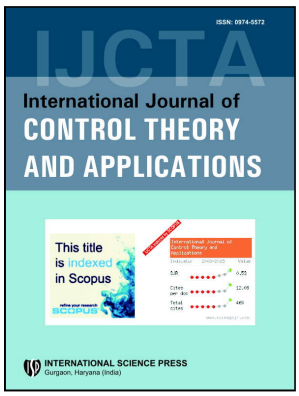


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# An Enhancement of BAT Algorithm using Diversity function for Routing optimization in WSN

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***Abstract:*** Routing technique and further working with optimization of path for data transmission is always a problem while working with MANET or wireless network. BAT algorithm provides a solution with its working scenario and extra computation. Thus it still needs to be low energy consumption and provide heavy outcomes with the current demand. In this paper a diversity function is further introduced and computed along with the BAT algorithm execution to opt out efficient energy module throughout the section scenario of routing. A setup using NS2 is performed with traditional BAT [1] and proposed BAT algorithm. A result observe with parameter such as PDR, End to end delay etc shows that the enhancement of BAT provide better result as compare to traditional mechanism.

***Keywords:*** Bat algorithm, WSN, energy optimization, network simulation

## 1. INTRODUCTION

A term MANET/WSN is used for Mobile ad hoc network which is independent structure of portable nodes connected by wireless links in a standalone fashion in a larger network. Nodes can connect, disconnect and re-connect as the time goes on and all the time the network connections will work between the nodes that are part of it [2]. Routing is a process of deciding the best route within the network. Previously, the term routing also supposed forwarding network traffic amongst network. Nevertheless, that latter perform is healthier described as forwarding. Routing is performed for a lot of types of network, together with the telephone network (circuit switching), digital data networks (such because the internet), and transportation networks. The different problems which can raise in packet delivering such as ordering of packet transfer and ordering of packet receiving in MANET. Maintaining the ordering of packet is hard to keep in real network multicast routing. Another issue such as loss of packet while delivering multiple numbers of heavy packets in one attempt or in heavy congestion network, such things additionally causes network packet delay.

A cellular network is created dynamically by independent of cell nodes which can be linked via Wi-Fi hyperlinks with no using the existing set up or federal management. The nodes can freely move randomly and organize themselves erratically; thus, the networks wireless topology can change constantly and unpredictably. These networks can operate in a standalone manner, or can be connected to the large Internet. Mobile ad hoc network are infrastructure-less network so they do not require any fixed infrastructure. Each node will be able to communicate directly with any node to reside surrounded by its broadcast range.

## 1.1. MANET/WSN Challenges

The capabilities of MANET introduce several demanding challenges that need to be studied cautiously earlier than an extensive commercial deployment can be expected. Those include:

1) *Routing:* Because the topology of the network is continuously converting, the problem of routing packets among any pair of nodes turns into a difficult assignment. Maximum protocols should be based on reactive routing in place of proactive. Routers among nodes may probably comprise more than one hop, which is extra complex than the single hop conversation [3].

2) *Security and Reliability:* To the commonplace vulnerabilities of wireless connection, an ad- hoc network has its precise safety problems due to e.g. nasty neighbour relaying packets. The function of distributed operation requires one of kind schemes of authentication and key management. Also, Wi-Fi hyperlink characteristics introduce additionally reliability problems, because of the confined wireless transmission range, the published nature of the Wi-Fi medium (e.g. hidden terminal problem), mobility-induced packet losses, and information transmission blunders.

3) *Quality of Service (QOS):* Providing exceptional quality of service stages in a continuously converting surroundings can be a assignment. The inherent stochastic feature of communication quality in MANET makes it tough to provide fixed ensures at the supplied to a device.

4) *Internetworking:* Similarly to the conversation within an ad-hoc network, internetworking among MANET and fixed networks (especially IP based totally) is frequently expected in lots of cases. The coexistence of routing protocols in this sort of mobile device is a task for the harmonious mobility control.

5) *Energy consumption:* For most of the light-weight mobile terminals, the conversation-related capabilities must be optimized for lean energy consumption. Conservation of energy and energy-conscious routing have to be taken into consideration. Because the electricity saved is equivalent to energy produced.

