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## Diet system using modified RETE algorithm

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### ABSTRACT

People across the globe are becoming more conscious regarding their weight, eating more healthy food and avoiding junk food. A system that can measure calories and nutrition in everyday meals can be very useful for maintaining our health. Calories and nutrition measurement system is very beneficial for the people to measure and manage their daily food intake. Dieticians are educated with nutrient value of foods; hence they can provide a diet based on a person's eating timing, height and weight. The system is an expert system so it asks all this data from the user and processes it. The system stores and processes this data and then calculates the Body Mass Index and Body Fat and provides the user with a personalized diet to fulfill their goals.

**Keywords:** Modified RETE Algorithm, BMI, BMR, Expert System, Diet.

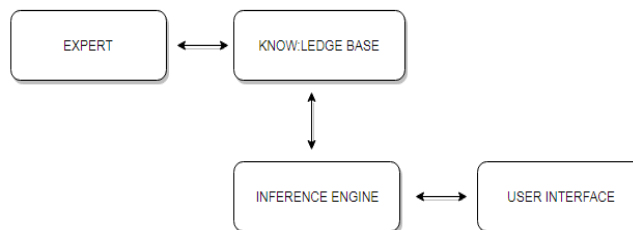
### 1. INTRODUCTION

Nowadays, people are suffering from many issues regarding their fitness and also following a proper nutritional diet. Often at times, people seek out dietetic care for concerns about their weight. While this is common, before you seek out a dietician, one needs to make sure they are ready to commit to the appropriate number of consultations, the care regime they recommend, and the eating and lifestyle behavior changes that the dietician recommends. Our proposal will provide the user with a system which suggests a diet based on the user's height, weight, eating habits and age. The system will use Artificial Intelligence so that the system can make intelligent decisions. The system has been trained with large data set of food varieties and their nutritional values. Once the system has the user's body mass index, it needs to know about the eating habits of the user. The user has to provide information regarding his breakfast, dinner and lunch timings. Once the system has this data, it suggests the user a diet plan as per the user's Body Mass Index. Thus, the need to travel to a dietician can be eliminated.

### 2. ADDITIONAL BACKGROUND

#### A. Expert System

The field of expert systems is the most important applied area of Artificial Intelligence. An expert system (ES) is a knowledge-based system that employs knowledge about its application domain and uses an inference (reason) procedure to solve problems that would otherwise require human competence or expertise. Expert systems gain their knowledge from the expert who has knowledge about a narrow domain stored in the expert systems knowledge base.



Components of expert system are:-

**Expert:** Experts provide the necessary information on which the system is built. Their experience and knowledge regarding the subject contributes to a credible system. Multiple experts are generally needed for large systems.

**Knowledge engineer:** The knowledge engineer has two tasks. The engineer should be able to gather and analyze the knowledge from the expert. Intelligence, tact, empathy, and proficiency in specific techniques of knowledge acquisition are all required from a knowledge engineer. Knowledge can be acquired via interviews with varying degrees of structure, analysis of protocols, observing experts at work and analyzing it.

**Knowledge Base:** The knowledge base of an expert system consists of both factual and heuristic knowledge. Notions must be represented in the Knowledge Base as actions to be taken under circumstances, causality, time, dependencies, goals, and other concepts.

**Inference Engine:** Facts of a specific case are combined with the knowledge contained in the Knowledge Base for a recommendation. The orders in which the production rules are applied are controlled by the inference engine, in a rule-based expert system.

**User Interface:** This is where the user is asked to enter all the information, and this is the source of input that can be used by the Inference Engine.

### B. Benefits of Expert Systems

- An Expert System can complete its part of the tasks much faster than a human expert.
- The error rate of successful systems is low, sometimes much lower than the human error rate for the same task.
- Expert System makes consistent recommendations.
- Expert Systems are a convenient vehicle for bringing to the point of application difficult-to-use sources of knowledge.
- Expert Systems can capture the scarce expertise of a uniquely qualified expert.

