OPTIMAL PATH PALNNING FOR NODE LOCALIZATION USING BAT AND GWO OPTIMIZATION TECHNIQUES: A COMPARITIVE STUDY

R.Kavi priya[1], Dr.M.Tamilarasi[2], Dr.l.Ashok kumar[3]

[1]Assistant Professor, , [2]Associate Professor, [3]Associate Professor

[1] Dept of CSE [2]Dept of IT [3]Dept of IT

[1]Jayam college of Engg &Tech [2]Vivekanandha college of Engg [3]M.Kumarasamy college of Engg.

Abstract - Wireless sensor networks play an emerging role in real time application. A collection of sensor nodes which deploy to monitor and sense the information about the surrounding environment is called WSN. There are many research focuses in Wireless sensor networks are that optimal path planning between the sensor nodes, energy preservation, node localization, security etc. In our paper the primary focus is that avoid obstacles and provide optimum path planning as well as energy preservation in WSN between the nodes for node localization. To find location of node plays an important role in WSN. First unknown nodes are distributed in the network region in which cluster head node selects .The MH is to moves in and around the area of network and find its own location and broad cast the message to the unknown node using swarm intelligence algorithm in a way the localization error is minimized and maximum the number of node is localized. We propose a swarm intelligence method called BAT algorithm and Grey Wolf Optimization (GWO). The CH node finds its own location using GPS and CH node broadcasts its location to the Unknown node in a way CH nodes finds obstacles and provide optimum path planning using BAT algorithm an. In this paper a comparative study of BAT algorithm-and GWO based path planning provide outcomes in comparison to other existing algorithm like in several metric such as increase the ratio of localization and minimize the error rate of localization

Keywords: WSN's ,BAT, GWO, Cluster Head

I. INTRODUCTION

A sensor is a device used to identify events or any changes in the surrounding environment and broad cast the information to other electronic device. Node Localization in wireless sensor network has been idea of concern in recent years in many applications. A group of sensor nodes can form a wireless sensor network. Node Localization problem of these sensors is an interested area in WSNs due to its critical information. In localization Problem, need to find the location of sensor node as well as to reach the destination requires optimal path and avoid obstacles in its path.

In the previous research there are many methods to find the node localization by using optimal path such as sub-goal network, potential field method, Voronoi diagram. These classical methods have some drawbacks it takes long time to find the optimal path and aware about the environment to reach the destination. Now a days so many metaheuristic algorithms are there to overcome the draw backs of the earlier algorithm to estimate the optimal path such as Genetic Algorithm(GA), Particle swarm optimization(PSO), Grey wolf Optimization(GWO), Whale Optimization Algorithm(WOA), Ant colony Optimization,Cuckoo-searh algorithm.

In our research paper proposes a BAT algorithm and analysis with the Grey wolf optimization.. The main interesting research of this paper is that Head of the mobile Node moves around the networks and be responsible for delivers its own location to the nearby nodes. On receiving the MH signals, some Unknown Nodes will be able to evaluate their locations. When providing the location to the unknown nodes, MH plans the optimal path in indeterminate environment and avoided the surrounding obstacles. Some challenges faces in this paper such as path minimization, avoid obstacles, energy efficiency

This paper presents BAT algorithm as wll comparative study with grey wolf optimization .Bat Algorithm was developed by Xin-She Yang in 2010[1]. The Bat algorithm is based on the behaviour of bats while searching the food. Bats are charming animals and are capable of calculating distance by echolocation .Mean while they find obstacles and the difference between the food and the background obstacles. Micro bats use a sonar, called, echolocation, to detect prey, avoid obstacles. Based on the behaviour of the Bat, MH predicts the distance for upgrading their own location to the unknown nodes. Grey Wolf Optimization is inspired by the social behaviour of grey wolves and it works on leadership hierarchy hunting Strategy

Further chapter is structured as follows: Section II offers a survey about the related research. In section III provides a BAT algorithm. Section IV is about brief description of proposed model. Section V offers comparison and analysis of grey wolf and whale optimization with BAT algorithm.

