An improved Whale Optimization Approach for Effective Data Transmission for IoT Communication

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Abstract — Internet of Things (IoT) offers interconnection among several wireless communication devices for the provision of device accessibility and in-built capacity. IoT provides device interaction and provision of advantages capability for networking and socialization with consideration of intermediate devices. Through innovation in technology IoT devices convert cyber environments with hyper-connectivity. IoT communication contains several smart devices such as body sensors, smartphones, tags, electronic gadgets, and so on. IoT communication is involved in the provision of heterogeneous connectivity among devices for the provision of interface and connectivity for enhancing service quality. The data sending among IoT devices is affected by several threats that have an impact on the network's performance. To overcome the limitation related to IoT communication, it is necessary to develop an appropriate technique for enhancing IoT network communication performance. In this research developed a multi-channel routing approach is adopted in IoT communication. The developed approach utilizes a meta-heuristics approach with probability-based characteristics. For the meta-heuristics approach this research utilizes whale optimization technique combined with probability characteristics for improving the IoT communication performance of the network. The proposed approach utilizes initially constructs the IoT communication path for information sharing and gathering. This path information is identified through the objective function of a meta-heuristic approach. Based on the objective function hoping between the devices is minimized through which data are transmitted in the network. Simulation is performed as a unique proposed approach with a coverage area of 100 meters. For identification of the optimal path in the network, WOA identifies the path of communication through probability function. Comparative analysis of research exhibited that WOA provides significant performance with the identification of optimal value at the range of 1.0746e-78. Further, the proposed probability-based WOA approach significantly improves the performance of the IoT network.

Keywords — The Internet of Things (IoT), Meta-heuristics, Whale Optimization, Multi-path, Optimal path.

I. INTRODUCTION

The Internet of Things (IoT) provides interconnection of variant wireless communication devices which offers ubiquitous accessibility of devices and in-built intelligence capacity. IoT offers interaction with devices and provides

sufficient capability advantages of networking and socialization with consideration of intermediate devices. Emerging innovation in IoT devices transforms the lives in the cyber-physical-social environment through hyper-connectivity [1]. Devices such as smart tags, body sensors, embedded objects, smartphones, bio-Nano-things, and conventional electronic gadgets. IoT devices provide heterogeneous connectivity to withstand interface and connectivity demand to improve the quality of service [2]. IoT communication is categorized as the Social Internet of Things (SIoT), this belongs to the specialized IoT subset. Gene rally, IoT provides heterogeneous communication among devices to perform a specific task through collaboration and socialize approach. Due to an emerging interest in the IoT research domain mobility management protocols are arisen to withstand the present environment. The nodes of IoT devices are a growing area of interest domain and it leads to the development of routing management protocol has attracted the attention of researchers. The characteristics static of nodes is not dominant. The provision of access to information requires the routing management protocol for the identification of user location. The devices in IoT are moving within the infrastructure or outside the infrastructure [3].

II. LITERATURE REVIEW

Multipath routing involved in the demonstration of the efficiency of routing through improving the performance of the IoT network in which alternate paths are identified between source and sink. This technique needs to cope with the existing solution for consideration of different limitations [4].

Several factors are involved in IoT design protocol for routing those protocols are presented and explained in the following section [5].

In IoT, devices data are generated expired within a specified time since it is required for data transmission from source to a destination within the stipulated period. It is necessary to handle the latency of protocol routing for the appropriate maintenance of service quality [6].

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The IoT device protocol utilizes a single path while other paths are kept as backup else those paths are used as multipath for round-robin fashion which involves the establishment of the path in a single time [7].

The distribution of traffic in the IoT devices is not equal for all established links in the network, for multiple routes traffic are spreading in all routes which alleviate the device congestion in the links and bottlenecks [8].

III. RELATED WORKS

Mauro A. A. da Cruz [9] presented research for open-source middleware for evaluation of proprietary solutions such as Intel for the Intel Smart Campus with consideration of different performance metrics. The evaluation is performed based on the middleware. Results stated that developed metrics perform effectively and considered as middleware for IoT solutions. The middleware offers significant performance through the proposed approach.

Jilong Li [10] proposed a scheme for minimizing end-to-end delay in the IoT network. This study focused on the quality of network from source to destination node at expected IoT communication lifetime through consideration of IoT heap traffic in the network. The proposed approach effectively broadcasts RREQ between clusters of flooding. Through the proposed scheme RREQ overhead and search time for a path are minimized and improves the efficiency of the network transmission rate. The simulation results demonstrated Since the suggested method decreases channel congestion interference and information queue. Further the simulation results demonstrated the method scheme performs effectively rather than existing approaches. But this research fails to provide the amount of performance enhancement through the proposed scheme.

