International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 11
***Article Received:** 10 September 2023 **Revised:** 20 October 2023 **Accepted:** 30 October 2023*

A Study on Micro Topology Induced by Graphs and Its Applications

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Abstract:

The purpose of this paper is to introduce a Micro topological space induced by a graph which depends upon a neighbourhood between the vertices based on simple graphs. Micro-continuity via graph theory also analyzed. Further, a real life application of graph isomorphism between two directed graphs through the concepts of Micro$_G$-homeomorphism for the problem concerning about environmental deterioration is investigated.

Keywords: Neighbourhood, Micro topology, Micro$_G$-continuity, Micro$_G$-homeomorphism, Graph Isomorphism.

1. Introduction

Graph theory can describe a lot of cases such that network, electrical circuits and information systems as vertices and edges which representing the nature of the trend to be studied. In 2016, Lellis Thivagar [6] generated the nano topological space via graph theory by using neighbourhood between the vertices based on directed graph. In 2021, Waleed Ramadhan Kalifa [8], generalized the nano topological space via graph theory which depends on a neighbourhood between the vertices based on undirected graphs. Abd. E1. Fattah [1], also studied some nano topological structures via ideals and graphs in 2020. Arafa Nasef [2] et al established some properties on Nano topology induced by Graphs in 2017. Kandil. A [5] presented a generalization of nano topological spaces called I.nano topological spaces which based on ideals in 2021. Micro topology is a simple extension of nano topology. In this paper, as an extension of Nano topology via graph theory we introduced the new measure generated by a Micro topology. The main contribution of the present work is to generate the Micro topological space induced by the vertices of the graph and study some properties on it. Moreover, as an application on real life problem, the similar influences of natural and man-made disasters affecting the environment through Micro topology via graph isomorphism technique is discussed.

2. PRELIMINARIES

Definition 2.1. [4] A graph G is an ordered pair of disjoint sets (V, E) where V is non-empty and E is a subset of unordered pairs of V. The vertices and edges of a graph G are the elements of V = V(G) and E = E(G) respectively. We say that a graph G is finite (resp. infinite) if the set V(G) is finite (resp. infinite).

Definition 2.2. [4] Let G = (V, E) be a directed graph and u, $v \in V(G)$, then

(i) u is invertex of v if $\overrightarrow{uv} \in E(G)$,

(ii) u is outvertex of v if $\overrightarrow{vu} \in E(G)$,

(iii) The indegree of a vertex 'v' is the number of vertices 'u' such that $\overrightarrow{uv} \in E(G)$,

(iv) The outdegree of a vertex 'v' is the number of vertices 'u' such that $\overrightarrow{vu} \in E(G)$,

Definition 2.3. [6] Let G be a graph, $v \in V(G)$. Then the neighbourhood of v is denoted by N(v) and is defined by $N(v) = \{v\} \bigcup \{u \in V(G) : \overrightarrow{uv} \in E(G)\}$.

Definition 2.4. [2] Let G = (V, E) be a graph. H be a subgraph from G, N(v) is a neighbourhood of v in V(G). Then

(i) The Lower approximation $L:P[V(G)]\rightarrow P[V(G)]$ is $L_N[V(H)]= \bigcup_{v\in V(G)} \{v:N(v) \subseteq N(H)\}$.

(ii) The Upper approximation $U: P[V(G)]\rightarrow P[V(G)]$ is $U_N[V(H)] = \bigcup_{v\in V(G)} \{v: N(v) \cap N(H) \neq \phi\}$.

(iii) The Boundary region is $B_N[V(H)] = U_N[V(H)] - L_N[V(H)]$.

Definition 2.5. [6] Let G = (V, E) be a graph, N(v) be a neighbourhood of $v \in V$ and H be a subgraph of G, $\tau_N[V(H)] = \{V(G), \phi, L_N[V(H)], U_N[V(H)], B_N[V(H)]\}$ forms a topology on V(G) called the nano topology on V(G) with respect to V(H).

$(V(G), \tau_N[V(H)])$ is a nano topological space induced by a graph G.

Definition 2.6. [7] A graph G (V, E) is a set of vertices and edges. If there is an edge between the vertices, it is said to be adjacent of neighbourhood if there is a relation between vertices, it is called as adjacency relation. Adjacency matrix is used to represent graph in memory, where 1 represents edge and 0 represents no edge.

Definition 2.7. [3] Two graphs $G_1 = (V_1,X_1)$ and $G_2 = (V_2,X_2)$ are said to be isomorphic if there exists a bijection f: $V_1\rightarrow V_2$ such that u,v are adjacent in G_1 if and only if f(u) and f(v) are adjacent in G_2. If G_1 is isomorphic to G_2, we write $G_1 \cong G_2$. The map f is called an isomorphism from G_1 to G_2.

Theorem 2.8. [3] Let f be an isomorphism of the graph $G_1 = (V_1,X_1)$ to the graph $G_2 = (V_2,X_2)$. Let $v\in V_1$. Then deg v = deg f(v).