II LITERATURE SURVEY

Localization in wireless sensor network has been interested in different kind of situations. Accuracy, cost, and scalability are three main factors to be considered when designing localization method with high energy efficiency.[2] develops a Range-Free localization technique with mobile anchors equipped with GPS. Their method offers coarse positioning accuracy with low computational expense. Conversely the energy consumption of their scheme as themobile anchors moves randomly.

Kim et al. developed a new range-based localization scheme of mobile beacon-assisted localization (MBAL) [3].Their technique has simple computational algorithm for movement path selection. Their scheme also uses a new range-checking technique for position-ambiguity problem. Although this scheme offers more promising results over random movement method, it fails to have the lowest energy consumption then compare to other schemes. Li et al. used graph theory for the path planning of mobile anchors [4]. They considered the wireless network sensor as a connected undirected graph; then they redefined the path-planning problem into traversing graph and Spanning Tree with Breadth-First (BRF) and Backtracking Greedy (BTG) algorithms for the latter.

Karim et al. developed a Range-free localizing scheme by using Mobile Anchor (RELMA) for large scale WSNs, offering higher accuracy and energy efficiency. However the movement of the mobile anchors is random, leading to more energy consumption.

Chen et al. proposed a localization technique based on ring overlapping with reference and blind nodes . The anchor sensor node can move snake-like for localization static sensor nodes. They implement Received Signal Strength Indicator(RSSI) values to localize the rings including reference and blind nodes. By overlapping the rings with each other and by utilizing the location of reference nodes ,they implemented an algorithm to localize the blind nodes.

III BAT ALGORITHM

The Bat algorithm is a novel meta-heuristic population-based algorithm developed by Yang7and inspired by the echolocation behavior of the fascinating animals, bats. The micro bats utilize an echolocation to find their prey, locate their roosting crevices in the dark, and avoid obstacles; this micro bat has the capacity to locate the positions of prey by sending high and short audio signals, by collision, and via the echo of the signal sender. Substantially, the main steps of Bat algorithm are:

All bats use echolocation to sense distance, and they also `know' the difference between food/prey and background barriers. After hitting and reflecting, the bats transform their own pulse into useful information to explore how far away.

The pulse rate can be simply determined in the range from 0 to 1.where 0 means there is no emission and ‘1’ means that the bat is emitting their maximum. Bat send signal with frequency 1

Bats fly randomly with initial values: velocity v_i^t, position x_i^t,loudness A_I^I,frequency f i , f i ∈[fmin, f max] depending on the domain size of the problem of interest emission pulse rate r_i^t i∈[1, .. , N], and D-dimensional space

X(I,j) = LB(j)+ rand (0,1) * UB(j) – LB(j) **(1)**

where rand ∈ [0, 1] is a random vector drawn from a uniform distribution, and the values of Upper Bound (UB) and Lower Bound (LB) depend on the domain size of the problem treated. Movement of virtual bats: new positions and new velocities at time step t are updated by:

$$f_i = f_{min} + (f_{min} - f_{max})\ \text{rand}, \quad (2)$$

$$v_i^t = v_i^{t-1} + (x_i^t - x_*)\, f_i \quad (3)$$

$$x_i^t = x_i^{t-1} + v_i^t \quad (4)$$

where rand ∈ [0, 1] is a random vector drawn from a uniform distribution, and *x* is an existing global best location (solution). For the local search part, only 1 solution is chosen among the actual best solutions, and for each bat, a new solution is generated locally using random walk according to the following equation:

$$x_{new} = x_{old} + \epsilon A^t \quad (5)$$

where $\epsilon \in [-1, 1]$ is a random vector drawn from a while $A^t = < A_I^I >$ is the average loudness of all the bats at this time step.

