A HYBRID RECOMMENDER SYSTEM CONSIDERING THE NUTRITIONAL INFORMATION AND USER PREFERENCES

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Abstract: Individual eating habits are critical to battling the health related issues. Ongoing advances in cell phones and wearable sensors advances have enabled computerized health and nutrition checking through captured images of food has increased the awareness about nutrition among people. With the objective to removing problems of conventional nourishment process, we have prepared a recommendation strategy that can work to keep track of proper diet plans. In this paper, we present new intuitive versatile framework that empowers automated flow of process dependent on client's clicked pictures and gives dietary intercession while following clients' dietary and physical exercises. Notwithstanding utilizing strategies with computer vision and Machine learning, one novel approach of this framework is the acknowledgment of the current diet habits and user preferences. We will also prepare a chart of users with per user BMI calculation and generating proper food based nutrition chart. To prove our results, we have used the comparison of precision, recall and accuracy as parameters.

Keywords: **Machine learning, Recommendation systems, Content based filtering, health and nutrition, nourishment process .**

I. INTRODUCTION

AI guided diet is in its very early stage. The infancy period of processing food and exercise based data processing with machine learning and other artificial intelligence areas are still to process. Now a days, a human being suffering from many health problems such as fitness problem, maintaining proper diet problem, etc. Therefore we have decided to take this research for providing special dietician information and proper exercise knowledge for normal persons and for obesity suffering peoples also. The effective personal dietary guidelines are very essential for managing our health, preventing chronic diseases and the interactive diet planning helps a user to adjust the plan in an easier way. The website is to be produced on Artificial Intelligence and Dietician. Here, there are two persons, the admin and user. The user fills the registration form and then login to the website. After login users have to fill personal information including age, weight, height, gender and exercise level. For calculating BMI age, weight, height, gender and exercise level are necessary. On the basis of calculated BMI (Body Mass Index) Artificial Dietician will display the proper dietician for logged user. Various AI techniques are presented and recommender system's challenges are also presented. Artificial Intelligence (AI) techniques like (a) fuzzy sets, (b) Artificial Neural Networks (ANNs), (c) Artificial Immune Systems (AIS) (d) Swarm Intelligence (SI), and (e) Evolutionary Computing (EC) are used to improve recommendation accuracy as well as mitigate the current challenges like scalability, scarcity, Cold-start etc.

A healthy eating plan for busy people needs to be easy-to-start and easy-to-follow. As explained, Sitting in the same position for a prolonged period of time, invites many diseases. So we can take 2-3 minutes short breaks after every couple of hours to avoid these problems [7][8]. Keeping the body hydrated is also very necessary and due the busy schedule people tend to forget to intake of more fluids. In this era of smart phones, there are apps which can be easily installed on the phone to give a reminder for water, food as per the body requirements. Instead of taking smaller portions at regular intervals, people combined their breakfast and lunch which is very bad for health. Fruits also play important roles in one's health and Shouldn't be missed. It's easy to them to work and eat them at regular intervals. Start by reading food labels and learning about portion sizes and the reasons why eating more fruit and vegetables, along with high fiber foods and low-fat dairy products daily, will improve your health. Also, The National Institutes of Health (NHI) reports that hypertension is one of the possible problems of poor nutrition. Hypertension, also known as high blood pressure, is called the silent killer, because it frequently remains undetected and thus untreated until damage to the body has been done.

Fig. 1 Glycemic Index [4]

II RECOMMENDER SYSTEM

The rising number of health problems and the associated risk to live became a major cause of requirement of automated food suggestions depending on the life style and food habits. Some of the health issues which majorly occurs are blood pressure ,hypertension ,increasing heart diseases ,fatigue, boredom, stress, insomnia , hair loss because of tension, skin problems etc. Recently in the dailies there was an article that we are heading towards bald youth. Problems that may occurs due to lack of calories are low blood pressure starvation, trouble concentrating, decreased muscular strength, hair loss and the problems that occurs due to large amount of calories are obesity that occurs when actual body weight is at least 20% greater than ideal body weight, also high calories cause stress on the body, reduced muscles mass etc. Calories is the amount of energy which is needed by the body for breathing, kidney functions, cell metabolism ,muscles activities etc so it should be consumed in an appropriate amount and should not exceed the required amount as it is hard to maintain such a diet plan. Though there are many systems that will suggest you the healthy food but healthy within your calories is yet not developed. Hence, it is important to make such a system which will able to suggest you the food which will be in your calorie limit and thus will be healthy for your health. The proposed recommender system will allow a user to keep track of what amount of calories is needed for that body and how much is consumed by that body and thus recommend him with the healthy food options.[5]