## 1.2. Related Work

Bat Algorithm a bat algorithm, which uses social behavior of the bats to form solution for the optimization problem is getting popular in now days.

Bat is the only mammals which having wings and uses echolocation to find the prey. Bats have the capability to sense echolocation and differentiate between the food and other objects. Bats emit loud sound and sense reflection of that sound to recognize objects. Bats fly randomly, with random velocity and frequency and varying wavelength and adjusting their wavelength according to the position of the prey. Bats poses advanced capability some bats can have advanced vision. Bats can hunt without seeing the object. [4]

On the basis of these characteristics of the bat a meta-heuristic algorithm can be form to provide various optimal solutions for the optimization problems. That provides an improved performance as compare to various techniques. Like in Genetic algorithm mutation and some other operation can be performed which degrades the performance of the whole technique.

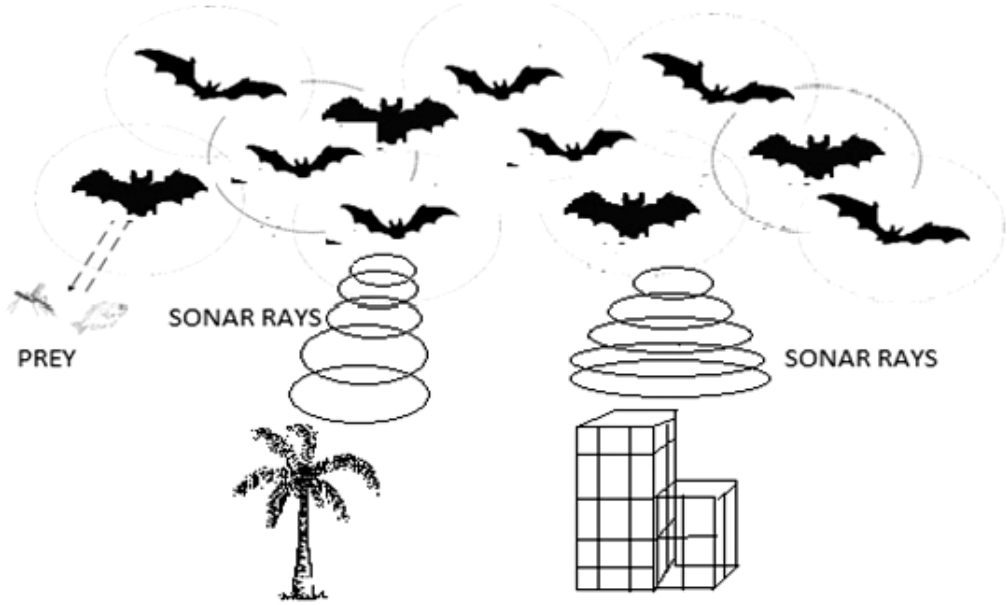


**Figure 1: Bat Algorithm.**

### 1.3. AODV (Ad-hoc on demand distance vector ) Routing Protocol

AODV is a reactive protocol. The routing table does not frequently update by reactive routing protocols. when there is any data packet to send, it start route discovery process by flooding which is the main reason of routing overhead. AODV is a known as distance vector routing protocol. Whenever any node needs to initiate communication through other nodes, it investigates for existing pathway near the sink node, in its related routing table. If it not find any pathway obtainable, after that node transmits route request message to its neighbor node. Any node who receives this message search for a path that lead to the sink node. If there is still no path available subsequently, it retransmits the route request message and establishes a path lead to RREQ originating node. This enables in organizing the end to give up direction when the equal node gets direction respond (RREP) message. Each node has to follows this method until the route request message (RREQ) gets to a node which has suitable path to the goal node or route request message (RREQ) gets to the goal node itself. Other way is to RREQ receiving node will have send a route respond message to the sender of route request message (RREQ). on that the RREP message comes on the supply node, which at first gives RREQ message. In the end of this request-respond technique a path among source and sink spot node is built and is to be had for similarly communication exchange. In circumstances where there is no RERR (route error) message is concerned for nodes that likely obtained its route error (RREP) message. This message assists to update or else re-evaluate the path when an intermediary node departs a network or drop its subsequently hop neighbor. Each node by AODV protocol retains a routing table, which include a hop count, a next hop node and a sequence number. Every packets predetermined to the goal node are sent to the subsequently hop node. The current distance between source and destination node are represented by hop count. AODV routing protocol does not present routing overhead, until a route request (RREQ) message is made.

