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Research Article

Separation Axioms on Neutrosophic Bitopological Space

Harun-or-Rashid[1] and Saikh Shahjahan Miah[2]

[1]Department of Electrical & Electronic Engineering, Khwaja Yunus Ali University, Sirajganj-6751, Bangladesh.

[2]Department of Mathematics, Mawlana Bhashani Science and Technology University, Tangail-1902, Bangladesh.

Corresponding author: harun.eee@kyau.edu.bd (Harun-or-Rashid, Department of Electrical & Electronic Engineering, Khwaja Yunus Ali University, Sirajganj-6751, Bangladesh)

Abstract

An idea we want to introduce here about the neutrosophic (N) T_i- bitopological space (i = 0, 1, 2, 3, 4) by following the neutrosophic (N) bitopological space in this study and try to find out their various characteristics. In many different fields of application, including decision-making, pattern recognition, picture segmentation, etc., neutrophilic sets have been used to describe uncertainty. Through neutrosophic topology, the concept of neutrosophic separation axioms is intriguing. By defining neutrosophic (N) T_i-bitopological space (i = 0, 1, 2, 3, 4), we demonstrate some intriguing findings with examples about the neutrosophic (N) separation axioms.

Keywords: Neutrosophic (N) bitopological space, Neutrosophic (N) set, Separation Axioms of Neutrosophic (N).

1. Introduction

Neutrosophy indicates, Neutrosophic (N) set generalized the fuzzy set (Zadeh, 1995) with intuitionistic fuzzy set (Atanassov, 1986), which is grounded by Smarandache (Smarandache, 1998). Then, Salamas *et al.*, 2012 introduced a suggestion on neutrosophic (N) bitopological space. The opinion of a neutrosophic (N) point in neutrosophic (N) bitopological space was first suggested by Arokiarani *et al.*, 2017. Few separation axioms based on the neutrosophic (N) crisp topological spaces were examined by Al-Nafee *et al.*, 2019. The neutrosophic (N) soft sets concept was grounded by Maji, 2013. In neutrosophic (N) bitopological space, Das *et al.*, 2020 developed the generalization of neutrosophic (N) b-open sets and also created the neutrosophic (N) $\emptyset$-continuous functions and neutrosophic (N) $\emptyset$-open sets (Das *et al.*, 2020). The neutrosophic (N) soft topological space was first introduced by Bera *et al.*, 2017. Das *et al.*, 2020 also expressed simply neutrosophic (N) soft open set. The separation axioms on neutrosophic (N) soft topological space were presented by Gunnuz *et al.*, 2019. The p-separation structures of neutrosophic (N) soft are the most important and exciting ideas of neutrosophic (N) soft topology. Mehmood *et al.*, 2020 studied on generalization of separation axioms of neutrosophic (N) in neutrosophic (N) soft topological space in this paper. Acikgoz *et al.*, 2021 researched separation axioms of neutrosophic (N) topological space and established several fundamental conclusions.

Soft b-separation axioms in neutrosophic (N) soft topological space were presented by Khattak *et al.*, 2019. In neutrosophic (N) topological space, Suresh *et al.*, 2020 worked on "separation axioms of NS". No findings on separation axioms of neutrosophic (N) (T_i-space, i = 0, 1, 2, 3, 4) on neutrosophic (N) bitopological space has been reported in the neutrosophic (N) literature. We want to approach new concept on separation axioms of neutrosophic (N) (T_i-space, i = 0, 1, 2, 3, 4) on neutrosophic (N) bitopological space and study of its various relationships. We conclude all remarks and also mention some research scopes in future in the same direction.

2. Fundamental Results:

We review some fundamental definitions and findings on neutrosophic (N) sets and neutrosophic (N) bitopological space in this part.

2.1 Definition:

The structure of a neutrosophic (N) sets, U on a non-empty defined set X is –

$U = \{(r, T_{R(r)}, I_{R(r)}, F_{R(r)}): r \in X\}$

Where, $T, I, F: X \rightarrow]'0, 1^{+}$[T – Truth, I – Indeterminacy and F – False membership functions] (Zadeh, 1995)

2.2 Definition:

The null neutrosophic (N) sets (0_N) and absolute neutrosophic (N) sets (1_N) on X are defined as like –