Dmitrii Chemodanov [11] presented an Artificial Intelligent (AI) for consideration of different geographic routing approach. The proposed scheme relies on the imagery of satellite through the adoption of deep learning techniques. The proposed scheme utilizes a greedy forwarding mechanism which minimizes local minimum problem with diversified traffic in the network which emulates electrostatic repulsive forces. The theoretical analysis of results demonstrated that Greedy forwarding provides an approximation bound of 3.291 as the shortest path value duct consideration of unit disk graphs or symmetrical links the network. The simulation results of both event-driven approach and numerical values involve incident-supporting hierarchical approach for improving the throughput of the network to reduce failure of devices and challenges related to mobility management. However, this research fails to provide a mathematical explanation of the IoT devices.

Zhijie Han [12] proposed an approach for application of IoT cloud specifically for Healthcare applications. This research proposed approach combines the concept of Trie and hash methods. The proposed algorithm is named as hash offset Trie match on the longest prefix (HOTMLP) algorithm. The proposed HOTMLP divides the longest prefix in the routing table where common prefix is identified in the routing table. Route prefixes are placed in the hash table to reduce step size and storage space.. Through the application of the Trie method prefix matching entry will be identified.

Analysis of the proposed approach demonstrated that it exhibits several advantages such as faster, ease of update and minimal storage space. The proposed prefix involves longer prefix matching complexity with the order of $O(2+n/k)$. In other cases, it uses “n” is 8 for IPv4 address is 16 and IPv6 address is 32. Experimental results analysis illustrated that the proposed approach performs effectively based on the core routing approach with improved lookup efficiency and forward tens and millions of packets per second [7].

Luca Calderoni [13] discussed several IoT platforms specifically for the management of the network. The proposed system involves the scientific community which concerns IoT solutions. Results demonstrated that LGPL offers significant testbed for IoT manager. This research fails to provide a detailed mathematical explanation about the proposed concept.

Soobin Jeona Inbum Jung [14] proposed an approach named as MinT Improved (MinT-I) for improving the performance of middleware for thread adjustment. The performance is aimed to enhance the performance through different connection parts concerning retransmitting, packet reception, analyze and processing. Experimental results illustrated that the proposed MinT-I approach improves the throughput effectively at the rate of 25% to 35% for middleware. But the proposed MinT-I approach focused on resource usage and memory optimization. Further the proposed approach reduces power consumption level and latency of IoT devices.

Sankar Mukherjee & G.P. Biswas [15] offered a whole solution that covers network protocols, spectrum distribution, node deployment, MANET routing, and mobility pattern, as well as the implementation of IoT applications that are simulated using the Omnet++ simulator and demonstrated to be feasible and perform well.

ValentinaCasola et al. [16] proposed an approach for supporting the IoT system with an appropriate security analysis scheme. The proposed model composes of an automated process for modeling threats and assessment of risk through the identification of a control scheme for implementing prior security factors. The effectiveness and application are adopted for an automated system for commercial products of IoT applications.

Morteza Safaei Pour [17] determined the magnitude involved in the exploitation of IoT applications. Also, this research examined the backbone of operator network and Internet Service Providers (ISPs) based on the geolocation database with consideration of the environment in hosting with the classification of an inferred device of IoT based on the consideration of hosting sector especially manufacturing sector. The results demonstrated that the IoT system is subjected to an insecurity paradigm and it is a landscape for IoT applications.

Mahmudul Hasan [18] evaluated different machine learning models involved in anomaly and attack prediction of the IoT system. The machine learning Logistic Regression (LR), Support Vector Machine (SVM), Decision Tree (DT), Random Forest (RF), and Artificial Neural Network (ANN) are the algorithms studied in this study (ANN). Recall, precision, accuracy, F1 score, and area under the Receiver Operating Characteristic Curve are among the measurements assessed. For classifiers like random forest, decision tree, and

knapsack, the accuracy value is 99.4% and ANN. This technique has similar accuracy while comparative analysis stated that Random Forest exhibits significant performance.

IV. PROPOSED METHODOLOGY

This research aimed to improve the performance of IoT network communication hence the adopted meta-heuristics approach for performance enhancement. this section presented the proposed multi-channel approach for performance enhancement of IoT communication. This section also presented the proposed methodology for performance enhancement of the IoT communication along with the software used, phases of research and expected outcome. This chapter presented the basic concept related to the routing strategy and proposed meta-heuristics approach.

