piece of numerous individuals' work and life.

In monetary life, because of the far reaching utilization of network technology, the working proficiency of the information resource dependent industries, (for example, banks, railroads, coordinations, and so on.) expands, the cost appreciates a sharp decay and the financial advantage builds step by step [3]. With the powerful pattern of the worldwide in formalization, governments around the globe, the military and endeavors are always expanding the pace of data development. Government divisions of numerous nations, a wide range of logical research organizations, and enterprisers have associated with the Internet by means of such entryway as the routeres, giving an advantageous method to completely share and utilization of data assets on the system [4].

With the further advancement of the Internet, there come a wide range of issues regardless of in innovation or social morals, among which the security of the data influences a ton [5]. Being the transportation center point of the transmission of Internet data, the router is the center hardware in executing the interconnection of 168 L. Hu and Q. Zhang the whole system. In this way, to guarantee the wellbeing and in addition unwavering quality of the data transmission on the Internet, we should think about the issues of the security of the routeres in the interconnection and terminal on the Internet. [6]

A routing protocol demonstrates how switches talk with one another, appropriating information that enables them to pick courses between any two centers on a PC arrange. Steering calculations choose the specific choice of course. Each switch has a prior adapting just of frameworks attached to it directly.[7] A routing protocol shares this information first among brief neighbors, and after that all through the framework [8]. Thusly, routeres get data of the topology of the framework. The specific characteristics of routing protocols fuse the manner by which they go without directing circles, the manner by which they select favored courses, using information about jump costs, the time they require to reach steering assembly, their flexibility, and diverse components [9].

In this analysis work, various hierarchical clustering algorithms that are proposed for grouping the wireless sensor nodes those is present in the environment is discussed. The clustering that can be applied on both heterogeneous and homogeneous wireless network environment is discussed. The operation and functionality of each clustering algorithms are given in depth to understand the routing skill of each nodes. The merits and demerits that are present in the every clustering algorithm are presented to find the better clustering approach.

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II. DISCUSSION OF VARIOUS ENERGY EFFICIENT CLUSTERING BASED ROUTING PROTOCOLS

Hierarchical routing is better than level based directing convention as the last one faces high control parcel overhead and high inertness because of flooding. Therefore, diminishing throughput just as the lifetime of the sensor hubs. In progressive steering, many grouping calculations have just been proposed. The group heads are all the more dominant, experience more traffic and are less vitality obliged gadgets as opposed to sensor hubs. A various leveled convention decreases crash in the remote system and furthermore empowers the obligation cycling of sensor hubs for expanded vitality effectiveness. However the plan of these conventions faces a few goes up against, for example, determination of group heads, bunch arrangement, extra overheads acquired amid bunch head change and different counts prompting vitality wastage for dynamic grouping in huge sensor systems.

Manjeshwar et al [10] introduced the Threshold-sensitive Energy Efficient sensor Network (TEEN) which is like LEACH with the exception of that the hubs are permitted to transmit just when the detected esteem is not exactly a limit esteem. This convention decreases the complete number of transmissions. In spite of its preference, it is appropriate for time basic applications, for example, interruption and blast location. Power-Efficient Gathering in Sensor Information System (PEGASIS) [11] is an improvement over LEACH. It is an ideal chain based convention in which the sensor hubs transmit information just to their closest neighbors which further impart to the base station as indicated by its turn.

Drain is one of the various leveled steering conventions in which bunch head choice and group development is irregular. Be that as it may, the job of cluster head (CH) is turned among the bunch individuals in order to equitably disseminate the vitality dispersal over the bunch. Many improved LEACH conventions have been executed concentrating on various zones [12]. Ibriq et al [13] utilized Genetic Algorithm (GA) to produce vitality effective progressive bunches. The base station communicates the GA-based groups setup, which is gotten by the sensor hubs and the system is arranged as needs be. This strategy is an upgrade of the LEACH convention which prompts enhanced arrangement of the vitality effective groups.

Ding et al [14] proposed a distributed weight-based energy-efficient hierarchical clustering protocol (DWEHC). Every hub initially finds its neighbors (in its walled in area locale), at that point ascertains its weight which depends on its lingering vitality and separation to its neighbors. The biggest weight hub in an area may turn into a bunch head. Reproductions results showed that DWEHC produces very much adjusted groups. Both intra bunch and between group vitality utilization is extraordinarily improved.

Xing et al [15] proposed a dependability estimates that coordinate the traditional availability based system unwavering quality with the detecting inclusion measure demonstrating the Quality of Service (QoS) of the WSN. And furthermore this work proposed a dynamic methodology for assessing such inclusion arranged QoS unwavering quality. Dependability measures can mirror the QoS of WSN through the joining of the detecting inclusion and the system network, and this methodology for the unwavering quality investigation is computationally productive and simple to execute.

