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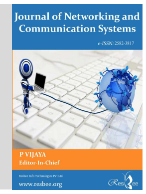

Sensor Activation in WSN using Improved Cuckoo Search and Squirrel Search Algorithm

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Abstract: In Wireless Sensor Network (WSN), the development is augmented and an increased enormous concentration in computer vision. A huge amount of sensors are used to carry out dispersed sensing of the target field in WSN. The existing techniques exploited wireless chargers to provide energy to Sensor Networks (SNs), other than supplied energy is not adequate to control the sensor nodes. Hence, this work presents a method to reduce the energy utilization per node adopting effectual scheduling of sleep/awake of nodes. The technique experiences two stages for the sensor activation such as the initialization stage, and the activation stage. The initialization stage is proposed by a network beginning that is performed to express the network parameters to nodes or sensors. Subsequently, in every slot proposed optimization method is used to activate sensors in the activation stage. The proposed improved cuckoo search and squirrel search optimization approach named (Improved CS-SSA). Hence, the proposed technique produces control in terms of the turn-ON or OFF of sensors that represent active sensors and employ itself in sensing and monitoring distributed environment. The proposed technique performance is superior to other existing techniques through throughput, maximum energy, and alive nodes, correspondingly.

Keywords: WSN; Sensor Nodes; Optimization Method; Energy; Alive Nodes; Throughput

Nomenclature

Abbreviations	Descriptions
WSN	Wireless Sensor Network
BS	Base Station
MWSNs	Mobile WSN
EC	Evolutionary Computing
CH	Cluster Heads
FEC	Forward Error Correction
MCSS	Maximum Coverage Sets Scheduling
ARQ	Automatic Repeat Request
SNs	Sensor Nodes
MIP	Mixed Integer Programming
EH	Energy Harvesting
OPTIC	Optimal Clustering
LBCP	Load Balanced Clustering Problem
HARQ	Hybrid ARQ

1. Introduction

In recent times, WSNs have gained great interest in industrial environments because of the increasing variety of their applications. Wireless sensor nodes are organized in factories to obtain data to prevent several troubles in operations through untimely notifications in real-time procedure control applications. And procedure control applications, preservation of applications for health monitors utensils every so often to identify unforeseen changes and therefore, to evade from maximum repair operating cost and delays offered by the temporary breakdown of machine operational. Moreover, to monitor the environment, industrial mobile robots progress about machines and standardize deployed SNs. In addition, the industrial environment monitoring applications attentive managers if there is any crisis,

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such as seepage of flammable gases or liquids. Utilizing the WSNs benefits, industrial applications are grown self-organizing and self-configuration characteristics.

Moreover, a lot of benefits of WSNs, minimum power communication constraints of SNs persuade packet drops, and mistaken packet deliveries in wireless links. Since noises, and Rayleigh Field interference on wireless channels might imperil consistent communication, using error recognition and improved methods turn out to be necessary to advance the link reliability. Nevertheless, to provide the reliability reasons the considerable energy costs on WSNS because of packet retransmissions or fixed cost of error control strategies. Finally, EH techniques offer a feasible solution for battery-powered industrial SNs to get a better lifetime of the network.

In the literature, there are substantial efforts to deal with utilizing energy-saving and a lifetime of network expansion in WSNs. Dynamic route by utmost remaining battery power. It expanded the lifetime of the network by balancing energy utilization between diverse sensors. Nevertheless, these routing protocols need an association between sensors and therefore establish additional delay. The partitioning of the network into numerous clusters was an additional effectual technique expanding the lifetime of the network. There are a few open problems concerning cluster size optimization, cluster formation, and a selection of clusters. These problems in order reason additional energy utilization, additional fixed cost, otherwise extra latency. Data gathered by neighboring sensors may symbolize superfluous information because of temporal-spatial data correlation. Eradicating redundancy might be helpful regarding energy conservation.

The most important contribution of this work is to propose a technique for data transmission and sensor activation based on energy-constrained SNs. At first, WSN has experimented with energy-constrained SNs, and subsequently; the sensors are activated based on the following stages: a) Initiation stage, b) Activation stage. At first, the WSN is initialized to express parameters of network to SNs. Subsequently, the activation stage is performed to activate SNs based on proposed Improved CS-SSA. The Improved CS-SSA method is proposed through the hybridization of the CS and SSA. Next initializing the SNs in WSN, sensor activation is performed, to state if to turn-on sensor or turn-off sensor via proposed fitness functions. The fitness function has weights and residual nodes for estimation. Hence, in a distributed area the optimally controlled sensors gain itself in monitoring and sensing a distributed environment.

