

Fuzzy based approach for diet prediction

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Abstract -- In the current era, people are too busy to think about what they are eating and its effects on their health. Over the years there has been an accretion of such diseases due to the loss of nutrition owing to unhealthy diet followed on an everyday basis and motionless life. In this work a method is devised for creating a proper diet plan for people of each age group using data collected from many different sources. A diet list will be proposed to the user by calculating the necessary amount of carbohydrates, vitamins and minerals, milk protein, meat protein, fat and sugar according to the age group they fall in. Fuzzy logic is many-valued logic in which there are various input and output along with the member function. The work will propose a fuzzy logic technique which shows the accurately balanced diet for each age group.

Keyword -- Diet recommendation, Fuzzy logic, FIS editor

I. INTRODUCTION

A healthy diet plays a vital role in a human's life. A balanced diet is useful for maintaining health as well as the prevention of various diseases. A person who takes a balanced diet seems to be fit all the time. Nonetheless, what actually is a balanced diet? A balanced diet includes an appropriate amount of all nutritional groups, such as carbohydrates, minerals, protein, fat and sugar for maintaining the health. All the issues related to the health of a person are related to the diet. In Ayurveda, "Dosha" is a Sanskrit word which is termed as a root of the body. It plays a key role in maintaining bodily health. In the case of plants, all the activity related to their growth will always depend upon the root thus the 'Dosha' acts in the same manner in the human body. If there is little disturbance in 'Dosha' it causes diseases like joint pain, insomnia etc. It also maintains the temperature of the body. If there is unbalance in temperature it leads to various afflictions such as burning sensation in body etc. Seasonal changes also affect the human body. Human being's physical activities also change according to the seasonal variation. In summer lots of energy is consumed in comparison to the winter season. Diet also varies according to the season. With proper diet one can maintain the health and be free from these diseases. In today's age, there are many techniques to predict a healthy diet for a person. In this paper, a fuzzy technique is proposed which gives better results in the real-world problem to recommend a healthy diet that is full of nutrition with different uncertainty.

In medical science, a dietician is a person who prescribes a diet to a person according to age, weight illness and level of physical activity. Dietician having vast and lengthy experience can help one to solve any issue related to health [1]. The diet recommendation of a dietician is not always exact but approximate. The precision in the diet is still important, and the fuzzy logic technique is used to represent the fuzziness of the rest of the parameters [1]. Dieticians always recommend the diet in such manner such as to eat a little after every 2 hours, intake more fruits and vegetables as well as juices etc. and to enforce these in computer language is typical. In our universe, each person is unique and has different characteristics as well as different features. This is believed to be due to the different proportion of 'Dosha' of a person at the time of birth [2]. According to Ayurveda, there are six seasons in a year. Each season consists of 2 months and according to the season, the diet and illnesses will vary. For example, in winter season the people often suffer from joint pain. If a person takes an appropriate diet according to weight and age then there is no need for any medical treatment because the balanced diet itself acts a medicine in Ayurveda [3]. The paper is further organized into various sections Section II discusses the Fuzzy Concept, section III discusses the Fuzzy Ontology, section IV discusses the Literature Review, section V discusses The Work itself, section VI discusses the Results, and the last section discusses the Conclusion of the paper.

II. FUZZY CONCEPT

As there is an adaptive change in technology the complexity of the system also increases, so it's become very difficult and impossible to manage the uncertainty in data in the form of ambiguity. In the real world complex problem finding an accurate solution is typical. So, for this uncertainty, the term introduced is the fuzzy logic.

