Volume 3, Issue 6, June 2013 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Optimization of Mobile Agent Using Mixed Metric Approach of Counter and Response Time in Fuzzy Logic

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Abstract— As the world is running towards speed, every user wants the accurate result quickly and with no overhead. Mobile agent helps to solve this issue. To improve the response time and to reduce cost, optimization techniques can be added which will help to select the best optimized itinerary on which the mobile agent has to go. This paper proposes a new optimization technique which uses the Fuzzy Mix Metric approach using the counter and response time. Here the best optimized itinerary is analysed among the other different paths which are taken under different cases.

Keywords— Mobile Agent, Fuzzy Logic, Mixed Metric, Optimization Techniques, Counter Approach, Response Time Approach

I. INTRODUCTION

Number of users are continuously increasing in communication system, so the need of speed and correctness is too increasing. To tackle this, mobile agents [11] are used in which the data is not centralized, but is localized at different node. As the mobile agents are dispatched throughout the network, this increases the network load. To reduce this optimization techniques [9] are introduced .There are various optimization techniques which helps to improve the response time. The mobile agents should be Adaptive learner, Autonomous, and Mobile in nature. Mobile Agent consists of code, data and one of the most important execution state. Now the question is that, How the mobile agents work?

A. Working of Mobile Agent

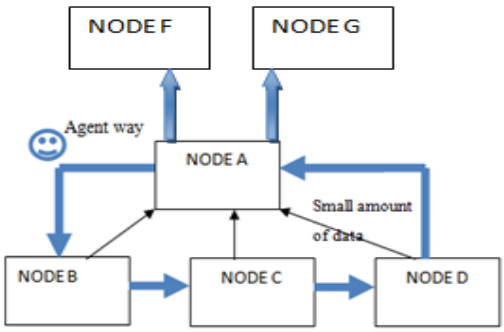


Fig. 1

1) *Creation:* Here creation of mobile agent takes place and its state is also initialized here.
2) *Dispatches:* An Agent is sent to new host.
3) *Cloning:* Clone of the Mobile Agent is born and original state is also copied to the clone. As this is done in NODE A, here the clone is sent to NODE B, NODE F and NODE G.
4) *Deactivation:* Here the agent is deactivated and its state is stored in the disk
5) *Activation:* Here deactivated agent is again activated and its state is restored from the disk.
6) *Retractions:* An agent is brought back from a remote host along with its state to the home machine. This is done in NODE D.
7) *Disposals:* An agent is ceased and its state is lost forever.

This is the way the mobile agent works[11] in the network. Here in this paper our main focus is the optimization for mobile agents .many optimization techniques are there , but counter and response time are the two approaches which are introduced in this paper .Using both of these approaches we use mixed metric approach in fuzzy logic[5] to get the best optimized path.

B. Fuzzy Logic

L.A. Zadeh introduced Fuzzy logic[3] theory in 1965. Plato said that fuzzy logic was the region between true and false known as the third region as it was realised that the things can't be only true or false. Example: The water can't be

only hot or not hot. It can be very cold, cold, medium, hot and very hot, thus there are five cases which tell us the thruthness about the status of water temperature, which is only possible by using fuzzy logic Hence fuzzy logic tells about the degree of thruthness. To use fuzzy logic we must know about the membership function and the fuzzy rules too.

C. Membership Function

Membership functions[2] were introduced by Zadeh in the first paper on fuzzy sets (1965). They represent degree of thruthness. Most easy and justified method to explain membership function is by expressing it by mathematical formula. Membership function is between 0 and 1. There are various kinds of membership functions.

1) *Crisp Membership Functions:* This one is the classical one .In this crisp sets allow only full or no membership function. So this is not the flexible one, to overcome this fuzzy membership functions were introduced whose fuzzy sets allows partial membership.
2) *Triangular Membership Functions:* The triangular curve is a function of a vector, x, and depends on three scalar parameters *a*, *b*, and *c*, as given by

$$f(x;a,b,c)=\begin{cases}0, & x\le a\\ \dfrac{x-a}{b-a}, & a\le x\le b\\ \dfrac{c-x}{c-b}, & b\le x\le c\\ 0, & c\le x\end{cases}$$

The parameters a and c locate the "feet" of the triangle and the parameter b locates the peak.

