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Fuzzy Implication on Mutation for Uncertain Paths

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Abstract— In real, network analysis have numerous uncertainties in the communication path. Uncertainties affect the possibility of mutation in the path due to the fuzziness of the interplay, error rate and environmental factors. The said paper works out the fuzziness in the mutation of path for the uncertain factors. It quantifies the performance of the mutation as well as the genetic algorithm. It provides fuzzy model to deals with the factors affecting the uncertainty of the shorter paths. Fuzzy implications are considered for different factors. The new edges formed during mutation are also dealt with fuzzy concept. This is a robust metaheuristic algorithm that defines the shorter path problem from a different plane using genetic and fuzzy tool. The transfer of packet is delayed due to natural and human issues like, disruption, natural calamity, and human error during installation etc. The work provides alternative paths to reach to the destination with the uncertain factors.

Keywords—Genetic Algorithm, Mutation, Fuzzy Logic, Fuzzy Implications and Shorter path .

I. INTRODUCTION

During journey there are many possible paths from source to destination. Finding the most suitable path is the issue here. Deciding the shortest and the shorter path is problematic with the natural calamity, lack of knowledge, traffic and disruption of network due to some human error. A little modification in the path is required to reach to the destination, which is termed as “mutation”. Possible shorter paths are found by the mutation technique. Genetic Algorithm becomes a tool for this kind of problem.

A hybrid algorithm with the concept of Genetic Algorithm is developed, which was developed creating new leveled graph. Possible paths are represented by chromosomes. Optimization problem provide more suitable solution. Fit individual’s takes part in evolution of the solution. Then they fuse to produce next generation. Fitted offspring’s are retained and unfitted are discarded. [8][9][10]

Dijkstra’s algorithm finds a shortest path between two nodes in a given graph. It also provides paths from a desired node to other nodes in the graph. The idea of the algorithm was introduced by Leyzorek in 1957.

Soft computing is referred to as computation intelligence. It provides solution to NP-Complete problems. It is different from hard computing. It is tolerant to uncertainty, approximation and partial truth and false. Computational models only analyze simple systems. [2][3][6][7]

Fuzzy logic deals with multi-valued logic. It is the enhanced logic far more than probability. It was introduced in1965 by Lotfi Zadeh as fuzzy set theory.

Process of fuzzy logic:

1. Represent every element values with fuzzy membership function.

2. Implement fuzzy output function to the elements.

3. Implement de-fuzzy function to get the crisp values.

II. RELATED WORK

A hybrid algorithm from genetic programming for routing problems has introduced when path get disrupted. Runtime decision has been taken in the algorithm. Genetic evolution has taken in consideration to achieve the solution to take decision on runtime. It doesn’t take the guarantee for shortest path but it takes the guarantee to reach to the destination by other shorter paths. Different shorter paths are considered as chromosomes. The chromosomes are fused to get next generation means possible paths form the present node to the destination. [1][4][5]

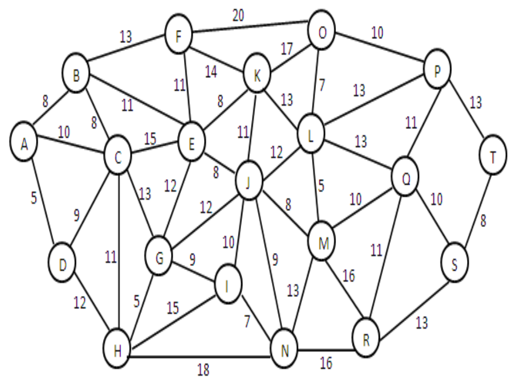

Figure 1. Graph

The graph (Figure 1) has been reduced to a leveled graph (Figure 2) with less number of nodes. In the leveled graph the source node is the first level node and the destination node is the last level node.

