

Design and Development of an Intelligent Diet Recommendation System for Metabolic Disorders Patient

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Introduction

“Eat your food as your medicines. Otherwise, you have to eat medicines as your food.”, is the best-awarded words in London. The main sources of the maximum health-related problem are coming from our diet, nutrition, and daily lifestyle. According to the World Bank, India is one of the highest-ranking countries in the world for the number of children suffering from malnutrition. Global Hunger Index (GHI) Report by IFPRI ranked India 100th out of 118 countries with a serious hunger situation. Amongst South Asian nations, it ranks third behind only Afghanistan and Pakistan with a GHI score of 29.0.

As we know that mainly in developing countries like India are having the largest number of adults under the grip of many health-related issues. Reasons are well-known facts that are the root causes: the mismanaged lifestyle especially unhealthy diet, physically inactivity playing a key role. The absence of diet plan as per energy criterion is one of the major factors that is to handled intelligently. As we know that the rapid change in food habit and lifestyle of South East Asian are generally high rates of cardiovascular diseases, diabetes, cancers, and Metabolic disorders diseases.

Nowadays for a Metabolic disorders patient's diet management with proper nutrition is very important but in our busy lifestyle, we sometimes can't decide which food, what amount has to take to maintain proper nutrition. However, each person with a different lifestyle, different food habit creates a selective diet plan. Since Soft Computing Fuzzy tools are so close to the human way of thinking, Soft Computing tools-based decision making is effective for developing such kind of system that helps us to provide which food and how much it is better according to our personal information, physical activity, environment, food habit etc.

Based on nutritional information data and observed patient physical conditions, environmental situations, daily lifestyle, food habits we developed a Soft Computing based decision-making system. The main object of the current study is to propose a new algorithm to solve the daily nutritional requirement with proper ratios of the macros (carb., protein, fat, and fiber) according to the patient's information using utility matrix and maximizing Fuzzy set concept.

Ideas

First, we required a nutritional Knowledge Base (KB), which we collected from a mobile application software HealthifyMe. As we know that our daily required calorie not only depends on our physical information like sex, age, height, weight also it is depended on our environmental conditions. As an example, it is required more calories in winter than in summer also in high altitude area public required more energy than in low altitude area. So, such kind of barriers is removed in this study. After taking this kind of factors for calculating the daily required calories according to the patient's food choice our recommendation system suggests the patients which food is better for dinner menu for maintaining the proper nutritional ratio. To validate the result of the proposed system here we have used the degree of match algorithm with the suggestions of a nutritionist. Also, here we have elaborated a sensitivity analysis for small perturbations in the values of patient's food choice to the overall output.

Experiment

Here we have taken a diabetic patient from middle India. The input 1,2 and 3 data of this patient is given in table 1, table 2 and table 3 respectively.

Table 1 - INPUT 1.

INPUT 1a				INPUT 1b		
Sex	Weight	Hight	Age	Phy. Act.	Temperature	Altitude
Male	70kg	173cm	25years	90mint/Day	27°C	98m

Table 2 - INPUT 2

Items	Quantity	Amount	Carbohydrate	Protein	Fat	Fiber
Breakfast						
Tea	1cup	250ml	11.5	4.2	4.4	0
Ankurit Chana	½ katori	50gm	6.7	2.1	0.7	1.9
Mung	¼ cup	51gm	28.9	12.2	0.7	8.5
Puri	3 pcs	75gm	32.7	6.0	8.0	4.9
Launch						
Tawa Roti	4pcs	140gm	69.4	12.1	1.7	10.7
Rice	1katori	100gm	25.6	2.5	0.3	0.4
Cabbage Subzi	1katori	100gm	4.7	1.9	4.2	2.8
Boondi Raita	1katori	150gm	8.1	3.9	7.9	0.8
Evening Snack						
Boiled Egg	2pcs	100gm	1.9	12.3	12.3	0
Banana Shake	1glass	250ml	29.3	6.5	5.5	1.3

Table 3 – INPUT 3 (Interested items for Dinner)

Item	Carbohydrate	Protein	Fat	Fiber
Roti	17.4	3.0	0.4	2.7
Rice	25.3	2.5	0.3	0.4
Mixed Veg	5.3	1.8	3.0	2.1
Soyabean Badi Sabji	7.1	4.9	4.0	2.8
Chicken Curry	5.6	19.2	3.8	2.4
Arhar Dal	21.6	7.4	2.0	3.8
Green Salad	3.2	1.4	2.1	1.5
Hot Milk	11	8	10.2	0

We first calculate required Total Calorie i.e. near about 2335.4 according to the above information.

Then for this particular patient we calculate daily required calorie from carb i.e. about 1284.5, protein i.e. about 525.5, Fat i.e. about 624.3 and fiber about 34gm. For easy of calculation, we convert these number of nutrient calories to gram format in an array i.e. [321.13, 131.37, 71.36, 33.73].

After applying our algorithm, we get the Fuzzy Optimal value for each alternatives i.e. choice Dinner items.

Fuzzy Optimal Alternative								
$A^{optimal}$	0.47 _{Roti}	0.36 _{Rice}	0.87 _{Mix.Veg}	1.00 _{Soya.B.S}	0.85 _{Chicken.C.}	0.66 _{A. Dal}	0.95 _{G.Salad}	0.94 _{H.Milk}

So according to our experimental result, we suggest this patient for 1st preference take **Soyabean Badi Sabji**, 2nd preference **Hot milk**, 3rd **Green Salad**, 4th **Mixed Veg**, 5th **Chicken Curry**, 6th **Arhar Dal**, 7th **Roti**, 8th **Rice**.