2. Literature Review

In 2020, Xiu Zhang et al [1], studied the life of MWSNs. MWSNs was an extraordinary kind of WSN in which the SNs were changeable in a definite area. A system model was proposed to extend the lifetime of the network for MWSNs. This work exploits five EC techniques to extend the lifetime of the MWSN optimization model. In 2020, Amrita Ghosal et al [2], addressed the issue of maximization of a lifetime in WSNs by formulating a new clustering method whereas clusters were created energetically. In particular, the network lifetime was analyzed at first maximization issue by balancing the energy utilization between CH. An optimal clustering method, in that the cluster radius was calculated exploiting discontinuous direction technique of multiplier based on the analysis was provided. A novel On-demand, an OPTIC algorithm for WSNs was proposed. In 2020, Nazli Tekin and Vehbi Cagri Gungor [3], presented lifetime analysis for error control techniques that were FEC, ARQ, and HARQ in diverse industrial environment channel circumstances. Moreover, the effect of energy yielded techniques on the lifetime of the network was examined. A new MIP framework was proposed to extend the lifetime of the network whilst gathering application consistency. In 2019, Chuanwen Luo et al [4], investigated the MCSS issue: presented a coverage set gathering in that every coverage set covers all targets in WSN. The issue was to discover practicable scheduling for coverage set gathering to make the most of the lifetime of the network. Initially, the MCSS issue was NP-hard was proven. Next, the issue as an integer linear programming issue was formulated. Finally, a greedy method, named Greedy-MCSS, to resolve the MCSS problem was proposed. In 2020, Ramin Yarinezhad, Seyed Naser Hashemi et al [5], presented a cluster-based routing protocol for WSNs. It resolves LBCP using an FPT -estimate method which encompasses an estimated factor of 1.1 which means it was considerably additional accurate than preceding approximation factors stated for this issue. The proposed protocol exploits an energy-aware routing method to discover the optimal routing tree which links Cluster Heads to the base station. In 2019, LiuYang et al [6] proposed two censoring methods that permit SNs to create decisions locally on whether to broadcast sampled data. The proposed method can expand the network lifetime using a minimum loss of performance. In 2020, Artur Mikitiuk and Krzysztof Trojanowski [7], presented 3 heuristic methods for sensors activity scheduling. An arbitrary and fine-tuning method, a method enthused by cellular automata, and a hypergraph technique was proposed. As a result of these methods do not stand for best solutions and can be additionally enhanced, the attained schedules as an input for a local search scheme.

3. System Model of WSN

The system model of WSN is explained in this section. WSN comprises SNs and BS using every SNs equipped by means of memory, processor, power unit, and transceivers. Multiple SNs are used in the WSN to sense the network in the model. Hence, while the node is in an active state, it is used for transmission of data and reception, when if the node is in an inactive state, a node not at all engages in the transmission of data to store energy to expand network lifetime. The lifetime of the network is a significant metric to monitor and sense motivation. It might unsuccessful to fulfill the monitoring needs due to diverse causes, such as SNs expiration, and network disconnection in WSN. Hence, if one inclination to possess the WSN to develop provided that probable without put back nodes, and batteries, subsequently it obligatory to raise their energy. Hence, this work explains an effectual method to increase the energy of the SNs to increase the lifetime of the network. Let A SNs $a_1,a_2,...,a_A$ are arbitrarily positioned in WSN to cover B targets $b_1,b_2,...b_B$. Each SN presents initial energy H and obtains the capability to alter itself for transmission of data. The sensing range choice is $s_1,s_2,...s_l$ regarding energy utilization $h_1,h_2,...,h_l$. Also, the BS is positioned in the communication range of every sensor to aid the efficient transmission of data. Moreover, the main motivation is to arrange the set of sensors so that it is in charge of sensing the targets and all other sensors in a sleep mode. The objective is to minimize the transmission of energy by the possession of SNs in sleep mode that is not embraced in the transmission of data in order to minimize the lifetime of the network. Fig. 1 demonstrates the system model of WSN.