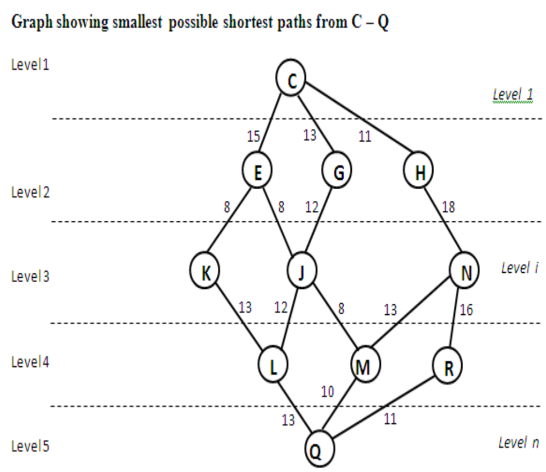

Figure 2. Leveled Graph

All possible paths from C to Q are considered as chromosomes (Figure 3). These chromosomes contain the Dijkstra's shortest path. The fusion of chromosomes took place and gives possible paths and even bridges (new edges).

There are seven possible chromosomes means seven possible shorter paths. Chromosomes 3 and chromosomes 4 (Figure 4) are fused and chromosome 2 and chromosome 5 has turned up as next generation (Figure 5). [10]

The robust work deals with the runtime decision in the path. Due to some natural calamity and technical error the predefined course is redefined, which is termed as 'Mutation'.

Total Seven Possible Paths

C – E – K – L – Q	→ 49	Chromosome 1
C – E – J – L – Q	→ 48	Chromosome 2
C – E – J – M – Q	→ 41→Min	Chromosome 3
C – G – J – L – Q	→ 50	Chromosome 4
C – G – J – M – Q	→ 43	Chromosome 5
C – H – N – M – Q	→ 52	Chromosome 6
C – H – N – R – Q	→ 56 → Max	Chromosome 7

Figure 3. Possible Chromosomes

C	E	J	M	Q	Chromosome 3
C	G	J	L	Q	Chromosome 4

Figure 4. Parent Chromosome

C	E	J	L	Q	Chromosome 2
C	G	J	M	Q	Chromosome 5

Figure 5. Child Chromosomes

III. METHODOLOGY

The proposed work represents a fuzzy model to the mutation and the runtime decision of the algorithm. The uncertainty of the network path affects the decision of shortest and shorter paths. The uncertain path searches a stochastic variable in the stochastic environment. Natural calamity, lack of knowledge, traffic in the network, and disruption of the network due to some human error, Ignorance and indolence are the causes of the discontinuous network. This occurs at any point of time, before or after the packet started its journey.

To design the Fuzzy model a network is considered. Graph G = (v, E) where v is the set of vertices and E is the Set of Edges. Let the source node be denoted as 's' and destination node be denoted by 'd'. The fuzzy representation of the possible paths (P) is as follows:

X = be the set of all possible paths or chromosomes.

$F = \{(P, \mu_{path}(P)) \mid P \in F \text{ and } P \in X\}$ and $\mu_{path}(P)$ is the measurement of certainty.

Where $\mu_{path}(P)$ is the membership function of possible path P. If the length of the prescribed chromosome is high then the membership of the chromosome reduces because length of the path has increases. If the length increases too much then the path will become non-preferable path and the membership function reduces, almost tends to negligible.

The length of the Dijkstra's path is shortest it got the maximum membership function until a new mutated bridges path comes into action. During mutation the chromosomes create a new connection means a new edge, which will be responsible for possible shortest path.

Fuzzy Set and Membership functions of the chromosomes / paths are as follows:

F = {(49, 0.4736), (48, 0.5269), (41, 0.9), (50, 0.4203), (43, 0.7933), (52, 0.3137), (56, 0.10)};

As the maximum length of the path is 56 and the minimum length of the path is 41. This fuzzy set is left open, which is described in the diagram given below (Figure 6.)

