BMI-Aware Diet Planning and Personalized Nutritional Recommendation Using Rule-Based and LLM Reasoning Systems

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Abstract: In today's modern world, unhealthy eating habits and busy lifestyles have become major contributions to health issues like obesity, malnutrition and chronic diseases. Even though there are many standard nutritional guidelines many individuals fail to follow because of various reasons [1],[2]. The reasons may vary from person to person such as based on their age, previous health conditions, personal choices etc. So they find it difficult to follow and adapt generalized nutritional plans that are available.

Many users are looking forward to having their own personalized nutritional plan rather than any other generalized nutritional plans. To overcome this challenge, this research proposes a customized nutritional plan for every individual by collecting data from user inputs like age, gender, height, weight, health conditions, personal choices, tastes etc[3].[5],[7]. Our project is aimed to use a rule-based system that gets predefined rules from the standard nutritional guidelines which are useful to make a free from danger and clinically accepted diet plans for each BMI category by filtering unsuitable, unhealthy foods and maintaining proper nutritional balance [4], [6].

The result of our project is a user-friendly and smart nutrition recommendation system that gives accurate, personalized, and preference-aware diet plans. By combining health data evaluation with NLP techniques, our project helps users follow healthier diets while still enjoying foods of their tastes and cultural preferences [5].

Index Terms: BMI Calculation, Personalized Diet Planning, Nutritional Recommendation, Rule-Based System, Large Language Model, Health NLP, User Food Preferences.

I. INTRODUCTION

In today's busy world, it is not easy for many people to follow a healthy and balanced diet. People are busy with their daily work and their eating habits change based on their lifestyle and culture. Also, every person has different nutritional needs. Because of this reason, common diet plans that are the same for everyone are not suitable for all individuals. So many people are not able to follow these general diet suggestions properly [1], [2].

Due to this problem, researchers started looking for better solutions that can give diet plans based on each person's needs and preferences. With the development of artificial intelligence, new diet recommendation systems are being designed which are better than normal diet charts [3], [4]. These systems use different types of user data such as age, BMI, food habits, and nutrition values to suggest suitable meals. The main aim is to provide food recommendations that are healthy and also match the user's taste and health goals.

Many machine learning models like Random Forest, XG- Boost, and neural networks are used in these systems to analyze food and health data [6]. By using these models, the system can understand patterns in the data and give more accurate diet suggestions. Some systems also provide easy filtering options so that users can select meals based on their preferences in a simple way.

Other related research focuses on creating personalized weekly meal plans by considering seasonal foods and food

variety [8], [12]. These systems use trusted food databases and follow nutritional rules to maintain proper balance of nutrients in the meal plans. This helps in making the diet plans practical and easy to follow.

Overall, these studies show that general diet guidelines are slowly changing to personalized and smart nutrition systems. As more health data is available, these systems can help people follow better eating habits and maintain good health. This project aims to develop an AI-based nutrition recommendation system that is simple for users and also follows proper machine learning methods.

II.   PROBLEM STATEMENT

Unhealthy eating habits and busy lifestyles have made it difficult for many individuals to follow balanced and healthy diets. Most existing diet plans provide generalized recommendations that do not consider individual personal choices, food preferences and basic health conditions. As a result, users find these plans hard to follow. Although some nutrition systems use advanced technologies, they may generate complex outputs which are not understandable by users so it leads to reducinguser trust. Therefore, there is a need for a simple, safe and personalized nutrition recommendation system that uses BMI supported by rule-based logic and provides clear, understandable explanations to help users make better dietary choices.

III.   OBJECTIVES

- To design a BMI-based nutrition recommendation system that categorizes users into appropriate health groups.
- To apply rule-based nutritional guidelines for generation of safe and clinically acceptable diet plans.
- To personalize diet recommendations based on user in- puts such as user personal preferences and basic lifestyle details.
- To use a large language model to represent diet plans along with explanations in simple and user-friendly language.
- To develop a system that is easy to use and adaptable for future enhancements.

IV.   LITERATURE REVIEW

In the current situation, many people are thinking more about their health and its problems because of their lifestyle. Based on this, many new diet plans and food systems are given by computers. As the studies show that bad eating habits and no personal diet plans are the reasons to cause problems like obesity, less nutrition, and other health problems. So scientists started making automatic systems that use Body Mass Index (BMI) to give food advice for each individual [1], [4].