Moussaoui [16] proposed a Distributed Energy-proficient Clustering-based Hierarchy Protocol (DECHP), which appropriates the vitality dispersal equitably among all sensor hubs to improve arrange lifetime and normal vitality investment funds. This work is an expansion of the calculation to be specific DWEHC approach where the even vitality sharing isn't finished. Execution of the proposed DECHP convention is evaluated by reenactment and contrasted with other grouping based conventions (LEACH. Drain C, and PEGASIS). The recreation results demonstrate that DECHP beats its comparatives by consistently setting CHs all through the entire sensor field, performing adjusted bunching, and utilizing a geological and vitality mindful steering ways between CHs to exchange melded information to the BS.

Lung et al [17] proposed Distributed HAC (DHAC) calculation which gives a base up bunching approach by gathering comparative hubs together before the Cluster Head (CH) is chosen. DHAC can oblige both quantitative and subjective data types. With programmed CH turn and rescheduling, DHAC abstains from reclustering and accomplishes uniform vitality scattering through the entire system lifetime. DHAC can maintain a strategic distance from the time and vitality devoured by reclustering. In the group upkeep arrange, DHAC utilizes programmed CH revolution and rescheduling to guarantee uniform vitality dissemination inside bunches. DHAC further evades superfluous vitality utilization of rescheduling by considering the system traffic load.

Heikalabad [18] proposed the various leveled directing calculation dependent on new group head determination and bunch development convention to be specific REACH. This calculation chooses a best sensor hub as a bunch head as far as vitality and separation. The principle commitment of this calculation is to choose a best sensor hub as far as vitality and separation as a bunch head by an improved technique. Additionally the steering calculation utilized in proposed convention is multi jump so that can adjust the vitality utilization among hubs. Reproduction results demonstrate that the REACH delay the system lifetime about 40% and 13% in contrast with the LEACH and HEED, individually.

Gawdan et al [19] exhibited a Novel Secure Key Management (NSKM) module giving a productive adaptable post-dissemination key foundation that permits the various leveled bunching topology stage to arrangement adequate security administrations. In this work an exertion has been made to couple progressive grouping based directing with Novel Secure Key Management module. The determination of SCH among CHs dependent on its area and its separation to BS, utilizing in-organize keys age and mixing the greater part of correspondence types in WSNs have been one of a kind highlights of this work.

Khan et al [20] directed research is the improvement of another Zone-Based Hierarchical Framework (ZBHF) with

coordinated recently proposed Zone-Based Self-arranging Clustering (ZBSC) plot for vitality effective WSNS. The key component of the proposed arrangements is simply the minimization of vitality utilization amid the self-association bunching procedure to amplify organize lifetime. The plan has been actualized and assessed in a hand crafted Java based test system. The reproduction results confirm that ZBHF and ZBSC give productive system foundation to amplifying system lifetime as contrast with existing arrangements.

Singh Tripti, Neha Gupta et al [21] recommended an improvement of LEACH. In our proposed calculation, static grouping with dynamic determination of bunch heads is recommended inside each group. It forestalls arbitrary and concentrated determination of bunch heads. An insignificant increment in vitality prompts unmistakable improvement in the throughput. Recreation results demonstrate that the calculation is considerably more productive and mean that this calculation can offset hub's vitality utilization with the throughput when contrasted and LEACH. Besides, the outcomes got are needy upon extra imperatives, for example, area data.

Ateya et al [22] presented the Multilevel Hierarchical Clustering (MLHC) calculation, which is another steering convention that decrease the vitality utilization in heterogeneous WSNs. MLHC is a group based steering convention which utilizes bunching of WSNs more than one time each round. After the primary bunching happens, the leaders of the groups frames a more elevated amount of grouping with one another. The leaders of the second dimension of groups can speak with the Base Station (BS). Recreations demonstrate that MLHC decrease vitality dispersal and delay the existence time of the general system contrasted and other existing conventions. Likewise MLHC increment the strength area (time from the beginning of system until the passing of first hub).

Sabet et al [23] proposed another decentralized various leveled group based steering calculation. In this work new methodology grouping and multi bounce directing calculations are performing at a similar stage to diminish control parcels. As per non-uniform vitality utilization among hubs, groups are shaped so that bunch heads have the most competency in sending undertaking of intra-group and between group transmission tree. Vitality utilization, modification degree and the accurate separation that every datum crosses to achieve the base station are three primary alteration parameters for group heads decision. Re-enactment results demonstrate that the proposed convention prompts decrease of sensor hubs' vitality utilization and delays the system lifetime, altogether.

III. RESULTS & DISCUSSIONS

In this section, merits and demerits of the various hierarchical clustering algorithms that are proposed by various authors has been given. In table 1, all the research methodologies that have been proposed earlier is described with their technique along with merits and demerits. In this table, the simulation tool that is used for performance analysis is also given along with the results obtained from the performance evaluation. The number of nodes that are considered for the performance evaluation is also given.

