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AUTOMATED HEALTHCARE SYSTEMS' REVIEW

Abstract: An automated healthcare system is a high-tech integrated approach to monitoring individuals' health and providing appropriate recommendations. The goal is to review and analyze existing approaches for measuring healthcare parameters. Various existing applications are analyzed to select the best implementations and correct their shortcomings.

Keywords: Automated system, healthcare, optimization, application.

Introduction

Automated healthcare systems are becoming a necessary element of our daily lives with the continuous improvement of technology and the rapid development of modern life. This article is dedicated to various aspects and impacts of automated systems aimed at people's general well-being and comfort in the modern world.

A sedentary lifestyle has become a defining characteristic of modern society, where technological advances and changes in work and leisure habits have significantly changed the way we lead our daily lives. This way of life can affect physical health, so more people consider caring for their health. Due to greater workload and long working hours, people forget to pay attention to health. That is why an automated system for healthcare is extremely relevant and will facilitate the process of healthcare.

An important aspect is the study of how these systems can facilitate and optimize people's daily functioning, providing them with a convenient, efficient, and individualized approach to maintaining health and lifestyle.

In addition, it is important to address ethical, security, and data protection issues in the context of using automated care systems. Contributing to the convenient integration of these technologies into everyday life, we set ourselves to reveal the advantages and consider the possible risks arising from implementing automated healthcare systems.

People's desire to take care of their health has led to the emergence of many health monitoring and care applications and websites with a narrow specialization.

To care for your health in more detail, you must install various applications and use websites that monitor certain parameters. It may not be convenient to check every application throughout the day, so this automated system will contain the most used functions of these applications. In addition, not all applications and websites have detailed user settings, which can lead to many inconveniences when using these applications.

Healthcare monitoring systems

The following applications were selected for analysis: “Calorie Counter by Lose It!” and “Calorie Counter App: Fooducate.”[1,2]

Calorie Counter by Lose It!

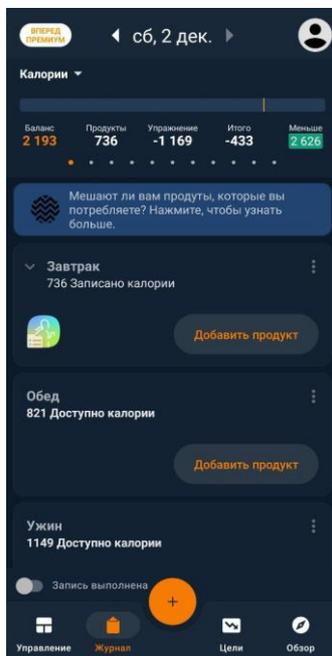


Fig. 1. “Calorie Counter by Lose It!” application

“Calorie Counter by Lose It!” is a mobile application for Android and IOS, with which you can monitor your health. The free version of this application includes the following features: recording of products for each meal, recording of exercises performed or to be performed, and tracking of weight, calories gained, nutrients received, and calories lost. For 1,000 UAH/year, you can get better functionality, which includes the following functions: tracking water consumption, hours of sleep, blood pressure, blood glucose level, and body fat content. Also, the premium plan includes displaying statistics in the form of graphs.

After researching this application, we identified the following advantages and disadvantages.

Advantages

1. Many clarifying questions for the appropriate adjustment of the program for the user;

2. Convenient and clear user interface;

3. The ability to record products in the menu and calculate their calorie content;

4. The possibility of creating a recipe and adding it to a meal;

5. A large list of products that can be added to the menu;

6. Ability to add training.

Disadvantages

1. Very limited free functionality;
2. It is not possible to separately remove the product from the meal;
3. Partially translated interface.

