System for Calculating and Managing Kilocalories Consumed and Spent through Various Domestic, Physical and Sports Activities

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Abstract: In times like the ones we are experiencing in the present year of 2020, motor activity is limited, predisposing to sedentary lifestyle and the imbalance between caloric consumption / energy expenditure, favoring the obesogenic phenomenon. To alleviate these circumstances, each individual must be able to obtain information on energy intake and energy expenditure on a daily basis, to control the caloric value of each meal and determine the daily energy expenditure of motor activity. The information on the caloric value of foods can be obtained from the food composition table (Regulation - EU, no. 1669/2011). Information on the caloric expenditure of motor activities is also characterized (Ainsworth, Haskell, Herrmann, Meckes, Bassett, Tudor-Locke et al., 2011). It is only necessary to consider the duration of activities and body mass. To obtain these values and establish, in real time, a comparison between the energy intake and the energy expenditure, we created a system, represented by a responsive WebApp, with the possibility of being accessed by several devices, as well as tablets and mobile phones. The WebApp uses Ajax, jQuery, PHP, SQL and JSON technologies and a MySQL database. The system also includes a backend, supported by a proprietary Model-View-Controller framework, for parameterization.

1 INTRODUCTION

In times of recollection, as we experience today, our motor activity is quite limited, due to the confinement of the small dwelling spaces where we live in. These constraints make us more sedentary, with all the resulting consequences related to the health and well-being of each one of us.

In parallel with the decrease of daily physical activity, we maintained (in some cases, even increased) daily food consumption, which affects the caloric consumption / energy expenditure balance. This behavior may have undesirable consequences for health, individual well-being and overall quality of life. Last instance it is a driven force linked to the obesogenic factor.

One way to alleviate the previous problems would be to obtain information on daily food consumption and, in parallel, obtain information on energy expenditure through motor activities of a domestic nature, physical activity practices, or even sports practices, that each of us perform during the day.

This information can help to control the caloric food consumption of each single meal and help to translate that into daily energy expenditure associated with the different daily activities. Thus, allowing each one to decide what to eat and what to engage with motor, physical and sports activities.

The information on caloric consumption can be obtained by calculating the kilocalories existing in the most varied foods, multiplying it by the amount consumed, using solid and / or liquid volume units. The information on energy expenditure is obtained by calculating the kilocalories resulting from the expenditure of metabolic units per minute, for several motor, physical and sports activities, already characterized at this level (Ainsworth, Haskell, Herrmann, Meckes, Bassett, Tudor -Locke et al., 2011). For these activities, the total caloric expenditure will be calculated by multiplying the referred values by the duration of each motor activity, taking into account the individual body mass.

As there is not an easy and accessible way to obtain these values and establish, in real time, a comparison between energy input and expenditure, we decided to create an information system to support the process of collecting, storing, calculating, presenting and comparing the results. This makes it

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possible not only to obtain the data, but also to manage the information and use it to make final decisions about which foods to eat and what motor tasks to perform.

In order to operationalize this system and allow it to go into production, a frontend was developed, represented by a Web application, specifically a WebApp, supported by a responsive single-page application (SPA). This feature allows access to both a desktop computer and a laptop, as well as mobile devices such as tablets and mobile phones. The WebApp uses Ajax technology, combined with the jQuery JavaScript library, the PHP programming language, the SQL language, to query the database and objects in JSON format, for interoperability between the database and the HTML markup language.

The system also includes a backend component, for the corresponding management and administration. The implementation of this component was made using a proprietary framework, supported by a Model-View-Controller (MVC) pattern, which was assigned the name Agon and where the entire system is parameterized. To support the two components of the system, a MySQL database was created where all foods were inserted, as well as physical and sport activities, in the respective data model tables, defined for this purpose.

Bearing in mind that the system is intended to reach the largest number of users, it offers the possibility to use both Portuguese and English languages, depending on the user preference.

Currently, the system does not yet allow several meals per multiple days to be saved. In the future it will be necessary to create a feature to register users and allow them to access their reserved areas. At this point, we expect the users to be able to keep a record of the energy supply, as well as the caloric expenditure and therefore monitor the respective evolution, during the intervals of time they consider necessary. To make the system even more international and global, more languages are expected to be included further on.

2 METHODOLOGY

2.1 Variables

To calculate the caloric intake, the nutritional information of each food was used, as defined in the table of food composition, according to the EU, Regulation N.º 1669/2011. For each 100 g or 100 ml, this table characterizes food using, all together 40 constituent elements, including the energy value expressed in terms of calories.

For the calculation of energy expenditure, we are using the codes and metabolic units (MET) indicated by Ainsworth, Haskell, Herrmann, Meckes, Bassett, Tudor-Locke, et al (2011), as established for motor, physical and sports activities. For a personalized energy expenditure, the authors also refer the need to take into account not only body mass (BM), but also the total duration (TD) of the activity in minutes.

2.2 Processing of Food Data

Processing of food data. Through the WebApp frontend component, each user can choose the foods ingested or to be ingested, from a total of one thousand and one hundred and forty-six (1146) possible foods, previously saved in a MySQL database.

