Fuzzy Based Particle Swarm Optimization Routing Technique for Load Balancing in Wireless Sensor Networks

S. Balaji, E. Golden Julie, M. Rajaram, Y. Harold Robinson

Abstract—Network lifetime improvement and uncertainty in multiple systems are the issues of wireless sensor network routing. This paper presents fuzzy based particle swarm optimization routing technique to improve the network scalability. Significantly, in the cluster formation procedure, fuzzy based system is used to solve the uncertainty and network balancing. Cluster heads play an important role to reduce the energy consumption using particle swarm optimization algorithm, the cluster head sends its information along data packets to the heads with link. The simulation results show that the presented routing protocol can perform load balancing effectively and reduce the energy consumption of cluster heads.

Keywords—Wireless sensor networks, fuzzy logic, PSO, LEACH.

I. INTRODUCTION

WIRELESS sensor network (WSN) is used to monitor wide coverage area [1]. Features manipulating sensor network intend are blunder forbearance, reachability, working atmosphere, sensor network hierarchy, broadcast medium and energy utilization [16]. Hence, the important challenge for WSN is load balancing in the network. Several routing protocols have been proposed to increase the WSN lifetime [5]. Clustering routing protocols are developed by using a large amount of neighboring nodes which consist of cluster nodes and cluster heads (CHs). Clustering routing protocols can have the improved scalability, reduced load, reduced power consumption [8]. CHs of high level network are the combination of all the cluster members of a top level network with the communication to the Base Station of the WSN [31]. Low Energy Adaptive Clustering Hierarchy (LEACH) protocol has been proposed for clustering routing technique. The common path of LEACH is to improve the lifetime of a WSN by reducing the power consumption of the sensor nodes [6]. To solve the problem, the various levels of improved algorithms are implemented to increase the CH distribution [9].

Multiple routing protocols are used to minimize the energy consumption for data communication [12]. In this initial phase, the node can generate a pseudo-random number from 0 to 1 [2]. LEACH-C is the centralized algorithm that means all CHs are formed by the base station [4]. An established Quality of Service scheme has been premeditated, where the neighbor assortment algorithm and the path assortment algorithm are used to choose a path by vehicles which are likely to move at comparable speeds and in the direction of comparable directions [13]. An innovative routing protocol is used to generate the channels with non-evaporation period for routing, and then it attempts to diminish packet failure. Due to evaporation reuse, the path with some protection strategies is used to enlarge the throughput in WSN [14].

Snooze and energetic of nodes will occasionally assist to preserve their power for more time. The occurrences happening in any ingredient of the network must be recognized by the nodes [15]. In I-LEACH, at the outset, the possibility based assortment criterion for a CH was substituted recognized by the nodes [15]. In I-LEACH, at the outset, the possibility based assortment criterion for a CH was substituted recognized by the nodes [15]. In I-LEACH, at the outset, the possibility based assortment criterion for a CH was substituted recognized by the nodes [15]. In I-LEACH, at the outset, the possibility based assortment criterion for a CH was substituted recognized by the nodes [15]. In I-LEACH, at the outset, the possibility based assortment criterion for a CH was substituted recognized by the nodes [15].
Depth Based Routing protocol (DBR) [23] is used to choose the power, environmental or spatial data. In this technique, the sagacity data from the surroundings are routed to the regular descends [51].

A tree-based data fusion clustering routing algorithm (TBDFC) is proposed to minimize the consumed energy in WSNs [24]. Routing path is additionally recommended and calculated using meta-heuristic iteration based Bat algorithm [25]. The fundamental functioning attitude is based on hydraulic weight available along dissimilar strengths in the sea. Opportunistic routing has been performed to execute the adjacent paths for unappeasable procedure. For up-stream, broadcasting is another level of distributed systems; it is a controlled up-stream related to the planned time of every process of broadcasting that avoids divergence from creature source to the up-stream information, and improve the limited bandwidth utilization [26]. The new algorithm is used to improve Data Base Administrator with the relation of the Interleaved Polling with Adaptive Cycle Time (IPACT) methodology that involves a queue-based preparation scheme [28].