(a) $0_N = \{(r, 0, 1, 1): r \in X\};$ (b) $1_N = \{(r, 0, 1, 1): r \in X\};$

2.3 Definition:

Let $H = \{(r, T_{H(r)}, I_{H(r)}, F_{H(r)}): r \in X\}$ and $K = \{(r, T_{K(r)}, I_{K(r)}, F_{K(r)}) : r \in X\}$ are two neutrosophic (N) sets on defined set X. Then, the results are –

(a) $H^c = \{(r, 1 - T_{H(r)}, 1 - I_{H(r)}, 1 - F_{H(r)}): r \in X\};$

(b) $H \subseteq K$ if and only if $T_{H(r)} \leq T_{K(r)}$, $I_{H(r)} \geq I_{K(r)}$, $F_{H(r)} \geq F_{K(r)}$, for all $r \in X$

(c) $H \cup K = \{(r, T_{H(r)} V T_{K(r)}, I_{H(r)} \wedge I_{K(r)}, F_{H(r)} \wedge F_{K(r)}: r \in X\};$

(d) $H \cap K = \{(r, T_{H(r)} \wedge T_{K(r)}, I_{H(r)} \vee I_{K(r)}, F_{H(r)} \vee F_{K(r)}: r \in X\}.$

2.4 Definition:

If the following three axioms hold (Salamas *et al.*, 2012), then, τ be a non-empty collection of neutrosophic (N) sets on X, which is called a neutrosophic (N) bitopology on X:

(a) (0_N) and (1_N) must be the members of non-empty τ.

(b) $U_1, U_2 \in \tau \Rightarrow U_1 \cap U_2 \in \tau;$

(c) $\cup \{U_i: i \in \Delta\} \in \tau$, for all sets, $\{U_i: i \in \Delta\} \subseteq \tau,$

If τ_1 and τ_2 are neutrosophic (N) sets on X, then (X, τ_1, τ_2) is taken as a neutrosophic (N) bitopological space (Salamas *et al.*, 2012). Each member of non-empty τ is considered as a neutrosophic (N) open set and U^c will be a neutrosophic (N) closed set when $U \in \tau$.

2.1 Example:

Let, $X = \{r_1, r_2\}$ is a defined set.

where, $r_{1_{.3,.4,.8}}$ and $r_{2_{.7,.6,.6}}$ be two (02) Neutrosophic (N) points on X.

Then, $R = \{(r_{1,}\ .3, .4, .8), (r_{2,}\ .7, .6, .6)\}$ will be the Neutrosophic (N) set formed by the union of $r_{1_{.3,.4,.8}}$ and $r_{2_{.7,.6,.6}}$.

2.5 Definition:

A neutrosophic (N) continuous mapping defined by one-to-one and onto function, $\mu: (X, \tau_1) \to (Y, \tau_2)$ (Arokiarani *et al*., 2017), if $\mu^{-1}(K)$ is a neutrosophic (N) open set on X; Where, K is a neutrosophic (N) open set in Y.

2.6 Definition:

A mapping $\mu: (X, \tau_1) \to (Y, \tau_2)$ is taken as a neutrosophic (N) open mapping (Arokiarani *et al*., 2017), if $\mu(K)$ is a neutrosophic (N) open set on Y, Where, K be a neutrosophic (N) open set on X.

3. Neutrosophic (N) T_i - Bitopological spaces:

To explore the various connections of the concept of neutrosophic (N) separation axioms via neutrosophic (N) bitopological space, we introduce this part.

3.1 Definition:

A neutrosophic (N) bitopological space, (X, τ_1, τ_2) is said to be a neutrosophic (N) T_0- bitopological space, iff any pair of neutrosophic (N) points $X_{m,n,p}$,$Y_{q,r,t}$ $(X \neq Y)$ on X, $\exists$ an neutrosophic (N) open set U s.t.

$$U \in \tau_1 \cup \tau_2 \text{ and } X_{m,n,p} \in U, Y_{q,r,t} \notin U \text{ or } X_{m,n,p} \notin U, Y_{q,r,t} \in U.$$

3.1 Example:

Let, $X = \{x, y\}$ and

$\tau_1 = \{0_N,\ 1_N,\ \{< x,\ .4,\ .3,\ .6 >, < y,\ .2,\ .3,\ .2 >\}, \{< x,\ .4,\ .3,\ .6 >\}\}$

$\tau_2 = \{0_N,\ 1_N,\ \{< x,\ .6,\ .5,\ .8 >, < y,\ .4,\ .5,\ .4 >\}, \{< x,\ .6,\ .5,\ .8 >\}\}$, then, (X, τ_1, τ_2) be neutrosophic (N) T_0- bitopological space.