In situations wherein there may be no route error message is concerned for nodes that probably obtained its RREP message. This message can help to replace or re-calculate the path while intermediary node departs a network or may lose its next hop neighbor.

## 2. PROPOSED METHODOLOGY

In existing techniques there are various variants of BAT are presented. But, in this technique multiple routes are considered to provide solution. Thus selection mechanism is required to select an optimized route to transmit

packet. That process consumes too much time which increases the waiting time to route packets that increases the delay which degrades the performance of the whole technique. In there are multiple links presented to connect one node to other, when an optimized route selected some other shortest route also selected with that which also increases the normalized routing ratio.

A new technique is required which resolves all the routing related issues in existing techniques.

### 2.1. Proposed algorithm

A pseudo code is presented here through which proposed model is performed:

1. Setup the complete environment and configurations.
2. Initialize the bat population xí=(í = 1, 2…n) and further initialize all the nodes, setup the position for each node for movement.
3. Define neighbour node and its frequency *f*í at xí
4. Initialize the energy levels aß and the loudness(trust) Tí
5. While (t < Maximum no. of iterations)
6. Produce new solutions through adjusting frequency, by modifying values, and updating velocities and locations/solutions

   Fi = Fmin + ( Fmax - Fmin)β,

   $Vi^{t+1} = Vi^{t} + (Xi\ t - X^*)Fi$ ,

   $Xi^{t+1} = Xi^{t} + Vi^{t}$ , - Bat Equation Using Bat.
7. Execute diversity optimization on outcome solution using DEF, diversity evaluation factor;

   Def = optimizing (fi); finding similar pattern and continuous link.
8. If (rand > rí)
9. Select a result between the best solutions
10. Generate a solution and proceeding for next solution level.
11. End if
12. Generate a new solution by ranging in a row and product as output
13. If (rand < Aí & *f*(xí) < *f*(x*) & rand<def)
14. Accept the new solutions
15. Increase rí and reduce Aí, finally opt the route.
16. End if

The below flow diagram shows the complete details on how the experiment is performed and executing in a manner.

## 3. EXPERIMENT AND RESULT

To implement proposed technique, NS2 simulator is used which provides an enhanced functionality to develop research projects for communication network. In that way it provides a framework to develop such projects.

