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Fuzzy Toolbox for Security of MANET

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ABSTRACT: Design and Simulation for Mobile Ad Hoc Networks (MANETs) is a complex and tedious task. A user wants to design its own scenario, analyzing it with varying number of nodes and check the performance based on security parameters to carry out normal or safe working of ad-hoc network needs a Decision Support System. DSS should be more user friendly, simple, and easy to understand. It should be more effective and efficient for decision making of the user. Here fuzzy applied DSS has been designed for maintaining the security of ad-hoc network.

KEYWORDS: Simulation; MANET; ad-hoc network; Decision Support System

I. INTRODUCTION

Mobile Ad Hoc Network (MANETs) consist mobile nodes which are free to move or join the network at any moment of time. Due to this mobility, it becomes complex and tedious to design network scenario, analyse it and check performance of the network from security point of view. To reduce processing time of the user for proper decision making before design phase, GUI in MATLAB has been designed with fuzzy approach. For ad-hoc network design and analysis, network simulator is needed. Here Network Simulator-2 (Ns-2.34) is used to design scenario for varying number of nodes with varying number of sources, mediators and destinations. Starting from five to twenty five nodes different scenarios are generated. Here total five cases are considered. Table I shows five cases with number of sources, mediators and destinations.

Table I: Cases with varying number of nodes

Case	Source	Destinations	Mediators	Total Nodes
I	2	2	1	5
II	2	2	2	6
III	4	4	3	11
IV	5	5	4	14
V	10	10	5	25

After simulation, obtained data is stored in Microsoft Excel sheet. Analysis has been studied using Excel graphs. To minimize the uncertainty and nonlinearity in the result, fuzzy approach is used. All parameters are fuzzified and result is again used for Ns-2 scenario for performance analysis. The fuzzified result is also stored in Microsoft Excel sheet. Both results, before fuzzy approach and after applying fuzzy approach, have been compared to observe the improvement in the result. The same phenomenon has been workout through GUI developed using MATLAB.

II. RELATED WORK

In [9], researcher has studied and analysed the performance of mobile nodes with various parameters in MANET. Here speed is the important parameter taken into consideration and has been simulated using MATLAB. It shows impact of number of mobile nodes on nodes speed and its distribution in the network area. In [10], the researcher has studied and analysed energy consumption in MANET. As mobile nodes are battery powered hence limited resource utilization is possible. Therefore it becomes an important issue. Energy consumption by a node in flow, nearby flow and for collision has studied and analysed. It is helpful to calculate accurate and more energy required for a node during transmission. In [3] travelling salesman problem has been implemented using one's assignment method using MATLAB programming. In [4] and [5] image processing with different aspect has shown using MATLAB

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programming. In [7], packet dropping has been analysed for wireless network. A fair dropping algorithm has been proposed in congestion policy. In [8], throughput analysis using energy aware routing scheme has been studied. Mobile nodes have limited resource availability in terms of bandwidth, energy utilization etc. For improving network performance, efficient energy aware routing technique has been analysed and studied.

III. INTEGRATED DESIGNED SECURITY FUZZY TOOLBOX

In the networking environment, according to the functionality, varieties of tools are available to check the network performance. Different tools available as per functionality are various scanners, analysers, sniffers, traffic monitoring tools, bandwidth monitoring tools, password crackers etc. These tools are designed for specific purpose only.
In ad-hoc network, huge complexity exists due to mobile nature of nodes. Speeds, Energy, Transmission time, Packet drop are few parameters of mobile nodes which strongly affects on the secure working of the network. So researcher has taken these parameters for performance analysis. For performance improvement, analysed parameters are throughput, packet delivery ratio and end to end delay.

