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Keywords: fuzzy graph, intuitionistic fuzzy graph, information extraction, single-valued neutrosophic graph, mobile networks.

I. Introduction

Telephony, appeared in the 1830s, it was based on music notes, for the exchange of messages. It then became a communication system essentially ensuring the transmission and reproduction of speech. Telephony also enables more advanced services such as voicemail, conference calling or voice services. Telephony is based on a telecommunications network, typically, telephony network consists of four main types of equipment: terminals, central systems, ancillary servers, and the access media. we mainly distinguish three types of access media: (i) Land line network, known as Public Switched Telephone Network (PSTN), (ii) wireless network, known as mobile networks, and (iii) private network, whose companies have their own call centre. According to the last report published by the National Telecommunications Regulatory Agency (ANRT) of the kingdom of morocco, the rate of possession of individuals (12 to 65 years) by mobile phone is slightly increasing in May 2017 (95% against 94.4% in 2015).the use of smartphones by individuals recorded a notable evolution and increased to 67% instead of 54.7% in 2015 [1]. with the rapid explosion on access to the telephone network, the number of calls received becomes considerable. Nowadays, the terms "priority of incoming call", "priority of numbers", "trust of calling equipment", etc. are used [2]. Guarantee a quality of experience (QoE) for the customer is therefore becoming a necessity and especially a promoter axis. However, the amount of information that the service provider must process to ensure QoE is very high, and the decision to route, hold, or reject the incoming call must be at real-time.

Recent time the theory of graph is utilized for various process to deal with uncertainty and vagueness in data sets. It is a mathematical tool which deals with large number of data or information in efficient manner. Graph theory is one of the richest research area in mathematics as it has applications in enormous fields including management sciences [3], social sciences [4], computer sciences [5], communication networks [6], in description of group structures [7], database theory [8], economics [9] etc.

L. A. Zadeh [10] introduced the theory of fuzzy sets (FSs) in 1965 as a tool to deal with uncertainties. It was Kaufmann [11] who define FG but an illustrated work on FGs was done by Rosenfeld in [12]. The theory of FGs is of great importance and in the recent decades, it has been used extensively in many areas such as cluster analysis [13-16], slicing [16], in the solution of fuzzy intersecting equations [17, 18], data base theory [8], networking [19], group structures

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[20, 21], chemical structures [22], navigations [23], traffic controlling [24] etc. The concept of FGs have worth in graph theory as it is the best tool to deal with uncertainties. K. Atanassov [25, 26] proposed the concept of intuitionistic fuzzy sets, an extension of FSs which creates space for IFGs. The concept of IFGs were proposed by R. Parvathi and M. G. Karunambigai [27]. The structure of IFGs is successfully applied in social networks [28], clustering [29], radio coverage network [30] and shortest path problems [31] etc. IFGs effectively deals with uncertainties due to its advance structure. In 1995 F. Smarandache proposed neutrosophic logic which provides a base for neutrosophic set (NS) theory [32, 50]. NS theory is a generalization of IFSs and among one of the best structures of fuzzy logics describing the uncertain situations soundly. To apply NS theory in real life situations a discrete form of NSs is introduced known as single-valued neutrosophic set (SVNS) [33] which give rise to the theory of SVNGs [34, 35]. SVNG is of more advanced structure than IFGs and successfully applied in navigations [36], minimum spanning tree problem [37], shortest path problem [38] so far. Some potential work for SVNGs have been done in [39-50] for partial ignorance in the given information at different granulation [51-52].In this paper, we have focused on analysis of mobile network for extracting some information to describe the offered or carried network for multi-decision analytics.

Although FG theory has been applied to many real-life problems as discussed earlier however literature provide very less attention has been paid about a mobile network model (MNM) and its analysis for information processing. In a mobile network, there are variable factors such as: receiving a call either from known or unknown number, ignoring a call or couldn't attend due to enormous reasons, and rejecting a call for some reasons. In this case, extracting some useful information or pattern to take a particular decision is a major problem for the researchers. To solve this problem the current paper aimed at developing a neutrosophic set based mobilephone network by presenting NMNM in the field off SVNGs. It is proposed that, how SVNGs can be utilized to store the record of incoming or outgoing calls and how neutrosophic logic can be considered a best tool for such type of problems.

This article is organized as follows: Section 2 consists of some basic ideas. The complete description of NMNM is presented in section 3. In section 4, an algorithm is proposed while in section 5 the proposed NMNM is illustrated by a flow chart. At the end a hypothetical example is discussed in section 6. Some special circumstances and significance of neutrosophic mobile network model are presented in section 7. The article ended with some advantages of proposed model and some concluding remark and discussion.