BMI is used in many diet systems because it is easy to categorize people into groups like underweight, normal, overweight, and obese. But many old BMI systems give the same diet plan to each user and do not think about what each person likes to eat, preferences or lifestyle [2], [8].

To overcome this issue, rule-based diet systems were made [4], [6]. These systems follow a set of standard food rules from nutrition guides to give meal ideas for different BMI groups. Rule-based systems are easy to understand and give correct results but sometimes they are too hard for people to follow. To make it easier, some researchers added natural language methods. These systems try to explain food advice in a simple and understandable language. So it is easier to read, but still the system cannot answer all questions or change food options for each person as they require.

There are many updates in Large Language Models in current days available for creating a particular and personal guide to better people's health [5], [9], [10]. LLMs can give natural and simple explanations based on user input. Many studies show that combining rule-based logic with language models can help users understand the diet plans better [5], [10]. When we use computers to help with health things they can make mistakes. Give bad advice. A lot of the tools we have now're good at looking at health information or good at talking to people but not good at doing both. If we only use computers to make decisions they might give us advice that's hard to understand. If we only use rules to make decisions they might not work well for each person.

Our project is trying to do something. We are combining things: looking at health information using rules to make good diet decisions and using a computer program to explain things in a way that makes sense. The system follows the rules that doctors and nutritionists use. It gives people advice in a clear and simple way. The health advice is easy to understand because the system is designed to present it in a manner. Our project is using health analysis and a

language model to make sure people get advice that they can use. This ensures the diet plans are accurate, safe, personalized, and easy for users to trust.

V.   PROPOSED SYSTEM

This project is about a diet system that uses the Body Mass Index, which's the BMI. The BMI diet system helps people to check their health and get some easy to follow food advice. It is really simple to use. Any person can use the BMI diet system without needing to know a lot about things. The BMI diet system is made to be easy for everyone to use.

A. System Architecture
The system is really simple to use. It does things one step at a time. First the system asks the user for some details about the user. Then the system calculates the users Body Mass Index to figure out the users health status. After that the system uses rules to suggest foods that are good for the user. The language model is like a helper that explains the advice in easy to understand words so the user knows what the system is saying about the user's health and the foods that are good for the user.

VI.   METHODOLOGY

A.   Collection of User Information
The system will ask you for some information like your age, your gender, how tall you are, how much you weigh, what you like to do, the food you like and what you want to achieve for your health. It only asks for the things that're really necessary. The system makes sure that the information about you is kept private and safe. Your privacy is important when it comes to the system and your health goals[5].

B.   Input Checking and Data Preparation
The system takes a look at the information to find any mistakes. It checks the height and the weight of the person. If there are entries, these are fixed by the system. The data is then made ready so it can be used for calculation. This really helps to get results when we use the data for the calculation   of the height and the weight.

C.   BMI Calculation and Health Grouping
The Body Mass Index is figured out using a formula [11]. People are put into groups, like underweight, healthy, overweight or obese. The Body Mass Index group decides what kind of food advice people get.
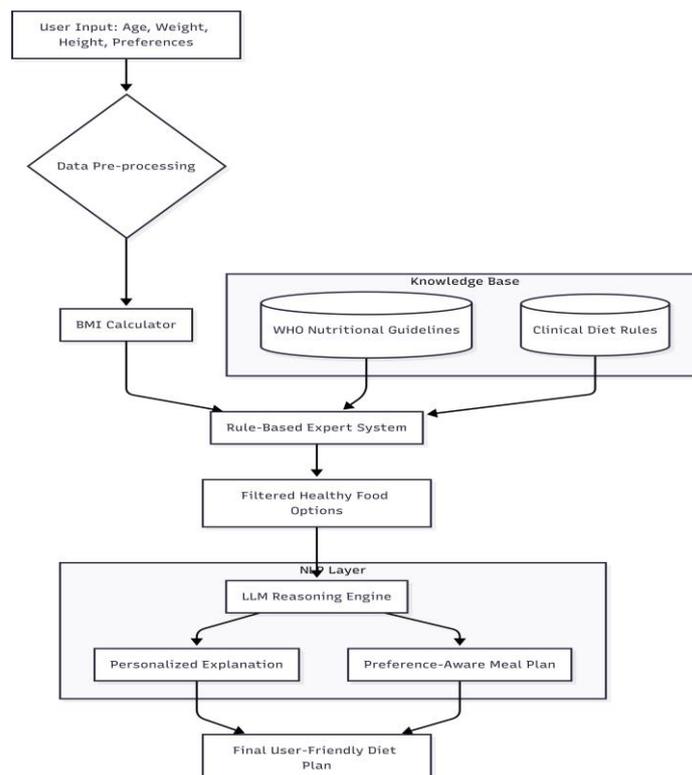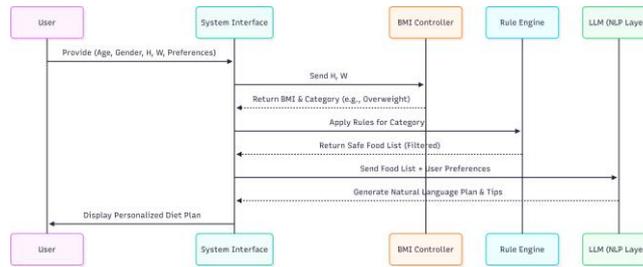
D.   Working Flow

