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Radius and Diameter of Some Family of SV Neutrosophic Graphs

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ABSTRACT

In the present article, we deduce a characterization of SVN eccentric vertex. The concepts of SVN graph are examined. Also we obtained some definitions SVN on a vertex like SVN eccentric vertex, SVN radius, SVN diameter, SVN centered and SVN periphery. We derive some important results based on these SVN radius, diameter, center and periphery.

1. Introduction

The Neutrosophic sets launch by Smarandache [10, 11] is a great exact implement for the situation uncertainty in the real world. These uncertainty idea comes from the theories of fuzzy sets [5], intuitionistic fuzzy sets [2, 4] and interval valued intuitionistic fuzzy sets [3]. The representation of the neutrosophic sets are truth, indeterminacy and falsity value. These T, I, F values belongs to standard or nonstandard unit interval denoted by] −0, 1+[[6,9].

The idea of subclass of the NS and SVNS introduced by Wang et al. [12]. The idea of SVNS initiation by intuitionistic fuzzy sets [1 ,7], in this the functions Truth, Indeterminacy, Falsity are not dependent and these values are present within [0, 1] [8]. Neutrosophic theory is widely expands in all fields especially authors discoursed about topology with respect to neutrosophic [13-19].

Graph theory has at this time turn into a most important branch of mathematics. It is the division of combinatory. The Graph is a extensively important to analyze combinatorial complication in dissimilar areas in mathematics, optimization and computer science. Mainly significant object is well-known. The uncertainty on the subject of vertices and edges or both representations to be a fuzzy graph.

In this manuscript, discus about SVN graphs and neutrosophic distance between two vertices of the graph based on this define SVN eccentricity, radius, diameter, center and periphery with respect to distance. Also find some important results on these topics.

2. Preliminaries:

Explanation 2.1 SVN sets:-
A SVN set is explained as the membership functions represented as a triplet set in W is denoted by $\{< w, T, I, F >: w \in W\}$, these functions are mapping from W to $[0,1]$. Where T denote truth membership, I denote indeterminate value and F denote false value of W.

Example. Let $W = \{w_1,\ w_2,\ w_3\}$
$A = \{< w_1,\ 0.3,\ 0.2,\ 0.7 >, < w_2, 0.5,\ 0.3,\ 0.1 >, < w_3, 0.8,\ 0.05,\ 0.4 >\}$ is a SVN set in W

Explanation 2.2 SVN relation on W

Let W be a non-empty set. Then we call mapping $Z = (W, T, I, F)$, $F(w): W \times W \to [0,1] \times [0,1]$ is a SVN relation on W such that $T_Z(w_1, w_2) \in [0,1], I_Z(w_1, w_2) \in [0,1], F_Z(w_1, w_2) \in [0,1]$.

Explanation 2.3 Let $Z_1 = \left(T_{Z_1}, I_{Z_1}, F_{Z_1}\right)$ and $Z_2 = \left(T_{Z_2}, I_{Z_2}, F_{Z_2}\right)$ be a SVN graphs on a set W. If Z_2 is a SVN relation on Z_1, then

$$T_{Z_2}(w_1, w_2) \le \min\left(T_{Z_1}(w_1), T_{Z_1}(w_2)\right)$$
$$I_{Z_2}(w_1, w_2) \ge \max\left(I_{Z_1}(w_1), I_{Z_1}(w_2)\right)$$
$$F_{Z_2}(w_1, w_2) \ge \max\left(F_{Z_1}(w_1), F_{Z_1}(w_2)\right) \text{ for all } w_1, w_2 \in W$$

Explanation 2.4. The symmetric property defined on SVN relation Z on W is explained by

$$T_Z(w_1, w_2) = T_Z(w_2, w_1),\quad I_Z(w_1, w_2) = I_Z(w_2, w_1),\quad F_Z(w_1, w_2) = F_Z(w_2, w_1)$$

Explanation 2.5 SVN graph

The new graph in SVN is denoted by $G^* = (V, E)$ is a pair $G = (Z_1, Z_2)$, where $Z_1 = \left(T_{Z_1}, I_{Z_1}, F_{Z_1}\right)$ is a BSVNS in V and $Z_2 = \left(T_{Z_2}, I_{Z_2}, F_{Z_2}\right)$ is SVNS in V^2 defined as

