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Improving The Stability and Quality of Service in Cluster Head using Rule Base System in MANET

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Abstract— This paper considers the problem of finding high and low frequency node disjoint and multi constrained QoS using different paths from source to destination with the help of agent based fuzzy inference system. CGSR protocol divide the network into several small areas called clusters and the members of each cluster entrusted to a special node called cluster-head. A fuzzy logic system was proposed by which we select a suitable cluster-head to improve the quality of CGSR protocol. Selecting an appropriate cluster-head can save the power of overall network because the Cluster-Head node consumes more power than other ordinary nodes and the node with the highest chance is elected as the cluster-head. The cluster head is selected by applying (LLC) Least Cluster Change algorithm [6].

(1) Determination of various paths and selecting resource information (energy, mobility, distance, and chance) of the intermediary nodes from source to destination.

(2) Identification of node disjoint and multi-constrained QoS paths using Takagi-Sugeno method. Takagi-Sugeno Fuzzy Inference System (TSFIS) finds a fuzzy QoS weight from existing resource information of the intermediary nodes.

(3) Choosing the finest path based on the fuzzy QoS weight.

(4) Maintain QoS path when path splits due to mobility of nodes or link failure. The model outcome states that our proposed protocol is better than I-MAN on the basis of data fall, delay, load and throughput. Therefore, the proposed system gives a proficient result in the presence and of threats because it provides a suitable protocol on the source of network contexts.

Keywords— Fuzzy Logic System, Hops, QoS, MANET, FIS.

I. INTRODUCTION

The QoS constraint of link consist of factor like end-to-end delay, bandwidth, packet loss rate, jitter etc. Multi-constraint QoS factor are inexact and unsure due to active topology of MANET. Though, choosing a path, which assure all constraints, is a NP complete problem. There is no exact statistical model to explain it. Fuzzy logic helps us to give a reasonable tool to explain the different types of QoS problem. Fuzzy logic is a hypotheses theory based that not only maintains several inputs, but also use the persistent vague information. Therefore accepting fuzzy logic to resolve different problems in ad hoc network is a suitable option. Multi-constraint based routing protocols make use of QoS content paths rather than the particular shortest path to trace the packets. If Multiconstraint QoS paths are set up with multiple node disjoint paths connecting a particular source and a particular destination, then the source node utilizes these paths as crucial and backup routes means latest route detection is appeal when all of the paths fail or only a single route exists. It helps to decrease overhead in determining substitute routes and more delay in packet delivery. So, in this paper we assume both multi-constraint QoS routing and node disjoint routing in MANET. A token based scheduling [12] algorithm is used inside a cluster for allocation the bandwidth among the member of the cluster.

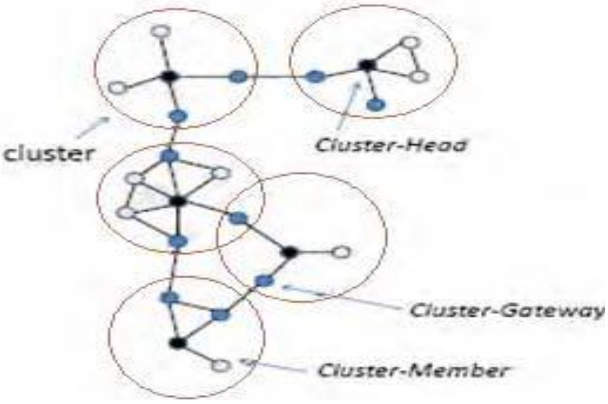

Fig.1 Clustering in adhoc network

(1) Quality-Means effectiveness can be defined as to retrieve the most relevant set of document for a query. Process text and store text statistics to improve relevance is used.
(2) Speed-Means efficiency may be defined as a process queries from users as fast as possible for its specialized data.

CGSR assume that all communication passes through the cluster-head. Communication between two clusters takes place through the common member nodes that are member of both the clusters. These nodes which are members of more than one cluster are called gateways. Following Diagram shows how clustering takes place in an adhoc network.

