Fuzzy Rule Based Metagraph model of Air Quality Index To Suggest Outdoor Activities

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Abstract : **A fuzzy approach is used to calculate the air quality index of atmosphere to suggest the outdoor activities of human. The atmosphere always affects the human body and the hazards materials are badly influence the atmosphere . Our fuzzy metagraph model suggest the outdoor activity based on AQI to protect human body. Fuzzy logic is very powerful tool for representing uncertain knowledge, hence this research work is present better performance to suggest outdoor activities for human.**

Key words: Air Quality Index(AQI),fuzzy logic,metagraph.

I. INTRODUCTION

Air Quality Index (AQI) is used as a indicator of air pollution. This Index of air quality is determine by calculating the degree of pollutions in the particular area and includes the five main pollutants (SO_2,NO_2,CO,PM_{10},O_3).

AQI is represented between 0 to 500, where 0 representing good air and 500 representing hazardous air.

Table.1 Break Point Concentrations And AQI Values For India

S.No	Index	Category	SO_2 (24 hr avg) ($\mu gm/m^3$)	NO_2 (1-hr avg) ($\mu gm/m^3$)	CO (8-hr avg) ($\mu gm/m^3$)	O_3 (1-hr avg.) ($\mu gm/m^3$)	PM_{10} (24-hr avg.) ($\mu gm/m^3$)
1	0-100	Good	0-80	0-80	0-2	0-180	0-100
2	101-200	Moderate	81-367	81-180	2.1-12	180-225	101-150
3	201-300	Poor	368-786	181-564	12.1-17	225-300	151-350
4	301-400	Very poor	787-1572	565-1272	17.1-35	301-800	351-420
5	401-500	Severe	>1572	>1272	>35	>800	>420

Fuzzy logic was initiated in 1965 by Lotfi A. Zadeh and it was first invented as a representation scheme and calculus for uncertain or vague notions. It is basically a multi-valued logic that allows more human-like interpretation and reasoning in machines. It allows intermediate categories between notations such as true/false, hot/cold, black/white etc. as used in Boolean logic. In fuzzy system values are indicated by a number in the range of 0 to 1. Where 0 represents absolute falseness and 1 represents absolute true. Fuzzy rule based expert system could be used in business, robotics, manufacturing, online servicing and many other field of decision making with imprecise and uncertain knowledge.We use this fuzzy rule based system for risk management.

Decision support system is used to take decision quickly in complicated situations. Fuzzy metagraph is very remarkable and powerful tool. The main purpose of DSS is to provide support to analyse any system to user with effective manner hence it helps user to concentrate their efforts to solve the problem

II. FUZZY METAGRAPH

A metagraph is a graphical structure that represent directed relationships between sets of elements.

For given finite generating set X={ x_i, i=1………I}, a metagraph is an ordered pair S=<X,E> . In which E is a set of edges E={ $ě_{k, k=1……K}$}, and each edge is an ordered pair $ě_k$=< V_k , W_k >. We take V_k X is the in vertex of the edge $ě_k$ and W_k X is the out vertex .The co input of any   x V_k is $V_k \setminus \{ x\}$ and the output of any x W_k is $W_k \setminus \{ x\}$. Also V_k $W_k \neq \phi$ for all k.

The Fuzzy metagraph is a new method of constructing fuzzy knowledge base. Based on the analysis of existing fuzzy graph a new graph theoretic construct.

A fuzzy metagraph is a triple Š ={X,x, Ě } where X is a finite set and ǽ is a fuzzy set on X

and Ě is a fuzzy edge set {ěk, k=1……K}. Where each component ěk in Ě is characterized by an ordered pair. In which E is a set of edges E={ ěk, , k=1……K}, and each Eage is an ordered pair.

