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Study on Disappearance of House Sparrow Using Induced Fuzzy Cognitive Maps (IFCMs)

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Abstract - Sparrows are a group of small size birds.Sparrows are easily identified by their smoothly rounded heads. They are omnivorous birds that mainly eat seeds and substitute their diet with berries, fruits and small insects. They are found in woodlands and across farmland. Human being's want to have comfortable and luxurious life style nowadays, due to that other species particularly house sparrow are disappearing in the urban cities. In this paper, we analyzed the disappearance of house sparrow using induced fuzzy cognitive maps (IFCMs).

I.INTRODUCTION

1.1 Description

House sparrows are small birds, weighing about 30 grams and measuring 14cms. They have a short, conical bill, like many seed-eaters. The male has a grey crown and dark chestnut nape and back, with black streaks. In the breeding season he has a large black bib with contrasting pale grey cheeks and belly. After breeding, the bib reduces to a small patch under the chin, and the black bill turns pinkish-cream.

The female has a sandy-brown back streaked with black, and pale grey undersides. She has a buff curved 'C' from behind the eye to the neck.Both sexes have a single white bar on the wing.

1.2 Habitat

House sparrows tend to live in association with humans, often nesting around houses and sheds, or hanging around restaurants. They can spread disease by contaminating human food.

1.3 Nesting

The male builds a bulky domed nest, often in a hole. He renovates the nest periodically, even when not in use. The female lays four or more grey-white eggs with brown spots and streaks.

II.DISAPPEARANCE OF HOUSE SPARROW

House sparrows was the most widely distributed species of the world. Today it is suddenly disappearing in the urban environment. What this translates into is that the modern urbanization has reached a level where it can trigger the extinction of a species. In the past, when the cities were small and there were villages around, with agricultural land around them, these were vast lungs of open spaces that separated the urban and the rural, constantly replenished the air. In the fields there were occasional clusters of indigenous fruit trees and bushes that were ideal nesting places for a number of birds including sparrows. At such places, there was also a pond that got filled each year with the monsoon spillover from the entire region. In the fields and the grazing lands there were thorny bushes and trees that provided safe nesting havens for sparrows and other small birds that kept the area clean of insects. The insects made ideal infant food for their young ones. In those days, the crop was harvested and gathered at one place where the grain was separated from the chaff, giving ample time to the sparrow to take their share for their pest control services rendered to the farmer. When the harvest moved to the open grain markets, the birds still had a chance to peck at it. Back in the household when women cleaned the grain in courtyards, sparrows were always a constant companion, feeding on the stray seeds of weeds that were separated and discarded.

As fields, bushes, tree clusters, marshes and the water bodies disappear, they are being replaced by urban dwellings, watertight pavements and roads. Naturally, only some habitants of the erstwhile eco-system are able to survive.With no food or safe nesting, birds perish or migrate to more agreeable habitat.Today the reasons for the sparrows' decline are largely electromagnetic radiation from mobile phones and lack of insect food due to excessive use of pesticide in urban gardens.

III. BASIC NOTION AND DEFINITIONS

We proceed to state the definitions of IFCMS model.

3.1 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 [10] for the first time. Using two basic types of elements; concepts and casual relationship, the cognitivemap can be viewed as a simplified mathematical model of a belief system. FCMs were proposed with the extension ofthe 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}.

3.2. Definition:

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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 P_i to concept P_j measures how much Pi 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, …,Pn 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 ai in the ON state, for i = 1, 2, …, n. Let P_1P_2, P_2P_3, …,P_iP_j. be the edges of the FCM (i ≠ j). Then the edges form a directed cycle.

3.3. 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.

3.4. Algorithmic Approach in IFCM
Even though IFCM is an advancement of FCM it follows the foundation of FCM, it has a slight modification only in Algorithmic approaches. 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 c_1 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.

Analysis using IFCMs model
We take the following attributes as reason for disappearance of house sparrow:
C_1-Rapid Urbanization

Urbanization means an increase in the proportion of people living in urban areas compared to rural areas. An urban area is a built-up area such as a town or city. A rural area is an area of countryside.Urbanization can cause problems such as transport congestion, lack of sufficient housing, over-rapid growth and environmental degradation. Many cities display particularly sharp inequalities in housing provision, health and employment.

C_2-Architecture Changes
The traditional architecture allowed sparrows to make their nests in a holes, roofs, crevices of old houses .But modern architecture which introduced box – styled flats have no provision for sparrows to nest and lay eggs.

