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Diet Recommendation System Using Supervised Machine Learning

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ABSTRACT

In today's modern world, people all around the globe are becoming more interested in their health and lifestyle. But just avoiding junk food and doing exercise is not enough; we require a balanced diet. A diet recommendation system in modern gyms assists in the planning of a balanced diet in gyms. It can replace or reduce the trainer's work in gyms when it comes to diet planning. A balanced diet that can be prepared based on our height, weight, and age. The diet plan can be divided into two categories based on user preferences: weight loss and weight gain. Diet recommendation systems in gyms can be implemented by using supervised machine learning algorithms to predict more accurate diet plans. Some supervised machine learning algorithms are Random Forest, kNN, and Naive Bayes. Some applications are available in the play store or app store, such as Diet Tracker, 90 Day Slim Plan, etc. But these applications' costs are higher. As a result, in comparison to this type of application, the diet recommendation system is a better solution to this problem and doesn't need trainers to plan a well-balanced diet.

1. INTRODUCTION

Nowadays, the average human being suffers from various health problems, such as fitness problems, inappropriate diets, mental health problems, etc. Various studies show that an inappropriate and inadequate diet is the major cause of various health issues and diseases. A study by the WHO reports that inadequate and imbalanced food intake causes around 9% of heart attack deaths, about 11% of ischemic heart disease deaths, and about 14% of gastrointestinal cancer deaths worldwide. Moreover, around 0.25 billion children are suffering from vitamin-A deficiency; 0.2 billion people are suffering from iron deficiency (anemia); and 0.7 billion people are suffering from iodine deficiency. The main objective of this work is to recommend a diet to different individuals.

The recommender system deals with a large volume of information by filtering the most important information based on the data provided by a user and other factors that take care of the user's preferences and interests. It finds the match between user and item and imputes the similarities between users and items for recommendation based on their physical aspects (age, gender, height, weight, body fat percentage), and preference (weight loss or weight gain). The recommendation process has basically three stages, which are the information collection phase, the learning phase, and the recommendation

phase. Information is first collected about a particular problem, and then the various solutions related to that problem are categorized. After the collection of information, the learning phase comes in, in which various conclusions are drawn from that information, and in the last phase, i.e., the recommendation phase, an output is given in which various recommendations are made.

In our project, the output of recommendations is based on a user's physical attributes, preferences, and body mass index (BMI). A balanced diet is one that gives your body the nutrients it needs to function correctly. Calories in food are a measure of the amount of energy that food contains. Our bodies use calories for basically everything, like breathing, walking, running, etc. On average, a person needs 2000 calories per day, but specifically, the intake of calories depends upon a person's physical aspects like weight, height, age, and gender.

EXISTED SYSTEM

Several studies have been proposed for different recommendation systems related to diet and food. These systems are used for food recommendations, menu recommendations, diet plan recommendations, health recommendations for specific diseases, and recipe recommendations. The majority of these recommendation systems extract users' preferences from different sources, like users' ratings.

A Food Recommendation System (FRS) is proposed. For diabetic patients that used K-mean clustering and the Self-Organizing Map for clustering analysis of food. The proposed system recommends the substituted foods according to nutrition and food parameters. However, FRS does not address the disease level issue adequately because the level of Diabetes can change hourly depending on the situation. Patient and the food recommendations may also vary accordingly.

Tags and latent factor are used for android based food recommender system. The system recommends a personalized recipe to the user based on tags and ratings provided in user preferences. The proposed system used latent feature vectors and matrix factorization in their algorithm. Prediction accuracy is achieved by use of tags which closely match the recommendations with users' preferences. However, the authors do not consider the nutrition in order to balance the diet of the user according to his needs.

Content based food recommender system is proposed which recommend food recipes according to the preferences already given by the user. The preferred recipes of the user are fragmented into ingredients, which are assigned ratings according to the stored users' preferences. The recipes with the matching ingredient are recommended. The authors do not consider the nutrition factors and the balance in the diet. Moreover, chances of identical recommendation are also present because the preference of the user may not change on daily basis.

Disadvantages:

- Highly cost.
- The model's accuracy is lower than we expected.
- The KNN algorithm is used in the development of existing system. KNN is a lazy learner algorithm, as it takes more time to compute the results.