The knowledge base is made up of a set of rules that defines input and output metrics. The input metrics involve threats, network size, and mobility and cooperation level. The output metrics consist of all the present solution and protocols required for secured routing. The behavior monitoring system measures the input metrics and grades the MANET in terms of LOW, MEDIUM and HIGH protection modes to handle diverse MANET contexts. The Inference Engine will decide the finest solutions on the bases of rules used in the rule based system. We have used doctor like diagnostic pattern to identify the perfect behavior of the network. If the network is cooperative then the inference engine chooses the LOW protection mode. Thus, it saves battery power and bandwidth which enhance network cooperation [11]. Choosing a suitable protection mode will certainly enhance network cooperation and maximizes the battery life span. In this work we have taken only three protection modes but it can be extended to satisfy the exact demand.

II. RELATED WORK AND MOTIVATION

Recently, more concentration is required to describe definite network parameters while specifying the routing metrics. Example includes link capacity, delay in the network, link stability and identifying low based mobility nodes [7]. The schemes are usually based on the previous work done, which is in that case is enhanced using new metrics.

In the last years, a great deal of literature has been published in the field of energy efficient wireless sensor networks. There exists relatively little work with regard to biologically inspired algorithms for routing in communications networks. However, there are a number of notable examples which show that these concepts can provide a significant performance gain over traditional approaches.

a) D. Cascado et.al. [2010]

In this paper we have studied that battery life is a key resources that must be conserved as much as possible. The main way of achieve power saving in this type of circuitry is to implement low-power RF (Radio frequency) circuitry and network protocols that try to minimize the transmission by the air. In this paper presents a power-saving method for wireless sensor networks with real- time constrains.

b) Yu Wang [2010]

A power model is described in which every node can send its state between energy save mode & active mode. In this pape

r purpose a routing protocol for further energy control now a new routing function dealt with both MAC layer is defined. Regard as the remaining power of node for corresponding traffic load to attain whole power effectiveness. In this paper we studied that protocols can remarkably increase the life time-span of network with minimum power utilization when checked with the routing method according to the shortest path and without energy control mode.

c) IlkerDemirkol, CemErsoy [2009]

The main objective is minimizing the energy consumption so that the lifetime is maximized under the limited battery capacity constraints. In most event-driven WSN applications, the end-to-end delay, and hence, the medium access delay should be minimized. Majority of the WSN MAC protocols are contention-based wherein contention window size setting involves an important trade-off between the collision probability and idle listening durations in contentions where both are aimed to be lowered for efficient network operation. In this paper, the energy optimizing and the delay optimizing contention window sizes are derived as a function of the number of contending nodes. For this purpose, we present separate analyses for the contention delay and for the energy consumed which are verified with detailed simulations.

d) *DanyanLuo, DechengZuo, XiaozongYang [2008]*

Energy saving routing protocols in wireless sensor networks is necessary for increasing the network lifetime. Less energy consumption can be achieved by reducing the node transmission radius. In this paper to presents a transmission radius self-adjust energy-saving routing protocol (RSES) for WSNs. In this paper RSES prolong the network lifetime and has balanced n/w load and routing traffic.

Research works show the limited use of AI techniques to optimize MANET performance. The use of AI technique is presented in I-MAN. It is an Intelligent MANET routing system that deployed already available routing protocols to their best advantages. Saeed emphasized on the Intelligent MANET optimization system in his Doctor of Philosophy thesis. I-MAN protocol enforces improvised processes with a lesser no of metrics such as mobility, network size that is not efficient for all network contexts and cannot be customized further.

The proposed work is better than the existing solutions because of its object oriented design that can be further customized on the basis of network contexts. Our protocol consumes less energy and enhances network performance because it describes a suitable protocol based on network contexts. On the other hand existing solutions employ Adhoc services to protect a network thus, consumes more energy and bandwidth and degrade network performance.