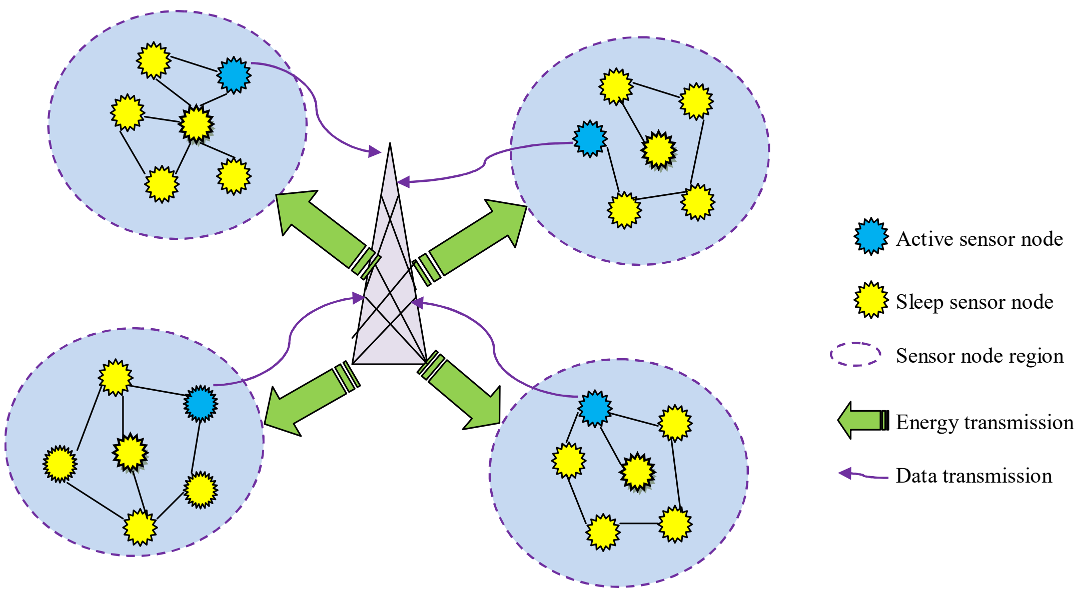

Fig. 1. *System model of a WSN*

4. Proposed Model for Extending Network Life Time in Sensor Activation

In WSN, the sensor activation model exploiting proposed algorithms to augment sensor network lifetime is illustrated in this section. In addition, the experimentation area of WSN is experimented with exploiting energy-constrained sensors that are in charge to initiate sensing and monitoring distribution area in their sensing range. In addition, every senor is restricted to its sensing range and transmission range and confirms that no two sensors are positioned in a similar place. The lifetime of the network is formulated based on occupied sensors in transmission and sensing. Therefore, sensor activation form is formulated by keeping sensors activated using scheduling sensors, to determine if to keep sensors on or to a turn-off that conversely improves the network lifetime. The activated schedule comprises a series of sensor covers that is activated in consecutive slots so that individual sensor in activated sensor cover clenches nonzero energy. The activated schedule experiences two stages called the initialization segment and the activation segment. The initialization segment is carried out by an initializing network to present network parameters of SNs. In the activation stage, the proposed method is in charge of activating the SNs in every slot. The proposed improved CS is used to control the sensors if to ON the sensor or to OFF. The sensor indicates turn-on states' active mode of sensors when other state's sensors sleep state, which is determined based on the needs of nodes in the transmission of data. Hence, optimally-controlled sensors attract in sensing and monitoring in a distributed area distributed environment.

For sensor activation, the optimized sensor activation algorithm is exploited to manage WSN nodes. Moreover, the SN lifetime is expanded by stating link stability status. Hence, the network model is taking into consideration for sensor activation, if to turn-on or off based on definite techniques that include mobility technique, energy technique, and a lifetime of link. The energy model is calculated to identify the residual energy of nodes included in the communication. In addition, the mobility model is used to determine nodes location exploiting average directions and velocities. Subsequently, the lifetime of the link can be used to measure the reasonableness of the routes to attain efficient transmission of data. Moreover, the activation of the sensor is performed exploiting two stages: Initial stage is the initialization stage, and next, is the activation stage.

4.1 Initialization Stage

In WSN, the network model is estimated regarding energy, a lifetime of the link, and mobility models in the initialization stage. The concise design of these techniques is explained in this section.

