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Development of Hybrid Ad Hoc on Demand Distance Vector Routing Protocol in Mobile Ad hoc Network

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ABSTRACT: MANET include wirelessly in a self-configured, self-healing network while not having permanent communication that is linked in a collection of mobile networks. The network topology varies normally in MANET nodes and is free to stir erratically and individually. In the existing technique, Ad hoc On-Demand Distance Vector (AODV) was employed for node selection to attain the shortest path strategy. In this technique, huge amount of control messages are transferred which consumed bandwidth of the network and increase congestion. In the proposed system, the hybrid AODV technique incorporates the MFR (Most Forward within Radius) technique is utilizing to detect the shortest path routing algorithm. The MFR technique has been performed for the neighbor node selection whereas Hybrid AODV has been performed for the shortest path routing algorithm. Firefly algorithm is also incorporate in Hybrid AODV to find out the optimum path based on the updating equation. The performance analysis and the comparative analysis of this paper are measured by using End to End delay, Average Routing Overhead, Throughput. Proposed algorithm (HAODV) shows improvement in all these parameters.

Keywords: AODV, End to end delay, Firefly algorithm, Hybrid AODV, MFR, MANET, Routing overhead, Throughput.

I. INTRODUCTION

A MANET can be described as a system that includes wirelessly connected hosts. A gathering of more terminals with wireless interactions along with network capability is referred in MANET [1, 2]. That communicates with each other without any consolidated supervisor. Wireless links are free changeable and also occasionally acts as a router at the similar time are linked with mobile hosts [3]. In MANET, it is a sovereign methodology along with the nodes is shared in wireless standard. The concern of the network varies arbitrarily as well as actively. A communication link is frequently busted in MANET because the nodes are liberated to move wherever [4].

The most popular routing protocol is AODV and it is also simple along with a well-organized on-demand MANET routing protocol [5, 6]. To supports unicast along with multicast routing and routes to destinations on demand recognized in the protocol. The MANET routing protocol urbanized because of particularly in AODV [7]. The route discovery methodology operation and therefore the route maintenance operation is the two various operations to seek out and maintain in AODV. It's a desired algorithm for MANET also further as acquires the routes strictly on-demand [8].

Briefly, the main contributions of this paper are as follows:

– Proposing a Hybrid AODV routing algorithm based on shortest path selection strategy.

– It improves end to end delay, throughput and routing overhead with the traditional AODV.

Section I talks about the introduction and the research study and survey of the work have been written in section II. Section III discusses about the related work used in proposed method. Section IV discusses the proposed technique and Section V discusses the performance investigation and result. Finally, in section VI, the conclusion of the paper is given.

II. LITERATURE SURVEY

The AODV routing protocol creates the shortest path which depends on the best signal as well as strength quality. The routing process is happening when the path attain to best signal strength will leads to increasing in the Packet delivery ratio (PDR). The foremost concept of this network is to deliver packets with minimum losses which lead to improved Quality of Service (QoS). The minimization of link failure for routing is very difficult in this technique. The minimum losses and minimum link failure was explained by Devika and Sudha (2019) [1].

AODV and DSR are the on-demand unicasting routing protocols to evaluate their performance based on Quality of Service (QoS). For MANETs, together AODV and DSR routing algorithms are executed on the root of an on-demand gateway discovery algorithm anywhere every other through the entry and exit point of a system and where required. Through simulation with increasing the node density using the ns-2 network simulator, we perceive that the performance of AODV and DSR routing protocols are varying according to the situation as directed to premier the performance level for both of these protocols is produced by Robinson *et al.*, (2019) [4]. The consequences give out in this paper decorate the significance of carefully assessing and executing both of these protocols for MANETs.

The hybrid Ant Colony Optimization (ACO) along with Firefly optimization technique along with swarming algorithm (FA) is used in Ad-Hoc On-Demand Distance Vectoring (AODV) routing protocol to transmitted of signals in a MANET model to increase the efficiency along with decreasing the losses to overcomes the drawbacks of ACO based AODV was described by Rath *et al.*, (2017) [6]. The execution study of the hybrid routing protocols was compared with the traditional ACO and traditional AODV by ensuring a lessening of network load by neglecting re-discovery endeavors among the paths.

Reactive routing protocols are used, at the same time source requirements to throw a packet to the destination so the process of the searching route resolve initialize, till it discovers the optimal path [7, 8]. Since it, a lot concentrates on less reliable routes important to elevated control overhead and packet loss.

Raw *et al.*, (2015) was explained the MFR technique in which the investigation of position-based routing in vehicular ad hoc network (VANET) to attain the optimal route amid the vehicles [10]. The node-based MFR has been performed by the mathematical expression which is mainly designed for avoiding the internal nodes depend on the transmission assortment for supplementary transferring the packets. The outcomes of this technique explain the performance of the border nodes which is advantage of the routing algorithm with less delay.