Tree Based Opportunistic Routing (TBOR) discovers a multipath routing scheme to achieve the threshold possibility of high throughput [27]. Geographical routing protocols afford extended detachment data forwarding and superior improvement across the destination [39]; direct to enlarge indicator reduction and packet failure problems in the system [29]. Assortment joining methods are used at the destination node to connect the data from assorted range of divisions [30]. Shifted assortment is the simplest diversity merging method amongst the channel position data of the route under reflection. In [32], the outage presentation is identified for the shifted assortment method in supportive DF communicating network over other related fading network channels. In [34], the supportive system uses switch-and-stay transmit assortment scheme for obtaining the outage possibility in a related fading network channel. In [35], the presentation of a solitary middle node supportive network is calculated using a harmonizing fault method [36].

A most favorable assortment joining method is scrutinized for the supportive system using complete network and an end to end symbol error possibility is calculated by shifting technique [37]. The consequence of association limitation ($A_q$) is glowing scrutinized for nakagami-m fading channel [38]. In [40], a bit fault possibility and outage possibility are calculated.

In [41], the Quality of Service is improved by using the cooperative system relays. The end to end delay is obtained with controlled and observe technique [43]. Virtual back bone path computation is based on the restrictions like message success rate, communication rate, and greatest connectivity [42], [66].

WSNs are susceptible to numerous hazards. Antagonists are accomplished of conciliating sensor nodes that snoop on information, insert fake information plus dissipate system supplies [33]. Consequently, cryptography methods have been proposed for handling security related problems efficiently in WSNs [44]. There are numerous constraints in the implementation of cryptography methods in WSNs like storage, broadcasting, performance analysis and also dispensation capacities [48].

Design of cryptography based protocols requires understanding of the constraints and accomplishing sufficient encoding and decoding techniques [51]. Cryptography crashes are determined and evaluated by using the scalable parameters of improvements in WSNs, and such crashes possibly used by opponents [16]. But the substantial dismissal in WSNs escorts to exceptional probable in scheming them for progressing their stipulation of detailed provision regardless of crashes [60]. The organization should be able to acclimatize in narrative way that unanticipated damage when the organization is originally arranged [54].

Confidence establishment amongst nodes is a mandatory for appraising trustworthiness of other nodes since endurance of WSNs is dependent on combined in addition to unquestioning scener of the nodes [64]. Cryptography in addition to confidence is two tremendously mutually dependent impressions and owing to the mutually dependence, the expressions are used as signatures, when developing protected networks [47]. But, cryptography is not the identical as confidence, the most important distinction being that it is additional complex and has superior overheads [46].

Confidence in WSNs has a momentous ingredient to engage in recreation in construction of systems and appending or reducing sensor nodes from systems, on account of the enlargement of the system, or substituting unreliable nodes in a horizontal in addition to translucent method [45]. The performance of the energetic non-linear schemes for WSNs are involving network arithmetical representations which may be griped in a specialized method by fuzzy logic. Real-time implementations like decision making systems, patterns recognition, control systems and network modeling may implement fuzzy if-then rules [49], [63].

A data-mathematical representation [50] is used for quantitative quantity of expectation in addition to build a new expectation structure with numerous conviction conclusion features. Fuzzy logic regulations calculation process is approved for modernizing node’s conviction. [61]. The narrative confidence method proposes elastic in addition to practicable process in routing verdict making, believing both conviction constraints as well as nasty node recognition in multi-agent networks [65]. Performance evaluation was developed for generating effectiveness of trust model as well as multi-case trust improvement in recovering network communication dominance, trust energetic flexibility, malicious nodes recognition, attack confrontation as well as enhancements to network security [62].

In contradiction of previous methods, general experimentations have been developed for calculating effectiveness of the proposed battering resistance of system security [54].

Dissimilar behaviors are created to dissimilar behavioral data to distinguish malicious nodes and recognize their behavior data [52]. The cryptography of WSNs is then
improved by numerous parameters for switching several categories of un-trusted movement. Simulation results showed that the proposed conviction management structure can disconnect ordinary nodes and un-trusted nodes and discriminate dissimilar types of un-trusted nodes [53].

method is a mathematical representation which identifies the estimation of one node by adjacent nodes in the network. In confidence based method, owing to the prejudice of conviction assessments, it has several uncertainties [59].