4.1.1 Energy model

In this section, the energy model [8] to attain efficient transmission of data is demonstrated in WSN. Every node in attendance requires substantial energy to contribute to the transmission of data in WSN. Since WSN is powered using the battery, nodes in network utilize energy supplied more than the battery for effectual communication. At first, the transmission of energy over battery is filled throughout communication, other than after the transmission energy is gradually reduced that is stated as residual energy and it is devised as,

$$E_t^r(u+1) = E_t^r(u) - E_t^P \times b(u,u+1) - E_t^Q \times b(u,u+1) \tag{1}$$

In eq. (1), E_t^P indicates the energy needed to transfer an information bit, $E_t^r(u)$ indicates node energy t at the time u, E_t^Q is energy utilized by a node to receive a bit, and b indicates a number of bits transferred from time u to time $u+1$, . The energy utilized for transmission of data is stated by enchanting the dissimilarity among initial energy and residual energy and it is indicated in eq. (2)

$$E^C = E_t - E_t^r \tag{2}$$

In eq. (2), E_t^r is the residual energy, E^C indicates the utilized energy, $E_t = 1$, that is the initial energy.

4.1.2 Mobility model

It [8] is used to describe the movement of the nodes and to assess modify in position, acceleration, and velocity regarding the time. The mobility model is exploited to determine SNs performance whilst broadcast data. The technique is used to imitate real-life applications in a sensible way. Let first location of the node as t and w by means of location (y_1,z_1) and (y_2,z_2). The nodes t and w changes its location based on the variable velocities in a precise direction by means of angles ϕ_1 and ϕ_2 in the positive x-axis. The node t is enthused to a distance D_1 and the node w is enthused to distance D_2. in time $u=0$ to u. After mobility, in time u,, nodes t and w transmits to a novel location $l(y_3,z_3)$ and $m(y_4,z_4)$. Hence, the Euclidean distance $D_{(tw,0)}$ among nodes t and w at $U=0$ it is stated in eq. (3).

$$D_{(tw,0)} = \sqrt{|(y_1 - y_2)|^2 + |(z_1 - z_2)|^2} \tag{3}$$

Let node t and w alters its location in a variable velocity v_1 and v_2 assembly a n angle ϕ_1 and ϕ_2 by means of the x-axis, distance D_1 and D_2 traveled by a node in a definite time u and it is stated as below:

$$D_1 = v_t \times u \tag{4}$$

$$D_2 = v_t \times u \tag{5}$$

By the time $U=u$, while node $t(y_1,z_1)$ moves at distance D_1 creating an angle ϕ_1 with x-axis and the novel location of the node w is, $l(y_3,z_3)$. Hence, the value of (y_3,z_3) in time u is stated as below:

$$y_3 = y_1 + v_t \times u\mathrm{Cos}(\phi) \tag{6}$$

$$z_3 = z_1 + v_t \times u\mathrm{Sin}(\phi) \tag{7}$$

Likewise, while a node t and w moves to a new location $l(y_1,z_1)$ and $m(y_4,z_4)$

$$y_4 = y_2 + \nu_w \times u\mathrm{Cos}(\phi) \tag{8}$$

$$z_4 = z_2 + \nu_w \times uSin(\phi) \tag{9}$$

While a node t and w moves to a new location $l(y_3, z_3)$ and $m(y_4, z_4)$, subsequently the new distance and it is stated as below:

$$D_{(tw,u)} = \sqrt{|(y_3 - y_4)|^2 + |(z_4 - z_3)|^2} \tag{10}$$

In eq. (10), $D_{(tw,u)}$ indicates the distance among two nodes t and w with location $l(y_3, z_3)$ and $m(y_4, z_4)$

i) Cumulative distance

It is stated as the distance from a sender to a transmitter, taking into consideration the distance values calculated hitherto. It is estimated by the sum of distance data as it produces regarding time.

$$D_t = \sum_{\substack{t=1 \\ w \neq t}}^{G} D'_{t,w} \tag{11}$$

In eq. (11), G indicate neighborhood.

4.1.3 Lifetime of link model

The lifetime of the link model [9] is used to estimate the link lifetime concerning the nodes. In the network, the link for routing data packets is recognized, consequently that the nodes in the link are exploited to form the best paths. The link splintering is a general issue in routing information from one SN to other SN that happens because of the dynamic behavior of the network. Therefore, the lifetime of link estimation is necessary to reduce the stoppage, as this affects the procedure of path collection. The lifetime of the link is calculated based on nodes mobility, its coordinates, and direction. Presume nodes t and the w in-network located at $l(y_3, z_3)$ and $m(y_4, z_4)$ correspondingly. The link that subsists among these nodes facades the lifetime of link as stated in eq. (12).

