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# Evaluation of Energy Efficient Routing Protocols with Optimization Technique in Wireless Sensor Networks

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**Abstract**

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The significant inconveniences in Wireless Sensor Networks are to amplify the system timeframe of sensors. The best vitality proficient convention is Two Tier Distributed Fuzzy Logic Protocol (TTDFP) to lessen the vitality utilization and it can expand the lifetime of Wireless Sensor Network. Bunching and Routing methods can be utilized to speak with Cluster-Head and base station. In the event that the base station is much a long way from the Cluster-Head, vitality utilization will be expanded and it can decrease the lifetime of Wireless Sensor Network. To defeat these, Particle Swarm Optimization (PSO) system is actualized with this convention so as to accomplish the most extreme lifetime of Wireless Sensor Network. PSO is utilized to broaden the vitality proficiency and Fuzzy Routing calculation with DSDV Protocol is utilized to discover the directing way. It is anything but difficult to execute and the change figuring speed is snappy. The proposed convention is tested broadly and the outcomes are contrasted with the past work conventions with exhibit their predominance regarding vitality proficiency, throughput and Packet Delivery Ratio.

***Keywords:*** *TTDFP, PSO, Wireless Sensor Networks, Cluster Head, Clustering, Routing.*

## 1. Introduction

Mechanical advancements have made the age and use of remote sensor hubs conceivable. Systems of such hubs are named as Wireless Sensor Networks (WSNs). These hubs are fueled with batteries which can't be revived effectively much of the time. Therefore, vitality necessities of hubs have pulled in consideration among scientists that drove the inclination to adapt them with vitality reaping procedures. A Lifetime of the system is particularly essential in mission basic frameworks, for example, outside natural observing, military observation, and hazardous situation checking. In a system, hubs might be apportioned into Clusters. Each Cluster comprises of a solitary Cluster-Head (CH) and at least one part hubs. CHs are likewise called as pioneers since they sort out data gathering from their part hubs at that point exchange made data to structured areas. Bunching in WSNs guarantees extraordinary execution prerequisites and furthermore expands the adaptability of the system. Steering method is required for sending the information between the sensor hubs and the Base Station, in order to indicate correspondence. Along these lines, different Routing conventions have been created to diminish the vitality utilization and to expand the system lifetime.

## 2. Related Works

Komal Roshan and Kritika Raj Sharma [1] they have proposed a bunching technique if there is discontinuous assurance of gathering heads rather than subjective decision it can realize more viability. Phan Thi The, Vu Nhu Manh, Tran Cong Hung, Le Dien Tam [2] they have presented a technique that joins moving sinks by fixed-way sink with fluffy grouping calculation that outcomes the proposed calculation has better execution as far as system life, solidness and bundle conveyance contrasted with Leach, Cluster Head Election instrument utilizing Fuzzy rationale (CHEF). N.G. Palan, B.V. Barbadekar, Suahs Patil [3] they have introduced a LEACH convention, where group Head (CH) determination process named as 'round' (r) [4] they have proposed LEACH-P which is a novel way to deal with improve existing LEACH convention utilizing PSO based bunching. The proposed

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calculation is reenacted comprehensively and the outcomes . C. Vimalarani, R. Subramanian, and S. N. Sivanandam [5] they have detailed Enhanced PSO-Based Clustering Energy Optimization (EPSO-CEO) calculation for Wireless Sensor Network in which bunching and grouping head choice are finished by utilizing Particle Swarm Optimization (PSO) calculation as for limiting the power utilization in WSN. Comparative works are accounted for in [11, 12, 13, 14, 15].

## 3. Proposed Model

This section must contain specific details about the materials studied, instruments used, specialized chemicals source and related experimental details which allow other research worker to reproduce the results. The system lifetime can be upgraded by utilizing fittingly heaps of directing conventions and bunch based calculations are utilized to accomplish the execution need in WSN. Advancement of vitality in correspondence turns out to be basic as indicated by existing exploration approaches. For amplifying lifetime of the WSN, vitality utilization of every sensor hub has a critical Part of a job while imparting among other sensor hubs. In this thesis we have proposed a convention dependent on PSO Clustering calculation utilizing PSO strategy is proposed for vitality preservation. The ideal choice of Cluster Head utilizing PSO decreases the power utilization of every sensor hubs by sending information parcels to its Cluster Head rather than legitimately sending the base station. Fluffy Routing calculation with DSDV convention to improve the lifetime of a system. Right off the bat DSDV convention finds the course for correspondence of hubs. The chose course should be enhanced. Since various courses devour diverse vitality, the more vitality is required as the hubs increments in the course of system. In this way Fuzzy Routing convention is utilized for streamlining of course. The upgraded course devours less vitality.