A new user wants to work with ad-hoc network for designing its own network scenario is somewhat difficult task. After designing for further improvement, a change should be done in the previously designed scenario and repeat the same process for performance analysis. So it becomes very tedious and time consuming job. To reduce such overload, researcher has developed an integrated security tool using MATLAB. It fetches data stored in Microsoft Excel sheets. MATLAB GUI provides quick result to the user by providing fuzzy speed; safe mediator based on packet drop, time and bandwidth utilization to carry out safe and normal working of the network. Here user has to provide only mediator count and based on it, he will get result. Developed GUI tool is more user friendly, simple and easily understandable to the user. It also provides direct connectivity to the Fuzzy Inference System where user can analyse the speed based on throughput, packet delivery ratio and end to end delay. This tool also provides connectivity to the Fuzzy Inference System for Queuing and Routing policy which are the primary security parameters.
This phenomenon helps the user to take desired and proper decision according to his or her own designed scenario for regulating speed and maintaining packet drop, energy, time, throughput, delay etc. at the required level before design phase.
Designed MATLAB GUI contains four menus:

- Primary Security Parameter selection GUI
- Safe Mediator Selection
- Safe Speed Evaluator
- FIS connectivity

Fig.1 shows Main Menu GUI developed using MATLAB. First menu provides importance of primary security parameters to the user providing proper queue management and routing policy analysis with GUI created using Microsoft Visual Basic 6.0 as shown in Fig.2.

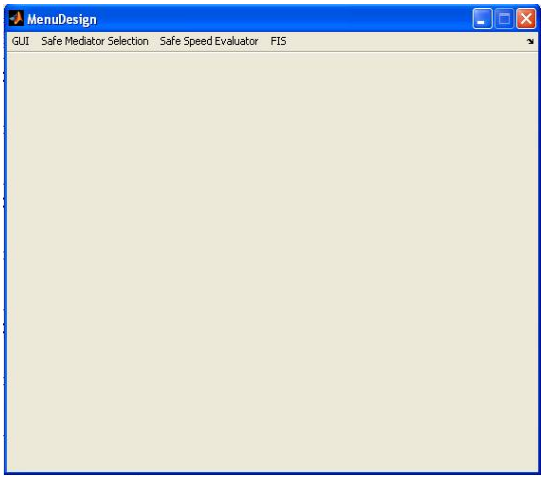

Fig.1: Main GUI

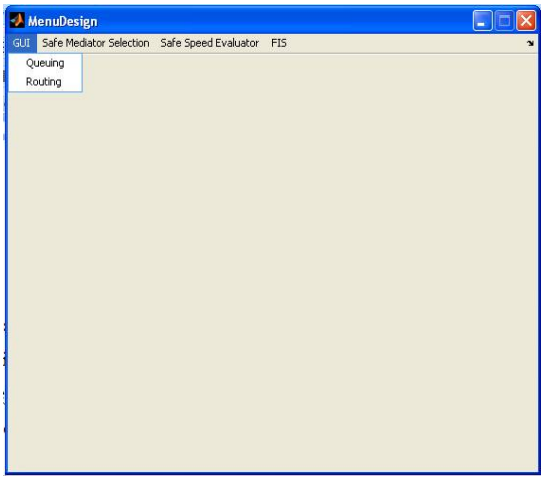

Fig.2: Primary Security GUI Menu

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Fig.3 and Fig.4 shows output window of Queue Management Control System and Optimal Path Selection Management System. For analysis of above mentioned policies, system has been designed with actual values taken by those parameters in the networking environment. It elaborates importance and analysis of transmission delay and safe secure optimal path principle.

