An Adaptive Fuzzy C Means With Seagull Optimization Algorithm for Analysis of WSNs in Agricultural Field With IoT

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Research Article

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Posted Date: August 10th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-746283/v1

An Adaptive Fuzzy C Means with Seagull Optimization Algorithm for Analysis of WSNs in Agricultural Field with IoT

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Abstract: In recent years, the environmental monitoring in agriculture field is an essential required application. To achieve the environmental monitoring of agriculture fields, the wireless sense networks (WSN) and Internet of Things (IoT) is utilized. In the WSN, the energy consumption is a main issue to access the medium and transfer the networks. Hence, in this paper, Adaptive Fuzzy C means clustering and Seagull Optimization Algorithm (AFCM-SOA) is developed for monitoring environmental conditions in agriculture field. Two main objective functions are utilized to empower the presentation of the WSN such as load balancing and energy efficient operation. The proposed method is a combination of Fuzzy C Means Clustering and Seagull Optimization Algorithm (SOA). The energy efficient and load balancing is achieved by optimal routing scheme by proposed method. The Fuzzy C-Means Clustering is utilized to empower the energy efficient operation and load balancing. In the Fuzzy C-Means Clustering, the SOA is utilized to select the optimal path selection. The proposed method is executed by NS2 simulator and performances are compared with existing methods such as Atom Search Optimization (ASO) and Emperor Penguin Optimization (EPO) respectively. The performance metrics are delay, drop, throughput, energy consumption, network lifetime, overhead and delivery ratio.

Keywords: *clustering, agriculture fields, environmental monitoring, fuzzy c means clustering and seagull optimization algorithm.*

1. Introduction

A rural country like India is following the usual techniques of land testing. Energy access is one of the notable components of the test structure. Focuses on large homesteads [1] by integrating different sensors from key sensors and key intelligence, making it possible to screen and control conditions within the farm to get the most out of it. This will greatly help farmers by avoiding the money normally spent on irrigation and preparation, and at the same time reducing the burden of care [2] on them [3]. Many developers are tapping into a mechanized water system structure to use electronic controls and energy efficient time division multiple access (TDMA) [4] techniques. The planned water system was completed with the help of four sensors and solenoid valves. The information provided by the sensors was understood by the microcontroller, which operates both the mixer and the engine as indicated by the soil requirement. The WSN is an emerging innovation that covers a wide range of potential applications, including climate monitoring, agribusiness, vehicle testing, locations of interest, medical structures, and automated investigation [5].

The ongoing methods of machine development have induced in agriculture monitoring system with Internet of Things (IoT) and WSN; Thus, there is a high amount of utility testing on the energy efficiency of remote sensor systems [6]. Among WSNs, energy use is main significant difficulties as sensor centers, and cluster heads has a short lifespan unaffected by the demands on energy use [7]. Of late, standalone test tasks have become zero in providing a potential WSN framework for energy use, and several calculations have been presented to control GPS intended for the sensor hub area ID. These contain free in addition achievable calculations to compute the distance data travels in addition network points between known centers and obscure sensor center areas [8]. WSNs are envisioned as monetary arrangements for surveillance, home security, detection of energy use over a period of time, and military intelligence [9]. There is a significant problem with energy productivity in the WSN in addition its requirements. Hence, it can be fundamental that energy use is utilized effectively with goal of being able to draw the life of the company extraordinarily [10].

There are some difficulties in planning WSNs in light of the fact that sensor centers control energy, controlling power and memory [11]. A few energy-efficient steering traditions have been proposed in writing to manage the restricted battery life of sensor centers to extend enterprise life. Developed by a number of experts to accomplish energy efficient grouping [12], for example, the low-energy versatile cluster packing order (Leach, etc.) leaches the centers autonomously by punching. cluster Head (CHs) complete a cluster of centers fill different groups with switches that intersect between the sink center to help control identity strength CHs complete the transmission error instead of each center within the organization, thereby determining the transmission. Energy is enhanced and stored by generating global information. As of late, the Artificial Intelligence (AI) [13] strategy is used to choose optimal cluster center of the bunching approach like Genetic Algorithm (GA), Particle Swarm Optimization (PSO) [14] and Gravitational Search Algorithm (GSA) [15] individually.

The remaining part of the article is prearranged as follows, section 2 provides the detail review part of the recent research correlated to energy efficient approach. Section 3 given the detail description of the proposed algorithm, system model and objective functions. The experimental evaluation of the proposed methodology is explained in section 4. The conclusion part of the paper is presented in section 5.

2. Literature Review

Many methods are available to achieve the energy efficient and load balancing of WSN. Some of the methods are reviewed in this section.

Alma Rodríguez *et al.,* [16] have introduced the Energy-efficient Cluster Steering Conference for WSN, which was related on the Yellow Saddle Goat Fish Algorithm (YSGA). The conference was planned to increase the life of the company by decreasing energy use. The organization reflects a base station in addition group leaders in its team structure. The determination of the size and ideal cluster heads of the group leaders is dictated by the YSGA calculation, though the sensor centers can be pushed to its nearest cluster head. The cluster structure of the system was restructured by the YSGA to empower better transmission of team leaders in addition decrease transmission distances. Experimentations show serious outcomes and the projected operating conference controls energy use, improves lifespan, and pulls the best time of the system in relation to the manifestation of performance clustering routing protocols.

Ramadhani Sinde *et al.,* [17] have introduced energy-efficient planning using in-depth reinforcement learning (DRL) (E2S-DRL) calculations at WSN. The E2 S-DRL contributes three stages: drawing the network lifetime and minimizing network latency: the compilation stage, the duty cycling stage and the steering stage. The E2 S-DRL begins with the boxing stage, where we decrease the energy consumption that is brought about during the information federation. This was accomplished through a zone-based clustering (ZbC) plot. In the ZbC plot, link propagation and particle swarm optimization (PSO) calculations were used. Duty cycling was adopted in the second phase by implementing DRL computation, from which E2S-DRL effectively minimizes the energy use of individual sensor centers. Transfer delay was eliminated in the third (operating) phase using Firefly Algorithm (FFA) and Ant Colony Optimization (ACO). This work was demonstrated in Network

Simulator 3.26 (NS3). The outcomes can be significant in the arrangement of forthcoming measurements contains the network lifetime, power usage, performance and deferral.

Rajkumar Singh Rathore *et al.,* [18] have introduced the hybrid whale and grey wolf optimization (WGWO)-a remote sensor system-based energy-based ensemble system. In the introduced research, two meta-heuristic calculations were used, in particular, the whale and the dark wolf to extend reliability of the grouping tool. The abuse in addition investigative competences of the crossover WGWO method were much greater than the conventional differentiated metaheuristic calculations currently available throughout the assessment of the calculation. This semi-ethnic method yields the optimal results. hybrid whale grey wolf optimization -based clustering system group development and gradual CH selection. The exhibition of the introduced plot is different and the status of existing craft operating traditions.

Sepehr Ebrahimi Mood *et al.,* [19] have introduced a user-independent and dynamic strategy that identifies the best number of clusters, coordinates clusters, and determines the best cluster heads in each round. In this strategy, the effective energy use and connection quality were considered to find the best number of clusters. Then, at that point, the calculation began to integrate the low sponges with the high energy level team leaders. Here, he researched another health mission to accomplish these places. The Gravitational Search Algorithm (GSA) was provided to deal with this regulatory problem. In this calculation, the power distance total scaling technique was used to find the mass properties. Then, at that time, a fuzzy logic controller is used to recognize the limits of this calculation to control the abuse and investigation capabilities of the strategy during the calculation cycle. Later, at that time, GSA's adaptation was used to find the appropriate response to fitness function, to find the best number of groups, and to sort these clusters correctly.