A. Routing Performance Measures in IoT Communication

As stated by the name Internet of Things composes of two things such as Internet" and Things". Here the first terms denote the aspect of the network -orientation where servers of the Internet are interconnected through the central building for computing device communication. This requires an effective for contexts such as Urban-Low Power, Lossy Networks (LLNs), Building Automation, and Home Automation, a routing protocol is used. Despite the fact that these domains are divided into categories due to differences in pattern, network size, and mobility. The following are the primary limits of IoT communication that are stated and classified as a result of this:

B. Traffic Patterns IoT

T routing pattern need to match with the traffic and deployment area of the network. No need every protocol needs to be performed efficiently but it requires a single appropriate protocol for deployed IoT communication network.

C. Energy Efficiency

IoT devices are deployed based on the battery-driven for an extended period with consideration of IoT communication. Routing protocol with efficient energy consumption functionality is considered as a major function of IoT communication. Based on the node of constraint communication higher rate of information can be collected in the network.

D. Scalability

This IoT protocol stack ranges from 100 to 1,000,000 nodes, which requires significant performance and memory usage. IoT network increase in size subjected to increases in table size for routing.

E. Mobility

IoT communication does not subject to mobility often even it requires an appropriate routing scheme for changes in node location. Additionally, IoT subjected to unique challenges for offering significant performance.

F. Directionality

IoT communication not able to cope with the wireless network and bi-directional connectivity among nodes.

Routing protocol offers identification of IoT links and identifies the best path for transmission.

G. Transmitter Usage

With the consideration of energy consumption rate is higher for constrained devices. Hence, the IoT communication mainly relies on a sparse network.

Based on the consideration of the above parameters into consideration this research proposed an effective routing approach.

H. Existing Method

The Internet of Things is a large network that network devices allow information to be transformed without the need for human contact. This allows for remote object management by allowing interaction with the physical environment. The Internet of Things can be used in a vast number of applications. such as semantic, wireless sensor networks, data modeling, cloud computing, processing, and so on. Generally, IoT devices are heterogeneous in nature since it includes various functionalist, resolution, and operating condition, and so on. Existing routing techniques include a decentralized approach for controlling energy which involved the transmission of energy. This utilizes cluster tree topology for the construction of the IoT network through location and data sensing data can be transmitted through the network. The constructed tree collect data from different sources and delivers data. Even this approach includes the construction of spanning-tree this forwards data to the destination node but data transmission over the network using constructed tree vein the energy level of the IoT network. The other techniques utilized in IoT for data transmission are:

I. Cluster-based Routing

This is predicated on the use of a spanning tree to transmit data from source to destination. Frequent communication among devices, on the other hand, causes energy loss in the network.

J. Context-primitive Methods

This approach involved in the transmission of data through the ranking process among nodes. Also, it classifies the entire region categories, but this approach is not appropriate for a large area.

K. Centralized Routing

Based on the formulation of routing table data are transmitted between senders to the receiver. Node shortest paths are estimated using a sink node also sink node capable for maintaining network topology. This technique is not effective due to increased routing overhead.

Hence, there is a lot of demand for improving the performance of IoT communication since existing techniques are limited to certain constraints. The developed approach uses a multi-channel routing technique for improving the performance of IoT communication. The developed approach includes the construction of IoT network with an estimation of node information, once information about IoT nodes is estimated multi-path-based optimization is employed for estimation of an effective path for data transmission in the

network. Some other existing techniques included for routing in IoT communication are shown in below table:

TABLE I: EXISTING TECHNIQUES

Method	Steps
Hierarchical cluster-based routing with decentralized energy efficiency	Based on the residual energy of the device's data are transmitted in the network for transmission of data
Velocity (VLECET)	Tree topology is adopted for data transmission among the cluster network.
Relay chain routing that adapts	Load balancing is applied for the estimation of relay nodes in the network
Mobile Data Gathering using Bounded Relay Hops (BRH-MDG)	Data are gathered and transmitted to the destination node using a polling approach.
Cluster-Based Routing with Low Energy Consumption	This transmits data in a cluster network, where devices are grouped as different clusters and data can be transmitted between those clusters.
Primitive method	Through ranking nodes in IoT, network data are transmitted

