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A Study on Road Accidents by Adolescence in Chennai using Induced Fuzzy Cognitive Maps (IFCMS)

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Abstract - Accidents are unplanned events which happen in an unforeseen situation. Road accidents caused by two wheelers are of major concern in the life of adults. Two wheelers have poor safety compared to other means of road transportation. The reasons for accidents are many and some are fuzzy in nature. In order to prevent accidents we must know how does it happen? In this paper, we analyze the causes of road accidents by adolescence in Chennai using Induced Fuzzy Cognitive Maps (IFCMs). IFCMs are a fuzzy-graph modeling approach based on expert's opinion. This is the approach to study the problems with imprecise information.

Keywords- Induced Fuzzy Cognitive Maps (IFCMs)

I. INTRODUCTION

Urban transport facilities in most of the Indian cities are inadequate over the years. The development of public transport system has not kept pace with the traffic demand both in terms of quality and quantity. As a result, the use of the undesirable models such as personalized transport, mainly two wheelers and intermediate public transport, mainly three wheelers, is growing at a rapid speed. This result, not only in restricting the traffic flows but also putting the pedestrian's life at a great risk. Chennai is one of the metropolitan Cities in India. Chennai has recorded the highest number of road accidents. The number is a staggering 31,152 cases in the years between 2007-2010.Also,In 2012 and 2013, the number of accidents are 9663,9710 respectively. Interestingly, Chennai also has the most dangerous roads and the least diligent motorist in Tamilnadu, A road traffic crash result from a combination of factor related to the components the system comprising roads, the environment vehicles and road users, and the way they interact. There are several causes for road accidents. In this paper, we analyse the causes of road accidents by adolescence using Induced Fuzzy Cognitive Maps (IFCMs)

II. BASIC NOTION AND DEFINITIONS

We proceed to state the definitions of IFCMs model.

A. Definition

Fuzzy Cognitive Maps (FCMs) are digraphs that capture the cause/effect relationship in a system. Nodes of the graph stand for the concepts representing the key factors and attributes of the modeling system, such as inputs, variable states, components factors, events, actions of any system. Signed weighted arcs describe the casual relationships, which exists among concepts and interconnect them, with a degree of causality. The constructed graph clearly shows how concepts influence each other and how much the degree of influence is. Cognitive Maps (CMs) were proposed for decision making by Axelrod for the first time.Using two basic types of elements; concepts and casual relationship, the cognitive map can be viewed as a simplified mathematical model of a belief system. FCMs were proposed with the extension of the fuzzified casual relationships. Kosko[3], introduced FCMs as fuzzy graph structures for representing casual reasoning. When the nodes of the FCM are fuzzy sets then they are called fuzzy nodes. FCMs with edge weights or causalities from the set {-1, 0, 1} are called simple FCMs. Consider the nodes/concepts P_1, P_2, P_3, …, P_n of the FCM. Suppose the directed graph is drawn using edge weight e_{ij} from{-1,0,1}.

B. Definition

The matrix M be defined by $M = (e_{ij})$ where e_{ij} is the weight of the directed edge P_iP_j. M is called the adjacency matrix of the FCM, also known as connection matrix. The directed edge e_{ij} from the casual concept Pi to concept P_j measures how much P_i causes P_j .The edge e_{ij} takes values in the real interval [−1, 1]. $e_{ij} = 0$ indicates no casuality. $e_{ij} > 0$ indicates casual increase / positive casuality. $e_{ij} < 0$ indicates casual decrease / negative casuality.

Simple FCMs provide quick first-hand information to an expert's stated casual knowledge. Let P_1, P_2, P_3, …,P_n be the nodes of FCM. Let $A = (a_1, a_2, …, a_n)$ is called a state vector where either $a_i = 0$ or 1. If $a_i = 0$, the concept a_i in the OFF state and if $a_i = 1$, the concept a_i in the ON state, for i = 1, 2, …, n. Let P_1P_2 , …,P_iP_j . be the edges of the FCM ($i \neq j$). Then the edges form a directed cycle.

