Fuzzy Connectedness in Fuzzy Quad Topological Space

Ranu Sharma[1, a], Bhagyashri A. Deole[2,b] and Smita Verma[3,c]
[1, 3]*Department of Applied Mathematics and Computational Science,*
SGSITS, Indore (M.P.), India,

Abstract- *The purpose of this paper is to study fuzzy connected space and fuzzy separation in fuzzy quad topological space (Fq-topological space) and study some of their properties.*

Keywords- *Quad topological spaces, q-connected space and q-separation, Fq- topological spaces, Fq-connected space and Fq-separation.*

Mathematics subject classification:54A40

I.INTRODUCTION

W. J. Pervin [11] was define connectedness in a bitopological space. I.L. Reilly [12], J. Swart [15] and T. Birsan [1] studied connectedness in bitopological spaces .B. Dvalishi [3] studied connectedness in bitopological space. A. Kandil and others[5] studied connectedness in bitopological ordered spaces and in ideal bitopological spaces.

Tri topological space is a generalization of bitopological space. The tri topological space was first initiated by Martin Kovar [8]. S. Palaniammal [10] studied tri topological space and he also introduced fuzzy tri topological space. N.F. Hameed and Moh. Yahya Abid [4] gives the definition of 123 open set in tri topological spaces. D.V. Mukundan [9] introduced quad topological space. We [16] [17] introduced tri connectedness in tri topological space and quad connectedness in quad topological space.

In 1965, Zadeh L.A. [18] introduced the concept of fuzzy sets. In 1968 Change C.L. [2] introduced the concept of fuzzy topological spaces. K.S. Sethupathy Raja and S. Lakshmivarahan [14] introduced connectedness in fuzzy topological space. Kandil A. [6] [7] introduced fuzzy bitopological spaces. We [13] introduced fuzzy connectedness in fuzzy tri topological space. In this paper, we introduce fuzzy connectedness and fuzzyseparated setsin fuzzy quad topological space.

II. PRELIMINARIES

***Definition 2.1[10]*:** Let X be a nonempty set and T_1, T_2 and T_3 are three topologies on X .The set X together with three topologies is called a tri topological space and is denoted by (X, T_1, T_2, T_3)

***Definition 2.2[11]*:** A bitopological space is (X, T_1, T_2) said to be connected if and only if X cannot be expressed as the union of two non-empty disjoint sets A and B such that A is T_1 open and B is T_2 open. When X can be so expressed, we write $X = A/B$ and called this a separation of X .

***Definition 2.3[16]*:** Let (X, T_1, T_2, T_3) be a tri topological space, a subset A of X is said to be tri disconnected if and only if it is the union of two non-empty tri separated sets. That is, if and only if there exist two non-empty separated sets C and D such that $C \cap tri\,cl(D) = \phi$, $tri\,cl(C) \cap D = \phi$ and $A = C \cup D$, A is said to be tri connected if and only if it is not tri disconnected.

***Definition 2.4[14]*:** A fuzzy topology X is said to be disconnected if $X = A \cup B$, where A and B are non-empty open fuzzy sets in X such that $A \cap B = \phi$. A fuzzy topological X is said to be connected if X cannot be represented as the union of two non-empty, disjoint open sets on X .

Definition 2.5[9]: Let X be a nonempty set τ_1 , τ_2 τ_3 and τ_4 are fuzzy topologies on X .Then a fuzzy subset χ_λ of space X is said to be fuzzy q-open if $\chi_\lambda \prec \tau_1 \cup \tau_2 \cup \tau_3 \cup \tau_4$ and its complement is said to be fuzzy q-closed and set X with four fuzzy topologies called fuzzy q-topological spaces $(X, \tau_1, \tau_2, \tau_3, \tau_4)$.