Oluwasegun Julius Aroba *et al.,* [20] have introduced a Gaussian elimination method merged with distributed energy efficient clustering (referred to as DEEC-Gauss) to guarantee energy efficient regulation in remote climates. And, reason behind the use of DEEC-Gauss group calculation was that with 100 centers in the WSNs, it fills the hole in the writing because analysts are reluctant to use this program before making energy-efficient improvements somewhere in the range. Still executes 1,000 and 5000 adjustment and quick time yield. In this trial, an exhibition of in-depth group calculations using entertainment, in particular, DDEEC, EDEEC_E and DEEC, contradicted the proposed Gaussian Elimination Clustering Algorithm (DEEC-Gauss). The proposed DEC-CAS algorithm gives a 4.2% enhancement over the primary hub dead, a further 2.8% enhancement over the 10th hub dead, and the general season is extended and varied and Updated during other contemporary calculations.

3. Proposed System Model

Generally, the WSN is consists of a greater number of low powers, inexpensive and small sensor nodes. This sensor-nodes are usually used in different applications such as environment monitoring of motion, pressure, humidity, weather forecasting, volcanic earthquake timing, vehicular movements and military reconnaissance. In this proposed methodology, the agriculture field is considered to monitoring IoT system with the help of WSN. The agriculture field of monitoring system with WSN networks have working based on limited life with battery energy storage. Additionally, heavy load traffic of sensor nodes is considered as main factor which must be solved to enable the better characteristics of WSN in applications. The system model is consisting a sensor node with a design of sink node. The sink node is generally located in the middle of the detection area, the sensor nodes are created in random manner at initial conditions. The system model with WSN architecture is illustrated in figure 1. In this proposed design methodology, adaptive algorithm is designed to reduce the energy consumption of sensor nodes in WSN. In the WSN architecture, the dead nodes also consumed power to transfer the data but it drops the data rate and consume extra power from the battery which reduce the system performance and lifetime of the sensor nodes also reduced. To avoid this, the AFCM-SOA in WSN based clustering is introduced which identify the best sink node for each clustering. The proposed algorithm-based clustering progress completely reduce the extra energy consumption of the node. At initial conditions, in the WSN network each node created with similar energy sources. During communications process, the WSN is reduce the energy of each node depends upon the process. After that, the WSN network, high energy node must be selected as sink node which is also named as cluster head. Because, the cluster head pays major role in the system to avoid the extra consumption of power and which enable the proper communication process in the system.

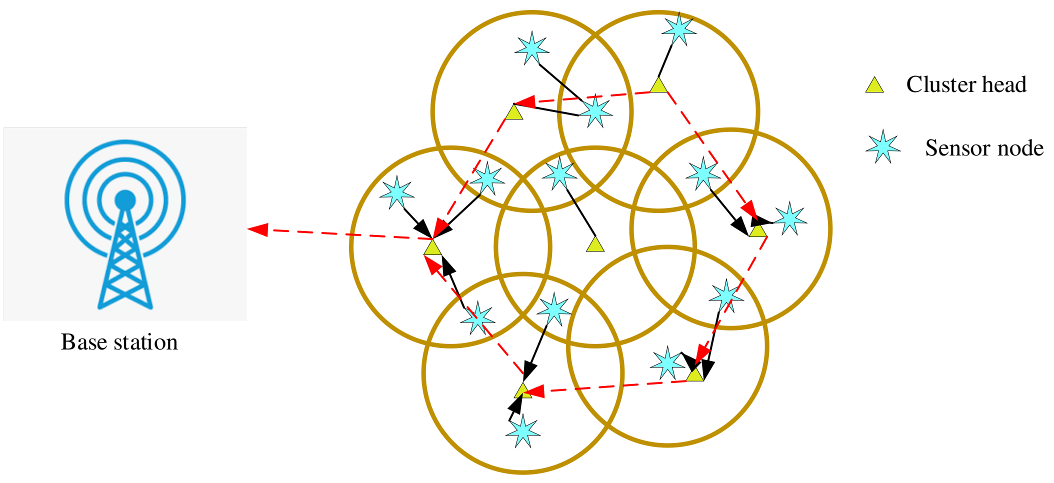

Figure. 1 Architecture of WSN

In the figure, cluster head, sensor node and base station with the architecture is illustrated. The cluster head is designated and reduce the energy consumption of node. In the WSN system, the node has the ability to communicate directly with remaining nodes in the system. The cluster head is communicating towards the base station. The sensor node gathers the data from the monitoring area and transfers it to the sink node through the multi hop or single hop. In this proposed methodology, load balancing of the WSN is achieved with the help of proposed approach. The AFCM-SOA is utilized to enhance the performance of the WSN. This optimization method is used to avoid energy hole issue in the structure. The energy hole problem may happen due to heavy load of each nodes and especially in the cluster head nodes. In the design of proposed methodology, the load balancing model of sensor node also checked with the consideration of proposed algorithm. Similarly, energy efficient clustering, load balancing of sensor nodes is achieved with the help of proposed algorithm. The proposed method is working towards attain the load balancing, energy efficient clustering objectives. The two objectives are considered which surely enhance the system performance. The proposed algorithm is used to achieve objective functions with select the clustering and avoid load balancing. The energy model of the WSN design is formulated as follows,

Energy model:

In this paper, the energy model is designed and which computing the energy consumption of WSN structure. The WSN architecture is specially designed with two different types of communication channels such as multipath channel based on the distance among transmitter and receiver and free space channel [21]. The distance of the channels is always lower than the reference free space model which is always utilize. Then, the multi path fading channel is utilized. The energy model of proposed architecture for transmitter is mathematically formulated and presented below,

$$Ener^{T}(1,D)=\begin{cases}L*E^{Elec}+1*\epsilon^{FS}*D^{2}, & D<D^{O}\\ L*E^{Elec}+1*\epsilon^{MP}*D^{2} & D\geq D^{O}\end{cases} \tag{1}$$

Where, ϵ^{MP} is described as energy required for the amplifier multi path padding channels, ϵ^{FS} is described as energy essential for the amplifier in free space in addition E^{Elec} is described as energy essential for the electronic circuit. The complete required energy of transmitter with d (distance) is computed from equation (1). The energy requirement of receiver is formulated as below equation,

$$Ener^{R}(L)=L*E^{Elec} \tag{2}$$

Where, $Ener^R(L)$ is described as energy requirement of receiver, $\epsilon^{MP} * D^2$ and $\epsilon^{FS} * D^2$ is computed based on the distance among receiver and transmitter. E^{Elec} is computed by considering various characteristics such as signal spreading, filtering of the signal, modulation and digital coding.

3.1. Objective function

In this work, the gateways and sensor nodes are initialized with the area 200m^2*200 m^2. Our first objective function is reducing the energy consumption of the WSN network. Our second objective function is balancing the load in the network in addition reduce the energy hole issues. The sink node or cluster head is only transmitting with base station. The sink node can be collected the information from the remaining nodes in the network. The load balancing and reduce the energy consumption is achieved with the help of proposed method. The three objective functions are used to enable the energy consumption reduction and load balancing operation is enabled. The two objective functions are described as follows,

3.1.1. Energy efficient objective

In the WSN architecture, the energy consumption of nodes is reduced to enhance the lifetime of the system. The energy efficient technique can be implementing through the optimal routing path selection. Here, our fitness function can be developed to discovery out best routing path selection from the BS through sink node [22]. The optimal routing path is selected based on complete distance computations which considered as key point to find the optimal routing path. The complete distance function is computed based on below equation,

$$Distance = \sum_{I=1}^{N} D(G^I, NEXT\ (G^I) \tag{3}$$

Where, $Distance$ of the gateway G^I among next gateway of the WSN design structure. The complete number of gateways is computed based on below equation,

$$L = \sum_{I=1}^{M} NEXT\ count(G^I) \tag{4}$$

The optimal routing is selected with the help of proposed technique. The routing is computed by calculating low distance function and least number of gateways. Hence, the low distance is computed based on complete distance traversed, higher fitness parameter for the answers and number of gateways. Generally, the distance function and number of gateways is inversely proportional to the routing characteristics of WSN architecture. This distance function is selected with highest value is considered as optimal solution in the population. The complete routing fitness function can be mathematically expressed as follows,

$$Fitness\ (1) = \frac{K}{(W^1 * D + W^2 * H)} \tag{5}$$

Where, K is described as proportionality constant and (W^1, W^2) is described as weight parameter which taken as [0, 1] when added these weight parameters must be taken as 1. With the consideration of fitness function, the system stabilities the complete distance and number of gateways in the network structure. Similarly, the proposed method is load balancing approach is considered as second objective function and fitness function which presented in below section.