II. Basic Concepts

In this section, some elementary concepts are demonstrated related to graphs including FGs, IFGs and SVNGs. For undefined terms and notions, one may refer to [34-46, 50].

Definition 1[50]. Neutrosophic Set (NS)

Let X be a space of points and let x∈ X. A neutrosophic set $\overline{S}$ in X is characterized by a truth membership function$T_{\bar{S}}$, an indeterminacy membership function$I_{\bar{S}}$, and a falsehood membership function $F_{\bar{S}}$.$T_{\bar{S}}$, $I_{\bar{S}}$and$F_{\bar{S}}$are real standard or non-standard subsets of $]0^-,1^+[$. The neutrosophic set can be represented as

$$\overline{S}=\left\{\left(x,T_{\bar{S}}\left(x\right),I_{\bar{S}}\left(x\right),F_{\bar{S}}\left(x\right)\right):x\in X\right\}$$

The sum of $T_{\bar{S}}(x)$,$I_{\bar{S}}(x)$and $F_{\bar{S}}(x)$ is

$$0^-\leq T_{\bar{S}}\left(x\right)+I_{\bar{S}}\left(x\right)+F_{\bar{S}}\left(x\right)\leq 3^+.$$

To use neutrosophic set in the real life applications such as engineering and scientific problems, it is necessary to consider the interval [0, 1] instead of $]0^-,1^+[$ for technical applications.

Definition 2: A pair $G=(V,E)$ is known as

1. Fuzzy graph if

a) $V=\{v_i: i\in I\}$and$T_1: V\to[0,1]$ is the association degree of $v_i\in V$.

b) $E=\{(v_i,v_j):(v_i,v_j)\in V\times V\}andT_2: V\times V\to[0,1]$ is defined as $T_2(v_i,v_j)\leq\min[T_1(v_i),T_1(v_j)]$ for all $(v_i,v_j)\in E$.

2. Intuitionistic fuzzy graph if

a) $V=\{v_i: i\in I\}$such as $T_1: V\to[0,1]$ is the association degree and $F_1: V\to[0,1]$ is the disassociation degree of $v_i\in V$ subject to condition $0\leq T_1+F_1\leq 1$.

b) $E=\{(v_i,v_j):(v_i,v_j)\in V\times V\}T_2: V\times V\to[0,1]$is the association degree and $F_2: V\times V\to[0,1]$ is the disassociation degree of $(v_i,v_j)\in E$ defined as $T_2(v_i,v_j)\leq\min[T_1(v_i),T_1(v_j)]$ and $F_2(v_i,v_j)\leq\max[F_1(v_i),F_1(v_j)]$subject to condition $0\leq T_2+F_2\leq 1$ for all $(v_i,v_j)\in E$.

3. Single-valued neutrosophic graph if

a) $V=\{v_i: i\in I\}$such as $T_1: V\to[0,1]$ is the association degree, $I_1: V\to[0,1]$ is the indeterminacy degree and$F_1: V\to[0,1]$ is the disassociation degree of $v_i\in V$ subject to condition $0\leq T_1+I_1+F_1\leq 3$.

b) $E = \{(v_i, v_j): (v_i, v_j) \in V \times V\}$ $T_2: V \times V \to [0,1]$ is the association degree, $I_2: V \times V \to [0,1]$ is the indeterminacy degree and $F_2: V \times V \to [0,1]$ is the disassociation degree of $(v_i, v_j) \in E$ defined as $T_2(v_i, v_j) \le \min[T_1(v_i), T_1(v_j)]$, $I_2(v_i, v_j) \ge \max[I_1(v_i), I_1(v_j)]$ and $F_2(v_i, v_j) \ge \max[F_1(v_i), F_1(v_j)]$ subject to condition $0 \le T_2 + I_2 + F_2 \le 3$ for all $(v_i, v_j) \in E$.

Example: The following figures $1(a, b, c)$ are the examples of FG, IFG and SVNG respectively.

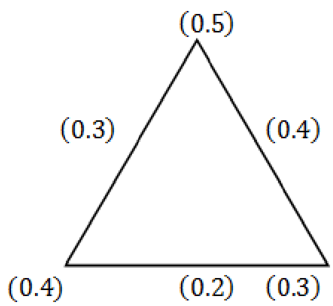

Figure 1 (a): Fuzzy graph.

