A STUDY ON THE CAUSES FOR CHILD TRAFFICKING USING NEUTROSOPHIC COGNITIVE MAPS (NCMS)

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Abstract: Child Trafficking acts as a form of modern – day slavery. It is defined as the recruitment, harboring, transportation, obtaining a person by means of force, fraud or coercion for the purpose of a commercial sex act or labor services. It continues to be the second largest criminal industry in the world.This paper analyses the causes of Child Trafficking using Neutrosophic Cognitive Map model (NCM). This paper has four sections. Section one deals with the overall existing problem of child trafficking. Section two deals with the description of FCM and NCM. Section three gives the study and analysis of the problem using NCM model. Section four gives the conclusion and suggestion based on the study.

Keywords: FCMs, NCMs, Hidden pattern, fixed point, Child Trafficking.

Introduction:

Child trafficking: India is acting as the country of source, destination and transit for trafficking. Trafficking is carried over for various purposes such as commercial, sexual exploitation etc…. Majority of the trafficking is within the country but large number takes place from Nepal and Bangladesh. Children are trafficked to Middle Eastern countries for sport such as camel racing. There are no national or regional estimates for the number of children trafficked every year. But 40% of prostitutes are children, and there is a growing demand for young girls in the industry.

There are two types of Child trafficking,

1. Domestic
2. International

The internal or domestic component of human trafficking is much larger than international one. Internationally more than 200,000 American children are at risk for being lured into sex trafficking each year.

Factors Contributing Child Trafficking: There are many contributing factors to child trafficking, which include economic deprivation, illiteracy and ignorance, lack of employment opportunities, social status, and political uprisings. Many of the families in India are unable to afford the basic necessities of life, which forces the parents to sell their children off to gangs, and the gangs to exploit them. This paper aims at analyzing the causes for Child Trafficking using NCM model.

Preliminaries

Fuzzy Cognitive Maps (FCMs) are more applicable when the data in the first place is an unsupervised one. The FCMs work is based on the opinion of the experts. FCMs model the world as a collection of classes and casual relations between classes.

Definition 2.1 A NCMs is a directed graph with concepts like policies, events, etc, as nodes and casualities as edges. It represents casual relationship between concepts.

Definition 2.2 When the nodes of the NCM are fuzzy sets then they are called as fuzzy nodes.

Definition 2.3 A NCMS with edge weights or casualities from the set{-1, 0, 1, I} are called simple NCMs.

Definition 2.4 Let C_i and $C_j$denote the two nodes of the NCM. The directed edge from $C_i$to $C_j$denotes the casuality$C_i$on $C_j$called connections. Every edge in the NCM is weighted with a number in the set {-1, 0, 1, I}. Let eij be the weight of the directed edge C_iC_j, $e_{ij} \in$ {-1, 0, 1, I}. e_{ij} = 0 if $C_i$does not have any effect on C_j, e_{ij}= 1 if increase (or decreases) in C_i causes decrease(or increase) in C_j, e_{ij} = I if the relation or effect of $C_i$on C_j is an indeterminate.

Definition 2.5 Let C_1, C_2,……..,C_n be nodes of a NCM. Let the neutrosophic matrix N (E) be defined as N (E) = (e_{ij}) where e_{ij} is the weight of the directed edge C_iC_j, where $e_{ij} \in$ {-1, 0, 1, I}. N (E) is called the netrosophic adjacency matrix of the NCM.

Definition 2.6: Let C_1, C_2,….C_n be the nodes of an NCM. Let A=(a_1, a_2,…., a_n), where $a_i \in$ {0,1,I}. A is called the instantaneous state neutrosophic vector and it denote the on - off position of the node at an instant

a_i =0 if a_i is off (has no effect)

a_i=1 if $a_i$is on, (has effect)

a_i=I if $a_i$is indeterminate, (effect cannot be determined) where i = 1, 2, …, n.

Definition 2.7: Let C_1, C_2,……..,$C_n$be nodes of a NCM. Let C_1 C_2, C_2C_3, ……C_iC_j be the edges of NCM. Then the edges form a directed cycle. An NCM is said to be cyclic if it possesses a directed cycle. An NCM is said to be acyclic if it does not possess any directed cycle.

Definition 2.8: An NCM with cycles is said to have a feedback. When there is a feedback in the NCM.i.e when the casual relations flow through a cycle in a revolutionary manner the NCM is called a dynamical system.

Definition 2.9: Let $C_1 \overrightarrow{C_2}$, $\overrightarrow{C_2C_3}$, ……$\overrightarrow{C_{n-1}C_n}$be cycle, when C_i is switched on and if the casuality flow through the edges of a cycle and if it again causes Ci , say that the dynamical system goes round and round. This is true for any node C_i, for i= 1,2,…..n the equilibrium state for this dynamical system is called the hidden pattern.