$$L_{t,w} = \frac{-(gh + de) + \sqrt{(g^2 + e^2)k^2 - (ge - dh)^2}}{(g^2 + e^2)} \tag{12}$$

In eq. (12), g, h, d, and e indicates parameters and k indicates transmission range, and it is stated in eq. (13).

$$\left.\begin{aligned} g &= A_t \cos\varphi_t - A_w \cos\varphi_w \\ h &= y_3 - y_4 \\ d &= A_t \sin\varphi_t - A_w \sin\varphi_w \\ e &= z_3 - z_4 \end{aligned}\right\} \tag{13}$$

In eq. (13), A_w indicates the speed of the node w, A_t indicates mobility speed for the node t, φ_t indicates the motion direction of the node t, and φ_w indicates the motion direction of the node w.

i) The cumulative lifetime of the link

It is similar to link lifetime that is calculated exploiting a definite time period at that all SNs in attendance in WSN is used for estimation, G indicates the total count of neighborhood nodes.

$$L_t^C = \sum_{\substack{t=1 \\ w \neq t}}^{G} L_{t,w} \tag{14}$$

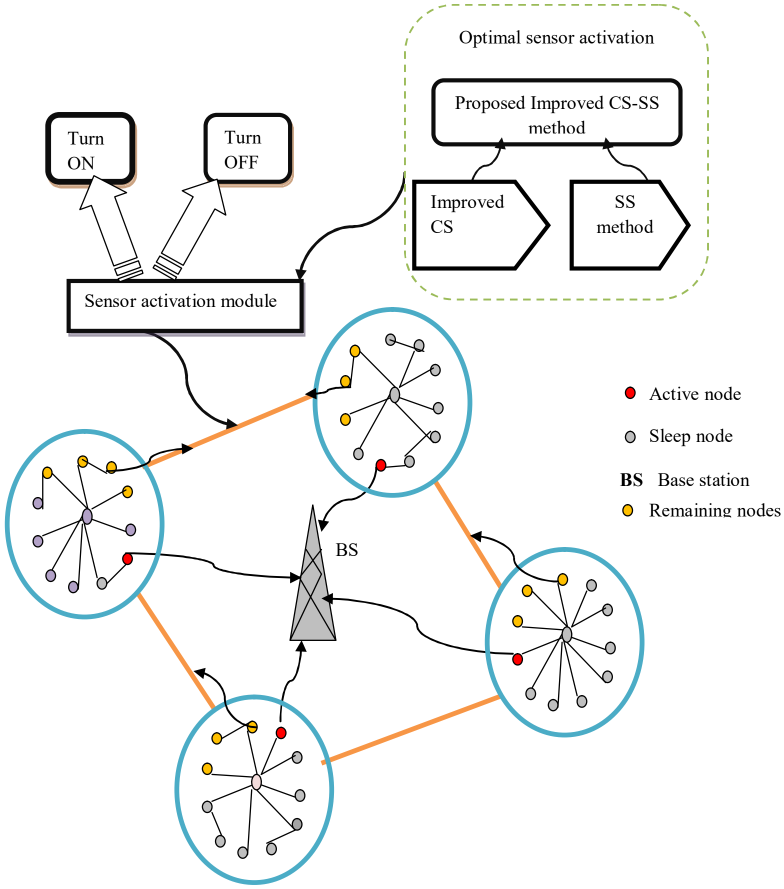

Fig. 2. *Schematic model of sensor activation exploiting proposed model*

4.2 Sensor Activation

The sensor activation is a procedure to activate SNs at the transmission of data. Hence, a proposed sensor activation algorithm is modeled to advance energy-quality tradeoff. The method is adopted is based on definite target manoeuvre, and alteration of activated range to evaluate the tracking quality. In WSN the SNs are in charge to perform diverse tasks with diverse sensing targets in a concurrent way. The sensing task comprises multiple sensors to attain the effectual quality of sensing. Moreover, the sensor activation method is used based on two schemes: Initially, it is to enhance the accurateness and expand a choosy node activation method which awakes the sensors regarding the predicted path of the target from its sleeping mode. The equivalent sensor activation method tends to create an effectual performance of the network and it is obtained by expanding network lifetime. In this method, cumulative link lifetime, energy, cumulative distance, and transmission range is represented for estimation. Hence, the study is performed based on the energy position of SNs and produces the consequence based on two factors which are energy income and energy dispatch. In this network, energy income is estimated based on the recharge rate of WSN, and energy dispatch is attained by the sensor activation method by the proposed method. Initially, the total SNs present in the system is estimated and subsequently, the activation of SNs is performed to calculate the number of SNs in active mode and the count of SNs in sleep mode. Subsequently, in the WSN the residual nodes present are estimated to determine the mode that the residual SN adapts. Hence, the proposed method is used to find the mode of residual SN that able to either sleep mode or active mode. Therefore, the SNs are switched to active mode from sleep mode frequently. Fig. 2 states the schematic diagram of sensor activation exploiting the proposed model.