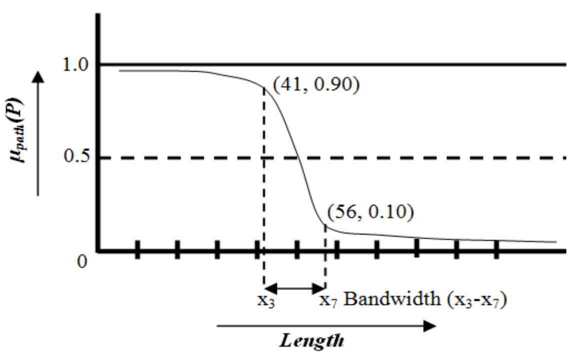

Figure 6. Membership value

The property of left open fuzzy membership function is represented by:

If lim x→ -∞ =1 and lim x→ +∞=0; (Left Open)

Unavailable paths will be represented as:

$\mu'_{path}(P) = 1 - \mu_{path}(P)$

Longer routes are the paths which are not considered in the pool of population. The membership values for Natural Calamity are dependent on the current report of the paths. So, feedbacks on the condition of the paths are very necessary. This similar kind of feedback is also necessary on the condition of the traffic in the route. Knowledge about the path depends how much the path is in use for those particular nodes. Feedbacks are also required for Human error. If accident occurs in the paths, even then the paths get hampered. For networks other than rail, road, air and sea other kinds of human errors are involved, like network infrastructure, poor maintenance, wrong tools implemented and poor performing tools etc. The fussy inputs and membership function are the next to discuss.

Natural calamity depends upon the atmospheric condition through which the route passes. If it passes through hill then during rainy season and winter the route becomes unsafe to use for rain and fog respectively. If the route passes through or beside river due to over flow of water the route get flooded and become unsafe. Atmospheric changes control the traffic. If the route passes through plane field then it becomes a preferable route, so the traffic is high. Lack of knowledge is dealing with knowledge of the shorter and shortest path. Even with the condition of the routes. Human errors occur due to poor maintenance of the route, improper add-ons in hardware etc. The fuzzy set and membership function s of Network Calamity (N_C), Traffic (T_R), Lack of Knowledge (L_K), Human Error (H_E) are as follows.

Network Calamity (N_C) = {(49, 0.75), (48, 0.35), (41, 0.25), (50, 0.85), (43, 0.85), (52, 0.45), (56, 0.3)};

Traffic (T_R) = {(49, 0.6), (48, 0.75), (41, 0.85), (50, 0.5), (43, 0.4), (52, 0.5), (56, 0.15)};

Lack of Knowledge (L_K) = {(49, 0.6), (48, 0.7), (41, 0.9), (50, 0.8), (43, 0.5), (52, 0.3), (56, 0.10)};

Human Error (H_E) = {(49, 0.7), (48, 0.3), (41, 0.2), (50, 0.8), (43, 0.9), (52, 0.4), (56, 0.3)};

IV. RESULTS AND DISCUSSION

After evaluating the fuzzy relation (R) between the fuzzy set the results are as follows:

R (X x Y) =

	N_C	T_R	L_K	H_E
Chromosome 1	0.75	0.6	0.6	0.7
Chromosome 2	0.35	0.75	0.7	0.3
Chromosome 3	0.25	0.85	0.9	0.2
Chromosome 4	0.85	0.5	0.8	0.8
Chromosome 5	0.85	0.4	0.5	0.9
Chromosome 6	0.45	0.5	0.3	0.4
Chromosome 7	0.3	0.15	0.1	0.3

Where, X = {Chromosome 1, Chromosome 2, Chromosome 3, Chromosome 4, Chromosome 5, Chromosome 6, Chromosome 7};

Where, Y = {Network Calamity (N_C), Traffic (T_R), Lack of Knowledge (L_K), Human Error (H_E)};

Where, (X x Y) is the Cartesian product.