3) *Trapezoidal Membership Functions:* The trapezoidal curve is a function of a vector, x, and depends on four scalar parameters *a*, *b*, *c*, and *d*, as given by

$$f(x;a,b,c,d)=\begin{cases}0, & x\le a\\ \dfrac{x-a}{b-a}, & a\le x\le b\\ 1, & b\le x\le c\\ \dfrac{d-x}{d-c}, & c\le x\le d\\ 0, & d\le x\end{cases}$$

The parameters *a* and *d* locate the "feet" of the trapezoid and the parameters *b* and *c* locate the "shoulders."

4) *Gaussian Membership Functions:* The Gaussian curve is given by

$$f(x)=\exp\left(\frac{-0.5(x-c)^2}{\sigma^2}\right)$$

Where *c* is the mean and σ is the variance. We can also make our own membership function by proposing new mathematical formula.

5) *Pi Shaped Membership Function:* These functions were given by Giarratano and Riley in 1993

f(x; b,c)= S(x;c-b,c-b/2,c) for x<=c
= 1-S(x; c, c+b/2, c+b) for x>c
S(x;a,b,c) = 0 for x<a
= 2(x-a)(x-a)/(c-a)(c-a) for a<=x<b
= 1-2(x-c)(x-c)/ (c-a)(c-a) for b<=x<=c
= 1 for x>c

D. Fuzzy Rules

Fuzzy Rules[1] are the "if/ then" rules which are proposed in fuzzy logic. Fuzzy rules replace the conventional rules. by using fuzzy rules we can make Rule Matrix .Example: Fuzzy rules-

1. If a is X and b is L then y1 is P.
2. If a is Y and b is L then y1 is Q.
3. If a is X and b is N then y1 is R.
4. If a is Y and b is N then y1 is S.

E. Fuzzy Matrix

b \ a	X	Y
L	P	Q
N	R	S

F. Fuzzy Mixed Matrix Approach

In this more than one metrics are taken and then mixed by using fuzzy rules to get best results which are the combination of both metrics[10].

II. PROPOSED APPROACH

Counter and response time are the two metrics' which affects the performance of network. Due to increase in counter overload is increased as here counter counts the number of nodes in the network. As the response time becomes more it means that we are getting the results very late and the user don't wait for the result for so much time. We will use these two approaches like input to get fuzzy mixed metric with the help of fuzzy sets, membership function according to input and output linguistic values and a rule matrix which will define the rules defined by us.

First fuzzy metric: Counter

Three fuzzy sets are

1. Small counter
2. Medium counter
3. High counter

Second fuzzy metric: Response time

Three fuzzy sets are

1. Small response time
2. Medium response time
3. High response time

Fuzzy mixed metric: Counter-Response Time

Five Fuzzy mixed metric sets are

1. Very small
2. Small
3. Medium
4. High
5. Very high

The degree of the output fuzzy will help us to decide the best and optimized path. As if the counter and response time both is minimum, route is maintained in memory for current transmissions and saved for future use.

A. *Fuzzy Rule matrix*

Counter and response time has three fuzzy sets i.e. small, medium and high. The rule matrix will provide 9 rules with the AND product of two input variables. Here in this fuzzy if a and b then c rule based matrix is used. The rule matrix is shown as follows

TABLE I
FUZZY RULE MATRIX

R C	**SMALL**	**MEDIUM**	**HIGH**
SMALL	FR1	FR2	FR3
MEDIUM	FR4	FR5	FR6
HIGH	FR7	FR8	FR9

Here C- Counter, R- Response Time, FR- Fuzzy Rules Thus this matrix gives us the 9 rules.

B. *Fuzzy Rules*

1. If counter is *small* and response time is *small* then fuzzy mixed metric is *very high*
2. If counter is *medium* and response time is *small* then fuzzy mixed metric is *high*
3. If counter is *high* and response time is *small* then fuzzy mixed metric is *high*
4. If counter is *small* and response time is *medium* then fuzzy mixed metric is *high*
5. If counter is medium and response time is *medium* then fuzzy mixed metric is *medium*
6. If counter is *high* and response time is *medium* then fuzzy mixed metric is *medium*
7. If counter is *small* and response time is high then fuzzy mixed metric is *medium*
8. If counter is medium and response time is *high* then fuzzy mixed metric is *small*
9. If counter is *high* and response time is *high* then fuzzy mixed metric is *very small*

Corresponding rule matrix is shown in following Table. The rules defined here are the rules which come under the fuzzy sets each of them defined by fuzzy metric

TABLE III
PROPOSED FUZZY RULE MATRIX

R C	**SMALL**	**MEDIUM**	**HIGH**
SMALL	VERY HIGH	HIGH	HIGH
MEDIUM	HIGH	MEDIUM	MEDIUM
HIGH	MEDIUM	SMALL	VERY SMALL

C. *Membership Function*

The rules mentioned above can be implemented by using membership functions; here we will use triangular membership function because of its simplicity.

