International Journal of Engineering, Management, Humanities and Social Sciences Paradigms (IJEMHS)
(Volume 22, Issue 01)
Publishing Month: June 2016
An Indexed and Referred Journal with Impact Factor: 2.75
ISSN: 2347-601X
www.ijemhs.com

Design a Proposed Algorithm for Tracking of Object in Wireless Sensor Network Using Bacterial Forging Optimization Algorithm

Bharat[1] and Deepak Goyal[2]

[1]**M. Tech. Student, VCE Rohtak, Haryana (India)**
bharat9214@gmail.com
[2]**Associate Professor and HOD, CSE Department, VCE, Rohtak, Haryana (India)**
deepakgoyal.vce@gmail.com

Publishing Date: June 23, 2016

Abstract

This paper based on design such kind of algorithm that are used for tracking of object in WSN that more energy efficient for tracking of object that is required for checking the varying speed of target, target precision and missing target recovery. BFOA works for providing the energy efficient clusters and cluster head selection and the task of object tracking is performed by prediction based clustering algorithm.

Keywords: *WSN, BFOA, Cluster Head, Object Tracking, PES.*

1. Introduction of WSN

Wireless Sensor Networks (WSN) have gained world-wide attention in recent years due to the advances made in wireless communication, information technologies and electronics field [6,9].The concept of wireless sensor networks is based on a simple equation: Sensing + CPU + Radio = Thousands of potential applications. It is a sensing technology where tiny, autonomous and compact devices called sensor nodes or motes deployed in a remote area to detect phenomena, collect and process data and transmit sensed information to users. The development of low cost, low-power, a multifunctional sensor has received increasing attention from various industries. Sensor nodes or motes in WSNs are small sized and are capable of sensing, gathering and processing data while communicating with other connected nodes in the network, via radio frequency (RF) channel. WSN term can be broadly sensed as devices range from laptops, PDAs or mobile phones to very tiny and simple sensing devices. At present, most available wireless sensor devices are considerably constrained in terms of computational power, memory, efficiency and communication capabilities due to economic and technology reasons. That‘s why most of the research on WSNs has concentrated on the design of energy and computationally efficient algorithms and protocols, and the application domain has been confined to simple data-oriented monitoring and reporting applications. WSNs nodes are battery powered which are deployed to perform a specific task for a long period of time, even years. If WSNs nodes are more powerful or mains-powered devices in the vicinity, it is beneficial to utilize their computation and communication resources for complex algorithms and as gateways to other networks. In wireless sensor networks there are several wireless sensors which are capable of sensing a special phenomenon in the environment and send the data back to one or several base stations. The main feature of WSN that makes it unique is its flexibility in terms of the shape of the network and mobility of the sensors. Without any wires, WSN can be deployed in areas where regular sensor networks cannot operate.

Also the self-shaping feature of WSN, along with the freedom of the wireless sensors movement makes it an ideal tool for the situations where the sensors are mobile. Having these features, WSN is used in medical applications, military purposes, disaster area monitoring etc. The flexibility of wireless sensor networks comes with a series of challenges. Since wireless sensors are not physically connected to any central source they are completely dependent on their battery to operate; also wireless sensors positions are not determined prior to the network deployment, thus sensors should be able to operate in a way that can automatically generate an optimum routing path and deliver the sensed information back to the base-station. Base-station integrates the received data and applies a process over it and sends the results to be viewed by a user or for further processing. Each wireless sensor node is not physically connected to any source of power, thus its own battery is the only reliable power supply for it. Sensor nodes are also constrained on bandwidth. Considering these two limitations, routing and sensing algorithms that use innovative methods to preserve the power of the sensors are required. Since the lifetime of the network is highly dependent on the lifetime of the Sensors Sensing Environment Base-Station sensors' batteries, preserving the energy in the sensors will increase the lifetime of the network.