Definition 2.10: If the equilibrium state of a dynamical system is a unique state vector, then it is called a fixed point. Consider the NCM with C_1, C_2,……., C_9 as nodes . For example let us start the dynamical system by switching on C_1. Let us assume that the NCM settles down with C_1 and C_n on i.e. the state vector remain as (1,0,0,……,1) this neutrosophic state vector (1,0,0,…….,1) is called the fixed point.

Definition 2.11: If the NCM settles with a neutrosophic

state vector repeating in the form
$A_1 \longrightarrow A_2 \longrightarrow \ldots\ldots\ldots A_i \longrightarrow A_1$ then this equilibrium is called a limit cycle of the NCM.

Definition 2.12: Finite number of NCMs can be combined together to produce the joint effect of all NCMs. If N (E_1), N (E_2),……., N(E_P) be the neutrosophic adjacency matrices of a NCM with nodes C_1, C_2….. C_n then the combined NCM is got by adding all the neutrosophic adjacency matrices N (E_1), N (E_2),……., N(E_P). We denote the combined NCMs adjacency neutrosophic matrix by N (E) = N (E_1) +N (E_2) +……. +N(E_P).

Method of Determination of Hidden Pattern: Let {C_1, C_2…..C_n} be nodes of an NCM, with feedback. Let E be the associated adjacency matrix. Let us find the hidden pattern when C_1 is switched on when an input is given as the vector A1= (1,0,0,…..0) , the data should pass through the neutrosophic matrix N(E), this is done by multiplying A_1 by the matrix N(E). Let A_1 N(E) = { a_1,a_2,…a_i….,a_n} with the threshold operation that is by replacing a_i by 1 if a_i>k and ai by 0 if a_i<k (k-a suitable positive integer) and a_i by I if $a_i$is not a integer. We update the resulting concept; the concept $C_1$is included in the updated vector by m.

Adaptation of Neutrosophic Cognitive Maps to the study: Here, the dynamical system by a very simple model for the reasons of child trafficking are illustrated. At the first stage, the following ten arbitrary attributes (C_1,C_2,…,C_{10}) aretaken. It is not mandatory to consider only ten attributes but one can increase or decrease the number of attributes according to requirement. The following attributes are taken as the main nodes for study: Using the linguistic questionnaire and the experts' opinions the following ten concepts have been identified and taken for the study, ie {C_1,C_2, ..., C_{10}}.

The concepts given below are taken as the main nodes for our problem:

C_1-Poverty
C_2-Illiteracy and lack of vocational
Opportunities
C_3-Unemployement
C_4-Bonded Labour
C_5-Sexual exploitation
C_6-Illegal activities
C_7-Political uprising
C_8-Entertainment
C_9-Social factors
C_{10}-High profit, low risk

Analysis Of The Problem: Now we proceed on to analyze the problems using FCM. Let us consider the ten concepts {C_1, C_2, ..., C_{10}}

The results listed above were collected from the expert's opinion and the following diagram summaries their inter-relationship.

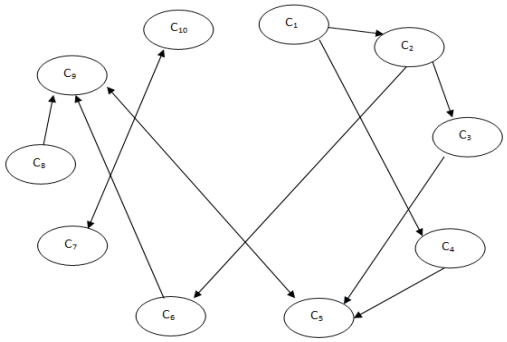

Fig 1: Directed Graph for the Experts openion

The matrix associated with the above graph is

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
C_1	0	1	0	1	0	0	0	0	0	0
C_2	0	0	1	0	0	1	0	0	0	0
C_3	0	0	0	0	1	0	0	0	0	0
C_4	0	0	0	0	1	0	0	0	0	0
C_5	0	0	0	0	0	0	0	0	1	0
C_6	0	0	0	0	0	0	0	0	1	0
C_7	0	0	0	0	0	0	0	0	0	1
C_8	0	0	0	0	0	0	0	0	1	0
C_9	0	0	0	0	1	0	0	0	0	0
C_{10}	0	0	0	0	0	0	1	0	0	0

Now using the matrix A of the Fuzzy Cognitive Map (FCM) the on state, we determine the hidden pattern. Suppose the concept C_1 is in the on state and other nodes are in the off sate.

(i) Let the initial input vector be

X_0= { 1 0 0 0 0 0 0 0 0 0 }.

$X_0 A \rightarrow \{1\ 1\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\} = X_1$

$X_1 A \rightarrow \{1\ 1\ 1\ 1\ 1\ 1\ 0\ 0\ 0\ 0\} = X_2$

$X_2 A \rightarrow \{1\ 1\ 1\ 1\ 1\ 1\ 0\ 0\ 1\ 0\} = X_3$

$X_3 A \rightarrow \{1\ 1\ 1\ 1\ 1\ 1\ 0\ 0\ 1\ 0\} = X_4 = X_3$

X_3 is the hidden pattern which is the fixed point.