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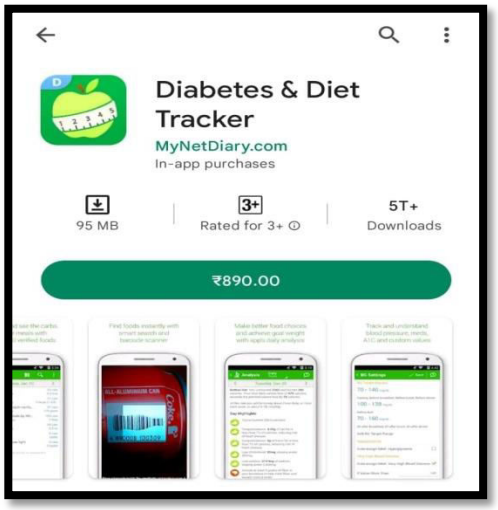

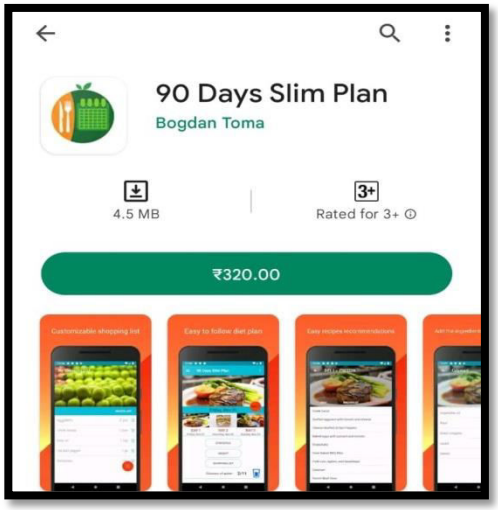

PROPOSED SYSTEM

There is an increasing demand for dietary advice as the prevalence of obesity and chronic diseases continues to rise. A number of online services offer dietary recommendations to their users, but these approaches have several limitations. We propose a new system for recommending diets that is designed to overcome these limitations. Our approach is based on a number of factors, including a user's body type and fitness goals, their personal preferences regarding diet type, and their socioeconomic background.

- A balanced diet that can be prepared based on our height, weight ,age , BMI(Body Mass Index) and body fat percentage . In this system, we have taken five classes to predict whether a person is healthy or unhealthy. Based on that, we divided the diet plan into three categories such as : breakfast, lunch, dinner.
- This system provides the diet plan

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in terms of calories, proteins, fats, ... etc

- The food intake will be based on the person's BMI.

3.3 ANALYSIS MODEL

The spiral model is one of the most important software development life cycle models for risk management. In its diagrammatic representation, it looks like a spiral with many loops. The exact number of loops in the spiral is unknown and can vary from project to project. Each loop of the spiral is called a phase of the software development process. The exact number of phases needed to develop the product can be varied by the project manager, depending on the project's risks. Because the project manager dynamically determines the number of phases, he or she plays an important role in developing a spiral-model product. The radius of the spiral at any point represents the expenses (cost) of the project so far, and the angular dimension represents the progress made so far in the current phase.

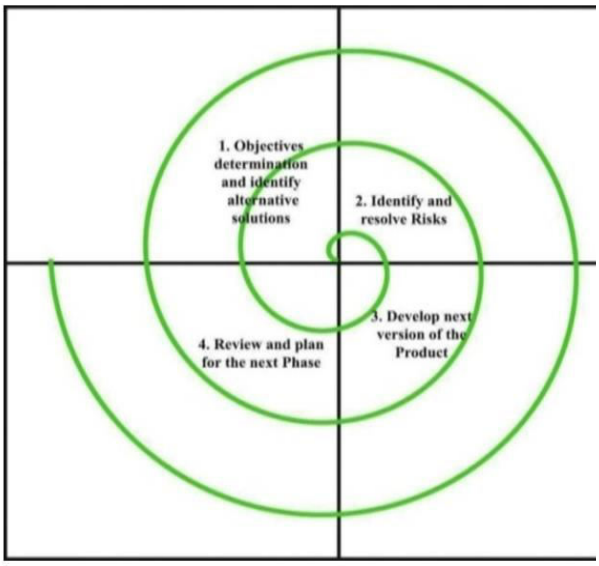

Fig: 2. Spiral Model

Each phase of the spiral model is divided into four quadrants, as shown in the above figure 2.

The functions of these four quadrants are discussed below.

1. **Objectives determination and identification of alternative solutions:** requirements are gathered from the customers, and the objectives are identified, elaborated, and analysed at the start of every phase. Then, in this quadrant, alternative solutions to the phase are proposed.
2. **Identify and resolve risks:** During the second quadrant, all the possible solutions are evaluated to select the best possible solution. Then the risks associated with that solution are identified, and the risks are resolved using the best possible strategy. At the end of this quadrant, a prototype is built for the best possible solution.
3. **Develop the next version of the product:** During the third quadrant, the identified features are developed and verified through testing. At the end of the third quarter, the next version of the software will be available.
4. **Review and plan for the next phase: In the fourth quadrant, customers evaluate the software's current state.** Finally, planning for the next phase begins.

Risk Handling in the Spiral Model

A risk is any adverse situation that might affect the successful completion of a software project. The most important feature of the spiral model is handling these unknown risks after the project has started. Such risk resolutions are easier to achieve by developing a prototype. The spiral model supports coping with risks by providing the scope to build a prototype at every phase of software development.