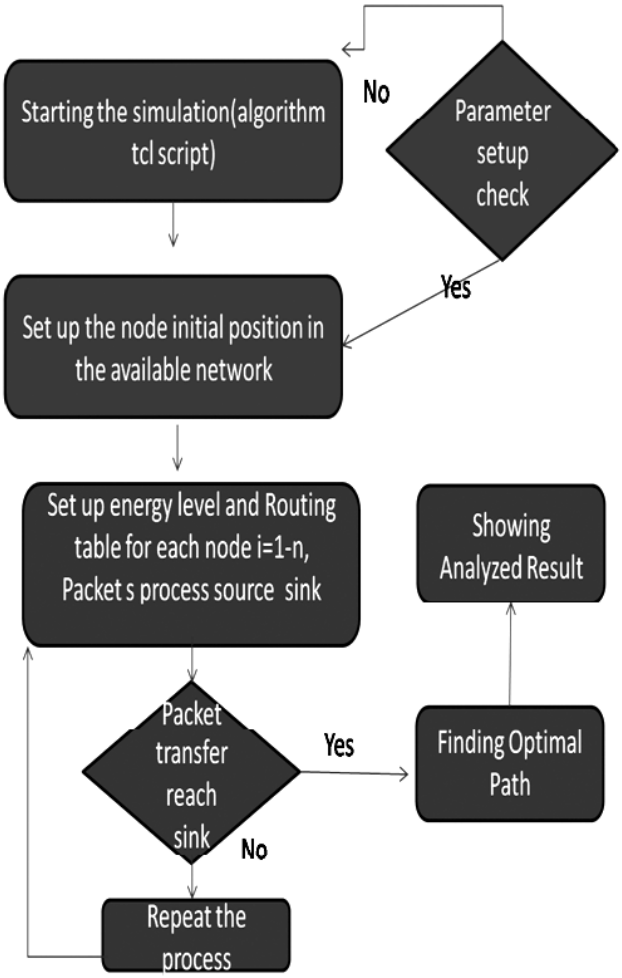


**Figure 2: flow diagram of complete scenario**

Network simulator is used to analyze the standard BAT[5] and modified BAT. The existing BAT is run on this simulator and with same environment this simulator will again run for Modified BAT to show

**Table 1**
**Simulation Scenarios**

| | |
|---|---|
| No. of Nodes | 30 |
| No. of Source | 10 |
| Area | 1000×1000 |
| Mobility model | Random waypoint |
| Bandwidth | 2mbps |
| Speed | 0, 1, 5, 10, 15, 20m/s |
| Pause time | 10 sec |
| Buffer Size | 100 |
| Transmission range | 2100m |
| Sensing range | 2100m |
| Packet size | 1012bytes |
| Traffic source | Constant Bit Rate (CBR) |
| MAC protocols | IEEE 802.11 |

the comparison of performance on parameters: end-to-end Delay, Packet Delivery Ratio (PDR), Throughput, normalized route load and energy. The Modified Technique is simulated with following scenarios:

## 3. RESULT ANALYSIS

A comparison analysis for the results for existing and proposed technique is shown in this section.

Evaluation Parameter : Normalized routing load, PDR (Packet Delivery Ratio), Throughput, End-to-End Delay and Energy are used to calculate performance of technique [6].

### 3.1. Normalized Routing load

Routing load over the various nodes is in MANET is measured to manage the routing load in MANET.

### 3.2. Throughput

It is the measure of whole performance of the technique which measures the performance of the techniques.

### 3.3. PDR (Packet Delivery Ratio)

It is the ratio of, no. of packet accurately delivered to the destination.

### 3.4. Average Delay

It is measure of time taken to getting response to deliver packet from source to destination.

A graphical analysis for the proposed technique is shown in graph, which shows a graphical comparison over the techniques.

**Table 2**
**Packet Delivery Ratio**
**(PDR) Vs Speed**

| *Speed(m/s)* | *BAT* | *Modified BAT* |
|---|---|---|
| 0 | 82.77 | 85.93 |
| 1 | 81.54 | 86.54 |
| 5 | 75.27 | 79.60 |
| 10 | 73.19 | 73.89 |
| 15 | 72.49 | 74.33 |
| 20 | 69.59 | 75.49 |

### 3.5. End-to-end Delay Vs Speed

It is the instant used for a packet to be transmitted in the network from source to goal. Because of clustering and central coordinator delay is decreases of modified BAT as compare to the existing BAT.


**Figure 3: Packet Delivery Ratio (PDR)**

End-to-end delay∑ ( arrive time – send time ) / ∑ Number of connections

**Table 3**
**Average Delay Vs Speed**

| *Speed(m/s)* | *BAT* | *Modified BAT* |
|---|---|---|
| 0 | 29.20 | 25.41 |
| 1 | 20.84 | 19.42 |
| 5 | 24.95 | 23.15 |
| 10 | 45.12 | 41.17 |
| 15 | 56.20 | 55.65 |
| 20 | 69.96 | 69.03 |