### C. Limitations of Expert Systems

- Limitations of the technology
- Problems with knowledge acquisition

### D. Modified RETE Algorithm

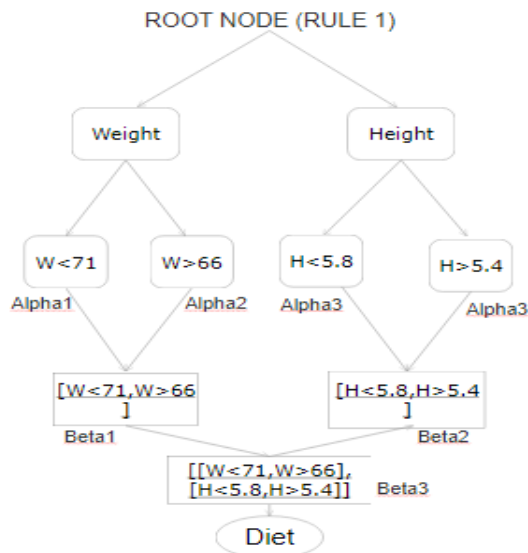
The RETE algorithm is a pattern matching algorithm designed by Dr Charles L. Forgy of Carnegie Mellon University. RETE is a Latin word which means net. It is a very efficient algorithm for matching facts against the patterns in rules. Understanding of the RETE algorithm will make it easier to understand as to why writing rules In one way is much more efficient[1].

The RETE network is a direct acyclic graph that consists of nodes representing patterns in the conditions of the rules. The nodes behave like filters; they test the incoming token and send only those that have passed the test. The RETE network consists of two parts: alpha network and beta network. Alpha network consists of nodes known as alpha nodes. Each alpha node consists of one input that defines intra-elements. Beta nodes are components of Beta network where two inputs are taken from each node so as to define inter-element conditions.

A token is created from the assertion of each fact. Initially the tokens enter the root node, for each token type, the network then split a branch. A copy of the token is received by each kind node and it then performs a SELECT operation to select similar tokens. Alpha nodes receive a copy of token node from the kind node. On receiving the token, the alpha nodes perform a PROJECT operation and from that token components are extracted that match with pattern variables. The conditions are basically evaluated by the alpha nodes. The possible cross product for a rule is then determined by the Beta node. Then, finally rules containing action will be executed.

The RETE network begins with a root node called as the RETE Node. A major drawback of RETE is that it is limited to only one root node and the entire process is based on only one parameter. We will be making use of three parameters and these parameters will play a crucial role in determining the diet. Age, Body Mass Index and Body fat of the user will be taken into consideration. Upon calculation of these, assigned rules will be fired and a diet will be selected from our knowledge base. This diet will then be modified taking into consideration the preferences and medical conditions of the user. The user will also be provided with the option of searching for alternatives.

Example: IF weight <71 or weight>66 and Height>5.4 or Height<5.8 we will get a particular Diet.



### 3. PROPOSED APPROACH

The system will provide the user with user interface where the users have to register and login accordingly. The user also has to enter their details such as measurements (height, weight, and age), their goal and medical conditions. All this input will be used by the inference engine which will match the input with the data present in the knowledge base using a pattern matching algorithm. There are many such pattern matching algorithms like Decision tree algorithm, Genetic algorithm [4] but best algorithm for expert system application is RETE algorithm.

Our application will use the input and calculate the BMI and BMR (Basal Metabolic Rate) match this BMR with the database stored in the knowledge base. The data stored in the Knowledge base is taken from the real and highly qualified dietitians, so the data is accurate. Our application is designed to give user a feel that they interacting with a real human expert. After data matching is done, the application will give a proper diet according to a particular user.

The formula for BMI is:-

$$\text{BMI} = (\text{Weight In Kilograms} / (\text{Height in Meters} * \text{Height in Meters}))$$

Category	BMI range -kg/m <sup>2</sup>
Severe Thinness	<16
Moderate Thinness	16-17
Mild Thinness	17-18.5
Normal	18.5-25
Overweight	25-30
Obese Class I	30-35
Obese Class II	35-40
Obese Class III	>40

BMR formula:-

For females = 10 x (Weight in kg) + 6.25 x (Height in cm) - 5 x (age) - 161  
 For males= 10 x (Weight in kg) + 6.25 x (Height in cm) - 5 x (age) + 5

These equations are multiplied by the physical activity factors to estimate daily caloric needs.

The physical activity factors are:-

- 1.2 for sedentary people
- 1.3 for moderately active

- 1.4 for active people

The diet will have four sections. First section will have food items for breakfast along with their nutritional value; second section will have food items for lunch. Third and fourth sections will have food items for evening snacks and dinner respectively. The user can also find a alternative food item for any food with the same nutritional values. The application will also provide a set of exercises that can be carried out by the users but only according to their medical conditions. Just as the option to find alternative food items, the user will also have the option to find an alternative exercise. This will help the user find a variety of options thereby ensuring the satisfaction of the user.