III. RELATED WORK USED IN METHODOLOGY

The main purpose of the MANET is to diminish the link breakage because of the mobility of paths in the protocol. An acceptable time in favor of broadcast is established in the stable route in MANETs. In the traditional AODV, it won't check the route in a periodic manner. So that the transmission of data after discovers the rate is taking more delay. The locally repair a busted connection does not continue the routing mechanism. Hence, the proposed HAODV based protocols; the route detection process is on-demand, which is more efficient in the dynamic nature of MANET. The rate is created only when it is required. In table-driven protocols the delay is advanced.

A. MFR

The MFR routing algorithm is accessible in an investigative technique. The execution of the MFR routing strategy is estimated. The amount of time in the bond is offered for transmission is resulting in as the lifetime of a wireless connection and also its unit is seconds. The network maintains the random variable is considering in the duration of a wireless connection among bi nodes. From an origin device S to destination device D are further considered which comprises of series of m wireless connections form-1 midway nodes. The duration of the i_{th} link in the route is $\mathrm{X_r}$. The lifetimes of X_r , $i = 1,2,\ldots\ldots,m-1$ are identically disseminated (iid) arbitrary variables, each within rate μ are implicit [9, 10]. The path fails among the origin S along with destination D when any link of the route breaks. Therefore it consists of m links is a arbitrary variable articulated as follows in the duration of this route r.

$$\mathrm{X_r} = \min\left(\mathrm{X_{l_1}}, \mathrm{X_{l_2}}, \ldots\ldots \mathrm{X_{l_m}}\right) \quad (1)$$

Where Xr is identically distributed arbitrary variable with rate m μ. The life span of utilizing a solitary route r is a random variable R within the rate m μ, where $\mathrm{R} = \mathrm{X_r}$

During a lifetime L, the clear successful message delivery may terminate. The probabilities Q that communication delivery terminates within L are consequent. The duration of message rescue is an identically distributed arbitrary variable D within rate λ is implicit. D and L are separately sustained via unsystematic variables the probability of successful message delivery is articulated [6, 8].

The analysis has been examined by MFR routing algorithm and also considering the probability of flourishing message delivery. This analysis indicates the duration of a path is superior to the duration of message delivery.

Initially, the AODV defines a route which has less number of hops to accomplish the target. Due to the execution elapse mobility, the optimal path converted to suboptimal paths. Hence, the essential nodes have turn into relay nodes. The AODV cannot believe supplementary optimal routes dynamically it accessible only smaller hop calculations. Hence, the relay nodes determine per hop delay and depletion of nodes energy and bandwidth. To overcome the drawbacks of the AODV, the proposed hybrid AODV routing procedure has been designed for the dynamic routing algorithm. By utilizing dynamic and optimal routing protocol, the unwanted relay nodes get eradicated from the energetic path and shortcut discovery is agreed.

IV. PROPOSED METHODOLOGY

A hybrid AODV protocol of the MANET is based on the boundary nodes of the network. The dimension of the boundary is computed by means of the radius of the boundary B, where B is the perimeter of the region. There are overlapping nodes between the nodes and each node is different in dimension.

In the proposed methodology, each interior node is communicating with its boundary node using MFR protocol and the nodes are clustered between the cluster head by utilizing optimal AODV protocol. The central node is accurately equivalent to zone radius with the minimum distance of the nodes which is the peripheral nodes of the individual boundary. If the nodes minimum distance is less than the radius of the interior nodes, then the nodes is said to be exterior nodes. The cluster boundary routing is done by utilizing the gateway.

In the proposed hybrid routing algorithm, the MFR incorporate with optimal AODV routing beneath dynamic cluster head path for the distributed networks, the primary issues of the distributed network is the occurrence of the shortest path and it depend on chosen neighbors in the network. The information is transferred to the destination based on the neighbor nodes and each data packet must have a destination identifier and it will continue still it's accomplishing the target. After receiving the packet, to attain the common purpose of routing packets along the optimal path so that the routing tables are constructed, maintained and updated. Routing table update and path finding are the two main sections in the hybrid routing methods.

A. Calculation of fireflies count

In the proposed HAODV, the firefly optimization technique is used for the HAODV routing protocol in which the optimal shortest path has been selected to transmit the packets from source to the destination to avoid the routing overhead and increase in packet deliver ratio.

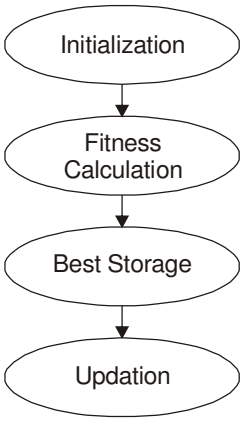

Fig. 1. Flow chart of the optimization algorithm.