5. Proposed Approach for Sensor Activation in WSN

5.1 Fitness Function

From a set of solutions, fitness is estimated to determine the best solution. By the weights and the residual nodes, the fitness function of the proposed method is calculated. Moreover, the fitness is taking into consideration as an utmost function. Hence, the solution producing the utmost fitness is taking into consideration as the best solution. Therefore, the solution presenting the utmost fitness value is taking into consideration for sensor activation. The fitness of the proposed method is calculated exploiting weight ω engaged by residual nodes D, whereas $1 \le D \le A$ and A is the total count of nodes in WSN, and the fitness is devised in eq. (15).

$$M = \sum_{j=1}^{f} \omega_j * D_j \tag{15}$$

whereas, D_f indicate the residual nodes and ω_j indicate the weights.

5.2 Proposed Improved CS- SS model

The CS model enthused by parasitic traits of cuckoo bird [10] is proposed. The fundamental objective is to use novel solutions to alternative weak solutions in nests. Furthermore, a cuckoo bird carried out:

Levy flight when producing novel solutions. The novel solution for the subsequent generation is stated in eq. (16).

$$Y_i(h+1) = Y_i(h) + \alpha \otimes \text{levy}(\lambda) \tag{16}$$

In eq. (16), $Y_i(h+1)$ states search position of similar cuckoo in the subsequent generation and $Y_i(h)$ state the current search position of a cuckoo i. In addition, α states step size frequently measured one, and $\otimes$ indicate element-wise multiplication operator like which exploited in PSO. $\text{levy}(\lambda)$ indicate arbitrary walk employing Levy flight. The Levy distribution can be estimated as $\text{levy} \approx u = t^{-\lambda}$ for λ ranging from [1 to 3]. The Levy step used trendy Mantegna's procedure [13] is indicated in eq. (17).

$$\text{levy} = \frac{u}{|v|^{1/(\lambda-1)}} \tag{17}$$

To control step size a new method is combined to produce CS adaptive. The step size is stated concerning the fitness value of individual nests for the current generation in the search domain. Therefore, α is ignored that is fixed in the traditional CS method. The adaptive step size is stated in eq. (18).

$$\text{step}_i(h+1) = \left(\frac{1}{h}\right)^{\left|\frac{\text{best } f(h) - f_i(h)}{\text{best } f(h) - \text{worst}(h)}\right|} \tag{18}$$

In eq. (18) h states the current generation, $f_i(h)$ indicates the fitness function value of i^{th} nest in g^{th} a generation, and $\text{bestf}(h)$ and $\text{worstf}(h)$ indicates the optimal objective function value and the worst fitness function value of the present generation, respectively. The aforesaid formulation produces step size adaptive. It reduces with maximizing in the count of generations. Currently, a new solution for the subsequent generation is indicated as below:

$$Y_i(h+1) = Y_i(h) + rn \times \text{step}_i(h+1) \tag{19}$$

A brief explanation of the Improved CS technique is described in [11].

The Squirrel Search (SS) method is recent evolutionary computing methods inspired by searching manners of southern flying squirrels and an effectual form of the movement named gliding [12]. The squirrels demonstrate a dynamic foraging scheme to optimally exploit nutrient resources. In the forest region, for each squirrel initial location is uniformly distributed and it is stated in eq. (20).

$$FS_i = FS_L + rn(0,1) \times (FS_U - FS_L)) \tag{20}$$

whereas FS_L and FS_U are the upper and lower location limits correspondingly of i^{th} flying squirrel. $rn(0,1)$ indicates a uniformly distributed arbitrary count ∈ [0,1].