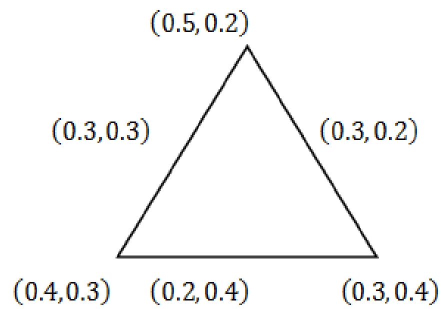

Figure 1 (b): Intuitionistic fuzzy graph.

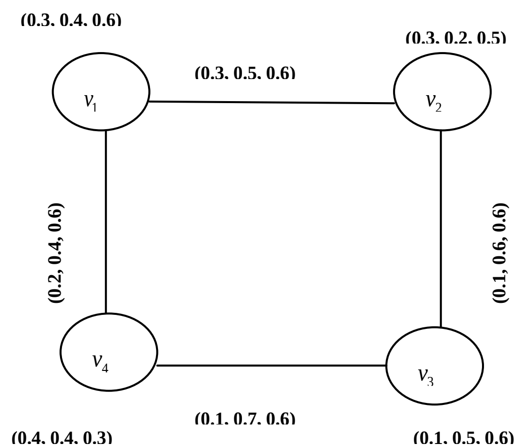

Figure 2 (c): Single valued neutrosophic graph.

III. A Neutrosophic Mobile Netowrk Model

Computing the load of a given Telephone network is one of the major issue for the researchers to extract some useful information for descriptive analysis of carried or offered traffic. It used to measure by "Erlang Unit" which represents the average number of concurrent calls carried by the given telephone network. As for example a radio channel is busy at all time can be considered as load of 1 Erlang. Similarly, an office having two telephone operators and both are busy on each time. It means the office is having two Erlangs. It means the Erlang unit represents the offered traffic value followed by average number of concurrent calls which is basically depends on call arrival rate, λ, and the average call-holding time (the average time of a phone call), h, given by: (https://en.wikipedia.org/wiki/Erlang_(unit)).

$$E = \lambda h \quad (1)$$

Where h and λ are represented by the same units of time (seconds and calls per second, or minutes and calls per minute).

The problem arises when the user or expert want to analyze the instantaneous traffic to find the exact number of calls received, not received or uncertain due to some reasons to know the level of traffic, recording devices, or solving other security issues. In this case, characterizing the uncertainty and vagueness in telephone network based on its acceptation, rejection and indeterminacy is major problem. To solve this problem current paper introduces a mathematical representation of telephone network using SVNGs where (T, I, F) can further be divided into some situations as given below:

$\boldsymbol{T}$ can be considered as received calls and is divided into subcases $[\boldsymbol{T_1}, \boldsymbol{T_2}, \ldots \boldsymbol{T_n}]$ where $\boldsymbol{T_1}$ represents

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calls coming from a saved number and T_2 represents calls made from some unknown numbers or these can be calls from family member or from friend's circle or from unknown number etc.

I can be considered as calls which couldn't be answered due to many reasons $[I_1, I_2, I_3, \ldots I_n]$ represents calls not attended due to driving, busy schedule or meeting or incoming call is from unknown number or any other reason.

F represents those calls which are rejected due to numerous reasons such as $[F_1, F_2, F_3, \ldots F_n]$ stand for rejected calls as incoming call is from unknown number or due to hate or behavior of caller etc.

It is clear from the above explanation that in NMNM, all possibilities can be described effectively. Such a model based on SVNGs described uncertain situation better than crisp graphs or fuzzy graphs or intuitionistic fuzzy graphs due to diverse nature of the NS theory. Moreover, it should be noted that in this network the total number of incoming calls is equal to $T + I + F$ denoted by S.

The value of **Truth, neutral and falsity** membership grades can be calculated as

$$\left(\frac{\textbf{No. ofcallsattended}}{\textbf{S}}, \frac{\textbf{No. ofcallsleftunattended}}{\textbf{S}}, \frac{\textbf{No. ofcallsrejected}}{\textbf{S}}\right) \quad (2)$$

where S is the total number of incoming calls.

Neutrosophic mobile network model is presented in the following figure 3.