III. A Fuzzy Approach for Calculating AQI

Fuzzyfication - Comprises the process of transforming crisp values into grades of membership for linguistic terms of fuzzy sets. The membership function is used to associate a grade to each linguistic term. The fuzzification is the first step in fuzzy logic processing   involves a domain transformation where the crisp inputs are transformed into fuzzy inputs). To transform crisp inputs into fuzzy inputs, membership function must first be determined for each point. For our model purpose we defined following linguistic variables and membership function for each input and output variables.
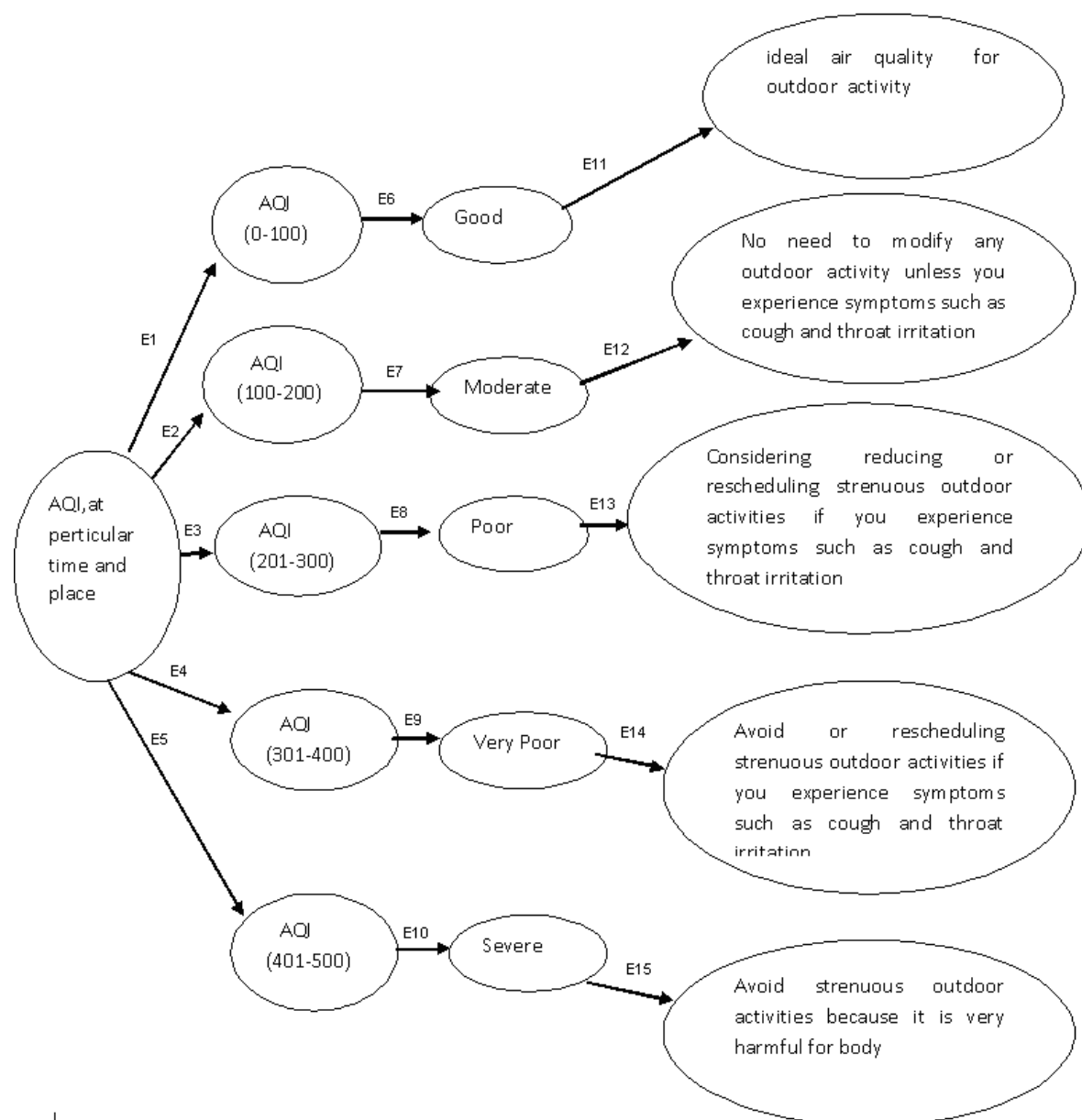
Fuzzy Metagraph for AQI :

Fig 1 Fuzzy Metagraph for AQI

Rule:

   (1) If AQI at particular time and place is observed Then Value of AQI is (0-100) OR(101-200) OR(201-300)OR(301-400)OR(401-500).

