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Chemical Reaction Optimization Based Approach for Scheduling Links in Wireless Sensor Network

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Abstract: ***In sensor network there are large numbers of wireless sensor nodes powered by small batteries. Reduction of energy consumption of nodes is one of the key issues in data aggregation operation of Wireless sensor network. When sensor node not receiving data, there is lot of energy wastage. To save this energy wastage, links are schedule such that it can wake up only once in scheduling period by assigning the consecutive time slots to each link to fulfill its data collection task. Here we proposed new meta-heuristic technique, called Chemical Reaction Optimization (CRO) inspired by the nature of chemical reaction for scheduling link of nodes. It will optimize the reaction cost with best communication path having minimal distance. In virtue of the link scheduling, the energy consumption by nodes can be reduced which will better in performance than traditional approach.***

Keywords: Chemical Reaction Optimization, Metaheuristic, Link Scheduling, Optimization**.**

1. Introduction

Wireless sensor networks (WSNs) have small, expensive and battery powered wireless sensor devices that organize themselves into radio networks. A typical task in WSN-based data gathering applications is data aggregation, in which processed aggregated data is forward from children node to its parent node with highest value.

As the most sensor nodes batteries are non rechargeable, so for reducing energy consumption scheduling activities of node is one of the key issues. Idle listening state consumes more energy than receiving .so when not listening nodes are schedule to sleep and active when it is necessary. By using such a sleep scheduling nodes start up after a regular interval of time to check the channel for activity.

TDMA link scheduling does not take into account, the energy consumption of state transition from one node to another and requires extra energy for that. Even if the packets are small it will consume more energy than necessary. Each node can be scheduled consecutive time slots so that it only needs to start up once to fulfill all its tasks.

In the TDMA MAC protocols, by reducing the time slot channel utilization and network throughput can be improved. Also the energy consumed in the state transitions can be saved. All the TDMA-based protocols proposed earlier for WSNs have the intrinsic objective of minimizing energy utilization with reducing obstruction.

The Chemical Reaction Optimization is an efficient algorithmic framework for scheduling the activities. In this work we are proposing this algorithm for scheduling the links in wireless sensor network for reducing the energy consumption.

2. Motivation

Meta-heuristic scheduling (or Guided-random-search-based) techniques work by guiding the searching for solutions in a network region. Meta-heuristic scheduling typically takes additional time, but they can achieve good feat for a wide range of arrangement scenarios. Well-known examples of meta-heuristic scheduling techniques include Genetic Algorithms (GA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Simulated Annealing (SA) and Tabu Search (TS), etc. recently, a newly proposed meta-heuristic method, called Chemical Reaction Optimization (CRO) had demonstrated its effectiveness using the concept of chemical reaction to search the optimal point for various optimization problem.

3. Chemical Reaction Optimization

In this we assimilate the CRO scaffold to schedule the neighboring links on varied computing systems. basically CRO is a method which resembles with the chemical reactions even if it has not capture every fundamental of chemical reaction. The first two laws of thermodynamics states the principle of chemical reaction. preservation of energy says that energy cannot be formed, nor be shattered, it can convert from one form to another and also relocate from one entity to another. A chemical substance in reaction possesses prospective and kinetic energy. The energy of the surrounding is stored in central energy buffer in CRO. In second law, entropy of. Reacting systems will increased by faster movement of molecule having more kinetic energy. With this, we capture this phenomenon of converting potential energy to kinetic energy to release this excessive energy chemical substances manipulate itself for stabilization. This manipulation is called chemical reactions.

3.1 Characteristics

Energy conservation and transformation governs the algorithmic philosophy of CRO. With this assumption we

operate the solution through a arbitrary sequence of elementary reaction.CRO is the variable population based metaheuristic. There may not be the same number of molecules in different iterations. In CRO algorithmic framework we only define the general operation of agent and the energy organization scheme. To suit the characteristics of the problem certain implementation details can be adjust. There is more litheness for users to customize the framework to meet the desired requirements. CRO can be programmed in object oriented programming language. It is possible to design good operators for optimization for achieving better presentation for a particular problem.

3.2 Possible Contribution of Research

Chemical reaction optimization algorithmic framework design to solve link scheduling problems in wireless sensor network Adapting the conventional CRO framework and designing a new solution encoding method, new operations for performing elementary chemical reactions and a new function suitable for the scheduling scenarios considered in work. Conducting simulation to verify the efficiency of the proposed CRO.

4. Proposed Work

Whole work is based on the concept of chemical reaction as in chemical reactions there is left hand side of reaction and right hand side of reaction .left hand side of reaction are the elements or nodes needed to perform the communication between source and destination and on right hand side we have direct communication path between source and destination i.e. the result of the reaction. After reacting the elements to balance the reaction there are some intermediate reactions perform for getting the desired product from reactant. This concept of basic chemical reaction is used in wireless sensor network. To communicate between source and destination node decided by the user. Here the reaction is nothing but the communication link between source and destination. As such there is n number of paths between source and destination nodes with the difference in intermediate nodes which selects randomly in wireless sensor network. Now for this work chemical reaction is nothing but a routing problem in sensor network. Routing means to find the best path in the communication link. For that we have to schedule that communication link for sending the packet through best possible path. Here we are using the cost function for finding the distance between the nodes. To balance the reaction we need to optimize that cost function which directly depends on the distance between the nodes.