3.1.2. Load balancing objective

In this section, the objective function is fixed as load balancing approach which avoids the energy hole problem in the network. The clustering approach is introducing to solve this problem in the network. This load balancing approach is considered as the second objective function and second fitness function of the proposed approach. In the WSN network, the gateway takes energy to achieve processes such as transmitting the data straight the BD or gateway by optimal routing path, aggregating data the received data and getting data from sensor nodes within related clusters [23]. The energy consumed of the gateway, connected with the number of sensor nodes to active the various inter cluster performance in each round. The clustering approach based on the WSN formulated it is presented below,

$$E(Cluster) = N^I * Ener^R + N^I * Ener^{DA} + Ener^T(G^I, NEXT\ (G^I) \tag{6}$$

Where, $Ener^R$ is described as receiver data consumers energy, $Ener^{DA}$ is described data aggregation energy and $Ener^T(G^I, NEXT\ (G^I)$ is described as communicating combined data to the next entry in the selected routing way. The gateway may be consumed energy to frontward the incoming data after the various gateways. Hence, the used up of the gateway under incoming data from the gateway to next gateway is formulated as follows,

$$Data(G^I) = \begin{cases} 0 & IFNEXT\ (G^I) \neq G^J \forall G^J \epsilon G \\ \sum\{Data(G^I) | Next(G^I) = G^I, G^I \epsilon G\} & Else \end{cases} \tag{7}$$

In the WSN, the incoming information can be established by gateway in addition it is transferred to additional gateway through the path. The energy requirement to frontward incoming data can be computed based on below equation,

$$Forward(G^I) = Data(G^I) \times Ener^T(G^I, NEXT\ (G^I) + Data(G^I) \times Ener^R \tag{8}$$

At last, the complete energy required pf the gateway is the addition of energy essential to process the formation of cluster in addition frontward the data established from different gateways. The complete gateway energy consumption can be expressed as below equation,

$$gateway(G^I) = cluster(G^I) + forward(G^I) \tag{9}$$

The gateway lifetime is computed based on below equation which is defined as ratio total energy consumption of gateway and of residual energy of gateway.

$$Life\ (G^I) = \frac{Residual\ (E)}{Gateway\ (E)} \tag{10}$$

This proposed method is used to form a cluster to reduce energy hole issues in addition load also balanced in the network structure. In the fitness function is compute distance among gateway in addition the BS. The near gateways to the BS can be associated to low amount of sensor nodes. And, the gateways distant from the BS which associated to a large count of sensor nodes. The gateways connected close to the BS which handover data coming from the gateways and it is situated distant from the BS. Therefore, the load is balanced and heavy load BS also released and which is forward to less load BS in the WSN network.

The proposed algorithm is balancing the load by constructing fitness function towards to clustering function. The fitness function related to clustering function is presented as follows,

$$clustering(G^I) = K * |Load((G^I) - Distance((BS, (G^I)) * \alpha| \tag{11}$$

$$\alpha = \frac{\sum_{I=1}^{N} Load(G^I)}{N} \tag{12}$$

Where, $Distance((BS, (G^I))$ is described as distance of BS and gateway and $Load((G^I)$ is described as data received by gateway. Finally, the clustering fitness of the proposed method is formulated as follows,

$$Fitness(2) = \frac{\sum_{I=1}^{N} clustering(G^I)}{N} \tag{13}$$

With the assistance of projected techniques, the fitness function of clustering-based load balancing is achieved in the WSN system.

3.2. Proposed Fuzzy C means algorithm

Based on the proposed FCM algorithm [24] can be mentioned purpose of clustering. The detection of effective clustering with the clusters is CHs and formed and selected based on the energy. Therefore, the method of SOA is specified for the purpose of routing to transport the aggregate data from CHs to the Sink node. The node of QoS based on different constraints is based on the candidate nodes and are CH set are selected. The selection of nodes is completed based on delay, packet loss, bandwidth and residual energy. The CH and sink distance function are required to empower energy efficiency and important for empowering network lifetime and energy spending. Hence, the clusters formation among the node's formation is given precedence. The clustering approach of fuzzy c-means is used in formation of cluster to the determination set of space d-dimensional with the cluster in k. significantly, the process analysis of clustering, the multi-objective function is definite.

The determination of cost function is the head cluster and the following equation is utilized,

$$CH^i = \delta^i * \left({f^i}/{S_t^i} \right) * \omega_i * N(C^i) \tag{14}$$

Basically, the method plays and vital role to assigning membership with every data point corresponding to every center of cluster and the distance based to the center cluster also the point of data. Furthermore, the neighboring data to center cluster more is its association through the specified center of cluster. Obviously, the association outline in every top is supposed in equal toward single. Thereafter, all the association iteration with centers cluster is rationalized according on the equations:

$$\mu^{ij} = \frac{1}{\sum_{K=1}^{C} \left(\frac{D^{ij}}{D^{ik}}\right)^{\left(\frac{2}{M}-1\right)}} \tag{15}$$

$$v^{ij} = \frac{\left(\sum_{I=1}^{N} (\mu^{ij})^{M} x^{i}\right)}{\left(\sum_{I=1}^{N} (\mu^{ij})^{M}\right)}, \forall J = 1,2,..,C \tag{16}$$

While, the number of data points are represented as *'n'*,*'vj'* stands for *j*th center bunch *'m'* be index of fuzziness m € [1, ∞]. The center cluster number denoted as *'c'*. Where, *'μij'* is the representation of the membership of *i*th information to *j*th middle cluster respectively. The notable data of *'Dij'* is the distance of Euclidean involving *i*th data and *j*th center bunch.

The major objective function of reduction in algorithm of fuzzy c-means

$$J(U,V) = \sum_{I=1}^{N} \sum_{J=1}^{C} (\mu^{ij})^{M} \|X^I - V^J\|^2 \tag{17}$$

Therefore, the Euclidean detachment $'\|X^I - V^J\|$ involving *i*th data and jth in middle cluster.

Assume the group of information point $X = \{x1, x2, x3 \ldots, xn\}$ and $V = \{v1, v2, v3 \ldots, vc\}$ is the center set.

1) The process to arbitrarily choose *'c'* centers off cluster.

2) The procedure of estimation in fuzzy membership $'\mu_{ij}'$ using:

$$\mu^{ij} = \frac{1}{\sum_{K=1}^{C} \left(\frac{D^{ij}}{D^{ik}}\right)^{\left(\frac{2}{M}-1\right)}} \tag{18}$$

3) The process of fuzzy centers computation $'v_j'$ using:

$$v^{ij} = \frac{\left(\sum_{I=1}^{N} (\mu^{ij})^{M} x^{i}\right)}{\left(\sum_{I=1}^{N} (\mu^{ij})^{M}\right)}, \forall J = 1,2,..,C \tag{19}$$

4) The procedure of updating the Fuzzy

The process of optimal cluster points clustering, the selection of cluster heads is much special and the procedure of SOA is utilzied and choose the heads of cluster. While the analysis steps of the propsoed SOA is utilzied and determined the cluster heads and optimal cluster based on their energy level. Originally, the clustering are formed depending upon the distance. Based on the distance with its centroid point is chosen. Subsequent to that the cluster heads are selected optimally depending on the level of clusters energy. Therefore, the cluster contains maximum energy so as to choose and cluster head (CHs) become formed. Then the performance of routing is to analzye the remianing function of nodes objective. Regaring that the utilization of protocol to analzye the consumption of energy level. Earlier, the protocols with differents functions are utilzied but it provided not the suitable outcomes. In this paper, the protocol of AFCM-SOA is utilzied and to analzye the characteristics of dynamic WSN then it provides the suitable outcomes. Other than, it contains no other gives the much more efficient to the node. Concerning to solve this issues the algorithm of SOA algorithm is to improved and performd.