On the origin of fuzzy active programming hypothesis, in trusted routing structure, [56] developed a trusted routing protocol that thrusts out untrustworthy nodes for attaining trustworthy route rescue path. A reactive routing algorithm is proposed for generating a lot of confidence links in a route discovery that finds dependable or confidence requisites of network data packets. Experimental results confirmed that the confidence-based routing algorithm is able to achieve the improvements in Packet Delivery Ratio [55], [58]. Confidence method is a mathematical representation which identifies the estimation of one node by adjacent nodes in the network. In confidence based method, owing to the prejudice of conviction assessments, it has several uncertainties [59].

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nodes can perform their cluster by finding the CH that needs the low energy communication.

\[
\delta(n) = \frac{P_{CH}}{1 - P_{CH} \times \left( n \mod \frac{1}{P_{CH}} \right)}
\]  

where \( P_{CH} \) is the probability for CH, \( g \) is the number of groups and \( n \) is the group of sensor nodes.

The Fuzzifier can have every crisp input in the Fuzzy set. The crisp input vector \( c' = (c_1', \ldots, c_p') \).

\[
\sigma_{c_1}(c_i) = 1, \text{ if } c_i = c_1' \quad (2)
\]
\[
\sigma_{c_1}(c_i) = 0, \text{ if } c_i \neq c_1' \quad (3)
\]

The three inputs have the interval \([0,1]\). Figs. 2-4 demonstrate the membership functions of Energy, Density and Distance.

Let us assume that the input variable Energy as \( i_1 \), the input variable Density as \( i_2 \) and the input variable Distance as \( i_3 \). The Output variables are probability as \( j_1 \) and Radius as \( j_2 \).

**A. Rule**

If \( i_1 \) is \( F_1 \)

\( i_2 \) is \( F_2 \)

\( i_3 \) is \( F_3 \)

\[ \ldots \ldots \]

\( i_n \) is \( F_n \)

Then

\[ j_1 \text{ is } G_1 \]

\[ j_2 \text{ is } G_2 \]

\[ \sigma_{F_1}(c_i) \text{ and higher membership functions } \sigma_{F_1'}(c_i) \]

\[ f(i) = \sigma_{F_1}(c_1) \times \ldots \ldots \times \sigma_{F_p}(c_p) \]

\[ f'(i) = \sigma_{F_1'}(c_1) \times \ldots \ldots \times \sigma_{F_p'}(c_p) \]

Defuzzification using the average of

\[ q_j(x) = \frac{q_{j_R}(x) + q_{j_P}(x)}{2} \]

The Extend Output can be calculated as

\[ q_{\text{ext}}(x) = [q_j(x), q_{jk}(x)] \]

**B. Algorithm**

Step 1: Compute Probability and Radius

If Base station receives sensor nodes information, then calculate probability and radius using FLS

Sensor node \((x)\) is in alive

\((fx.\text{probability, } fx.\text{radius}) = \text{ FLS}(fx.\text{energy, } fx.\text{density, } fx.\text{distance})\)

End If

Step 2: Calculate optimized Cluster Node

\[ \text{Cocn} = \left[ \frac{(xpn-xpd)/n + 0.5} \right] \]
Step 3: Calculate Path

\[
\text{Path} = \text{Sort ([f.probability],’descending’)}
\]  

(9)

Step 4: Generate CH

Path (i) = initialClusterHead

if distance of (Path (i), fj) is less than

\[ f_{\text{Path}(i)} \times \text{radius} \]

fj is notClusterHead

increase the value of i

otherwise fj is the clusterHead

If CH (QS =Small and CS=Near and RE=High)

Then

Selected CH is extra to optimal cost path to

Accomplish sink

If CH (QS =Large and CS=Far and RE=Low)

Then

Selected CH is added to below optimal cost path

So it not selected to reach sink

Step 5: Routing

For every connection do

set beginning value \( \beta_{i,j}(x) = 1 \)

end for

for every Cluster_Head do

calculate the \( O_i \)

end for

while not end do

for every particle do

randomly find a Cluster_Head

for I = 1 to n do

calculate possibility \( P_{Oi} \)

choose alternate Cluster_Head

with possibility \( P_{Oi} \)

end for

end for

compute the routing path discovery length \( D_k \) of the \( k \)th particle

for every connection do

Change beginning value \( \beta_{i,j}(x) \)

end for

end while

Choose the shortest path into short_pathij

Find the alternate Cluster_Head nearest into the Base_Station as

the new leader

for every Cluster_Head do

transmit packet using leader control function

end for

Step 6: Energy Consumption

The Energy consumed while transmitting the node of x-bits packet

with the distance can be calculated as

\[
\text{Energy Transmitted (x,distance)} = \text{Energy Transmitted send (x)} + \text{Energy Transmitted received (x,distance)}
\]