Calorie Counter App: Fooducate

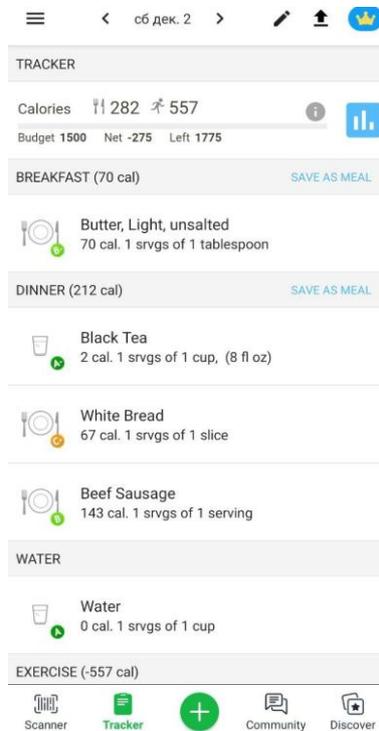


Fig. 2. “Calorie Counter App: Fooducate” application

“Calorie Counter App: Fooducate” is a mobile app for Android and IOS that allows you to track the calories and nutrients your body takes in and loses throughout the day. Like the previous one, this application allows you to fill in the menu and monitor the nutrients in the selected products. You can also set the type of exercises performed during the day to count calories burned [2].

We found the following advantages and disadvantages after researching the application,

Advantages

1. The ability to record products in the menu and calculate their calorie content;
2. The possibility of recording the amount of water consumed during the day;
3. Availability of recommendations based on the results.

Disadvantages

1. The interface is not convenient and difficult to understand;
2. Products are added only in prescribed portions;

3. Absence of graphs for statistics of received nutrients.

There are also websites selected for analysis such as: “My diet meal plan”, “SuperCook”.

My diet meal plan

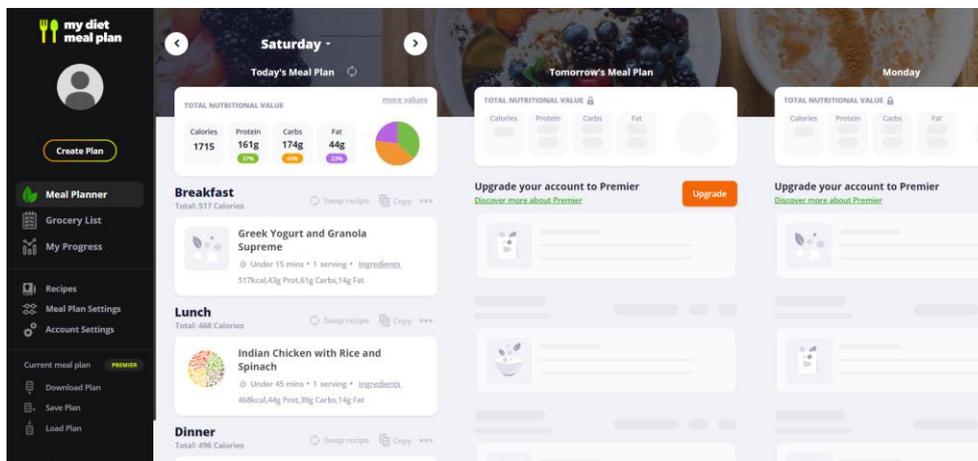


Fig. 3. “My diet meal plan” web application

“My diet meal plan” is a web application that generates a meal plan. Users can choose dietary preferences for a more precise setting and products to which he or she is allergic. Based on the user's physical data, the application calculates the required daily amount of calories and generates a meal plan for the day [3].

After reviewing the functionality of this application, we highlighted the following advantages and disadvantages.

Advantages

1. Convenient and easy-to-use interface;
2. There is an opportunity to specify products to which there is an allergy;
3. Together with the plan, there are the ingredients that make up the dish and the recipe for its preparation;
4. Available detailed characteristics of nutrients in the composition of dishes;
5. There is an opportunity to choose popular meal plans;
6. You can replace the dish with another one with a similar number of calories.