L. Flow Chart of Proposed

M. Proposed Methodology

To improve the performance and adopt significant routing in IoT communication this research uses meta-heuristics-based optimization known as Whale optimization through a multi-channel routing approach. In the proposed technique IoT devices are arranged in mesh form and transmission is performed between IoT devices. In the framed IoT devices spectrum optimization approach through a heuristic algorithm is adopted for transmission of data from the devices to devices in the IoT system. For analyzing every device detail involved in IoT connectivity, the proposed framework employs an optimization technique. The optimization method

considers the distance between IoT devices, energy consumption, device routing, and other factors. After the evaluation of all network parameters of IoT devices efficient routing path is evaluated through the consideration of energy level, multiple routing paths are identified through an optimization algorithm that offers a significant path. Through the identified path data are transmitted between source devices to destination devices for effective transmission. This proposed multi-channel routing with optimization approach expected to improve the performance of the system.

N. Whale Optimization Approach

Whales are the world's largest mammals, measuring 30-meters in length and weighing 180 tons, as we all know. Killer whales, Minke whales, Sei whales, humpback whales, right whales, finback whales, and blue whales are among the seven kinds of whales. Whales are commonly seen as predators. A mathematical model for the meta-heuristics approach is constructed and its performance is presented based on this presented:

O. Encircling Prey

Humpback whales are capable of locating their prey and encircling them. Because the search space's character is uncertain. The agent's stance is given as follows, based on the evaluation of the intended prey:

$$\tilde{D} = |C\vec{X}(t) - X(t)| \quad (1)$$

$$\vec{X}(t+1) = \vec{X}(t) - \vec{A} \cdot \vec{D} \quad (2)$$

where t show the current iteration, A, C show coefficient vectors, and X show the significant solution for vector position identification.

This vector can be calculated using the following formula:

$$\vec{A} = 2\vec{a} \cdot \vec{r} - \vec{a} \quad (3)$$

$$\vec{C} = 2 \cdot \vec{r} \quad (4)$$

In the preceding equation, the number of iterations decreases linearly. This is taken into account while evaluating the exploratory phase.

P. Proposed Multi-Path Optimization (Probability Whale Optimization Approach)

The multipath routing strategy entailed identifying alternate paths for each network node's destination node. With a higher frequency of nodes in the network, the cost of data transmission must be higher. Routing decisions are monitored via the determination of the network's probabilistic value by including a probability model.

$$G(P) = \begin{cases} 1 & p \leq p_0 \\ 0 & p > p_0 \end{cases} \quad (5)$$

The value 1 denotes the connection is successful and the average path of the IoT communication is represented as,

$$f(v_i) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(p_i - p_{avg})^2}{2\sigma^2}} \quad (6)$$

$2\sigma^2$ reflects the IoT communication path's variance and p_{avg} . In IoT communication, it provides a way of data transmission.

The most efficient path for information communication in the IoT network is calculated using,

$$E(N) = \rho d \lambda \quad (7)$$

The packet transferred and other parameters are displayed in this number of nodes.

V. EXPERIMENTAL RESULTS

Influenced by a variety of elements, one of which is the network. The purpose of this research was to use an effective routing approach to improve the communication performance of IoT devices. The challenges associated with IoT communication and threats are presented in the existing chapter. This research offered an effective multi-channel routing technique for increasing the performance of the IoT communication system utilizing a heuristic approach to tackle the obstacles associated with IoT communication. The heuristic approach is employed for the optimization of IoT network performance. The optimization algorithm implemented in this research is whale optimization which involved in improving the performance of IoT communication.

The results acquired using the proposed optimization approach were provided in this chapter. The following is how the current chapter is structured: The first segment discussed the development of the IoT network and followed by communication established in IoT communication. In next section presented about multi-channel communication performed in IoT communication. Finally, this section offers the overall performance of the proposed approach with other existing approaches.

A. Proposed Optimization Algorithm

Pseudo-code of the proposed Multi-Channel probability WAO algorithm
Set the value of the Whales population
$X_i(i=1,2, \dots, n)$
Calculate the fitness of each search agent
$X^* = \text{Best search agent}$
While ($t < \text{the number of iterations that can be done at the most}$)
For every search agent, Update a, A, C, I and P
If1 ($p < 0.5$)
If2 ($ A < 1$)
Update position current search agent
Else if2 ($ A > 1$) , Select X_{rand} (Random Search agent)
Update position of current search agent
End if2
Else if1 ($p < 0.5$)
Update position current search
End if1
End for
Calculate each search agent
Update X^* if there is better solution
$t = t + 1$
end while

B. Construction of IoT Network

The data has been transmitted in the form of wireless communication in which data has been transmitted among

nodes or IoT devices. The proposed heuristics approach objective function is to enhance the performance of IoT communication. The below Fig.1 illustrates the construction of IoT communication in which 50 devices are constructed. The constructed IoT devices are deployed in the coverage area of 100meters.