Definition 2.6[9]: Let $(X, \tau_1, \tau_2, \tau_3, \tau_4)$ be a fuzzy quad topological space and let $\chi_\lambda \prec X$. The intersection of all fuzzy q-closed sets containing χ_λ is called the fuzzy q-closure of χ_λ & denoted by $q-cl(\chi_\lambda)$. We will denote the fuzzy q-interior(resp. fuzzy q-closure) of any fuzzy subset,say of χ_λ by fuzzy $q-\text{int}(\chi_\lambda)(q-cl(\chi_\lambda))$,where $q-\text{int}(\chi_\lambda)$ is the union of all fuzzy q-open sets contained in χ_λ , and $q-cl(\chi_\lambda)$ is the intersection of all fuzzy q-closed sets containing χ_λ .

III. Fq-CONNECTEDNESS IN Fq-TOPOLOGICAL SPACE

Definition3.1: Let $(X, \tau_1, \tau_2, \tau_3, \tau_4)$ be a fuzzy quad topological space. X is said to be Fq-connected if X cannot be written as the union of two disjoint non-emptyFq-open sets.

Example 3.2:Let X= {1, 2, 3, 4} be a nonempty fuzzy set. Consider four fuzzy topologies $\tau_1 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{1\}}, \chi_{\{1,2\}}\}, \tau_2 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{1\}}, \chi_{\{1,3\}}\}, \tau_3 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{4\}}\}, \tau_4 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{2\}}\}$ Fq-open sets are $\{\tilde{1}_X, \tilde{0}_X, \chi_{\{1\}}, \chi_{\{4\}}, \chi_{\{2\}}, \chi_{\{1,2\}}, \chi_{\{1,3\}}\}$, X cannot be written as the union of two non-empty disjoint Fq-open sets. Hence XisFq-connected.

Theorem3.3:Fq-topological space X is called Fq-connected if and only if X cannot be written as the union of two non-empty disjointFq-closed sets.

Proof: Suppose X isFq-connected. If $X = \chi_{\lambda_1} \vee \chi_{\lambda_2}$ where χ_{λ_1} and χ_{λ_2} are two non-empty disjointFq-closed sets. $\chi_{\lambda_1} = \tilde{1}_X - \chi_{\lambda_2}$ And $\chi_{\lambda_2} = \tilde{1}_X - \chi_{\lambda_1}$. Since χ_{λ_1} and χ_{λ_2} are Fq-closed sets and χ_{λ_2} , χ_{λ_1} are Fq-open sets. $X = \chi_{\lambda_1} \vee \chi_{\lambda_2}$ Where χ_{λ_1} and χ_{λ_2} are non-empty disjoint Fq-open sets.

Claim: X is Fq-connected.

If not, let $X = \chi_{\lambda_1} \vee \chi_{\lambda_2}$ where χ_{λ_1} and χ_{λ_2} are two nonempty disjoint Fq-open sets. $\chi_{\lambda_2} = \tilde{1}_X - \chi_{\lambda_1}$ And $\chi_{\lambda_1} = \tilde{1}_X - \chi_{\lambda_2}$, χ_{λ_1} and χ_{λ_2} are Fq-closed sets.

$X = \chi_{\lambda_1} \vee \chi_{\lambda_2}$ Where χ_{λ_1} and χ_{λ_2} are non-empty disjoint Fq-closed sets.

Hence X is Fq-connected.

Theorem 3.4:An Fq-topological space X is Fq-connected if and only if there does not exist a non-emptyfuzzy set which is both Fq-open and Fq-closed.

Proof: Suppose X is Fq-connected. If there exists a non-emptyfuzzy set χ_δ which is both Fq-open and Fq-closed.Then $\tilde{1}_X - \chi_\delta$ is a non-emptyfuzzy subset of X which is both Fq-open and Fq-closed. Hence $\chi_\delta \vee \tilde{1}_X - \chi_\delta = X$ where χ_δ and $\tilde{1}_X - \chi_\delta$ are non-empty disjointFq-open sets. Hence there does not exist a non-emptyfuzzy set which is both Fq-open and Fq-closed.

Conversely, if there does not exist a fuzzy non-empty set which is both Fq-open and Fq-closed.