### 3.1 Block Diagram

Fig.1 shows the Block Diagram of Proposed Methodology. This method combines two algorithms in the PSO Clustering used to select Cluster Head and in the Fuzzy Routing Algorithm with DSDV Routing protocol used to select the routing path. Finally, these two algorithms are unified into performed in a data aggregation process.

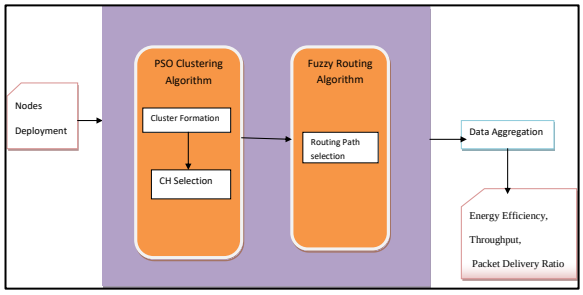


Fig. 1 Block diagram for proposed Methodology

### .3.2 Node Creation

The wireless node are created an that they square measure interconnected with one another and that they will communicate severally and therefore the node are created. Fig. 2 describes the node creation method. First set the properties like queue length, locations. Then use to required protocols for node creations, finally implement the routing algorithms. In this way we get the number of nodes.

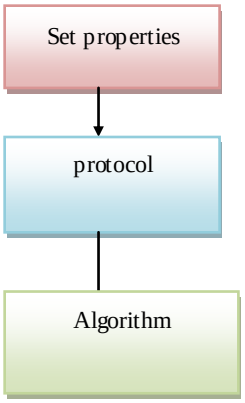


Fig 2 Node Creation

### PSO-Based Clustering Algorithm

PSO-Based Clustering Optimization calculation to shape bunches and group head choice with a conveyed technique utilizing static sink hub. Particle Swarm Optimization (PSO). Particle Swarm Optimization (PSO) is a populace based advancement plot. The arbitrary arrangements of the framework zone unit instated with a populace and pursuit ideal arrangements in each age. The potential arrangements in each age alluded to as particles .Each molecule in PSO keeps the keep record for every one of its facilitates that related with getting the higher goals by following this best particles. Wellness capacity of each molecule is executed and the wellness esteem (best arrangement) is determined and put away.. The wellness worth of this ideal molecule is named "pbest." PSO streamlines the best populace esteem that is acquired so far by any molecule in the neighbors and its area

is called lbest. At the point when all the produced populaces as topological neighbors by a chose molecule, at that point the best esteem is picked among the created populace and that specific best esteem is the best arrangement and it is known as gbest.

### 3.3 Cluster Formation

The Cluster is formed by the sink on the basis of distributed clustering. For clustering sink broadcasts info collection message to all sensor nodes. Sensor nodes after receiving this message start to send its node information such as node id, location (distance from the base station in □ and □ position), energy loss and energy ratio (velocity), and current energy to send base station. Then base station initiates the group method steps as follows.

Step 1: Conversion of problem into the PSO space in which the PSO particle has two dimensions such as particle position and velocity.

Step 2; Estimation of fitness value using fitness function.
Fitness Function:
Our planned fitness perform for PSO based mostly group is to optimize the common distance and average energy of the member nodes and from this cluster head and head count. Figure 3 shows the cluster formation using PSO.
The fitness value is calculated for the particle by using the formula given in the following:

$$f(i) = \propto * \sqrt[n]{\prod_{i=1}^{n} (E_i - \overline{E})} +$$

$$\beta * \sum_{i=1}^{n} \frac{Num_i}{Distance_i} +$$

$$(1 - \alpha - \beta) * \frac{n}{\sum_{i=1}^{n} (Num_i - \overline{N})^2}$$

where $\alpha$ ,$\beta$ are weighing parameters (normalized values) and □ denotes number of members covered within the cluster.

Step 3: Generation of new particles from the initial solution .Formation of new particles from the old one is a generation of a new particle.

Step 3.1: Estimation of new velocity: the current velocity of a taken particle is considered to the rate at which the particle's position is changed. New velocity is calculated as follows:

new velocity = □ * old velocity
+ $w_1$(local best position − current best position)
+ $w_2$(global best position− current best position)

where □ is inertia weight and $w_1$ and $w_2$ are basic PSO tuning parameters.