Table 1(a). Comparison Analysis of various methods

Year	Method	Type of data transferred	Number of nodes considered	Results	Simulation tool	Merits	Demerits
2001	TEEN	Real time data	100	Energy dissipated – 0.5 J, Number of alive nodes - 75	NS 2	It is well suited for the critical applications The users are enabled to control the energy consumption activities	In case of large number nodes routing would be more complex tasks
2002	PEGASIS	Real time data	100	Energy consumption – 3 times better than existing works	NS 2	Communication cost is reduced considerably by transferring data to most nearest nodes Improved energy conserved route establishment	Presence of more number of nodes with short lifetime would be uneven load balancing
2004	Genetic Algorithm (GA) for Hierarchical Clusters	Real time data	200	Percentage of alive nodes – 50 % better in random topology creation	NS 2	Data transmission is done via the set of cluster heads with enough resource availability Optimal energy conservation is achieved by forming clusters using genetic algorithm	Local convergence problem of genetic algorithm would lead to inefficient network routing

Table 1(b). Comparison Analysis of various methods

Distributed weight-based energy-efficient hierarchical clustering protocol (DWEHC)	Distributed weight-based energy-efficient hierarchical clustering protocol (DWEHC)	2005	It is more suitable for the heterogeneous network environment The clustering is done based on weight value which would lead to efficient clustering	More communication cost might be consumed	Real time data	2005	300, 1000
progressive approach with reliability measures	progressive approach with reliability measures	2006	In addition to energy factors, QoS factors also considered for evaluation Better and reliable routing is guaranteed	Calculation of every reliability measures leads to more computation overhead Can't support complex the wireless network environment	Real time data	2006	50
Distributed Energy-efficient Clustering-based Hierarchy Protocol (DECHP)	Distributed Energy-efficient Clustering-based Hierarchy Protocol (DECHP)	2007	Perform well by covering the large coverage area Routing can be done well	Route reestablishment is complex due to distributed nature of nodes More computation overhead	Real time data	2007	500

Table 1(c). Comparison Analysis of various methods

Distributed HAC (DHAC) algorithm	2008	Avoid the unnecessary energy consumption Balance the network traffic load efficiently.	Degraded in performance when the sink node is located far from the network	Real time data	NS 2	100	Number of nodes alive, energy dissipation
Improved LEACH	2009	Trust also ensured along with the energy dissipation values Assure the security during data transmission Less data loss by selecting alternate path in case of node failure	There is an possibility of irrelevant alternate path selection which might lead to performance degradation	Real time data	NS 2	150	Average cluster diameter – 0.77
REACH	2010	Well balanced energy consumption in the distributed nodes Increased network life time	It can only support the network with less network density More computation overhead and energy cannot be evenly distributed in high network density	Real time data	NS 2	200	40 % better energy dissipation

Table 1(c). Comparison Analysis of various methods

Novel Secure Key Management (NSKM)	2011	Assure the security during transmission of data packets It can provide the security against the replay and node capture attacks Assure the trust value	Cannot perform well on heterogeneous network environment	Real time data	Castalia simulator	300	Better storage overhead and security optimization
Zone-Based Hierarchical Framework (ZBHF)	2012	Higher network coverage region can be handled well Energy conserved route establishment is guaranteed in the heterogeneous network Zone based routing enables routing optimization in the intra clusters	Improper location zone manager might affect the entire network performance	Real time data	JAVA	320	Energy consumption – 0.01 J

Improvement of LEACH	2013	Optimal conservation of residual energy in the nodes Data packet loss is reduced considerably More reliability is guaranteed	It might degrade the system performance in case of missing information values	Real time data	Castalia -3.2	100	More throughput with less latency

Table 1(d). Comparison Analysis of various methods

Multilevel Hierarchical Clustering (MLHC) algorithm	2014	Provides better performance than previous hierarchical clustering algorithm by forming clusters from the available clusters Accuracy and energy conservation of the network is increased	Cluster head selection is not considered which might lead to the reduced performance	Real time data	Matlab	100	More reliable
decentralized hierarchical cluster-based routing algorithm	2015	Improved performance by decentralizing the routing path establishment process Inter cluster formation leads to the better routing efficiency	More possibility of premature delay in cluster head nodes	Real time data	NS 2	100 random 100 non uniform	Improved network life time

IV. CONCLUSION

In this work we have overviewed and informed about research take a shot at vitality effective progressive group based directing protocol for remote sensor systems as for their capacity necessity. The fundamental goal of a large portion of the current various hierarchical protocol lies on the most proficient method to broaden the system lifetime and how to make a progressively productive utilization of the basic assets, for example, battery control. A ton of studies has just been finished by scientists and furthermore demonstrated that grouping proficiently expands the solidness and lifetime of remote sensor systems. Be that as it may, it likewise uneven characters the vitality utilization among the hubs. To structure any convention for WSN, vitality constraint of a hub assumes a significant job. Every protocol talked about in this paper has singular points of interest and entanglements. To ration vitality balanced among the sensor hub numerous multi jump based information transmission has been considered. In light of the assessment and discourse, it is presumed that multi bounce correspondence are increasingly appropriate for tending to the vast majority of the issues, for example, vitality effectiveness, inclusion and parity vitality utilization among sensor hubs in remote sensor systems.

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