3. MICRO TOPOLOGICAL SPACE INDUCED BY A GRAPH

Definition 3.1. Let G (V, E) be a graph. n(v) be a neighbourhood of v in V and H be a subgraph of G. Then $\mu_n[V(H)] = \{N\bigcup(N'\bigcap\mu): N, N'\in \tau_n[V(H)]\}$ where $\mu\notin\tau_n[V(H)]$ forms a Micro topology on V(G) with respect to V(H). Thus the Micro topological space induced by a graph is denoted by $(V(G), \tau_n[V(H)], \mu_n[V(H)])$ and the elements of $\mu_n[V(H)]$ are called $Micro_G$-open sets and the complement of a $Micro_G$-open set is called a $Micro_G$-closed set.

Example 3.2. Let G = (V, E) be a graph (as in figure 1). Then $n(v_1) = \{v_1,v_4,v_5\}$, $n(v_2) = \{v_2,v_3,v_5\}$, $n(v_3) = \{v_2,v_3,v_4\}$, $n(v_4) = \{v_1,v_3,v_4\}$, $n(v_5) = \{v_1,v_2,v_5\}$. If H is a subgraph with vertices $V(H) = \{v_2,v_3,v_5\}$ then $L_n[V(H)] =\{v_2\}$, $U_n[V(H)]= V(G)$, $B_n[V(H)] =\{v_1,v_3,v_4,v_5\}$ and $\tau_n[V(H)] = \{V(G), \phi, \{v_2\}, \{v_1,v_3,v_4,v_5\}\}$. If $\mu = \{v_3\}\notin\tau_n[V(H)]$ then $\mu_N[V(H)] = \{V(G), \phi, \{v_2\}, \{v_3\}, \{v_2,v_3\}, \{v_1,v_3,v_4,v_5\}\}$ is a Micro topological space induced by a subgraph H from G.

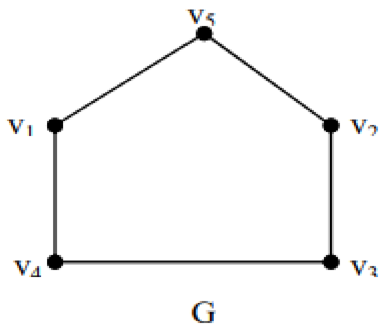

Figure 1: (Cyclic graph)

4. MICRO-CONTINUITY VIA GRAPH THEORY

Definition 4.1. Let G = (V, E) and G = (V′, E′) be two isomorphic graphs with the Micro topological spaces induced by the subgraphs of $G_1$and G_2 are $(V(G),\tau_n[V(H)],\mu_n[V(H)])$ and $(V'(G'), \tau_n[f(V(H)), \mu_n[f(V(H))])$ respectively. Then the mapping $f:(V(G), \tau_n[V(H)], \mu_n[V(H)]) \to (V'(G'), \tau_n[f(V(H))], \mu_n[f(V(H))])$ is called $Micro_G$-continuous on V(G) if the inverse image of each $Micro_G$-open set in V′(G′) is a $Micro_G$-open set in V(G).

Example 4.2. Let G = (V, E) and G′ = (V′, E′) be two isomorphic graphs (in figure 2). To construct a Micro topology on G generated by V(H). Assume that H is a subgraph from G with vertices V(H) = {a,d}, Then n(a) = {a,b,c}, n(b) ={a,b,c}, n(c) = {a,b,c}, n(d) = {a,d}. Also $L_n[V(H)] = \{d\}$, $U_n[V(H)] = V(G)$, $B_n[V(H)] = \{a,b,c\}$ and $\tau_n[V(H)] =\{V(G), \phi, \{d\}, \{a,b,c\}\}$. If $\mu = \{a\}$ then $\mu_n[V(H)] = \{V(G), \phi, \{a\}, \{d\}, \{a,d\}, \{a,b,c\}\}$.

Define a function $f: V(G) \to V'(G')$ as f(a) = 2, f(b) = 3, f(c) = 4, f(d) = 1.

To construct a Micro topology on G′ generated by f(V(H)) = {1,2}. Assume that K is a subgraph from G′ with vertices f(V(H)) = {1,2}. Then n(1) = {1,2}, n(2) = V′(G′), n(3) = {2,3,4}, n(4) = {2,3,4}. Also here, $L_n[f(V(H))] = \{1\}$, $U_n[f(V(H))] = V'(G')$, $B_n[f(V(H))] = \{2,3,4\}$ and $\tau_n[f(V(H))] = \{V'(G'), \phi, \{1\}, \{2,3,4\}\}$. If $\mu = \{2\}$ then $\mu_n[f(V(H))] = \{V'(G')\ \phi, \{1\}, \{2\}, \{1,2\}, \{2,3,4\}\}$. Hence f is $Micro_G$-continuous on V(G).