Claim: X is Fq-connected. If not, let $\chi_{\delta_1} \vee \chi_{\delta_2} = \tilde{1}_X$ where χ_{δ_1} and χ_{δ_2} are disjoint non-emptyFq-open sets. Since $\chi_{\delta_2} = \tilde{1}_X - \chi_{\delta_1}, \tilde{1}_X - \chi_{\delta_1}$ is Fq-open set.

χ_{δ_1} isFq-closed set. χ_{δ_1} is a non-emptyfuzzy set which is both Fq-open and Fq-closed.Hence X is Fq-connected.

Theorem 3.5:X is Fq-connected if and only if X cannot be written as the union of two non-emptyfuzzy sets χ_{δ_1} and χ_{δ_2} where

1. $\chi_{\delta_1} \wedge Fq-cl\chi_{\delta_2} = \tilde{0}_X$
2. $\chi_{\delta_2} \wedge Fq-cl\chi_{\delta_1} = \tilde{0}_X$

Proof: Suppose X is Fq-connected.

If $\chi_{\delta_1} \vee \chi_{\delta_2} = \tilde{1}_X$ where χ_{δ_1} and χ_{δ_2} are non-empty fuzzy sets such that

$\chi_{\delta_1} \wedge Fq-cl\chi_{\delta_2} = \tilde{0}_X$ And $\chi_{\delta_2} \wedge Fq-cl\chi_{\delta_1} = \tilde{0}_X$.

Since $\chi_{\delta_1} \wedge \chi_{\delta_2} \prec \chi_{\delta_1} \wedge Fq-cl\chi_{\delta_2} = \tilde{0}_X$, $\chi_{\delta_1} \wedge \chi_{\delta_2} = \tilde{0}_X$

Hence χ_{δ_1} and χ_{δ_2} are disjoint non-empty fuzzy sets.

Let $\chi_{\{x\}} \le Fq-cl\chi_{\delta_1} \Rightarrow \chi_{\{x\}} \succ \chi_{\delta_2} \Rightarrow \chi_{\{x\}} \le \chi_{\delta_1}$ [Since $\chi_{\delta_1} \vee \chi_{\delta_2} = \tilde{1}_X$]

$Fq-cl\chi_{\delta_1} \le \chi_{\delta_1}$ Always $\chi_{\delta_1} \le Fq-cl\chi_{\delta_1}$

Hence $\chi_{\delta_1} = Fq-cl\chi_{\delta_1}$

Let $\chi_{\{x\}} \le Fq-cl\chi_{\delta_2} \Rightarrow \chi_{\{x\}} \succ \chi_{\delta_1} \Rightarrow \chi_{\{x\}} \le \chi_{\delta_2}$,

$Fq-cl\chi_{\delta_2} \le \chi_{\delta_2} \Rightarrow Fq-cl\chi_{\delta_2} = \chi_{\delta_2}$, since $\chi_{\delta_2} \le Fq-cl\chi_{\delta_2}$

χ_{δ_1} And χ_{δ_2} are Fq-closed sets.

Hence $\chi_{\delta_1} \vee \chi_{\delta_2} = \tilde{1}_X$ where χ_{δ_1} and χ_{δ_2} are disjoint non-emptyFq-closed sets. Hence X is Fq-connected.

Hence X cannot be written as the union of two nonempty fuzzy sets A and B where $\chi_{\delta_1} \wedge Fq-cl\chi_{\delta_2} = \tilde{0}_X$ and $\chi_{\delta_2} \wedge Fq-cl\chi_{\delta_1} = \tilde{0}_X$

Conversely, X cannot be written as the union of two nonempty sets χ_{δ_1} and χ_{δ_2} where $\chi_{\delta_1} \wedge Fq-cl\chi_{\delta_2} = \tilde{0}_X$ and $\chi_{\delta_2} \wedge Fq-cl\chi_{\delta_1} = \tilde{0}_X$

Claim: X is Fq-connected. If not, $\chi_{\delta_1} \vee \chi_{\delta_2} = \tilde{1}_X$ where χ_{δ_1} and χ_{δ_2} disjoint non-emptyFq-closed sets.

