Fuzzy Cognitive Maps based Mathematical Model for Prediction of "Parkinson Disease"

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Abstract: This note explains about "Parkinson Disease which may be a long-term disorder of the central nervous system". The research paper focuses on analysis of symptoms of "Parkinson Disease" to predict the disease in early stage. Concept of FCMs was used to interpret the diagnostic symptoms of "Parkinson Disease". The target is to draw connection between the symptoms and provide likely explanation.

Key words: FCMs, IFCMs, Symptoms of "Parkinson Disease", Understanding of Disease.

I. INTRODUCTION

"Parkinson's disease is a chronic complication of the central nervous system, primarily within the type of the motor system". The symptoms sometimes come back, the motor symptoms of the malady come back from the death of the cells of the structure, a vicinity of the middle of the brain. As a result, dopamine is too little in these regions. The rationale for this death is small familiar, however it conjointly includes the place of the proteins within the Lewy bodies within the neurons. The diagnosing of typical cases is because of the symptoms related to completely different diseases. There's no cure for Parkinson's disease. The treatment sometimes consists of an antiparkinsonian treatment (L-dopa or levodopa). However, this is often an honest time because the disease progresses and neurons are still lost, these medications are less effective and, at identical time, complicate unjust movements. Diet and sure styles of rehabilitation Surgery of tiny electrodes for deep stimulation The check of treatments for non-mobility - Similar symptoms of Parkinson's disease, like sleep disorders and emotional issues, are a touch sturdy In 2015, the Parkinson's disease affected nearly one. 2 million folks and killed quite 117,400 people. Parkinson's disease sometimes affects people over sixty years old, a few hundredth of whom are affected. Few people became affected in the age of fifty, it's known as young - Parkinson's disease attack. Lifespan at the time of diagnosing is between seven and fourteen years. The malady is named the memory of an English physician, James Parkinson, to whom the WHO gave the elaborate description in an essay on paralysis of exposure, 1817.

II. SYMPTOMS OF PARKINSON DISEASE

At the beginning of the ill-health, the first tremors, rigidity, idleness and displacement difficulties. Disorders of thought and behaviour may occur. Dementia is usually employed in advanced stages of the disease. Depression and anxiety are common in additional than a third of people with parkinson's disease. The choice symptoms are sensory, sleep and emotional issues. The rationale for parkinson's disease is usually unknown, however, each of them is expounded on genetic and environmental factors. With a loved one, it's attainable to put pressure on the disease itself. There's conjointly the next risk once exposed to parents with safe pesticides, and among people who have had head injuries, whereas reducing the prospect of smoking and people who drink coffee or tea. supported the literature and also the study, few symptoms of the disease were preserved here to interpret the disease as tremor, rigidity, akinesia, instability of the posture, facial mask, modification of the writing, speech modification, memory loss.

III. FCM

Fuzzy cognitive maps of researchers are signed procedures that cowl fully differing kinds of data to draw and analyse sophisticated operational systems. Throughout the tactic of learning and understanding, a particular affirmative mapping system, during which the tactic of illustration and public construction researchers of FCM ensured the perception of obstacles, created the rationale. An FCM consists of the various parts, ideas, nodes, factors, and reciprocal influences, additionally due to the prospects of measuring weighted squares described by arrows between weather. The analysis of the link between the aims of the beings found throughout an SEI to seek out and interpret the map and perceive its structural properties and, therefore, its dynamism. Structured ways for collection and secret writing information will reprocess comparative studies.

An FCM may be a directed graph with ideas like rules, events, nodes, and relations, etc. It represents the motive relationship between ideas. If the rise (or decrease) of 1 thought leads to the rise (or decrease) of another thought indicate what's worthy. If there is no relationship between a pair of ideas, the price zero is given. If increasing (or decreasing) one relation decreases (or increases) another, specify -1. Therefore, FCMs are described during this system.

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IV. PROCESS FOR IFCM

IFCM is an up-gradation of FCM. IFCMs have some modifications in algorithms as per the demand of the model. To interpret the answer of the interest undergo the next stages:-

1) For the model, collect the unattended information which is in determined factors as mentioned nodes. during this model impulsive attributes are some of the symptoms of Parkinson Disease.

2) A directed graph was drawn in line with consistent to the skilled opinion

3) Connection matrix, 'P' was obtained from the directed graph i.e FCMs. Here the quantity of rows of the given matrix is the adequate number of these impulsive attributes.

4) State vector was considered 'C_1' which was in ON position then. $C_1 \times P$ found and the state vector was updated for the threshold at each stage.

5) The edge value wass calculated by assigning one for the connection between any 2 symptoms or arbitrary attributes, if not then zero was alloted. The symbol $\rightarrow$ represents the merchandise of the result.

6) Every part within the 'C_1' vector was taken singly and products of the given matrix were calculated. The vector that has the foremost sort of one`s which happens initially wass taken into consideration as 'C_2'.

7) 'C_2' vector was increased another time to matrix and alsoto the result's thought of as the output to present model.