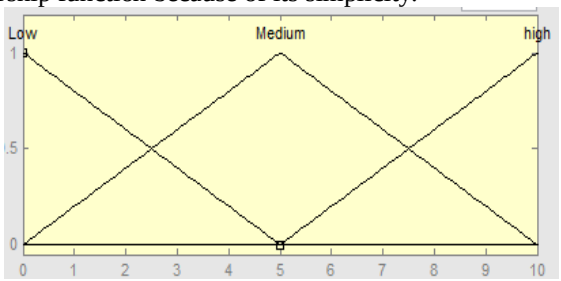


Fig. 2: μ for Counter

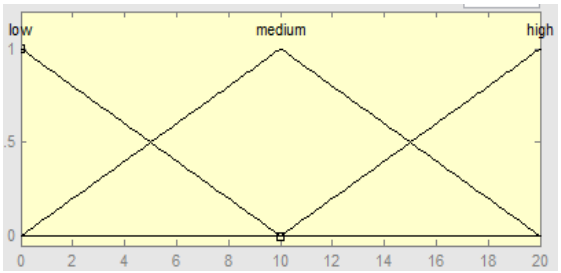


Fig 3: μ for Response Time

By applying membership function by using the input values of counter and response time we will get the output which has been termed as rank.

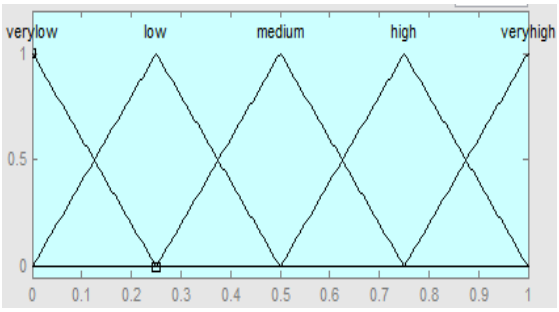


Fig. 4: μ for Rank

And then after getting the output we will apply the mathematical comparison operation for different output fuzzy sets to take decisions easily, quickly and with no overhead.For all the input variables, just find out all the output values and then store the outputs in the system cache if the outputs are ranked very high, high and very low.

The question is why to store these values?

- If the output is very high means it is the best optimized path and we should use that path currently and to use this path in future too we should store it
- If the output is high this means that the value of counter or response time is low so if in future the traffic becomes low then the rank can get very high for that path so we should store such types of path too

If the rank is very low then this is the path from where the mobile agents should never go, so we should keep information of such paths also.

III. IMPLEMENTATION AND RESULTS

Here we are taking a network diagram. For simplicity we are taking only a general view in Fig.5.

In this network diagram end user will dispatch a mobile agent from a dispatcher to different nodes with an information retrieval query ,from where the mobile agent will get its result it will come back to the end user with the information of that node. The end user will send the mobile agents to all nodes and then on the behalf of the calculated Rank which is evaluated with the two inputs counter and response time we will decide which is the best optimized path .

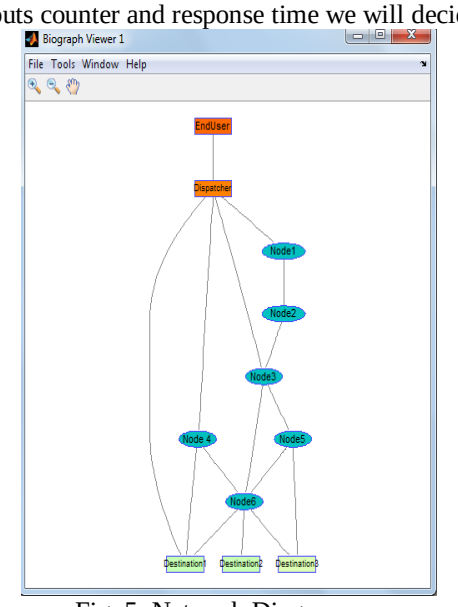


Fig. 5: Network Diagram

As the mobile agent goes from one node to another node its counter is increased by one ,this is the way in which we will calculate counter and for response time we are assuming the waiting time, processing time and transmission time=0.5. Waiting time will depend on the no of requests on that node so is dynamic in nature, like waiting time processing time is also dynamic in nature and at last is the traffic which is responsible for increase in response time is also dynamic in nature.

