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A Study of the attitudes of road user in Enhancing the Gross National Happiness using Combined Fuzzy Cognitive Maps (CFCMs)

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Abstract-The traffic system consists of road users, vehicles, roads , traffic control devices and the general environment. The safety of road users defends on desired speeds and desired safety distances. The growing number of vehicles, population and indiscipline attitude of road users are some of the concerns for the road accidents. In recent years the number of road accidents growing rapidly. This is our main concern for taking this study. In this paper we use Combined Fuzzy Cognitive Maps (CFCMs) to study the attitudes of road users in enhancing the gross national happiness. This paper has four sections. In section one gives the Basic notation and definition. Section two describes the hidden pattern of CFCMs. Section three deals with the Description of the problem and analysis using Combined Fuzzy Cognition Maps. In final section gives the conclusion based on our study.

Keywords - Road, Standard living, Happiness, Combined Fuzzy Cognitive Maps.

I. INTRODUCTION

Political scientist R. Axelrod [1] introduced cognitive maps for representing social scientific knowledge and describing the methods that are used for decision making in social and political systems. We have found many neuroscientists who would add lifelong learning to maintain your cognitive maps by H. Bernard Wechsler[2] Developed Nation or Under developing Nation predominantly works on upliftmen of its people by making certain policies , rules , laws etc., to manifest their development in Socio-Economic Wellbeing and Happiness. Every Country faces problems of increase death toll by natural calamities like Earthquake, Tsunami which cannot be predicated at earliest. In this paper our concern about attitude of road users tends towards calamity on roads. The study of negligence of road users causes more casuality on roads, to our surprise the main concern of attitudeof road users play a vital role for deficiency on roads leads to disastrous accidents in and around the city.

II. BASIC DEFINITION AND NOTATIONS

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 classes and causal relations between classes.FCMs are fuzzy signed directed graphs with feedback. The directed edge e_{ij} from causal concept C_i to concept C_j measures how much C_i causes C_j. The time varying concept function $C_i(t)$ measures the non-negative occurrence of some fuzzy event, perhaps the strength of political sentiment , historical trend or military objective. The edges e_{ij} take values in the fuzzy causal interval [–1, 1]. $e_{ij} = 0$ indicates no causality, $e_{ji} > 0$ indicates causal increase, C_j increases as C_i increases (or C_j decreases as C_i decreases). $e_{ji} < 0$ indicates causal decrease or negative causality. C_j decreases as C_i increases (or C_j increases as C_i decreases) Simple FCMs have edges values in {–1, 0, 1}.

A. Definition

An FCM is a directed graph with concepts like policies, events etc. as nodes and causalities as edges. It represents causal relationship between concepts they are called as fuzzy nodes.

B. Definition

FCMs with edge weights or causalities from the set {–1, 0, 1}, are called simple FCMs.

C. Definition

Consider the nodes/ concepts $C_1, \ldots, C_n$ of the FCM. Suppose the directed graph is drawn using edge weight $e_{ij} \in \{0, 1, -1\}$. 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 the 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.

D. Definition

Let $C_1, C_2,\ldots, C_n$ be the nodes of an FCM. $A = (a_1, a_2,\ldots,a_n)$ where $a_i \in \{0, 1\}$. A is called the instantaneous state vector and it denotes the on-off position of the node at an instant $a_i = 0$ if a_i is off and $a_i = 1$ if a_i is onfor $i = 1, 2, \ldots, n$.

E. Definition

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If the equilibrium state of a dynamical system is a unique state vector, then it is called a fixed point.

F. 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.

G. Definition

Finite number of FCMs can be combined together to produce the joint effect of all the FCMs. Let E_1, E_2,…, E_p be the adjacency matrices of the FCMs with nodes C_1, C_2, …, C_n then the combined FCM is got by adding all the adjacency matrices E_1, E_2, …, E_p.

We denote the combined FCM adjacency matrix by $E = E_1 + E_2 + \ldots + E_p$.

Suppose $A = (a_1, \ldots, a_n)$ is a vector which is passed into a dynamical system E. Then $AE = (a'_1, \ldots, a'_n)$ after thresholding and updating the vector suppose we get $(b_1, \ldots, b_n)$ we denote that by $(a'_1, a'_2, \ldots, a'_n) \hookrightarrow (b_1, b_2, \ldots, b_n)$. Thus the symbol '↪' means the resultant vector has been thresholded and updated.Wehave just briefly recalled the definitions. For more about FCMs please refer BartKosko. Here we approach the problem through attributes using Combined Fuzzy Cognitive Maps (CFCMs) that are basically matrices which predict the feelings of all the attributes under certain conditionsBefore we proceed to apply Combined Fuzzy Cognitive Maps (CFCMs) to this problem we define a set of 10 attributes given by expert . We work with analyzing them using directed graph and its connection matrices.