The attendance of predator cautions squirrels, and they use the minimum arbitrary walk to discover a neighboring hiding place. For optimum nutrition source the dynamic searching activities of flying squirrels are shown as below:

$$FS_{at}^{h+1} = \begin{cases} FS_{at}^{h} + d_h \times G_c \times \left(FS_{at}^{h} - FS_{at}^{h}\right); & R_1 \ge P_{dp} \\ \text{Random location} & \text{Other wise} \end{cases} \tag{21}$$

whereas R_1 specifies an arbitrary figure within [0,1], d_h specifies an arbitrary flying distance, FS_{at} specifies the location of a squirrel on acorn nut tree, FS_{ht} specifies the location of the squirrel obtaining the optimum food source (hickory nut tree), G_c specifies the gliding constant that balances exploitation and exploration, and h specifies the current iteration.

The synergistic behavior of Improved CS employing superior exploitation and exploration capacity and dynamic foraging behavior of Squirrel Search has enthused to propose a hybrid Improved CS-SS technique for this application. Further, this will enhance exploitation and the exploration capacity of Improved CS. Hence, in this paper hybrid method of Improved CS-SS is used. Moreover, the constraint-handling model is combined with the proposed techniques in this paper.

The Improved CS-SS method to increase edge magnitude is proposed. The discovering is evaluated with executions of Improved CS, such as SS, and CS methods are stated in this paper. The Improved CS method exploits the Levy flight characteristics of cuckoo by means of adaptive step size. The SS method exploits a dynamic foraging behavior of flying squirrels. The proposed Improved CS-SS method is a hybrid optimization model. Moreover, the adaptive step size feature of the Improved CS method is supplemented by the dynamic foraging behavior of the SS model. These outcomes in an enhanced convergence.

For next-generation, novel solution in Improved CS-SS method is stated as below:

$$Y_i(h+1)=\begin{cases}Y_i(h)+f_h\times F_c\times(bestf(h)-Y_i(h)); rn<p\\ Y_i(h)+rn\times step_i(h+1); \text{ otherwise}\end{cases} \quad (22)$$

Where as F_c indicates a flying constant to balance exploitation and exploration, f_h indicates an arbitrary flying distance of the cuckoo, proposed to furthermore improve the Improved CS algorithm performance. The rn value is among [0,1], and if this value is lesser than mutation probability, the cuckoo will use small steps to improve exploration. If the value of rn is higher than mutation probability, it will use adaptive steps to improve exploration.

Algorithm 1: Pseudo code of the proposed method

Initialize number of nests (N) arbitrarily
Set the flying constant (Fc), mutation probability (*pa*), and a count of iterations;
Describe the fitness function exploiting eq. (15);
Initially set generation (g) = 1 and estimate the fitness function (15) for all the nests;
while
Calculate bestf and worstf of fitness model values for the current generation,
Calculate adaptive step size exploiting Eq. (18),
Calculate the new position of nests exploiting Eq. (22),
Once again calculate fitness function
Select a nest (say j) arbitrarily,
if fitness(j) > fitness(i) exchange nests i and j
End
The worst nests are redundant exploiting mutation probability and novel nests are build at novel positions;
Increment $h = h + 1$;
while (h ≤ max iterations) or end criterion not fulfilled.
Optimal solutions are ranked and detailed.

6. Result and Discussion

6.1 Experimental Procedure

The outcomes of the conventional techniques regarding the proposed technique were shown and the effectiveness of the technique was established through the performance analysis of the techniques in this section. Moreover, the experimentation was carried out exploiting the WSN nodes arranged in the cluster. Here, the analysis is based on the number of nodes, which consists of 50, 100 nodes. Moreover, the alive nodes, energy, and throughput were considered for proposed and conventional methods such as Cuckoo Search (CS), Artificial Bee Colony (ABC), and Grey Wolf Optimization (GWO).

6.2 Performance Analysis

Table 1 summarizes the analysis of the techniques based on the estimation measures, throughput, alive nodes, and energy with 50 nodes and 100 nodes. Moreover, the alive nodes, throughput, and energy are considered at the end of the communication exploiting the proposed model with conventional ABC, CS, and GWO methods. The overall analysis states that the proposed technique is better than existing techniques.

