Investigation of Effect of Smart Phone on Children using Combined Disjoint Block Fuzzy Cognitive Maps (CDBFCM)

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Abstract

Over 1.8 billion people own smart phones and use their devices on a daily basis. This widespread use of technology trickles down to the youngest members of our society. It was noted that 56 percent of children between the ages of 10 to 13 own a smart phone. While that fact alone may come as a shock, it is estimated that 25 percent of children between the ages of 2 and 5 have a smart phone. In this paper we have investigated the effects of smart phone on children using Combined Disjoint Block Fuzzy Cognitive Maps (CDBFCM). This method is introduced by W. B. Vasantha Kandasamy and A. Victor Devadoss is analyzed in this paper. The Combined Disjoint Block FCM is defined in this method becomes effective when the number of concepts can be grouped and are large in number. In this paper we analyzed the problems and find out the major effects of smart phone on children using neutrosophic tool. This paper has five sections. First section gives the information about the development of Fuzzy Cognitive Maps and about the effects of taking alcohol on human body. Second section gives the preliminaries of Fuzzy Cognitive Maps and Combined Disjoint Block Fuzzy Cognitive Maps. In section three we explain the method of determining the hidden pattern. In the fourth section, we give the concepts of problem. Final section gives the conclusion based on our study.

Keywords: Combined disjoint Fuzzy Cognitive Maps; Smart phone; Children.

Introduction

In 1965 L. A. Zadeh has introduced a mathematical model called Fuzzy Cognitive Maps. After a decade in the year 1976, Political scientist R. Axelord used this Fuzzy model to study decision making in social and political systems. Then B. Kosko enhanced the power of cognitive maps considering fuzzy values for the concepts of the cognitive maps and fuzzy degrees of interrelationships between concepts. FCMS can successfully represent knowledge and human experience, introduced concepts to represent the essential elements and the cause and effect relationships among the concepts to model the behaviour of any system. It is a very convenient simple and powerful tool, which is used in numerous fields such associal, economical, Medical etc. No matter how one can use smart phone it is dangerous to health and affects entire body. Using smart phone is enormously harmful to child’s health. However, there is no concrete proof that mobile technology is linked to adverse outcomes. Smart phones and technology do offer benefits to our children. Here is a quick rundown of the benefits technology can offer our youth:

- A child is more capable of: handling rapid cyber searches, making quick decisions, developing visual acuity, and multitasking.
- Games help develop peripheral vision.
- Visual motor tasks like tracking objects or visually searching for items is improved.
- Internet users tend to use decision-making and problem-solving brain regions more often.

Many experts and educators feel that interactive media has a place in a child’s life. Smart phones and tablets can foster learning concepts, communication, and camaraderie.

Here are a few recommendations to make the most of time spent on a smart phone:
- Children under two should not be using screens or electronic devices.
- Play alongside your children and interact with them face-to-face.
- Make sure smart phones don’t interfere with opportunities for play and socializing.
- Limit screen use to one or two hours a day. This includes smart phones, TV, computers, etc.
- It is all right to use a smart phone as an occasional treat.
- Model positive smart phone use.
- Encourage family meals and communication.
- Look for quality apps that promote building vocabulary, mathematical, literacy, and science concepts.
- Keep smart phones out of the bedrooms.

In this paper, various effects of using smart phone on children are discussed and finally the major effects are identified.

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2 Preliminaries

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

2.1 Definition

When the nodes of the FCM are fuzzy sets then they are called fuzzy nodes.

2.2 Definition

FCMs with edge weights or casualities from the set \{-1, 0, 1\} are called simple FCMs.

2.3 Definition

An FCMs is a directed graph with concepts like policies, events etc, as nodes and casualities as edges. It represents casual relationships between concepts.

2.4 Definition

Consider the nodes/concepts \(C_1, C_2, ..., C_n\) of the FCM. Suppose the directed graph is drawn using edge weight \(e_{ij} \in \{-1, 0, 1\}\). The matrix \(E\) be defined by \(E = (e_{ij})\) where \(e_{ij}\) is the weight of the directed edge \(C_iC_j\). \(E\) is called the adjacency matrix of FCM, also known as the connection matrix of the FCM.

It is important to note that all matrices associated with an FCM are always square matrices with diagonal entries as zero.

2.5 Definition

Let \(C_1, C_2, ..., C_n\) be the nodes of an FCM. \(A = (a_1, a_2, ..., a_n)\) where

\[ a_{ij} = 0 \text{ if } a_i \text{ is off and } a_{ij} = 1 \text{ if } a_i \text{ is on for } i = 1, 2, ..., n. \]

2.6 Definition

Let \(C_1, C_2, ..., C_n\) be the nodes of an FCM. Let \(C_1C_2C_3C_4, ..., C_iC_j\) be the edges of the FCM\((i \neq j)\). Then the edges form a directed cycle. An FCM is said to be cyclic if it possesses a directed cycle. An FCM is said to be acyclic if it does not possesses any directed cycle.