- **The prototyping model** also supports risk management, but the

risks must be identified completely before the start of the development work on the project. But in real life, project risk may occur after the development work starts; in that case, we cannot use prototyping. In each phase of the spiral model, the features of the product are dated and analysed, and the risks at that point in time are identified and resolved through prototyping. Thus, this model is much more flexible compared to other SDLC models.

Why is the Spiral Model referred to as the Meta Model?

The spiral model is called a "meta model" because it subsumes all the other SDLC models. For example, a single-loop spiral actually represents the iterative waterfall model. The spiral model incorporates the stepwise approach of the classical waterfall model. The spiral model uses the approach of **the prototyping model** by building a prototype at the start of each phase as a risk management technique. For example, a single-loop spiral actually represents an iterative waterfall model. Spiral models use prototype models to create prototypes before starting actual product development.

A spiral model allows you to mitigate risk and take a systematic approach. Spiral models can also be viewed as supporting evolutionary models. Also, the spiral model can be considered as supporting the evolutionary model; the iterations along the spiral can be considered as evolutionary levels through which the complete system is built.

Spiral Model Advantages: The spiral model has several advantages.

1. Risk Handling: In projects with many unknown risks that occur as the development proceeds, the spiral model is the best development model to follow due to the risk analysis and risk handling at every phase.

2. Good for large projects: It is recommended to use the spiral model in large and complex projects.

3. Flexibility in Requirements: - Change requests in the requirements at a later phase can be incorporated accurately by using this model.

4. Customer Satisfaction: Customers can see the product's development during the early stages of software development, and they become accustomed to the system by using it before the entire product is completed.

3.4 METHODOLOGY

3.4.1 Data preprocessing

Data preprocessing is an important step in the data mining process. It is the first and crucial step while creating a machine-learning model. It refers to the cleaning, transforming, and integrating of data in order to make it ready for analysis. When creating a machine learning project, it is not always the case that we come across clean and formatted data. And while doing any operation with data, it is mandatory to clean it and put it in a formatted way. So for this, we use data preprocessing tasks. The goal of data preprocessing is to improve the quality of the data and make it more suitable for the specific data mining task. In the below figure 3 depicts the process of data preprocessing.

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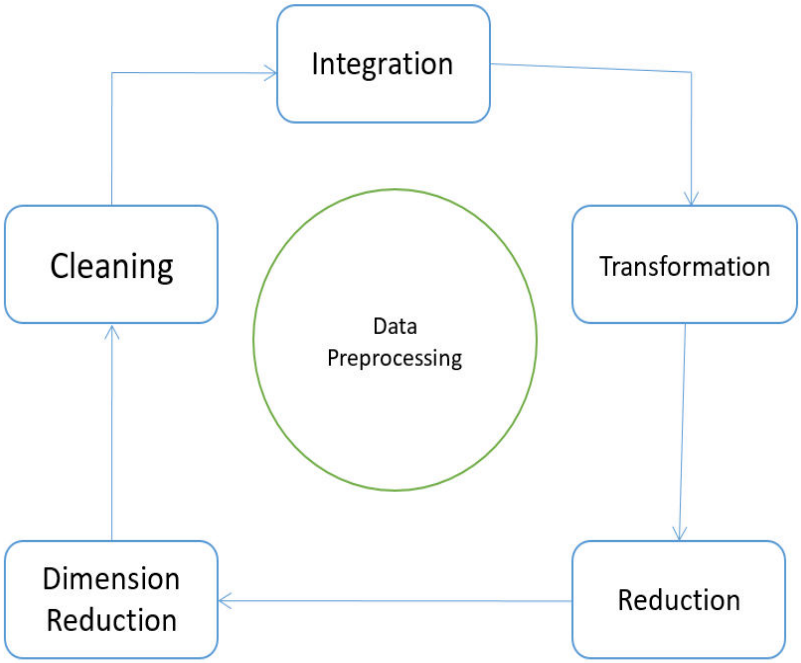

Fig: 3 Process of Data Preprocessing

Data preprocessing steps:

- **Data cleaning:** This step involves identifying and removing missing, inconsistent, or irrelevant data. This can include removing duplicate records, filling in missing values, and handling outliers.
- **Data integration:** This step involves combining data from multiple sources, such as databases, spreadsheets, and text files. The goal of integration is to create a single, consistent view of the data.
- **Data transformation:** This step involves converting the data into a format that is more suitable for the data mining task. This can include normalising numerical data, creating dummy variables, and encoding categorical data.
- **Data reduction:** This step is used to select a subset of the data that is relevant to the data mining task. This can include feature selection (selecting a subset of the variables) or feature extraction (extracting new variables from the data).
- **Data dimension reduction:** This step is used to convert continuous numerical data into categorical data, which can be used for decision trees and other categorical data mining techniques.

3.4.2 Algorithm

- The Classification algorithm is a Supervised Learning technique that is used to identify the category of new observations on the basis of training data.
- Classification algorithms are decision trees ,naives bayes ,random forest ,…etc

Random forest

Random Forest is a classifier that contains a number of decision trees on various subsets of the given dataset and takes the

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average to improve the predictive accuracy of that dataset. Instead of relying on one decision tree, the random forest takes the prediction from each tree and based on the majority votes of predictions, and it predicts the final output.

