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A META HEURISTIC HYBRID MOTH SEARCH ALGORITHM FOR OPTIMIZING LINK QUALITY AND SHORTEST PATH ROUTING IN WIRELESS SENSOR NETWORKS

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Abstract

The Internet of Things tends to attract deep interest in areas such as electronic, environmental management and enhance the effectiveness from researchers, the industry, citizens and government. IoT provides internet connectivity between connected phones in any context, anytime or anywhere. Wireless sensor networks (WSNs) consequently play an important role in developing a robust, affordable and convenient network of smart devices. Even then, sensor networks are restricted in scope of power, processing, and memory. In this framework, authors proposed a routing protocol of hybrid meta-heuristic moth search algorithm based differential evolution (HMSA-DE). By choosing routes based on the quality of the link, residual energy and recommended measuring mechanisms, the HMSA enhances reliability and energy efficiency. In addition, HMSA offers an event-based load balancing system that further prevents premature node / network power consumption. The findings suggest that HMSA improves the life cycle and availability of the network as well as the performance of IoT application services. It distributes limited network resources evenly and reduces the packet loss rate compared with the results of network protocols.

Keywords:

Moth Search Algorithm, Differential Evolution, Routing Protocol, Network Lifetime, Packet Loss, Wireless Sensor Networks

1. INTRODUCTION

A new generation of intelligent and comprehensive IoT networks has been formed due to the increased popularity of wireless technologies. IoT [1] is a technology of information exchange that allows you to communicate anywhere and anytime. IoT is based on the concept of interacting devices or objects through network signal to allow instant communication. These are RFID tags, sensor networks, actuators or mobile phones, etc. Wireless sensor networks [2] [3] play an important role to provide cloud connectivity that integrates the real and virtual worlds in this context. WSN / IoT applications have a substantial impact on quality of life and also economic benefits. IoT / WSN as such calls on universities, companies and governments to promote the development of emerging technologies and applications such as efficient home and business, healthcare, home environmental monitoring and intelligent cities. For example, ubiquitous systems and wireless sensing technology offer effective methods to increase food chain productivity [4] [5]. Patients can use medical sensors in intelligent treatment to monitor important parameters such as body temperature, blood pressure, ECG (electrocardiogram) and respiration. Major hospitals can also implement an advanced monitoring system to check the condition of the patient [6]. The SmartSantander project [7] offers a proactive research methodology continuing to support typical programs and practices and services in terms of practical implementation [8]. It incorporates more than 20,000 IoT modules in topologies with dozens or hundreds of nodes depending on installation, pollution control and parking management. The identified data shall be sent to a base station (BS) for further service in many IoT systems. This must be achieved through efficient routing protocols that are keys to improve the transmission of WSN data, energy efficiency and scalability. As a result, the WSN/IoT functionality faces unique challenges for an effective design of communication standards owing to limited resources and the unpredictability of low-power wireless interconnection that often lack the QoS functionality. Multi-travel-compatible routing protocols are also necessary to accomplish data transfer in distinct IoT applications with low latency, loss rate and power consumption [9].

This article addresses WSN/IoT (Homogeneous Node) flat panel architecture stability, consumption of power and the planning of algorithm safety and security and indicates an altered version including its knowledge-based network algorithm. It aims to resolve such shortcomings and could not only transmit low-latency, packet drop and high reliability data, but also allocate radio resources rationally by increasing the network lifetime. The approach employed provides the optimal pull-end routing protocol based on information among both low overheads. The help extend the remaining energy to adjacent routers via an on-demand transmission system by enhancing energy efficiency. Besides that, the technique was proposed requires a packet transmission event-based framework that tries to avoid feed-hole issues. This approach extends to the proceeding previous studies [10] [11] as (i) assist in simplifying the route selection process by evaluating the quality and information about end-to-end interconnection. (ii) Use a new approach to simplify link quality estimates. (iii) Conduct an in-depth study of the solution proposed.