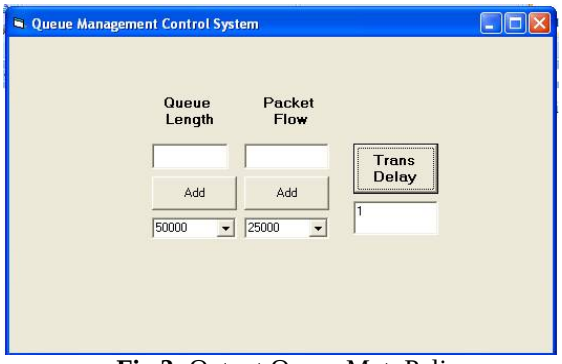

Fig.3: Output Queue Mgt. Policy

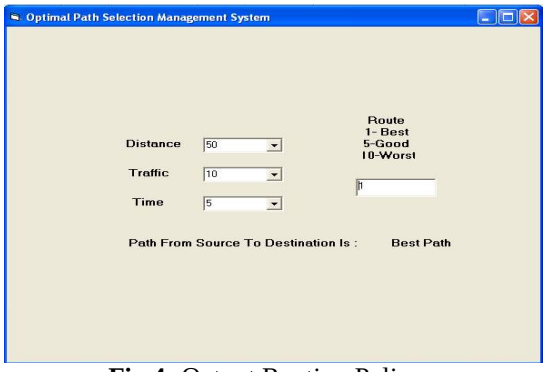

Fig.4: Output Routing Policy

Second Menu provides Safe Mediator Selection based on Packet Drop, Time Factor, Bandwidth Utilization and Combined approach.Fig.5 shows sub-item menu for Safe Mediator Selection.

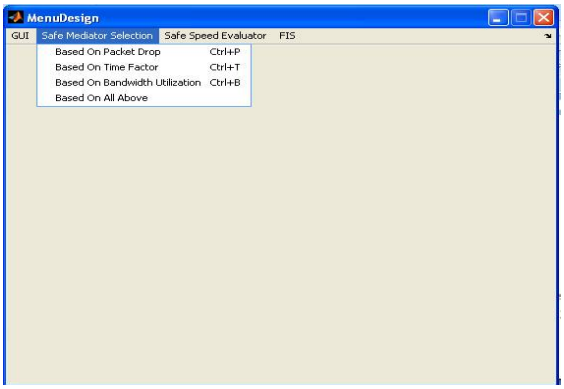

Fig.5: Sub-items of Safe Mediator Selection Menu

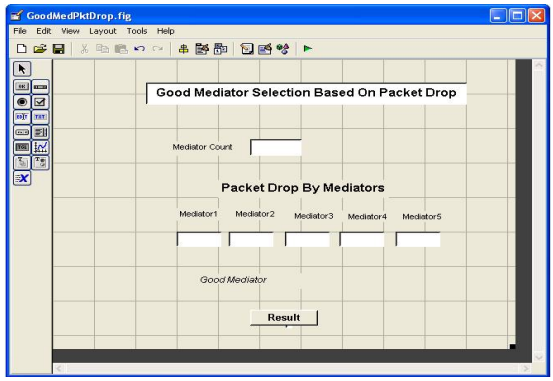

Fig.6: GUI for mediator selection based on packet drop

Fig.6 shows sample GUI for good or safe mediator selection based on packet drop. Similar GUI has been designed for safe mediator selection based on transmission time, bandwidth utilization and combined approach.

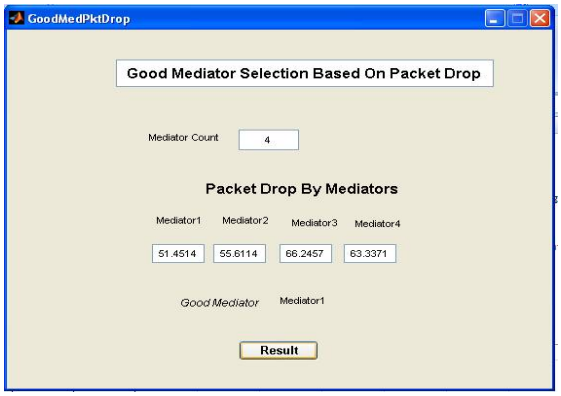

Fig.7: Output (Safe Mediator Based On PacketDrop)

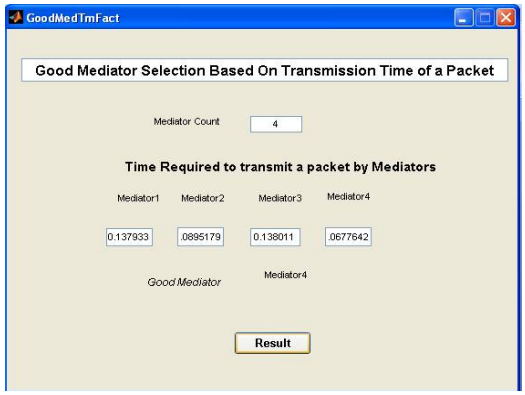

Fig.8: Output (Safe Mediator Based On Transmission Time)