B. Routing Process

In the projected hybrid routing algorithm, the procedure of routing comprises of six sections. They are route demand initialization method, route demand forwarding method; route demand receives method, route respond sending method, route respond forwarding method along with route respond receiving process. When the node desires to transfer the packets from starting place to target, it will initially verify the available path. If it is available, the information is transferred from source to the target if not the route discovery process is activated.

In the path finding procedure, initially the source nodes verify the boundary nodes acknowledgement signal strength is greater than or equal to the signal threshold (SIGNAL_THR) [11, 12]. If it is greater than or equal to the signal threshold, the boundary nodes find out the RSSM esteem therefore the routing table calling of the neighbors has been formed in addition to stored the attained RSSM esteem in the RSSM field with respect to the calling of the boundary nodes.

C. Optimal AODV routing process

Initially, the calling of the boundary nodes are set to 0 which is corresponding to the firefly counts, and demand firefly message has been transferred to the boundary nodes in which the initial firefly count set as 0. If the respond node of the demand firefly is a destination, it generate a access of demand fireflies designer in the routing table and therefore it counts the firefly and append it through the content of fireflies count field of responded demand firefly. Finally, the outcome of the firefly count is appended in the routing table entry.

The destination node might be retrieved multiple demand fireflies after remaining from the particular duration. It updates the firefly counts of the source nodes in the routing table which has higher firefly count esteem among multiple demand fireflies.

The nodes verify the reply firefly which is received from some other nodes and it is verified the nodes which beneath to destination node. If not, then it computes the fireflies count with the content of firefly count field of the reply fireflies and stored the count esteem in the routing table access and also store the outcomes of firefly count of reply fireflies. Finally, it forwards the reply fireflies to the neighbor node to achieve the target.

The nodes verify the reply firefly which is received from some other nodes and it is verified the nodes which beneath to destination node. If it is a destination, then it generates a routing table access of the reply fireflies' designer and therefore it update the firefly count in the routing table access. Finally, the information packet is transferred from source to the destination.

In the proposed hybrid routing protocol, the MFR incorporate with optimal AODV using firefly optimization algorithm is computed to transfer the data packets beginning source to the destination. The neighbor nodes are computed based on the MFR techniques and the overall routing protocol is generated based on the optimal AODV using firefly optimization algorithm.

V. PERFORMANCE ANALYSIS

In the projected hybrid routing protocol, the throughput, packet delivery ratio along with routing overhead has been performed for the performance analysis. The comparative analysis of the proposed routing procedure comprises of traditional DSR and traditional AODV protocols. The performance analysis has been computed it for varying number of devices. The simulation results have been designed by using MATLAB 2016a version. Node velocity is taken as 10 m/s and data velocity as 16 kbps. The maximum number of connections to CBR traffic is taken as 10.

In this study, the proposed system had shown good results when compared with the previous technique. Some of the initialization parameters of the node selection process have been explained as follows

Table 1: Initialization Parameters.

Number of wireless hosts	**50**	**100**	**150**	**200**
Mobility Model	Random Walk			
upper limit Channel Power	2mW			
Radio Bitrate	100kbps			
Execution period(s):	3400			
overall Packets transmit:	3397			
Execution Style:	Cmdenv-fast-mode			

– **Routing Overhead:** The average amount of information packets might be transferred in single information packet in this routing protocol which consumes additional bandwidth by overhead to bring information traffic.

Table 2: Routing Overhead with different amount of nodes.

Technique	N=50	N=100	N=150	N=200
HAODV	2.98	4.35	5.95	7.05
AODV	9.79	12.61	17.18	22.85

Table 2 demonstrates the routing overhead for the different amount of nodes. The average value of HAODV is of 5.082. The ADOV average value is 15.607. As a result, the HAODV obtained a better performance measure than AODV technique.

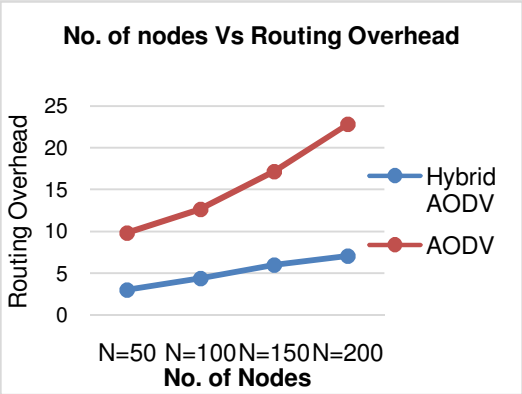

Fig. 2. Routing Overhead.

Fig. 2 illustrates the routing overhead of HAODV has been diminish when compared with other routing protocol. This data reflects that improvement of HAODV in terms of Routing overhead is 67.43% with AODV.