III. DESCRIPTION OF THE HIDDEN PATH USING COMBINED FUZZY COGNITIVE MAPS

A_1: Increase of Number of Vehicle

Increase in growth of population in manycountry explode to growth of more number of vehicle on roads makes inconsistent for road users.

A_2: Using of communicative devices

Usage of communicative devices like mobile phones, Bluetooth devices etc., are common, but dangerous.

A_3: Noise Pollution

Noise on roads are the most irritating source reported to date is road traffic High level noise is a disturbance to the human environment.

A_4 :Disobeying Traffic Rules

People mandatorily disobey the traffic rules causes road accidents and road traffic.

A_5: Improper time Mangement

Moving from one part of city to another for specific reason to complete the assigned job in stipulated time. Delayed journey provokes poor time management on roads gives menace for road users .

A_6: Poor Road Maintenance

The economic costs of poor road maintenance are borne primarily by road users. When a road is allowed to deteriorate from good to poor condition, each dollar saved on road maintenance increases VOCs by between $2 and $3.
Far from saving money, cutting back on road maintenance increases the cost of road transport and raises the net cost to the economy as a whole. Furthermore, when traffic levels rise, as they have been in most countries, the proportion of total road transport costs attributable to vehicle operation will also increase sharply, while those attributable to road expenditures will decline.

A_7: Lack of seriousness of Pedestrain Walkers

Negligence is known as the primary cause of many pedestrian accidents. A driver or a pedestrian will be seen as negligent if he performed a reckless action, which caused injuries to others. To be more specific, a person will be guilty of it if he has performed an action that he is prohibited from doing or if he has failed to perform an action that he is required to do.

A_8: Inexperienced Drivers

Inexperienced drivers expose themselves for unnecessary risk result with Loss of live, damage to vehicle , road collision.

A_9: Poor Parking Slots

The traffic problems are due to narrow roads. There are bottle necks created by lack of civic sense and encroachments by street venders and there should not be jumbling of business , education , hospital ,commercial places or hotels in a single road.

A_{10}: Improper Maintenance of Vehicle

The failure to perform needed repairs could lead to asset deterioration and ultimately asset impairment accounts for health and safety implications. Here it is important to mention that we do not say we have exhausted all the attributes related to these study or it is not necessary for one to take all 10 attributes the expert can choose to take only a few out of them or more attributes. Thus it is purely in the hands of the investigator to take the related attributes as per his/her wishes. Here the term 'expert' need not strictly mean an expert: it means someone who gives his views to us and has an understanding and expertise on the said disease and the related issues. However using the fuzzy directed graph we obtain the connection matrix. Using these connection matrix we

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determine the hidden pattern. The hidden pattern is a fixed point which shows that increased number of vehicle makes all the other nodes to be On they are all interconnected

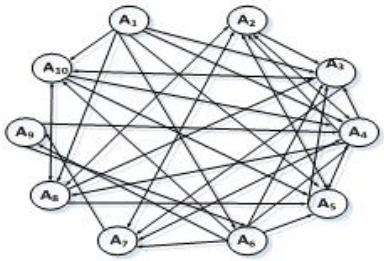

Fig.1

The related connection matrix is given by

$$A=\begin{vmatrix} 0 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 & 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 0 \end{vmatrix}$$

Consider the state vector / initial vector X_1=(1 0 0 0 0 0 0 0 0 0) i.e the only node 'increased number of vehicle ' is only the on state and all the rest are in the off state . Now passing X_1 into the connection matrix A we get

X_1A ↪ (0 0 1 1 1 1 0 1 0 1)= X_2 (Say)
X_2A ↪ (0 3 5 4 4 0 3 2 1 3)
↪ (0 1 1 1 1 0 1 1 1 1) = X_3 (Say)
X_3A ↪ (0 3 5 6 4 1 3 3 1 3)
↪ (0 1 1 1 1 1 1 1 1 1) = X_4 (Say)
X_4A ↪ (0 4 6 7 5 1 4 3 2 3)
↪ (0 1 1 1 1 1 1 1 1 1) = X_5= X_4