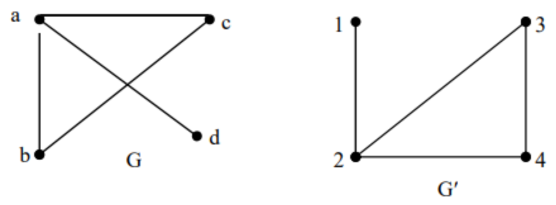

Figure 2. (Simple connected isomorphic graphs)

Theorem 4.3. Let G = (V, E) and G′ = (V′, E′) be any two isomorphic graphs with the Micro topological spaces $(V(G),\tau_n[V(H)], \mu_n[V(H)])$ and $(V'(G'), \tau_n[f(V(H))], \mu_n[f(V(H))])$ respectively. A function $f:(V(G),\tau_n[V(H)],\mu_n[V(H)]) \to (V'(G'),\tau_n[f(V(H))], \mu_n[f(V(H))])$ is $Micro_G$-continuous if and only if the inverse image of every $Micro_G$-closed set in V′ (G′) is $Micro_G$-closed in (V(G)).

Proof: Let f be $Micro_G$-continuous and V(F) be $Micro_G$-closed in V′(G′). That is V′(G′)–V(F) is $Micro_G$-open in V(G). Since f is $Micro_G$-continuous $f^{-1}(V'(G') - V(F))$ is $Micro_G$-open in V(G). That is $V(G) - f^{-1}(V(F))$ is $Micro_G$-open in V(G). Thus $f^{-1}(V(F))$ is $Micro_G$-closed in V(G). Hence the inverse image of every $Micro_G$-closed set in V′(G′) is $Micro_G$-closed in V(G).

Conversely, let the inverse image of every $Micro_G$-closed set in V′(G′)be $Micro_G$-closed in V(G). Let V(H) be $Micro_G$-open in V′(G′). Then $f^{-1}(V'(G') - V(H))$ is $Micro_G$-closed in V(G). Therefore, $f^{-1}(V(H))$ is $Micro_G$-open in V(G). Hence the inverse image of every $Micro_G$-open set in V′(G′) is $Micro_G$-open in V(G). Therefore, f is $Micro_G$-continuous on V(G).

5. MICRO-HOMEOMORPHISM VIA GRAPH THEORY

Definition 5.1. Let $G_1 = (V_1, E_1)$ and $G_2 = (V_2, E_2)$ be any two isomorphic graphs with the Micro topological spaces $(V_1(G_1), \tau_n[V_1(H)], \mu_n[V_1(H)])$ and $(V_2(G_2), \tau_n[f(V_1(H))], \mu_n[f(V_1(H))])$ respectively. A function $f: (V_1(G_1), \tau_n[V_1(H)], \mu_n[V_1(H)]) \to (V_2(G_2), \tau_n[f(V_1(H))], \mu_n[f(V_1(H))])$ is $Micro_G$-open map if the image of every $Micro_G$-open set in

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 11
***Article Received:** 10 September 2023 **Revised:** 20 October 2023 **Accepted:** 30 October 2023*

(V_1 (G_1)) is Micro$_G$-open in (V_2 (G_2)). The mapping f is said to be Micro$_G$-closed map if the image of every Micro$_G$-closed set in (V_1 (G_1)) is Micro$_G$-closed in (V_2(G_2)).

Example 5.2. From the Example 4.2, the image of every Micro$_G$-open set in V(G) is Micro$_G$-open in V′(G′). Thus the function f is a Micro$_G$-open map.

Definition 5.3. Let G_1 = (V_1, E_1) and G_2 = (V_2, E_2) be any two isomorphic graphs with the Micro topological spaces induced by the subgraphs V_1(H), and f(V_1(H)) are (V_1(G_1), τ_n[V_1(H)] , μ_n[V_1(H)]) and (V_2(G_2) , τ_n[f(V_1(H))], μ_n[f(V_1(H))]) respectively. Then the mapping f : (V_1(G_1), τ_n[V_1(H)], μ_n[V_1(H)]) → (V_2(G_2), τ_n[f(V_1(H))], μ_n[f(V_1(H))]) is called Micro$_G$-homeomorphism if

(i) f is one-one and onto
(ii) f is Micro$_G$-continuous
(iii) f is a Micro$_G$-open map.

Theorem 5.4. Let G_1 = (V_1 E_1) and G_2 = (V_2 E_2) be any two isomorphic graphs then there exists a Micro$_G$-homeomorphism f: (V_1(G_1), τ_n[V(H)], μ_n[V(H)]) → (V_2(G_2), τ_n[V(H)], μ_n[V(H)]) for every subgraph H of G_1.

Proof: Since G_1 and G_2 are isomorphic. By definition 2.8, there is an isomorphism f: V_1(G_1) → V_2(G_2) and deg(v) = deg(f(v)) ∀ v∈V_1(G_1). Suppose (V_1(G_1), τ_n[V(H)], μ_n[V(H)]) and (V_2(G_2), τ_n[f(V(H))], μ_n[f(V(H))]) are Micro topological spaces generated by V(H) and f(V(H)). Since f is a bijection. Clearly, it follows that f is 1-1 and onto.

(i) To prove that f is a Micro$_G$-open map, Let A be any Micro$_G$-open set in μ_n[V(H)]), then f(A) is Micro$_G$-open. Since deg(x) = deg(f(x)) ∀ x ∈A.

(ii) To prove that f is Micro$_G$-continuous, Let B be any Micro$_G$-open set in μ_n[f(V(H))] then f^{-1}(B) is Micro$_G$-open in μ_n[V(H)] and vice versa. Thus f is a Micro$_G$-homeomorphism.