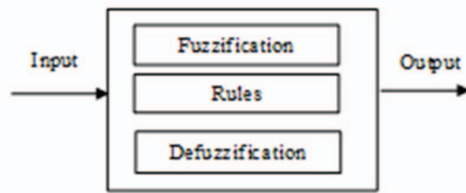


Fig 1: Block diagram of Fuzzy

Fuzzy logic was first introduced by the Lotfi A. Zadeh in the year 1965. It is a mathematical tool which is used for dealing with the uncertainty of data that exists in a complex problem. Fuzzy logic is a form of multi-valued logic that deals with the approximate value lying between 0 and 1. A 'crisp logic set' is one that deals with either 0 Boolean false or 1 Boolean true but not approximate. In a binary set, there are two values that are either 0 or 1 which then find the solution to a problem. Fuzzy logic variables have truth table whose values lies between the 0 and 1. In the Fuzzy logic technique, the linguistic variables are used. According to the current scenario, one of the most successful technologies is Fuzzy logic technology, that is used for developing the control system. It is a technique that is used to generate a precise solution based on the problem [4]. Fuzzy logic diagram consists of three parts i.e. input, output and member function. In Fuzzy it is provided several inputs and outputs. Based on the inputs it will create various rules for any problem. There are some terms used in Fuzzy Problems which have been defined below.

A. Fuzzy Set

A Fuzzy set is the sets on universe N which can accommodate the degree of membership. A fuzzy set F contains an object x to degree $f(x)$, then Degree $(x \in F)$ then map $F: X \rightarrow \{\text{membership degree}\}$ is known as membership function which equals to the degree in which x is an element of $F: X \rightarrow [0, 1]$. It represents the degree values lying between 0 and 1.

B. Fuzzy Set Type

Type-1: Fuzzy linguistic set can operate under some specific conditions. In day to day life, each person has different perceptions under the same situation. In type-1 user can determine the degree of achieving the characteristics of an object. Fuzzy set generates the building block by using fuzzy IF-THEN rules. IF part of rules is antecedent and THEN part is consequent. If high uncertainty level of data related to diet is present, then type-1 fuzzy set goes down.

Type- 2: Fuzzy linguistic set (FLS) has the ability to handle high-level uncertainty in data. Membership function value for each member of a fuzzy set lies between 0 and 1. In the case of a type-1 fuzzy set, the member function value does not exactly lie between 0 and 1. Type-2 FLS include a footprint of uncertainty and it can also exactly determine the degree of achieving the characteristics of an object. It produces the output in certain intervals. The footprint of uncertainty (FOU) provides an additional degree of freedom that makes it possible to directly model and handle uncertainties [5].

III. FUZZY ONTOLOGY

Classical ontology is not efficient enough to deal with imprecise and vague knowledge. It does not give an accurate result in case of a high level of uncertainty and is also not exact when the values lie between the 0 and 1. Fuzzy ontologies always provide imprecise solution [5]. It is a method that is used for characteristics of one object and its relationship with other characteristics of another object.

Fuzzy ontology shows the hierarchical relationship between the antecedent and consequence. It always shows the exact values which lie between 0 and 1 in case of a high level of uncertainty. The fuzzy ontology model could be used to determine individual dietary status to propose the most suitable and healthy dietary plan for an individual [6].

Fuzzy ontology consists of tuple such as $\langle I, C, R, F, A \rangle$ [2]. It is the set of individuals called instance. C is the set of concepts. Consider the fuzzy set F on the domain $C: I \rightarrow [0, 1]$. E is the set of entities. It indicates that $E \rightarrow C \cup I$ where R is the set of relations so that $R \in R$ fuzzy relation in the domain is $R: E \rightarrow [0, 1]$. The Fuzzy ontology is capable of dealing with the fuzzy logic.

IV. LITERATURE REVIEW

Mei-Hui Wang et al.[5] proposed a technique which is based on the type -2 fuzzy set and type-2 ontology knowledge used for personal diabetic diet recommendation. It focuses on maintaining such type of system which judges the diabetic level. In this paper, it creates the nutritional facts on the basis of the common food of the Taiwanese. According to the age he recommends a diabetic diet.

M.K. Ojha et al [7] proposed an intelligent diagnosis of human disorders based on Ayurveda using fuzzy logic. It focuses on Ayurveda treatment. It uses the fuzzy logic technique.

It creates a certain set of rules for diagnosis and prove the performance of the system satisfactory.

In Alexander et al [8] a software called Nutri-Expert in fuzzy technique and heuristic search is used. It always provides better mathematical modelling of the nutrition problem. This mainly focuses on the type of diseases such as diabetes and according to the disease type of diet is recommended.