As our motivation to the combined effect of the system we now for the same set of ten attributes seek the opinion of another expert . The directed graph given by the second expert is as follows

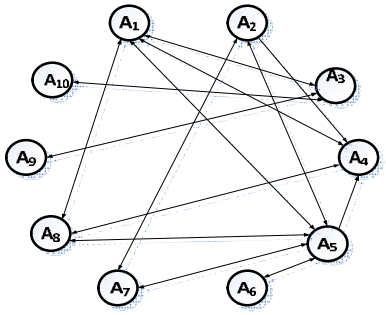

Fig.2

The related connection matrix is given by another expert

$$B=\begin{vmatrix} 0 & 0 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{vmatrix}$$

Consider the state vector / initial vector Y_1=(1 1 0 1 1 1 1 1 1 1)i.e., we take all the attributes are on except noise pollution. Now passing Y_1 into the connection matrix B we get

Y_1B ↪ (3 2 1 4 5 1 2 3 0 0)
↪ (1 1 1 1 1 1 1 1 0 0) = Y_2 (Say)
Y_2B ↪ (4 2 1 4 5 1 2 3 1 1)
↪ (1 1 1 1 1 1 1 1 1 1) = Y3 (Say)
Y_3B ↪ (4 2 3 4 5 1 2 3 1 1)
↪ (1 1 1 1 1 1 1 1 1 1) = Y_4= Y_3

The hidden pattern is a fixed point which shows that increased number of vehicle makes all the other nodes to be on they are all interconnected. The directed graph given by the third expert is as follows.

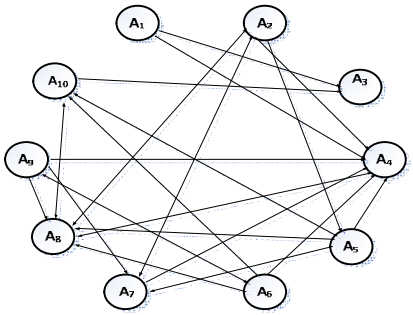

Fig.3

The related connection matrix is given by third expert

$$C=\begin{vmatrix} 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \end{vmatrix}$$

Consider the state vector / initial vector
Z_1=(0 1 0 1 0 0 1 1 0 1). Now passing Z_1intothe connection matrix we get

Z_1C ↪ (0 2 1 3 1 0 1 3 0 1)
↪ (0 1 1 1 1 0 1 1 0 1) = Z_2 (Say)
Z_2C ↪ (0 2 1 4 1 0 2 4 0 2)
↪ (0 1 1 1 1 0 1 1 0 1) = Z_3 = Z_2

The hidden is what we have obtained is the fixed point. Let us denote the combined connection matrix is S=A+ B + C.

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$$S=\begin{vmatrix} 0 & 0 & 3 & 3 & 2 & 1 & 0 & 2 & 0 & 1 \\ 0 & 0 & 1 & 3 & 3 & 0 & 3 & 2 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 2 \\ 1 & 1 & 1 & 9 & 1 & 0 & 1 & 3 & 0 & 0 \\ 1 & 2 & 1 & 3 & 0 & 1 & 2 & 2 & 0 & 1 \\ 0 & 0 & 1 & 2 & 2 & 0 & 1 & 1 & 2 & 2 \\ 0 & 3 & 0 & 2 & 1 & 0 & 0 & 0 & 1 & 0 \\ 1 & 2 & 1 & 3 & 2 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 2 & 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 3 & 1 & 1 & 0 & 0 & 2 & 0 & 0 \end{vmatrix}$$

Consider the state vector / initial vector
P_1= (1 0 0 0 0 0 0 0 0 0) .
P_1S ↪ (0 0 3 3 2 1 0 2 0 1)
↪ (0 0 1 1 1 1 0 1 0 1) =P_2 (say)
P_2S ↪ (4 5 6 6 3 1 5 8 4 3)
↪ (1 1 1 1 1 1 1 1 1 1) = P3 (say)
P_3S ↪ (4 8 12 19 12 4 9 13 4 7)
↪ (1 1 1 1 1 1 1 1 1 1) = P_4= P_3
Which is the fixed point for S

IV. CONCLUSIONS

The Study converges to the people of country on their Well-being and Happiness while on transportation on roads, to have effective time management and accidents free society. When we civilians of our country obey traffic rules and control population span prevent us from noise pollution and accidentfree zone

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