Grid Based Stateless Routing Protocol For Wireless Sensor Networks

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ABSTRACT

Maritime Search and rescue at sea plays an important role in ensuring the safety of life at sea. However, the use of Wireless Sensor Network (WSN) technology in marine transportation can withstand situations where the measurement information is insufficient. In data processing and networking for maritime applications, Wireless Sensor Networks (WSNs) have become an emerging trend due to their amazing capabilities. It is one of them. Node localization is an important factor. Because the location of the reporting node is unknown until and the data collected from his node is completely useless. The main purpose of this paper is to further improve localization using the Grid Based Stateless Routing Algorithm. To achieve this goal, range-free and distributed schemes with applications of Direction Based Forwarding (DBF) and Grid Based Reliable Routing (GBRR) for moving target nodes in maritime rescue networks are proposed. Results are compared to existing algorithms Particle Swarm Optimization (PSO) and Butterfly Optimization Algorithm (BOA). The proposed method has approximately 10% less localization error compared to PSO, BOA, and GBSR. The proposed algorithm is validated with respect to localization accuracy, node positions, localization error, and computation time.

Keywords: ***GBRR, GBSR, DBF, Localization, Swarm Optimization.***

INTRODUCTION

Wireless Sensor Network (WSN) protocols are designed to ensure efficient communication and data transfer among the sensor nodes in the network. These protocols must take into account the limited resources of sensor nodes[1], such as processing power, memory and battery life. Large-scale wireless sensor networks (LS-WSNs) have attracted a lot of research interest, especially in the context of performing environmental monitoring and periodic data collection tasks.

In order to make the research fit the actual situation more closely, the situation of the base station bunching is the cycle where detecting region is isolated in gatherings to balance the energy level of sensor hubs known as group. In Wireless sensor networks consist of small nodes with sensing, computation, and wireless communications capabilities. Many routing, power management, and data dissemination protocols have been specifically designed. The Real time example can be shown in figure 1.

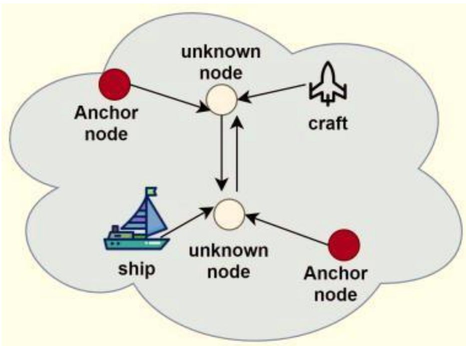

Figure 1: Localization in maritime rescue.

In this article proposes a “clever Grid-Based Reliable Routing Protocol (GBRR)” with the coordinated effort of grouping and matrix based steering highlights, which accomplish extensibility and versatility for irregular sent sensor networks at a thick and huge scope region, to exploit upgraded group directing to tackle the overburden issue on bunch heads. The rest of the article is organized as follows. Section-1, ‘‘Related work’’ gives an overview of related work.

Section-2, ‘‘Problem statement’’ describes our system model and states the objectives that we deal with in this work. Section-3, ‘‘GBSR’’ presents the data gathering problem, describes the details of the proposed protocol GBSR, and argues that it meets its objectives. In section-4, ‘‘Protocol simulation and result analysis

The main contributions of this article can be summarized as follows:

- The Grid – Based Reliable Routing (GBPR) algorithm is a bio-inspired optimization algorithm used for solving optimization problems in various fields, including engineering, computer science, and economics. The algorithm is based on the concept of power reduction, which is inspired by the behavior of animal groups [2], such as fish and birds, in finding optimal routes.
- WSN protocols play a critical role in ensuring efficient communication and data transfer in WSNs while taking into account the limitations of sensor nodes. The selection of a suitable protocol depends on the specific application requirements and the characteristics of the WSN[3], such as the number of nodes, the topology, and the communication range.
- The energy proficiency of D2D (EE-D2D) is boosted without endangering the nature of administration (QOS) necessities of the other level client[4]. The advancement conspire disintegrates into two sub issues. To begin with, the Sequential Max Search (SMS) asset block distribution calculation is applied to D2D clients. Second, a hereditary advancement approach (GA) is utilized to streamline the force of the transmitter and base stations.

LITERATURE REVIEW

Suleiman Zubair, NorsheilaFisal (2021), “Reliable geographical forwarding in cognitive radio sensor networks using virtual clusters” and analyzed a need for implementing reliable data transfer in resource-constrained cognitive radio ad hoc networks[5] is still an open issue in the research community.