$T_{Z_2}(w_1, w_2) \le \min(T_{Z_1}(w_1), T_{Z_1}(w_2))$

$I_{Z_2}(w_1, w_2) \ge \max(I_{Z_1}(w_1), I_{Z_1}(w_2))$

$F_{Z_2}(w_1, w_2) \ge \max(F_{Z_1}(w_1), F_{Z_1}(w_2))$ for all $w_1, w_2 \in V$

SVNSG of an edge denoted by $w_1 w_2 \in V^2$

Explanation 2.6. Let $G = (Z_1, Z_2)$ be a SVNSG and $a, b \in V$

A path $P : a = w_0, w_1, w_2, ... w_{k-1}, w_k = b$ in G is sequence of distinct vertices such that $(T_B(w_{m-1}, w_m) > 0,\ I_B(w_{m-1}, w_m) > 0,\ F_B(w_{m-1}, w_m) > 0)$, $m = 1, 2, ..., k$ and length of the path is k ,where a is called initial vertex and b is called terminal vertex in the path.

Explanation 2.7. A SVN graph $G = (Z_1, Z_2)$ of $G^* = (V, E)$ is called strong SVN graph if

$T_{Z_2}(w_i, w_j) = \min(T_{Z_1}(w_i), T_{Z_1}(w_j))$

$I_{Z_2}(w_i, w_j) = \max(I_{Z_1}(w_i), I_{Z_1}(w_j))$

$F_{Z_2}(w_i, w_j) = \max(F_{Z_1}(w_i), F_{Z_1}(w_j))$,for all $(w_i, w_j) \in E$

If $P : a_1 = w_0, w_1, w_2, ..., w_{k-1}, w_k = c_1$ be a path of length k between a_1 and c_1 then

$(T_{Z_2}(a_1, c_1), I_{Z_2}(a_1, c_1), F_{Z_2}(a_1, c_1))^k$ is defined as

$$(T_{Z_2}(a_1, c_1), I_{Z_2}(a_1, c_1), F_{Z_2}(a_1, c_1))^k = \begin{cases} \sup\{T_{Z_2}(a_1, w_1) \wedge T_{Z_2}(w_1, w_2) \wedge ..... \wedge T_{Z_2}(w_{k-1}, c_1), \\ \inf\{I_{Z_2}(a_1, w_1) \vee I_{Z_2}(w_1, w_2) \vee ..... \vee I_{Z_2}(w_{k-1}, c_1), \\ \inf\{F_{Z_2}(a_1, w_1) \vee F_{Z_2}(w_1, w_2) \vee ..... \vee F_{Z_2}(w_{k-1}, c_1) \end{cases}$$

$(T_{Z_2}(a_1, c_1), I_{Z_2}(a_1, c_1), F_{Z_2}(a_1, c_1))^\infty$ is said to be the strength of connectedness between two vertices a_1 and c_1 in G, where

$$(T_{Z_2}(a_1, c_1), I_{Z_2}(a_1, c_1), F_{Z_2}(a_1, c_1))^\infty = \left(\sup_{k \in N}\{T_{Z_2}(a_1, c_1)\},\ \inf_{k \in N}\{I_{Z_2}(a_1, c_1)\},\ \inf_{k \in N}\{F_{Z_2}(a_1, c_1)\}\right)$$

If $\left(T_{Z_2}(a_1, c_1) \ge (T_{Z_2}(a_1, c_1))^\infty, I_{Z_2}(a_1, c_1) \le (I_{Z_2}(a_1, c_1))^\infty, F_{Z_2}(a_1, c_1) \le (F_{Z_2}(a_1, c_1))^\infty\right)$

then the arc $a_1 c_1$ in G is called a strong arc.

A path $a_1 - c_1$ is strong path if all arcs on the path are strong

3. SVN distance

Explanation 3.1
SVN distance is defined as the length of , $a-b$ strong path between a and b if there is no other strong path longer than P between a and b and we denote this by $S.N.d(a, b)$. Any $a-b$ strong path whose length is $S.N.d(a, b)$ is called a $a-b$ SVN path.