Throughput (messages/second): The complete amount of retrieved information packets separated by overall duration of execution period. For the throughput of this network, messages are delivered per one second.

$$\text{Throughput} = \frac{\text{Number of bytes received} \times 8}{\text{execution time} \times 1024} \text{Kbps}$$

Table 3: Throughput with varying number of nodes

Technique	N=50	N=100	N=150	N=200
HAODV	315.34	345.92	365.98	370.11
AODV	276.17	309.29	320.85	321.76

Table 3 demonstrates the throughput versus different amount of nodes with the comparative analysis with traditional AODV technique. HAODV shows 12.11% increased the throughput as comparison to AODV. The better outcomes of the HAODV are attained because of the optimal path selection in the AODV routing network.

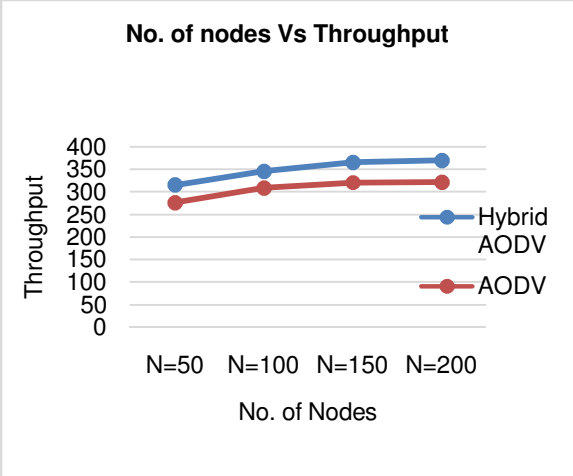

Fig. 3. Throughput.

Fig. 3 demonstrate the throughput of the network with different amount of nodes. In the proposed HAODV, the parallel computation of neighbor node selection along with optimal path selection has been performed which leads to less power consumption hence the throughput of the proposed model provide the better outcomes.

End to End delay: It is the overall execution period for the data transmission begins from source to destination across MANET. The end to end delay has been performed which is depend on routing finding latency, queuing at the border queue along with retransmission hindrance, broadcast and transmission period.

Table 4: End to End delay with number of nodes.

Technique	N=50	N=100	N=150	N=200
HAODV	0.11	0.16	0.19	0.26
AODV	0.59	0.64	0.71	0.76

Table 4 explained the end to end delay with varying number of nodes has been calculated. The average esteem of the end to end delay of HAODV is 0.18. The average esteem of traditional AODV is 0.67.

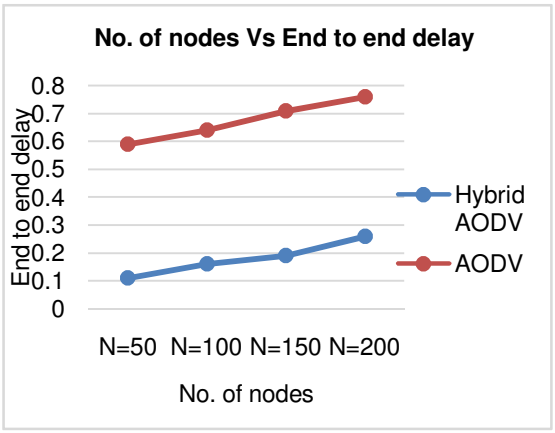

Fig. 4. End to End delay.

From the Fig. 4, the HAODV illustrate the lower end to end delay when compared with traditional AODV technique. Hence, the lesser end to end delay has been attained for the proposed HAODV technique when compared with other comparative analysis. Table 4 reflects that average End to end delay of HAODV has decreased with respect to AODV. Average End to end delay has reduced 73.13% with respect to AODV.

VI. CONCLUSION

In the proposed technique, the optimal HAODV technique is used to found the shortest path from origin to target place. As a result of the study, the proposed technique illustrated the best performance measure when compared to the other technique. The main objective of the proposed system requires reliable, scalable, and self-organizing, rapidly deployed and they use a dynamic routing algorithm which leads to a better increase in routing overhead, Average-End-to-end Delay and throughput. This proposed technique was implemented by MATLAB. It has been analyzed that the proposed hybrid technique performs good quality as compared to AODV routing protocol in terms of the performance analysis. By comparing those protocols performance measurements, it has been shown that reactive topology-based algorithms are better than proactive topology-based routing procedures.

VII. FUTURE SCOPE

The security in MANETs has also become more important accordingly in future. Inherent characteristics of MANET i.e. wireless medium, broadcast transmission and lack of centralized administration render mobile ad hoc networks vulnerable to security hazards. Security aspects in the work have not been considered which can be taken care of as future extension of the work. Secondly, for the selection of the neighbor nodes; it may be consider selecting energy efficient nodes in the future work.

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