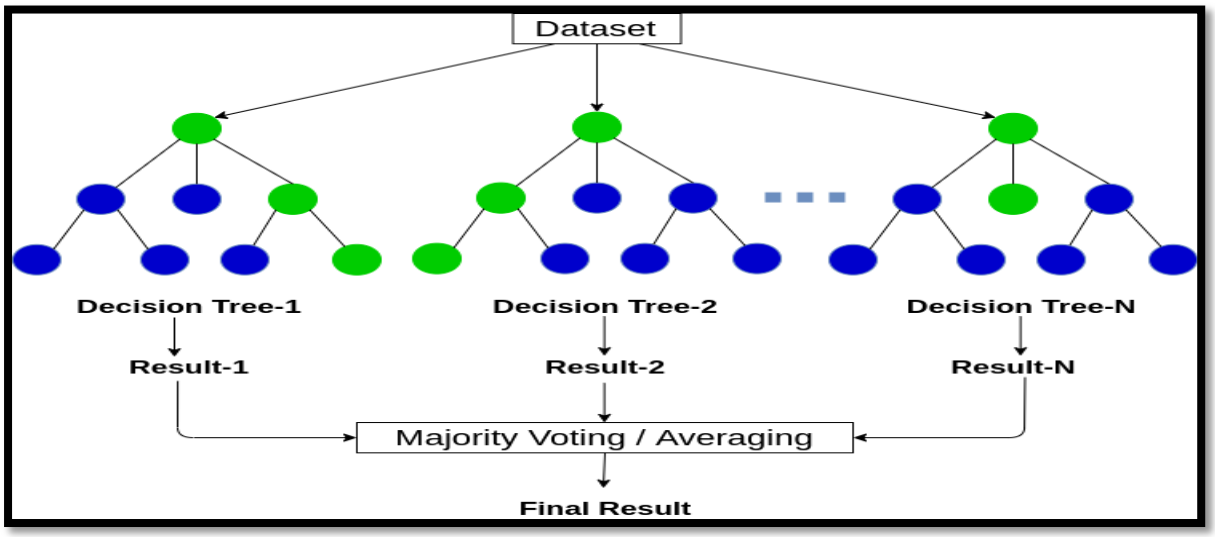

Fig: 4. Random forest

3.4.3 Flowchart

A flowchart is a graphical representation of an algorithm. Programmers often use it as a program-planning tool to solve a problem. It makes use of symbols that are connected among themselves to indicate the flow of information and processing. In the below figure 5, it shows how the data is analyzed and then implemented using the random forest algorithm. Following that, classification evaluation metrics such as precision, recall, and f1-score are used to determine the accuracy of the model.

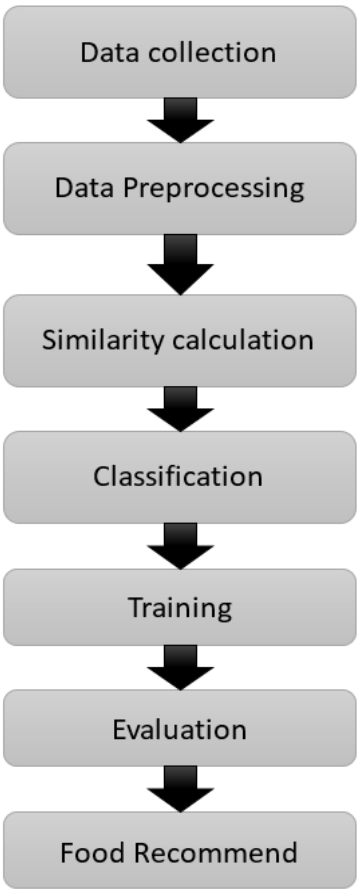

Fig: 5. Flow chart

FEASIBILITY STUDY

A feasibility study is a high-level capsule version of the entire process intended to

answer a number of questions, like: What is the problem? Is there any feasible solution to the given problem? Is the problem even worth solving? A feasibility study is conducted once the problem is clearly understood. A feasibility study is necessary to determine that the proposed system is feasible by considering the technical, operational, and economic factors. By having a detailed feasibility study, the management will have a clear-cut view of the proposed system.

The following feasibilities are considered for the project in order to ensure that it is variable and does not have any major obstructions. A feasibility study encompasses the following things:

- Technical Feasibility
- Economic or financial feasibility
- Operational feasibility

In this phase, we study the feasibility of all proposed systems and pick the best feasible solution for the problem. The feasibility is studied based on three main factors, as follows:

4.1 TECHNICAL FEASIBILITY

In this step, we verify whether the proposed systems are technically feasible or not. i.e., all the technologies required to develop the system are readily available or not.