$\Rightarrow \chi_{\delta_1} = Fq-cl\chi_{\delta_1}$ And $\chi_{\delta_2} = Fq-cl\chi_{\delta_2}$.

And $\Rightarrow \chi_{\delta_1} = \tilde{1}_X - \chi_{\delta_2}$ and $\chi_{\delta_2} = \tilde{1}_X - \chi_{\delta_1}$ Hence

$\Rightarrow \chi_{\delta_1} \wedge (\tilde{1}_X - \chi_{\delta_1}) = \tilde{0}_X$, $\chi_{\delta_1} \wedge \chi_{\delta_2} = \tilde{0}_X$

$\Rightarrow \chi_{\delta_1} \wedge Fq-cl\chi_{\delta_2} = \tilde{0}_X$. Similarly $\chi_{\delta_2} \wedge (\tilde{1}_X - \chi_{\delta_2}) = \tilde{0}_X \Rightarrow \chi_{\delta_2} \wedge \chi_{\delta_1} = \tilde{0}_X$.

Hence $\chi_{\delta_1} \vee \chi_{\delta_2} = \tilde{1}_X$ where χ_{δ_1} and χ_{δ_2} are non-empty fuzzy sets such that

$\chi_{\delta_1} \wedge Fq-cl\chi_{\delta_2} = \tilde{0}_X$ and $\chi_{\delta_2} \wedge Fq-cl\chi_{\delta_1} = \tilde{0}_X$. Hence X is Fq-connected.

IV.Fq-SEPARATED SETS IN Fq-TOPOLOGICAL SPACE

Definition 4.1 Let $(X, \tau_1, \tau_2, \tau_3, \tau_4)$ be a fuzzy quad topological space. Two non-empty fuzzy subsets χ_{δ_1} and χ_{δ_2} of X are called Fq-separated if $\chi_{\delta_1} \wedge Fq-cl\chi_{\delta_2} = \tilde{0}_X$ and $\chi_{\delta_2} \wedge Fq-cl\chi_{\delta_1} = \tilde{0}_X$.

Theorem 4.2: If χ_{δ_1} and χ_{δ_2} are Fq-separated then χ_{δ_1} and χ_{δ_2} are disjoint.

Proof: $\chi_{\delta_1} \wedge \chi_{\delta_2} \prec \chi_{\delta_1} \wedge Fq-cl\chi_{\delta_2} = \tilde{0}_X$ Since χ_{δ_1} and χ_{δ_2} are Fq-separated.

$\Rightarrow \chi_{\delta_2} \wedge \chi_{\delta_1} = \tilde{0}_X$. χ_{δ_1} And χ_{δ_2} are disjoint sets.

Result 4.3: Converse is not true.

Example4.4: Let $X = \{a, b, c\}$ be a non-empty fuzzy set, consider four topologies

$\tau_1 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{a\}}\}, \tau_2 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{a\}}, \chi_{\{a,b\}}\}, \tau_3 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{a\}}, \chi_{\{a,c\}}\}, \tau_4 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{a,b\}}\}$

Fq-open sets are $\{\tilde{1}_X, \tilde{0}_X, \chi_{\{a\}}, \chi_{\{a,b\}}, \chi_{\{a,c\}}\}$

Fq-closed sets are $\{\tilde{1}_X, \tilde{0}_X, \chi_{\{b,c\}}, \chi_{\{c\}}, \chi_{\{b\}}\}$

Let $\chi_{\delta_1} = \chi_{\{a,b\}}$ and $\chi_{\delta_2} = \chi_{\{c\}}$, χ_{δ_1} and χ_{δ_2} are disjoint sets. $Fq-cl\chi_{\delta_1} = Fq-cl\chi_{\{a,b\}} = \tilde{1}_X$

$\chi_{\delta_2} \wedge Fq-cl\chi_{\delta_1} = \chi_{\{c\}} \wedge Fq-cl\chi_{\{a,b\}} = \chi_{\{c\}} \wedge \tilde{1}_X = \chi_{\{c\}}[\neq \tilde{0}_X]$

Since $\chi_{\delta_2} \wedge Fq-cl\chi_{\delta_1} \neq \tilde{0}_X$, χ_{δ_1} and χ_{δ_2} are not Fq- separated.

