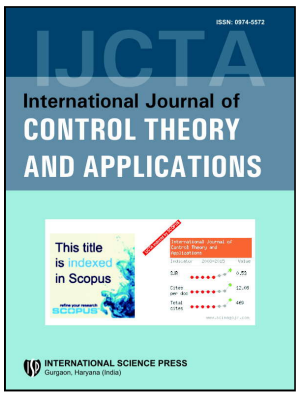

International Journal of Control Theory and Applications

ISSN : 0974-5572

Volume 10 • Number 13 • 2017

Design of Strategies for Routing in WSN using Bio-Inspired Computing

Bharathi M.A.[1], B.P. Vijaya Kumar[2] and Amartya Singh, V. Sem[3]

[1] Department of Computer Science and Engineering BMSIT&M, Bengaluru, Karnataka, India, Email: bharathi_m@bmsit.in
[2] Department of Information Science and Engineering MSRIT, Bengaluru, Karnataka, India
[3] Department of Information Science and Engineering BMSIT&M, Bengaluru, Karnataka, India

Abstract: The energy issue in wireless sensor network is still a question that requires an efficient solution to be given. The area of wireless sensor network has been researched from more than a decade but no better solution is yet found for retention of cumulative lifetime of the network. This paper introduces a newly designed decision strategy "Wasp Mimic Routing Decision Model"(WMRDM) that is based on unique cognitive and social behavior of wasp, where it was strongly felt that adoption of their patterns in social behavior can highly be formulated in the area of wireless sensor network.[1] The objective of this paper is to design strategies and decision making of data routing model, based on bio-inspired computing. The feasibility of the design is verified by computer simulation using MATLAB software.

Keywords: Wasps, Data Aggregation, Cluster head, Access point

1. INTRODUCTION

Many artifacts have been built throughout history, and many of which obtained their inspiration from phenomena in the natural world. It is noted that "progress often occurs at the boundaries between disciplines." [1] In the field of computer science, especially in artificial intelligence, there is growing interest in parallel-distributed intelligent theories and approaches that are inspired by the principles of nature and that can solve difficult problems. A vast literature exists on bio- inspired approaches for solving an impressive array of problems and, more recently, a number of studies have reported on the success of such techniques for solving difficult problems in all key areas of computer science. The two most predominant and successful classes or directions in BIAs involves Evolutionary Algorithms and Swarm based Algorithms which are inspired by the natural evolution and collective behavior in animals respectively. But still, this has been further refined so as to classify the algorithms based on the area of inspiration from nature so as to enhance a broader view over the domain. In addition, few studies on the Bio-inspired computing and Evolutionary Algorithms can be found in literature or references.[2]

The proposed system highlights a possibility of considering a design of a new WSN that has optimized lifetime using biologically inspired algorithm drawing the motivation from the cognitive behavior of a wasp.[3] Proposed system is discussed in Section II followed by Implementation and results in Section III. Section IV discusses about some concluding remarks.

2. PROPOSED ALGORITHM

The proposed system chose to use the phenomenon studied from the social behaviour of wasp for the purpose of reliable routing or transmission of data on the wireless sensor network and hence termed as Wasp Mimic Routing Decision Model (WMRDM).[4] The proposed WMRDM will be applied on wireless sensor network considering data aggregation technique for routing.[5] The consideration of the proposed system is as follows:

- Considering each node as wasp, cluster of nodes as swarm of wasps and one of the wasp as cluster leader.
- Simulating the behaviour of wasp ready for laying eggs mapped to sensor nodes on considered wireless sensor network.
- Consider each cluster have unique numbers of nodes where the nodes will be classified again based on residual power in current pass.
- Consider a data aggregation scheme where the sink is located in far distance with respect to the other clusters in order to check the efficiency of data communication.
- Consider before initiating simulation, each nodes have maximum battery-lifetime in order to check the enhancement in first node death.
- Finally consider the availability of neighbour nodes and sink node for decision making in choosing a transmission model. Once the simulation is initiated it will draw the logic of operation from the social behaviour pattern of wasp that is equivalent to a node in WSN.