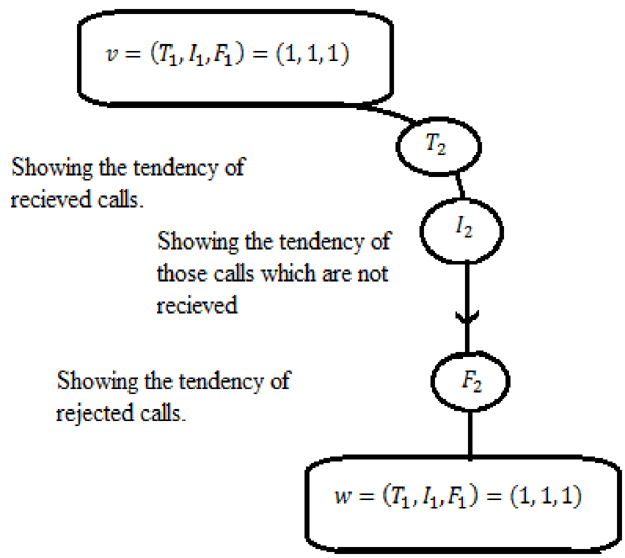

Figure 1: Neutrosophic Mobile Network Model

The figure 3 represents a neutrosophic mobile network model. Using the formula (2), the values of T_2, I_2, F_2 changes in different situations. This value becomes $(0, 1, 0)$ when no calls is received and it becomes $(0, 0, 1)$ when all calls are rejected.

The following example illustrate NMNM in a better way.

Example 1: Let us suppose 100 calls came on a mobile at end of the day and described in form of following information:

1. 60 calls were received truly among them 50 numbers are saved and 10 were unsaved in mobile. In this case these 60 calls will be considered as truth membership i.e. 0.6.
2. 30 calls were not-received by mobile holder. Among them 20 calls which are saved in mobile contacts were not received due to driving, meeting, or phone left in home, car or bag and 10 were not received due to uncertain numbers. In this case all 30 not received numbers by any cause (i.e. driving, meeting or phone left in home) will be considered as Indeterminacy membership i.e. 0.3.
3. 10 calls were those number which was rejected calls intentionally by mobile holder due to behavior of those saved numbers, not useful calls, marketing numbers or other cases for that he/she do not want to pick or may be blocked numbers. In all cases these calls can be considered as false i.e. 0.1 membership value.

The above situation can be represented as:

- neutrosophic set: (0.6, 0.3, 0.1)
- or hesitant neutrosophic set: ({0.5, 0.6}, {0.2, 0.3}, {0.1}) or interval valued neutrosophic set: ([0.5, 0.6], [0.2, 0.3], [0.1, 0.1])

IV. Algorithm

In this section, an algorithm is proposed describing the flow of NMNM. Here a network of some neutrosophic mobile phones is assumed and the quantity of received, not attended and rejected calls is expressed in the form of single-valued neutrosophic numbers. The NMNM is not limited to store the data of small networks but it can be applied to large networks as well.

It is assumed that the number of incoming calls received or not received or rejected could be unlimited in this case. In order to calculate the membership grades of T, I and F, formula given in(2) could be of use. The edges in NMNM enables us to get the percentage of calls attended, ignored or rejected at any instant between two mobile numbers. To enable the caller for making or receiving unlimited number of calls, we must assign a neutrosophic number $(1,1,1)$ to each vertex.

- Let $v_j = (1,1,1)$ and $v_k = (1,1,1)$ be two vertices representing two mobile phone numbers.
- $e_{jk} = \left(T_{jk}, I_{jk}, F_{jk}\right)$ be the edge of v_j and v_k.
- Let S denote the number of all calls between two neutrosophic mobile numbers.
- $T_{jk} = \frac{numberofcallsrecevied}{S}$
- $I_{jk} = \frac{numberofcallsleftunattended}{S}$
- $F_{jk} = \frac{numberofcallsrejected}{S}$

This can be written as following propositions:

Let us suppose, total number of all calls between two neutrosophic mobile number =s, m= total number of calls received, n-total number of calls rejected then the number of unattended calls are (s-m-n). This can be written as $(\frac{m}{s}, \frac{s-m-n}{s}, \frac{n}{s})$ neutrosophic number for determining the n^{th} call.

Initially one call is made and received then truth value is $\frac{1}{1} = 1$, indeterminacy value is 0, falsity value is 0. In case two calls are made and received then too truth value is $\frac{2}{2} = 1$ and so on…

If two calls are made and 1 is received and 1 ignored, then truth is $\frac{1}{2} = 0.5$ and indeterminacy is $\frac{1}{2} = 0.5$ so we may say that 50% calls are received and 50% are ignored. If 3 calls are made and number of received, ignored and rejected calls are 1 so we have $(0.33, 0.33, 0.33)$ which make sense that 33% calls are received, 33% calls are ignored and 33% calls are rejected. Similarly, the algorithm works for n^{th} calls.

