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ENERGY EFFICIENT TEACHING LEARNING BASED OPTIMIZATION FOR DISCRETE ROUTING PROBLEMS IN WIRELESS SENSOR NETWORKS

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Abstract- Wireless sensor networks (WSNs) are composed of sensor nodes, having limited energy resources and low processing capability. Accordingly, major challenges are involved in WSNs Routing. Thus, in many use cases, routing is considered as an NP-hard optimization problem. Many routing protocols are based on metaheuristics, such as Ant Colony Optimization ACO) and Particle Swarm Optimization (PSO). In this paper, we propose a new routing approach based on Teaching Learning Based Optimization (TLBO) which is a recent and robust method, consisting on two essential phases: Teacher and Learner. As TLBO was proposed for continuous optimization problems, this work presents the first use of TLBO for the discrete problem of WSN routing. The approach is well founded theoretically as well as detailed algorithmically. Experimental results show that our approach allows obtaining lower energy consumption which leads to a better WSN lifetime. Our method is also compared to some typical routing methods; PSO approach, advanced ACO approach, Improved Harmony based approach (IHSBEER) and Ad-hoc On-demand Distance Vector (AODV) routing protocol, to illustrate

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TLBO's routing efficiency.

KEYWORDS: Wireless sensor networks, Routing, TLBO, Particle Swarm Optimization.

1. INTRODUCTION

Wireless Sensor Networks (WSNs) are network systems formed by sensors able to communicate without using any specific network infrastructure. There are various categories of sensors, depending on the environmental situation (temperature, humidity, pressure, etc. . .) . Thus, WSNs are used in many applications such as disaster relief, environmental control, precision agriculture, medicine and health care. Nonetheless, there are some intrinsic limitations for the sensors like low process capacity or power, and limited lifetime. Hence, new issues appeared in operations research and optimization field.

Particularly, many researchers have tended to focus on routing problems.

Routing in WSN differs from routing in traditional communication networks by the lack of infrastructure, unreliable links, and energy consumption. On the other hand, it's qualified as an NP-hard optimization problem, which means the necessity of metaheuristics to deal with it. Metaheuristics are robust techniques that start with a set of initial solutions called initial population in the context of evolutionary algorithms. Then step by step explores a sequence of solutions to reach the near-optimal solution. Recently, researchers have addressed these challenges by adopting optimization strategies.

There is a diverse range of metaheuristic algorithms used to optimize routing in wireless sensor networks including the Genetic Algorithm (GA) used to create energy efficient clusters for routing in wireless sensor networks. The Particle Swarm Optimization (PSO) [11–13] which is a simple, effective and computationally efficient optimization algorithm, investigated to address WSN issues such as optimal deployment, node localization, clustering, data aggregation, and routing. The Artificial Bee Colony (ABC), proposed in is an energy-efficient cluster based ABC procedure, for selecting the optimal cluster heads in order to reduce the consuming energy. Harmony Search (HS) used by Zeng, B. and Dong, Y. in to propose an Improved

Harmony Search Based Energy Efficient Routing Algorithm (IHSBEER) for WSNs. And Ant Colony Optimization (ACO), etc

2. LITERATURE SURVEY

Routing problem in wireless sensor networks

Forwarding data from source to destination in wireless sensor networks differs from that in classical networks in various ways. There is no infrastructure, wireless links are unreliable, sensor nodes may fail, and routing protocols have to meet strict energy saving requirements. Many routing algorithms developed for wireless sensor networks depend on the mobility of sensors or sinks, application field, and network topology. Overall, routing techniques are categorized according to the network structure or the protocol operation routing criteria.