2. RELATED WORK

Many applications in those kinds of instances have limited packet delays and errors tolerance. Cluster-based routing protocols are an alternative in various IoT initiatives to improve the quality and energy consumption [12], such as multimedia fire detection. A hierarchy includes nodes with different roles or accountability areas (heterogeneous nodes which have been categorized as primary and non-primary) [13]. The formation of a group of sensor nodes in which the Group nodes communicate (sensor-to-sensor) each other and outside the BS sensor [14]. An additional camera and battery can be installed in each node [15]. Selecting cluster headers to evaluate root causes is technically

diverse: residual energy, link effectiveness and location. The WSN routing protocol is described by flat and hierarchical classifications of location/cluster [16]. Flat frame can be considered as an appropriate solution over several application areas in IoT (Homogeneous Node Network) such as satisfied home or office, medical, pollution and many smart city services. It takes a long time for these algorithms to generate clusters and increase latency and difficulty which are not suited for other IoT applications. The architecture of the tree-based routing protocol is often used in WSNs. The sensor networks share a particular target node or BS. Multi-hop LQ [17] creates multi-tabbed trees in order to move messages over long distances and inevitably help create a unique traffic model. The complicated user interface of application areas such as smart parking and boundary control helps to prevent pervasive IoT. The routing model needs to start taking different models of congestion into account for these problems, such as one-to-many and many-to-many. Distinct routing protocol formations provide multiple ways of broadening the network lifecycle and enhancing service quality. Use of the architecture should be supervised by the innovative development, including the aim and criteria of quality of service [18]. Due to its low operating complexity and high performance, design-based techniques were always an appropriate method for many consistent IoT scenarios. The Energy Efficient Unicast Routing Protocol (EEURP) [19] offers a cost clustering method based on hop count, average final consumption and lower power. EEURP also uses both these fields to imply the total remaining energy on the road or the lowest level of energy on the way to RREQ and RREP messages. Lower energy indicates whether there's any hope for a significant level of energy, especially on the road. EEURP also utilizes other fields to signify the total remaining energy on the road or the lowest level of energy on the way to RREQ and RREP messages [20]. Lower energy indicates whether there is hope for a significant level of energy, particularly on the road. This approach is necessary for assessing the power level of the track as whole but it adds considerable signalling costs, leading further to resource consumption and congestion on the WSN. The main disadvantage of EEURP is that it does not have included a mechanism for predicting the quality score of a link [20]. EEURP hardly focuses on network resilience but does not know the support of QoS for IoT applications. EEURP is tested on 802.11 wireless broadcast with a network monitoring bandwidth higher than standard WSN / IoT [21] [22]. The plan for the route is as followed [23]: a simple route based on weighted rings and a round ring. Each network sensor tends to prefer a mobile user to route only those packets from each rotation and use a simple routing method. Each source node can select so many nodes to route ever other packet using a data scheduling scheme for transmission paths. The framework should allow the packet to start offering its destination [24]. Circular Weighted Routing is a proper evaluation mechanism that proportionally weighs that every routing node with measured value. The protocol now uses stream as its routing method, but it does not currently fix the issues in Hall. The evaluation of success by focusing used in the experiment does not really illustrate end to end network performance even when routing is considered [25].

2.1 MAJOR CONTRIBUTIONS

The motivation behind this work is to describe a HMSA-based routing protocol to enhance the link quality. The proposed algorithm implementation could be used in WSN / IoT applications such as the homes and offices, healthcare, environment monitoring and intelligent cities. In order to improve reliability of the device and support IoT applications, the quality and residual power of the wireless link in the course of the route selection process is considered. Various steps involved are described as:

- Choosing the shortest path is important for message delivery and often includes other potential links.
- Reduce the use of WSNs used to balance power consumption and improve network life.
- Actually, the method is recommended to solve the link quality issue for WSN routing technology. It reduces the functionality of the target by using the link quality for each plug-in connection between two node pairs.

3. PROPOSED MODEL

In this article, a differential Evolution (DE) method based on a hybrid meta-heuristic moth search algorithm such as HMSA-DE to connect the network nodes to balanced power distribution consumption is defined. The DE algorithm is commonly used to focus on improving the usage of MSA through the evaluation of the DE algorithm in the Genetic Algorithm (GA) and the ES algorithm as a search engine technique as depicted in Fig.1. These attributes include the large GA population and self-adaptive ES mutations. The impact of various meta-heuristic (MH) algorithms has been determined according to their properties. It is due to its simplicity, stability and capability that build quality the Metaheuristic (MH) algorithm is used. The significant proportion of algorithms is easy to install and relatively uncomplicated.

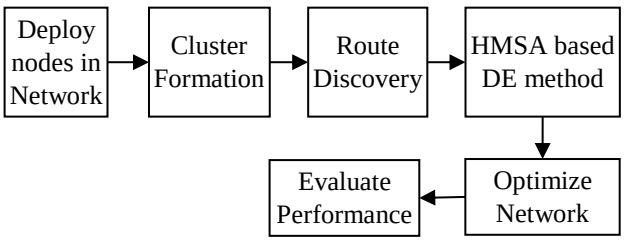

Fig.1. Proposed Model

3.1 LINK QUALITY ESTIMATION

Links in WSN communication systems often are unreliable because of alterations in quality and poor interconnection. Instability of the connection is primarily due to the necessity that use low power radios which can interfere, crosstalk and distort multipath ways.