The algorithm proposed here explain every possibility that might be happen in a mobile network proving the worth of SVNGs as the most suitable tool for modeling such type of network.

V. Flowchart

A flowchart below described the NMNM step by step. It is assumed here that the total number of call could possibly be received or ignored or rejected is 100 (For the sack of simplicity). Here it is also assumed that initially the number of phone calls made so far is zero. In other words, it may be assumed that initially there is no edge between two nodes v_j and v_k. The illustrated flowchart is described as follows:

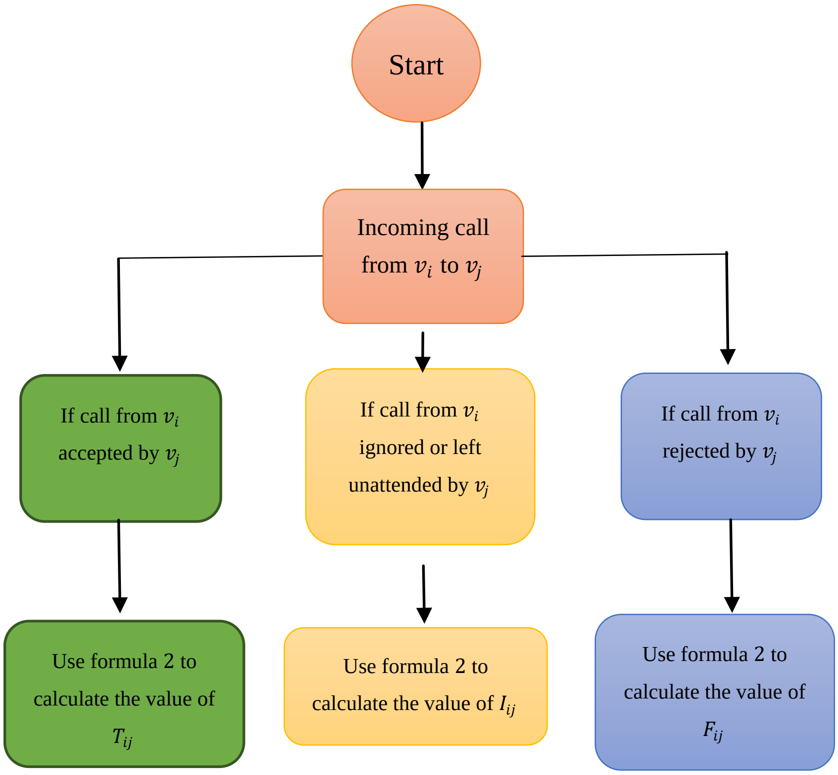

Figure 2: Flow chart describing algorithm of NMNM

In this flow chart, we keep the number of calls limited to 100 but in large networks or in real-life this number of calls cannot be restricted to 100. So, one may set the desired range of calls by their own consent.

VI. Illustrated Example

Consider a network of three people connect to each other via mobile phones which are represented by vertices of SVNGs. The following table 1 describe the calling data (total number of calls, received calls, calls not attended and rejected calls) of these three peoples.

Table 1: Specifying the calling data of a group

Pair	Total calls	Received calls	Not attended calls	Rejected calls	Corresponding Edge
John-Aslam	24	15	5	4	(0.625, 0.208333, 0.166667)
Aslam-Chris	15	7	5	3	(0.466667, 0.3333, 0.2)
Chris-Aslam	19	15	4	0	(0.789474, 0.210526, 0)
Chris-John	5	0	5	0	(0, 1, 0)
John-Chris	8	4	3	1	(0.5, 0.375, 0.125)

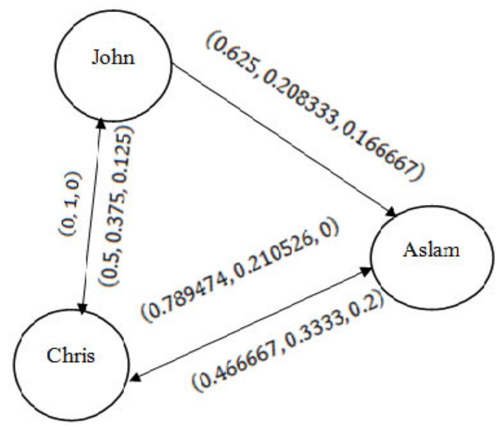

Figure 3: A network of people connected via mobile numbers

In this example, a network of finite number of people is illustrated. The edges in this network is in the form single-valued neutrosophic numbers showing the percentage of number of calls received, left unattended or rejected. The Figure 5 shows that maximum true calls happens among Chris and Aslam due to maximal true membership-values, minimum indeterminacy and minimum falsity membership-values when compared to others. Similarly, other information can be extracted from the proposed method.