2. Object Tracking

Object tracking is one of the challenging and non trivial applications for Wireless Sensor Network in which network of wireless sensors are involved in the task of tracking a moving object. Object Tracking is widely used in many applications like military application, commercial applications, field of surveillance, intruder application and traffic applications. There are various metrics for analyzing object tracking such as cluster formation, tracking accuracy, cluster head life time, miss rate, total energy consumed, distance between the source and object, varying speed of the target, etc. The open issues in object tracking are detecting the moving object's change in direction, varying speed of the target, target precision, prediction accuracy, fault tolerance and missing target recovery. The object tracking algorithm should be designed in such a way that it result in good quality tracking with low energy consumption. The good quality tracking extends the network lifetime and achieves a high accuracy. In order to obtain an energy efficient tracking with low energy consumption, an assumption is made that all the sensor nodes have same energy level. Because, even if a sensor node fails, other sensor node can take the responsibility and carry out the tracking process.

3. BFO Algorithm for Cluster Head Selection

Bacterial Foraging Optimization (BFO) is a population-based numerical optimization algorithm. In recent years, bacterial foraging behaviour has provided rich source of solution in many engineering applications and computational model. It has been applied for solving practical engineering problems like optimal control, harmonic estimation channel equalization etc. In this thesis, BFO has been used for cluster head selection to provide improved energy efficiency in routing.

3.1 Bacteria Foraging Optimization

The process of natural selection tends to eliminate animals with poor foraging strategies and favour the propagation of genes of those animals that have successful foraging strategies, since they are more likely to enjoy reproductive success. After many generations, poor foraging strategies are either eliminated or shaped into good ones. This activity of foraging led the researchers to use it as optimization process. The Escherichia Coli or E. coli bacteria that are present in our intestines also undergo a foraging strategy. The control system of these bacteria that dictates how foraging should proceed can be subdivided into four sections, namely, chemotaxis, swarming, reproduction, and elimination and dispersal.

3.2 BFO Algorithm

The algorithm that models bacterial population chemotaxis, swarming, reproduction, elimination, and dispersal is given here (initially j=k=l=0). For the algorithm, updates to the θi automatically result in updates to P number of sensor nodes. The procedure of BFO is as follows.

1) First of all, get sample no of sensor nodes to be optimized
2) Initialize, the value of p,S,Nc,N,s,Nre, Ned, Ped and the c(i), i=1,2… S. The initial values for the θi, i = 12…. S must be chosen.
3) Elimination-dispersal loop: l = l +1
4) Reproduction loop: k=k+1
5) Chemotaxis loop: j=j+1 a) For i =1, 2….S, take a chemotactic step for bacterium i as follows. b) Compute cost function J(I,j,k,l) . The cost function of

the BFO is calculated in the following way: First sum the distance squares from each node to the CH for an one cluster. Then this value for all the clusters should be summed over.) c) Let J last)=J(I,j,k,l) to save this value since we may find a better value via a run.

4. Proposed Work

The nodes are clustered using the Bacterial Foraging Optimization Algorithm using the reproduction and elimination and dispersal processes of BFOA in which events can occur such that all the bacteria in a region are killed or a group is dispersed into a new part of the environment [10]. During the process of reproduction, individual will reproduce themselves in appropriate conditions in a certain way. For bacterial, a reproduction step takes place after all chemotactic steps.

$$J^{i}_{\text{health}} = \sum_{j=1}^{N_c+1} J(i,j,k,l)$$

Where J_i is the health of bacterium i. Sort bacteria and chemotactic parameters C(i) in order of ascending cost (higher cost means lower health). For keep a constant population size, bacteria with the highest *J*health values die. The remaining bacteria are allowed to split into two bacteria in the same place. In the evolutionary process, elimination and dispersal events can occur such that bacteria in a region are killed or a group is dispersed into a new part of the environment due to some influence [11]. They have the effect of possibly destroying chemotactic progress, but they also have the effect of assisting in chemotaxis, since dispersal may place bacteria near good food sources. From the evolutionary point of view, elimination and dispersal was used to guarantees diversity of individuals and to strengthen the ability of global optimization Elimination and dispersal events have the effect of possibly destroying chemotactic progress, but they also have the effect of assisting to place bacteria near good food sources.