Technical feasibility determines whether the organization has the technology and skills necessary to carry out the project and how these should be obtained. The system can be feasible because of the following reasons:

- All of the technology required to develop the
- This system is flexible and can be expanded.
- This system can guarantee accuracy, ease of use, and
- Our project is technically feasible because all the technology needed for our project is readily

4.2 ECONOMIC FEASIBILITY

In this step, we verify which proposal is more economical. We compare the financial benefits of the new system with the investment. The new system is economically feasible only when the financial benefits are greater than the investments and expenditures.

Economical feasibility determines whether the project goal can be achieved within the resource limits allocated to it or not. It must determine whether it is worthwhile to proceed with the entire project or whether the benefits obtained from the new system are not worth the costs. Financial benefits must equal or exceed the costs. In this issue, we should consider:

- The cost of running an entire system
- The cost of h/w and s/w for the class of application being
- The development
- The cost of maintenance

Our project is economically feasible because the cost of development is very minimal when compared to the financial benefits of the application.

4.3 OPERATIONAL FEASIBILITY

In this step, we verify different operational factors of the proposed systems, like manpower, time, etc.; whichever solution uses fewer operational resources is the best operationally feasible solution. The solution should also be operationally possible to implement. Operational feasibility determines if the proposed system would satisfy user objectives and could be integrated into the current system's operation.

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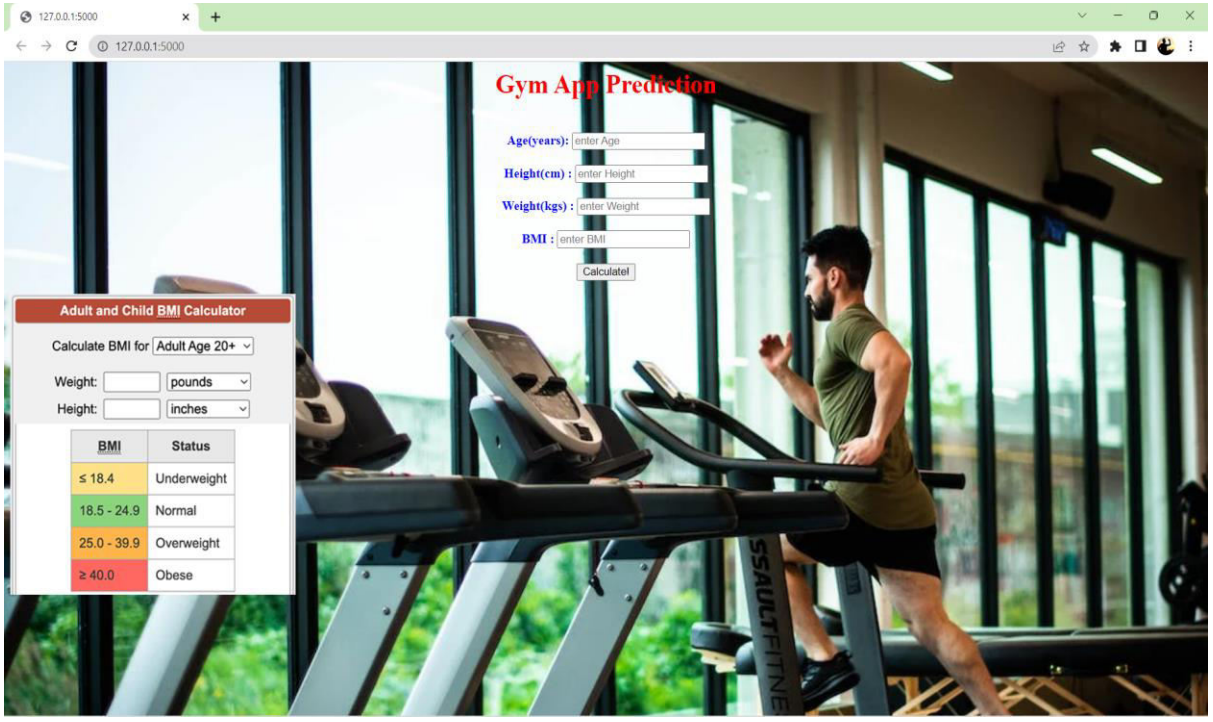
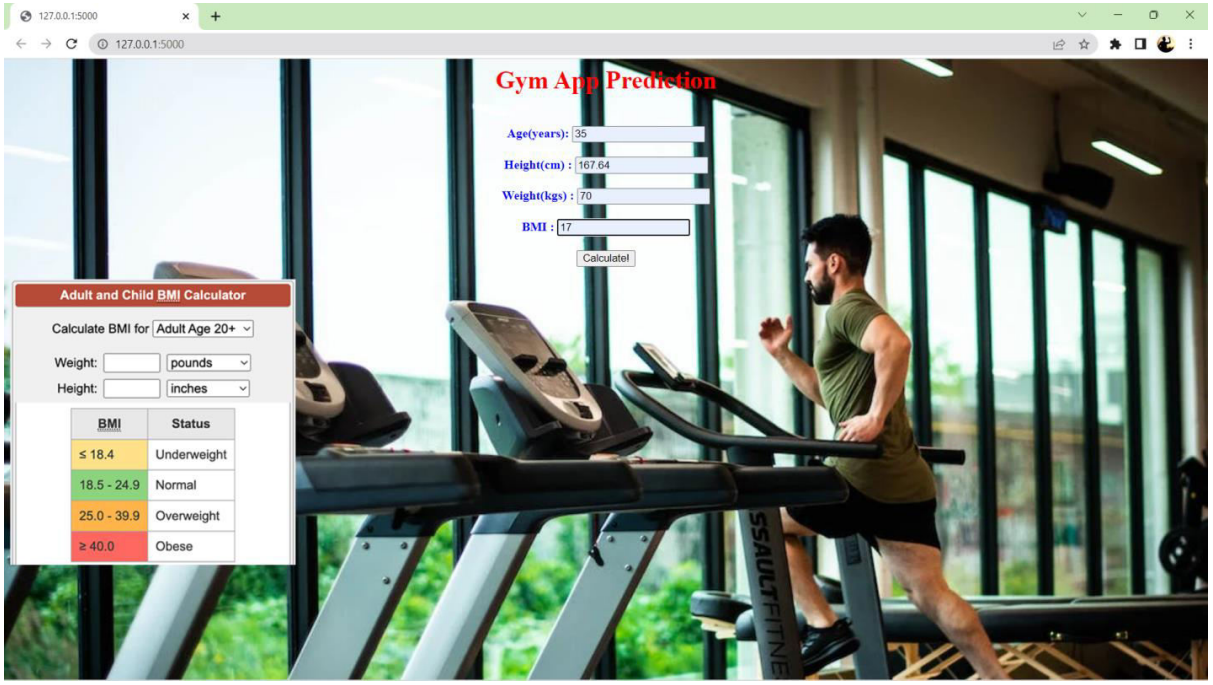
- The methods of processing and presentation are completely accepted by the clients since they can meet all user.
- The clients have been involved in the planning and development of the
- The proposed system will not cause any problems under any