3.3. Seagull Optimization Algorithm

In this proposed methodology, the seagull optimization algorithm is developed to select the cluster head and routing process in FCM. A detailed description of the seagull optimization algorithm is presented in this section. Normally, seagulls are named Laridae, and they a sea birds that can be presented complete world. Many sea birds are available, from that seagulls are omnipresent and they annoy tubercular, amphibians, rodents, fish and eats. So, the seagulls are smart birds [25]. The seagulls are attracting fish with their bases by utilizing bread morsels which producing rain. The seagulls are consuming fresh and saltwater. The seagulls have a singular couple of barrels correct ended their judgements to shower the salt after their system by introductory the beak. The village is the most specified place. The for seagulls. Based on their knowledge, the prey location is computed by seagulls. In the seagulls, the attacking mechanism and migration is the most significant process. Relocation is defined as the cyclical changes of seagulls from one place to additional place to compute the most plentiful in addition richest energy sources. seagull behavior is formulated as follows,

- ❖ The seagull travel in a collection throughout relocation. The seagulls can be various in their early position to avoid accidents.
- ❖ Seagulls are fly in a collection t the way of the optimal existence seagull.
- ❖ The remaining seagulls are updated with the positions related to the fittest seagull.

The mathematical model of attacking the prey and migration is presented as follows,

3.3.1. Migration

In the relocation process, the algorithm proceeds with the seagulls change from one position to another. In the migration process, the seagull must compensate for three scenarios.

Avoiding the collisions: In the SOA, the collision should be avoided among neighbors, and additional parameters are employed for the computation of optimal search agent position.

$$Cs = A \times Ps(X) \tag{20}$$

Where A can be described as movement characteristics of search agent, X can be described as current iteration, Ps can be described as the current position of search agent and Cs can be represented as search agent position which did not collision with remaining search agents. The movement characteristics of the search agent are presented as follows,

$$A = Fc - (X \times \left(\frac{FC}{Maxiteration}\right) \tag{21}$$

$$\text{Where, } X = 0,1,2, \ldots, \max iteration \tag{22}$$

Where Fc can be described as value 2, A can be described as linearly reduced from Fc to 0, Fc can be described to control the frequency of considering parameter.

The movement towards best neighbors' direction:

Once avoiding the Collison among neighbors, the search agents are locating towards the movements of the best neighbor.

$$Ms = B \times (Pb(X) - PS(X)) \tag{23}$$

Where, B can be described as randomizes that is responsible for efficient balancing among exploitation and exploration, $Pb(X)$ can be described as best fit search agent, $PS(X)$ can be described as search agent and Ms can be described as search agent position.

$$B = 2 \times S = A^2 \times RD \tag{24}$$

Where RD can be described as an arbitrary number presented in the variety of [0,1].

Remain near to the best search agent:

At last, the search agent can location updating related to the best search agent that is presented as follows,

$$DS = |Cs + Ms| \tag{25}$$

Where DS can be described as the distance among the best-fit search agent and search agent.

3.3.2. Attacking of prey

The exploitation motive is exploiting the experience in addition history of the search procedure. In the migration process, the seagulls can change the attack angle condition. Based on weight and wings, the seagulls are maintaining their altitude [26]. During the prey attacking, the spiral drive characteristics can occur in the air. This spiral movement behavior can be presented as follows,

$$X^` = R * \cos(K) \tag{26}$$

$$Y^` = R * \sin(K) \tag{27}$$

$$Z^` = R * K \tag{28}$$

$$R = U * e^{KV} \tag{29}$$

Where, e can be described as the base of the natural logarithm, $u \; and \; v$ can be described as spiral shape constants, k can be described as a arbitrary number within the variety of $[o \leq k \leq 2\pi]$, and radius of every turn of the spiral is denoted by R. The search agent updating process is computed by the below equation,

$$Ps(X) = \left(DS * X^` * Y^` * Z^`\right) + Pbs(X) \tag{30}$$

Where, $Pbs(X)$ can be described as an optimal answer and apprises the location of other search agents. The flowchart of the SOA can be presented in figure 2.

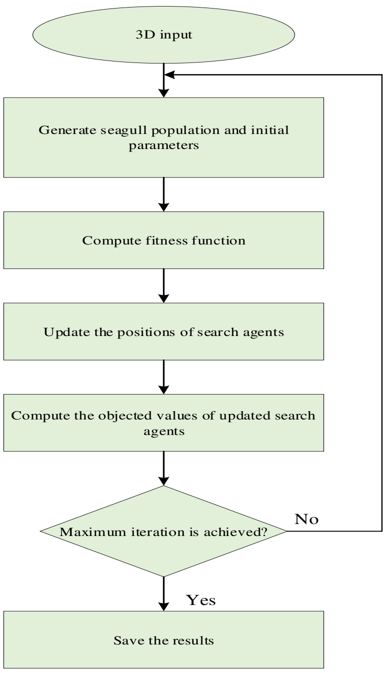

Figure. 2 Flowchart of the proposed methodology

Fitness function

Once the initial population is completed, the fitness function can be computed. Based on the fitness function, the cluster centre and routing strategy is selected. Based on the fitness function, the cluster center and routing process is selected which are utilized to enhance the optimal energy efficient and load balancing process. The SOA is started with a randomly generated population. After that, the search agents have updated their positions based on the optimal search agent under the iteration procedure. The A value can be linearly reduced from the FC to 0. To achieve the smooth changeover among exploitation and exploration, the variable B is accountable. So, the SOA can be careful as the global optimal solution since of its optimal exploitation and exploration capability. Based on AFCM-SOA, the energy efficient and load balancing is achieved in the WSN for agriculture applications.

4. Performance Algorithm

The simulation of this proposed model is implemented using NS2 simulator, the application constraints of the projected technique is obtainable in table 1. The proposed method can be designed to achieve two objective functions such as, load balancing by clustering in addition energy consumption reduction by optimal routing. These objectives are attained with the help of proposed algorithm. The proposed algorithm is combination of clustering and AFCM-SOA. In the clustering approach, the path selection is selected with the assistance of SOA algorithm. The presentation of the proposed method is analyzed in this section by presentation metrics such as delay, drop, throughput, delivery ratio, energy consumption, lifetime, overhead. These parameters are analyzed with conditions. The conditions, the performances of the proposed is evaluated and compared with the already existing methods such as PSO and ASO. The comparison analysis is proving the efficiency of the proposed method. In the WSN architecture, the 100 nodes are created with conditions also analyzed. The application parameters of the projected technique can be presented in table 1.

Table. 1 Implementation parameters

S. No	Description	Value
1	Channel	Wireless channel
2	Propagation	Two ray rounds
3	MAC	802_11
4	Antenna	Omni Antenna
5	Dimension of X	1000
6	Dimension of Y	1000
7	Maximum packets	2500
8	Simulation time	100
9	Initial energy	10
10	Initialization of nodes	100
11	Initial transmit power	0.660
12	Initial receive power	0.395
13	Initial idle power	0.035

The objective functions are load balancing by clustering and energy consumption reduction by optimal path selection. Initially, the node creation of the WSN is illustrated in the figure 6. The mathematical formulation of the performance metrics is presented follows,

Throughput: It is the successful delivery of messages or packets to the destination over a communication channel. It is expressed as in kilobits per second (Kbps) and is denoted as:

$$Throughput = \frac{Numberofbitsreachedthedestination}{1000} \tag{32}$$

Delay: Delay can be defined as time duration gap among receiver node received packet and source node sending a packet. During computing delay, the complete delay functions are considered such as queuing delay, processing delay, transmission delay and propagation delay. This delay function can be formulated as follows,

$$Delay = \sum_{n=1}^{m}(R_n - S_n) \tag{33}$$

Delivery ratio: It can be defined as the transferred end node data which related to the computation of data which was transferred by the transmitter.

Network life Time (NLT): The complete lifetime of the whole network with the consideration of receiver and transmitter lifetime.

Energy consumption: It can be defined as, during communication the node consume energy and firm number of false information are connected into a network.

Drop: The dropped information in the receiver while comparing with the transmitter.

Overhead: The greater number of users are signed in network for access the data which considered as overhead condition. This overhead must be solved by proposed architecture. The performances of the proposed method are analyzed in this section.