We will store various results in the end user cache for further use. Outputs of four paths are taken in four cases shown in this paper later.

Case 1: If both counter and response time are low then the rank will be very high it means that , it is the best optimised path .as here both the traffic and time to retrieve results are high.

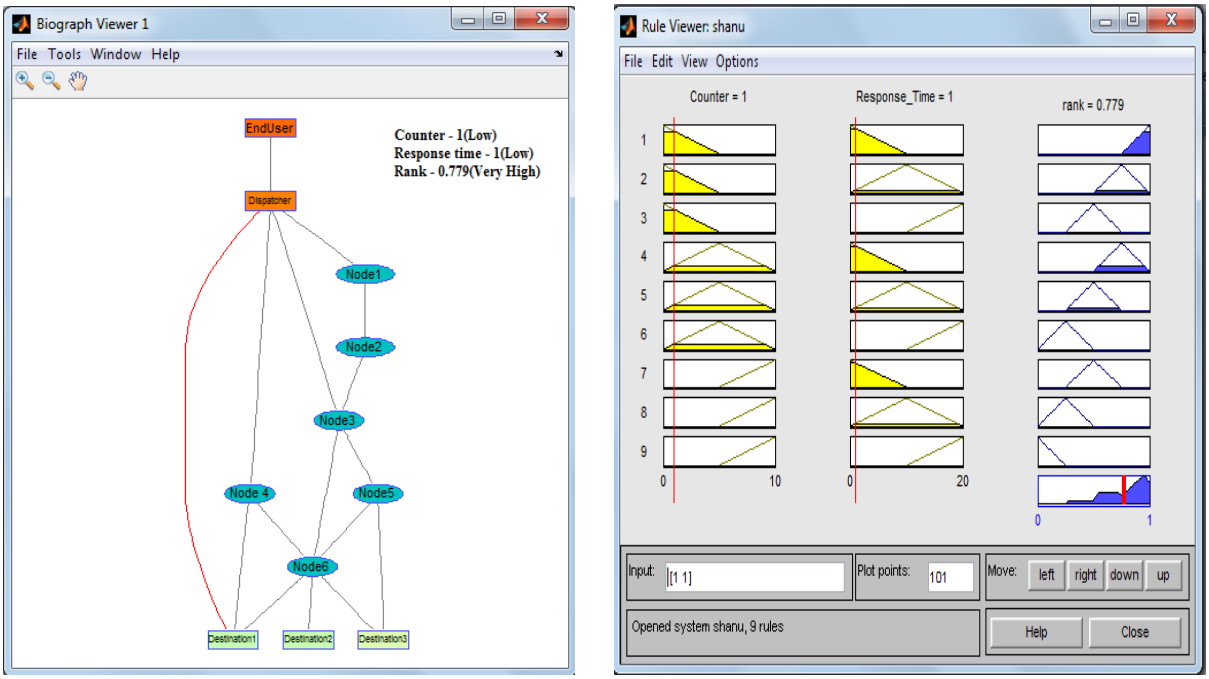


Fig. 6(a)

Case 2: If counter value is Medium and response time is low then the rank will be high it means that, it is the optimised path.