2.1. WMRDM Methodology

The flow of the proposed WMRDM system in WSN is exhibited in Figure 1. The process consists of six steps:

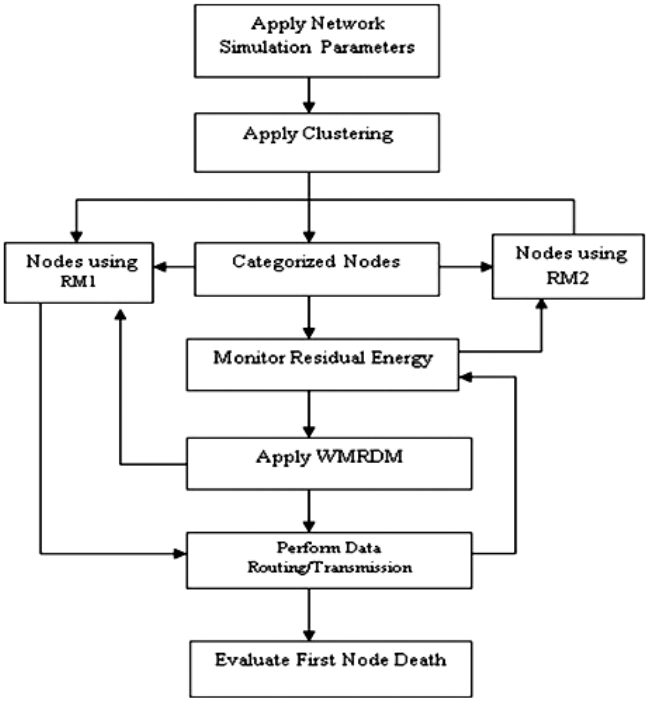

Figure 1: WMRDM Design Methodology

The proposed system is experimented on 32 bit OS with core i3 processor using MatLab as programming tool and the accomplished results are compared with LEACH protocol . A simulation environment is created considering 1000 nodes with. Once the simulation starts the WMRDM system starts classifying the nodes to Cluster leader as well as deciding the routing strategy.

2.2. Wasp Mimic Routing Decision Model for Transmission:

The parameters for WMRDM for the above design requirements and constraints where based on time and reliability the routing decisions are made. The illustrations for the generalized model are realized below.[9]

Let , Td be the time for a node to transmit sensed data directly from node to sink (Routing Model1) Let, Ti be the time required to transmit data using Routing Model2

where $Ti \neq 0$ and $Ti > Td$

Probability of a node using Routing Model 1 is p. (1)

Probability of a node using Routing Model 2 is 1 – p. (2)

Probability of using CH, we need to take into account the fact that since Routing Model1 takes less time than Routing Model 2 (because transfer of data from CH1 , CH2…CHn till it reaches the sink where store and forward is used),Assuming the Routing Model1 takes half the time of Routing Model 2,generalizing the model a node can transmit during a period of length Td is given by

$$Td / Ti \tag{3}$$

Probability of a node using transmission model2 is is given by

$$q = [(1-p) /p]Td / Ti = (1-p)Td / (pTi) \tag{4}$$

Where $q <= 1$.

Let $\prod$ be the probability of losing data or obsoleteness of data due to Routing Model2 due to multiple hops.[10]

3. EXPERIMENT AND RESULT

The following simulation parameters are considered for analyzing the decision making of routing model.

- Area of the network : 1000 * 1000
- Node density : 0.01
- No. nodes in the network : 1000
- Initial energy of node : 5 Joules
- No. of bits transmitted by each node : 100 bits
- No. of bits present for transmission by each CH : 500 bits.

The results after simulation were taken and analyzed which yielded the plot of the graph given below.

4. CONCLUSION

In this paper, the new routing decision making strategies are discussed and have been generated in a systematic methodology. Firstly, the design requirements and design constraints are summarized based on the characteristics of the existing routing protocols. Then, the atlas of new designs are obtained through the process of the creative mechanism design approach, and the graph has been obtained.