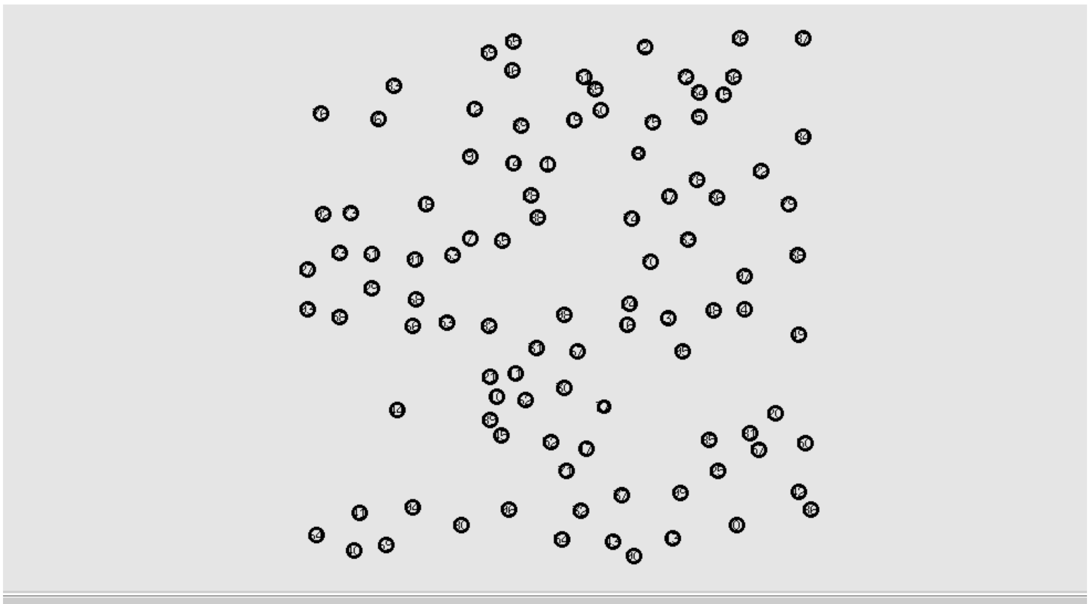

Figure. 3 Initialization of sensor nodes

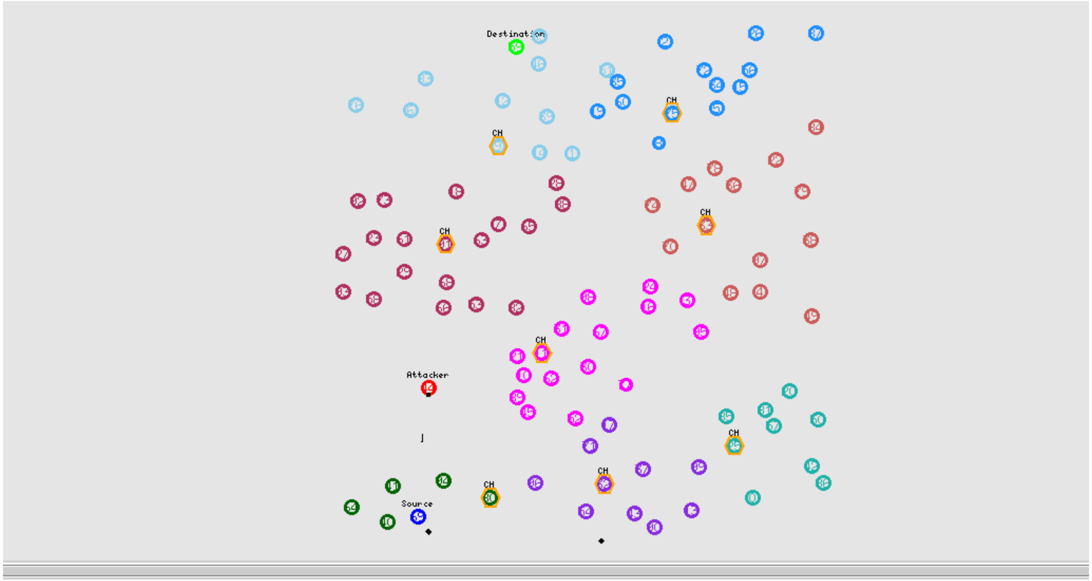

Figure. 4 Initial cluster head selection

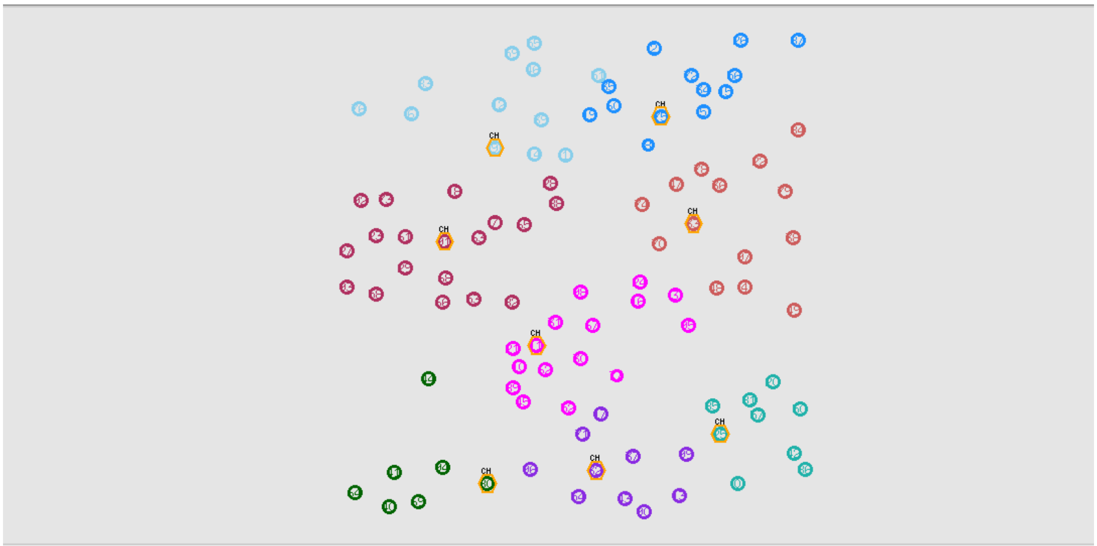

Figure. 5 Cluster formation

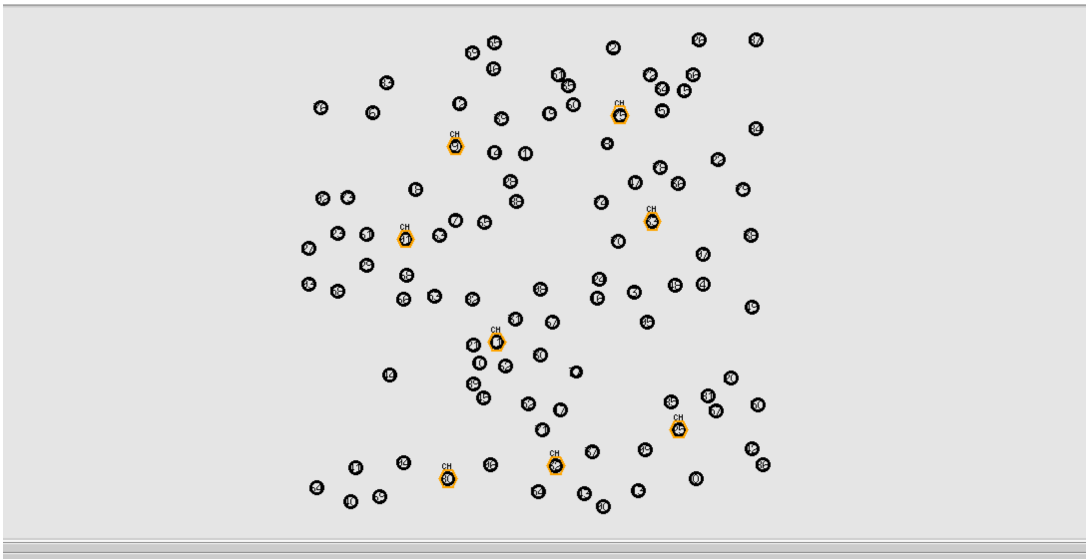

Figure. 6 Cluster head selection

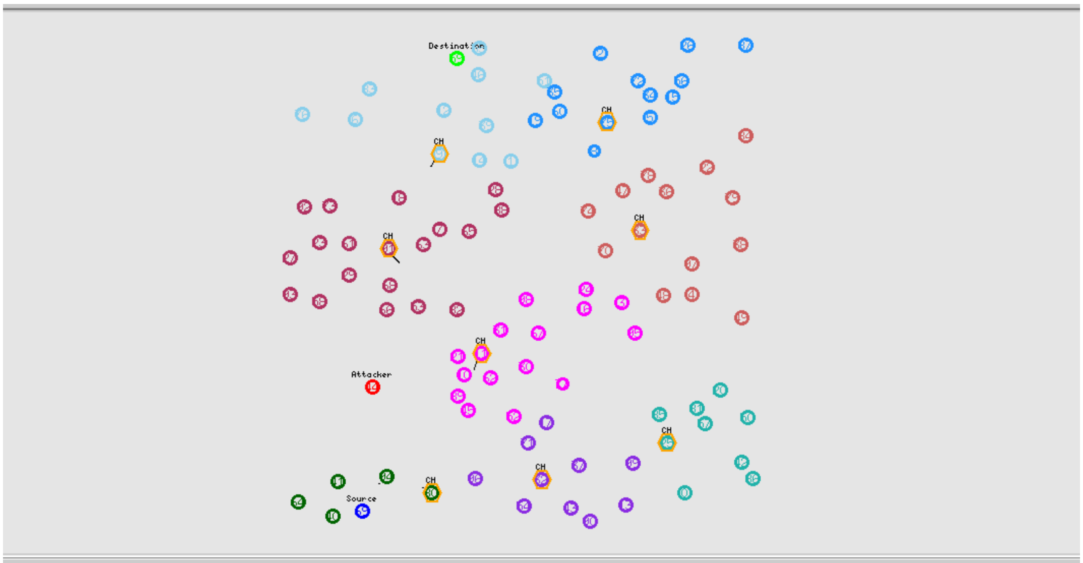

Figure. 7 Optimal routing

The initialization of nodes, initial cluster head selection, cluster formation, cluster head selection and optimal routing conditions are illustrated in the figure 3-7. The cluster formation is formed with the assistance of proposed algorithm. The proposed algorithm is used to formation of cluster by cluster head selection. The optimal clustering techniques used to load balancing the WSN structure. The optimal routing is achieved with the assistance of proposed algorithm which avoiding the extra energy ingesting of the WSN architecture. The cluster head formation is illustrated in the figure 6. And optimal routing procedure of node selection is illustrated in figure 7. The performance metrics are analyzed and presented in follows.

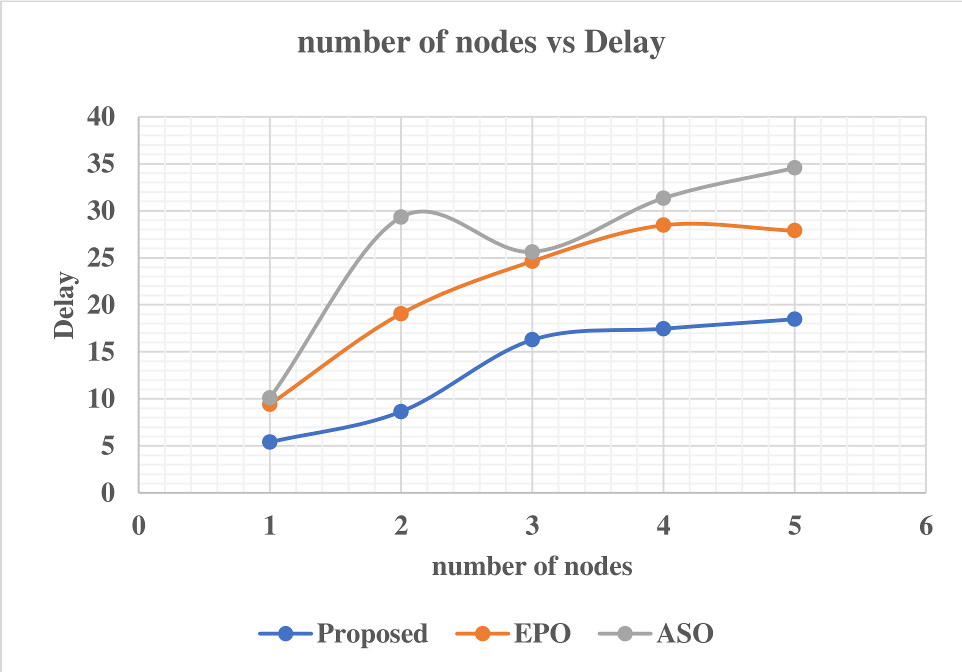

Figure. 8 Analysis of Delay