Content based filtering and collaborative filtering methods for recommendation.
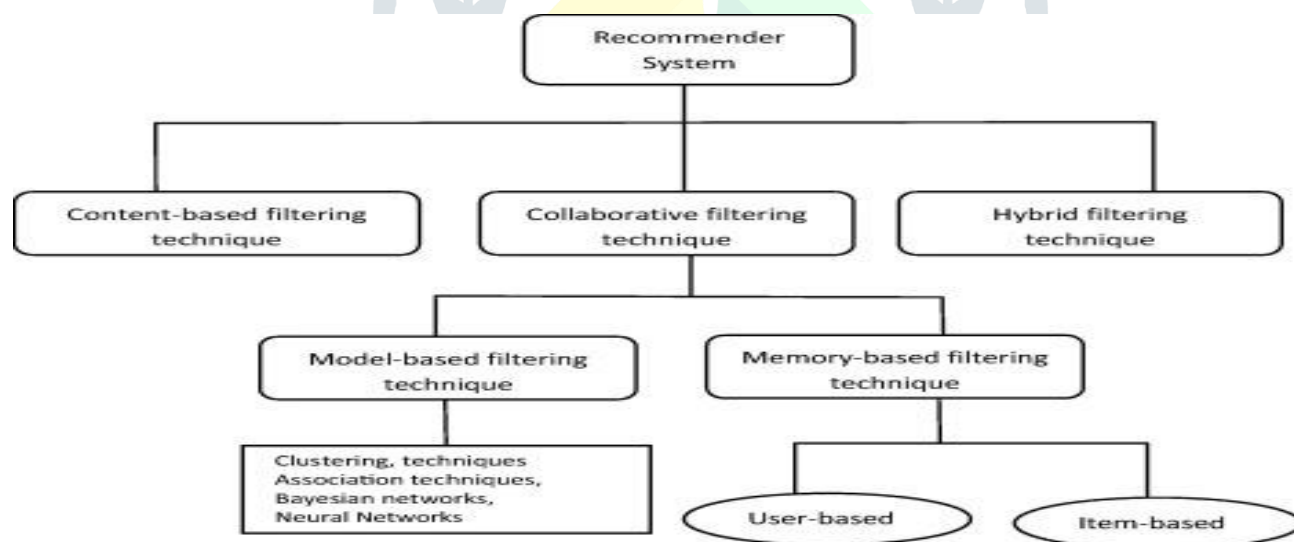

Fig. 2 Recommender System [7]

Content-based recommendation

- **The requirement**
  - some information about the available items such as the genre ("content")
  - some sort of *user profile* describing what the user likes (the preferences)
- **"Similarity"** is computed from item attributes, e.g.,
  - Similarity of movies by actors, director, genre
  - Similarity of text by words, topics
  - Similarity of music by genre, year
- **The task:**
  - learn user preferences
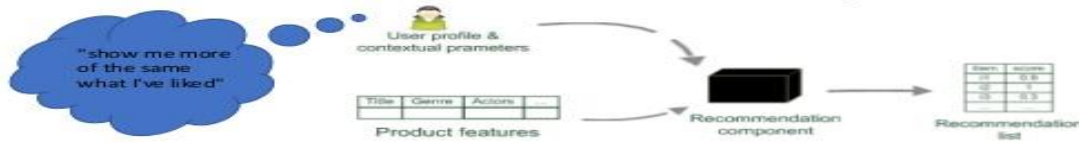 - locate/recommend items that are "similar" to the user preferences

Fig. 3 Content based recommendation [3]

III PROPOSED WORK

AI enabled personalized food recommended system allows its user to make use of their available food products and on the basis of available calorie for the healthy options are recommended by the proposed algorithm . This will partition among the healthy food available and the total food available. Due to this Recommended System user's are able to work on their health like user wants to eat something which is not healthy such as pizza ,burger ,chips etc which is exceeding the available calorie limit then CRS will not allow you to eat pizza, burger it will suggest you which will be healthy for your health.

In this research we proposed a healthy food Recommender System in which information is taken from the kaggle food data of people belonging to the age group 18-24 .This information includes the basic knowledge like age ,weight, height, lifestyle, disease (if any) and food taken by that person till evening. This information is given as input to calorie and BMI calculators for calculating the BMI and calorie consumed by that person, it is based on the information of a person, which will result the BMI. BODY MASS INDEX calculator is used to calculate the total fat of the body on the basis of weight and height.

If BMI $\leq$ 18.5 then the person is UNDERWEIGHT,
If BMI=18.5-24.9 then the person is NORMALWEIGHT.
If BMI=25-29.9 then the person is OVERWEIGHT.
If BMI $\geq$30 then the person is OBESE.
After calculating BMI and calories the result is given to the where we apply rules and IR techniques.
We have proposed the algorithm with deep learning – a branch of machine learning to take benefits of accurate prediction of food items for the user.