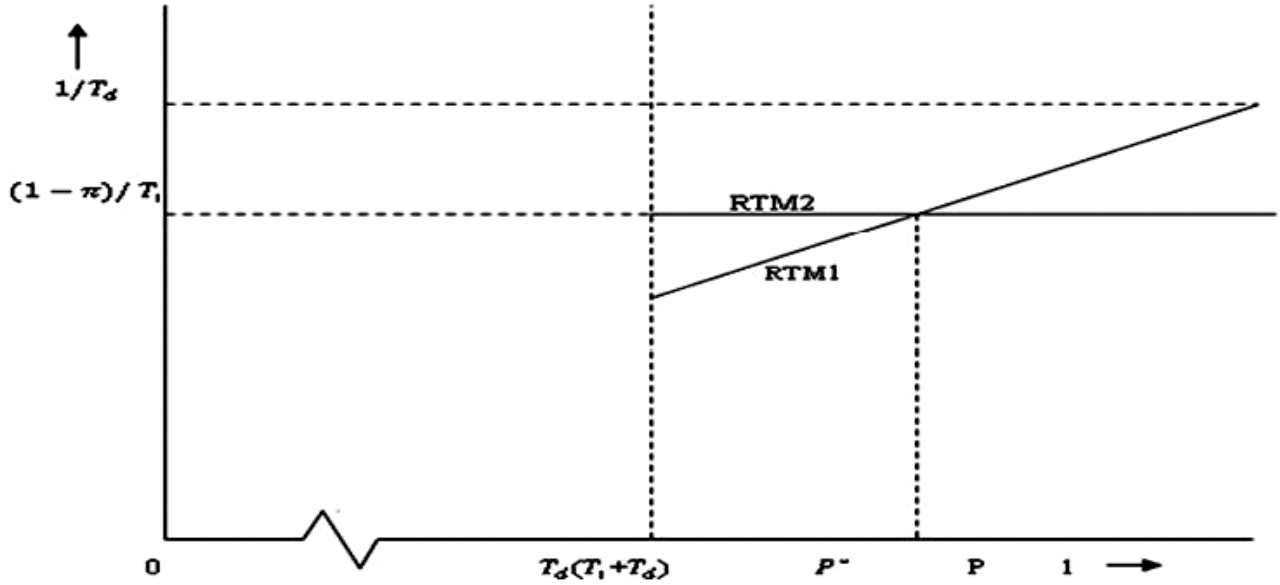

Figure 2: The payoffs to RTM1 and RTM2 as a function of p, the number of nodes in the population, for values of p for which the model is defined. The figure shows a case in which 1/Td> (1-π)/ Ti. The values of P^* is (1-π) Td/ Ti.

REFERENCES

[1] Xiang Feng, Francis C. M. Lau, Nature-Inspired Particle Mechanics Algorithm for Multi-Objective Optimization, Multi-Objective Memetic Algorithms, Studies in Computational IntelligenceVolume 171, 2009, pp. 255-277

[2] Holland, J.: Adaptation in Natural and Artificial Systems. MIT Press, Cambridge (1976)

[3] Dorigo, M.: Optimization, Learning and Natural Algorithms. Ph.D. Thesis, Dipartimento di Elettronica, Politecnico di Milano, Italy (1992) (in Italian)

[4] Dorigo, M., Maniezzo, V., Colorni, A.: Ant System: Optimization by a Colony of Cooperating Agents. IEEE Trans. Systems, Man, Cybernet., Part B 26(1), 29–41 (1996)

[5] Kennedy, J., Eberhart, R.: Particle Swarm Optimization. In: IEEE Conf. Neural Networks, pp. 1942–1948. IEEE Press, Los Alamitos (1995)

[6] Hans-Georg Beyer and Hans-Paul Schwefel, Evolution strategies A comprehensive introduction, Kluwer Academic Publishers , Natural Computing 1: 3–52, 2002.

[7] Rainer Storn, Kenneth Price, Differential Evolution – A Simple and Efficient Heuristic for Global Optimizationover Continuous Spaces, Journal of Global Optimization, Kluwer Academic Publishers, 11: 341–359, 1997

[8] Jason Lester Hill, System Architecture for Wireless Sensor Networks, Doctorial Thesis, University of California, Berkeley, 2000

[9] Bharathi M A, B P Vijayakumar ,Mallikarjuna, " Bio-Inspired Approach for Energy Utilization in Wireless S e n s o r Networks, published in Elsevier Proceedia indexed by Scopus and EI, Pg.No, 3864-3868, doi:doi:10.1016/j.proeng. 2012.06.444.

[10] Bharathi M A, B P Vijayakumar, "Reverse Game Theory Approach for Aggregator Nodes Selection with ACO based Routing in Wireless Sensor Networks", published in International Journal of Computer Science Issues (IJCSI), ISSN 1694 – 0814, Volume 9, Issue 6, No.2 November 2012, Pg.No 292-298. Impact Factor 0.242.