RESULTS





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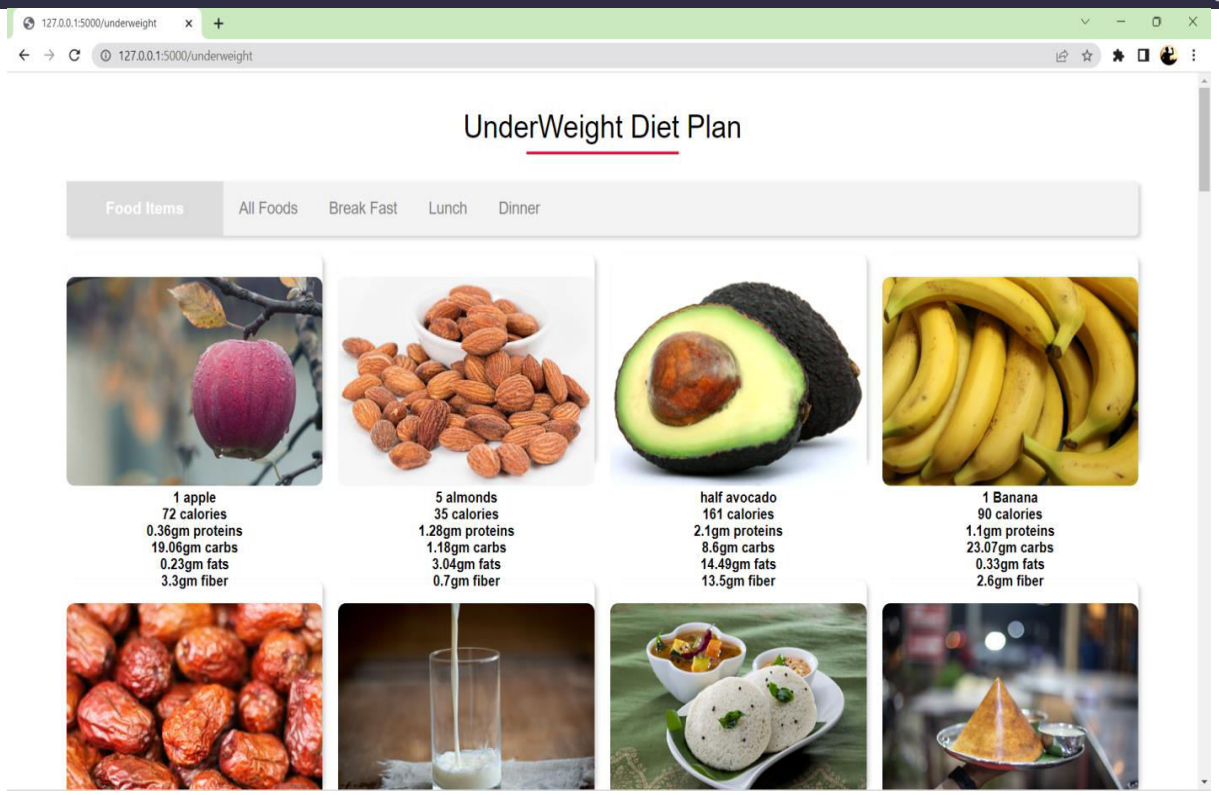