Table 1. *Performance analysis of proposed and exiting techniques*

Methods	Number of nodes	Alive nodes	Energy	Throughput (%)
CS algorithm	50	8	0.099	85
	100	8	0.056	86
ABC algorithm	50	8	0.098	86
	100	9	0.063	85
GWO algorithm	50	8	0.113	85
	100	9	0.062	86
Proposed method	50	10	0.122	85
	100	12	0.088	87

6. Conclusion

This work proposes policy for data communications in WSN via presenting the Improved CS-SS approach to start the communication in SNs to reduce energy utilization by presenting effectual scheduling of sleep/awake of nodes. The proposed Improved CS-SS was the hybridization of the CS and SS algorithm. Moreover, the proposed algorithm was processed in two stages, like the initialization stage, and activation stage. The network initiation was carried out to state the network parameters in the initialization stage. Subsequently, the proposed optimization approach was used to execute the activation of the sensor in every slot in the second phase. Hence, the proposed method produces control concerning the sensor ON or OFF that indicates active sensors as maintained by transmission requirement. Hence, in a distributed area the optimally controlled sensors connect in sensing and monitoring distributed environment. The examination of the techniques was performed exploiting the performance measures; throughput, energy, and alive nodes in addition to the analysis disclose the efficiency of the proposed technique which obtained the maximum throughput, energy, and alive nodes correspondingly.

References

[1] Xiu Zhang, Xiaohui Lu, Xin Zhang,"Mobile wireless sensor network lifetime maximization by using evolutionary computing methods", Ad Hoc Networks,Volume 10115, April 2020.

[2] Amrita Ghosal, Subir Halder, Sajal K. Das,"Distributed on-demand clustering algorithm for lifetime optimization in wireless sensor networks", Journal of Parallel and Distributed Computing, Volume 141,July 2020,Pages 129-142.

[3] Nazli Tekin, Vehbi Cagri Gungor,"The impact of error control schemes on lifetime of energy harvesting wireless sensor networks in industrial environments" Computer Standards & Interfaces, Volume 70June 2020.

[4] Chuanwen Luo, Yi Hong, Deying Li, Yongcai Wang, Qian Hu," Maximizing network lifetime using coverage sets scheduling in wireless sensor networks", Ad Hoc Networks,Volume 981, March 2020.

[5] Ramin Yarinezhad, Seyed Naser Hashemi,"Increasing the lifetime of sensor networks by a data dissemination model based on a new approximation algorithm",Ad Hoc Networks,Volume 1001, April 2020.

[6] Liu Yang, Hongbin Zhu, Haifeng Wang, Kai Kang, Hua Qian," Data censoring with network lifetime constraint in wireless sensor networks", Digital Signal Processing, vol 92September 2019, pp 73-81.

[7] Artur Mikitiuk, Krzysztof Trojanowski,"Maximization of the sensor network lifetime by activity schedule heuristic optimization", Ad Hoc Networks,Volume 96, January 2020.

[8] Yadav, A.K. and Tripathi, S., "QMRPRNS: Design of QoS multicast routing protocol using reliable node selection scheme for MANETs," Peer-to-Peer Networking and Applications, volume.10, number.4, page no.897-909, 2017.

[9] Balachandra, M., Prema, K.V. and Makkithaya, K., "Multiconstrained and multipath QoS aware routing protocol for MANETs," Wireless networks, volume.20, number.8, page no.2395-2408, 2014.

[10] Yang, X.S., Deb, S.: Cuckoo search via Levy flights. In: World Congress on Nature and Biologically Inspired Computing, pp. 210–214. IEEE (2009).

[11] Naik, M.K., Panda, R.: A novel adaptive cuckoo search algorithm for intrinsic discriminant analysis based face recognition. Appl. Soft Comput. 38, 661–675, 2016.

[12] Jain, M., Singh, V., Rani, A.: A novel nature-inspired algorithm for optimization: squirrel search algorithm. Swarm Evol. Comput. 2018.

[13] Mantegna, R.N.: Fast, accurate algorithm for numerical simulation of Lévy stable stochastic processes. Phys. Rev. E 49(4), 4677–4683 (1994).

[14] Praveen Kumar Reddy M,Rajasekhara Babu M,"Cluster Head Selection in IoT Using Enhanced Self Adaptive Bat Algorithm",Journal of Networking and Communication Systems (JNACS), Volume 2, Issue 4, October 2019.

[15] Kale Navnath Dattatraya,Raghava Rao K,"Hybrid FruitFly Optimization Algorithm and Wavelet Neural Network for Energy Efficiency in WSN",Journal of Networking and Communication Systems (JNACS), Volume 3, Issue 1, January 2020.

[16] Rama Rao A,Valli Kumari V,Satyananda Reddy Ch,"Self Adaptive Harmony Search Algorithm for QoS Routing in MANET",Journal of Networking and Communication Systems (JNACS), Volume 3, Issue 1, January 2020.