Remark 5.5. From the above theorem, it is shown that, Every isomorphic graphs provide Micro$_G$-homeomorphism. As in classical topology, If a function f is Micro$_G$-homeomorphism then there exists an isomorphism between the graphs. If not, there does not exist an isomorphism and is shown in the following example.

Example 5.6. Let G_1 = (V_1, E_1), G_2 = (V_2, E_2) and G_3 = (V_3, E_3) (in figure 3) be three graphs. Based on Micro$_G$-homeomorphism, we can check whether the following graphs are isomorphic or not.

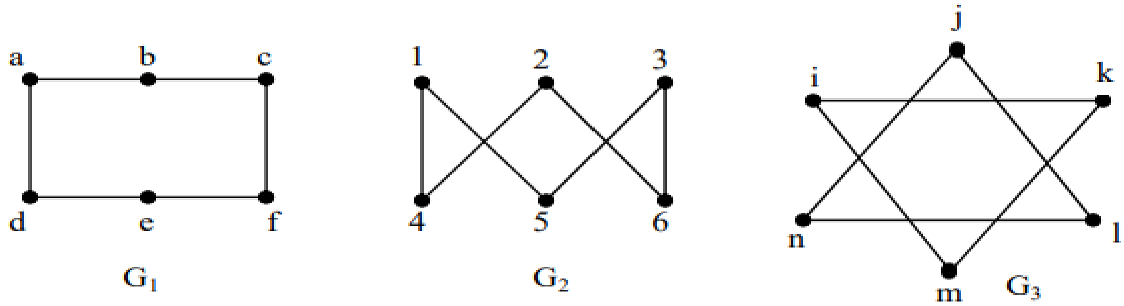

Figure 3

To determine the isomorphism between the graphs G_1 and G_2:

Let G_1 = (V_1, E_1) be a graph. Then n(a) = {a,b,d}, n(b) = {a,b,c}, n(c) = {b,c,f}, n(d) = {a,d,c}, n(e) = {d,e,f}, n(f) = {c,e,f}. Here H is a subgraph with vertices V_1(H) = {d,e,f} then L_n[V_1(H)] = {e}, U_n[V_1(H)] = {a,c,d,e,f}, B_n[V_1(H)] = {a,c,d,f} and τ_n[V_1(H)] = {V_1(G_1), ϕ, {e}, {a,c,d,f}, {a,c,d,e,f}}. If μ = {a} then the Micro topological space induced by a subgraph H from G_1 is μ_n[V_1(H)] = {(V_1(G_1), ϕ, {a}, {e}, {a,e}, {a,c,d,f}, {a,c,d,e,f}}. Let G_2 = (V_2, E_2) be a graph. Then n(1) = {1,4,5}, n(2) = {2,4,6}, n(3) = {3,5,6}, n(4) = {1,2,4}, n(5) = {1,3,5}, n(6) = {2,3,6}.

Define a function f: V_1(G_1) → V_2(G_2) as f(a) = 1, f(b) = 5, f(c) = 3, f(d) = 4, f(e) = 2, f(f) = 6. Let K be a subgraph with vertices f(V_1(H)) = {2,4,6} then L_n[f(V_1(H))]

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 11
Article Received: 10 September 2023 Revised: 20 October 2023 Accepted: 30 October 2023

= {2}, $U_n[f(V_1(H))]$ = {1,2,3,4,6}, $B_n[f(V_1(H))]$ = {1,3,4,6} and $\tau_n[f(V_1(H))]$ = {$V_2(G_2)$, ϕ, {1},{2},{1,3,4,6}, {1,2,3,4,6}}. If μ = {1} then the Micro topological space induced by a subgraph K from G_2 is $\mu_n[V_1(H)]$ = {$V_2(G_2)$, ϕ, {1}, {2}, {1,2}, (1,3,4,6}, {1,2,3,4,6}}. Here f is bijective and the inverse image of every $Micro_G$-open set in $V_2(G_2)$ is $Micro_G$-open in $V_1(G_1)$. Therefore f is $Micro_G$-continuous. Also the image of every $Micro_G$-open set in $V_1(G_1)$ is $Micro_G$-open in $V_2(G_2)$. Then f is $Micro_G$-open map. Hence f is $Micro_G$-homeomorphism. Therefore, there is an isomorphism between the graphs G_1 and G_2.

To determine the isomorphism between the graphs G_2 and G_3:

Let $G_2 = (V_2, E_2)$ be a graph. Then n(1) = {1,4,5}, n(2) = {2,4,6}, n(3) = {3,5,6}, n(4) = {1,2,4}, n(5) = {1,3,5}, n(6) = {2,3,6}. Here H is a subgraph with vertices $V_2(H)$ = {1,3,5} then $L_n[V_2(H)]$ = {5}, $U_n[V_2(H)]$ = {1,3,4,5,6}, $B_n[V_2(H)]$= {1,3,4,6} and $\tau_n[V_2(H)]$ ={$V_2(G_2)$, ϕ, {5}, {1,3,4,6}, {1,3,4,5,6}}. If μ = {1} then $\mu_n[V_2(H)]$ = {$V_2(G_2)$, ϕ, {1}, {5}, {1,5}, {1,3,4,6}, {1,3,4,5,6}} is the Micro topological space generated by a subgraph H from G_2. Let $G_3 = (V_3, E_3)$ be a graph. Then n(i) = {i,k,m}, n(j) = {j,l,n}, n(k) = {i,k,m}, n(l) = {j,l,n}, n(m) = {i,k,m} n(n) = {j,l,n}.