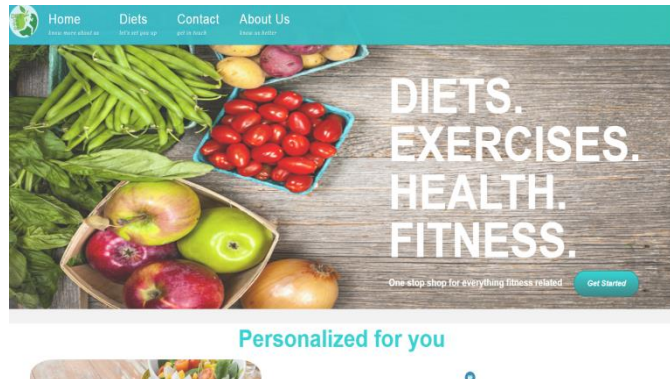
Some of our database regarding nutritional value are given below.

ID	F_Name	Calories	Carbs	Fats	Fibre
Filter .	Filter	Filter	Filter	Filter	Filter
1	Apples	49.05	11.83	0.1	1.97
2	Apricots	51.6	11.96	0.42	2.15
3	Avacado	190.0	1.9	19.5	3.4
4	Banana	95.0	20.9	0.3	4.2
5	Blackberries	25.25	5.1	0.2	3.1
6	Blackcurrants	28.0	6.6	0.0	3.6
7	Blueberries	57.0	14.49	0.33	2.4
8	Cherries	39.0	9.5	0.1	0.7
9	Clementines	47.0	12.02	0.15	1.7
10	Cranberries	15.0	3.4	0.1	3.0

ID	F_Name	Calories	Carbs	Fats	Fibre
Filter	Filter	Filter	Filter	Filter	Filter
23	Limes	25.2	8.9	0.2	2.4
24	Loganberries	17.0	3.4	0.0	2.5
25	Lychees	58.0	14.3	0.1	0.7
26	Mango	57.0	14.1	2.6	0.7
27	Melon	34.0	8.2	0.2	0.7
28	Nectarine	35.9	8.0	0.1	1.1
29	Olives	164.1	3.5	16.2	3.1
30	Oranges	37.4	8.5	0.06	1.7
31	Papaya	26.1	6.6	0.1	1.2
32	Passion Fruit	36.0	5.8	0.4	3.3

#### 4. SYSTEM INTERFACE





## 5. COMPARISON WITH EXISTING SYSTEM

Name of Application	Disadvantage	Advantages
My Fitness Pal	Does not provide direct and complete diet.	Keeps a track of users complete nutrition intake.
My diet Coach pro	It is a paid app and mainly based on Us food products	Calorie Counter, reminder.
HealthifyMe	Most of the services in app are paid and user do not get a proper diet.	Personalized Coach(Paid)
Lose it	Important features are paid and diet is not clearly given	Allows to connect to fitbit

## 6. ADVANTAGES

- User can get free diet plan for free.
- User will be able to get a diet which is recommended by various experts and not just one dietitian.
- User can save time and money of going to a physical dietitian.
- We will also provide tips and instructions about various exercise to keep a user healthy.
- Android Application and web application are using security mechanism as well as investigation mechanism in case of security breaches as listed from [8] to [13].

## 7. LIMITATIONS

- Cannot connect to fitbit as of now.
- Don't have personal coach.



## 8. CONCLUSIONS AND FUTURE WORK

The system is a useful tool for educating users on nutritional related topics with the help of large and reliable database created with help of expert dieticians. Many people consult a dietician when in need of a proper diet to go with their exercises. Since, our proposal will help the people with the diet; they will not need to visit dieticians. Our diets will be provided by professional dieticians thus eliminating any or all fears the users have regarding our diet. The users will be getting diet delivered to their screens for them which will save time as well as money as the services provided by our project will be free of cost, unlike other options on the market currently. The end-user application will be built on an Android platform and web platform with a simple and efficient human-device interface. Our application is using artificial intelligence algorithm called RETE algorithm so each and every user will get a personalised diet according to their need and preferences.

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