Fig. 1. construction of IoT communication.

The below Fig. 2 provides data communication performed among IoT communication. The established IoT infrastructure consists of 50 nodes and data were transmitted through other nodes of IoT devices in circular form. Data collected through IoT communication improves the communication range of IoT devices with improved communication range. Constructed IoT network involved in improved communication range of 145 meters of communication range.

Fig. 2. Data communication performed among IoT.

In the above figure the red circle indicates a higher interference communication channel for data transmission using IoT communication.

TABLE II: CONSTRUCTION PARAMETERS	
Parameters	Values
IoT devices	50
Communication Range	100meters
Data communication range	145meters

The above table also illustrates the constructed communication network among IoT devices data in tabular form.

C. Probability Whale Optimization Approach

Meta-heuristics algorithm involved mimicking the behavior of the whale's humpback which involved in optimization of the device location. WOA algorithm is based on the hunting behavior of the optimization of IoT devices which exhibits the hunting behavior of the whale with a bubble net attacking mechanism for identification of optimization value of the proposed approach. The multi-channel WOA provides a comparative advantage over other optimization techniques with improved network performance of the network. The below Fig. 3 provides the coverage range of the proposed multi-channel routing through the proposed WOA approach in the 3-D plot. The 3-D graphical representation of WOA offers an IoT communication scenario.

Fig. 3. coverage range of WOA in 3-D Plot.

The above Fig. 3 3-D plot demonstrates the coverage range obtained by the proposed multi-channel WOA approach. The routing of network the IoT devices is enhanced by the developed WOA approach since the designed IoT infrastructure involved in the coverage range of 100 m. The proposed multi-channel WOA provides coverage range of 100 m in both x and y-direction which means it significantly perform with IoT infrastructure. Even in z-direction also the coverage is obtained as 200 m hence the WOA improves the coverage efficiently. Further at the edges also the performance of IoT devices is higher for which means it has minimal interference rate and it will effectively enhance the data transmission scenario of IoT device communication.

In the meta-heuristics approach optimization algorithm, the main functionality is the evaluation of effective objective function. To improve the performance of multi-path communication among IoT devices WOA involved in the identification of optimal solution through which the data in the IoT network infrastructure that has been built is performing well. Value optimization in the development of an effective optimal path for data transfer among IoT network architecture. Using the identification of optimal values data in the network improves the performance of the constructed network.

Fig. 4. Optimal value for data transmission among IoT devices.

Fig. 4 provides the optimal value for data transmission among IoT devices. The designed multi-channel WOA algorithm is evaluated for 500 iterations where efficient communication among devices is observed at the transmission range of 10 to 10e-60. In Fig. 4 even the communication is obtained as 200 m in z-direction similar manner 7 also illustrates the efficient path for the establishment of communication among IoT devices for improved communication performance among IoT devices. The optimal solution obtained by the multi-channel WOA presented in the below table.

TABLE III: OPTIMAL SOLUTION

Optimal Solution Obtained by WOA	
2.2194e-40	-7.2417e-41
2.5912e-40	6.4058e-42
-8.3253e-41	-3.1569e-41
6.3461e-41	-8.2749e-41
8.8161e-41	-6.2968e-40
1.1528e-40	2.0169e-40
-7.3556e-41	-1.1542e-40
6.4877e-41	-4.8099e-41
-3.781e-40	2.231e-40
5.8582e-41	5.9911e-41
1.3771e-40	-5.9152e-41
-2.4907e-40	2.0032e-40
-6.4648e-41	-1.1137e-40
-1.5285e-40	-2.7656e-40
-9.834e-41	1.133e-41

The above table provides an optimal value identified for the developed multi-channel WOA algorithm. Optimal value identified are 15 values where the data can be evaluated for identification of optimal value for the metaheuristics approach. For the identified values IoT network provides efficient network performance for improving IoT device communication. Through the proposed approach optimal value identified for the WOA approach is identified as 1.0746e-78 which is considered as an optimal value for the developed IoT infrastructure.

Fig. 5. IoT device communication.