Jaya et al. [6] used fuzzy ontology for diet recommendation. This paper also shows that an unhealthy diet leads to illness. If the person follows a healthy diet, then they feel better and being healthy is taken as the prevention of any medical treatment. A rich food contains a certain amount of calories. Calorie also varies according to the age and weight of the human being. 2200kcal per day is recommended to adults including physical activity but it's too much for those who do not do any physical activity and also for fatty people so less amount of calorie intake is recommended to them. The data for the user is retrieved from the ontology based on the rules and queries. This will sure that person will take a healthy diet according to his body condition and body preferences.

Chang-Shing lee[9] describes the genetic fuzzy markup language that is used to describe the knowledge base and rule of the diet domain which includes the six main food categories. It is used to build fuzzy food ontology which is used to collect the nutritious meal. This provides the healthy dietary level of food eaten in one day. It also compares the result with the diet recommended by the dieticians. This paper also shows that the GFML based mechanism is workable for diet-domain.

V. PROPOSED WORK

In this fuzzy logic is used to recommend a healthy diet plan for people from different age groups. With the help of fuzzy variable and fuzzy sets generate the food ontology by using fuzzy ontology[10-15]. The diet is also affected by religion, culture and lifestyle. In this, a certain amount of data was collected from various websites and books. A healthy diet is always depending on some factors such as age, weight etc. In this work, the user enters two input age group and nutrition. From collected data, the database is generated by fuzzy ontology when a certain input is provided by the user.

VI. EXPERIMENTAL RESULTS

For this work, data was collected from websites and books based on recommendations by various dieticians. After that the collected random data was put in the excel sheet and aligned in order. There are two input fields and one output. It includes four age group children, youth, adults and seniors.

It contains five nutrition factors such as carbohydrates, vitamins and minerals, meat protein, milk protein, fat and sugar. Food includes vegetables, green leafy vegetables, chicken, egg, milk, cereals, fruits, sugar etc.

The dataset is proposed in the fuzzy toolbox. For fuzzy toolbox first, open MATLAB and write fuzzy in command window then fuzzy dialog window opens as shown in the

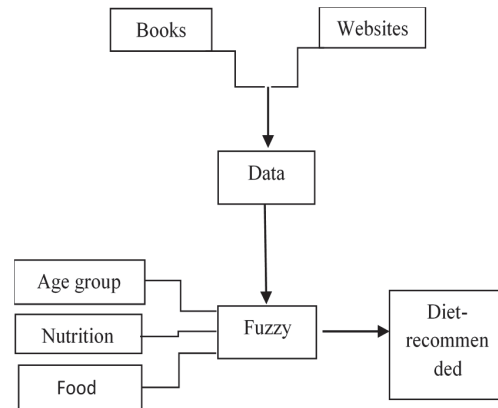


Fig 2: Model for diet recommendation

snapshot below. Here we provide a various number of inputs and it depends upon the user how many inputs they need. In this diet prediction, there are two inputs Age group and Nutrition. There is only one output that is recommended percentage of diet per day as shown in Fig 3.

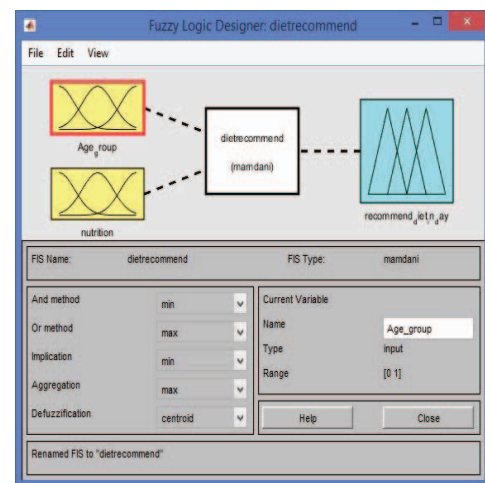


Fig 3: Selection of two inputs and one output

For creating the membership function click on any input here and then add various membership functions as shown in Fig 4.