Disadvantages

1. It is not possible to specify available ingredients to generate a meal plan based on them;
2. A small number of preferences settings;
3. Inability to ban a certain product.

SuperCook

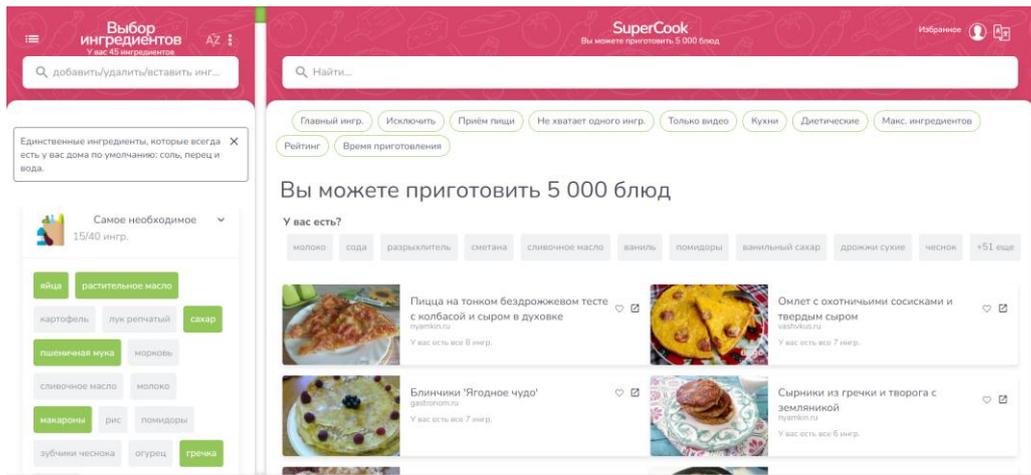


Fig. 4. “SuperCook” web application

“SuperCook” is a web application allowing users to learn recipes based on available ingredients. The user can choose from the list of available products at home. Based on these ingredients, the web application selects recipes that contain the selected products [4].

The identified advantages and disadvantages of this web application are presented below.

Advantages

1. Clear interface;
2. A large number of dishes for different combinations of products;
3. The ability to highlight the products that should be included in the dish;
4. Selection of products through search;
5. Recommendation of dishes relative to the one being reviewed.

Disadvantages

1. Recipes are on third-party sites, which can be dangerous;
2. There are no indicators of the number of calories and nutrients.

Calculations

The revised Harris-Benedict equation for calculating basal metabolic rate (BMR) will be used to calculate the number of calories used throughout the day. But there are many versions of this equation [5, 6].

Below is the original Harris-Benedict equation from 1818-1819:

International system of units (1):

$$\begin{aligned} \text{MaleBMR} &= (13.7516 \times \text{weight}) + (5.0033 \times \text{height}) - (6.755 \times \text{age}) + 66.473 \\ \text{FemaleBMR} &= (9.5634 \times \text{weight}) + (1.8496 \times \text{height}) - (4.6756 \times \text{age}) + 655.0955 \end{aligned} \quad (1)$$

Imperial system (2):

$$\begin{aligned} MaleBMR &= (6.23762 \times weight) + (12.7084 \times height) - (6.755 \times age) + 66.473 \\ FemaleBMR &= (4.33789 \times weight) + (4.69798 \times height) - (4.6756 \times age) + 655.0955 \end{aligned} \quad (2)$$

1984 Rose and Shizgal revised the Harris–Benedict equation (3) [6].

$$\begin{aligned} MaleBMR &= (13.397 \times weight) + (4.799 \times height) - (5.677 \times age) + 88.362 \\ FemaleBMR &= (9.247 \times weight) + (3.098 \times height) - (4.33 \times age) + 447.593 \end{aligned} \quad (3)$$

This equation provided greater accuracy.