3.1 Theorem:

Let $\mu: (X, \tau_{11}, \tau_{12}) \to (Y, \tau_{21}, \tau_{22})$ is a both one–one and neutrosophic (N) continuous function of a neutrosophic (N) bitopological space $(X, \tau_{11}, \tau_{12})$ to another neutrosophic (N) bitopological space $(Y, \tau_{21}, \tau_{22})$. If $(Y, \tau_{21}, \tau_{22})$ is a neutrosophic (N) T_0- bitopological space, then, $(X, \tau_{11}, \tau_{12})$ is also a neutrosophic (N) T_0- bitopological space.

Proof:

Let, $(Y, \tau_{21}, \tau_{22})$ be a neutrosophic (N) T_0- bitopological space. Also, let $X_{m,n,p}$,$Y_{q,r,t}$ $(X \neq Y)$ be any two neutrosophic (N) points in $(X, \tau_{11}, \tau_{12})$. Since $\mu: (X, \tau_{11}, \tau_{12}) \to (Y, \tau_{21}, \tau_{22})$ is one-one function. So $\mu(X_{m,n,p}), \mu(Y_{q,r,t})$ are also distinct neutrosophic (N) points in $(Y, \tau_{21}, \tau_{22})$. Since $(Y, \tau_{21}, \tau_{22})$ is a neutrosophic (N) T_0- bitopological space, so their exist a neutrosophic (N) open set U in Y, $U \in \tau_{21} \cup \tau_{22}$ and $\mu(X_{m,n,p}) \in U$, $\mu(Y_{q,r,t}) \notin U$ or $(X_{m,n,p}) \notin U$, $\mu(Y_{q,r,t}) \in U$. Therefore $X_{m,n,p} \in \mu^{-1}(U)$, $Y_{q,r,t} \notin \mu^{-1}(U)$ or $X_{m,n,p} \notin \mu^{-1}(U)$, $Y_{q,r,t} \in \mu^{-1}(U)$, Since μ is a neutrosophic (N) continuous function. So $\mu^{-1}(U)$ neutrosophic (N) open set in $(X, \tau_{11}, \tau_{12})$. Therefore for any pair of distinct neutrosophic (N) points

$X_{m,n,p}$,$Y_{q,r,t}$ in (X, τ_1, τ_2) their exist an neutrosophic (N) open set $\mu^{-1}(U)$ such that $X_{m,n,p} \in \mu^{-1}(U)$, $Y_{q,r,t} \notin \mu^{-1}(U)$ or $X_{m,n,p} \notin \mu^{-1}(U)$, $Y_{q,r,t} \in \mu^{-1}(U)$.

Hence $(X, \tau_{11}, \tau_{12})$ is n neutrosophic (N) T_0- bitopological space.

3.2 Definition:
An neutrosophic (N) bitopological space, (X, τ_1, τ_2) is said to be a neutrosophic (N) T_1- bitopological space, iff any pair of neutrosophic (N) points $X_{m,n,p}$,$Y_{q,r,t}$ $(X \neq Y)$ in X their exists two neutrosophic (N) open sets: $U, V \in \tau_1 \cup \tau_2$ s.t. $X_{m,n,p} \in U$, $X_{m,n,p} \notin V$ and $Y_{q,r,t} \notin U$, $Y_{q,r,t} \in V$. Noticeably, all neutrosophic (N) T_1-bitopological space also be a neutrosophic (N) T_0- bitopological space.

3.2 Example:
Let, $X = \{x, y\}$

$\tau_1 = \{0_N, 1_N, \{< x, .4, .4, .1 >, < y, .6, .1, .2 >\}, \{< x, x, .4, .4, .1 >\}, \{< y, .6, .1, .2 >\}\}$,

$\tau_2 = \{0_N, 1_N, \{< x, .6, .6, .2 >, < y, .8, .3, .4 >\}, \{< x, .6, .6, .2 >\}, \{< y, .8, .3, .4 >\}\}$

be a neutrosophic (N) topology on X, Where, (X, τ_1, τ_2) be a neutrosophic (N) T_1- bitopological space.

3.2 Theorem:
Let, $\mu: (X, \tau_{11}, \tau_{12}) \rightarrow (Y, \tau_{21}, \tau_{22})$ be both one –one and neutrosophic (N) continuous function of a neutrosophic (N) bitopological space, $(X, \tau_{11}, \tau_{12})$ to another neutrosophic (N) bitopological space, $(Y, \tau_{21}, \tau_{22})$. Iff $(Y, \tau_{21}, \tau_{22})$ is a neutrosophic (N) T_1- bitopological space, then, $(X, \tau_{11}, \tau_{12})$ also a neutrosophic (N) T_1- bitopological space.