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Here user has to provide only mediator count, based on the parameter; fuzzified values from Microsoft excel sheet has been retrieved and displayed. Based on it GUI provides safe or good mediator useful for the user for its own ad-hoc network scenario. Similarly Fig. 7, Fig. 8, Fig. 9 and Fig.10 shows sample output based on fuzzy values for parameter packet drop, transmission time, bandwidth utilization and combined approach.

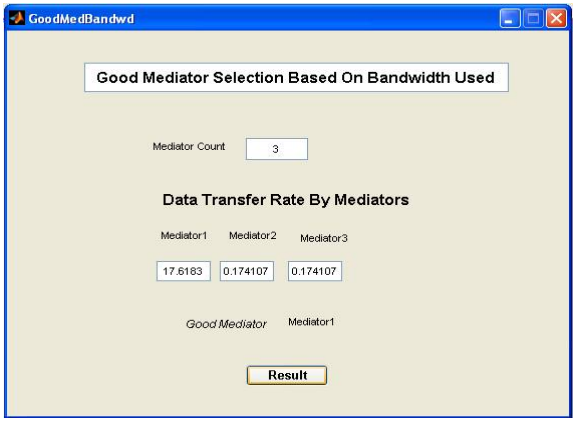

Fig.9: Output (Safe Mediator Based On Bandwidth)

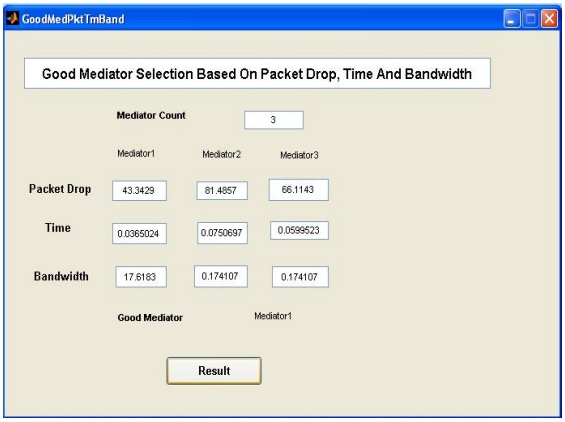

Fig.10: Output(Safe Mediator Based On Combined Approach)

Third menu provides Safe Speed Evaluation for getting safe fuzzy speed useful for the user while designing the scenario based on packet drop, available energy of mediators and end to end delay. Fig.11 shows sub-item menu of Safe Speed Evaluator. Fig. 12 shows sample output for getting safe fuzzy speed based on packet drop.