C. Definition

An FCM is said to be cyclic if it possesses a directed cycle. An FCM with cycles is said to have a feedback, 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. The equilibrium state for the dynamical system is called the hidden pattern. If the equilibrium state of a dynamical state is a unique state vector, it is called a fixed point or limit cycle. Inference from the hidden pattern summarizes the joint effects of all interacting fuzzy knowledge. Even though IFCM is an advancement of FCM it follows the foundation of FCM, it has a slight modification only in Algorithmic approaches

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a) Algorithmic Approach in IFCM

To derive an optimistic solution to the problem with an unsupervised data, the following steps to be followed:

Step 1: For the given model (problem), collect the unsupervised data that is in determinant Factors called nodes.

Step 2: According to the expert opinion, draw the directed graph.

Step 3: Obtain the connection matrix, M, from the directed graph (FCM). Here the number of rows in the given matrix = number of steps to be performed.

Step 4: Consider the state vector $S(X_1)$.by setting 1c in ON position that is assigning the first component of the vector to be 1 and the rest of the components as 0. Find $S(X_1) \times M$. The state vector is updated and threshold at each stage.

Step 5: Threshold value is calculated by assigning 1 for the values > 0 and 0 for the values < 1. The symbol '↪' represents the threshold value for the product of the result.

Step 6: Now each component in the C_1 vector is taken separately and product of the given Matrix is calculated. The vector which has maximum number of one's is found. The vector with maximum number of one's which occurs first is considered as C_2.

Step 7: When the same threshold value occurs twice. The value is considered as the fixed Point. The iteration gets terminated.

Step 8: Consider the state vector C_1 by setting C_2 in ON state that is assigning the second component of the vector to be 1 and the rest of the components as 0.Precede the calculations discussed in Steps 4 to 6.

Step 9: Continue Step 9 for all the state vectors and find hidden pattern.

III. ANALYSIS USING IFCMS MODEL WE TAKE THE FOLLOWING ATTRIBUTES IN THE CASE OF CAUSES

C_1 – Fatigue (Tiredness, Exhaustion, Lethargy)

C_2 – Tension to reach on time (Stress, Eagerness, Penalties for late arrivers)

C_3 – Blurred vision (lack of sharpness of vision, near- or farsightedness)

C_4 – Wrong decision by pedestrians

C_5 – Distraction to drivers (Co-Traveler, Road side bargaining or selling) An expert, a traffic policeman at chromepet, according to his opinion on the same set of 5 attributes has been converted into a connection matrix M.

$$M = \begin{array}{c} \\ C_1 \\ C_2 \\ C_3 \\ C_4 \\ C_5 \end{array} \begin{array}{c} \begin{array}{ccccc} C_1 & C_2 & C_3 & C_4 & C_5 \end{array} \\ \begin{pmatrix} 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 & 1 \end{pmatrix} \end{array}$$

a) Analysis using IFCMS

step 1:

Let C_1 (1 0 0 0 0)

C_1M= (1 0 0 1 1)M = (1 0 0 1 1) =C_1'

C_1' M ≈

(1 0 0 0 0)M=(1 0 0 1 1)

(0 0 0 1 0)M=(0 1 0 1 1)

(0 0 0 0 1)M=(0 1 1 1 1) = C_2

C_2 M=(0 1 1 1 1)M= (1 3 2 4 4)

↳(1 1 1 1 1)= C_2'

C_2' M ≈

(1 0 0 0 0)M= (1 0 0 1 1)

(0 1 0 0 0)M= (1 1 0 1 1) = C_3

(0 0 1 0 0)M= (0 0 1 1 1)

(0 0 0 1 0)M= (0 1 0 1 1)

(0 0 0 0 1)M= (0 1 1 1 1)

C_3 M = (1 1 0 1 1)M= (2 3 1 4 4)

↳ (1 1 1 1 1) = C_3'

C_3'M ≈

(1 0 0 0 0)M= (1 0 0 1 1)

(0 1 0 0 0)M= (11 0 1 1)= C_3

(0 0 1 0 0)M= (0 0 1 1 1)

(0 0 0 1 0)M= (0 1 0 1 1)

(0 0 0 0 1)M= (0 1 1 1 1)

(1 1 0 1 1) is the fixed point and the following triggering pattern is $C_1 \rightarrow C_5 \rightarrow C_2 \rightarrow C_2$ when the first state is kept in ON state.