V. EXPLORATION OF THE MODEL

A model to interpret "Parkinson Disease" to seek out the foremost probable symptoms. At the primary stage following seven arbitrary attributes are taken for the study. A Directed Graph is mentioned by using Symptoms of "Parkinson Disease":

P_1 = Tremor,

P_2 = Rigidity,

P_3 = Akinesia,

P_4 = Pousture Instability,

P_5 = Mask Face,

P_6 = Writing Change,

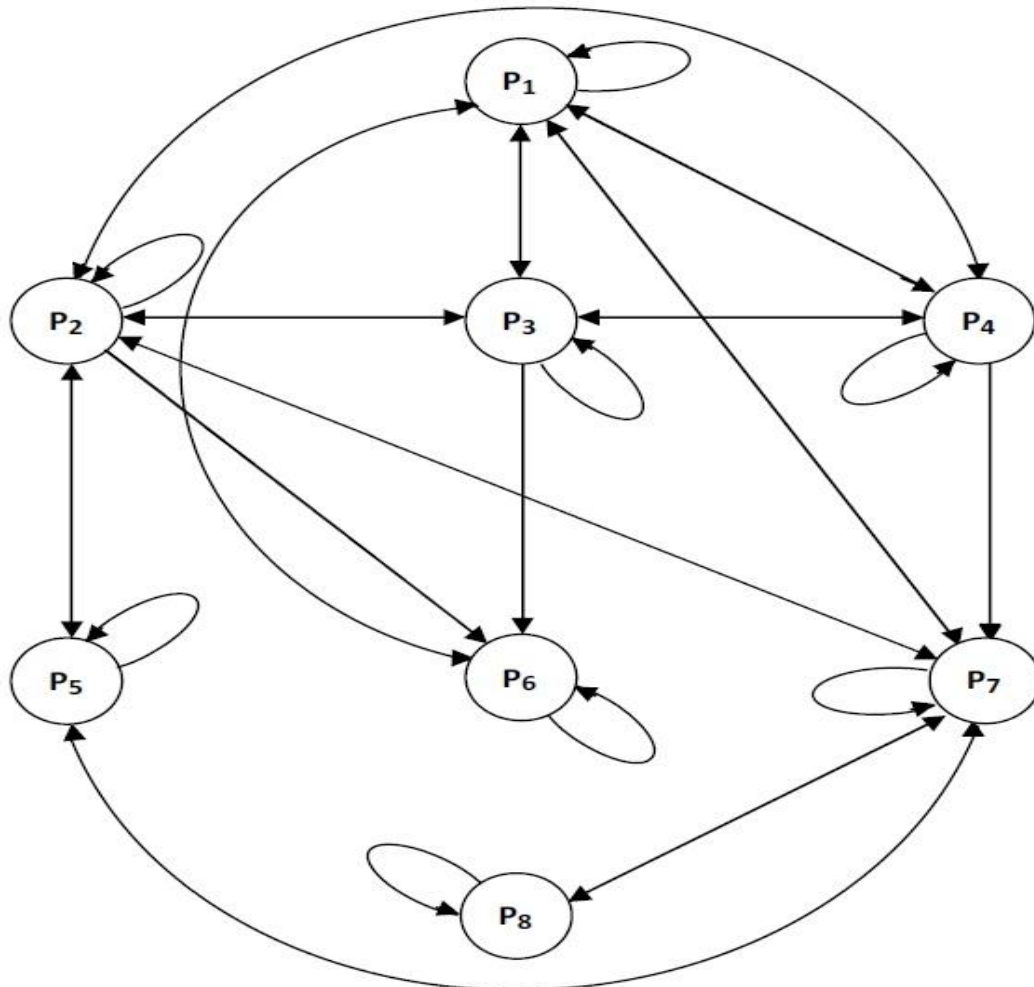P_7 = Speech Change,

P_8 = Loss of Memory.

Figure (1) : Directed graph with the use of symptoms of "Parkinson Disease".

VI. EXECUTION OF MODEL

Conferring to the study, symptoms of being grieved by "Parkinson Disease". Consider a matrix 'P' was made using figure (1),

$$P = \begin{array}{c} \\ P_1 \\ P_2 \\ P_3 \\ P_4 \\ P_5 \\ P_6 \\ P_7 \\ P_8 \end{array} \begin{array}{cccccccc} P_1 & P_2 & P_3 & P_4 & P_5 & P_6 & P_7 & P_8 \\ \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \end{bmatrix} \end{array} \quad \text{......... (1)}$$

To interpret the "Parkinson Disease" here IFCM method has been used. Initially P_1(Tremor), P_2(Rigidity), P_3(Akinesia), P_4(Pousture Instability) were taken for interpretation of the matter. Here it is supposed that only these states are ON and others are OFF. Then,

$$C_1 = \begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \end{bmatrix} \quad \text{.....................(2)}$$

Multiply C_1 with matrix 'P',

$$C_1 P = \begin{bmatrix} 3 & 3 & 4 & 4 & 1 & 3 & 3 & 0 \end{bmatrix}$$

i.e.,

$$C_1^1 P = \begin{bmatrix} 3 & 3 & 4 & 4 & 1 & 3 & 3 & 0 \end{bmatrix} \text{.....................(3)}$$

The edge value was calculated by assuming one (1) for relation between symptoms of individuals and zero (0) if for no relations.