VII. Some Special Circumstances and Significance of Neutrosophic Mobile Network Model

In this part of the article, some special cases are listed to extract meaningful information from the proposed method. It is discussed how proposed model is capable of dealing with such kind of situations. This is done in the following way:

Question 1: Is there any difference between saved and unsaved numbers? Did it influence the membership?

Answer: The answer to this question should be of the following form:
When both saved and unsaved numbers are

- *Received:* Then truth valued is increased by an amount.
- *Left Unattended:* Then indeterminacy values in increased by an amount.
- *Rejected:* Then falsity value is increased by an amount.

So saved and unsaved numbers are treated equally in such scenario. But In case the number is saved most probably the holder knows the person and pick the phone or reject it most of time. However, when number is unsaved then many times holders do not want to pick which affects indeterminacy membership-values a lot.

Question 2: How the proposed model deals with marketing numbers as they are important some time while some other time they are meaningless.

Answer: We have introduced a unique scenario to understand the telephone network using single-valued neutrosophic set and its properties as a first basic algorithm when none of the approaches are exists in this regard. Of course, we can control this issue by two cases. The first way is when we do not know that the incoming call is marketing call so it may be rejected or ignored. In second case, when we want to pick the same marketing call in some other time then the number can be saved in the phone as useful number. In this case the first time its membership-values will affect the indeterminacy or falsity value whereas in second case it affects the truth membership-values.

Question 3: When a person is in comma, then all calls on his/her mobile shall be left unattended similarly when a person is kidnapped, then all calls on his/her mobile gets rejection. How the proposed method explains such situation?

Answer: This is an impressive question towards one of the useful applications of our motive to introduce neutrosophic set in telephone network.

We will first try to understand the first case that is Coma means holder is in the operating system. In this case the call may go but holder cannot pick it due to uncertainty. Hence all the incoming call on holder's mobile will be unreceived (not rejected only unreceived) which can be clearly shown by (0, 1, 0). For example, suppose 10 calls came on to his/her mobile and are left unattended.... i.e. $s = 10, m = 0$ and $n = 0$. Then $\left(\frac{m}{s}, \frac{s-m-n}{s}, \frac{n}{s}\right) = \left(0, \frac{10-0-0}{10}, 0\right) = (0, 1, 0)$

Now we can understand the case of kidnapping. In this case, the call can be rejected by kidnapper or switch off the phone. It is well known that the kidnapper will not pick the phone or allow to ring the bell several times to understand the location. Hence all calls will be rejected and can be represented as (0, 0, 1) for all time. For example, if 10 calls made and rejected. Then $n = 10, s = 10. \left(\frac{0}{10}, \frac{10-0-10}{10}, \frac{10}{10}\right) = (0,0,1)$.

Hence the proposed NMNM can deal with every possibility than one my face. It shows its significance in extracting some meaningful information from mobile network based on their calls received and rejected. The analysis derived from the proposed method will be helpful in making an intelligent system.

In this article, the mobile network is discussed in the environment of SVNGs. It is observed that such a network cannot be established by ordinary FSs i.e. by FGs as FS theory only deals with association degree. Similarly, such a network is difficult to establish in the environment of IFS theory as it describes the association and dissociation degree of elements but in mobile network models we face several types of situations as described earlier. Therefore, the space of SVNG is so far, a best tool for describing such type of situation and for establishing a mobile network model.

VIII. Conclusion and Discussion

In this article, a method for information analysis in mobile network model is described using SVNGs, known as NMNM for precise representation of instantaneous traffic in an alternative way when compared to Erlang Number. The proposed method also describes the structure of FSs and IFSs to make it less resourceful in establishing such type of network for extracting some useful information. A mathematical proposition is also derived for restructuring the SVNGs to represent the received, un-received as well as uncertain calls when compared for depth analysis. The proposed NMNM model is explained using an illustrative example for better understanding. However, the analysis derived from the proposed method is not implemented in any real data sets. To solve this problem in near future the author will focus on comparative study of the proposed method.