Proof:
Assume that, $(Y, \tau_{21}, \tau_{22})$ is a neutrosophic (N) T_1- bitopological space. Also let $X_{m,n,p}$,$Y_{q,r,t}$ $(X \neq Y)$ is any two neutrosophic (N) points on X . Since $\mu: (X, \tau_{11}, \tau_{12}) \rightarrow (Y, \tau_{21}, \tau_{22})$ is one-one function. So $\mu(X_{m,n,p}), \mu(Y_{q,r,t})$ are also distinct neutrosophic (N) points of Y. Where, $(Y, \tau_{21}, \tau_{22})$ be a neutrosophic (N) T_1- bitopological space, so their exist two (02) neutrosophic (N) open sets, U,V on Y S.T. U,$V \in \tau_{21} \cup \tau_{22}$ and $\mu(X_{m,n,p}) \in U$, $\mu(X_{m,n,p}) \notin V$ or $\mu(Y_{q,r,t}) \notin U$, $\mu(Y_{q,r,t}) \in V$. Therefore $X_{m,n,p} \in \mu^{-1}(U)$, $X_{m,n,p} \notin \mu^{-1}(V)$ or $Y_{q,r,t} \notin \mu^{-1}(U)$, $Y_{q,r,t} \in \mu^{-1}(V)$. Here, μ is a neutrosophic (N) continuous function, both $\mu^{-1}(U), \mu^{-1}(V)$ are neutrosophic (N) open set on X. So that, for neutrosophic (N) points $X_{m,n,p}$,$Y_{q,r,t}$ in X, their exist an two neutrosophic (N) open sets $\mu^{-1}(U),), \mu^{-1}(V)$ S.T. $X_{m,n,p} \in \mu^{-1}(U)$ $X_{m,n,p} \notin \mu^{-1}(V)$ or $Y_{q,r,t} \notin \mu^{-1}(U)$, $Y_{q,r,t} \in \mu^{-1}(V)$.

Hence, $(X, \tau_{11}, \tau_{12})$ is a neutrosophic (N) T_1- bitopological space.

3.3 Definition:
A neutrosophic (N) bitopological space (X, τ_1, τ_2) is taken as a neutrosophic (N) T_2- bitopological space, iff neutrosophic (N) points $X_{m,n,p}$,$Y_{q,r,t}$ $(X \neq Y)$ in X, their exists two neutrosophic (N) open sets $U, V \in \tau_1 \cup \tau_2$ such that $X_{m,n,p} \in U$, $X_{m,n,p} \notin V$ and $Y_{q,r,t} \notin U$, $Y_{q,r,t} \in V$ with $R \subseteq S^c$.

Noticeably, all neutrosophic (N) T_2- bitopological space also be a neutrosophic (N) T_1- bitopological space.

3.3 Example:
Let, $X = \{x, y, z\}$ be a defined set.

Assume,
$\tau_1 = \{0_N\,,\ 1_N, \{< x,\ .4,\ .3,\ .6 >, < y,\ .2,\ .3,\ .2 >\}, \{< x,\ .4,\ .3,\ .6 >, < z,\ .2,\ .4,\ .7 >\}, \{< y,\ .2,\ .3,\ .2 >, < z,\ .2,\ .4,\ .7 >\}, \{< x,\ .4,\ .3,\ .6 >\}, \{< y,\ .2,\ .3,\ .2 >\}, \{< z,\ .2,\ .4,\ .7 >\}\}$
$\tau_2 = \{0_N\,,\ 1_N, \{< x,\ .6,\ .5,\ .8 >, < y,\ .4,\ .5,\ .4 >\}, \{< x,\ .6,\ .5,\ .8 >, < z,\ .4,\ .6,\ .9 >\}, \{< y,\ .4,\ .5,\ .4 >, < z,\ .4,\ .6,\ .9 >\}, \{< x,\ .6,\ .5,\ .8 >\}, \{< y,\ .4,\ .5,\ .4 >\}, \{< z,\ .4,\ .6,\ .9 >\}\}$ be a neutrosophic (N) topology in X, Where, (X, τ_1, τ_2) be a neutrosophic (N) T_2- bitopological space.