The user provides information about their health. The way they live their life. They tell us about their health and lifestyle. This includes things like what the user eats and how they take care of their body. The user gives us details about their habits and how they stay healthy. The health and lifestyle information from the user is very important.

- The input is checked
- The Body Mass Index is calculated
- The health group has been decided.
- The rules for food are applied. These food rules are important. People have to follow the food rules. The food rules are applied to everything that has to do with food.
- The person is going to get explanations that are added to things so they can understand them better. These simple explanations are added to make it easy for the person to know what is going on. The simple explanations that are added are very helpful.

VII.   RESULTS

The model, developed to generate diet plans based on BMI and also the user preferences we used various data sets like the macronutrients, micronutrients, user preferences , nutritional value and bmi categories [11], [12] and got the conclusions found relations between various columns and understood their relationship between variables and also results are like given the multiple diet plan to flexibly choose alternatives depicted and processed and analysed the data and implemented the rule based logic and finally got the result[4].[6]. The results are as follows,

A.   Individual BMI Predictions Table

This table shows us the Body Mass Index categories and the categories that were predicted for some sample users. It helps us see how the actual Body Mass Index categories are different from the predicted Body Mass Index categories, for these sample users.
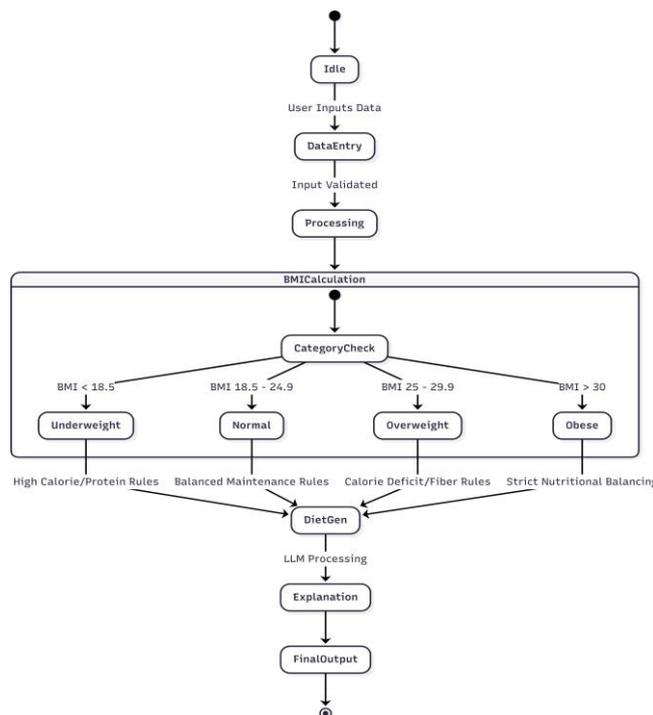
Individual BMI Predictions

Actual BMI	Actual Class	Predicted Class
17.5	Underweight	Underweight
24.1	Normal	Normal
27.2	Overweight	Overweight
31.4	Obese	Obese
29.0	Overweight	Obese

The predictions usually get it right. Match the actual class. There are a few mistakes and these mistakes mostly happen near the category boundaries. The predictions and the actual class are usually a match and this is what we see most of the time.