The calculation for threshold values was done by the iteration method. During this process it is supposes to be in ON position one by one and all $P_i's$ as supposed for P_1, Therefore,

$$C_1^1 P \sim \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} P \rightarrow \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 1 & 1 & 0 \end{bmatrix} \quad \text{.....................(4)}$$

$$C_1^1 P \sim \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} P \rightarrow \begin{bmatrix} 0 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \end{bmatrix} \quad \text{.....................(5)}$$

$$C_1^1 P \sim \begin{bmatrix} 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} P \rightarrow \begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 1 & 0 & 0 \end{bmatrix} \quad \text{.....................(6)}$$

$$C_1^1 P \sim \begin{bmatrix} 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{bmatrix} P \rightarrow \begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 1 & 0 \end{bmatrix} \quad \text{.....................(7)}$$

$$C_1^1 P \sim \begin{bmatrix} 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \end{bmatrix} P \rightarrow \begin{bmatrix} 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 \end{bmatrix} \quad \text{.....................(8)}$$

$$C_1^1 P \sim \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \end{bmatrix} P \rightarrow \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \end{bmatrix} \quad \text{.....................(9)}$$

$$C_1^1 P \sim \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \end{bmatrix} P \rightarrow \begin{bmatrix} 1 & 1 & 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix} \quad \text{.....................(10)}$$

$$C_1^1 P \sim \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} P \rightarrow \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 \end{bmatrix} \quad \text{.....................(11)}$$

Let $\quad C_2 = \begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 1 & 0 & 0 \end{bmatrix}$ ....(12)

Or $\quad C_2 = \begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 1 & 0 \end{bmatrix}$ ....(13)

Because the edge having a maximum 1`s will assumed because it might be 3rd or 4th iteration. Here it's important to understand the $2^{nd}$ iteration has maximum 1`s but it's excepted thanks to the primary value is zero which represents a serious symptom of the disease. When 3rd iteration has been taken as C_2, then,

$$C_2 P = \begin{bmatrix} 4 & 3 & 4 & 4 & 1 & 4 & 4 & 0 \end{bmatrix}, \text{ i.e.,}$$

$$C_2^1 P = \begin{bmatrix} 4 & 3 & 4 & 4 & 1 & 4 & 4 & 0 \end{bmatrix} \text{.....................(14)}$$

When 4th iteration has been taken as C_2, then,

$$C_2 P = \begin{bmatrix} 4 & 4 & 4 & 4 & 2 & 3 & 4 & 1 \end{bmatrix}, \text{ i.e.,}$$

$$C_2^1 P = \begin{bmatrix} 4 & 4 & 4 & 4 & 2 & 3 & 4 & 1 \end{bmatrix} \text{.....................(15)}$$

Here equation (14) & (15) both might be considered because the results of the mathematical model to interpret "Parkinson Disease" by using Fuzzy Cognitive Maps but (15) are going to be more suitable because during this result all major four symptoms of the disease have maximum value 4 for every.

VII. RESULT & DISCUSSION

On completion of the process following are the interpretations:

1) When we put P_1(Tremor), P_2(Rigidity), P_3(Akinesia), P_4(Pousture Instability) in ON position, we found that the result is $\begin{bmatrix} 3 & 3 & 4 & 4 & 1 & 3 & 3 & 0 \end{bmatrix}$ which is shown in equation (3).

2) After process finally we found that $\begin{bmatrix} 4 & 4 & 4 & 4 & 2 & 3 & 4 & 1 \end{bmatrix}$ which is shown in equation (15) and it shows that all four major symptoms of disease having maximum values.

3) Since all four major symptoms of disease having maximum values it means that if anyone suffering from these four symptoms then there is a possibility of "Parkinson Disease" then he needs to go for clinical advice or test.

4) In this result we found that P_6 (Writing Change) and P_7 (Speech Change) has values 3 and 4 respectively it means these two symptoms are also important and if they occur then it is important to consult a doctor to determine the problem.

VIII. CONCLUSION

Finally, it can be seen that all four major symptoms are important to understand "Parkinson Disease". As it is known that he common features of Parkinson's disease are easily remembered by the "TRAP" which is combination of all four major symptom. In which,

- **T– Tremor** causes resting tremors. The tremors that occur as you move (for example, looking for an object) are called essential tremors and are not a defining feature of the MP. In fact, it is a different but related disorder.
- **R – Rigidity** makes it difficult to move and stiffen arms and limbs.
- **A – Akinesia** does not lead or slow movements.
- **P – Postural instability** causes posture problems.

IX. FUTURE SCOPE OF THE RESEARCH

As per study it's been analysed that initial four symptoms square measure terribly initial and necessary if they occur at the same time for an extended time. Sometimes folks ignore them and so it makes drawback in future. Here authors tried to mention by the assistance of mathematical modelling an intelligent system is developed to aware the folks which may save several lives.

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