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Compact Forbidden Set AODV Routing Information Protocol's Radial-Based function Set on a Neural Network

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Abstract - Routing is one of the most crucial problems that significantly affects the performance of multihop networks, such as the Internet and Mobile Ad-hoc Networks.This study investigates the viability of adopting shortest path routing in wireless sensor networks. An ideal routing algorithm should struggle to locate the best route for data that must be transferred in a precise amount of time.In this paper Route Discovery, Traffic Aware RBF-Neural network Approximation, and Traffic Aware Route Selection are three methods are proposed for AODV advancement technique for route selection and packet forwarding

Keywords - Radial Basis, Congestion,RIP, packet delivery ratio, end to end delay, collision rate, mobility, route discovery

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INTRODUCTION

One of the first distance-vector routing systems, uses the hop count as a routing metric (RIP). RIP prevents routing loops by restricting the number of hops permitted on a path from source to destination. The maximum number of hops permitted by RIP is 15, which places a cap on the size of networks that the protocol can handle.

The routing tables of RIPv1 routers are updated every 30 seconds. Due to the limited routing tables in the early installations, the traffic was not heavy. However, when networks expanded in size, it became obvious that there could be a sizable traffic spike every 30 seconds even if routers were initialised at random times.

(RIP) is a dynamic routing system that uses hop count as a routing metric to determine the best route between the source and destination networks. Operating at the OSI Network layer, it is a distance-vector routing protocol with an AD value of 120. Port 520 is used for the RIP protocol[1].

The hop count is the number of routers that connect the source and destination networks. The optimum route to a network is determined to have the fewest hops, and as such, it is added to the routing table. RIP minimises routing loops by capping the number of hops that may be included in a path.

PROBLEMS IDENTIFIED AND FACTORS CONSIDERED IN AODV ROUTING(Compact Forbidden Set Routing Information Protocol)

The AODV routing protocol is the Compact Forbidden Set Routing Information Protocol which initializes the broadcast timer while doing route discovery, and it receives route replies that arrive only within the duration. If a response is received after the timer has expired, it will be rejected and discarded. Many factors, such as network density and traffic conditions, determine the time it takes for route responses to arrive.

- As the network becomes denser, the time it takes for a route reply to reach the source node increases.

- The source node maintains the timer duration in a consistent way that ignores traffic factors or network density, resulting in a greater loss of detected routes.

- A missing route raises the chances of missing the shortest route and also increases the number of hidden paths.

- In congested situations, the increasing number of rebroadcasts causes higher network traffic, which increases the number of missed cases.

- The overhead introduced by the broadcast technique has a significant impact on the network's throughput and performance.

RADIAL BASIS FUNCTION IN AD HOC ROUTINGAND ITS IMPACT ON FORBIDDEN ADOV ROUTING PROTOCOL

In universal function approximation, Radial Basis Functions (RBF) are an alternative to Multi Layer Perceptrons (MLP). RBF was developed to solve multivariate interpolation and numerical analysis difficulties. In neural network applications, where the training and query targets are both continuous, their prospects are identical. RBF network performs a local mapping, whereas MLP performs a global mapping, in which all inputs result in an output. Only inputs near specified receptive fields will activate them. RBF neural networks have a major advantage over MLP in terms of performance.[2]

In a multidimensional space, RBF neural networks optimally fit the training data. The global and local mappings in neural networks are shown in Figure1.

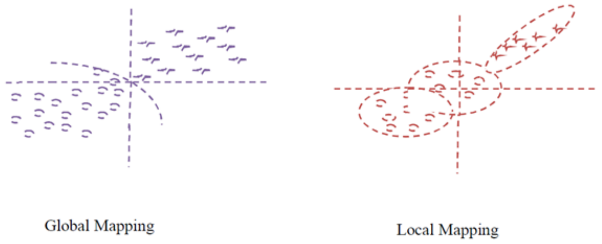


fig 1 Global mapping and local mapping

RBF Network Structure

A typical RBF network is a three-layered network. It is made up of three layers: an input layer, an output layer, and a hidden layer. The input for the pattern comes from the environment, which will be multi-dimensional. To train the data, it should be reduced. The Hidden Layer, which is the same size as the input layer, is made up of some locally tuned neurons centred over receptive fields for non-linear, local mapping. A radial basis function mathematically describes each unit.

$$\varphi_j(x) = \varphi(\|x - x_j\|), \qquad j = 1, 2, \dots, N$$

where N is the size of the training sample and x — xj denotes the vector's Euclidean norm (x-xj). The RBF's centre is defined by the jth input data point xj, and the pattern vector x is applied to the input layer. The links connecting the source nodes to the nodes in the hidden units are thus direct connections with no weights, unlike a multilayer perceptron. The output layer has a smaller number of computational elements or a single linear computational unit.[4,5]provides the network's response. The Gaussian function is employed as the radial basis function for each computational unit in the network's hidden layer.

$$\varphi_j(x) = \varphi(x - x_j) = \exp\left(-\frac{1}{2\sigma_j^2}\|x - x_j\|^2\right), \quad j = 1, 2, \dots, N$$

where σ_j is a measure of the width of the j^{th} Gaussi

All of the Gaussian hidden units are usually, but not always, given the same width o. In instances of this nature, the parameter that separates one hidden unit from another is the centre xj. The choice of the Gaussian function as the radial-basis function in RBF networks is based on the fact that it possesses a number of desired qualities.