III. PROPOSED WORK FOR RULE BASE SYSTEM

Generally, cluster-head election for mobile ad hoc network is based on the distance to the centroid of a cluster, and the closer one is elected as the cluster-head. In past presented a cluster-head election scheme using fuzzy logic system (FLS) for mobile ad hoc wireless networks. The linguistic knowledge of Cluster-Head election was based on parameters and fuzzy rules are set up based on this linguistic knowledge. The outputs were set up based on the linguistic knowledge.
The outputs of the fuzzy rules provide a Cluster-Head possibility, and node with the highest possibility is elected as the cluster-head. Other appropriate rules can be created that optimize routing efficiency (e.g., number of hops, QOS, etc).

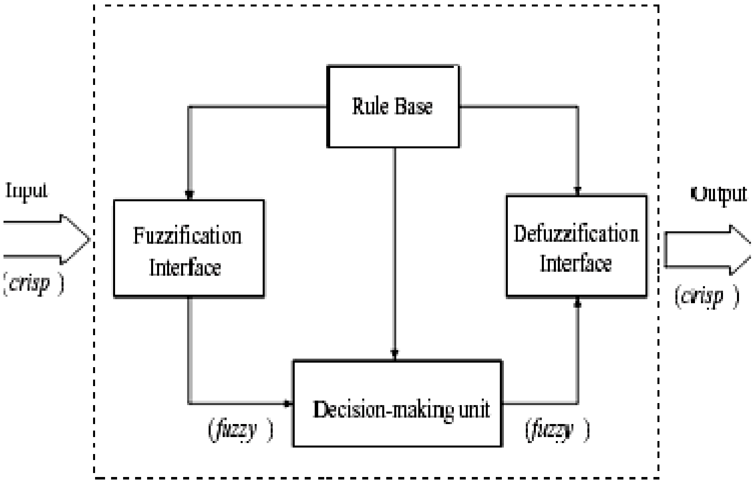

Fig. 2 Fuzzy logic System

Steps of fuzzy inference rule system are:-

Step 1: Fuzzy Inputs

It will find all inputs and calculate the degree to which they fit in to the fuzzy sets using membership functions.

Step 2: Apply Fuzzy Operator

In this step we calculate the extent to which each and every part of the predecessor has been proposed for each rule. If **the** predecessor of a particular rule contains more than one part, then the fuzzy operator is applied to get one number which shows the result of the predecessor for that particular rule. The output comes as a single truth value. The method either AND or OR operation.

Step 3: Apply Implication Method

Before applying implication, weights are assigned to every rule used in process. The input used for the implication method is a particular number specified by its predecessor, and the output results in a fuzzy set.

Step 4: Aggregate all outputs

Aggregation is the method in which the fuzzy sets that signify the output of every rule are aggregated into a particular
fuzzy set. Aggregation is calculated once for each output variable, former to the fifth and last step called defuzzification. The input used in the aggregation process is the catalog of all output functions used in the implication process for every rule. The output of the aggregation process is a single fuzzy set for each and every output variable.

Step 5: Defuzzify

The input used in the defuzzification process is a particular fuzzy set and the output comes as a single number. Fig. 2 shows the structure of a fuzzy logic system. When an input is appied to a FLS, the inference engine calculates the output set equivalent to each rule. The COG (Center of Gravity) is estimated using the following formula:

$$COG = \left(\sum \mu_A(x) * x\right) / \sum \mu_A(x)$$

where, $\mu_A(x)$ is the membership function of set A.

Many techniques are designed to choose suitable cluster head. In this case, we use LEACH [12] Algorithm.To become a cluster-head, each node n choose any number between 0 and 1. If the number is smaller than T (n), the node is selected as the cluster-head.
The Threshold is set at:

$$T(n) = \frac{P}{1 - P \times \left(r \bmod \frac{1}{P}\right)} \quad \text{if } n \in G$$

$$T(n) = 0 \quad \text{otherwise}$$

Where p is the cluster-head probability, current round by represented by r and G is the set of nodes that have not been elected as the cluster -heads in the last 1/P rounds [8].