In that same case, the routing protocol effectiveness for the routing protocol improves the protocol stability as well as the precision of the Link Quality Estimator (LQE). As has been mentioned, the quality of a link is usually calculated as a single value, such as RSSI or LQI. A single LQE value is therefore only one look at a given time and does not provide additional details about the remainder of the end-to-end connection capacity, number and quality.

3.2 PATH SELECTION AND LOAD BALANCING

The restrictions of node equipment and the diverse quality of the wireless connection are the key problems in ensuring a high standard of service availability, particularly energy gaps. It can lead to the early death of the node due to various power failures, road blockages or overuse. As stated earlier, routing solutions must use a load-balancing mechanism to redirect traffic to increase standards of quality (reduce packet loss and latency) and reduce power consumption. In WSN / IoT applications, the massive issue with the load balancing and fault tolerance is the use of multipath to decrease network traffic across different paths. Multipath nodes are using bandwidth aggregation as well as balanced energy consumption to increase data transfer reliability and performance.

3.3 PROPOSED HMSA-DE FOR ROUTING

It utilizes a synthesis process to improve efficiency of the optimization process, reducing the cost of measuring them. Authors investigated different combinations of optimization techniques in order to become more efficient. Hybrid optimization mainly reduces the compilation effort by using efficient techniques, but is costly and uses a more efficient optimization scheme. Users could use the greedy algorithm and assign the existing solution without false possibilities, if you want to choose applicants enthusiastically. In the preceding part, the remedy was managed to reach, but it was not conclusive. This process repeats until the finished or total optimal level solution is reached. This technique creates greedy rules for optimizing the location function at every stage.

4. RESULT AND DISCUSSION

4.1 ENERGY CONSUMPTION

Comparison of various existing systems along with proposed system in terms of energy consumption has been considered in Fig.2. As compared to standard methods, the proposed method demonstrated lesser energy consumption at 20%. The Fig.2 confirms the explicit success of the proposed method over the other methods but as the sensor node increases, there is increase in energy consumption as illustrated.

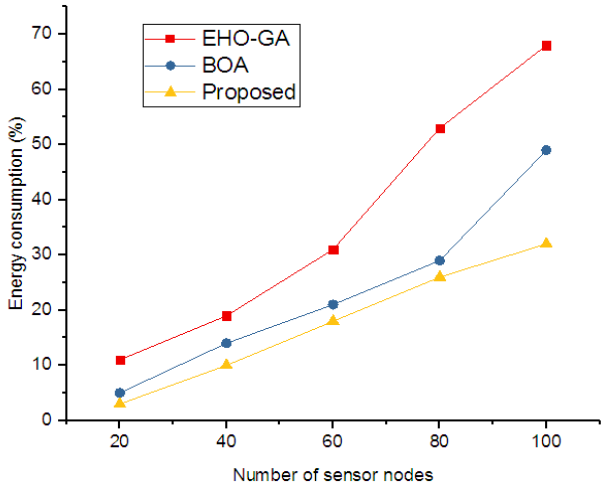

Fig.2. Energy Consumption

4.2 THROUGHPUT

The Fig.3 reflects the proposed system capacity in terms of throughput. The Fig.3 clearly indicates the improved performance of the proposed method in terms of throughput as compare to existing methods such as EH0-GA and BOA.

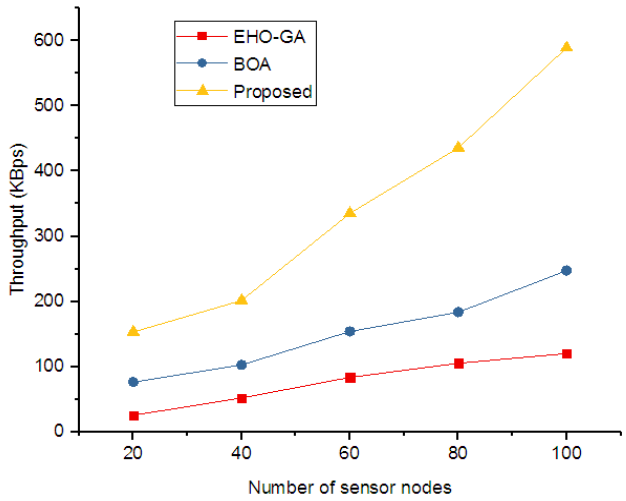

Fig.3. Throughput

4.3 END TO END DELAY

It is defined as the ratio of the total time required to send a packet to the receiver and the number of data packets received by the receiver. The end to end delay observation for proposed and conventional methods is shown in Fig.4. Compared to other existing systems, the proposed method achieved the lowest end to end delay. It increases with increase in the number of nodes but not as much as the other methods behave, which indicates better performance of proposed system.