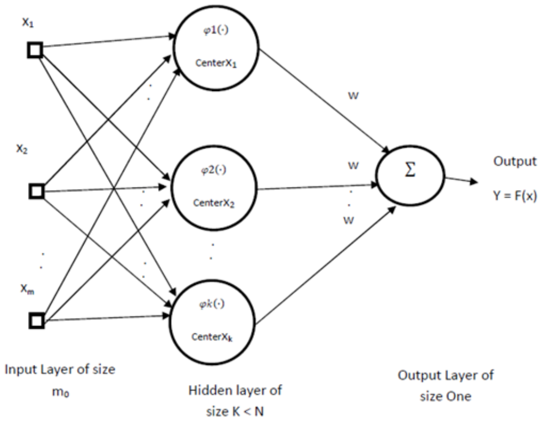
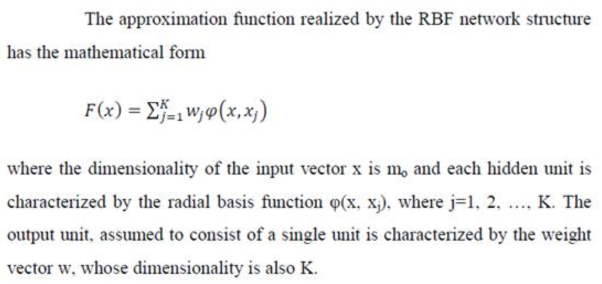


Fig 2

RBF Network Structure



The approximation function realized by the RBF network structure has the mathematical form

$$F(x) = \sum_{j=1}^{K} w_j \varphi(x, x_j)$$

where the dimensionality of the input vector x is m_o and each hidden unit is characterized by the radial basis function $\varphi(x, x_j)$, where j=1, 2, …, K. The output unit, assumed to consist of a single unit is characterized by the weight vector w, whose dimensionality is also K.

PROPOSED METHOD - TRAFFIC AWARE RBF NEURAL

NETWORK BASED AODV ROUTING.

Route Discovery, RBF-NN Approximation, and Traffic Aware Route Selection are three steps of the proposed AODV advancement technique for route selection and packet forwarding. This section delves into the above-mentioned stages in further depth. It depicts at any point in time, a snapshot of the network What happens while discovering route in this congested network is there will be delayed delivery of route replies which will be ignored and generates missing routes. This section addresses the issue by identifying hidden pathways and selecting a route based on the traffic conditions on the chosen road.

- **Neighbor Discovery**

Neighbor Discovery is the process of determining a set of neighbours located around any node in the MANET. The source node sends out a Hello message to the entire network and starts the hello timer. The hello reply message is received by the source node till the timeout expires. The hello message is received by nodes within the coverage of the source node, and when it is received, it generates a hello reply. Upon receiving any hello reply message, the source node adds the node ID from where the reply has been received to its neighbour table.[6,7]

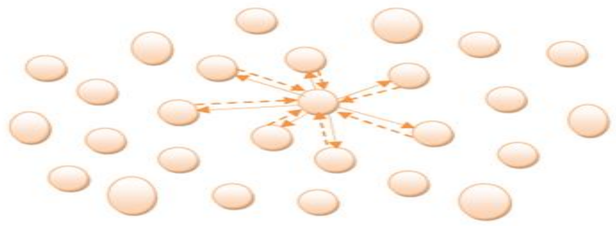
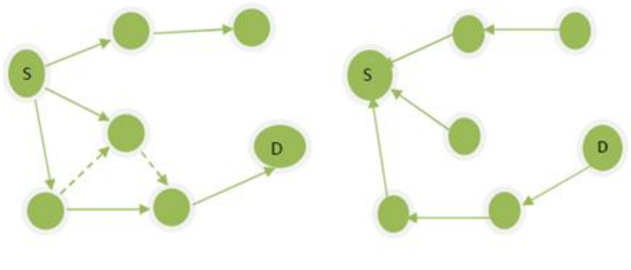