The process of cluster head selection is performed bf BFOA on the basis of energy associated with each node within the cluster. In this way optimization of sensors position in each cluster is performed by BFO. BFO algorithm for cluster head selection is as such follows:

Step1 Initialization of parameters
p: Dimensions of search space in WSN
S: Number of bacteria in the population
Nc: Number of chemotactic steps assigned
Ns: Swimming length WSN
Nre: Number of reproduction steps takes place
Ned: number of elimination dispersal steps
Ped: Elimination Dispersal probability
C(i): Size of step taken in random direction
Step2 *Elimination-dispersal loop*: $l = l + 1$
Step3 *Reproduction loop*: $k = k + 1$
Step4 *Chemotaxis loop:* $j = j + 1$
a) For i =1, 2….S, take a chemotactic step for bacterium i as follows.
b) Compute cost function J(I,j,k,l) . The cost function of the BFO is calculated in the following way: First sum the distance squares from each node to the CH for a one cluster. Then this value for all the clusters should be summed over.)
c) Let J last)=J(I,j,k,l) to save this value since we may find a better value via a run.
Step5 If ($j < N$c), go to Step 4.
Step 6 Reproduction: Computer the health of the bacterium *i*:

$$J^{i}_{\text{health}} = \sum_{j=1}^{N_c+1} J(i,j,k,l)$$

Sort bacteria and chemotactic parameters $C(i)$ in order of ascending cost *Jhealth*. Bacteria with the highest *Jhealth* values die, the remaining bacteria reproduce.
Step 7 If ($k < N$re), go to Step 3.
Step 8 Elimination-dispersal: Eliminate and disperse bacteria with probability *P*ed.
Step 9 If ($l < N$ed), go to Step 2.
After performing the task of cluster head selection, we are available with a wireless sensor network consisting the no. of nodes arranged in the form of clusters, with each cluster having cluster head.

Randomly the source and destination of the object are generated and the source transfers the object to its destination. In the case of sensor system direct transmission from source to destination is required, energy consumption is the main issue in this as energy required to transmit is directly proportional to the square of distance between them, hence the nodes will die very quickly. So to reduce the transmission energy, transmission distance is to be reduced. For this purpose cluster based hierarchal protocol is developed. Then at the time of transmission the data is transmitted to the cluster head of each cluster and then the cluster heads will use the data of their clusters and sends to the base station .In this way the transmission distance of each node in the clusters is reduced and BS receives data only from CHs, so the number of reception at the BS also reduced. Hence the overall energy consumption is reduced. Object Tracking is a challenging application for wireless sensor network where nodes of network will perform the task of tracking. Factors involved in tracking are target motion characteristics, miss rate and energy efficiency. Tracking of the moving object will be performed using Cluster Based and Prediction Based Algorithms together. In the case of Cluster Based Algorithm, Dynamic clustering algorithms constructs the cluster and assign the cluster head to each cluster. The cluster head nearest to the moving object is selected as active CH and all other will continue to remain in sleep mode. Active CH calculates the targets location and send the information to the base station. A cluster based tracking algorithm works in three phases are target detection, source localization and target state estimation. It itself consists of two algorithms those are Reduced Area Reporting (RARE_AREA) and Reduction Of Active Node Redundancy (RARE_NODE) that works for reducing the number of nodes participating in tracking and reduces the redundant information[14]. Selection of optimal nodes to conduct the tracking task guarantees the load balancing and extend the network lifetime. In case of Prediction Based Algorithm, both sensors nodes and base station will calculate the next location of the target. It also consists of three algorithms such as Prediction Based Energy Saving (PES), Dual Prediction Based Reporting (DPR), Distributed Predicted Tracking (DPT) which focuses on reduction of energy consumption by keeping most of the non working nodes in sleeping mode. In case of DPR both sensors and the base station calculates the next location of the target. If there is no acceptable difference between the actual and predicted location then no updates are send to base station that reduces the number of transmitted packets. Hence reduces the energy consumption by reducing the transmission distances. DPT uses the different algorithms for nodes and CHs. The protocol uses a clustering based approach for scalability and a prediction based tracking mechanism to provide a distributed and energy efficient solution, these are used to achieve less miss rate. Hence prediction based clustering algorithm is adopted. In which if the predicted location is within the cluster then there is no need of sending the information to the base station that reduces the number of packets transmitted that consequently reduces the energy consumption and energy efficient prediction-based method in a clustered network which consists of nodes at same energy level and range of communication. When the object transmitted from source to destination, as soon as the object starts moving base station will check for the object distance from different clusters using RSSI (Reduced Signal Strength Indicator). It estimates the distance between two sensors by measuring the power of the signal transmitted from sender to receiver, as the signal strength is inversely proportional to squared distance and check for the minimum distance. As soon as the distance is calculated base station inform the cluster head by giving the wake up call to the cluster head and this leads to the CH become active while all other continues to remain in sleep mode. Then active CH chooses three of its nodes as sensor nodes on the basis of distance from the CH. Then those three sensor nodes will continues the process of tracking of the moving object by calculating the current location of object with the help of trilateration algorithm which forms relation between three nodes and by solving three formed relations the coordinate of target (x,y) is obtained, and accordingly will inform to the cluster head which then give information to the base station and if the predicted location is outside the current cluster, then the cluster head near to the predicted location will become active cluster head and procedure continues until object reaches to its destination. Base station maintains the location of the object at any point during the transmission of the object from source to destination.