Define a function g: $V_2(G_2) \rightarrow V_3(G_3)$ as g(1) = i, g(2) = j, g(3) = k, g(4) = l, g(5) = m, g(6) = n. K is a subgraph with vertices g ($V_2(H)$)= {i,k,m} then $L_n[g(V_2(H))]$={i,k,m}, $U_n[g(V_2(H))]$ = {i,k,m}, $B_n[g(V_2(H))]$= ϕ and $\tau_n[V_2(H)]$ = ($V_3(G_3)$, ϕ, {i,k,m}}. If μ = {i} then $\mu_n[g(V_2(H))]$ = {($V_3(G_3)$, ϕ, {i}, {i,k,m}} is the Micro topological space generated by a subgraph K from G_3. Here g is 1-1 and onto But g is not $Micro_G$-continuous and not a $Micro_G$-open map. Hence g is not $Micro_G$-homeomorphism. Therefore, there does not exist an isomorphism between G_2 and G_3.

To determine the isomorphism between the graphs G_1 and G_3:

Let $G_1 = (V_1, E_1)$ be a graph. Then the Micro topology induced by a subgraph $V_1(H)$= {d,e,f} is $\mu_n[V_1(H)]$) = (V_1,(G_1), ϕ , {a}, {e}, {a,e}, {a,c,d,f}, {a,c,d,e,f}}. Let $G_3 = (V_3, E_3)$ be a graph. Then n(i) = {i,k,m}, n(j) = {j,l,n}, n(k) = {i,k,m}, n(l)={j,l,n}, n(m) = {i,k,m}, n(n) = {j,l,n}.

Define a function h:$V_1(G_1) \rightarrow V_3(G_3)$ as h(a) = i, h(b) = k, h(c) = m, h(d) = j, h(e) = l, h(f) = n. Let K be a subgraph with vertices $h(V_1(H))$ = {j,l,n} then $L_n[h(V_1(H))]$ = {j,l,n}, $U_n[h(V_1(H))]$= {j,l,n}, $B_n[h(V_1(H))]$ = ϕ and $\tau_n[h(V_1(H))]$ = {(V_3,(G_3), ϕ, {j,l,n}}. If μ = {i} then $\mu_n[h(V_1(H))]$ = {$V_3(G_3)$, ϕ, {i}, {j,l,n}, {i,j,l,n}} is the Micro topological space generated by a subgraph K from G_3. Here h is 1-1 and onto but h is not $Micro_G$-continuous and not a $Micro_G$-open map. Thus f is not $Micro_G$-homeomorphism. Therefore, there does not exist an isomorphism between the graphs G_1 and G_3.The isomorphism between these three graphs are represented as follows:

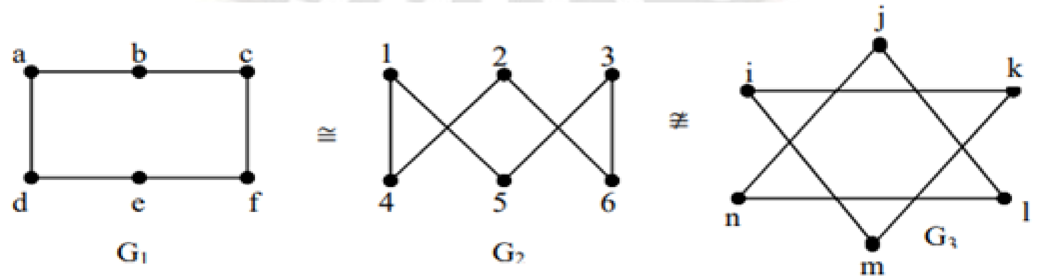

Figure 4. (Isomorphic and Non isomorphic graphs)

International Journal on Recent and Innovation Trends in Computing and Communication
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Theorem 5.7. Let $G_1 = (V_1, E_1)$ and $G_2 = (V_2, E_2)$ be any two isomorphic graphs with the Micro topological spaces induced by the subgraphs $V_1(H)$ and $f(V_1(H))$ are $(V_1(G_1), \tau_n[V_1(H)], \mu_n[V_1(H)])$ and $(V_2(G_2), \tau_n[f(V_1(H))], \mu_n[f(V_1(H))])$ respectively. If $f: (V_1(G_1), \tau_n[V_1(H)], \mu_n[V_1(H)] \rightarrow (V_2(G_2), \tau_n[f(V_1(H))], \mu_n[f(V_1(H))])$ is one-one and onto. Then f is a $Micro_G$-homeomorphism if and only if f is $Micro_G$-closed and $Micro_G$-continuous.