2.7 Definition

An FCM is said to be cyclic is said to have a feedback.

2.8 Definition

When there is a feedback in an FCM, i.e, when the casual relations flow through a cycle in a revolutionary way, the FCM is called a dynamical system.
2.9 Definition

Let \( C_1 C_2 \ldots C_n \) be a cycle. When \( C_i \) is switched on and if the causality flows through the edges of a cycle and if it again causes \( C_i \), we say that the dynamical system goes round and round. This is true for any node \( C_i \) for \( i = 1,2,\ldots,n \). The equilibrium state for this dynamical system is called the hidden pattern.

2.10 Definition

If the equilibrium state of a dynamical system is a unique state vector, then it is called a fixed point. Consider an FCM with \( \{C_1, C_2, \ldots, C_n\} \) as nodes. For example let us start the dynamical system by switching on \( C_1 \). Let us assume that the FCM settles down with \( C_1 \) and \( C_n \) on i.e., in the state vector remains as \((1,0,0,\ldots,0)\) is called fixed point.

2.11 Definition

If the FCM settles down with a state vector repeating in the form \( A_1 \rightarrow A_2 \rightarrow \ldots \rightarrow A_i \rightarrow A_1 \) then this equilibrium is called a limit cycle.

2.12 Definition

Finite number of FCMs can be combined together to produce the point effect of all the FCMs. Let \( E_1, E_2, \ldots, E_p \) be the adjacency matrices of the FCMs with nodes \( C_1, C_2, \ldots, C_n \) then the combined FCM is got by adding all the adjacency matrices \( E_1, E_2, \ldots, E_p \). We denote the combined FCM adjacency matrix by \( E = E_1 + E_2 + \cdots + E_p \).

2.13 Definition

Let \( C_1, C_2, \ldots, C_n \) be \( n \) distinct attributes of a problem \( n \) very large and a non-prime. If we divide \( n \) in to \( k \) equal classes i.e., \( k/n = t \) which are disjoint and if we find the directed graph of each of these \( k \) classes of attributes with \( t \) attributes each, then their corresponding connection matrices are formed and these connection matrices are joined as blocks to form a \( nxn \) matrix. This \( nxn \) connection matrix forms the combined disjoint block FCM of unequal classes/size.

2.14 Definition

Suppose \( A = (a_1, a_2, \ldots, a_n) \) is a vector which is passed in to a dynamical system \( E \). Then \( AE \) = \( A' \) after thresholding and updating the vector suppose we get \( (b_1, b_2, \ldots, b_n) \), we denote that by \( A' \) \( \gamma \) \( (b_1, b_2, \ldots, b_n) \). Thus the symbol \( \gamma \) means the resultant vector has been thresholded and updated. FCMs have several advantages as well as some disadvantages. The main advantage of this method is simple. It functions on expert’s opinion. When the data happens to be an unsupervised one the FCM becomes handy. This is the only known fuzzy technique that gives the hidden pattern of the situation. As we have a very well known theory, which states that the strength of the data depends on, the number of experts opinions. At the same time the disadvantages of the combined FCM is when the weightages are 1 and -1 for the same \( C_i C_j \), we have the sum adding to zero, thus at all times the connection matrices \( E_1, E_2, \ldots, E_p \) may not be conformable for addition. Combined conflicting opinions tend to cancel out and assisted by the strong law of large numbers, a consensus emerges as the sample opinion approximates the underlying population opinion. This problem will be easily overcome if the FCM entries are only 0 and 1.

3 Method of Determining the Hidden Pattern

Let \( C_1, C_2, \ldots, C_n \) be the nodes of an FCM 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 \( A_1 = (1,0,\ldots,0) \), the data should pass through the relation matrix \( E \). This is done by multiplying \( A_2 \) by the matrix \( E \). Let \( A_1 E = (a_1, a_2, \ldots, a_n) \) with the threshold operation that is by replacing \( a_i \) by 1 if \( a_i \geq k \) and \( a_i \) by 0 if \( a_i < k \) (k is a suitable positive integer). We update the resulting concept; the concept \( C_1 \) is included in the updated vector by making the first coordinate as 1 in the resulting vector. Suppose \( A_1 E \gamma A_2 \) then consider \( A_2 E \) and repeat the same procedure. This procedure is repeated till we get a limit cycle or a fixed point.

4 Concepts of the Problem

Using the linguistic questionnaire and the expert’s opinion we have taken the following twenty four attributes \( \{A_1, A_2, \ldots, A_{24}\} \).