IV. EXPERIMENT DESIGN METHODOLOGY

Cluster heads are selected and then the clusters ' members are determined. In this phase, each node calculates its energy, chance parameter based there main characteristics through fuzzy logic:

1. Energy
2. Density
3. Centrality

Nodes with higher capability introduce themselves to base station as cluster head' candidate, so they prevent those nodes which are not capable of being cluster head from sending their information. The network uses nodes with different factor after being launched. Nodes that remaining energy in comparison with network's total energy is less than threshold level are recognized as dead nodes and can't participate in competition. In base station, cluster heads are determined among cluster head candidates using genetic algorithm. Also, the number of times in which a node is selected as cluster head is considered.We design questions such as:-

If distance of a node to the cluster centre is near and the node energy is low, and the node movement is moderate, then chance that this node will be selected as cluster head is:

We need to set 3^3=27 rules for this FLS.

Expert knowledge is represented based on the following three parameters:-

Node Remaining Energy- the energy level present in each node is represented by the fuzzy variable Energy.

Node Distance - the distance of a node to the cluster centroid is represented by the fuzzy variable Distance.

Node Movement- a value which classifies the nodes based on how central the node is to the cluster is represented by the fuzzy variable Mobility.

These are 3^3=27 rule made for fuzzy rule base. The membership functions and their equivalent linguistic states are shown in table 1 and figure 3 to 8.

Table 1 Fuzzy Rule Base

	Energy	Density	Centrality	OUTPUT(chance)
1	low	Low	close	Small
2	low	Low	adeq	Small
3	low	Low	far	Vsmall
4	low	Med	close	Small
5	low	Med	adeq	Small
6	low	Med	far	Small
7	low	High	close	Rsmall
8	low	High	adeq	Small
9	low	High	far	Vsmall
10	med	Low	close	Rlarg
11	med	Low	adeq	Med
12	med	Low	far	Small
13	med	Med	close	Large
14	med	Med	adeq	Med
15	med	Med	far	Rsmall
16	med	High	close	Large
17	med	High	adeq	Rlarge
18	med	High	far	Rsmall
19	high	Low	close	Rlarge
20	high	Low	adeq	Med
21	high	Low	far	Rsmall
22	high	Med	close	Large
23	high	Med	adeq	Rlarge
24	high	Med	far	Med
25	high	High	close	Vlarge

The Fuzzy rules will follow the steps such as:

1. The time of first sensor node's death.
2. The time of whole network's death (the time in which sensor node's energy is finished completely).
3. Three scenarios are used to compare the efficiency of the suggested algorithm. Finally, the proposed algorithm leads to the lightest lifetime in sensor's network.
4. First scenario: In this scenario, the proposed algorithm is evaluated in the form of a heterogeneous network with three different nodes: An advanced node, a normal node and a node which is in a critical condition and has the lowest energy level.
5. Second scenario: In this scenario, the proposed algorithm which is a heterogeneous network with clustering routing is considered in a fuzzy state in which each node determines its capability for being a cluster head based on fuzzy logic.

6. Third scenario: In this scenario, in addition to a network with heterogeneous nodes and fuzzy logic, chaotic based genetic algorithm is proposed to choose the cluster head in base station. In this section, the number of generations is 100, the cross over probability is 0.6 and mutation probability is 0.1.
7. In case any cluster/node is week same case lower energy cluster will occupy the space and push the priority for such nodes.
8. In case cluster group density is low and centrality is close, rule will generate the Rsmall chance parameter.