   (2) If value of AQI is between (0-100) Then atmosphere is Good and ideal air quality for outdoor activity.

   (3) If value of AQI is between (101-200) Then atmosphere is Moderate and no need to modify any outdoor activity unless you experience symptoms such as cough and throat irritation.

   (4) If value of AQI is between (201-300) Then atmosphere is Poor and considering reducing or rescheduling strenuous outdoor activities if you experience symptoms such as cough and throat irritation.

   (5) If value of AQI is between (301-400) Then atmosphere is very poor and avoid or rescheduling strenuous outdoor activities if you experience symptoms such as cough and throat irritation.

   (6) If value of AQI is between (400-500) Then atmosphere is severe and strenuous outdoor activities because it is very harmful for human body.

Fuzzy inference rules – In this step the knowledge pertaining to the the given control problem is formulated in terms of a set of fuzzy inference rules. Fuzzy inference rule for the given problem are as follows
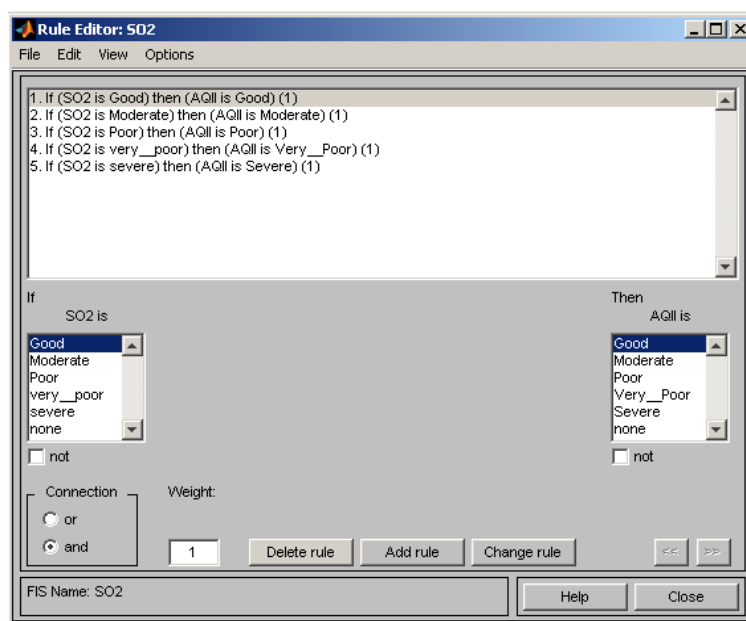