New studies were also reviewed, including a revised Harris–Benedict equation. Among the selected equations, it was found that this equation was the most accurate for both men and women (mean difference 8.32 and 8.93, respectively). This equation is presented below [7]:

International system of units (4):

$$\begin{aligned} MaleBMR &= (9.65 \times weight) + (5.73 \times height) - (5.08 \times age) + 260 \\ FemaleBMR &= (7.38 \times weight) + (6.07 \times height) - (2.31 \times age) + 43 \end{aligned} \quad (4)$$

Imperial system (5):

$$\begin{aligned} MaleBMR &= (4.38 \times weight) + (14.55 \times height) - (5.08 \times age) + 260 \\ FemaleBMR &= (3.35 \times weight) + (15.42 \times height) - (2.31 \times age) + 43 \end{aligned} \quad (5)$$

BMR is not an accurate measure because it does not consider lifestyle. Total daily energy expenditure (TDEE) is an indicator that determines how many calories a person spends during the day, taking into account his lifestyle. To do this, it is necessary to multiply the calculated BMR by the appropriate coefficient:

- Sedentary lifestyle (little or no physical exercise): activity factor = 1.2
- Lightly active (light exercise/sports 1-3 days/week): activity factor = 1.375
- Moderately active (moderate exercise/sports 3-5 days a week): activity factor = 1.55
- Very active (intense exercise/sports 6-7 days a week): activity factor = 1.725
- Extremely active (very hard exercise/sport and physical work or double training): activity factor = 1.9

It is also necessary to consider the body mass index (BMI).

International system of units (6):

$$BMI = \frac{weight}{height^2} \quad (6)$$

Imperial system (7):

$$BMI = 703 \times \frac{weight}{height^2} \quad (7)$$

BMI categories:

- Underweight (severe emaciation) < 16.0
- Underweight (moderate thinness) 16.0 - 16.9
- Underweight (moderate thinness) 17.0 - 18.4
- Normal range is 18.5 – 24.9
- Overweight (before obesity) 25.0 – 29.9
- Obesity (I class) 30.0 – 34.9
- Obesity (class II) 35.0 – 39.9
- Obesity (class III) ≥ 40.0

We can calculate healthy weight loss and weight gain based on the main indicators. For healthy weight loss, it is necessary to subtract 250-500 calories from the total daily energy consumption. For healthy weight gain, on the contrary, it is necessary to add 250-500 calories to the total daily energy consumption [8].

In addition to calories, it is also necessary to calculate the necessary amount of nutrients for a healthy diet. For this, we will use the following percentages:

1. Calculation of protein consumption - 10-30% of total calories (for adults)
2. Calculation of the amount of fat - 20-35% of the total caloric content (for adults)
3. Calculation of the use of carbohydrates - 45-65% of the total caloric content
4. The recommended water consumption is 1 kcal = 1 ml
5. Calculation of the number of grams of fiber (8):

$$Fiber = \frac{kcal}{1000} \times 14 \quad (8)$$

To calculate the required amount of nutrients in grams, you need to take into account the number of calories per gram for each macronutrient:

- Protein: 4 calories per gram
- Carbohydrates: 4 calories per gram
- Fats: 9 calories per gram

It is also necessary to take care of the normal amount of water in the body [9]. Below is the formula for calculating the required amount of water (9):

$$waterIntake = weight \times 0.03 \quad (9)$$

Conclusion

In this article, we have reviewed existing examples of healthcare systems, namely the mobile applications “Calorie Counter by Lose It!” and “Calorie Counter App: Fooducate” and websites “My Diet Plan” and “SuperCook”.

We explore their advantages and disadvantages for further implementation in rethinking existing healthcare systems to add new features based on user experience and analyzed data. Such a system should be scalable, reliable, secure, and flexible.

Also, this article examined the main calculations that should be done to improve a correct working healthcare system that will cover widely-used measurements such as BMR, TDEE, BMI, and daily water consumption. Also, there were examined calculations of nutrient consumption such as protein, fat, carbohydrates, and fiber.

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