***Definition4.5*:**Let$(X, \tau_1, \tau_2, \tau_3, \tau_4)$ be anFq-topological space. Let $\chi_\delta \leq \tilde{1}_X$. χ_δ is called Fq-dense if $Fq-cl\chi_\delta = \tilde{1}_X$.
Example 4.6:Let $X = \{a, b, c\}$ be a non-empty fuzzy set, consider four topologies

$\tau_1 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{a\}}\}, \tau_2 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{a\}}, \chi_{\{a,b\}}\}, \tau_3 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{a\}}, \chi_{\{a,c\}}\}, \tau_4 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{a,b\}}\}$

Fq-open sets are $\{\tilde{1}_X, \tilde{0}_X, \chi_{\{a\}}, \chi_{\{a,b\}}, \chi_{\{a,c\}}\}$

Fq-closed sets are $\{\tilde{1}_X, \tilde{0}_X, \chi_{\{b,c\}}, \chi_{\{c\}}, \chi_{\{b\}}\}$

Let $\chi_\delta = \chi_{\{a,b\}}$, $Fq-cl\chi_\delta = Fq-cl\chi_{\{a,b\}} = \tilde{1}_X$. Hence χ_δ is Fq-dense.

V. Fq-HYPER CONNECTED Fq-TOPOLOGICAL SPACE

Definition 5.1:AnFq-topological space $(X, \tau_1, \tau_2, \tau_3, \tau_4)$ is said to be Fq-hyper connected if every non-empty Fq-open set is Fq-dense in X.
Example 5.2:Let $X = \{a, b, c\}$ be a non-empty fuzzy set, consider four topologies

$\tau_1 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{a\}}\}, \tau_2 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{a\}}, \chi_{\{a,b\}}\}, \tau_3 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{a\}}, \chi_{\{a,c\}}\}, \tau_4 = \{\tilde{1}_X, \tilde{0}_X, \chi_{\{a,b\}}\}$

Fq-open sets are $\{\tilde{1}_X, \tilde{0}_X, \chi_{\{a\}}, \chi_{\{a,b\}}, \chi_{\{a,c\}}\}$

Fq-closed sets are $\{\tilde{1}_X, \tilde{0}_X, \chi_{\{b,c\}}, \chi_{\{c\}}, \chi_{\{b\}}\}$

$Fq-cl\chi_{\{a\}} = \tilde{1}_X$

$Fq-cl\chi_{\{a,b\}} = \tilde{1}_X$

$Fq-cl\chi_{\{a,c\}} = \tilde{1}_X$

Every non-empty Fq-open set is Fq-dense in X.
Hence X is Fq-hyper connected Fq-topological space.
Theorem 5.3:A Fq-topological space X is Fq-hyper connected if and only ifany two non-empty Fq-opensets intersect.
Proof:Let X be Fq-hyper connected.

Let χ_{δ_1} and χ_{δ_2} are two non-empty Fq-open sets.

Claim: $\chi_{\delta_1} \wedge \chi_{\delta_2} \neq \tilde{0}_X$

Suppose not then,Hence $\chi_{\delta_1} \leq \tilde{1}_X - \chi_{\delta_2}$

$Fq-cl\chi_{\delta_1} \prec Fq-cl(\tilde{1}_X - \chi_{\delta_2})$

Since X is Fq-hyper connected, $Fq-cl\chi_{\delta_1} = \tilde{1}_X$.