- Deep Learning

In neural networks, convolutional neural network (ConvNets or CNNs) is one of the main categories to do images recognition, images classifications. Objects detections, recognition faces etc., are some of the areas where CNNs are widely used.
CNN image classifications takes an input image, process it and classify it under certain categories (Eg., Dog, Cat, Tiger, Lion). Computers sees an input image as array of pixels and it depends on the image resolution. Based on the image resolution, it will see h x w x d(h = Height, w = Width, d = Dimension). Eg., An image of 6 x 6 x 3 array of matrix of RGB (3 refers to RGB values) and an image of 4 x 4 x 1 array of matrix of grayscale image.
Technically, deep learning CNN models to train and test, each input image will pass it through a series of convolution layers with filters (Kernels), Pooling, fully connected layers (FC) and apply Soft max function to classify an object with probabilistic values between 0 and 1. The below figure is a complete flow of CNN to process an input image and classifies the objects based on values.

- Convolution Layer

Convolution is the first layer to extract features from an input image. Convolution preserves the relationship between pixels by learning image features using small squares of input data. It is a mathematical operation that takes two inputs such as image matrix and a filter or kernel[4].

PROPOSED SYSTEM ARCHITECTURE
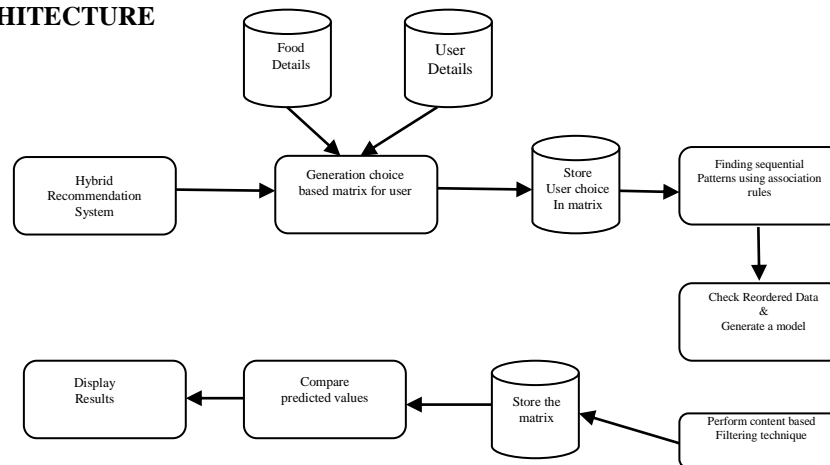
PROPOSED ALGORITHM

1. Read transaction/Food data and User data
2. Using Modified-Apriori algorithm, build association rule set
3. Min set size = 1
4. Min rule confidence – 10%
5. Min support is controlled by double input quick form node in %
6. Translate Antecedent collections into product name concatenations
7. Translate consequent item ID into consequent product name
8. Write association rule set
9. Calculate lift value in 2d matrix of order X product details table
10. Sort the product dataset details in lift value order (descending)
11. Generate a physical model with CNN
12. Form matrix based on new rules with dataset
13. Read the data from new matrix
14. Check the size and shape of two data sets (order and product details)
15. Check the data of one table
16. Check re-ordered level data from rules matrix and save it to matrix
17. Check order count of every product with content based filtering technique
18. Filter the product details by sorting them
19. Compare prediction to measurements
20. Output estimate of state
21. Display result.

IV   RESULT AND IMPLEMENTATION

Performance Measurement

Precision, Recall and Accuracy is measured in terms of True Positive (TP), True Negative (TN), False Positive (FP) and False Negative (FN).

- A true positive is an outcome where the model correctly predicts the positive class.
- A true negative is an outcome where the model correctly predicts the negative class.
- A false positive is an outcome where the model incorrectly predicts the positive class.
- A false negative is an outcome where the model incorrectly predicts the negative class.

Precision : $TP / (TP + FP)$

Recall : $TP / (TP + FN)$

Accuracy : $TP + TN / (TP + TN + FP + FN)$

Implementation strategies

Operating System	Ubuntu OS
Programming Language	Python 3.7
Libraries	OpenCV 3.6, TensorFlow, Keras
IDE	PyCharm 3 or Sublime

Table 1 Implementation Strategies

We use an Aggregated Residual Convolutional Neural network - ResNeXt-101 with 101 layers, pre trained on ImageNet dataset. We fine tune the model on Food-101 dataset, with more than 100 thousand images of 101 types of dishes. We achieve a significant improvement on accuracy.

The Response time of the given algorithm for 100 food items of similar type for different BMI and age group is conducted. The results are as follows:

Test1	Test2	Test3	Test4	Test5
20	23	21	22	17
12ms	15ms	25ms	12.5ms	14.8ms

The results with multiple criteria based food item suggestion generation is also tested.

Dataset Images	Training	Validation	Test
Total images	361658	7240	36200
Image per class	500	10	50

V CONCLUSION AND FUTURE WORK

In our research, we have proposed a novel architecture and algorithm to personalized recommendation of food to provide better support to patients and people. We have used machine learning and deep learning based model with trained food and food content data set. We have tried to find out all type of meals and dinner content possibility for veg, non-veg food items. Our results are promising as compared to previous results as shown in the comparison table 2 & 3. To take the research further, we can try to upload a complete meal image and find out the wholesome energy consumption in terms of preparing a healthy diet chart.

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