3.3 Theorem:
Assume that $\mu: (X, \tau_{11}, \tau_{12}) \to (Y, \tau_{21}, \tau_{22})$ be both one –one and neutrosophic (N) continuous function of a neutrosophic (N) bitopological space, $(X, \tau_{11}, \tau_{12})$ to another neutrosophic (N) bitopological space, $(Y, \tau_{21}, \tau_{22})$. If $(Y, \tau_{21}, \tau_{22})$ is a neutrosophic (N) T_2- bitopological space, here, $(X, \tau_{11}, \tau_{12})$ is also a neutrosophic (N) T_2- bitopological space.

Proof:
Since μ is a neutrosophic (N) continuous function, So, inverse image in, $(Y, \tau_{21}, \tau_{22})$ also be a neutrosophic (N) open set, $(X, \tau_{11}, \tau_{12})$. Also, it is known that, the complement of $(X, \tau_{11}, \tau_{12})$ is neutrosophic (N) closed set in a neutrosophic (N) bitopological space.

Here, since $(Y, \tau_{21}, \tau_{22})$ is a neutrosophic (N) T_2- bitopological space, So, every neutrosophic (N) open set on $(Y, \tau_{21}, \tau_{22})$ is also a neutrosophic (N) closed set on $(Y, \tau_{21}, \tau_{22})$.

Now, μ is a neutrosophic (N) continuous function

$\Rightarrow \mu\ (X) = Y$ is a neutrosophic (N) open set in τ_{21}, τ_{22}

$\Rightarrow \mu^{-1}\ (Y) = X$ is a neutrosophic (N) open set in τ_{11}, τ_{12}

Therefore, $(Y, \tau_{21}, \tau_{22})$ be a neutrosophic (N) T_2- bitopological space $\Rightarrow (\mu^{-1}(Y), (\tau_{11}, \tau_{12}))$ is a neutrosophic (N) T_2- bitopological space. Hence $(X, \tau_{11}, \tau_{12})$ be a neutrosophic (N) T_2- bitopological space.

3.4 Definition:
Suppose, (X, τ_1, τ_2) be an neutrosophic (N) bitopological space. Then, X is considered as a neutrosophic (N) regular bitopological space, iff any neutrosophic (N) point $X_{m,n,p}$ in X and neutrosophic (N) closed set Q with $X_{m,n,p} \in Q^c$, $\exists$ two (02) neutrosophic (N) open sets, $U,\ V \in\ \tau_1 \cup \tau_2$ S.t. $X_{m,n,p}\ \in U,\ Q \subseteq V$ and $U \subseteq V^c$.

3.4 Example:
A zero-dimensional space (every specified open cover of neutrosophic (N) bitopological space has a development i.e., a specified open cover s.t. any neutrosophic (N) point in the space is confined in neutrosophic (N) open set of this development.) w.r.to the small inductive dimension has a base consisting of close-open (neutrosophic (N) closed set and neutrosophic (N) open sets) sets. Such space is neutrosophic (N) regular bitopological space.

3.5 Definition:
An neutrosophic (N) bitopological space, (X, τ_1, τ_2) is considered as a neutrosophic (N) T_3- bitopological space, iff it's a neutrosophic (N) T_1- bitopological space and a neutrosophic (N) regular bitopological space.

Noticeably, all neutrosophic (N) T_3- bitopological space also be a neutrosophic (N) T_2- bitopological space.

3.5 Example:
The neutrosophic (N) discrete bitopological space, (X, τ_1, τ_2) be a neutrosophic (N) regular bitopological space, also neutrosophic (N) T_1- bitopological space. Therefore (X, τ_1, τ_2) be a neutrosophic (N) T_3- bitopological space.

3.4 Theorem:
For any neutrosophic (N) bitopological space (X, τ_1, τ_2), the resulting outcome are comparable to

(a) X be neutrosophic (N) regular bitopological space.

(b) For any neutrosophic (N) point $X_{m,n,p}$ and any neutrosophic (N) open set, U covering $X_{m,n,p}$, $\exists$ a neutrosophic (N) open set, V s.t. $X_{m,n,p} \in V \subseteq E_{cl}(V) \subseteq U$.

Proof: (a) $\Rightarrow$(b)

Let, (X, τ_1, τ_2) be neutrosophic (N) regular bitopological space. For any neutrosophic (N) point $X_{m,n,p}$ on X, and a neutrosophic (N) closed set Q with $X_{m,n,p} \in Q^c$, $\exists$ two (02) neutrosophic (N) open sets, V, F s.t. $X_{m,n,p} \in V$, $Q \subseteq F$ and $V \subseteq F^c$.