The number of nodes with delay performance metric is illustrated in figure 8. The projected technique is contrasted with conventional methods EPO in addition ASO algorithm. The delay of the system must be maintained in low level which is considered as best system. The delay of the proposed system is 5 in minimum and 20 in maximum rate. The projected algorithm can be reduced the delay of the system. The EPO algorithm is attained the minimum delay is 10 and maximum delay is 26. Similarly, the ASO algorithm is attained the minimum delay is 10 and maximum delay is 35. From the conclusion, the proposed method is achieved with the low delay which considered as best solution. Compared with the already existing methods, proposed method is providing the best results. The number of nodes with delivery ratio performance metric is illustrated in figure 9. The projected method is contrasted with conventional methods EPO and ASO algorithm. The delivery ratio of the system must be maintained in high level which is considered as best system. The delivery ratio of the proposed system is 0.6 in minimum and 0.9 in maximum rate. The proposed algorithm is reduced the delivery ratio of the system. The EPO algorithm is attained the minimum delivery ratio is 0.7 and maximum delivery ratio is 0.5. Similarly, the ASO algorithm is attained the minimum delivery ratio is 0.1 and maximum delivery ratio is 0.8. From the conclusion, the proposed method is achieved with the high delivery ratio which considered as best solution. Compared with the already existing methods, proposed method is providing the best results.

