7th Annual International Conference on Arab Women in Computing
In Conjunction with 2nd Forum of Women in Research
ArabWIC
جامعة الشارقة
UNIVERSITY OF SHARJAH

Diet recommendation system

Hanin Alshrebaty, Safaa Abdallah, Shahad Alshehhi
American University of Ras Al Khaimah
School of Engineering, Department of Computer Science and Engineering

7th Annual International Conference on Arab Women in Computing
In Conjunction with 2nd Forum of Women in Research
جامعة الشارقة
UNIVERSITY OF SHARJAH
ArabWIC

Introduction

Improper food consumption and a bad diet are the main causes of the vast majority of the illnesses and health issues in the world. Unfortunately, recent research works in the UAE have concluded that poor diets are widely adopted among individuals that consequently made the UAE ranked as the 16th in diabetes diffusion globally [1] since most of the people in the UAE adopt a poor diet that is rich in sugar and fat and they don't include in their meals as many vitamins and minerals as it should be. Our bodies require 6 major nutrients to function properly, and any deficiency in any nutrient would cause health issues. Those nutrients are carbs, fats, proteins, vitamins, minerals, and water [3]. Each nutrient has a certain daily value, those daily values determine the correct amount of the nutrient to be consumed in a day. In fact, most people don't know about the recommended values of nutrients, and even for those who know about them, it is overwhelming to manage those amounts.

To solve this issue and ensure that people will follow the system consistently, we have proposed a diet recommendation system that helps users improve their diet without restricting them to consume certain meals, but at the same time, we keep track of the nutrient values included in those meals and recommend for them meals to replace and other meals to add to their diet that could make their diet include the needed nutrients.

In our project, we focus on increasing the levels of vitamin A, vitamin C, vitamin B12, vitamin B6, vitamin D, vitamin E, fiber, iron, calcium, magnesium, Zink, protein in the user to be equal or higher than the daily values which are considered as lower limits. At the same time, we aim to limit the levels of calories, fat, cholesterol, sodium, carbohydrates, sugar to be no more than the daily value which is the higher limits.

The knowledge basis we used is the daily value of 18 different nutrients (vitA = 900 mcg, vitB12 = 2.4 mcg, viB6 = 1.7 mcg, vitC = 90 mg,

vitD =15 mcg, vitE = 15, fiber = 25 g, calcium = 90 mg, magnesium = 420 mg, zink = 11 mg, iron = 14 mg, protein = 50 g, calories = 2000 cal, fat = 78 g, carbohydrates = 275 g, sugar = 50 g, cholesterol = 300 mg, sodium =2.3 mg) , all the daily values were taken from the FDA, some nutrients daily values were found in [4], and other are found in [5].

For the first 12 nutrients (which are mainly vitamins and minerals), the healthy recommendation is to maintain at least the daily value because the daily values are considered as a lower limit [4]. On the contrary, the last six nutrients should be maintained no more than the daily values which is the upper limit [4] since overconsumption of them will develop some health issues. For instance, "Greater fat intake is a major cause of obesity and hypertension, diabetes, and gallbladder disease. Higher fat intake may heighten the risk of cancer directly" [6].

Our diet recommendation system consists of 15 functions that process 4 datasets to perform the recommendation process, the concept of the recommendation relies on the scoring function that is implemented to assign scores for the meals.

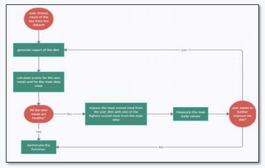
Objectives

1. Design a platform that helps users to have healthy lifestyles without limiting their diet to certain healthy meals
2. Improve the vitamins and minerals contained in the user meals
3. Aware users of the risks of not getting a sufficient amount of vitamins and minerals
4. reduce obesity rates caused by high levels of sugar and calories
5. reduce illnesses caused by poor diet
6. Encourage users to take care of their health

Materials and methods

Figure 1 shows the system framework

Fig 1



Firstly, the user is going to choose his planned breakfast, lunch, dinner, and snack. Then, the system will output a report based on the nutrients levels included in the given meals. According to that report, scoring function will assign scores for the meal nutrients Those scores helps to recognize the worst meal from the user selections to be replaced with one of the highest scored meals from the database that would replace the worst meal. After replacing that unhealthy meal, the system will recalculate the new values of the nutrients included in the new diet and show the improvement of the diet. If the user wants further improvement, the process will be repeated. If not, the function will be terminated.