B.   Confusion Matrix (BMI Categories – Tabular Form)
This chart is really helpful because it shows us how many people got the body mass index classification and how many got the wrong body mass index classification. The body mass index classifications are either correct or incorrect. This chart tells us how they are spread out.

When you look at the numbers, the high numbers are good because they mean the predictions were correct. The numbers that are not on the diagonal are also important. It is nice to see that they are low which means there were not many mistakes.

The predictions and the actual results match well when the diagonal has values and this is why we want to see high values for the predictions that are correct like the predictions from the machine learning model and low values for the predictions that are not correct which are the off-diagonal values.

	Predicted Violation	Predicted No Violation
Actual Violation	58	2
Actual No Violation	3	57

C.   Accuracy Comparison Graph
This bar graph presents accuracy, precision, recall, and F1- score of the system.
The metrics we have are all really good, above 90 percent. This means the performance of the metrics is strong and we can rely on them. The metrics are doing a job.

Accuracy Comparison Graph

	Accuracy	Precision	F1-Score	Recall
	93.0%	94.7%	95.7%	96.7%
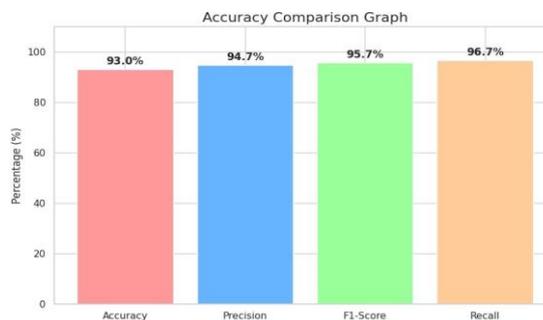
D.   Performance Metrics Table
This table gives us an idea of how the system is doing. It shows the points of the system evaluation metrics. The system evaluation metrics are what we are looking at here.
The fact that we have an error rate and we get high scores shows that the BMI-based rule system really works. We can see that the BMI-based rule system is effective because of these results, from the low error rate and the high scores of the BMI-based rule system[4].
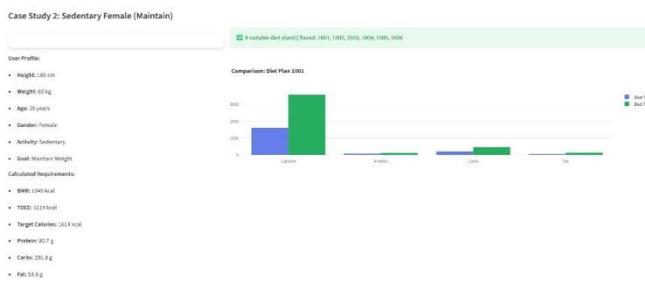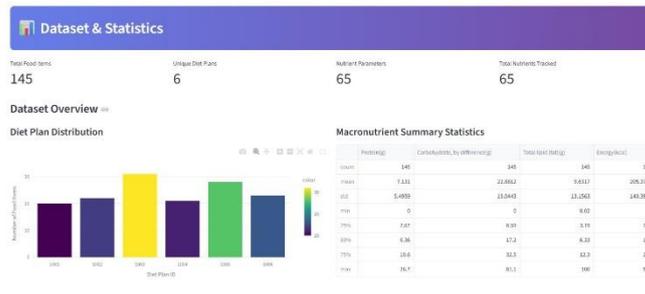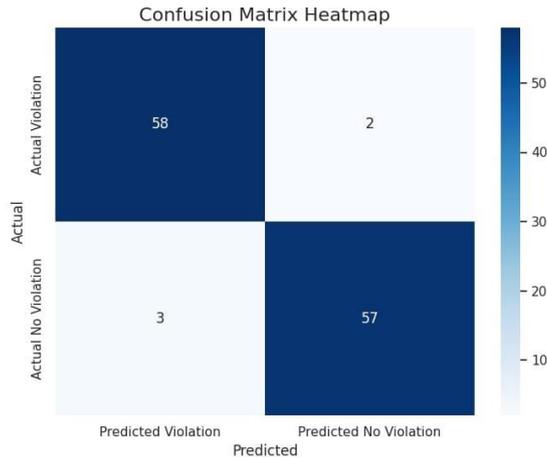
E.   Confusion Matrix Heatmap
The heatmap is a way to show how good or bad the predictions are by using colors. It uses color intensity to show what the computer got right and what it got wrong. The heatmap is really good, at showing predictions and incorrect predictions.