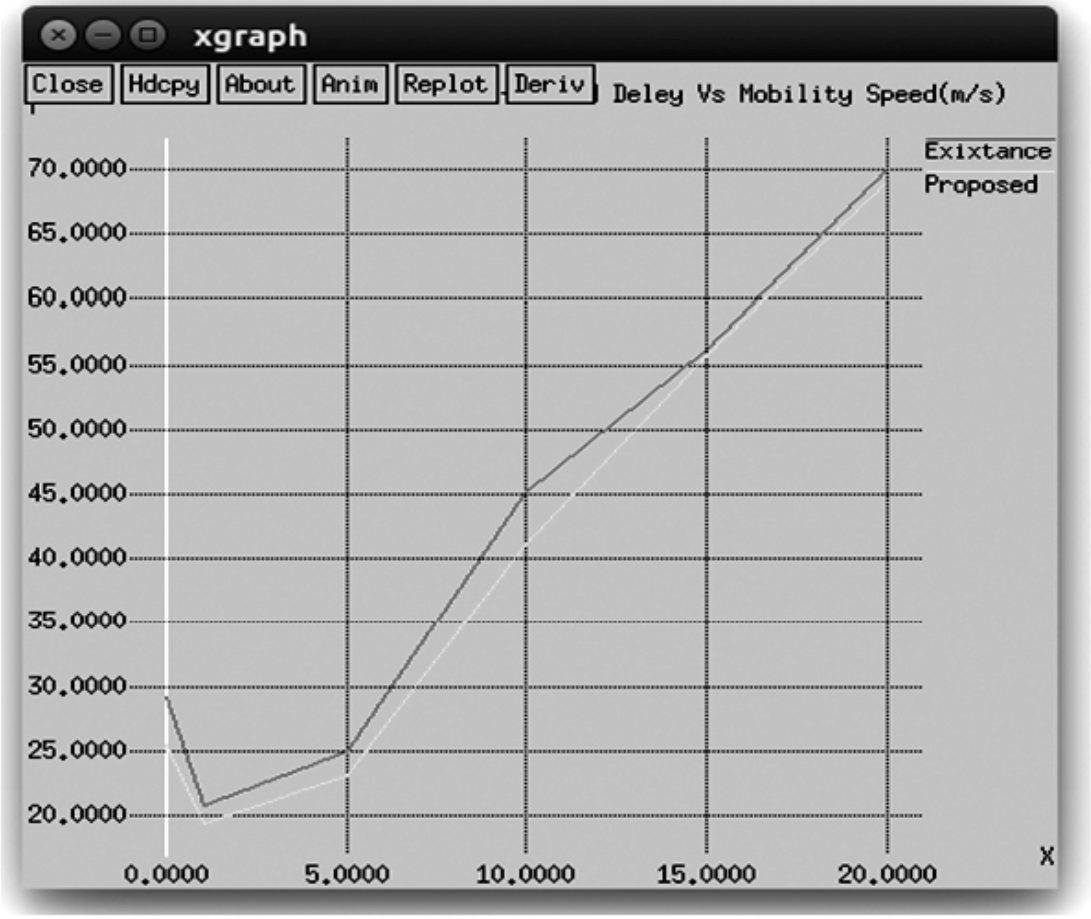


**Figure 4: End-to-end Delay Vs Speed**

## 3.6. Throughput Vs Speed

Network throughput is the average of successful message sent over a communication network. This data can be transport over the logical or physical link.

Transmission Time = packet Size / Bandwidth (sec)

Throughput = packet Size / Transmission Time (kbps)

Because PDR increases, the impact of it clearly shows on throughput that increases too.

**Table 4**
**Throughput Vs Speed**

| *Speed(m/s)* | *BAT* | *Modified BAT* |
|---|---|---|
| 0 | 76.89 | 78.46 |
| 1 | 77.27 | 80.00 |
| 5 | 73.26 | 75.60 |
| 10 | 70.32 | 71.63 |
| 15 | 67.47 | 69.44 |
| 20 | 61.28 | 62.81 |