Proof: Let f be a $Micro_G$-homeomorphism. Then f is $Micro_G$-continuous. Let $V_1(F)$ be an arbitrary $Micro_G$-closed set in $(V_1(G_1), \tau_n[V_1(H)], \mu_n[V_1(H)])$. Then $V_1(G_1) – V_1(F)$ is $Micro_G$-open. Since f is $Micro_G$-open $f(V_1(G_1) – V_1(F))$ is $Micro_G$-open in $V_2(G_2)$. That is $(V_2(G_2) – f(V_1(F))$ is $Micro_G$-open in $V_2(G_2)$. Therefore, $f(V_1(F))$ is $Micro_G$-closed set in $V_2(G_2)$. Thus the image of every $Micro_G$-closed set $V_1(G_1)$ is $Micro_G$-closed in $V_2(G_2)$. Hence f is $Micro_G$-closed.

Conversely, let f be $Micro_G$-closed and $Micro_G$-continuous. Let $V_1(H)$ be a $Micro_G$-open set in $(V_1(G_1), \tau_n[V_1(H)], \mu_n[V_1(H)])$. Then $V_1(G_1) – V_1(H)$ is $Micro_G$-closed in $V_1(G_1)$. Since f is $Micro_G$-closed $f(V_1(G_1) – V_1(H) = V_2(G_2) – f(V_1(H))$ is $Micro_G$-closed in $V_2(G_2)$. Thus f is $Micro_G$-open and hence f is $Micro_G$-homeomorphism.

6. APPLICATIONS

Everything that surrounds us referred to as the environment. All living and non-living organisms come under the environment. Earth is a home for different living species and we all are dependent on the environment for food, air, water and other needs. This environment is constantly changing, and with these changes, we need to become increasingly aware of the environmental issues. From past few years, disaster has emerged as security threat to India. Disaster can be simply termed as a sudden incident or happening which can be either natural or man-made and can potentially cause damage to the surroundings. Disasters have a devastating impact on human life, causing injury, death and widespread destruction of homes, belongings, businesses and infrastructures. The term natural disaster refers to the disasters that are triggered because of natural phenomenon like atmospheric, hydrologic, geologic etc. The term man-made disaster refers to the disasters resulting from human-caused hazards like terror attack, accidents, fires etc.

The natural and man-made hazards that kill thousands of people, destroy billions of dollars of habitat and property each year. Among natural factors, the sudden changes in the weather, the different types of natural disasters, etc affect the normal environment. Due to such changes, there are problems in the interrelationships that exist between food chain and food web. Due to various man-made factors, there are extreme destruction of environment. Industrialization, the pollution due to such industries, urbanization, construction of roads, bridges, etc are all man-made changes that cause a lot of change to environment.

In the following problem, we discussed about the impact similarities of the influences by both the natural and man-made hazards which are causing the depletion of natural resources.

7. PROBLEM

The problem about environment that we have found is determining the similarity between the high risk of Natural hazards and Man-made hazards in India. India is a diverse country in terms of climate, terrain and relief and thus is prone to different types of disasters. India has seen many disasters, some of which were natural, some were man-made and some were a combination of both. From natural disasters to man-made disasters, it is important to manage calamities with proper planning and mitigate these issues fast, reducing the loss of human lives and biodiversity. No matter what the nature of the disasters are, the damages caused by these disasters are devastating-from loss of human lives to loss of livestock to destruction of property to health crises. India has witnessed a large number of disaster. This brief aims to analyze the major disaster in India since 2001 and also assess the impact similarity of both natural and man-made disasters. Here the major

International Journal on Recent and Innovation Trends in Computing and Communication
ISSN: 2321-8169 Volume: 11 Issue: 11
***Article Received:** 10 September 2023 **Revised:** 20 October 2023 **Accepted:** 30 October 2023*

disasters in india since 2001 are collected from "The Economic Times" at https://m.economictimes.com and "Types of Disasters" at https://samhsa.gov have been analyzed and arrived at the most reliable conclusion by using the method of Graph isomorphism Via Micro-topology.

Disaster / Period	Landslide	Earthquake	Covid-19	Cyclone	Flood	Tsunami
2001-2004	–	✓	–	–	–	✓
2005-2008	–	–	–	–	✓	–
2009-2012	–	✓	–	✓	–	–
2013-2016	✓	–	–	–	–	–
2017-2020	–	–	–	✓	–	–
2021-2024	–	–	✓	–	✓	–

Table 1: Natural Disasters happened in India (2001 - 2024)

Disaster / Period	Collapse	Fire	Chemical spill	Radiation	Explosion	Gasleak
2001-2004	–	–	–	✓	–	–
2005-2008	–	–	–	–	✓	–
2009-2012	–	–	–	✓	–	✓
2013-2016	–	✓	–	–	–	–
2017-2020	✓	–	✓	–	–	–
2021-2024	✓	✓	–	–	–	–

Table 2: Man-made disasters happened in India (2001 - 2024)

In Table 1and 2, if ✓ is marked in the row for period and the column for disaster, it means that there is an occurrence of the disaster during the period and – shows that there is an absence of the disaster during the period. The manipulated data given in Table 1 and 2 can be represented in array form by using an adjacency relation.

The requirements of an adjacency matrix are given by the above information system.