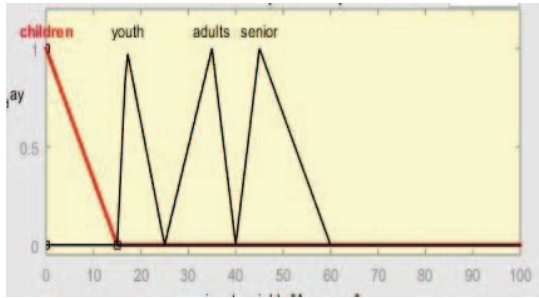


Fig 4: Membership function plots

For creating a rule double click on Mamdani then the dialog box opens in which all the input, as well as output, shown. Here rules are created according to each age group i.e. how many calories required per day. For example, in the case of children 33% of carbohydrates are required per day. In this work, there is the authority to change the rules in various manners, such as, a choice can be made to show in an indexed format then see all the rules that are generated in index format. The rules for input/output membership function.

- If (Age_group is children) and (nutrition is carbohydrates) then (recommend_diet_in_day is 33%) (1)
- If (Age_group is youth) and (nutrition is vitamins_and_minerals) then (recommend_diet_in_day is 50%) (1)
- If (Age_group is adults) and (nutrition is protein) then (recommend_diet_in_day is 20%) (1)
- If (Age_group is senior) and (nutrition is fat_and_sugar) then (recommend_diet_in_day is 20%) (1)

Rule-viewer:

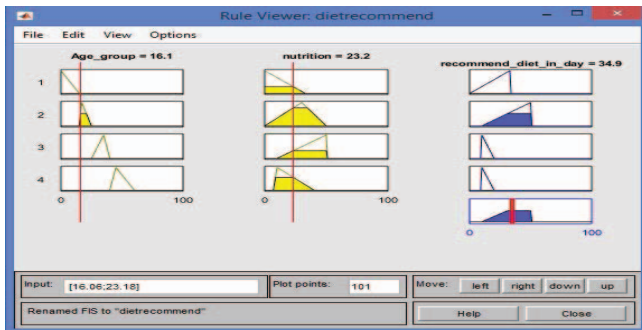


Fig 6: Rule view for input/output membership function

Surface view represents the mapping between the age group and nutrition as shown in Fig 7.

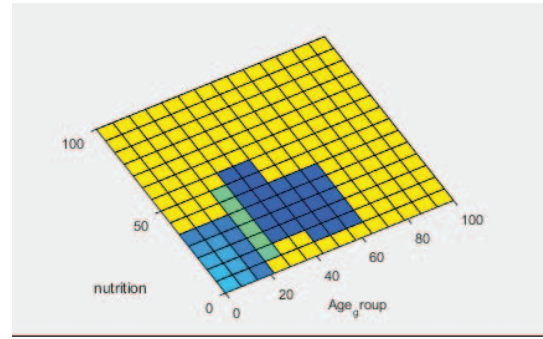


Fig 7: Surface View between age group and nutrition

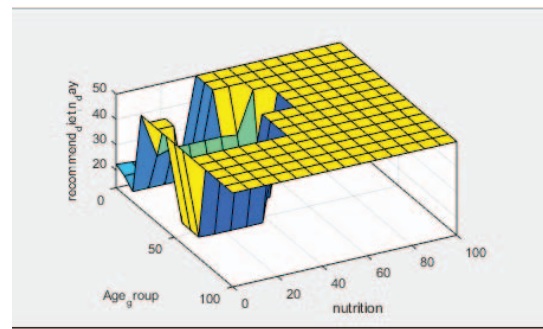


Fig 8: Surface View between food, nutrition and diet recommended

VII. CONCLUSION

Fuzzy logic is providing a good solution for a real-world problem. The proposed methodology recommends the diet plan by using the fuzzy logic. According to the experimental results, the recommended diet is more accurate than the diet taken from the dietician. If the age group is children, nutrition taken by the child is 23.2 then according to this, the diet recommended in the day is 34.5%. So the diet recommendation shows the precision value. In the increasing age, the diet taken by the senior or old age people is not more than 50%. Results show this and if the age is growing like at children stage then at that time the diet taken is more as shown by experimental results. The precision value is more than recall value, so it means the analysis shows a good result.

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