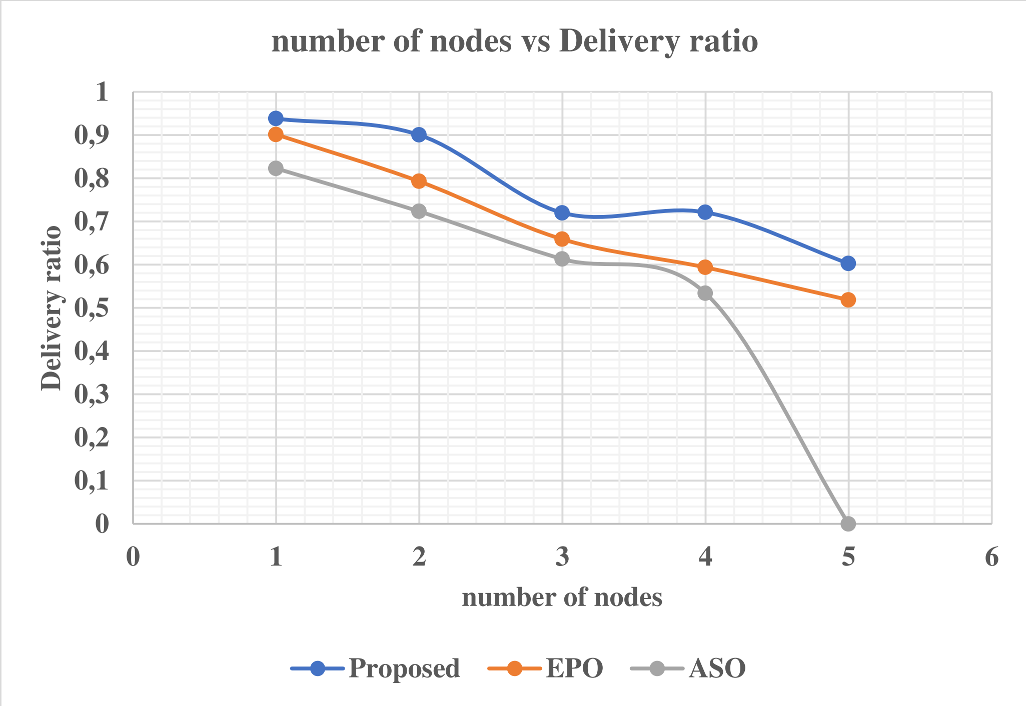

Figure. 9 Analysis of Delivery ratio

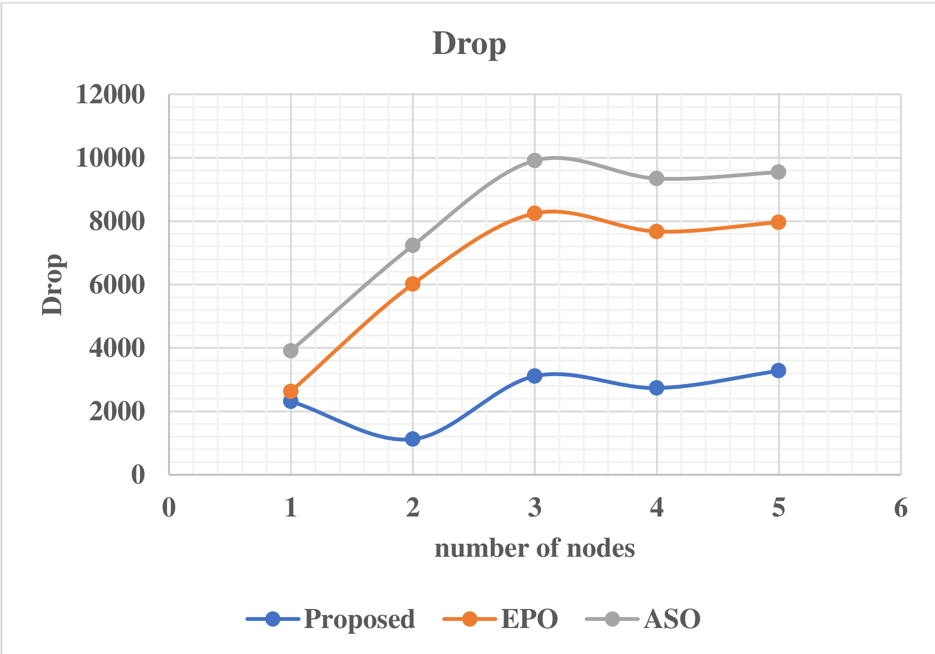

Figure. 10 Analysis of Drop

The number of nodes with drop performance metric is illustrated in figure 10. The proposed method is compared with existing methods EPO and ASO algorithm. The drop of the system must be maintained in low level which is considered as best system. The drop of the proposed system is 2000 in minimum and 2500 in maximum rate. The proposed algorithm is reduced the drop of the system. The EPO algorithm is attained the minimum drop is 2000 and maximum drop is 8000. Similarly, the ASO algorithm is attained the minimum drop is 4000 and maximum drop is 8000. From the conclusion, the proposed method is achieved with the low drop which considered as best solution. Compared with the already existing methods, proposed method is providing the best results. The number of nodes with energy consumption performance metric is illustrated in figure 10. The proposed method is compared with existing methods EPO and ASO algorithm. The energy consumption of the system must be maintained in high level which is considered as best system. The energy consumption of the proposed system is 4 in minimum and 5 in maximum rate. The proposed algorithm is reduced the energy consumption of the system. The EPO algorithm is attained the minimum energy consumption is 10 and maximum energy consumption is 12. Similarly, the ASO algorithm is attained the minimum energy consumption is 12 and maximum energy consumption is 16. From the conclusion, the proposed method is achieved with the low energy consumption which considered as best solution. Compared with the already existing methods, proposed method is providing the best results.