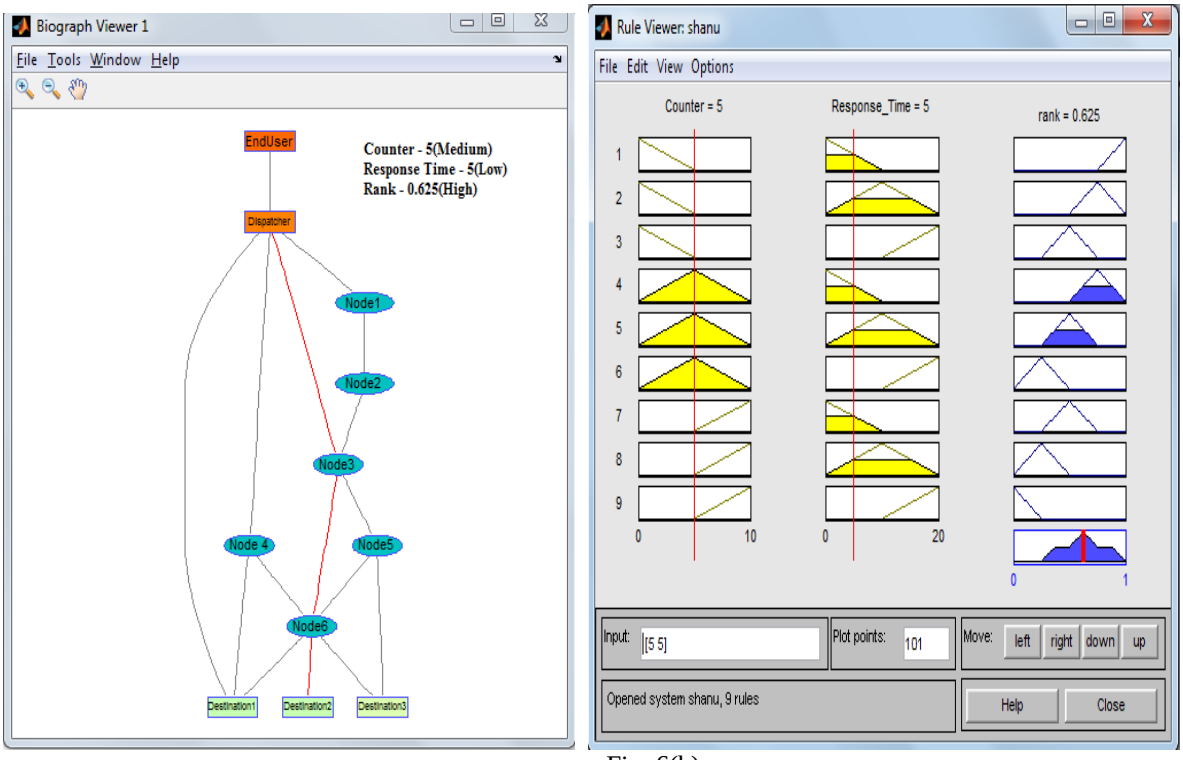


Fig. 6(b)

Case 3: If counter value is Medium and response time is high then the rank will be low it means that, it is the not a good path.

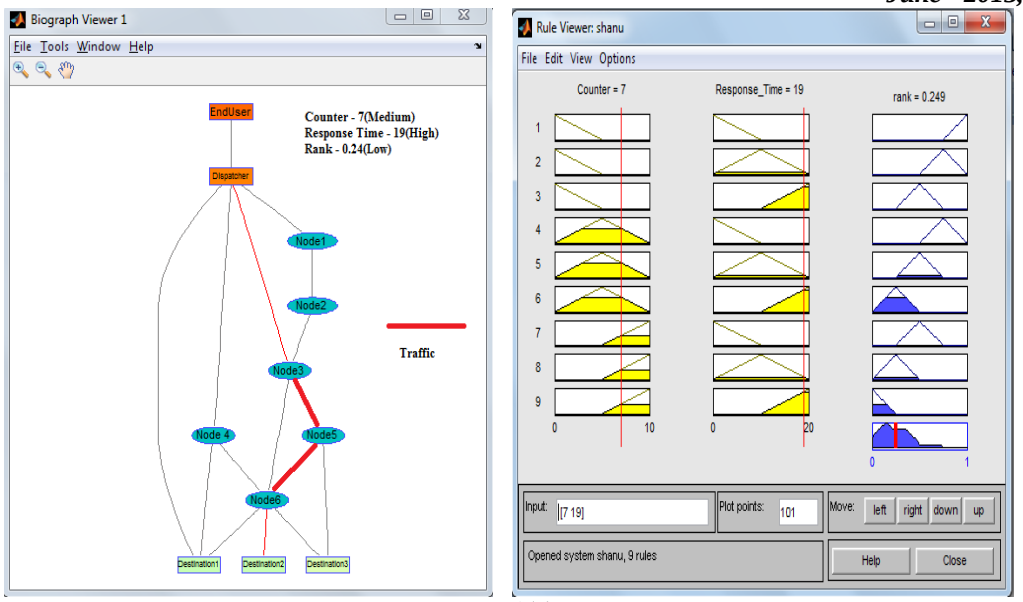


Fig. 6(c)

Case 4: If counter value and response time are high then the rank will be very low, means that, it is the worst path ever.