5. Methodology

Input: Number of nodes
Output: Current location of the Moving Object

Steps 1: Initially the nodes are clustered and the cluster head selection is done using BFOA.
Steps 2: The moving object is detected by the sensor using RSSI and the CH which is close to moving object becomes the Active CH.
Steps 3: The Active CH uses the prediction mechanism and predict the next location of the moving object as (xi+1,yi+1).

Steps 4: If the predicted location is within the cluster members, then the active CH selects the three nodes to calculate the current location using trilateration algorithm.
Steps 5: Else if the predicted location is outside the current cluster, then the CH near to the predicted location becomes Active CH and Step 4 is followed

Bacterial Forging Optimization Algorithm which is simple and easy to implement in order to optimize the cost for processing Client Job. BFO has been successfully applied in many areas of power system. This algorithm is very effective in giving quality solutions. It is motivated by the natural selection which contains the trends to eliminate the animals with poor foraging strategies and the favor those having successful foraging strategies.

6. Result

This figure shows cluster formation in the wireless sensor network by Bacterial foraging Optimization algorithm:

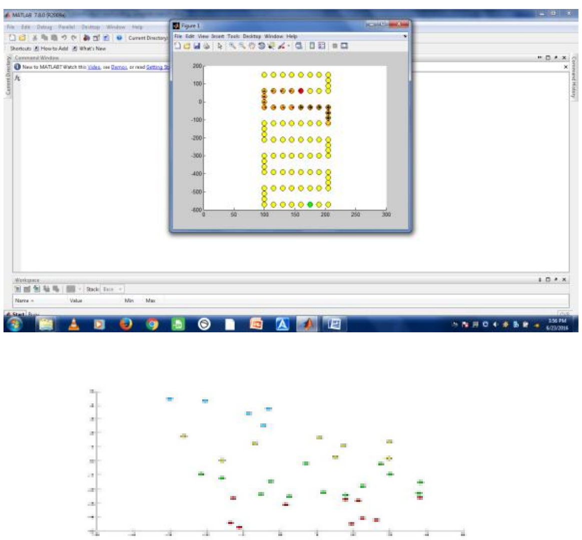

Figure 1: Cluster Formation by BFOA

This figure shows cluster head selection, random source and destination generation and data transmitted from source to destination via cluster heads.

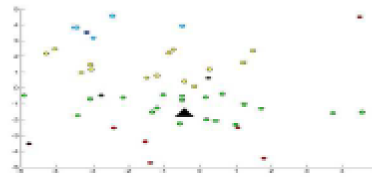

Figure 2: Data Transmitted From Source to Destination via Cluster Heads

7. Objective of the Work

1) Optimum route distance between nodes and sensors
2) Optimum or least power consumption between location points and sensors.
3) Maximum Bandwidth utilization.
4) Increase in Sensor Coverage.
5) Optimization of Mean location points of wireless sensors.