Step 7: Receiving Signal

\( \text{SE}_{\text{cn}} = \text{Number of Sensor nodes} \)

\( \text{SE}_{\text{ac}} = \text{CH} \)

CF: Cluster shaped

Base Station generates the network with FBPSO algorithm

to compute the list of CHs, then finds and transmits control

values to every sensor node and every initial node

demonstrates the joining cluster based on the factor of distance

and transmits control and data packets to their respective CHs.

The sensor nodes are haphazardly allocated in the network.

The sensor nodes and the base stations are the motionless of

hypothesis phase. Sensor nodes are harmonized with energy

restricted have the identical establishment energy,

communication path is identical. Nodes have their own data

such as location of the network node and energy consumption

so they send to the Base station with particular energy levels

during the network group stage.

To obtain the resource node’s location using a network

routing by representing the location optimization \( a_i \) which

consumes reduced communication cost. The packet for data

Communication follows some multihop sequential order.

\[
a_i \rightarrow b_1 \rightarrow b_2 \rightarrow \ldots \rightarrow b_n \rightarrow d
\]  

(10)

The communication cost between \( a_i \) and \( d \) can be obtained

by creating the network route \( c_i \) as cost \( (a_i, c_i) \). The

communication cost optimization solution can be obtained by

\[
X_0 = \min \sum_{i=1}^{N} [p(a_i) \min \text{cost}(a_i, c_i)]
\]  

(11)

Modified cost reduction function given by

\[
X = \sum_{i=1}^{N} p(a_i) \sum_{i=1}^{M} p(c_i | a_i) \text{cost}(a_i, c_i)
\]  

(12)

The probability distribution function that improves the

communication cost by

\[
G = \sum_{i=1}^{N} p(a_i) \sum_{i=1}^{M} p(c_i | a_i) \log(\text{cost}(c_i | a_i))
\]  

(13)

Such that
\[ X = \sum_{i=1}^{N} p(a_i) \sum_{j=1}^{M} p(c_i | a_j) \text{cost}(a_j, c_i) = X_0 \]  

The remaining energy can be obtained using the cost based function

\[ \text{cost}(c_i | a_j) = \frac{e^{-\beta \cdot \text{cost}(a_j, c_i)}}{\sum \frac{e^{-\beta \cdot \text{cost}(a_k, c_j)}}{\sum} \left(14\right) \]

Fuzzy Based radius procedure is used to fix the rules for creating the CH selection and distribution. It takes several round, output of the preceding round will be the input for the successor round.

FBPSO can embrace uncertainties outcome from inaccurate inputs and compound rules that are used to select the CHs in the Routing protocol of clusters. Moreover, in this paper, we need to utilize a FLS to compact with uncertainties in WSNs.

Table I demonstrates the Possibility of Chance of the three parameters Distance, Density and Energy based on Competition Radius Process using Fuzzy Inference Rule.

C. Tailback Node Selection

\[
\text{tailback\_Node\_Selection}(Tb) \\
\text{Max\_Energy} = -\infty; \\
\text{tailback\_node} = \text{NULL}; \\
\text{for} \ x = 1 \ to \ n \\
\quad \text{if} \ \text{branch\_node}(i) = \text{NULL} \ \text{then prolong; else} \\
\quad \quad \text{calculate max\_dist(max\_dist(x), max\_node(x));} \\
\quad \quad \text{compute energy\_consumed(energy(x));} \\
\quad \quad \text{if energy(x)} > \text{Max\_Energy} \\
\quad \quad \quad \text{Max\_Energy} = \text{energy(x);} \\
\quad \quad \text{tailback\_node} = x; \\
\quad \quad \text{end if} \\
\quad \text{end if} \\
\text{end for} \\
\text{return tailback\_node;} 
\]

III. PERFORMANCE EVALUATION

The solution for energy consumption and trust evaluation was found using 200 nodes in a certain area. The nodes were clustered using FBPSO algorithm. The simulation was done in NS2 tool. Table II illustrates the simulation parameters for the network model.