Report generator working principle: it prints a report about the user's diet and returns a list of the 18 nutrients along with their levels (high, ok, low).For the nutrients with a higher limit target, the levels of the nutrients will be either high or ok. If the nutrient level is higher than or equal to 20% of the daily value, it will be classified as high, otherwise, it will be ok. For the nutrients, a lower limit target, the levels of the nutrients will be either low or ok. If the nutrient level is lower than or equal to 5% of the daily value, it will be classified as low, otherwise, it will be ok. The levels of the nutrients will be extensively used in the scoring function.

Scoring function working principle: it assigns scores for:

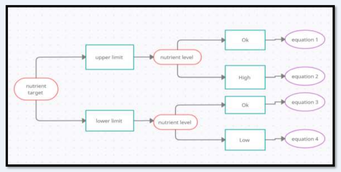
- The user meals that express the level of healthiness in them.
- The database meals that express to what extent those meals will fill let the user nutrients values closer to the recommended healthy values.

The scores will be calculated for each nutrient in the meal, and the overall score of the meal will be observed from the summation of its nutrients scores.

Since we want to make customized suggestions (based on the user nutrients levels) and since there are different targets for the nutrients (upper limit and lower limit) we have formulated four equations that are embedded in the scoring function.

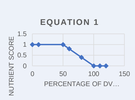
Figure 2 shows the criteria of choosing between the equations

Fig 2



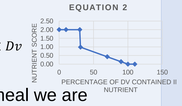
Equation #1

$$Score(x)\begin{cases} 1 & if \quad x \le 0.5 \\ 1-\frac{x-0.5\times DV}{(1-0.5)\times DV} & if \quad 0.5\times DV < x < Dv \\ 0 & if \quad x \ge DV \end{cases}$$



Equation #2

$$Score(x)\begin{cases} 2 & if \quad x \le 0.3 \\ 1-\frac{x-0.3\times DV}{(1-0.3)\times DV} & if \quad 0.3\times DV < x < Dv \\ 0 & if \quad x \ge DV \end{cases}$$



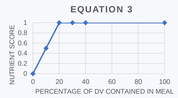
where x represents the value of the nutrient in the meal we are checking.

DV is the daily value of the nutrient that we are checking.

Equations 1 and 2 express that the more the percentage daily value of the nutrient, the less the score will be and vice versa. In this way, we are penalizing the nutrients with high percentage daily value and rewarding the nutrients with low percentage daily value because we don't want to exceed the upper limit.

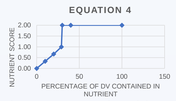
Equation #3

$$\text{Score}(x)=\begin{cases} 1 & \text{if} \quad x > (0.2\times DV) \\ \frac{x}{DV\times 0.2}, & \text{if} \quad x < (0.2\times DV) \end{cases}$$



Equation #4

$$\text{Score}(x)=\begin{cases} 2 & \text{if} \quad x > (\lambda\times DV) \\ \frac{x}{DV\times 0.2}, & \text{if} \quad x < (\lambda\times DV) \end{cases}$$



where DV is the daily value of the nutrient that we are checking.
x represents the value of the nutrient in the meal we are checking.
Equations 3 and 4 express that the more the percentage daily value of the nutrient, the more the score will be and vice versa. In this way, we are penalizing the nutrients with low percentage daily value and rewarding the nutrients with high percentage daily value because we don't want to go below the lower limit.

Results

Table 1 shows some nutrients scores from a meal

Recipe: Spinach tomato	Nutrients value	Daily value	Percentage DV	Score
Fiber (g)	3	25	12 %	0.6
Vit A (mcg)	146.4	900	16.27 %	0.813
Iron (mg)	2.1	14	15 %	0.75
Calcium (mg)	464.4	90	516 %	1
Magnesium (mg)	35.9	420	8.54 %	0.427
Zinc (mg)	1.8	11	16.6 %	0.818
Sodium (mg)	895	2300	38.91 %	1
Sugar (g)	3	50	6 %	1

Table 2 shows s sample user scores. In this user the least scored meal (croissants cheese) is replaced with the highest scored meal from the suggested meals (Avocado salad)

User Meals	Scores (out of 100)	Suggested meals	Scores (out of 100)	New User Meals
Breakfast Burrito	84.45	Avocado Salad	79.44	Breakfast Burrito
Croissants cheese	61.05	Quinoa Patties over Spinach	76.01	Avocado Salad
Mexican Casserole	84.45	Vegetable Latkes	75.01	Mexican Casserole
Chicken pad thai	75.13	Tostada Salad	74.65	Chicken pad thai
Guacamole pizza	73.01	Sweet Potato Soup	73.55	Guacamole pizza
Lime Chicken Salad	74.81			Lime Chicken Salad

Figure 3 shows the result of vitamins improvement that its target to achieve at least the daily value (lower limit)

It is clear that most of the vitamins' value has significantly progressed, while Vitamin D remained the same; however, this is expected because scientists proved that it is hard to satisfy our needs from vitamin D from the food, and we have to expose for the sun to generate this vitamin, but we have included vitamin D in in our system even though that it is almost impossible to satisfy our need for this vitamin, to indicate the importance of getting this vitamin from other resources.