V. RESULTS

The cluster head forwards the data of their sensor nodes to their base station after compressing it. Calculate the energy lost in compression and a large amount data sent to the base station.
Rule base system shows the concept the family of the node which is directly proportional to the output parameter.
In this paper we have used fuzzy logic approach, and have established a relationship b/w Energy, Distance and Mobility Chance corresponding to No. of Hops. This relationship has been shown in figure 7 i.e. Rule Viewer.
Fuzzy Inference system takes energy, distance, chance and mobility as inputs and provides us no. of hops as in figure3

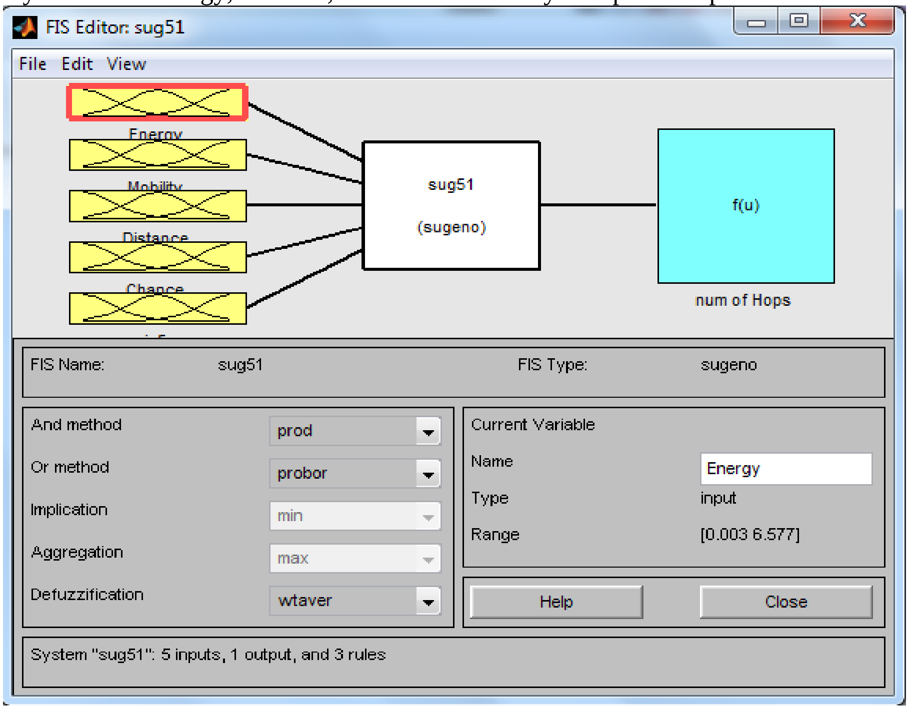

Fig. 3 Fuzzy Inference System

This will generate the overall probability for the cluster group rules with respect to output parameter.
Fuzzy rules will calculate the with respect to the chance and mobility too.