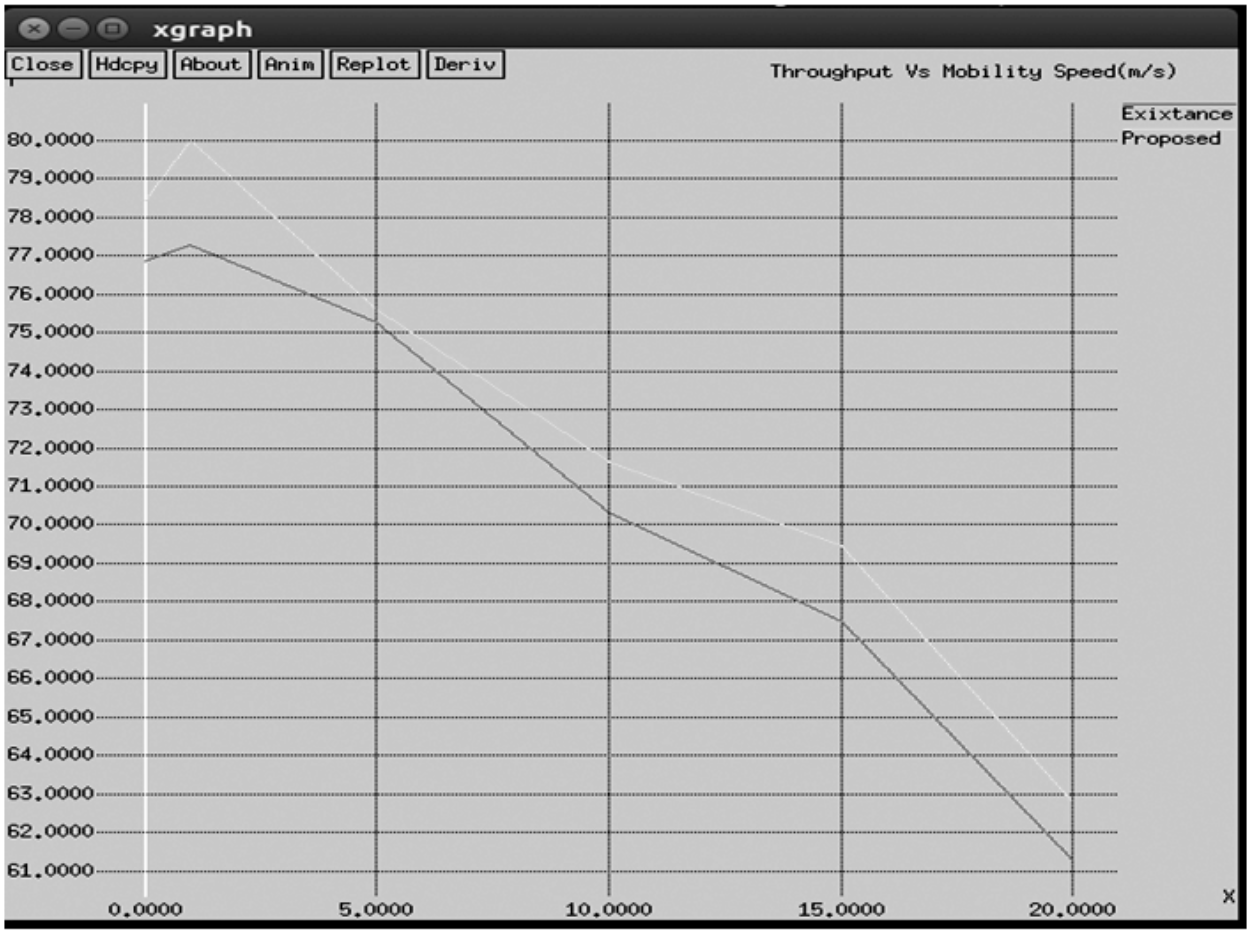


**Figure 5: Throughput Vs Mobility Speed**

A description over the implementation scenario to implement proposed technique and evaluation of the results of the technique is presented. On the evaluation presented in result analysis section, evaluation over all the parameter shows that, proposed technique provides better results as compare to the existing technique.

## 4. CONCLUSION

MANET (Mobile ad-hoc network), is a network in which several mobile devices are connected to communicate over a wireless channel. In the network devices are presented in movable form, because of that topology of the network changes frequently. Routing in that scenario is one of the difficult task to do, issues like packet loss, congestion and some others are occurs. BAT is a processing technique which used to deliver packet from source to destination, in that technique a table of the links at each node in present which contains the information about the other links to the other nodes. But in that technique there are multiple links are provided to connect to the next node, that requires a selection mechanism to select optimized node to deliver message from source to the destination that consumes to select optimized path, that introduce delay in the process. Because of the delay performance of the whole technique is degrades

Our proposed work is based on the weight (energy). The study of the proposed work is completed yet and the performance evaluation is completed after the proposed algorithm. A further work on QoS can be done with BAT algorithm.

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