If the best value obtained by the total N bats is higher than the precedent f(x*), the global best solution x* can be updated at this time. Only if the new solutions are updated can the loudness and emission rates decrease and increase, respectively. This means that these bats are headed for their prey. This relationship can be explained as follows:

if (rand (0, 1) < A_I^I ***& f(xi) < f(x),*** **(6)**

f(x) = f((xi), **(7)**

IV NODE LOCALIZATION USING BEHAVIOUR OF BATS

The anchor mobile characteristics and the method of finding the location of sensor nodes are presented. The purpose of this research is to present a robust method for estimating the location of sensors using a mobile anchor with low energy consumption in obstacle environment. Localization parameters of our methods are the behaviour of Bats. While mobile anchor broadcasting the beacons sequentially, the sensor nodes can receive the beacon messages when the anchor is in transition neighbor. Each sensor node is able to calculate its location using two beacon messages. We assume that the coordinates of two different locations of mobile anchor is (x1, y1) and (x2, y2). Each sensor node calculates its coordinate according to (1) and (2).

$$(x-x_1)^2 + (y-y_1)^2 = r^2 \quad (8)$$

$$(x-x_2)^2 + (y-y_2) = r^2 \quad (9)$$

Fig. 1 shows the location estimation of a sensor node. As we see it reflects two estimated locations for each sensor node. For finding the best solution the anchor uses the degree of antenna.

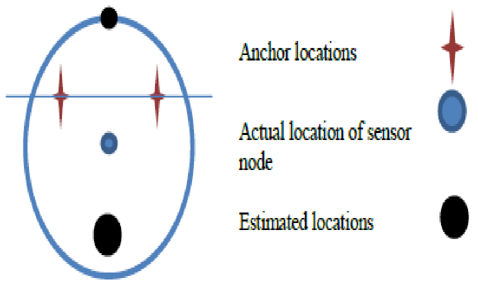


Fig 1. Location Estimation Of sensor nodes.

V ANALYSIS OF BAT ALGORITHM WITH GREY WOLF OPTIMAZATION

Meta heuristic optimization algorithms are becoming more familiar in engineering applications because they (i) rely on rather easy concepts and being straightforward to implement, (ii) do not require gradient information, (iii) can bypass local optima, (iv) are often used in a wide range of issues covering different disciplines. Vast numbers of algorithms are introduced for different combinatorial optimization problems.

5.1 Grey Wolf Optimization

The Grey Wolf Optimization (GWO) is one of the new algorithms proposed in 2016. This algorithm is inspired by the social behaviour of grey wolves and it works on leadership hierarchy hunting Strategy. Grey wolves are considered as the top-level predators, they live in a group size of 5–12 wolves. Based on the hunting strategy the grey wolves are classified into four categories suchs alpha, beta, Delta and omega .The alpha wolves are leader of the bundle. This wolf has the authority to make decision for sleeping place, hunting and so on. These wolves are otherwise called dominant wolves and they strictly instruct other wolves to follow his/her orders[5].

Grey wolf optimization is a swarm intelligent technique which mimics the leadership hierarchy of wolves. They are well known for their group hunting. Grey wolf belongs to Canidae family and mostly prefer to live in a pack. They have a strict social dominant hierarchy. The leader is a male or female called Alpha (a) [6]. The alpha is mostly responsible for decision making. The orders of the dominant wolf should be followed by the pack. The Betas (ß) are subordinate wolves which help the alpha in decision making.