Again, since U^c be a neutrosophic (N) closed set, So, $\exists$ a neutrosophic (N) closed set G(say) such that $V \subseteq G$ and so $E_{cl}(V) \subseteq G$.

Again, for a neutrosophic (N) closed set, G, $\exists$ neutrosophic (N) open set, U, s.t. $G \subseteq U$. Therefore $X_{m,n,p} \in V \subseteq E_{cl}(V) \subseteq G \subseteq U$.

This indicates that, $X_{m,n,p} \in V \subseteq E_{cl}(V) \subseteq U$. Now proved.

(b) $\Rightarrow$(a)

The outcomes are noticeable for the neutrosophic (N) regular bitopological space.

3.6 Definition:
A neutrosophic (N) bitopological space, (X, τ_1, τ_2) is taken as a neutrosophic (N) T_4- bitopological space, iff it's together neutrosophic (N) T_1- bitopological space and neutrosophic (N) normal bitopological space.

Noticeably, all neutrosophic (N) T_4- bitopological space also be a neutrosophic (N) T_1- bitopological space.

3.6 Example:
To show the application of separation axioms in our daily life via neutrosophic (N) bitopological space, we look on three department, namely English = x, Pharmacy $= y$, Law $= z$ of Khwaja Yunus Ali University. Based on several deeds and departmental activity. IQAC gives a degree of members as a neutrosophic (N) set as following:

$\{< x, .5, .4, .2 >, < y, .6, .2, .4 >, < z, .6, .4, .5 >\}$ and $\{< x, .6, .5, .8 >, < y, .4, .5, .4 >, < z, .4, .6, .9 >\}$. We may take into consideration various neutrosophic (N) bitopological qualities to examine the comparability of various developmental efforts as well as future decision-making. Here, $X = \{x, y, z\}$ and following neutrosophic (N) sets:

$P_1 = \{< x, .5, .4, .2 >\}$ $Q_1 = \{< x, .6, .5, .8 >\}$

$P_2 = \{< y, .6, .2, .4 >\}$ $Q_2 = \{< y, .4, .5, .4 >\}$

$P_3 = \{< z, .6, .4, .5 >\}$ $Q_3 = \{< z, .4, .6, .9 >\}$

$P_4 = \{< z, .6, .4, .5 >, < y, .6, .2, .4 >\}$ $Q_4 = \{< z, .4, .6, .9 >, < y, .4, .5, .4 >\}$

$P_5 = \{< x, .5, .4, .2 >, < z, .6, .4, .5 >\}$ $Q_5 = \{< x, .6, .5, .8 >, < z, .4, .6, .9 >\}$

$P_6 = \{< x, .5, .4, .2 >, < y, .6, .2, .4 >\}$ $Q_6 = \{< x, .6, .5, .8 >, < y, .4, .5, .4 >\}$

We take,

$\tau_1 = \{0_N, 1_N, P_1, P_2, P_3, P_4, P_5, P_6\}$ and $\tau_2 = \{0_N, 1_N, Q_1, Q_2, Q_3, Q_4, Q_5, Q_6\}$.

So, (X, τ_1, τ_2) be a neutrosophic (N) bitopological space, and it's a neutrosophic (N) T_2- bitopological space.

4. Conclusion:

We want to express the concept of neutrosophic (N) T_i- bitopological space (i=0,1,2,3,4) via neutrosophic (N) bitopological space and think about their diverse qualities. By specifying neutrosophic (N) T_i- bitopological space, (i=0,1,2,3,4), we ensure few exciting outcomes on separation axioms (SA) of neutrosophic (N) help of neutrosophic (N) bitopological space. We do believe that, further studies can be carried out in the future on other developed notions of separation axioms (SA) neutrosophic (N) via neutrosophic (N) bitopological space. The notion of neutrosophic (N) T_i- bitopological space (i=0,1,2,3,4) may be utilized for presenting the pairwise separation axioms (SA) under the neutrosophic (N) bitopological space. Our next expectation is that the recommended theories may be revealed in pentapartitioned neutrosophic (N) set (Mallick *et al.*, 2020) environment.

5. Conflict of interest:

The authors declare that they have no conflict of interest.

6. Authors Contribution:

All the authors have equally contributed for the preparation of this article.

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