For this, the user must press the button to add the food and following that a form will appear, as a modal. Then the user must enter in the search field at least the two initial characters of the desired food. When executing this operation, the system triggers the well-known typeahead functionality, showing in the next field of the form, a list, with all the food options registered in the database that begins with the characters typed or that are being typed. For this to happen in real time, the WebApp uses Ajax technology, combined with the jQuery JavaScript library, the PHP programming language, the SQL language, to query the database, and objects in JSON format, to exchange the data between the database and the HTML markup language. From the presented list of foods, the user selects only one.

The following field is numerical and is intended to be filled by the user with the amount consumed of the previously selected food.

The final field must be filled with the type of measurement unit used in the previous field. Here, the user has the possibility to choose between grams, kilograms, liters, deciliters and milliliters, by selecting the corresponding radio button.

To register the data associated with the selected food, the user must submit the form by pressing the 'add' button and thus sending the data to the database. With this operation, a food is added to the database table associated with the user.

After submitting the form, a data table is presented on the same screen, with the associated records of the submitted data and also with the energy value of the chosen food, calculated accordingly to the amount eaten and presented in the form of calories.

For each submission of a new food, a line is added. As soon as this data table has two or more rows, the total calories consumed is calculated and displayed at the bottom of the data table in question. If the user finds that he does not want to consider one of the records, he has submitted, he can delete it, by simply choosing the corresponding food button which is located at the last column of the data table. He can also delete all food records to calculate a new meal and related calories.

2.3 Processing of Physical Activity Data

To determine the energy expenditure associated with motor, physical and sports activities, the user proceeds in a similar way as he did previously for food. However, the user will have to select the activities option at the menu to use the corresponding features.

As soon as the user enters this part of the WebApp, for the first time, the system detects that he has not yet indicated the respective body mass and requests the necessary information. For that purpose, he is going to use a form with a single field, which appears again as a modal. Right after the form submission, the body mass value is stored in a session variable created when the user accessed the WebApp. The body mass value remains stored in this session variable until the user leaves the WebApp, closes the browser or intentionally changes the body mass value, using the same procedure.

After this first procedure, the user can choose one of the activities, previously introduced in the databases.

Here, the procedures are very similar to food registration, but much simpler and less technically demanding.

Thus, to register an activity already performed or to be performed, the user needs to press the button to add the activity. A form will appear again, but with only two (2) fields to fill in. The first will present the list of physical activities and one of them must be selected. Then, in the second field, the duration of this activity in minutes must be indicated.

After filling in these two fields, the form must be submitted, pressing the corresponding 'add' button, so that the data associated with the activity can be registered in the database.

As for food, whenever the form submission is successful, a data table appears on the same screen, where the lines represent the characteristics of the activities submitted, namely: i) the value of the metabolic units; ii) the calories expended per minute of activity (according to the value of the metabolic units); iii) the duration of the activity in minutes; and iv) in the last column of the data table the calories, calculated accordingly to the previous values when combined with the user's body mass.

For each submission of a new activity, a line is added to this second data table and also here, whenever it presents two or more lines, the sum of the duration of activities and the total sum of calories expended in the registered activities are calculated and presented.

The procedure for eliminating registered activities can also be carried out by choosing the button corresponding to the activity to be deleted that is located at the last column. There is also the option, to delete all records of previously registered activities, in order to calculate the kilocalories spent on another set of activities.

3 OUTPUTS

In addition to the data and information presented in the referred data tables, it is also possible to present a small dashboard, where only the values of calories ingested through food and calories spent through physical activities are placed, to check to what extent there is a balance between the two. These values are updated in real time, whenever the user adds more food or activity.

Hopefully with these results the users can become more aware of their eating habits and physical behaviors. They can also make decisions about the need to increase or decrease food intake and increase or decrease the need for physical activities, to maintain the balance between energy input / expenditure, so necessary for maintaining a good health, quality of life and individual well-being.

4 LIMITATIONS AND FUTURE DEVELOPMENTS

The present system also has some limitations. First being the reduced number of activities mainly physical and sports activities. Future versions will significantly increase the range of other activities.

The impossibility of maintaining a history of the records is another issue in development. Our option for this first version was to create a light, agile system without many features, to keep it easy to use at the expense of other features (e.g., maintaining the historical record). In addition, the need to develop it

in a very short time frame so that it becomes available and useful during the times we are living, influenced this limitation.

Another issue under development, is the lack of a personal reserved area, through a username and password that will have to be created, precisely to allow historical records, among other features. The possibility of historical records, allows the creation of time series that provide indications of the user's behavior, not only in real time, but also at different time frames.

The representation of data on the form of data graphical visualization and information, as well as the possibility of creating detailed reports, are also one of the handicaps at the current version of this system. In terms of design and graphic concept, there is still a significant amount of developments in progress, namely in the creation of interfaces oriented to the concept of user centered design, which should be combined with greater efficiency not only in terms of usability, but also of user experience (UX), while trying to facilitate the application use.

The lack of languages other than Portuguese and English somewhat limits the globalization and internationalization of the system, by a wider audience.

The small number of tests is still a limiting factor in order to obtain a more robust WebApp, capable of moving towards other levels of maturity. To mitigate this limitation, updating the application is something that we will do frequently in the future.

The backend part, intended for administration, will also have to undergo the corresponding changes and developments in order to support the features now stated.

To complement this WebApp, we still need to develop a hybrid or by preference a native app, to install on mobile devices with MAC OSX and Android operating systems, thus taking advantage of the possibilities from the graphic components offered by the operative system resources.

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