While analyzing FCM, when the attribute C_1 , "Poverty" is in the on state and other states are in the off state we get the attributes C_2, C_3, C_4, C_5, C_6, C_9 to be in the on state. i.e - Illiteracy and lack of vocational oppurtunities , Unemployment ,Bonded Labour ,Sexual exploitation, illegal activities and Social factors.

Now we reformulate a different format of the questionnaire where we permit the expert to give answers like the relation between certain nodes is indeterminable or not known. Now based on the expert's opinion also about the notion of indeterminacy we obtain the following neutrosophic directed graph.

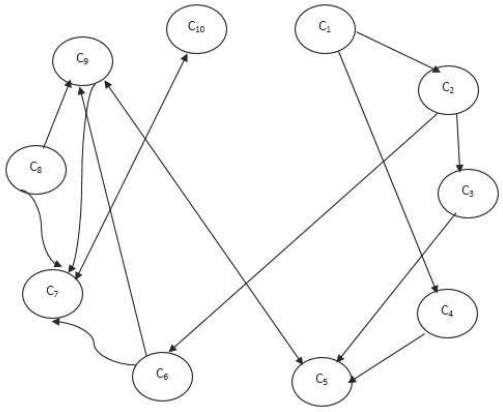

Fig 2: Neutrosophic Directed Graph.

The corresponding neutrosophic adjacency matrix N(E) related to the neutrosophic directed graph is given below

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	0	1	0	1	0	0	0	0	0	0
C2	0	0	1	0	0	1	0	0	0	0
C3	0	0	0	0	1	0	0	0	0	0
C4	0	0	0	0	1	0	0	0	0	0
C5	0	0	0	0	0	0	0	0	1	0
C6	0	0	0	0	0	0	I	0	1	0
C7	0	0	0	0	0	0	0	0	0	1
C8	0	0	0	0	0	0	I	0	1	0
C9	0	0	0	0	1	0	I	0	0	0
C10	0	0	0	0	0	0	1	0	0	0

Now using the matrix N(E) of the Netrosophic Cognitive Map (NCM) the on state, we determine the hidden pattern. Suppose the concept C_1 is in the on state and other nodes are in the off sate.

(i) Let the initial input vector be

X_0= { 1 0 0 0 0 0 0 0 0 0 }.

$X_0N(E) \rightarrow \{1\ 1\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\} = X_1$

$X_1N(E) \rightarrow \{1\ 1\ 1\ 1\ 1\ 1\ 0\ 0\ 0\ 0\} = X_2$

$X_2N(E) \rightarrow \{1\ 1\ 1\ 1\ 1\ 1\ I\ 0\ 1\ 0\} = X_3$

$X_3N(E) \rightarrow \{1\ 1\ 1\ 1\ 1\ 1\ I\ 0\ 1\ 0\} = X_4 = X_3$

Thus according to this expert opinion, "Illiteracy, Unemployment, Bonded labour, Sexual exploitation, Illegal activities and social factors are the major causes.. This mainly gives the indeterminate relating tos Political uprising.

Conclusion: Here in the analysis of FCM and NCM, in FCM the concept C_7, C_8, C_{10} are in OFF state and other concepts C_1 C_2 C_3 C_4 C_5 C_6 C_9 are in ON state. Where as in NCM C_1, C_2, C_3,C_4,C_5, C_6, C_9 are in ON state but C_8 in OFF state and $C_7$is in indeterminate position.

Advantages of this method (N.C.M):

1. NCMs measure not only the existence of causal relation between concepts or the absence of causal relations between two concepts but also gives representation to the indeterminacy of relations between any two concepts.
2. We cannot apply NCMs for all unsupervised data. NCMs will have meaning only when relation between at least two concepts Ci and Cj are indeterminate.
3. The class of FCMs is strictly contained in the class of NCMs. (All NCMs can be made into FCMs by replacing I in the connection matrix by 0).
4. The directed graphs in case of NCMs are termed as neutrosophic graphs.i.e. in the graph we have at least two edges which are related by the dotted lines, means the edge between those two vertices is an indeterminate.
5. All connection matrices of the NCM are neutrosophic matrices i.e. they have in addition to the entries 0, 1, .1, the symbol I.
6. The resultant vectors i.e. the hidden pattern resulting in a fixed point or a limit cycle of a NCM can also be a neutrosophic vector; i.e. signifying the state of certain conceptual nodes of the system to be an indeterminate i.e. it is not off i.e. .0. not on i.e.'1' and indeterminate relation is signified by I.
7. Because NCMs measure the indeterminate, the expert of the model can give due careful representation while implementing the results of the model.
8. In case of simple FCMs, we have the number of instantaneous state vectors to be the same as the number of resultant vectors but in case of NCMs we see the number of instantaneous state vectors is from the set {0,1} where as the resultant vectors are from the bigger set {0, 1, I}. This is also one of the major differences between NCMs and FCMs.

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