The whole work is divided in three parts.

- Network formation
- CRO population generation
- Link optimization

In network formation network options has been defined and then initialised for configuring nodes in network initialization phase. Then location of nodes has been setup and node has been created. Energy of node is setup by default energy model for network formation. Number of communication has been setup between the nodes for performing communication decided by the user.

In this basic CRO generation has done from its framework in which CRO reaction is initialised. CRO has been applied between the nodes to perform proper communication. In this module the vector shows the complete path of reaction. Vector, links per vector and number of iterations has been initialized for generating initial vector. It can be changed as per the requirement. Depend on the reaction cost with minimum distance path data send via that link.

Optimization of reaction cost has done after passing the path with minimum distance by CRO population generation. Optimizing the reaction cost between intermediate nodes by satisfying the condition that the current distance between the nodes should be less than the reference distance. This condition will continue for each contiguous link forming a loop resulting in optimized path using proposed chemical reaction optimization.

CRO population generation will operate in three phases. First is Initialization of system parameter, then process enters in loop for performing iterations for checking the collision and diffusion condition. Third is the final step of obtaining the best minimal point the condition will satisfy if the distance between current node and source node is more than the reference distance between source node and the previous node. These nodes are select randomly for solution generation. Whichever reaction cost is less that link is schedule to transmit the packet with minimum distance. Which will require minimum time for communication through minimum cost link. The distance between nodes is calculated by the Euclidian distance formula.

5. Working

We evaluated the performance of the proposed system. For this, we used NS2 simulator, where nearly 30 sensor nodes. We considered the default energy model for nodes location and energy of each node in the network. Then it asks for number of communications that has to be performed in the network by entering the source and destination for each communication link. Figure1 shows the network formation by randomly deploying the nodes in the network area.

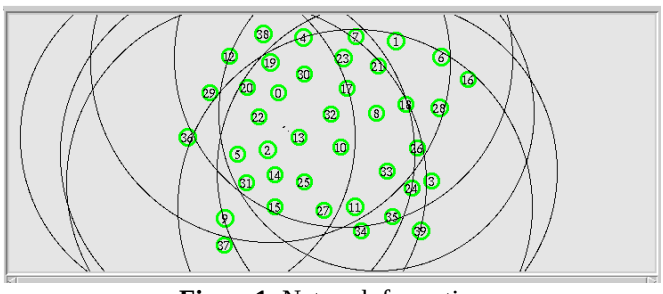

Figure1: Network formation

We have integrated this algorithm with the sensor network having default energy model and our system's performance was compared to the traditional algorithm. Figure2.show Energy Consumption comparison Graph with using proposed

CRO technique and with traditional approach. Figure3 shows Delay Graph in comparison with and without CRO with respect to simulation time. From this results and study of Proposed algorithm it is seen that the energy efficiency of nodes is improved and also the delay in sending the packets from source to destination is less than the normal delay.

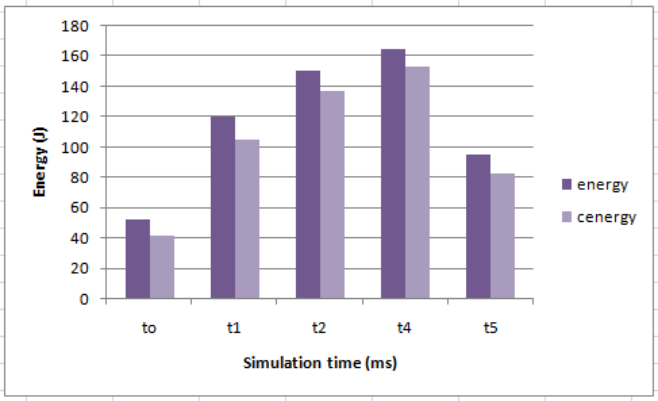

Figure 2: Comparison of energy consumption with and without CRO technique

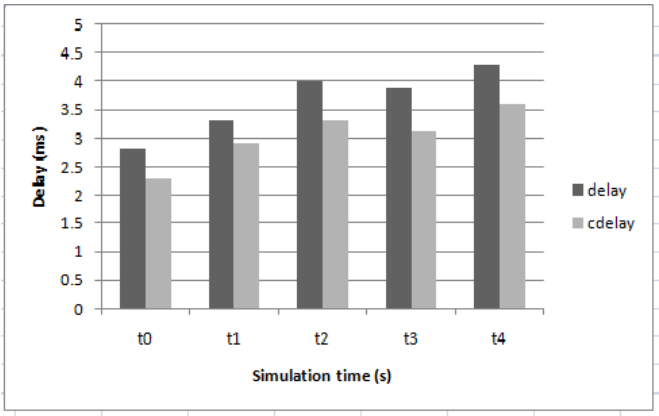

Figure 3: Comparison of Delay with and without CRO technique

6. Conclusion

The simulation result shows that the effectiveness of proposed Chemical reaction optimization algorithm. The improved energy efficiency of nodes than traditional algorithm shows that the CRO is better in performance. The scheduling of contiguous links has been done here by the intermediate reactions calculating the minimum distance between the links. Delay of packets also minimized using CRO Technique.

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