Fig 2 Rule Editor for SO_2

Simulation Result- We applied our suggested model to calculate Air Quality Index and found that our model gives satisfactory simulation results.
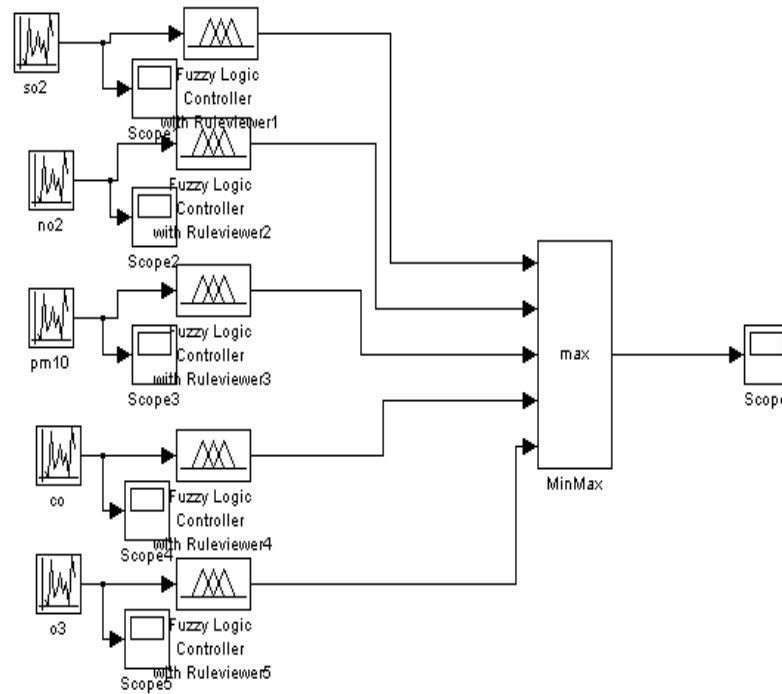
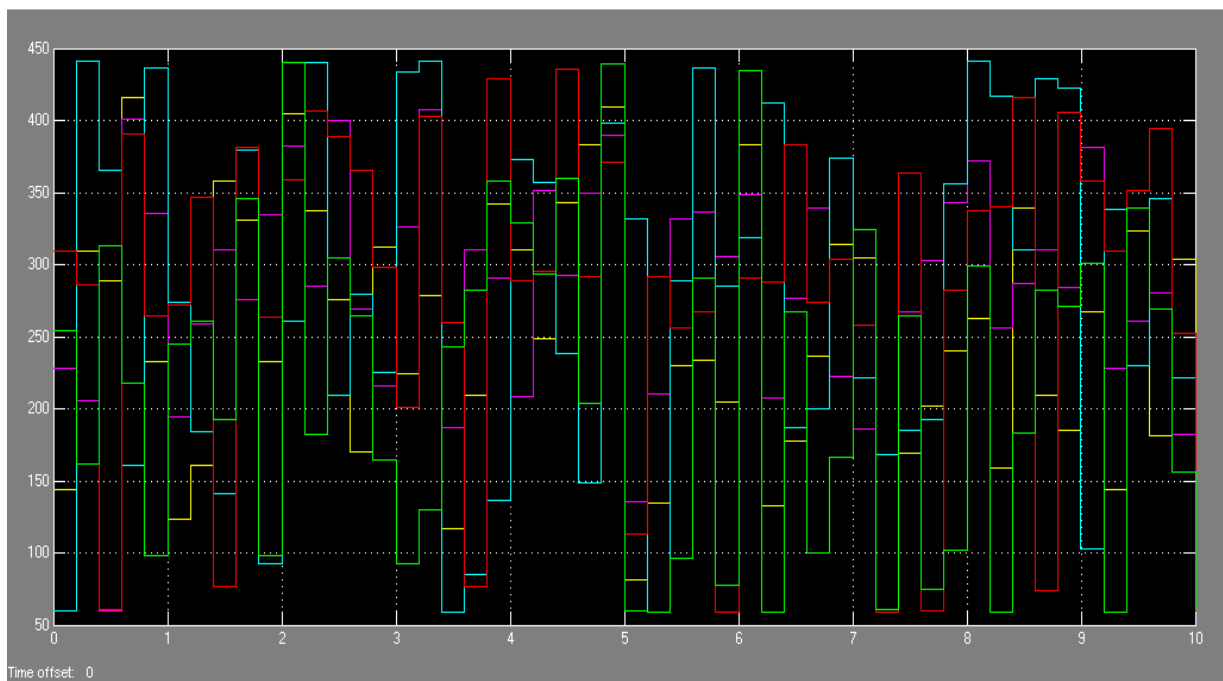Fig 3 MATLAB® Simulation Model for final AQI

Fig 4 MATLAB® Simulation graph containing AQI for all pollutant

IV.   CONCLUSION

Fuzzy rule based system of AQI based model, is the powerful model to give the suggestions to human outdoor activities on particular area. The result of this research work of fuzzy approach has better performance then linear Interpolation Approach used in past working. Our work will help to develop healthy environment in good atmospheric area as well as in polluted area.

V.   REFERENCES

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