4. SVN eccentric some family of graphs *(EccS.N.d (G))*

Theorem 4.1 *A SVN graph G is a SVN self centered if and only if every node of G is a SVN eccentric.*
Proof. Suppose G is a SVN self centered SVN graph and let b be a node in G. Let $a \in b^*_{S.N.d}$. So $e_{S.N.d}(b) = S.N.d(a,b)$. Since G is a SVN self centered SVN graph, $e_{S.N.d}(a) = e_{S.N.d}(b) = S.N.d(a, b)$ and this implies that $b \in a^*_{S.N.d}$. Hence b is a SVN *eccentric* node of G.
Conversely, let every node of G is a SVN eccentric node. If possible, let G be not SVN self centrad SVN graph. Then $rad_{S.N.d}(G) \neq diam_{S.N.d}(G)$ and $\exists$ a node $r \in G$ such that $e_{S.N.d}(r) = diam_{S.N.d}(G)$. Also let $p \in r^*_{S.N.d}$. Let U be a $r-p$ SVN in G. So there must have a node q on U for which the node q is not a SVN eccentric node of U. Also q cannot be a SVN *eccentric* node of every other node. Again if q be a SVN eccentric node of a node a (say), means $q \in a^*_{S.N.d}$. Then there exist an extension of $a-q$ SVN up to r or up to p. But this contradicts the facts that $q \in a^*_{S.N.d}$. Hence $rad_{S.N.d}(G) = diam_{S.N.d}(G)$ and G is a SVN self centered SVN graph.

Theorem 4.2 If *G is a complete SVN graph, then* $rad_{S.N.d}(G) = diam_{S.N.d}(G) = 1$.
Proof. Let G be a complete SVN graph. In this graph every node is directly connected by with other node. So there exists a strong path between any pair of nodes. Therefore the SVN eccentricity of the each node is 1. Hence $\mathrm{rad}_{\mathrm{S.N.d}}(\mathrm{G}) = \mathrm{diam}_{\mathrm{S.N.d}}(\mathrm{G}) = 1$.

Theorem 4.3 *For a connected SVN graph G,* $Per_{S.N.d}(G) = G$ *if and only if the SVN eccentricity of each node of G is same.*

Proof. Let $Per_{S.N.d}(G) = G$. Then $e_{S.N.d}(p) = diam_{S.N.d}(G)$, $\forall p \in G$. So every node of G is a SVN periphery node of G. Therefore G is a self centered SVN graph and $rad_{S.N.D}(G) = diam_{S.N.d}(G)$. So the SVN eccentricity of each node is same.

Conversely, let the SVN eccentricity of each node of G is *same*. So $rad_{S.N.d}(G) = diam_{S.N.d}(G)$. All nodes of G are SVN peripheral nodes and hence $Per_{S.N.d}(G) = G$.

Theorem 4.4 *For a connected SVN wheel graph G, the* $rad_{S.N.d}(G) = 1$ and $diam_{S.N.d}(G) = 2$.

Proof. In a SVN wheel graph G, every node is passing through the one node is called SVN central node. This SVN central node directly connected with all other nodes. Therefore SVN eccentricity of a SVN central node is 1 and SVN eccentricity of all other is 2. Hence $rad_{S.N.d}(G) = 1$ and $diam_{S.N.d}(G) = 2$.

Theorem 4.5 In a connected SVN cyclic graph G, the $rad_{S.N.d}(G) = diam_{S.N.d}(G) = \frac{n}{2}$. Where n is number of nodes in a SVN cyclic graph.

Proof. In a connected SVN cyclic graph G, let p be the any node then SVN eccentricity of p is path start from p to half of the length because in SVN cyclic graph there is two paths so that the maximum SVN distance is occurs at half of the length. Therefore every node SVN eccentricity is $\frac{n}{2}$. Hence $rad_{S.N.d}(G) = diam_{S.N.d}(G) = \frac{n}{2}$.

Theorem 4.6 In a connected SVN bipartite graph G, the $rad_{S.N.d}(G) = diam_{S.N.d}(G)$.

Proof. In a connected SVN bipartite graph G, there two partition of nodes. Let U_1 and U_2 are two vertices sets, the edges of SVN is from one vertex set U_1 to the vertex set U_2. The strongest path between any two vertices is direct edge from one vertex set U_1 to the vertex set U_2. Similarly strongest path between any two vertices from vertex set itself is path start from vertex in U_1 to vertex in U_2 and again vertex in U_1. Therefore SVN eccentricity of the SVN bipartite graph is same for all the vertices. Hence $rad_{S.N.d}(G) = diam_{S.N.d}(G)$.

5. Conclusions

This manuscript contains the extend part of SVN sets to SVN graphs. In this we computing results based on SVN graphs. In future also we go for the results based on SVN graphs and some applications on SVNG.

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