Fig. 5 provides the IoT device communication for the constructed device infrastructure. The optimal location identified for device communication is evaluated using simulation software. The evaluation of communication is performed through the constructed network for the transmission range of 500 m which has a base station count of 5 for the area location 100. For evaluation grid size considered are 20 with a packet count of 100 which means it significantly transmit the data among IoT devices effectively? the transmission range considered for analysis is 500 meters with packet count 100 with the coverage area of 100 meters with consideration of 50 IoT devices.

Fig. 6. IoT devices probability distribution.

The probability of IoT device used for the establishment of communication among IoT devices are demonstrated in Fig. 6. The IoT devices probability distribution is shown in the figure for the range of infinity which has the effective value range of 300 with significant performance. The analysis of device probability is effective rather than other approaches for the constructed IoT devices infrastructure.

D. Comparison of Proposed Vs Existing

The proposed multi-channel optimization algorithm has been examined effectively through comparison with another optimization algorithm.

Throughput

Fig. 7. Throughput calculation of proposed approach.

Fig. 7 shows a comparison of the suggested approach's throughput calculation with that of other known optimization approaches. Figure shows that firefly optimization, PSO, and KHA yield minimal throughput values of 76, 86, and 91, respectively, however the suggested multi-channel WOA delivers a throughput value of 93, which is much greater than the existing methodologies.

Packet Delivery

Fig. 8. The proposed approach's packet delivery rate.

The packet delivery rate analysis of the proposed approach with existing approach stated that proposed approach performs effectively rather than other approached since the firefly algorithm provides the optimal value of 89, PSO value of 90 and firefly provides a delivery ratio of 89 in which proposed multi-channel WOA offers delivery ration of 96. This is a substantial improvement over current method. The proposed approach's performance is compared to that of another optimization approach, which is shown in tabular form as follows:

TABLE IV: COMPARISONS OF PROPOSED VS EXITING

Optimization Approach	Throughput	Packet Delivery Ratio
PSO	86	90
KHA	91	86
Firefly	76	89
Multi-Channel WOA	93	96

The above table provides a comparative analysis of comparing the proposed optimization strategy to other optimization algorithms that are already in use. The proposed optimization algorithm is compared to existing approaches in a comparative study. In comparison to other existing techniques, WOA provides significant throughput and packet delivery ratio performance.

E. Finding of Research

For data transmission from source to destination, IoT connectivity necessitates multi-path communication. Higher energy levels are required for optimal data transfer between devices. As a result, this study employed whale optimization and uses a probabilistic routing strategy to convey data across IoT devices while reducing traffic overhead. For decision-making, a prediction of the target node was done. The proposed meta-heuristics-based optimization approach exhibits significant functionality for consideration of objective function. To improve the performance of multi-path communication among IoT devices WOA involved in the identification of optimal solution through which data in the constructed IoT network infrastructure perform effectively. The proposed multi-channel WOA provides coverage range of 100 meters in both x and y-direction which means it significantly perform with IoT infrastructure. Even in z-direction also the coverage is obtained as 200 meters hence the WOA improves the coverage efficiently. Optimal value identified are 15 values where the data can be evaluated for the identification of optimal value for the meta-heuristics approach. For the identified values IoT network provides efficient network performance for improving IoT device communication. Through the proposed approach optimal value identified for the WOA approach is identified as $1.0746e-78$ which is considered as an optimal value for the developed IoT infrastructure.

VI. CONCLUSION

The drastic development of IoT devices provides hyper-connectivity using a cyber-physical-social environment. The devices involved in IoT communication are smart tags, Smartphones, Nano-things, and fewer gadgets of electronics. Also, IoT provides connectivity in a heterogeneous manner to offer effective performance against interface and connectivity for the provision of significant quality of services. In an IoT environment based on user demand services need to be provided for the gathering of appropriate responses for the reception of services which put forth the requirement of effective performance of IoT communication. This user requirement can be achieved through the identification of the optimal path in the network. One other issue related to IoT communication is the management of mobility. Based on this into consideration this research aimed to develop an efficient meta-heuristic approach for improving the overall performance of IoT through a multi-channel routing approach. IoT device communication is subjected to a certain limitation in terms of energy, mobility, and resource management. To improve the performance of IoT communication this research utilizes a meta-heuristics approach known as Whale optimization technique for identification of significant path for transmission of data in

the IoT network. The evaluation is performed for consideration of 50 IoT devices for the coverage range of 100 meters. The analysis is performed comparatively with other existing optimization algorithms such as PSO, KHA, firefly, and multi-channel WOA. Simulation results demonstrated that the proposed multi-channel WOA effectively exhibits the throughput and packet delivery ratio.

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