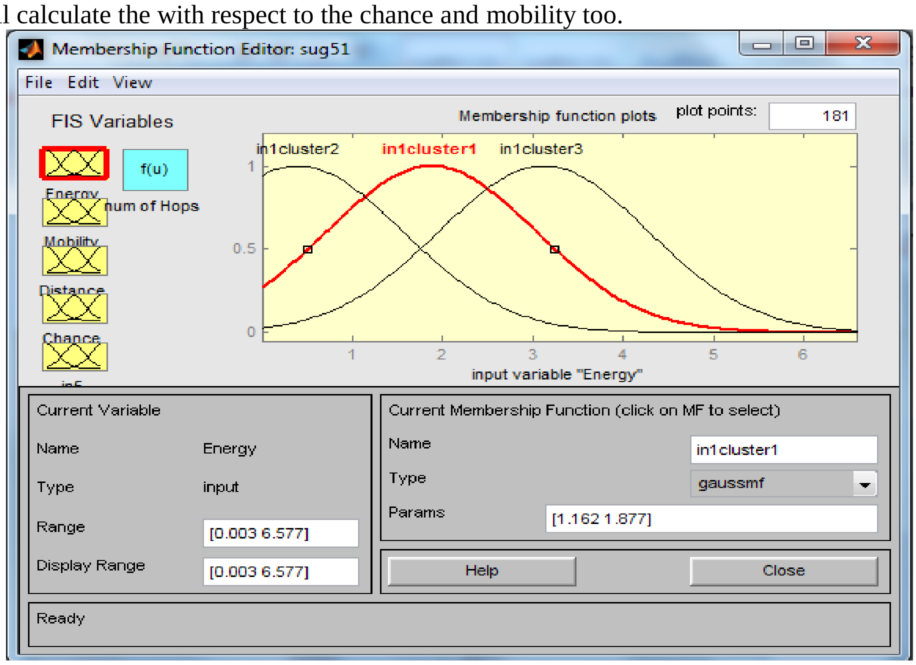

Fig. 4 Membership function between three clusters

Rule Editor in Fig. 5 shows the fuzzy logic rules on the basis of Energy, Mobility, Distance , Chance and give Output in the form of Quality of Service(QoS).

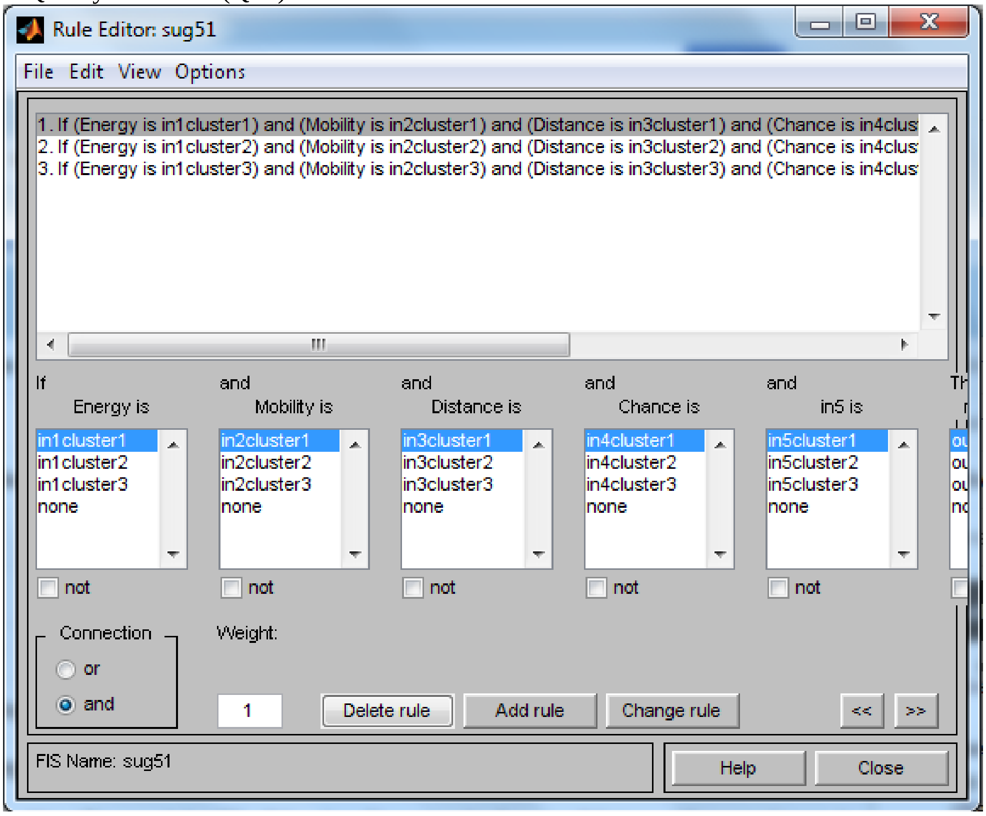

Fig. 5 Rule Editor

Surface Viewer depicts 3-dimensional co-relation among Energy, Distance, Mobility, Chance and No. of hops; with the help of surface viewer we can have the effect of any of two inputs on No. of hops at any time, as shown in figure 6.