Hence $\tilde{1}_X \prec Fq-cl(\tilde{1}_X - \chi_{\delta_2})$

Now $\tilde{1}_X - \chi_{\delta_2}$ is Fq-closed $\Rightarrow$ $Fq-cl(\tilde{1}_X - \chi_{\delta_2}) = \tilde{1}_X - \chi_{\delta_2}$

$\tilde{1}_X \prec (\tilde{1}_X - \chi_{\delta_2}) \Rightarrow \tilde{1}_X = (\tilde{1}_X - \chi_{\delta_2})$ Which implies $\chi_{\delta_2} = \tilde{0}_X$

Since $\chi_{\delta_2} \neq \tilde{0}_X$ $\chi_{\delta_1} \wedge \chi_{\delta_2} \neq \tilde{0}_X$.
Hence any two non-emptyFq-open sets intersect.
Conversely if any two non-empty Fq-open sets intersect.
Claim: X is Fq-hyper connected.

Let χ_{δ_1} be a non-empty Fq-open set.

Claim: $Fq - cl\chi_{\delta_1} = \tilde{1}_X$

If not, $Fq - cl\chi_{\delta_1} \neq \tilde{1}_X$

Then, $1 - (Fq - cl\chi_{\delta_1}) \neq \tilde{0}_X$

Let $\chi_{\delta_2} = 1 - (Fq - cl\chi_{\delta_1})$

$\chi_{\delta_1} = Fq - cl\chi_{\delta_1}$

Hence $\chi_{\delta_1} \wedge \chi_{\delta_2} = \tilde{0}_X$

But χ_{δ_1} and χ_{δ_2} are non-emptyFq-open sets.

Hence $Fq - cl\chi_{\delta_1} = \tilde{1}_X$

Hence χ_{δ_1} is Fq-dense in X.

***Theorem 5.4*:**X is Fq-hyper connected if and only if any Fq-closed set not equal to X has empty Fq-interior.
Proof:X is Fq-hyper connected.

Let χ_{δ_2} be a q-closed set where $\chi_{\delta_2} \neq \tilde{1}_X$

Claim: $Fq - \text{int}\,\chi_{\delta_2} = \tilde{0}_X$

If not, Let $\chi_{\delta_1} = Fq - \text{int}\,\chi_{\delta_2} = \tilde{0}_X$, $\chi_{\delta_1} \neq \tilde{0}_X$

Now χ_{δ_1} is a non-empty Fq-open set because $Fq - \text{int}\,\chi_{\delta_2}$ is Fq-open and X is Fq-hyper connected. Hence $Fq - cl\chi_{\delta_1} = \tilde{1}_X$ now χ_{δ_2} is anFq-closed set containing χ_{δ_1}

$\Rightarrow Fq - cl\chi_{\delta_1} \prec \chi_{\delta_2}$

$\Rightarrow \tilde{1}_X \prec \chi_{\delta_2}$

Hence $\tilde{1}_X = \chi_{\delta_2}$. Since $\tilde{1}_X \neq \chi_{\delta_2}$ Hence $Fq - \text{int}\,\chi_{\delta_2} = \tilde{0}_X$
Hence any Fq-closed set not equal to X has empty Fq-interior.
Conversely,
Now every Fq-closed set not equal to X has empty Fq-interior.
Claim: X is Fq-hyper connected.

Let χ_{δ_1} be a non-emptyq-open set.

Claim: $Fq - cl\chi_{\delta_1} = \tilde{1}_X$

If not, $Fq - cl\chi_{\delta_1}$ is anFq-closed set not equal to X.

Hence $\text{Fq} - \text{int}(Fq - cl\chi_{\delta_1}) = \tilde{0}_X$

Now $\chi_{\delta_1} \prec (Fq - cl\chi_{\delta_1})$

$\text{Fq} - \text{int}\,\chi_{\delta_1} \prec \text{Fq} - \text{int}(\text{Fq} - \text{cl}\,\chi_{\delta_1})$

Since χ_{δ_1} is Fq-open, $Fq - \text{int}\,\chi_{\delta_1} = \chi_{\delta_1}$

Hence $Fq-\operatorname{int}\chi_{\delta_1} \prec Fq-\operatorname{int}(Fq-cl\,\chi_{\delta_1}) = \tilde{0}_X$

Hence $\chi_{\delta_1} \prec \tilde{0}_X$

Since χ_{δ_1} is non-empty.