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References Références Referencias

1. https://www.anrt.ma/sites/default/files/publications/enquete_tic_2016_fr.pdf
2. https://encrypted.google.com/patents/CN101102362A?cl=en
3. Harary F, “Graph Theoretic Methods in the Management Sciences.”Management Science 5, (1959): 387–403.
4. Harary F and Norman R. Z, “Graph Theory as a Mathematical Model in Social Science.” Ann Arbor, Mich., Institute for Social Research, 1953.
5. Shirinivas S. G, Vetrivel S and Elango N. M, “Applications of graph theory in computer science an overview.” International Journal of Engineering Science and Technology, 2(9), (2010): 4610-4621.
6. Harary F and Ross I. C, “The Number of Complete Cycles in a Communication Network.” Journal of Social Psychology 40, (1953): 329–332.
7. Ross I. C and Harary F, “A Description of Strengthening and Weakening Members of a Group.”, Sociometry22,(1959):139–147.
8. Kiss A, “An application of fuzzy graphs in database theory, Automata, languages and programming systems.” (Salgotarjan 1990) Pure Math, Appl. Ser. A, 1, (1991):337–342.
9. Keller A. A, “Graph theory and economic models: from small to large size applications.” Electronic Notes in Discrete Mathematics 28(2007): 469-476.
10. Zadeh L. A, “Fuzzy Sets.” Information and Control 8, (1965): 338–353.
11. Kaufmann A, “Introduction a la Theorie des sons-ensembles flous. 1, Masson Paris, (1973): 41–189.
12. Rosenfeld A, “Fuzzy graphs.” In: L. A. Zadeh, K. S. Fu, M. Shimura, Eds., Fuzzy Sets and Their Applications, Academic Press, (1975):77–95.
13. Ding B, “A clustering dynamic state method for maximal trees in fuzzy graph theory.” J. Numer. Methods Comput. Appl. 13, (1992):157–160.
14. Bezdek J. C and Harris J. D, “Fuzzy partitions and relations an axiomatic basis for clustering.” Fuzzy Sets and Systems 1(1978):111–127.
15. Yeh R.T and Bang S.Y, “Fuzzy relations, fuzzy graphs, and their applications to clustering analysis.” In: L. A. Zadeh, K. S. Fu, M. Shimura, Eds., Fuzzy Sets and Their Applications, Academic Press, (1975):125–149.
16. Matula, D. W, “k-components, clusters, and slicings in graphs.” SIAM J. Appl. Math. 22(1972): 459–480.
17. Mordeson J. N and PengC-S, “Fuzzy intersection equations.” Fuzzy Sets and Systems 60, (1993): 77–8.
18. Liu W. J, “On some systems of simultaneous equations in a completely distributive lattice.” Inform. Sci. 50, (1990):185–196.
19. Kóczy L. T, “Fuzzy graphs in the evaluation and optimization of networks.” Fuzzy Sets and Systems 46, (1992): 307–319.
20. Takeda E and Nishida T, “An application of fuzzy graph to the problem concerning group structure.” J. Operations Res. Soc. Japan 19, (1976): 217–227.
21. Mordeson J. N and Nair P. S, “Applications of Fuzzy Graphs.” In: Mordeson J.N., Nair P.S. (eds) Fuzzy