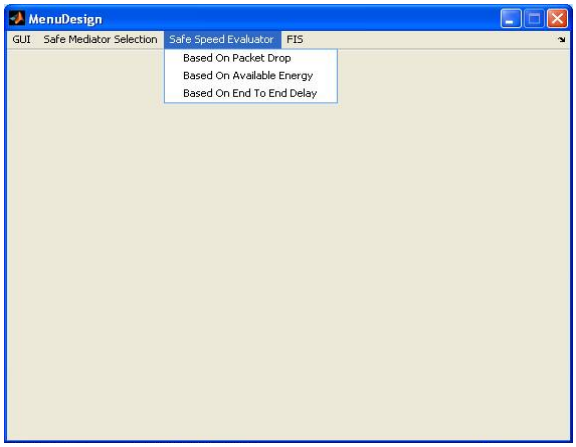

Fig.11: Sub Items of Menu Safe Speed Evaluator

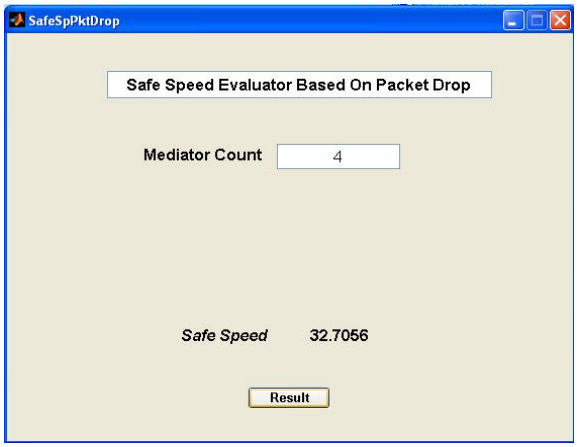

Fig.12: Output (Safe Speed Based on Packet Drop)

Table II shows the obtained fuzzy speed for varying number of mediators for different cases based on packet drop.

Table II: Fuzzy Speed (Based on Packet Drop)

Mediator Count	Fuzzy Speed
1	29.11
2	30.96
3	33.04
4	32.71
5	34.38

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Fig.13 and Fig.14 shows sample output for safe fuzzy speed based on energy and end to end delay for varying number of nodes.

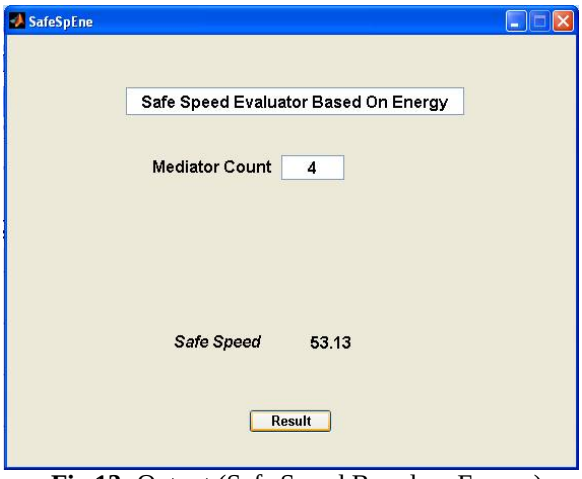

Fig.13: Output (Safe Speed Based on Energy)

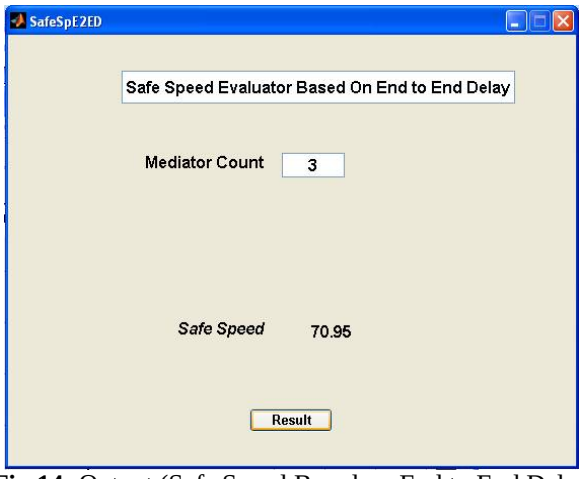

Fig.14: Output (Safe Speed Based on End to End Delay)

Table III and Table IV shows fuzzy speed based on energy and end to end delay for different number of mediators. Based on these values, user can take proper decision for designing its own network scenario.

Table III: Fuzzy Speed (Based on Energy)

Mediator Count	Fuzzy Speed
2	77.48
3	55.58
4	53.13
5	53.25

Table IV: Fuzzy Speed (Based on End to end delay)

Mediator Count	Fuzzy Speed
2	76.59
3	70.95
4	54.75
5	55.21

Table V shows summarized fuzzy safe speed for several scenarios generated using ns-2 for varying number of mediators with varying number of mediators.

Table V: Fuzzy Speed with varying mediator count

Mediator Count	Fuzzy Speed Based On		
	Packet Drop	Energy	End to End delay
2	30.96	77.48	76.59
3	33.04	55.58	70.95
4	32.71	53.13	54.75
5	34.38	53.25	55.21

Fig. 15 shows graphical representation of number of mediators against fuzzy speed for different parameters.