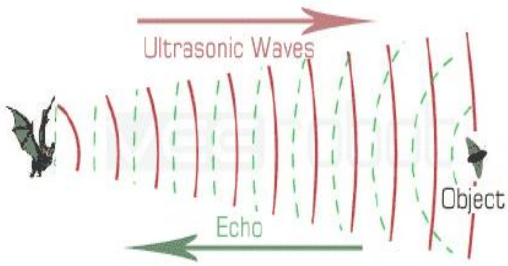
The beta is an advisor to alpha and discipliner for the pack. The lower ranking grey wolf is Omega (.) which has to submit all other dominant wolves. If a wolf is neither an alpha or beta nor omega then it is called delta. Delta(.) wolves dominate omega and reports to alpha and beta. The hunting techniques and the social hierarchy of wolves are mathematically modelled in order to develop GWO and perform optimization [8]. The GWO algorithm is tested with the standard test functions which indicates that it has superior exploration and exploitation characteristics than other swarm intelligence techniques. The GWO has been successfully applied for solving various engineering optimization problems.

5.1.1 **Pseudo code for GWO Algorithm**

1: Generate initial search agents Gi(i=1,2,....,n)
2: Initialize the vector's a ,A and C
3: Estimate the fitness value of each hunt agent
Gα =the best hunt agent
Gß=the second best hunt agent
Gδ =the third best hunt agent
4: Iter:=1
5: repeat
6: for i=1:Gs(grey wolf pack size)
Renew the location of the current hunt agent
End for
7: Estimate the fitness value of all hunt agents
8: Update the vectors a, A and C
9: Update the value of Gα, Gß, Gδ
10: Iter=Iter+1
11: until Iter>=maximum number of iterations

{Stopping criteria}
12: output Gα
End

5.2 BAT ALGORITHM



.Fig 2. Bat emitting the ultrasonic waves and gets it is an echo

5.2.1 Bat algorithm
begin
generate at random a population of k bats(k solutions)
for each bat i do define its loudness Ai ,its pulse
frequencyf_i and velocity v_i
set its pulse rate to ri ;
select the best solution x;*
while ((Max-Iter not reached) do
for each i=1to k do compute a new solution(f_i, v_i,x_i)
using these formulas
if(rand > r_i) then
select a solution x' among the best solutions;
improve the solution using this formula ;
end if;
generate at a random a new solution (f_i, v_i,x_i);
if(rand<A_i) and ($f(x_i)<f(x^*)$) then
accept the new solution ;
increase r_i and reduce A_i using these formulas end if
end for

The bat algorithm is a meta-heuristic algorithm for global optimization. It was inspired by the echolocation behaviour of micro bats, with varying pulse rates of emission and loudness. Echolocation consists in producing a sonar composed of 2 steps:
1. Emitting sound pulses,
2. Then detecting surrounding objects from the Reflected echo..

VI RESULTS AND DISCUSSION

The comparative study of BAT algorithm and GWO algorithm for node localization problem is successfully analysed and the Bat algorithm and grey wolf optimization algorithm estimates the unknown node location and provides minimum localization error compared to other metaheuristic algorithms PSO and MBA. GWO algorithm is better due to its hierarchical leadership strategy. This strategy improves the solution (unknown node position) with the aid of three known solutions. It outperforms the triangulation methods for large scale environment

Algorithm	Setting Parameters
ABC	Food Source = 20, the limit value = 10
FFA	α = 0.5, γ = 1, β = 1
CSA	p = 0.25, γ = 1.5, α = 0.01
BA	α = 0.9, Population Loudness (A) = 0.25, Pulse rate F ∈ [0, 2]
FPA	p = 0.8, γ = 0.1, λ = 1.5
GWO	α ∈ [0, 2], C ∈ [0, 3]

VII CONCLUSION

In wireless sensor network to find location of node plays an important role. In this study two optimization techniques i.e BAT algorithm and Grey wolf optimization algorithm have been inquired for optimal path planning to find node location. n. The main goal to use the meta-heuristic BA and GWO is to obtain the optimized path with minimum possible iteration and simulation time. In future work in order to improve the performance of localization algorithm, combines the properties of the two metaheuristic algorithms to handle the present obstacles and to find the optimal path from source point to destination point in a static and unknown environment. a hybrid bat - GWO positioning algorithm will be proposed

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