Graphs and Fuzzy Hypergraphs. Studies in Fuzziness and Soft Computing, 46, 2000, Physica, Heidelberg
22. Xu J, "The use of fuzzy graphs in chemical structure research." In: D.H. Rouvry, Ed., Fuzzy Logic in Chemistry, Academic Press, (1997): 249–282.
23. Neumann T. "Routing Planning as An Application of Graph Theory with Fuzzy Logic."TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, 10(4), 2016.
24. Myna R. "Application of Fuzzy Graph in Traffic." International Journal of Scientific & Engineering Research, (2015):1692-1696.
25. AtanassovK.,"Intuitionistic fuzzy sets." Fuzzy Sets and Systems, (1986): 87–96.
26. AtanassovK.,"On intuitionistic fuzzy set theory." Springer, Heidelberg (2012).
27. ParvathiR., KarunambigaiM. G., "Intuitionisticfuzzy graphs." Computational Intelligence, Theory and Applications (book), 139-150.
28. Chen S. M, Randyanto and Cheng S. H, "Fuzzy queries processing based on intuitionistic fuzzy social relational networks." Information Sciences 327, (2016): 110-24.
29. Karunambigai M. G, Akram M, Sivasankar S and Palanivel K, Int. J. Unc. Fuzz. Knowl. Based Syst. 25, (2017): 367-383.
30. Karthick, P and Narayanamoorthy S, "The Intuitionistic Fuzzy Line Graph Model to Investigate Radio Coverage Network, International Journal of Pure and Applied Mathematics 109 (10):2016, 79-87.
31. Mukherjee S, "Dijkstra's algorithm for solving the shortest path problem on networks under intuitionistic fuzzy environment." Journal of Mathematical Modelling and Algorithms, (2012):1-5.
32. Smarandache F, "Neutrosophic set - a generalization of the intuitionistic fuzzy set." Granular Computing, 2006 IEEE International Conference, (2006): 38–42.
33. Wang H, Smarandache F, Zhang Y and Sunderraman, "Single valued Neutrosophic Sets."Multisspace and Multistructure4, (2010): 410-413.
34. Broumi S, Talea M, Bakali A andSmarandache F, "Single Valued Neutrosophic Graphs." Journal of New Theory10, (2016): 86-101.
35. Broumi S, Talea M, Smarandache F andBakali A, "Single Valued Neutrosophic Graphs: Degree, Order and Size." IEEE International Conferenceon Fuzzy Systems (FUZZ),(2016):2444-2451.
36. Naz S, Rashmanlou H, Malik M. A. "Operations on single valued neutrosophic graphs with application." Journal of Intelligent & Fuzzy Systems, 32(3), (2017):2137-2151.
37. Ye J, "Single-valued neutrosophic minimum spanning tree and its clustering method." Journal of intelligent Systems, 23(3), (2014):311-324.
38. Broumi S, Talea M, Bakali A, Smarandache F, Kumar P. K, "Shortest path problem on single valued neutrosophic graphs."InNetworks, Computers and Communications (ISNCC), 2017 International Symposium on 2017 May 16, 1-6. IEEE.
39. Akram M, Shahzadi G, Operations on single-valued neutrosophic graphs, J. Uncertain Syst, 11(1), (2017):1-26.
40. Akram M, "Single-valued neutrosophic planar graphs." International Journal of Algebra and Statistics, 5(2) (2016):157-67.
41. Hamidi M, Saeid A. B, "Accessible single-valued neutrosophic graphs." Journal of Applied Mathematics and Computing (2017):1-26.
42. Broumi S, Smarandache F, Talea M and Bakali A," An Introduction to Bipolar Single Valued Neutrosophic Graph Theory." Applied Mechanics and Materials, 841 (2016):184-191.
43. Singh P. K., "Three-way fuzzy concept lattice representation using neutrosophic set."International Journal of Machine Learning and Cybernetics8(1),(2017):69-79
44. Broumi S., Dey A., Bakali A., Talea M., Smarandache F., Son L. H., KoleyD.,"Uniform Single Valued Neutrosophic Graphs." Neutrosophic Sets and Systems 17, (2017): 42-49. http://doi.org/10.5281/zenodo.1012249.
45. Broumi S., Bakali A., Talea M., Smarandache F.,"Isolated Single Valued Neutrosophic Graphs." Neutrosophic Sets and Systems, vol. 11, (2016):74-78.doi.org/10.5281/zenodo.571458
46. Shah N., Broumi S.,"Irregular Neutrosophic Graphs." Neutrosophic Sets and Systems 13, (2016):47-55.doi.org/10.5281/zenodo.570846
47. Shah N., "Some Studies in Neutrosophic Graphs." Neutrosophic Sets and Systems 12, (2016):54-64.doi.org/10.5281/zenodo.571148.
48. Shah N., Hussain A, "Neutrosophic Soft Graphs." Neutrosophic Sets and Systems11, (2016):31-44.doi.org/10.5281/zenodo.571574.
49. Malik M. A., Hassan A., Broumi S., Smarandache F.," Regular Single Valued Neutrosophic Hypergraphs." Neutrosophic Sets and Systems 13, (2016):-18 23.doi.org/10.5281/zenodo.570865
50. Smarandache F., "Neutrosophy. Neutrosophic Probability, Set, and Logic", ProQuest Information & Learning, Ann Arbor, Michigan, USA, (1998) 105 pages
51. Singh P.K., `Interval-valued neutrosophic graph representation of concept lattice and its (α, β, γ)-

decomposition'', Arabian Journal for Science and Engineering, 43(2)(2018):723-740, doi: 10.1007/s 13369-017-2718-5

52. Singh PK, ``m-polar fuzzy graph representation of concept lattice'', Engineering Applications of Artificial Intelligence, 67(2018): 52-62, https://doi.org/10.1016/j.engappai.2017.09.011