Figure 3. : Neighbor Discovery phase

- **Route Discovery**

The route finding is achieved by sending message into the network. The source node generates Route request message and broadcast on the network. The route request message is received by the neighbours within the transmission range of the originating node. The neighbour compares the ID of the destination node in the route request to its own ID and neighbour table. The node's neighbour table lists the nodes within its transmission range, and the node checks the presence of destination node ID in the neighbour table.[8.] If one of the neighbour IDs matches the destination ID, an route reply message is generated and sent back to the source node. If there is no such neighbour exist for a neighbour that receives the route request, it then rebroadcasts the same to its neighbour and the method is done recursively till all the node receives the message. When a node detects the presence of a destination ID in its neighbour database, it constructs a route reply message, adds its own ID at the end, and sends the reply packet back to the sender. In the first portion of Figure 3, the route request propagation is shown, with dotted lines indicating duplicate packets. As seen in part 2 of Figure 4, the route reply is unicast to the source node.



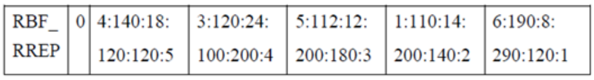
Route Request Propagation

Route Reply

Fig 4 Route Discovery phase

The format of traffic message created in the suggested approach is shown in Table 3.1. The first column displays the packet format; the second column displays the node ID to which the packet must be delivered; and the third column displays the node's details, as seen below.

Table1 Sample Format of Route Reply message



RBF_ RREP	0	4:140:18: 120:120:5	3:120:24: 100:200:4	5:112:12: 200:180:3	1:110:14: 200:140:2	6:190:8: 290:120:1

4:140:18:120:120:5 - The value 4 indicates the node ID, 140 indicates the remaining energy in Joules, 18 indicates the traffic in bytes, 120:120 indicates the x and y-axis coordinate coordinates, and 5 indicates the node's displacement speed. Similarly, the information in the next 4,5,6,7 columns is formatted in the same way. The seventh column indicates that node ID 6 has a link to the destination, has 190 Joules of leftover energy, and has an 8-byte-per-second traffic rate.[9,10] The value 1 represents the node 6's displacement speed, and the value 290:120 represents the location details.

```
Pseudo Code of Route Discovery

Input:  Neighbor Table NT, Route Table RUT, Location Table LT, Signal
        Strength Table SST, Speed Table SPT
Output: Selected Route SR
Step1: Generate RBFNN-RREQ message
Step2: Broadcast RBFNN-RREQ to the network
Step3: Initialize Route Timer RT
//From Source side
Step4: While RT is Running
        Receive RBFNN-RREP message
        If RBFNN-RREP==True then
            Add To Route Table RT
            Add Location details to LT
            Add residual energy to SST
            Add speed to SPT
        End
    End
//For intermediate nodes and destination
Step5: Receive RBFNN_RREQ message
Step6: Identify the destination node ID Dest-ID
Step7: Perform a look up in Neighbor table NT
Step8: If N contains Dest-ID then
        Create RBFNN-RREP message
        Add Node ID, Residual Energy, Traffic condition, Speed,
        location to RBFNN-RREP message
        Send RBFNN-RREP to the node from where the RREQ has
        been received
    Else
            Rebroadcast RBFNN-RREQ message
            Start route timer
            Receive all route replies
            Add own node ID to the reply and send
        End
Step9: Stop
```

Figure 3.10 depicts the best route selection when there are several paths between the source and the destination. The best path is used for 60 seconds in a simulated scenario. Based on traffic conditions, path 1 is picked as the optimum path for the first 30 seconds, while path 2 is taken as the optimum path for the next 30 seconds.

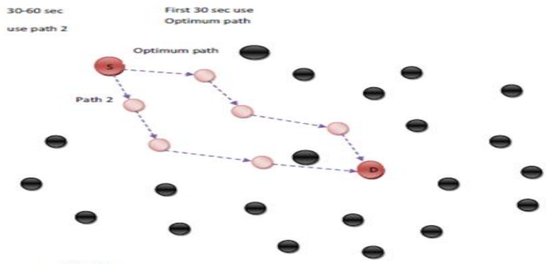


Fig 5 Optimum route selection

SIMULATED RESULTS

The network simulator NS 2 is used to simulate the RBFNN-based AODV protocol. The initial network setup in the network simulator with 30 nodes is shown in Figure 5