Zarifzadeh S, Yazdani N (2012), a “game-theoretic topology control framework” is proposed to study the problem of creating energy-efficient topologies for ad hoc networks in the presence of selfish nodes. Since the amount of energy consumed in each sensor node depends not only on its power but also on the volume of traffic it forwards [7], a new utility function that can better characterize the real interest of sensor nodes in energy optimization is proposed.

Heinzelman WB, Chandrakasan AP (2002), a“low-energy adaptive clustering hierarchy (LEACH) routing protocol”, which is a typical representative of hierarchical routing protocols in WSNs, is proposed for periodic data collection applications. In LEACH, each node independently proclaims itself as the cluster head periodically by equal probability round-robin method [9]. In PEGASIS, only one node will directly deliver the aggregated data to the sink each round.

Mark Weiser (2000), “Directed diffusion: a scalable and robust communication paradigm for sensor networks” for the new trends in the field of “pervasive” or “ubiquitous” computing in logistics. Over the past two decades, research challenges in pervasive computing have evolved following the rapid progress of information [11] and communication technology.

Objectives Of The Study

Our study gains inspiration from meaningful evaluation indicators such as reliability and latency and grid-based Stateless Routing framework is proposed for load balancing & Node Localization to ensure energy efficiency in WSNs.

PROPOSED METHODOLOGY

A. Network Model

In this article, we consider a sensor network consisting of N sensor nodes uniformly dispersed within a vast monitor field to continuously monitor the environment. We denote the i^{th} node by $s_i$and the corresponding sensor node set S = { S1,S2, ….. , Sn}.

- All sensor nodes are quasi-stationary after deployment.
- Data within different fields have different requirements concerning the transmission delay to the sink.
- All sensors are left unattended after deployment and have unique identification; the sensor nodes can be accurately located by GPS or some localization algorithm.
- All nodes have limited initial energy and nodes with different energy have different data- collecting abilities. The energy depletion of sleep nodes can be neglected.
- The energy of sink is unlimited, with strong computing and storage ability. Considering the need of real application, the sink is located far away from the sensing field.

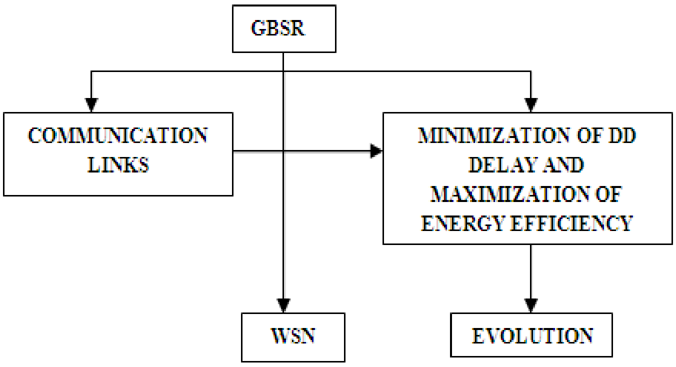

Figure 2: Complete workflow of GBSR algorithm

B. Network Initialization Phase

Consider the total number of sensor nodes N is randomly scattered in a given targeted scenario, the area of which is L 3 W, where L and W are the length and width of the scenario. In this article, we assume all nodes are aware of their energy, geographical location, and unique node ID [15].Once the deployment of network topology is completed, all sensors report their configuration information to the sink. Then, the base station begins to broadcast the message of grid division when it receives all sensors information. The Complete workflow of localization can be shown in figure 2.

C. Grid Formation

Grid is a set of bio-inspired algorithms tailored to the decentralized construction of a Grid information system [17] that features adaptive and self-organization characteristics. Such algorithms exploit the properties of swarm systems, in which a number of entities/agents perform simple operations at the local level. The Square Grid based formation can be shown in Figure 3.

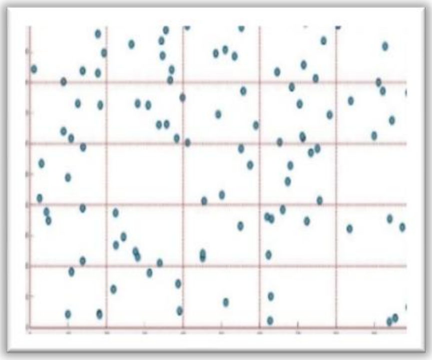

Figure 3: Formation of Grid

D. Communication Links

The greatest part of the examinations on DD expects bidirectional correspondence joins with a similar transmission range. Such balance improves on DD strategy and calculation plan. The intra-bunch control message design (Intra Cluster Route_ Msg) alludes to any jump that is in a similar group. An undivided attention hub can know whether the information is sent for it by perceive the principal indication of the control message. The third sign demonstrates the distance between the hub and objective where the message goes. [18] The fourth sign records the remaining energy of its group head.