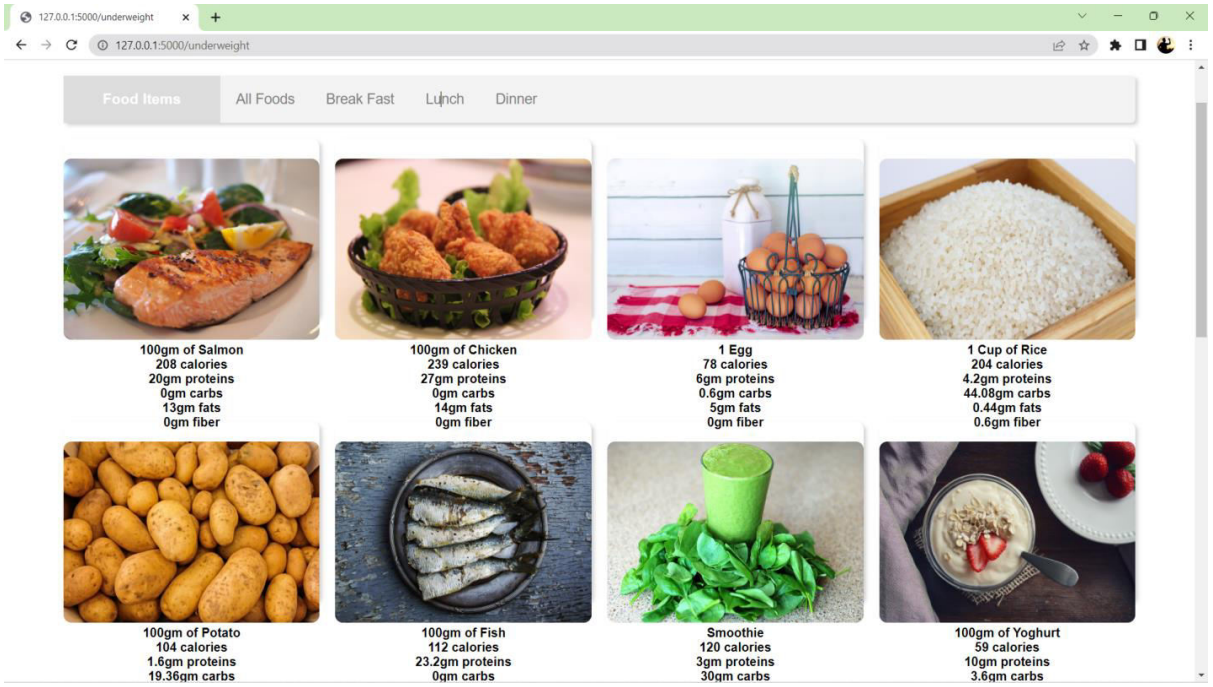

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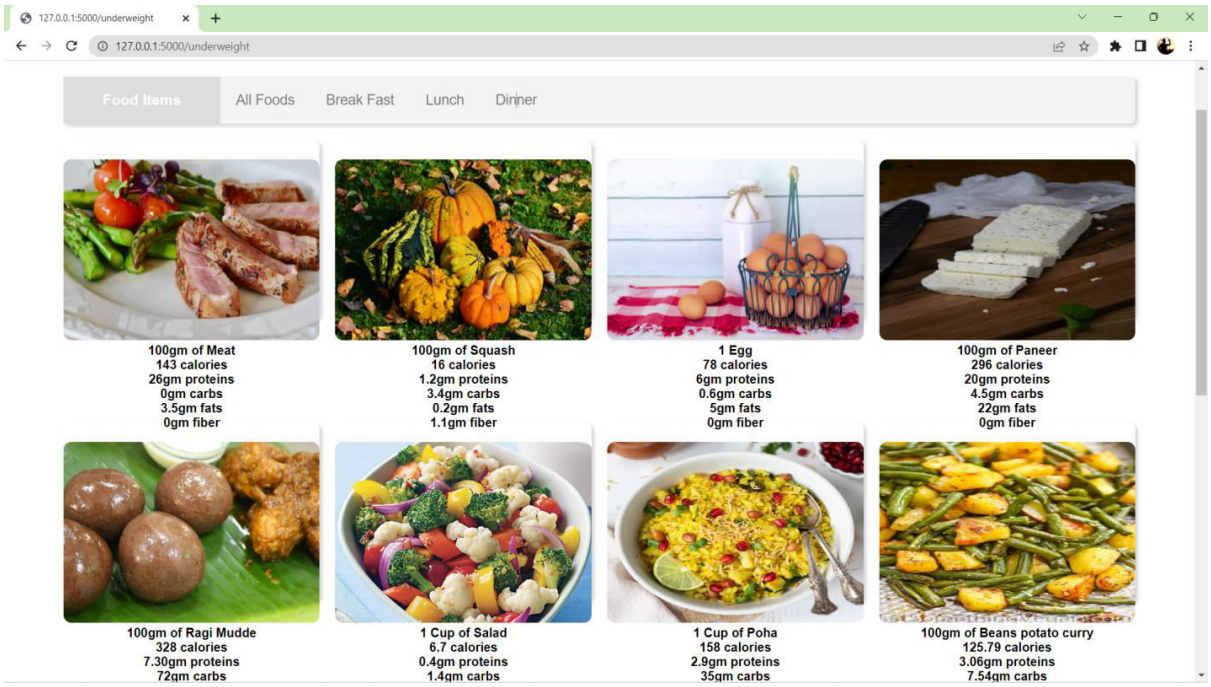