\( A_1 \) : Non- Malignant tumors
\( A_2 \) : Cancer
\( A_3 \) : Effects on the Brain
\( A_4 \) : Depression
$A_5$ : Academics
$A_6$ : Mal practice in exams
$A_7$ : Limits their creative minds
$A_8$ : Impedes learning ability
$A_9$ : Less sleep
$A_{10}$ : Addiction
$A_{11}$ : Alter the parent-child relationship
$A_{12}$ : Obesity
$A_{13}$ : Behavioral problems
$A_{14}$ : Desensitizes children to violence
$A_{15}$ : Inappropriate behaviour
$A_{16}$ : No time to learn about the consequences of their actions

These 16 attributes are divided into 4 classes $C_1, C_2, C_3, C_4$ with 4 in each class.

Let $C_1 = \{A_1, A_2, A_3, A_4\}$
$C_2 = \{A_5, A_6, A_7, A_8\}$
$C_3 = \{A_9, A_{10}, A_{11}, A_{12}\}$
$C_4 = \{A_{13}, A_{14}, A_{15}, A_{16}\}$

Now we take the expert opinion for each of these classes and take the matrix associated with the combined disjoint block FCMs. The experts opinion for the class $C_1 = \{A_1, A_2, A_3, A_4\}$ is in the form of the directed graph.

According to this expert the attribute non-malignant tumors is the reason for cancer. The attribute cancer effects the brain. The attribute effect on the brain is the reason for depression, non-malignant tumors. The related connection matrix $M_1$ is given below

$M_1 = \begin{bmatrix}
0 & 1 & 0 & 0 \\
0 & 0 & 1 & 0 \\
1 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 \\
\end{bmatrix}$

The experts opinion for the class $C_2 = \{A_5, A_6, A_7, A_8\}$ is in the form of the directed graph.
According to this expert the attribute malpractice in exams is the reason for academics. The attribute limits their creative minds is the reason for academics, impedes learning ability. The attribute impedes learning ability effects academics. The related connection matrix is $M_2$ given below.

$$M_2 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$

The experts opinion for the class $C_2 = \{A_9, A_{10}, A_{11}, A_{12}\}$ is in the form of the directed graph.

According to this expert the attribute addiction is the reason for less sleep, alter the parent-child relationship and obesity. The related connection matrix $M_3$ is given below.

$$M_3 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

The experts opinion for the class $C_4 = \{A_{13}, A_{14}, A_{15}, A_{16}\}$ is in the form of the directed graph.
According to this expert the attribute behavioral problems is the reason for desensitizes children to violence, in appropriate behavior and no time to learn about the consequences of their actions. The attribute in appropriate behavior is the reason for behavioral problems, desensitizes children to violence. The attribute no time to learn about the consequences of their actions is the reason for behavioral problems and in appropriate behavior.

The related connection matrix is $M_4$ given below.

$$M_4 = \begin{bmatrix} 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix}$$

Now the combined disjoint block connection matrix of the fuzzy cognitive maps $F$ is given by

$$F = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Suppose we consider the on state of the attribute non – malignant tumors and all other states are off the effect of

$$Y = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

on the CDBFCM is given by

$$YF = \begin{bmatrix} \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} = Y_4(Say) \\ \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} = Y_4(Say) \\ \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} = Y_4(Say) \end{bmatrix}$$
\[ Y_F: \gamma (\begin{array}{cccccccccccc}
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{array}) = Y_4 \text{(Say)} \]
\[ Y_F: \gamma (\begin{array}{cccccccccccc}
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{array}) = Y_5 = Y_2 \]

\( Y_2 \) is a fixed point of the dynamical system. When the state \( A_4 \) is on effects on the brain influences children. Suppose we consider the on state of the attributes non-malignant tumors, cancer, depression, academics, mal practice in xams, addiction and all other nodes are in off state.

Now we study the effect of the dynamical system \( F \)

Let \( T = (\begin{array}{cccccccccccc}
1 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{array}) \)

be the state vector depicting the on state vector \( T \) in to the dynamical system \( F \).

\[ T_F: \gamma (\begin{array}{cccccccccccc}
0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{array}) = T_4 \text{(Say)} \]
\[ T_F: \gamma (\begin{array}{cccccccccccc}
1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{array}) = T_3 \text{(Say)} \]
\[ T_F: \gamma (\begin{array}{cccccccccccc}
0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{array}) = T_2 \text{(Say)} \]
\[ T_F: \gamma (\begin{array}{cccccccccccc}
1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{array}) = T_5 = T_2 \]

Then \( T_2 \) is a fixed point of the dynamical system. Thus the attributes \( A_1, A_2, A_4, A_5, A_6, A_{10} \) are in the on states and the attributes effects on the brain, limits their creative minds, impedes learning ability, less sleep, alter parent-child relationships, obesity, behavioral problems, desensitizes children to violence, inappropriate behavior, no time to learn about the consequences of their actions are in the off state all other states become on.

5. Conclusion

We investigated the effects of using smart phone on children using CDBFCM model. The limit point of the dynamical system reveals that the attributes \( A_1, A_2, A_4, A_5, A_6, A_{10} \) are the main effects of using smart phone on children. This means non-malignant tumors, cancer, depression are the main effects of using smart phone on children and because of these their health is getting effected.

References