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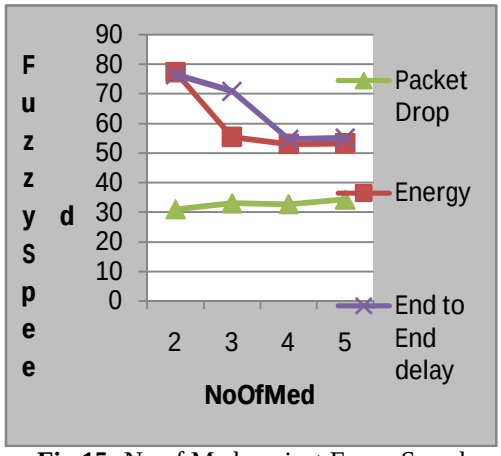

Fig.15: No of Med against Fuzzy Speed

Fourth menu provides direct connectivity to FIS created for analysis after simulation in ns-2 for taken security parameters to be used and analysed by the user as shown in Fig. 16. This option provides help to the user for analysing following parameters-

A. Throughput analysis considering Speed and Packet Drop
B. Packet Delivery Ratio analysis considering Speed and Energy
C. End To End Delay analysis considering Speed and Time
D. Fuzzy Routing analysis
E. Fuzzy Queue management analysis by using FIS.

Here speed is the common parameter has its relationship with other security parameters hence its analysis is more important. Variation in speed affects on packet drop, energy of mobile node and transmission time which are important security parameters. Therefore for simulating scenario using Ns-2, speed is the input parameter. Depending on different values of speed packet drop, energy and time are analyzed with performance parameters throughput, packet delivery ratio and end to end delay. This analysis is with and without fuzzy approach. To obtain result an awk script is written.

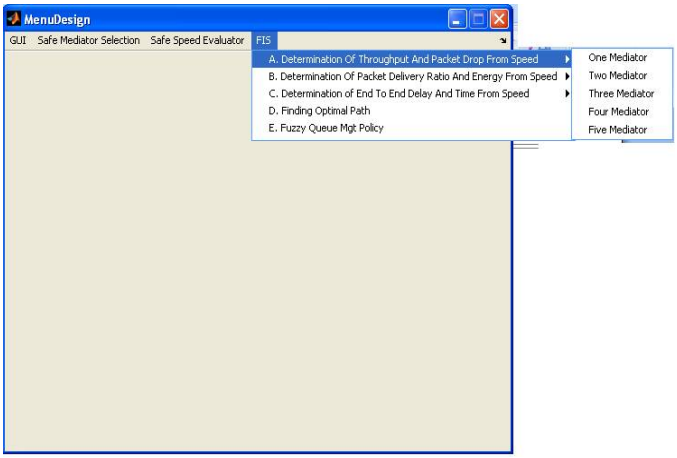

Fig.16: FIS Menu

IV. RESULTS

Designed integrated security fuzzy toolbox acts as a decision support system. It has been designed and developed with the help of fuzzy and non-fuzzy approach for different scenarios using Ns-2 simulator. The purpose behind

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development of this decision support security system is to help for a normal user for secure decision making for its own designed scenario in mobile ad-hoc network. It helps for the user during staring phase of actual network design. Early decision making is more important for secure, efficient and normal working of the network. To take fast and accurate decision in less time, designed security tool is more useful and adds more value in user's decision.

V. CONCLUSION AND FUTURE WORK

Designed GUI in MATLAB with fuzzy approach is time efficient and is more user friendly. It helps for a novice user from security point of view for designing a scenario for ad-hoc network, its analysis and check the performance. GUI provides safe fuzzy speed, safe mediator, safe and secure queuing and routing policy. With the help of which, user becomes comfortable for designing its own scenario considering safety in ad-hoc network. Fuzzy proves the best option for providing security for ad-hoc network.

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