Fig. 6 shows total number of route discovery, Fig. 7 shows packet delivery ratio versus number of paths, Fig. 8 shows delays obtained in the network, Fig. 9 shows routing overload versus number of paths, Fig. 10 shows load balancing and Fig. 11 shows energy consumption ratio. The simulation result shows that the presented algorithm worked well.

![Fig. 6 Total Number of Route Discovery](image)

![Fig. 7 Packet Delivery Ratio versus Number of Paths](image)
Fig. 8 Delays obtained in the Network

Fig. 9 Routing Overload versus Number of Paths

Fig. 10 Load Balancing

Fig. 11 Energy Consumption Ratio
IV. CONCLUSION

To increase the load balance and of the network in WSNs, this paper recommends an improved routing protocol Fuzzy Based Particle Swarm Optimization. FBPSO improves three important factors of distance, energy and density. Distance to the Base station as the input to compute the possibility of a node for CH and Radius. The fuzzy logic is used to decrease the uncertainties of existing in WSNs. The fuzzy introduction and Multi-hop routing method for transmission of data can handle the load balancing and reduce the consumption of the energy frequently. Better performance of our recommended algorithm has been exhibited by the simulation results. FBPSO algorithm can efficiently load balancing in the network and network lifetime.

<table>
<thead>
<tr>
<th>S.NO</th>
<th>DISTANCE</th>
<th>DENSITY</th>
<th>ENERGY</th>
<th>PROBABILITY</th>
<th>CHANCE</th>
<th>COMPETATION</th>
<th>RADIUS</th>
</tr>
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<tbody>
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<td>1</td>
<td>Low</td>
<td>Spare</td>
<td>Far</td>
<td>Very Weak</td>
<td>Medium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Low</td>
<td>Spare</td>
<td>Medium</td>
<td>Weak</td>
<td>Little Small</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Low</td>
<td>Spare</td>
<td>Near</td>
<td>Little Weak</td>
<td>Little Small</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Low</td>
<td>Medium</td>
<td>Far</td>
<td>Weak</td>
<td>Little Small</td>
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<td></td>
</tr>
<tr>
<td>5</td>
<td>Low</td>
<td>Medium</td>
<td>Medium</td>
<td>Little Weak</td>
<td>Little Small</td>
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<tr>
<td>6</td>
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<td>Near</td>
<td>Lower Medium</td>
<td>Small</td>
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<td></td>
</tr>
<tr>
<td>7</td>
<td>Low</td>
<td>Dense</td>
<td>Far</td>
<td>Little Weak</td>
<td>Small</td>
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<td></td>
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<tr>
<td>8</td>
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<td>Lower Medium</td>
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<tr>
<td>9</td>
<td>Low</td>
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<td>Small</td>
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</tr>
<tr>
<td>10</td>
<td>Medium</td>
<td>Spare</td>
<td>Far</td>
<td>Little Weak</td>
<td>Large</td>
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<tr>
<td>11</td>
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<tr>
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<td>Little Strong</td>
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<td>Higher Medium</td>
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<tr>
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<tr>
<td>22</td>
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<tr>
<td>23</td>
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<td>Little Large</td>
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<td>Strong</td>
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<tr>
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<td>Very Strong</td>
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TABLE II

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Number of nodes</td>
<td>200</td>
</tr>
<tr>
<td>Size of the Network</td>
<td>225 m x 225 m</td>
</tr>
<tr>
<td>Energy in the beginning</td>
<td>0.50 J</td>
</tr>
<tr>
<td>Length of the Data packet</td>
<td>4000 bits</td>
</tr>
<tr>
<td>Length of the Control packet</td>
<td>100 bits</td>
</tr>
<tr>
<td>Sender Transmitter expand</td>
<td>1.1dB</td>
</tr>
<tr>
<td>Receiver transmitter expand</td>
<td>1.1dB</td>
</tr>
</tbody>
</table>

REFERENCES


Mission 10x portal. He is a lifetime member of ISTE.

Cloud Computing. He has organized and conducted various national and conferences in network security, Mobile Computing, network security, and.

And also his methodology of teaching about TCP & UDP is hosted on Wipro.

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http://doi.acm.org/10.1145/1860093.1860118. URL

IEEE.on green computing and communications (GreenCom) (pp. 124–130). IEEE.


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