Networks structure gathers three different kinds of routing protocols: flat, hierarchical and location based routing. While negotiation, multipath, query and coherent based belong to protocol operation category. Recently, many works in WSNs focus on intelligent optimization using nature inspired metaheuristics systems. Many routing protocols are based on metaheuristics, the ones considered in this work for comparisons**.**

IACOR, the proposed routing protocol for a flat network. Using stable sensors and sink, the object is to locate the ideal way, with negligible vitality utilization and solid connections. When an event occurs, source node parts information to N parts, every part is transmitted to the base station by an insect. Ants choose the next hop by using probabilistic choice tenets, and so on until sink. This approach gives great results, comparing to routing protocol EEABR (Energy-Efficient Ant-Based Routing) and original ACO approach**.**

PSOR, the PSO routing protocol which is a population based protocol. It required an initial population (a number of paths from the source node to the sink) and redefined PSO equations to present an adequate adaptation for the discrete routing problem, then found the best path from the source to the destination. PSOR results are better than IACOR in terms of energy consumption and WSNs lifetime as illustrating the comparisons made using the same settings and experimental conditions**.**

3. EXISTING SYSTEM:

Wireless Sensor Networks (WSNs) are network systems formed by sensors able to communicate without using any specific network infrastructure.

There are various categories of sensors, depending on the environmental situation (temperature,situation),

(temperature,humidity,pressure,etc…)

Thus, WSNs are used in many applications such as diasaster agriculture,medicine and health care.

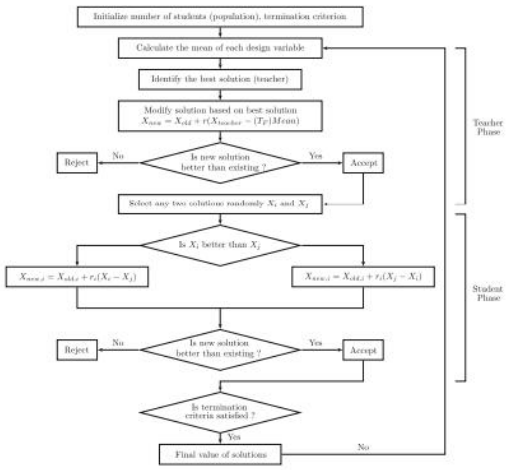
Nonetheless, there are some intrinstic limitations for the sensors like low process capacity or power.

Limited lifetime.

4. PROPOSED SYSTEM:

Teaching-learning-based optimization :

Teaching-Learning-Based Optimization algorithm (TLBO) is a novel optimization method proposed by Rao et al. This approach has been inspired by the teacher's influence and learners interaction. It outperforms some of the well-known metaheuristics regarding constrained benchmark functions, constrained mechanical design, and continuous nonlinear numerical optimization problems. TLBO has been applied to various problems such as the QoS multicast routing problem and optimal reactive power dispatch problem. It could be split into two basic parts: Teacher phase and Learner phase.



5. MODULES:

To implement this project we have designed following modules

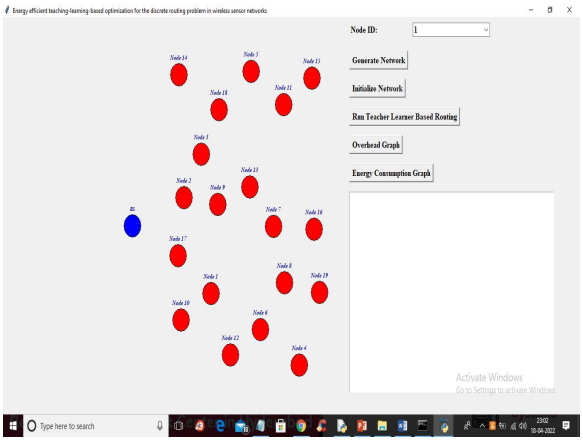
1. Generate Network : button to generate some dummy sensors like below screens.

2. Initialize Network : button to find parent nodes which are closer to base station or to find node which accept data from sensor and send to base station.