In Table 1, Let U = {u_1, u_2, u_3, u_4, u_5, u_6} be the Universal set of Natural hazards which are affecting the environment.

Let u_1 = Land slide, u_2 = Earthquake, u_3 = Covid -19, u_4 = Cyclone, u_5 = Flood, u_6 = Tsunami be the parameters (attributes) of Natural hazards.

From table 2, Let V = {v_1, v_2, v_3, v_4, v_5, v_6} be the Universal set of Man-made hazards which are influencing the environment.

Let v_1= Collapse, v_2 = Fire, v_3 = Chemical Spill, v_4 = Radiation, v_5 =Explosion, v_6 = Gas leak be the parameters of Man-made hazards.

Let D = {Yes, No} = {✓, –} be the domain (value of an attribute) set.

By an adjacency matrix of U, we will mean n×n matrix denoted as A_{ij} and is defined as,

$$A_{ij} = \begin{cases} 1 & if\ D = \text{Yes} \\ 0 & if\ D = \text{No} \end{cases}$$

The adjacency matrices of the above information systems are represented as,

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$$\begin{array}{c} \\ u_1 \\ u_2 \\ u_3 \\ u_4 \\ u_5 \\ u_6 \end{array}\begin{array}{c} \begin{array}{cccccc} u_1 & u_2 & u_3 & u_4 & u_5 & u_6 \end{array} \\ \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 \end{bmatrix} \end{array}$$

Figure 5

$$\begin{array}{c} \\ v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5 \\ v_6 \end{array}\begin{array}{c} \begin{array}{cccccc} v_1 & v_2 & v_3 & v_4 & v_5 & v_6 \end{array} \\ \begin{bmatrix} 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

Figure 6

The elements of the matrix indicate whether pairs of vertices are adjacent or not in the graph. If the $(i,j)^{th}$ entry of an adjacency matrix for a simple graph is 1 then there is an edge from u_i to u_j and 0 otherwise.

The direction of a simple directed graphs are drawn by using the following algorithm.

Algorithm

Step 1: Determine the neighbourhood set of each attribute.

Step 2: If $n(v_i) \cap n(v_j) = \phi$, then there is no edge between v_i & v_j.

Step 3: If $n(v_i) \cap n(v_j) = \begin{cases} v_i : v_j \to v_i \forall\, i \neq j \\ v_j : v_i \to v_j \forall\, i \neq j \end{cases}$.

Step 4: If $n(v_i) \cap n(v_j) \neq \phi$ and $i = j$ then there is no edge between v_i & v_j.

Step 5: Each $n(v_i)$ represents vertex.

Step 6: Connect between each $n(v_i)$ by edges with orientation.

By using the above algorithm, the following figure 7 & figure 8 are the directed graphs for the adjacency matrix given in figure 5 & figure 6 respectively.

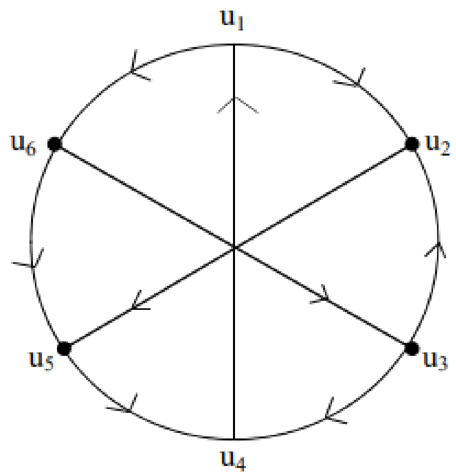

Figure 7. (G_1) 3-regular simple directed graph

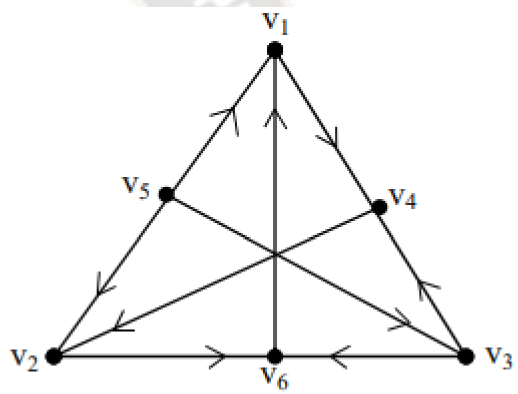

Figure 8. (G_2) 3-regular simple directed graph

The solution of this problem can be obtained by determining whether these two 3-regular simple directed graphs are isomorphic or not by using $Micro_G$-continuous and $Micro_G$-homeomorphism techniques.