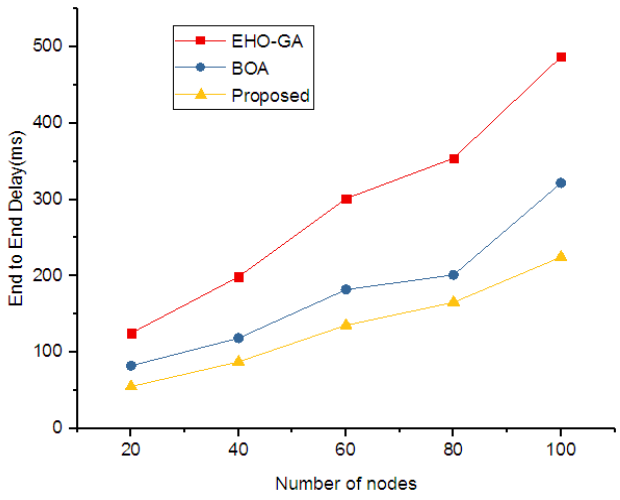

Fig.4. End to End Delay

4.4 PACKET DELIVERY RATIO (PDR)

The PDR analysis of the proposed and conventional systems is shown in Fig.5. It is more inherent than other systems. Compared to other systems, the proposed technique achieves the

highest PDR. With increase in number of sensor nodes, PDR also increases.

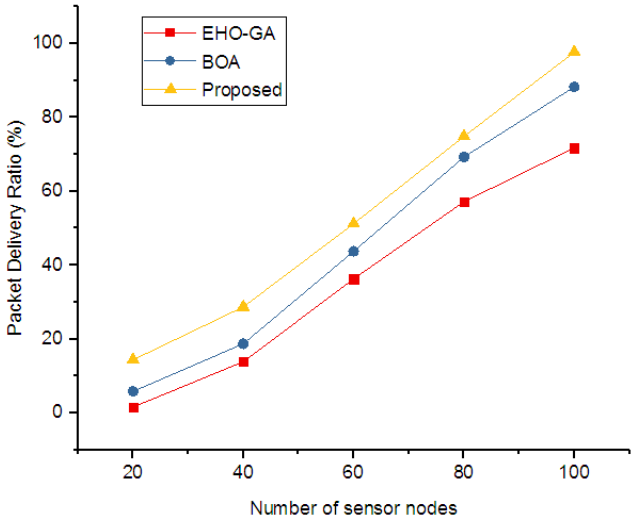

Fig.5. Packet Delivery Ratio

4.5 OVERALL PERFORMANCE

The Table.1. indicates the overall system performance in terms of various parameters like PDR, throughput, energy consumption and end to end delay by comparing these with the existing methods like EHO-GA and BOA. The performance metrics are evaluated by using 100 nodes attributed to other conventional methods. The Fig.6 also shows the comparison of existing methods with proposed method.

Table.1. Performance Comparison in terms of different parameters

Parameters	EHO-GA	BOA	Proposed
PDR	71.75 %	88.28 %	97.69 %
Throughput (kbps)	120.15	247.35	589.23
Energy Consumption (J)	68 %	49 %	32 %
End to End Delay (ms)	487.12	312.88	224.70

5. CONCLUSION

In this work, authors have developed energy efficient routing and link quality enhancement using HMSA-DE algorithm in WSNs. Originally, the improved DE was used to create groups with different number of nodes. The HMSA can then be developed to identify the proper node for the best possible CH on the basis of relevant NC, residual energy and measurements. The moth search algorithm is used to find better link quality. Finally, the proposed HMSA-DE routine protocol is used to transfer data efficiently.

The proposed work is simulated in MATLAB. The simulation results revealed that the proposed method shows better performance as compare to existing methods in terms of PDR, energy consumption, throughput and end to end delay. It also improves energy efficiency and network lifespan.

The proposed system can be expanded to optimize the number of levels in future. In addition to focusing on reducing high separation frequencies and CH distribution, areas such as using multiple BS to determine the best way to obtain maximum power for multi-hop cluster communication to reduce the load on CH are included. It can be assumed that a single BS method can further improve the energy efficiency and overall life of the WSN.

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