Fig 3

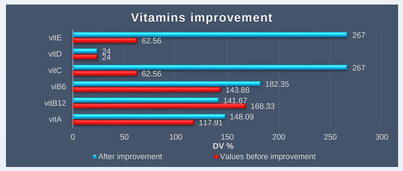


Figure 4 shows the improvement of the mineral that its target to achieve at least the daily value (lower limit)

The values after improvement are relatively increased, and most of the values are now almost higher than or equal to the daily values

However, calcium and Zink are still less than the daily value, but their new values are higher than the old value which means that we got some improvement in those minerals.

Fig 4

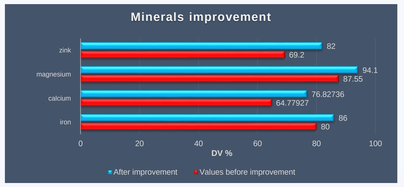
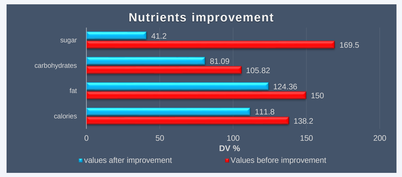


Figure 5 illustrates the improvement of the nutrients that its target to achieve no more than the daily value (upper limity)

the values of sugar, carbohydrates, fat, and calorie are relatively decreased. In addition, the level of sugar positively progressed in this diet. Although fat and calories values after improvement are greater than the upper limit, their presents are not greatly higher than 100% of DV and they did decrease from the initial values.

Fig 5



Conclusions

Our diet recommendation system has achieved its objectives which are designing a platform that helps users to have healthy lifestyles without limiting their diet to certain healthy meals and improving the vitamins and minerals contained in the user's meals. On the other hand, as we have minimized the level of fats, cholesterol, sugar, and sodium to be closer to the upper limit of the proper consumption, we can conclude that we would reduce future obesity that is caused by overconsumption of those nutrients. Besides, as we have designed the suggestion of a healthy meal to be a meal that it contains most of the nutrients missing in the user diet, we can say that we did improve the vitamins and minerals contained in the user meals. The results can be further improved if we added more instances to the dataset because we will be having more chances of getting high scores meals to suggest. Finally, improving the diet to achieve the upper limit of some nutrients and lower limit of another nutrient shall prevent illnesses caused by a poor diet which is the major objective of our diet recommendation system.

References

[1] "7 Ways That Overeating Affects Your Body", *Healthline*, 2021. [Online]. Available: https://www.healthline.com/nutrition/overeating-effects#2.-May-disrupt-hunger-regulation. [Accessed: 11- May- 2021].

[2] "Physical health - Food," *Head to Health*. [Online]. Available: https://headtohealth.gov.au/meaningful-life/physical-health/food#:~:text=Eating well helps to reduce,as how much you eat. [Accessed: 11-May-2021].

[3] H. S. Buttar, T. Li, and N. Ravi, "Prevention of cardiovascular diseases: Role of exercise, dietary interventions, obesity and smoking cessation," *Experimental and clinical cardiology*, 2005. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2716237/. [Accessed: 11-May-2021].

[4] "How to Understand and Use the Nutrition Facts Label", *U.S. Food and Drug Administration*, 2021. [Online]. Available: https://www.fda.gov/food/new-nutrition-facts-label/how-understand-and-use-nutrition-facts-label. [Accessed: 12- May- 2021].

[5] "Daily Value on the New Nutrition Facts Label", *U.S. Food and Drug Administration*, 2021. [Online]. Available: https://www.fda.gov/food/new-nutrition-facts-label/daily-value-new-nutrition-and-supplement-facts-labels. [Accessed: 16- May- 2021].

[6] L. KULLER, "Dietary Fat and Chronic Diseases", *Journal of the American Dietetic Association*, vol. 97, no. 7, pp. S9-S15, 1997. Available: 10.1016/s0002-8223(97)00724-4 [Accessed 12 May 2021].

Contact info

Hanin Alshrebaty
Email : haneenshrebate@gmail.com
Mob: 0562219819