Figure 7 shows the 3-regular directed graph G_1 where $U = V_1(G_1) = \{u_1, u_2, u_3, u_4, u_5, u_6\}$ and $n(u_1) = \{u_1, u_2, u_6\}$, $n(u_2) = \{u_2, u_5\}$, $n(u_3) = \{u_2, u_3, u_4\}$, $n(u_4) = \{u_1, u_4\}$, $n(u_5) = \{u_4, u_5\}$, $n(u_6) = \{u_3, u_5, u_6\}$. H is a subgraph with vertices $V_1(H) = \{u_2, u_5\}$. Then $L_n[V_1(H)] = \{u_2\}$, $U_n[V_1(H)] = \{u_1, u_2, u_3, u_5, u_6\}$, $B_n[V_1(H)] = \{u_1, u_3, u_5, u_6\}$ and $\tau_n[V_1(H)] = \{V_1(G_1), \phi, \{u_2\}, \{u_1, u_3, u_5, u_6\}, \{u_1, u_2, u_3, u_5, u_6\}\}$. If $\mu = \{u_1, u_4\}$ then $\mu_n[V_1(H)] = \{V_1(G_1), \phi, \{u_2\}, \{u_1, u_4\}, \{u_1, u_2, u_6\}, \{u_1, u_3, u_5, u_6\}, \{u_1, u_3, u_4, u_5, u_6\}, \{u_1, u_2, u_3, u_5, u_6\}\}$.

Figure 8 shows the 3-regular directed graph G_2, where $V = V_2(G_2) = \{u_1, u_2, u_3, u_4, u_5, u_6\}$ and $n(v_1) = \{v_1, v_4\}$, $n(v_2) = \{v_2, v_5\}$, $n(v_3) = \{v_3, v_4, v_5\}$, $n(v_4) = \{v_2, v_4\}$, $n(v_5) = \{v_3, v_5\}$, $n(v_6) = \{v_1, v_2, v_6\}$.

Define a function $f : U \rightarrow V$ as $f(u_1) = v_2$, $f(u_2) = v_4$, $f(u_3) = v_1$, $f(u_4) = v_5$, $f(u_5) = v_3$, $f(u_6) = v_6$, H is a subgraph with vertices $f(V_1(H)) = \{v_2, v_4\}$. Then $L_n[f(V_1(H))] = \{v_4\}$, $U_n[f(V_1(H))] = \{v_1, v_2, v_3, v_4, v_6\}$, $B_n[f(V_1(H))] = \{v_1, v_2, v_3, v_6\}$ and $\tau_n[f(V_1(H))] = \{V_2(G_2), \phi, \{v_4\}, \{v_1, v_2, v_3, v_6\}, \{v_1, v_2, v_3, v_4, v_6\}\}$. If $\mu = \{v_2, v_5\}$ then $\mu_n[f(V_1(H))] = \{V_2(G_2), \phi, \{v_4\}, \{v_2, v_5\}, \{v_2, v_4, v_5\}, \{v_1, v_2, v_3, v_6\}, \{v_1, v_2, v_3, v_4, v_6\}, \{v_1, v_2, v_3, v_5, v_6\}\}$.

Here f is a bijective function, f is $Micro_G$-continuous and $Micro_G$-open. Therefore, f is $Micro_G$-homeomorphism. Hence the graphs G_1 and G_2 are isomorphic. This shows that there is similar influences between both Natural and Man-made hazards.

8. CONCLUSION

In this paper, how the Micro-topology is deduced from any Nano-topological graph is defined and the concept of $Micro_G$-continuity, $Micro_G$-homeomorphism via graph theory are also studied. In addition to that, as an application, the factors affecting environment are discussed using Micro topology via graph theory. The solution arrived for this problem is,

the disaster is either natural or man-made, it had an evil impact on human life and environment.

Environment plays an important role in healthy living and the existence of life on planet earth. As a biggest internal security challenge we should focus on the management of disaster. It has seen most of the times intensity of disaster makes us and the government must think about the problem seriously. Educational institutions can play an active role by making the training of disaster compulsory for the students. After the training those students would be able to survive and save the lives of others during disaster. This study may go to a step ahead in discussing the disaster management.

REFERENCES

[1] Abd El-Fattah, El-Atik A and Hanan Z. Hassaan: "Some nano topological structures via ideals and graphs", Journal of the Egyptian Mathematical Society, 2020, PP: 1-21.

[2] Arafa Nasef, Abd El-Fattah, El-Atik: "Some Properties on Nano topology induced by graphs", AASGIT Jorunal of NanoScience, 3(4), 2017, PP: 19-23.

[3] Arumugam.S and Ramachandran.S: "Invitation to Graph Theory"; SCITECH Publications, India, 2003.

[4] Chartrand. G, Lesniak and Zhang.P:"Text books in Mathematics Graphs and Digraphs", Taylor and Francis Group LIC, California, 2010.

[5] Kandil. A, Et.Sheikh, S.A. Hosny, M and raafet, M: "Generalization of nano topological spaces induced by different neighbourhoods based on ideals and its application", Tbilishi Mathematical Journal, Vol. 14, No.1, (2021), PP:135-148.

[6] Lellis Thivagar, Paul Manuel and Sutha devi. V: "A detection for patent infringement suit via nano topology induced by graph", Cogent Mathematics, Vol.3, 1161129(2016). PPL1-10.

[7] Rachna Somkunwar and Vinod Moreshwar Vaze: " A comparative study of Graph isomorphism Applications"; International Journal of Computer Applications (0975-8887), Vol.162, No.7, 2017.

[8] Waleed Ramadhan khalifa and Taha Hameed Jasin: "On Study of some concepts in Nano continuity via graph theory". Open Access Library Journal, Vol. 8, 27568, 2021 PP:1-9.