Step 3.2: Estimation of new position of the particle is as follows:
new position = old position + new velocity.

Finally the new particle (new velocity and new position) arrives.

Step 4: Calculation of fitness value for new particles.

Fitness value of the new particles is estimated by using fitness function in Step 2 with new velocity and new position.

Step 5: Fitness value of old particle and new particle is compared and the best one is selected for the next iteration:

If new fitness value > old fitness value
select new particle;
else
old particle is forwarded to next iteration.

Step 6: For every iteration, one best solution is selected as a local best solution. The particle which has maximum fitness value in the current iteration is selected as lbest solution.

Step 7: The local best solutions from all iterations of the particle in which has maximum among all solutions are selected as a global best solution. The final solutions are decoded into clusters.

### 3.4 Cluster Head Selection

After Clustering, each sensor node maintains cluster list. Then the round procedure is initiated to perform cluster head selection.
Step 1. The members that are covered by the current node are communicated with each other to select a cluster head which follows as steps mentioned below.

$$f(i) = \propto * \sqrt[n]{\prod_{i=1}^{n} (E_i - \overline{E})}\ \Upsilon +$$

$$\beta * \sum_{i=1}^{n} \frac{Num_i}{Distance_i} \Upsilon +$$
$$(1 - \alpha - \beta) * \frac{n}{\sum_{i=1}^{n} (Num_i - \overline{N})^2}$$

where Y = {1, if member □ is covered by current node 0, else }, □ is number of members in the current cluster node, □

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and β are weighing parameters (normalized values), and  denotes the number of members covered within the competition range.

### 3.5 Route path Selection

Fuzzy Routing Algorithm extends the multi-hop routing approach defined with two input parameters, namely average link residual energy and relative distance is utilized in the selection of the routing path. We propose a Destination-Sequenced Distance-Vector Routing (DSDV) routing protocol. This method used to select routing path that connects all sensor nodes to CH and CH to the sink. Two crucial factors are considered when devising the fuzzy routing tier. Our rationale in devising this fuzzy routing tier is to minimize and balance the energy consumption over the whole network by a smaller number of transceiver unit activations through an efficient route selection. The first fuzzified parameter is Average Link Residual Energy (ALRE) and Fig. 3depicts the fuzzy set of this parameter. The chosen linguistic variables of this set are low, medium and high

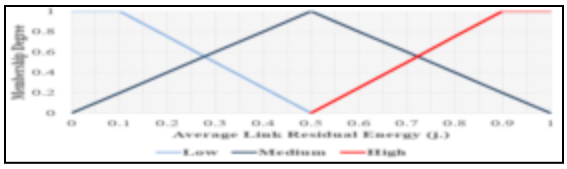


Fig. 3 Fuzzy Set of the First Input Parameter (ALRE).

The second fuzzified parameter is the Relative Distance (length) of a route. The fuzzy set of this parameter is depicted in Fig. 4. Close, regular and far are the chosen linguistic variables of this fuzzy set.

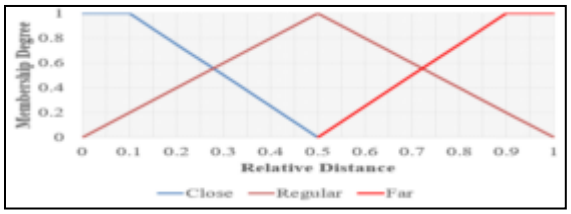


Fig. 4 Fuzzy Set of the Second Input Parameter (RD).

Computations of the values of Relative Distance (RD) and Average Link Residual Energy (ALRE) of a specific route r are presented in Equations, respectively.

$$RD_{r=\frac{Distance_r}{\max(Distance)}}$$

$$ALRE_{r=\frac{\sum_{i=1}^{m} RE_i}{m}}$$

The usage of the relative and average values does not necessitate the inclusion of the sink in the decision process. As in the previous phase, this established aspect promotes our fuzzy routing phase to be a distributed promising route election methodology. max(Distance) value in Equation. 4 can be deduced from the RREP packets received and utilized in the normalization procedure of varying link distances. The only fuzzified output parameter is the chance value of a received route. The set utilized for this fuzzified output variable is delineated in Fig. 5. There are a total of nine chosen linguistic variables.