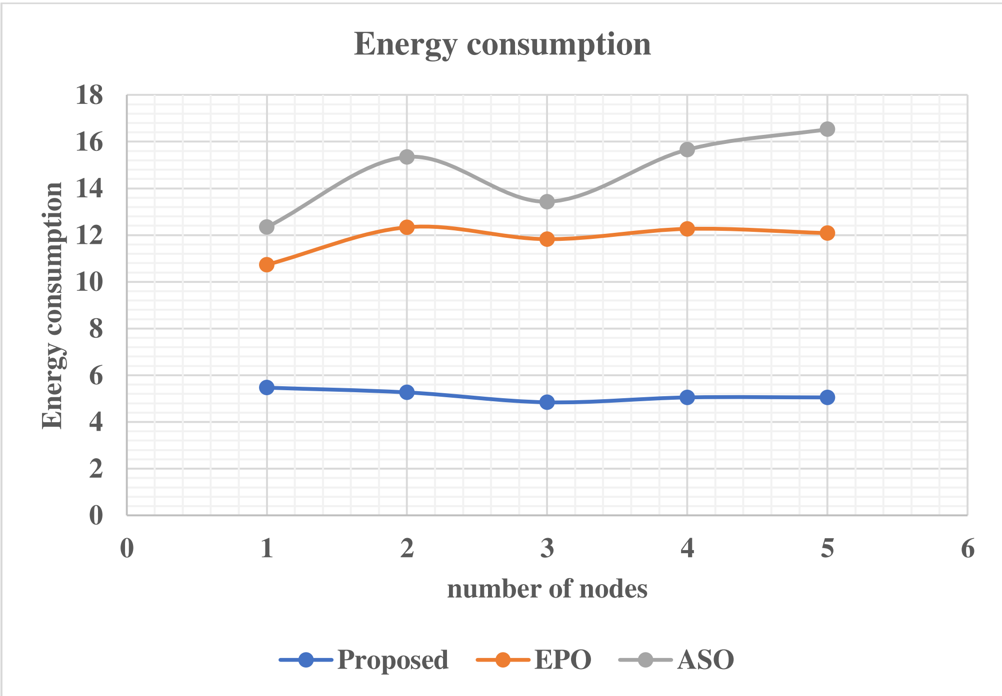

Figure. 11 Analysis of Energy consumption

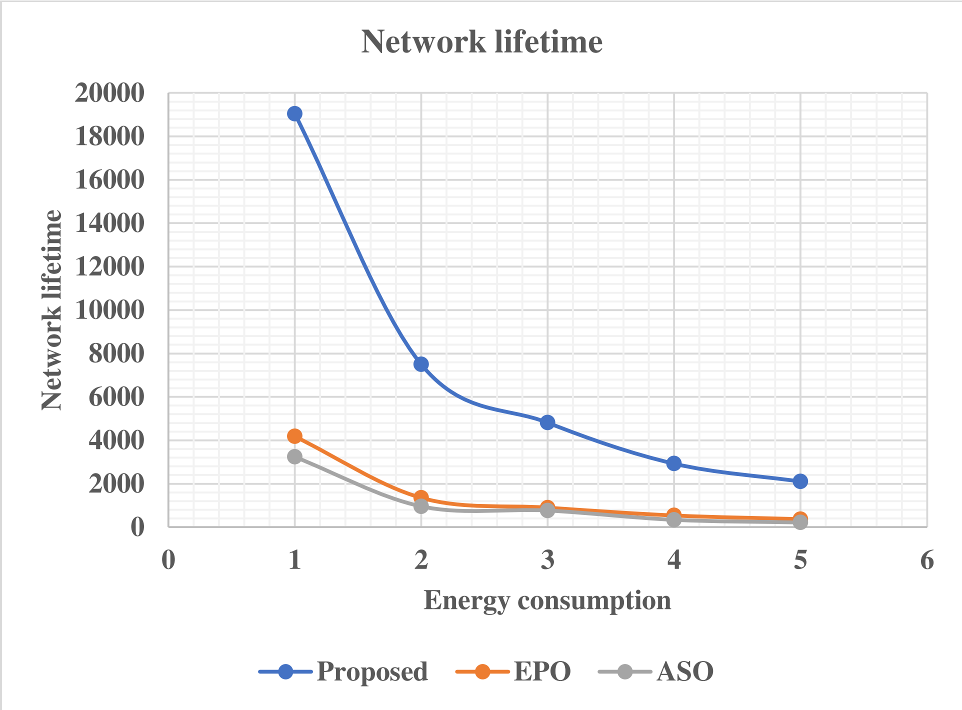

Figure. 12 Analysis of Network lifetime

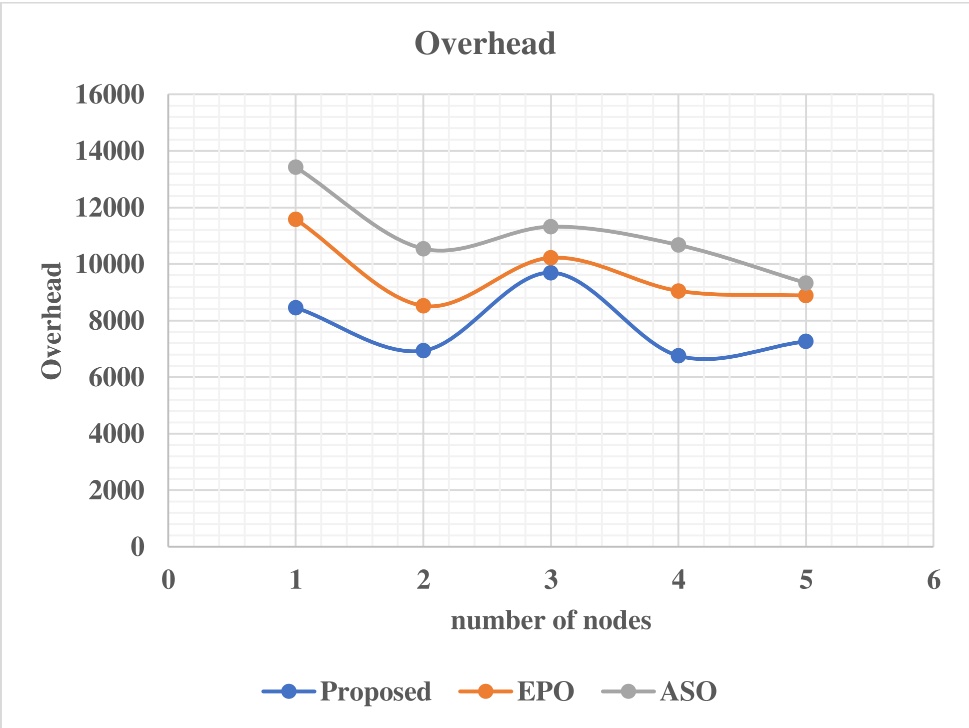

Figure. 13 Analysis of Overhead

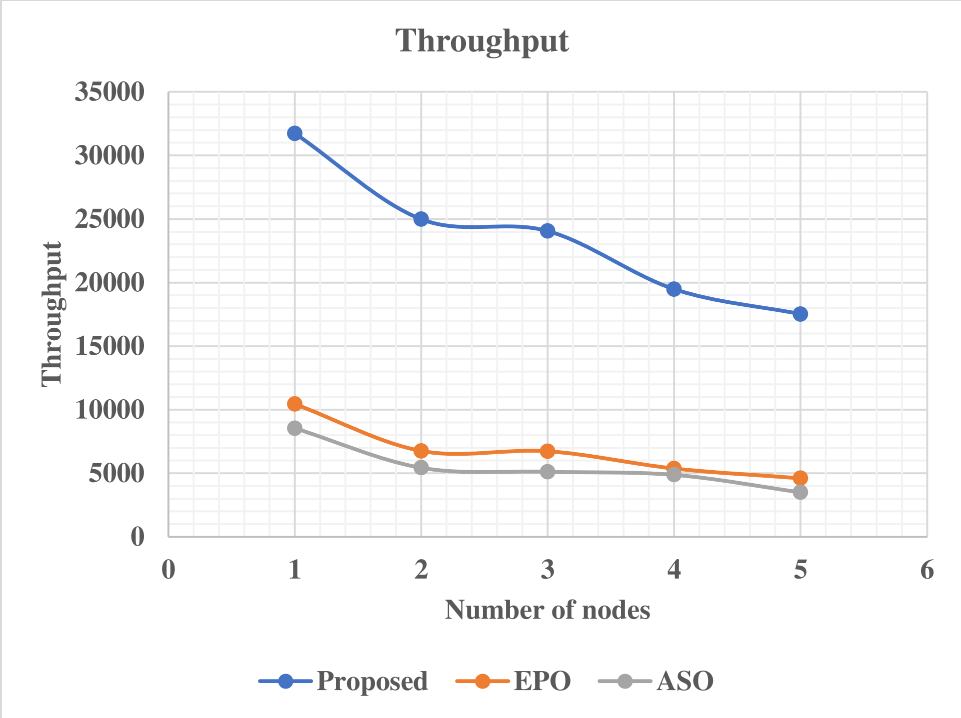

Figure. 14 Analysis of Throughput

The number of nodes with overheads and network lifetime performance metric is illustrated in figure 11 and 12. The proposed method is compared with existing methods EPO and ASO algorithm. The network lifetime of the system must be maintained in high level which is considered as best system. The network lifetime of the proposed system is 4500 in minimum and 20000 in maximum rate. The proposed algorithm is reduced the network lifetime of the system. The EPO algorithm is attained the minimum network lifetime is 2000 and maximum network lifetime is 5000. Similarly, the ASO algorithm is attained the minimum network lifetime is 2000 and maximum network lifetime is 4000. From the conclusion, the proposed method is achieved with the high network lifetime which considered as best solution. Compared with the already existing methods, proposed method is providing the best results. The number of nodes with overhead performance metric is illustrated in figure 13. The proposed method is compared with existing methods EPO and ASO algorithm. The overhead of the system must be maintained in low level which is considered as best system. The overhead of the proposed system is 8000 in minimum and 6000 in maximum rate. The proposed algorithm is reduced the overhead of the system. The EPO algorithm is attained the minimum overhead is 10000 and maximum overhead is 12000. Similarly, the ASO algorithm is attained the minimum overhead is 13000 and maximum overhead is 10000. From the conclusion, the proposed method is achieved with the low overhead which considered as best solution. Compared with the already existing methods, proposed method is providing the best results. The number of nodes with throughput performance metric is illustrated in figure 14. The proposed method is compared with existing methods EPO and ASO algorithm. The throughput of the system must be maintained in high level which is considered as best system. The throughput of the proposed system is 32000 in minimum and 20000 in maximum rate. The proposed algorithm is reduced the throughput of the system. The EPO algorithm is attained the minimum throughput is 11000 and maximum throughput is 6000. Similarly, the ASO algorithm is attained the minimum throughput is 4000 and maximum throughput is 8000. From the conclusion, the proposed method is achieved with the throughput which considered as best solution. Compared with the already existing methods, proposed method is providing the best results.

5. Conclusion

Hence, AFCM-SOA is developed for monitoring environmental conditions in agriculture field. Two main objective functions are utilized to empower the performance of the WSN such as load balancing and energy efficient operation. The proposed method is a combination of Fuzzy C Means Clustering and SOA. The energy efficient and load balancing is achieved by optimal routing scheme by proposed method. The Fuzzy C-Means Clustering is utilized to empower the energy efficient operation and load balancing. In the Fuzzy C-Means Clustering, the SOA is utilized to select the optimal path selection. The proposed method is executed by NS2 simulator and performances are compared with existing methods such as ASO and EPO respectively. The performance metrics are delay, drop, throughput, energy consumption, network lifetime, overhead and delivery ratio. Compared with the conventional methods, the proposed methodology has been achieved best performance. In future, the proposed methodology will be tested with the agriculture data-based energy efficient approach in WSN and IoT.

Data Availability Statement

The data used to support the findings of this study are included within the article.

Funding

Not Applicable

Conflicts of interest/Competing interests

Not Applicable

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