Hence $Fq-cl\,\chi_{\delta_1} = \tilde{1}_X$

Hence X is Fq-hyper connected.

***Theorem 5.5*:** If X is Fq-hyper connected, then X is Fq-connected.

Proof: Since X is Fq-hyper connected, any two nonemptyFq-open sets intersect .If X is not Fq-connected. Then $\chi_{\delta_1} \vee \chi_{\delta_2} = \tilde{1}_X$ where χ_{δ_1} and χ_{δ_2} are two non-empty disjoint Fq-open sets.

χ_{δ_1} And χ_{δ_2} are nonempty disjoint Fq-open sets contradicts the fact that X is Fq-hyperconnected. Hence X is Fq-connected.

VI. CONCLUSION

In this paper the idea of fuzzy connectedness and fuzzy separated sets in fuzzy quad topological space were introduced and studied.

REFERENCE

[1] Birsan T., Surlesspaces bitopological connexes, an sti. Univ. Al. cuza Iasi sect. I. t. XIV fase 2, 293-96(1968).
[2] Change C.L., Fuzzy topological spaces, J. Math. Anal. Appl. 24,182-190(1968).
[3] Dvalishi B., Connectedness of a fine topology and localization in bitopological spaces, gergian. Math. J., 11(4), pp 713 - 732(2004).
[4] Hameed N.F. & Mohammed Yahya Abid., Certain types of separation axioms in tri topological spaces. Iraqi journal of science. Vol 52, (2), 212-217 (2011).
[5] Kandil A., Tantwauy O., El. Sheikh S.A. & Hosny M., Connectedness in Ideal bitopological ordered space,Gen. Math. Notes, Vol 24, No.2, pp 37-52. ICSRS Publication(2014).
[6] Kandil A.,Nouh A.A. and El-sheikh S.A., On fuzzy bitopological spaces, Fuzzy sets and system , vol.74, issue 3,pp:353-363
[7] Kelly J.C., Bitopological spaces, Proc.LondonMath.Soc. 3 (1963).
[8] Kovar M., On 3-Topological version of Thet- Reularity, Internat. J. Matj, Sci., 23(6), 393-398(2000).
[9] Mukundan D.V., Introduction to quad topological spaces, Int. Journal of Scientific and Eng. Research, 4(7) 2483-2485(2013).
[10] Palaniammal S., Study of Quad topological spaces, Ph. D. Thesis(2011).
[11] Pervin. W.J., Connectedness in bitopological spaces, Indag Math., 29, 369-372(1967).
[12] Reilly I.L., On pairwise connected bitopological spaces, Kyungpook Math. J., 11(1) 25-28(1971).
[13] Sharma R., Deole Bhagyashri A., Verma S. ,Fuzzy Connectedness in Fuzzy Tri topological Space under communication in International journal of Mathematical Sciences (2018).
[14] Sethupathy Raja K.S. and Lakshmivarahan,Connectedness in fuzzy topological space, Kybernetika, 13(3), (1977).
[15] Swart J., Total disconnectedness in bitopological spaces and product bitopological spaces, Indag.Math.33, 135-145(1971).
[16] Tapi U.D., Sharma R. and Deole Bhagyashri A., Tri Connectedness in Tritopological Space is under communication in Indian Journal of Applied Research(2014).
[17] Tapi U.D., Sharma R. and Deole Bhagyashri A., Quad Connectedness in Quad topological Space,International Journalof Mathematical sciences and Eng. Applications, Vol 8, No. 5, 197-203 (2018).
[18] Zadeh L.A., Fuzzy sets, information and control (1965), 8,338-353.