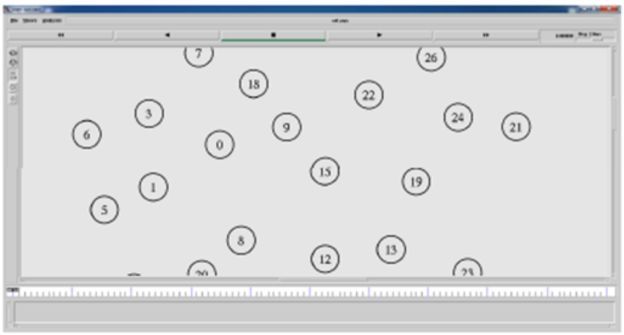


Fig 6 : Initial network setup

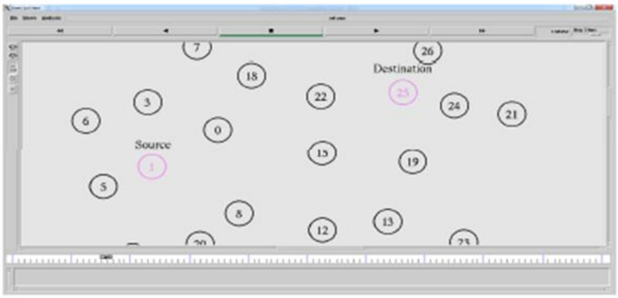


Fig 7 Source and Destination setup

Figure 6 depicts a snapshot of the source and destination during runtime, whereas Figure 7 depicts node mobility. And also depicts the many parameters that determine the network's QoS, including as throughput, packet delivery ratio, routing overhead, and average end-to-end delay.[13]

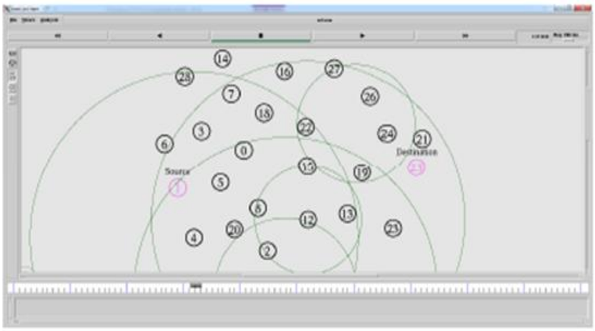


Fig 8 Node movement and route request propagation

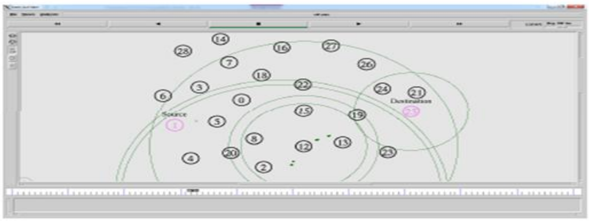


Fig 9 Packet transmission

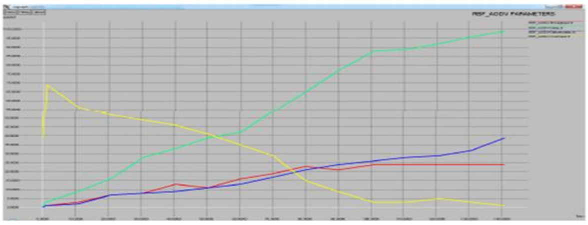
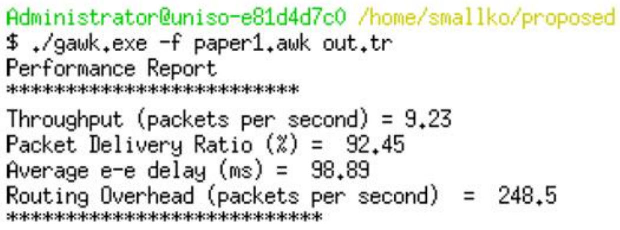


Fig 10 QoS parameters of RBFNN AODV

The calculated results of one set of simulations in network simulator are shown in Figure 10.



```
Administrator@uniso-e81d4d7c0 /home/smallko/proposed
$ ./gawk.exe -f paper1.awk out.tr
Performance Report
**************************
Throughput (packets per second) = 9.23
Packet Delivery Ratio (%) =  92.45
Average e-e delay (ms) =  98.89
Routing Overhead (packets per second)  =  248.5
****************************
```

Fig 11 Sample result of RBFNN AODV

CONCLUSION

To increase the performance of AODV routing and the performance of mobile ad hoc networks, traffic aware radial basis neural network based AODV routing has been presented. Unlike pure AODV routing, the proposed routing protocol takes into account a variety of aspects and employs a number of attributes like as speed, location, residual energy, and traffic conditions to select a specific path for forwarding data packets. By utilising radial basis neural networks, the suggested technique further includes dimensionality reduction and missing routes caused by the least constant timer values of route timer. [11.12]The suggested method eliminates missed situations and identifies the most efficient, traffic-free channel, lowering latency by 8.7% and increasing network throughput by 1.5 percent. [15]When compared to AODV, the overhead is reduced by 17.5 percent, and the PDR is improved by 3%. The results and discussion section of the thesis contains a detailed comparison of the results.

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