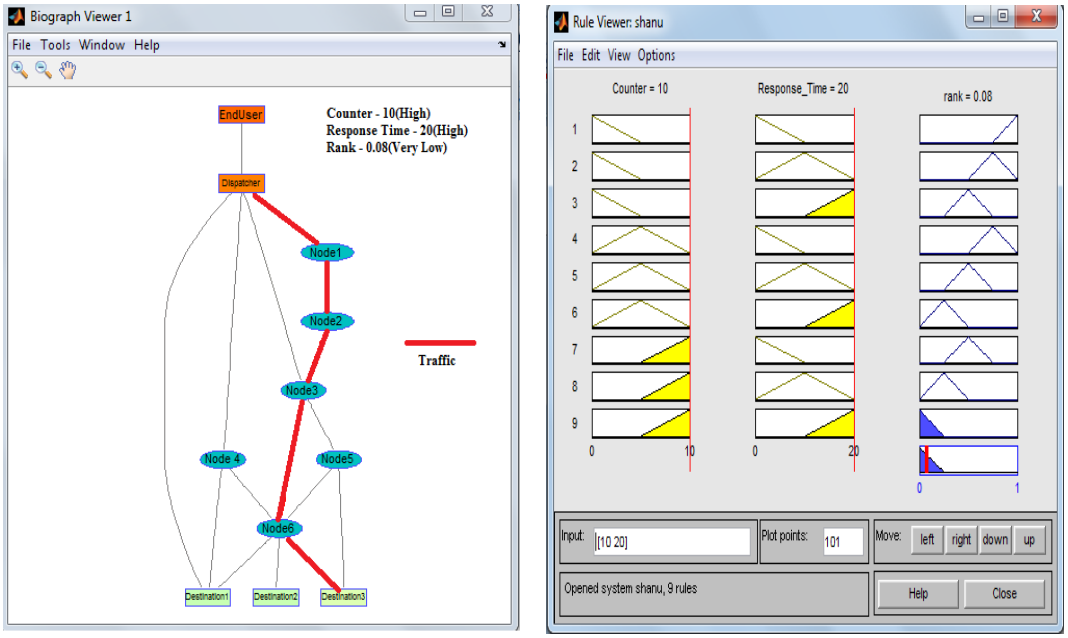
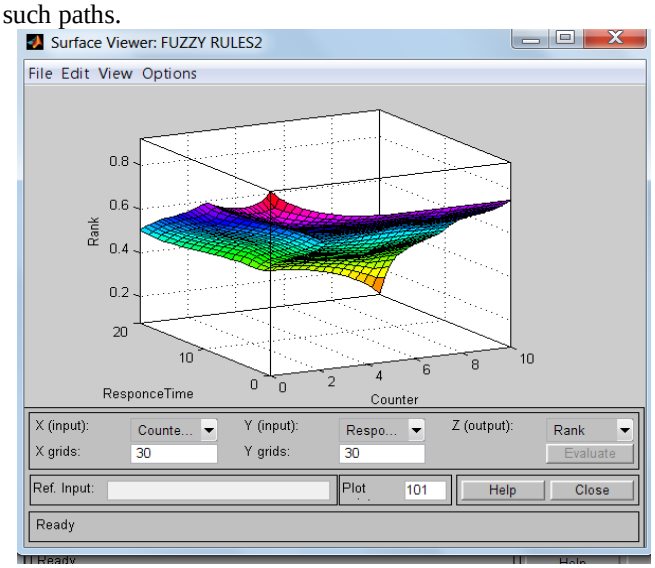


Fig. 6(d)

Here the rank is very low means that the path is very worst .this path should also be saved. So that in future we should not send the mobile agents to such paths.



Surface viewer depicts three dimensional correlations among counter, response time and rank. Surface viewer tells us the effect of any two inputs on rank at any time.

IV. CONCLUSIONS AND FUTURE WORK

This paper tells the mixed metric approach using Fuzzy interface system has been used as a tool to achieve the goal of optimization for mobile agent. Using Fuzzy membership function, we define two metrices named counter and response time. This paper enlightens the various optimization techniques which are used to optimize data, path and other things and proposes a new mixed metric approach using counter and response time for optimization of mobile agent.

In future, other optimization techniques can be used to increase the performance of the network. Concept of Fuzzy Genetic Algorithm, hybridization of GA and Fuzzy logic, may be used to further optimize the process.

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