Most values are concentrated on the diagonal, showing fewer misclassifications and high accuracy.

Confusion Matrix Heatmap

Metric	Value
Accuracy	93%
Precision	94.7%
Recall	96.7%
F1-Score	95.7%
Error Rate	7%

Aggregated Diet Plan Nutritional Values

Diet Plan Nutrient Heatmap
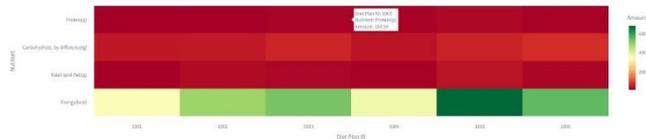
Sample User Profiles & Recommendations

Case Study 1: Active Male (Weight Loss)
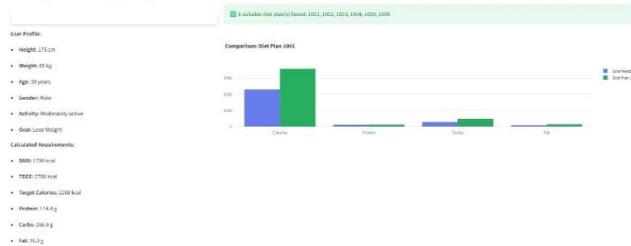
Sample Food Items by Diet Plan

Macronutrient Distribution Analysis

Macronutrient Distribution by Diet Plan
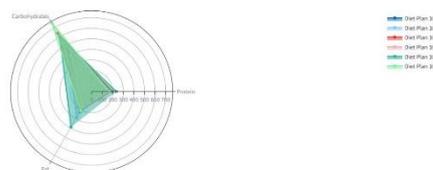
VIII.   DISCUSSION

The results of this project show that using Body Mass Index as a health indicator is a good way to plan diets for people. Body Mass Index is used along with dietary rules and explanations that people can understand[1],[2]. This system looks at a person's health using Body Mass Index. Gives them diet advice that is easy to follow[3].

Body Mass Index is something that doctors use a lot. So you can be sure that the advice you get is safe and consistent. Body Mass Index is a tool for this because it is easy to understand and it really works.

The new system is made to help people make food choices that are based on facts. It uses a person's Body Mass Index to figure out the diet plan for them.The system is better than others that just look at data and make suggestions without any control. The system is reliable because it follows rules and this prevents it from giving people advice that is not good for them[1],[4].

The Language Learning Model also lets people talk to it so users can ask the Language Learning Model about what food they like, how food they should eat and what nutrients they need[12]. This help from the Language Learning Model makes it easier for users to change what they eat and stay healthy which makes the Language Learning Model

more useful and easier to use than ways of planning what to eat[5].

The system is good. It has some problems. It mainly uses BMI and the information that the user gives it. So it is only as good as the information that is put into it[10],[11]. The system does not really think about things like how active you're if you have any health issues. It also does not consider how your body works. Because of this the system might not be good, for people who have health problems unless a doctor is helping them use it. The system has limitations and people should be aware of them when they use it.

The diet plan can be made better by adding more details about our health. For example it would be good to know what we need to eat based on how old we're. Our medical history and how much we exercise are also important. It would be great if the plan could keep track of how we're doing over time.

The system we have now is good. It works well. It gives us a starting point for a diet plan that is just right for each person. It shows that using our BMI to figure out what we should eat along with a diet plan that makes sense is a good idea. The diet plan is based on our BMI. It gives us good advice on what to eat.

IX.   CONCLUSION

The work presented in this project focuses on developing personalized diet planning that uses Body Mass Index as the core indicator for personalized nutrition guidance[1],[2]. Instead of following fixed diet plans which are the same rules to everyone, the application gives the suggestions based on individual body data [3], [4], [5], making the guidance more relevant to each user.

The system processes basic user inputs to determine BMI and then applies clearly defined nutrition rules to recommend a suitable diet plan. These recommendations are formed in a simple manner so that users can easily understand and involve them in daily life[6],[10]. Along with the diet plan short explanations are also provided to help users understand the reason behind each recommendation and also encourage mindful eating habits.

From the development view, this project clearly shows how fixed rules and simple explanations can work well together [4], [5]. Overall, this project tells that a simple BMI-based diet system can help people to live healthier lives because it is easy to use and easy to understand. If more features are added later, it can become an even better tool for daily nutrition guidance.

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