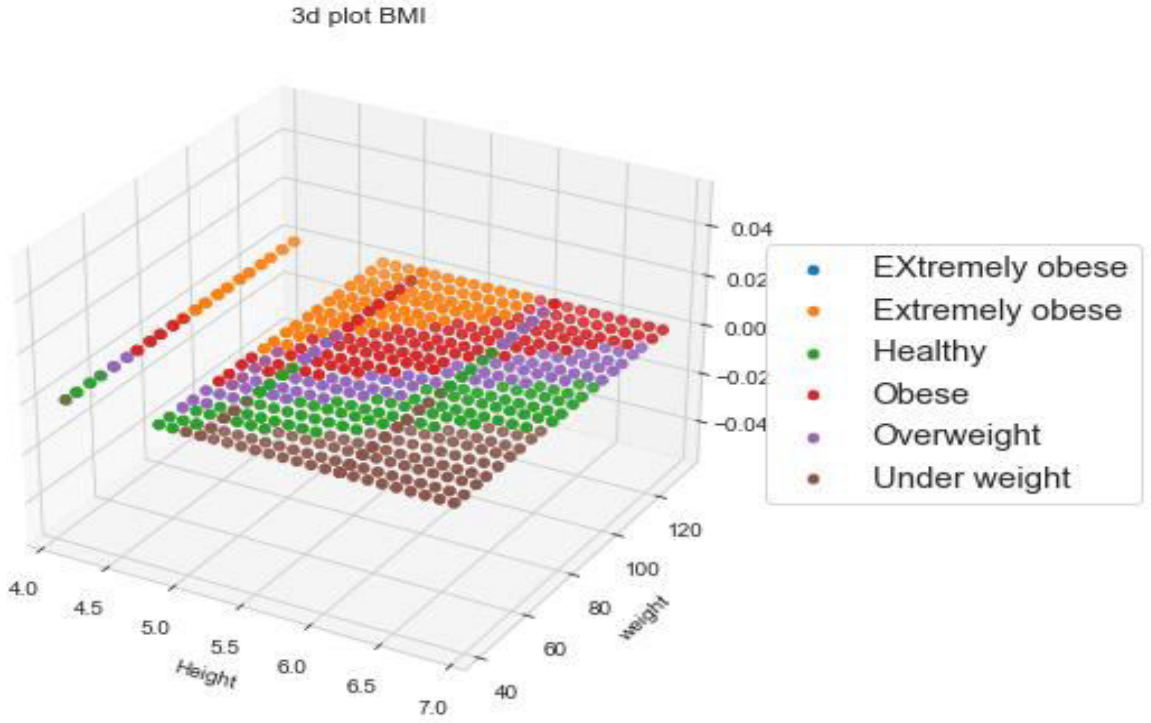

CONCLUSION

Emerging technologies like machine learning and artificial intelligence play an important role in the development of the IT (information technology) industries. A diet recommendation system should take into account an individual's dietary preferences and weight goals to provide personalized and scientifically supported nutrition recommendations. It should also be updated regularly to reflect the latest research and guidelines in nutrition. We have made use of these technologies to create a website for people who are consulting about their diet and want to lead a healthy life. The importance of nutritional guidance is increasing day by day to lead a healthy and fit life, and by accepting the user's preferences and a user's profile in the system, a healthy diet plan is generated. In the future, we plan to expand our project to include an Android application that will recommend diet plans as well as a basic exercise plan and its maintenance. Additionally, the system should consider cultural, socioeconomic, and other relevant factors that may impact an individual's ability to follow a specific diet. Ultimately, the goal of a diet recommendation system is to help individuals make informed choices about what to eat in order to support their overall health and well-being. By the end of our project, we concluded that if diet recommendation system was properly designed, implemented, and evaluated, it could be used as an effective tool to improve nutrition and promote a healthy lifestyle.

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