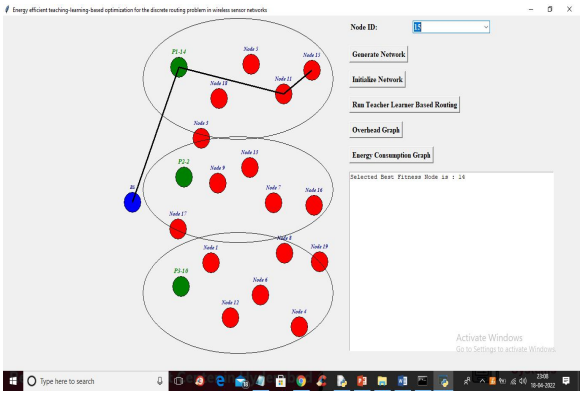
3. Run Teacher Learner Based Routing : button to send message like below screen.

4. Energy Consumption : graph button to get below graph.

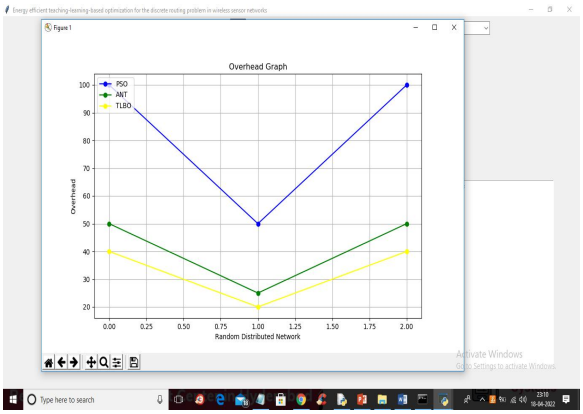
5. RESULTS



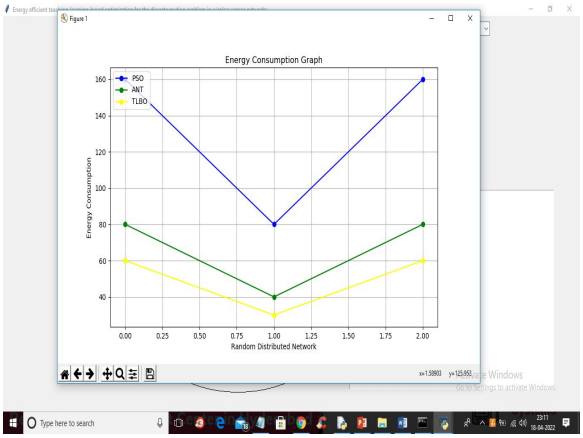
In above screen all red colour circles act like sensors and blue colour node is the base station and all red colour sensor will sense and send data to base station by using nearest routing nodes. Now click on 'Initialize Network' button to find parent nodes which are closer to base station or to find node which accept data from sensor and send to base station.



In above screen we can see sensor 15 chosen Node 11 as the best routing node and node 11 send data to head node P1-14 and P1-14 sending data to base station. Similarly you can select any sensor and then routing will perform using TLBO algorithm and now click on 'Overhead Graph' button to get below graph.



In above graph blue line represents ANT overhead and green line represents PSO over and yellow line represents TLBO and in all algorithms TLBO has less overhead and now click on "Energy Consumption" graph button to get below graph.



In above graph we can see PSO and ANT consume more energy compare to TLBO algorithm so TLBO is better than PSO and

ANT.

7. CONCLUSION:

Routing in WSN has introduced many challenges compared to traditional data routing in wired networks. This paper presents a new routing protocol using a novel optimization method based on the philosophy of the teaching-learning process combined with the edge recombination operator. That TLBO approach ensures a robust optimization of the energy consumption, thus increases network lifetime as validated by simulation results. By performing experimentation in the same simulation conditions, TLBOR protocol is compared to some routing protocol in WSNs such as: ACO, PSO and IHSBEER approaches and AODV protocol. Then overall the results show that our TLBOR protocol is better in terms of energy consumption and network lifetime. As a future work, it is planned to improve our routing approach by incorporating other quality of service (QoS) metrics and performing the experimentation in real WSN. Additionally, the improved approach will be applied to mobile nodes and networks with multiple sinks.

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