The between bunch control message design (Inter Cluster Route_ Msg) alludes to the transmission between bunches. The third sign demonstrates the distance between the hub and objective where the message goes. The fourth sign records the remaining energy of its group head. The between bunch control message design (Inter Cluster Route_ Msg) alludes to the transmission between bunches.

E. Cluster Formation

In this article, just square grid is considered. By comparison, we can see that our proposed Grid Based Routing Protocol algorithm has better adaptability than PSO and BOA which needs to increase the node localization and performance. The Square Cluster based formation can be shown in Figure 4.

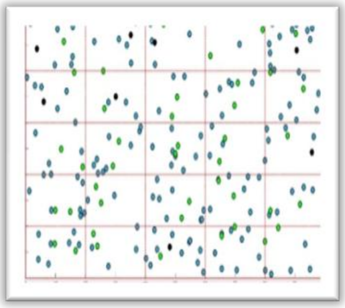

Figure 4: Formation of Cluster

SIMULATION PARAMETERS

A. Data Latency

Data Latency is thelengthen between the directions and the statistics transmission. A large quantity of nodes contributes to dissemble latency because a large range of paths are available. However, a large quantity of nodes is related to a large delay. In most WSN, a constant bandwidth, i.e., the quantity of facts transmitted per unit of time is used [19]. The data can be analysed and the results are shown in figure5. A greater bandwidth will increase the pace of the information transmission which makes the latency extra major.

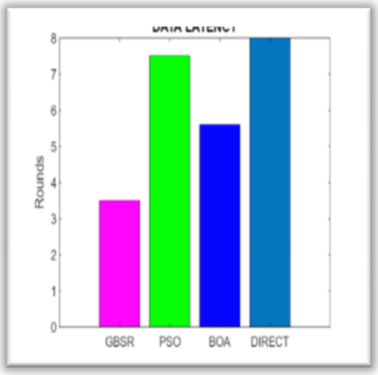

Figure 5: Data Latency

B. Energy Consumption

As a microelectronic device, the principal project of a sensor node is to notice phenomena, lift out data processing well timed and regionally and transmit or get hold of data. A regular sensor node is normally composed of four components a strength provide unit; a sensing unit; a computing/processing unit; and a speaking unit [16]. Except for the strength unit, all different aspects will devour strength when satisfying their task extensive study and evaluation of strength consumption in WSN. The data can be analysed and the results are shown in figure 6.

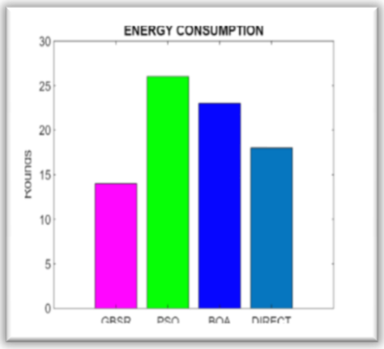

Figure 6: Energy Consumption

C. Throughput

Throughput is a way to consider the success of the data transmission. In fact, it measures the quantity of statistics that the community can method in a positive quantity of time, $T = \Sigma^{N}_{n=1} Dp_n \underline{Dp_s}/t$in which Dp^n is the number of data packets successfully transmitted through each node [22] and n, Dp^5 is the average size of the data packets, and t is the transmission time. In figure shown, Energy Throughput with full potential Chart.The data can be analysed and the results are shown in figure 7.

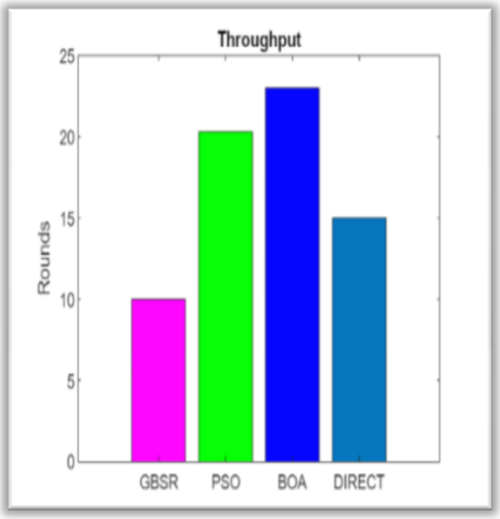

Figure 7: Throughput

D. Packet Delivery

We set the program that it will trade update and show the rounds when the energy of hub runs out of 90% of its underlying energy. We likewise analyse the lifetime produced by GBRR convention with LEACH, EADC and EADUC in a similar climate. Fig. 10 shows the correlation of these conventions regarding network lifetime [17]. We can see that GBRR perform better than LEACH, EADC and EADUC in delaying network lifetime. The data can be analysed and the results are shown in figure 8. To deal with state advances, every dynamic hub in the matrix gauges it is leaving time and sends this to its neighbours. Hubs arrange which hub will deal with steering through an application dependent positioning method embraced in GAF convention.