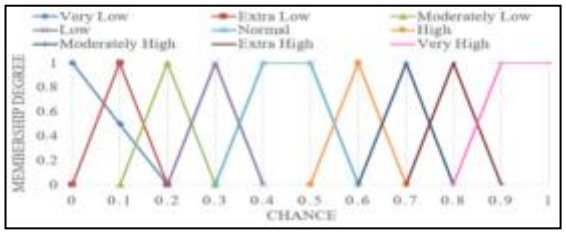


Fig. 5 Fuzzy Set of the output Parameter

Data aggregation

The source node then generates the request message that gathers information from its neighboring nodes in the transmission radius. The information like the hop count, the distance to the base station and the residual energy are to be collected from the neighboring nodes by the source node. The nodes that received the request message send the requested information to the sender node.

## 4. Results and Discussion

In this area the execution of the proposed PSO and Fuzzy Logic Protocol is tested and contrasted and the current TTDFP Protocol. There are 100 hubs conveyed in the 100 × 100 m2. The proficiency of the proposed framework is assessed dependent on the accompanying criteria: throughput and vitality productivity, parcel conveyance proportion. The hubs are haphazardly disseminated with the underlying hub vitality as 3 J. It is viewed as that the situation of the BS is (145,290) If the hub's vitality is equivalent or however zero, at that point the hub is considered on the grounds that the dead hub and it's off from the information total. Fig. 6, Fig. 7 and Fig. 8 speaks to the throughput, vitality effectiveness and Packet Delivery Ratio examination

Throughput:

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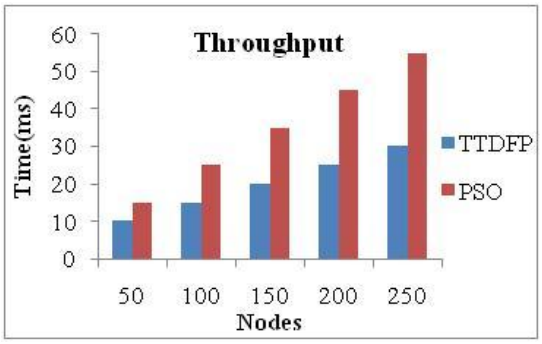


Fig. 6 Throughput

Energy Efficiency:

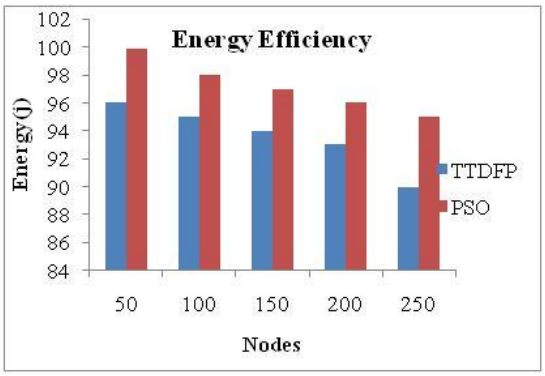


Fig .7 Energy Efficiency

Packet Delivery Ratio:

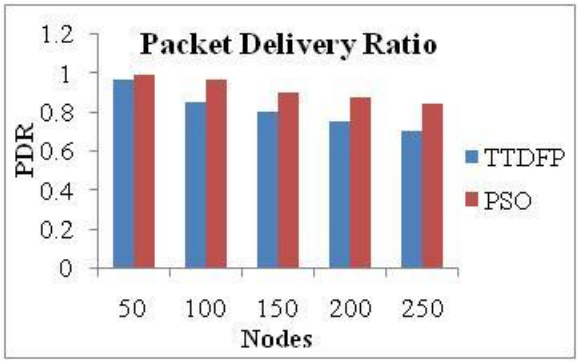


Fig 8.Packet Delivery Ratio

## 5. Conclusions

In this Paper, WSN have been detailed for two enhancement issues that is the directing calculation has been created by considering an exchange off between transmission remove and the quantity of jump tally .In the grouping stage i.e., vitality proficient steering and bunching separately, steering over leader of the CHs is considered for adjusting the vitality utilization of the CHs .All the CHs which are intensely utilized as next bounce transfer hubs in information sending are appointed lesser number of sensor hubs. Hence the vitality utilization of the CHs is altogether adjusted and the lifetime of the system is improved. This calculations depend on the induction of effective molecule encoding plan and wellness work for steering and grouping independently. The trial results have demonstrated that the PSO convention perform superior to the TTDFP as far as Throughput, Energy Efficiency and Packet Delivery Ratio.

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