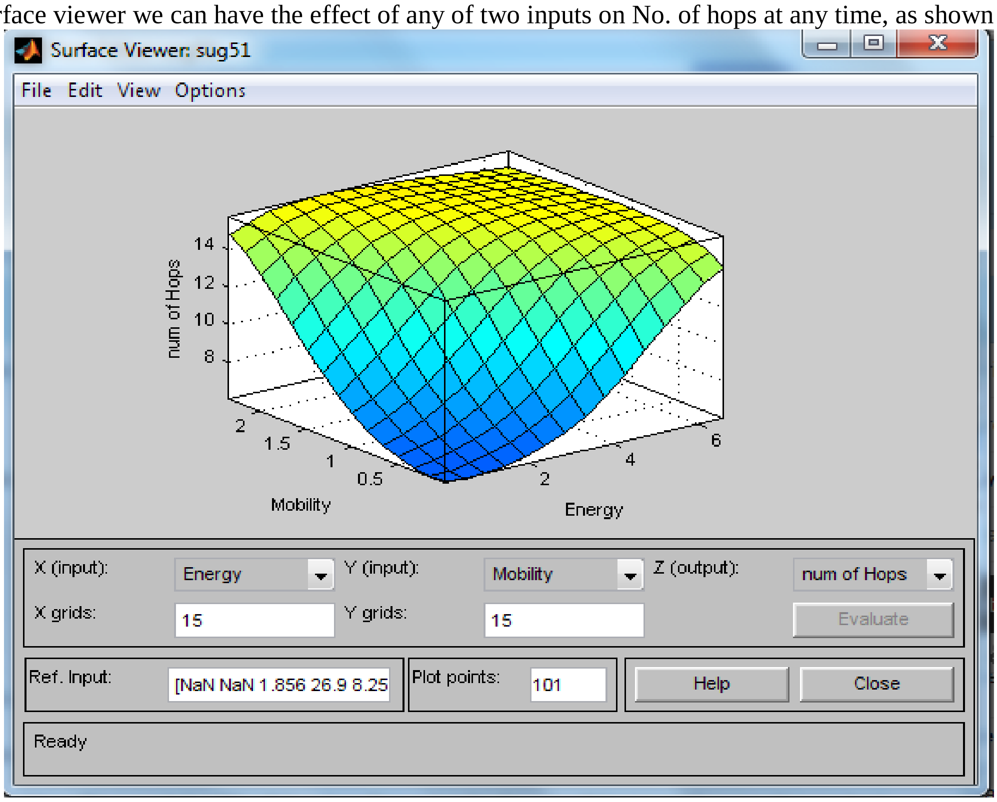

Fig. 6 Surface Viewer

In this paper we have used fuzzy logic approach, and have established a relationship b/w Energy, Distance and Mobility , Chance corresponding to No. of Hops. This relationship has been shown in figure 7 i.e. Rule Viewer. We can take random values for inputs like Energy, Mobility, Chance, Distance and calculate no. of hops as the output.