8. The Steps to Achieve the Objective

With minimum number of sensor nodes having maximum coverage in the network and the nodes are within the communication range. By making optimized wireless clusters using the Euclidean distance from all the location nodes to the Sensor Nodes. By making the Clusters of the sensor nodes with a corresponding central transceiver point which will be further chosen from a group of sensors. By Optimizing the Sensors position within each individual cluster, using BFO.

References

[1] Akyildiz, I.F.; Weilian Su; Sankara subramaniam, Y.; Cayirci, E., "A survey on sensor networks", Communications Magazine, IEEE, vol.40, no.8, pp. 102-114, Aug 2002.
[2] Chee-Yee Chong; Kumar, S.P., "Sensor networks: evolution, opportunities, and challenges", Proceedings of the IEEE, vol.91, no.8,pp. 1247-1256, Aug. 2003.
[3] Al-Karaki, J.N.; Kamal, A.E., "Routing techniques in wireless sensor networks: a survey", Wireless Communications, IEEE, vol.11, no.6, pp. 6-28, Dec. 2004.

[4] Heinzelman, W.; Chandrakasan, A.; and Balakrishnan, H.; "Energy Efficient Communication Protocol for Wireless Hawaii International Conference on System Sciences (HICSS '00), January 2000.

[5] Chih-Yu Lin, Wen-Chih Peng, and Yu-Chee Tseng, "Efficient In-Network Moving Object Tracking in Wireless Sensor Networks", IEEE Transaction on Mobile Computing, Vol 5, Issue: 8, Pg: 1044 – 1056, August 2006.

[6] Li-Hsing Yen and Chia-Cheng Yang, "Mobility Profiling Using Markov Chains for Tree-Based Object Tracking in Wireless Sensor Networks", IEEE Conference on Sensor Network 2006, Vol:6, Pg:220 – 225, June 2006.

[7] Babita Majhi and G. Panda and A. Choubey, "On the Development of a Newe Adaptive Channel Equalizer using Bacterial Foraging Optimization Technique," in Annual IEEE india conference, 2006, pp. 1-6.

[8] M. Younis K.Akkaya, "A survey on routing protocols for wireless sensor networks," Ad Hoc Networks, vol. 3, no. 3, pp. 325-349, 2005.

[9] KM Bakwad1, SS Pattnaik1, "Bacterial Foraging Optimization Technique Cascaded with Adaptive Filter to Enhance Peak Signal to Noise Ratio from Single Image" in the Department of ETV and ECE, National Institute of Technical Teachers' Training and Research, Chandigarh, 2011.

[10] K. M. Passino. Biomimicry of bacterial foraging for distributed optimization and control. IEEE Control Systems Magazine, 22: 52–67, 2002.

[11] KM Bakwad1, SS Pattnaik1, "Bacterial Foraging Optimization Technique Cascaded with Adaptive Filter to Enhance Peak Signal to Noise Ratio from Single Image" in the Department of ETV and ECE, National Institute of Technical Teachers' Training and Research, Chandigarh, 2011.

[12] Guojun Wang, Md. Zakirul Alam Bhuiyan and Li Zhang, "Two-level cooperative and energy efficient tracking algorithm in wireless sensor networks", Concurrency and Computation: Practice and Experience, September 2009.

[13] Khin Thanda Soe, "Increasing Lifetime of Target Tracking Wireless Sensor Networks", World Academy of Science, Engineering and Technology 42 2008.

[14] Wei-Peng Chen, Jennifer C. Hou and Lui Sha, "Dynamic Clustering for Acoustic Target Tracking in Wireless Sensor Networks", 11th IEEE International Conference on Network Protocols (ICNP'03), vol:3, Issue:3 ,Pg:258-271, Aug 2004.

[15] Yingqi Xu, Julian Winter and Wang-Chien Lee, "Dual Prediction-based Reporting for Object Tracking Sensor Networks", 2004 First Annual International Conference on Networking and services, Pg: 154-163, August2004.

[16] Yingqi Xu, Julian Winter and Wang-Chien Lee, "Dual Prediction-based Reporting for Object Tracking Sensor Networks", 2004 First Annual International Conference on Networking and services, Pg: 154-163,August2004.