C_3-Food Availability
Few years back, grains were sold in grocery stores. The grains spilt from gunny bags were a major source of feeding omnivorous birds like sparrows. The grains were dried in huge quantities out in the open, which gave the birds their share of the introduction of grains. But now the scenario different because of Food Bazaar and packaged food.
A major pressure on House Sparrows could be a decrease in the invertebrate prey that is necessary for rearing nestlings during the first few days of life. The changes in farming practices through the reduction in the diversity of plants in fields with weed free crops; the ploughing up of headlands to increase the amount of land under cultivation and the increase use of pesticides and herbicides have reduced the availability of arthropods in rural areas. This is through both direct toxic effects of pesticides on invertebrates and loss of food plants

C_4-Mobile Radiations
The scientists who are trying to unravel the cause of Sparrow's disappearance have identified the mobile phone. The effects of these mobile radiations on reproduction and fertility of eggs. Animals navigate by the Earth's magnetic fields and these waves can disturb a bird's ability to find their way around.

C_5-Lack of Nest Sites
A lack of holes suitable for nest sites on modern or renovated buildings has been proposed as a possible cause of the House Sparrow population decline. There has been an increase in the use of plastic fascia boards and the use of contoured tiles or roofing sheets to prevent the entry of birds on modern housing. House Sparrows predominantly nest in holes and gaps in soffit boards and under tiles, therefore this tendency may have an impact of the availability of nest sites.

C_6- Excessive Use of Pesticides

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The extensive use of pesticides and insecticides in our farms and gardens have created a scarcity of insects. The unleaded fuel, believed to be eco-friendly, has harmful byproducts. The fuel uses Methyl Tertiary Butyl Ether (MTBE) as an anti-knocking agent. By mixing with the byproducts of combustion, this kills small insects.

C_7-Pollution:

Sparrows are affected by industrial pollution and pollution from vehicles. And also due to the sounds produced by them is also one of the major factors for the decline. Humans also get affected by pollution but very small birds die.

According to an expert opinion on the same set of 7 attributes has been converted into a connection matrix M

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

Analysis using IFCMS:

Step 1

Let C_1= (1000000)

C_1M= (0011101) = C_1'

(0010000)M = (1100010) = C_2

(0001000)M = (1000001)

(0000100)M = (1100001)

(0000001)M = (1001010)

C_2= (1031202)

(1011101)= C_2'

(1000000)M = (0011101) = C_3

(0010000)M = (1100010)

(0001000)M = (1000001)

(0000100)M = (1100001)

(0000001)M = (1001010)

C_3M= (4201022)↪(1101011) = C_3'

(1000000)M = (0011101) = C_4

(0100000)M = (1010100)

(0001000)M = (1000001)

(0000010)M = (0010001)

(0000001)M = (1001010)

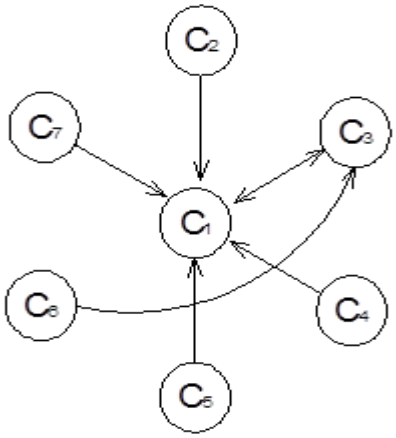
(0 0 1 1 1 0 1) is the fixed point and the triggering pattern is C1→ C3→ C1→ C1

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

Induced patterns for M by IFCMS

STEP NUMBER	ATTRIBUTES ON STATE	TREGGERING PATTERN
1	C_1 :(1 0 0 0 0 0 0)	$C_1 \rightarrow C_3 \rightarrow C_1 \rightarrow C_1$
2	C_2 :(0 1 0 0 0 0 0)	$C_2 \rightarrow C_1 \rightarrow C_1$
3	C_3 :(0 0 1 0 0 0 0)	$C_3 \rightarrow C_1 \rightarrow C_1$
4	C_4 :(0 0 0 1 0 0 0)	$C_4 \rightarrow C_1 \rightarrow C_1$
5	C_5 :(0 0 0 0 1 0 0)	$C_5 \rightarrow C_1 \rightarrow C_1$
6	C_6: (0 0 0 0 0 1 0)	$C_6 \rightarrow C_3 \rightarrow C_1 \rightarrow C_1$
7	C_7 :(0 0 0 0 0 0 1)	$C_7 \rightarrow C_1 \rightarrow C_1$

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



IV. CONCLUSION

In this section, the major findings were summarized using IFCMs and interviews data. While analyzing with IFCMs, it was observed that when rapid urbanization is taken as the ON state, the resultant vector is (0 0 1 1 1 0 1) While analyzing with IFCMs we observe that Architecture changes, food availability, mobile radiation, lack of nest sites and pollution are the major reasons for disappearance of house sparrows.

We suggest the following remedial measures to help house sparrow and also other creatures to survive: Avoid exotic plants. Native plants not only attract birds but also help the environment. Stop using chemical pesticides and fertilizers. Use organic fertilizers and pesticides only when needed. Install bird feeders which must be replenished with supply of bird food daily. Provide for nesting sites, nest boxes around the house.Plant hedges or creepers for birds to rest.

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