Technical sciences

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RECOMMENDER SYSTEMS ALGORITHMS FOR HEALTHY EATING

Summary. *Algorithms of recommendation systems related to healthy eating were investigated.*

Key words: *algorithm, food, nutrition, recommendations system.*

It's known that nutrition has a great impact on our health and most of people hear about some basic rules of proper food eating. Nevertheless, we should admit that this domain is more complicated than seems. Also, we should understand that healthy food eaten in wrong way can lead to disease too [1]. A term «balance» is used often in nutritionology but the meaning can highly vary depending on a context. It gives some basic understanding that we should eat different types of products and shouldn't eat too much or too little, but we don't have precise measurement of proportions in order to keep our bodies healthy and this is a problem [2].

There are a lot of software that can help to achieve some balance during eating food and they give some recommendations that can be measured with numbers. However, they use simple principles and it's difficult to say that

recommendation's accuracy is good enough. It's difficult to create an ideal recommendation system in such complex area, but seems that existing ones can be significantly improved.

The main part of each recommendation system is a computer algorithm that takes some information as an input and gives an appropriate suggestion for the specific context. Currently all these algorithms can be divided on two groups based on a strategy they use: collaborative filtering and content-based filtering [3].

Collaborative filtering uses information about past user behaviour – for example, information about purchases or ratings. In this case, it does not matter what types of objects are being worked with, but implicit characteristics that would be difficult to take into account when creating a profile can be considered. The main problem of this type of recommender systems is «cold start»: lack of data about users who have recently appeared in the system or objects. So, this strategy tries to find similar users and create a recommendation based on their experience [4]. This type can't be used in nutrition domain because each person has unique health status and requires individual approach.

Content-based filtering creates profiles of users and objects, user profiles may include demographic information or answers to a specific set of questions, object profiles may contain genre names, actor names, artist names, and other attribute information depending on the object type [4].

So, all the algorithms for this area must use content-based filtering, so the comparison was based on how profiles are created in these systems. In order to investigate the existing algorithms of recommendation systems for healthy eating, it is necessary to formulate a meaningful statement of a multi-criteria decision-making problem, conduct a stage of detailed information preparation for decision-making, provide a vector description of this problem and find its best solution based on the utility theory method.

An individual recommendation for a healthy diet is quite a difficult task, since many parameters need to be taken into account in order to choose the best algorithm. Therefore, it is necessary to consider the functional capabilities of the algorithms and choose the most effective one.

Each recommendation system uses not only the specific information about food, but also means that retrieve the information. A linear convolution with weighting coefficients for the specified algorithms was performed.

Criteria:

F1 – presence of photo recognition;

F2 – taking age into account:

F3 – the possibility of introducing physiological characteristics of a person;

F4 – counting calories;

F5 – consideration of gender;

F6 – execution speed;

F7 – takes into account the activity of life;

F8 – percentage of algorithm execution parallelization;

F9 – the ability to create a meal plan.

Criteria: f1, f2, f4, f5, f7, f9 have values 0 - 1 {no, yes}

Criteria f3, f6, f8 have normal values that need to be normalized.

Also, we can divide all recommendation systems on five groups that use different combination of the criteria. These groups are named as A, B, C, D and E.

Vector description of the problem:

$w(x) = 0.25f1 + 0.05f2 + 0.15f3 + 0.1f4 + 0.05f5 + 0.1f6 + 0.05f7 + 0.1f8 + 0.15f9$

Coefficients were retrieved by conducting a local survey.

Table 1

Criteria values for selected algorithms

Algorithm	F1	F2	F3	F4	F5	F6	F7	F8	F9
A	1	1	14%	0	0	300 instructions/ms	0	27.5%	1
B	0	0	14%	0	1	180 instructions/ms	1	12.5%	0
C	0	1	70%	1	0	100 instructions/ms	0	5%	1
D	1	0	42%	0	1	500 instructions/ms	1	65%	0
E	0	1	0%	0	1	260 instructions/ms	0	80%	0

A Pareto test was performed and it was determined that there is no dominance between the two algorithms.

$$x_{norm} = \frac{x - \min(x)}{\max(x) - \min(x)'}$$

where x is the value currently being processed,

– min(x) is the minimum value among all,

– max(x) is the maximum value among all

Table 2

Normalized criteria values for selected algorithms

Algorithm	F1	F2	F3	F4	F5	F6	F7	F8	F9
A	1	1	0.2	0	0	0.5	0	0.3	1
B	0	0	0.2	0	1	0.2	1	0.1	0
C	0	1	1	1	0	0	0	0	1
D	1	0	0.6	0	1	1	1	0.8	0
E	0	1	0	0	1	0.4	0	1	0

For each algorithm, the value of w(x) was found

Table 3

Value of w(x)

Алгоритм	w(x)
A	0.56
B	0.16
C	0.45
D	0.62
E	0.24

Algorithm D was determined to be the most attractive, while Algorithm B and E had the lowest performance.

Therefore, we can determine which criteria and how they influence on usability. In order to improve accuracy recommendation system must use more information about food products and person getting recommendation. Based on nutrition science, it's possible to suggest to use additional information as calories, proteins, fats and carbohydrates. Also, it's possible to use information about different macro- and micronutrients (f. e. muscles contraction requires potassium, calcium and magnesium) and their norms. Also, it's possible to use glucose norms and norms for bread units with age, gender, etc. Glucose is found in all foods [2].

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