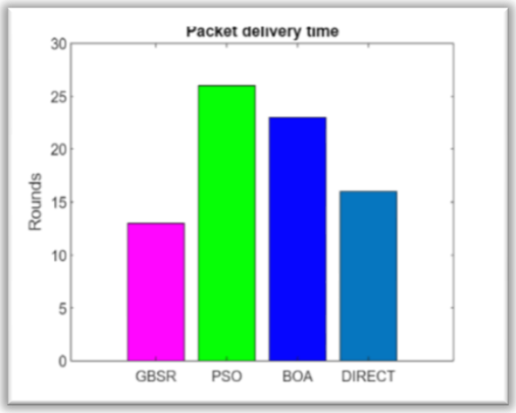

Figure 8: Packet Delivery

E. Result

Future DD calculations ought to be equipped for acquire data and to decide the openness of gadgets to anticipate future gatherings of gadgets by depending on proper data. A fast disclosure is required when two gadgets are in reach and need common correspondence [20]. New systems for DD ought to be detailed by remembering streamlining for the expectation and learning calculations. Both new elements are equipped for portraying trademark properties of portability and new data sources.

EXPERIMENTAL RESULTS

Future DD calculations ought to be equipped for acquire data and to decide the openness of gadgets to anticipate future gatherings of gadgets by depending on proper data [21]. A fast disclosure is required when two gadgets are in reach and need common correspondence.

Table 1: Localized Nodes and Number of Nodes Available

X axis	Y-axis	Localized node	No of Nodes
2.086	11.647	2.1	1
3.76438	8.646	3.06	2
3.5645	5.87	4.97	3
3.78743	10.858	4.54	5
4.84	13.64	5.43	7

New systems for DD ought to be detailed by remembering streamlining for the expectation and learning calculations. Both new elements are equipped for portraying trademark properties of portability and new data sources. The performance score is analyzed and the results are shown in table 1.The enhanced reliability, lower latency and energy efficiency of the presented scheme with randomly nodes and obstacles distribution.

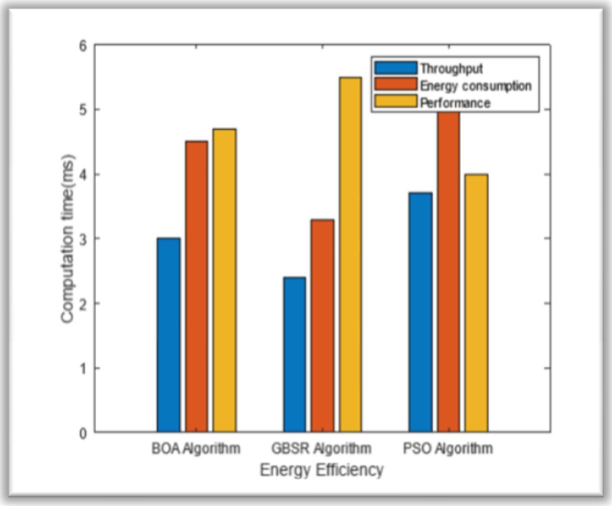

Figure 9: Analysis of different parameters of PSO, BOA, GBSR

CONCLUSION

In this paper, we have introduced and implemented the GBSR directing convention, which resolves the issue of the unwavering quality of hub to-hub interface quality in WSN. Using an energy-productive procedure, the technique utilizes the well-known course answer system to make virtual Grid-Based bunches around the following bounce hubs of the chose courses. The reproduction results show that the system can communicate information to the BS in viable bounces, in light of the fact that the procedure is intended to the select the hubs in the district that show the most elevated sending values. Further recreation reads up for examination with LEACH, EADC and EADUC have likewise uncovered the ideal ramifications of embracing this technique regarding network lifetime and energy utilization. The outcomes show that GBRR really distinguish the repetitive hubs and timetable them on the other hand in the climate with irregular obstructions. The overall Analysis can be shown in Figure 9 which were based on Node performance. Every one of these make GBRR solid plan that can further develop the general organization nature of administration for WSN.

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