The relation matrix speaks about the status of each path in a specific study. The study depends on the current value of the membership functions. This discloses the fact about the condition of the paths. When choosing the paths consideration about the status of the path is confirmed. The selection of path is smart as fuzzy logic discloses the fact about the status of the path. During travel when these values are acquired, decision is being taken which path to follow.

V. Conclusion and Future Scope

This paper gives different cutting edges to shortest and shorter path problem. Genetic algorithm is implemented to take dynamic decision. Then fuzzy logic model has being implemented to give more accurate result. Now, the work speaks about the creation is smarter to give suggestion about the shortest and shorter paths.

The membership values keeps on updating time to time to take smart decision about the routes. This becomes more helpful in emergency conditions. If the prescribed route is not alive then an alternative routes are available.

Fuzzy mappings and different kinds of relations are not dealt in the paper. They are the future prospect of the research. That will give clearer picture of relation developed between the chromosomes.

References

[1] Tarak N Paul and Abhoy C Mondal, "*Amalgamation of Graphs do not Affect the Search of the Set of Shorter Paths Algorithm*", International Journal of Advanced Computer & Research, Volume-4, Number-1, Issue-**14**, pp. **184 – 192**, **2014**, ISSN 22497277

[2] Tarak N Paul and Abhoy C Mondal, "Search the Set of Shorter Paths Using Graph Reduction Technique", International Journal of Advanced Computer & Research, Volume-3, Number-4, Issue-13, pp. 278 – 287, December 2013, ISSN 22497277.

[3] Renu Kumari and Tarak N Paul, "Optimization of Wired Genetic Antenna Using Genetic Algorithm", IOSR Journal of Computer Engineering (IOSR-JCE) e-ISSN: 2278-0661, p-ISSN: 2278-8727, Volume 19, Issue 1, Ver. I (Jan.-Feb, 2017).

[4] Tarak N Paul and Abhoy C Mondal, "Mutation in Path for the Packets in the Network During Journey form Source to Destination", International Conference on Advance Computational and Communication Paradigms-08-10 Sept. 2017, Springer, SMIT, Sikkim.

[5] Tarak N Paul and Abhoy C Mondal, "Set of Shorter Paths and Network Delay Deduction Using Genetic Algorithm", Page 346-351, IEEE ISACC-2015, Assam University, ISBN: 978-1-4673-6707-3.

[6] Tarak N Paul and Abhoy C Mondal, "CONSTITUTE A SUB-GRAPH WITH n-levels TO SEARCH A SET OF SHORTER PATHS USING GENETIC ALGORITHM", IEEE International Conference on Intelligent Computing and Intelligent System, Guangdong University, China, 3-0096-10943, Volume 3, pp 452-456, November 2011, ISBN 97816128441427, IEEE Catalog CFP1157HPRT.

[7] Tarak N Paul and Abhoy C Mondal, "Intelligent Traversing Method Using Genetic Algorithm For Long Distance", International Conference on Computing and System, pp 69-74, November 2010, ISBN 9380813015.

[8] Tarak N Paul and Abhoy C Mondal, "Combination of Graph Does Not Affect the Execution of Finding Group of Shorter Path Algorithm", Second International Conference on Computing and Systems, pp 348 - 356, September, 2013, ISBN-13:9789351342735.

[9] Tarak N Paul and Abhoy C Mondal, "Studies on Shortest Path Using Genetic Algorithm" Lambert Academic Publishing, Germany, ISSN No: 9783659913266.

[10] Tarak N PaulandAbhoy C Mondal, "Mutation in Path for the Packets in the Network During Journey form Source to Destination", Advanced Computational and Communication Paradigms, Chapter – 27, page – 279-288, AISC Vol-706, ISBN 978-981-10-8237-5. © Springer Nature Singapore Pte Ltd. 2018.

[11] "Network Routing Protocol using Genetic Algorithms", International Journal of Electrical & Computer Sciences, GihanNagib and Wahied G. Ali, IJECS-IJENS Vol:10 No:02.

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