When the second state is kept in ON state, the triggering pattern is

$C_2 \rightarrow C_2 \rightarrow C_2$

.

Similarly, the triggering pattern when the third state is kept in ON is

$C_3 \rightarrow C_5 \rightarrow C_2 \rightarrow C_2$

The triggering pattern when the fourth state is kept in ON is

$C_4 \rightarrow C_2 \rightarrow C_2$

The triggering pattern when the fifth state is kept in ON is

$C_5 \rightarrow C_2 \rightarrow C_2$.

The following table gives the triggering patterns when attributes are kept in ON state consecutively.

Table 1- Induced pattern for M by IFCM

No.	Attributes ON state	Triggering pattern
Step 1	C_1 :(1 0 0 0 0)	$C_1 \rightarrow C_5 \rightarrow C_2 \rightarrow C_2$
Step 2	C_2 :(0 1 0 0 0)	$C_2 \rightarrow C_2 \rightarrow C_2$
Step 3	C_3 :(0 0 1 0 0)	$C_3 \rightarrow C_5 \rightarrow C_2 \rightarrow C_2$
Step 4	C_4 :(0 0 0 1 0)	$C_4 \rightarrow C_2 \rightarrow C_2$
Step 5	C_5 :(0 0 0 0 1)	$C_5 \rightarrow C_2 \rightarrow C_2$

The interrelationship between the attributes reveals that C_2(Tension to reach on time) is the terminal node.

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Merging all these induced graphs on a single graph, we obtain the following graph.

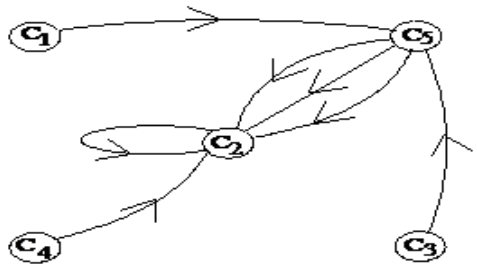

Fig 1: Induced graphs on a merged graph

From the graph, we can observe that all the nodes merged to the node C_2.Also, the node C_2(Tension to reach on time)plays a major role in relating all the nodes.Therefore, C_2(Tension to reach on time) is the most impactful cause in this study.The limit point corresponding to (1 1 0 1 1) highlights the attributes and C_1 – Fatigue (Tiredness, Exhaustion, Lethargy), C_2– Tension to reach on time,C_4– Wrong decision by Pedestrians, C_5 – Distraction to drivers which seems to be major causes for road accidents.

IV. CONCLUSION

In general, preventions need to be taken care to avoid accidents. To reduce the number of accidents, we must follow the traffic rules properly, so that we can overcome casualties caused by the road accidents. We suggest a few remedies which we need to pay attention to, Avoid over speeding, Avoid drunken driving, Avoiding distractions to driver, Avoiding safety gears like seat belts and helmets, Avoid overtaking in a wrong manner.

REFERENCES

[1]. Klir, G.J. and Folger, T.A(1988)., "Fuzzy sets, Uncertainty and Information", Prentice Hall, Englewood, Cliffs. N.J..
[2]. Pathinathan, T. Thirusangu .K. And John M.Mary "On causes for school dropouts- A fuzzyanalysis" .
[3]. Kosko, B., January(1986), "Fuzzy Cognitive Maps", International journal of man-machine studies, pp.62-75,.
[4]. Ponnivalavan, K., and Pathinathan,T.," The study ofSymptoms of Tuberculosis Using Induced Fuzzy Cognitive Maps(IFCMS)", International journal ofData Mining Techniques and Applications, ISSN: 2278-2419, Vol. 02, Oct. 2013, pp. 237-241.
[5]. http://www.mecs-press.org/ijisa/ijisa-v4-n9/IJISA-V4-N9-10.pdf
[6]. http://www.newindianexpress.com/cities/chennai/article558545.exe?service=print.
[7]. http://www.tn.gov.in/sta/ra2.pdf
[8]. http://www.timesofindia.com