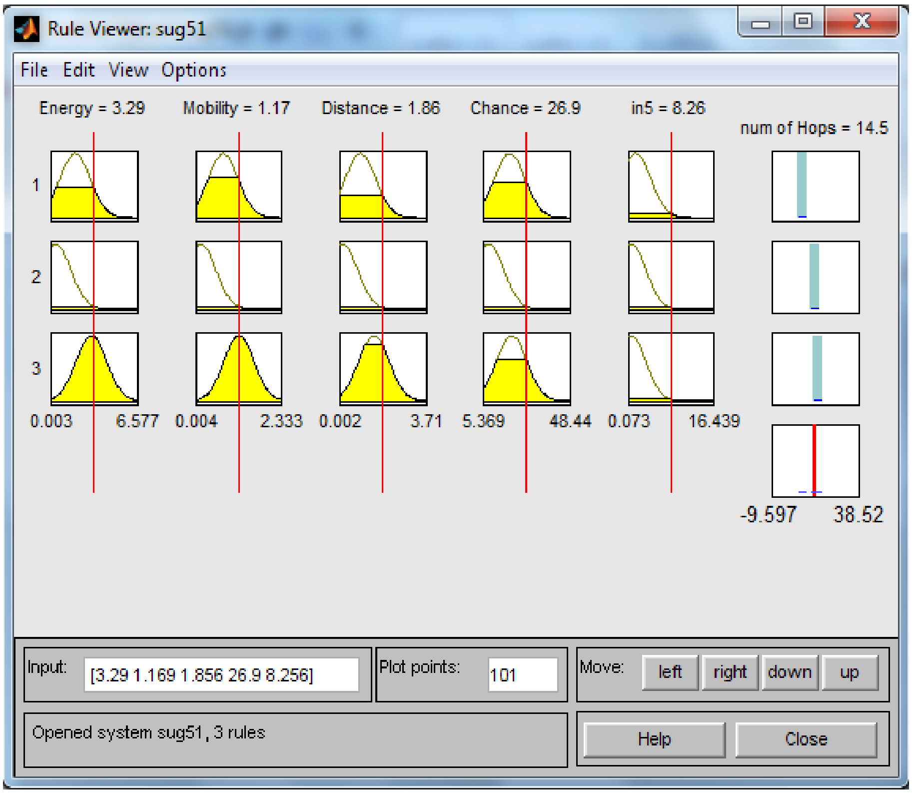

Fig. 7 Rule Viewer

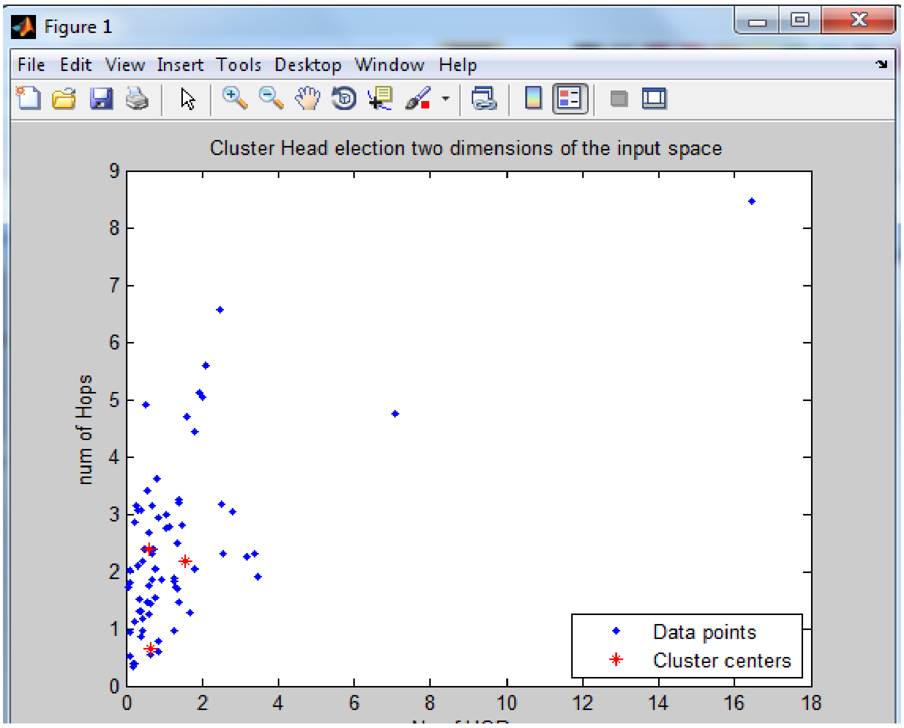

Fig. 8 Comparison between no. of hops and Qos

In cluster head election rule base system if increasing the number of HOPs comparivity to the Quality of service it will be in constant level parameter in a specific zone.

VI. CONCLUSION

In this paper, a new method which is based on fuzzy logic and genetic algorithm is represented to choose a cluster head if cluster head get fail ,should be priority for second lower parameter rule base concept. Moreover, this network has used nodes with multipath characteristics. Some of the advantageous of heterogeneous nodes are: the long lifetime of networks, increase in network's stability and decrease in data transference Quality of improvement. In simulation, the suggested algorithm is compared to LEACH. For the study of future android platform should be include the base station for the sensor node.

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