

# Developing a Computer Application for Calculating the Nutritional Value of Food and Daily Needs for Human

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## Abstract

*Nowadays, since most of the foods are highly processed, knowing their nutrition value and the human's daily needs are important to any person in order to maintain a healthy life. The paper present, in the first part, the architecture, the comprising categories, the advantages and disadvantages of two web applications that compute the nutrition value of food and the human's daily needs, i.e. SELFNutritionData application and Nutrition Value application. Based on their disadvantages, in the second part of the paper, the Food Nutrition Value and Daily Needs (FNVDN) application was developed. It integrates the computing of both nutrition value of food and human's daily needs. This application is easy and intuitive to use, and it is highly adaptive to the changes made in its databases.*

**Keywords:** *nutrition value; daily needs; body mass index; computer application; database*

**JEL Classification:** *C8; L66; I19*

## Introduction

Anderson (2005, p.147) states that the essence of the “nutritional value” concept was known before the vitamins were discovered by scientists, since the 1950s when the health food movement emerged, even if the ideology of this movement was a mix of science and spiritualism (McIntosh, 1996, p.41).

The nutritional value of a food represents “the usefulness of products and food groups to cover the consumer’s needs related to metabolism” (Ricke, et.al., 2012, p.240) and it is given by the content of water, calories, protein, total fat, fatty acids (saturated, monounsaturated and polyunsaturated), cholesterol, carbohydrate, dietary fiber, iron, potassium, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid (Gebhardt and Thomas, 2002, p.14-15).

Kumar (2005, p.62) and Tsao and McCallum (2010, p.147) consider that the food which we are eating nowadays has a 25-35% nutritional value of the food that was grown 50 years ago, because most of the food is processed. Thus, this food affects the human’s physical and mental health. The population’s health is a subject of high interest for public authorities, taking into account the negative externalities that could be generated by the consumption of low quality foods. Ensuring sufficient and good quality food products is a relevant concern of various stakeholders (public authorities, companies in various fields, consumer associations), taking into

account the challenges posed by globalization, liberalization of international trade with agricultural products, regional economic integration and the impossibility of complete elimination of the risks of extensive use of pesticides, food additives, genetically modified organisms or food irradiation. (Ene and Matei, 2012; Ene et al, 2017; Voica and Panait, 2017; Drăgoi et al. 2018).

The human's daily needs for nutrients are the nutritional requirements for one day, "the amount of every nutrient used by the body every day, and this amount must be replaced through the diet daily or derived from body stores" (Sharma et.al, 2016, p.78). Connor (2012, p.15) stresses that when the body meets the daily needs, the individual feels good (healthy).

Although there are a lot of scientific documentation about the human's daily needs which is easy to access via Internet, an exhaustive and custom assessment of daily needs can be done only by a nutrition-minded health professional based on the results of specific clinical tests (Smith, 2003, p.148).

The aim of the paper is to develop a computer application for calculating the nutritional value of food and the human's daily needs starting from the existing applications and processing well known available databases.

## **Web Applications which Compute the Nutrition Value of Food and Human's Daily Needs**

On the Internet, there are websites that contain application which compute the nutrition value of a food. The main web applications are SELFNutritionData and Nutrition value.

### **The SELFNutritionData Application**

It includes three different sub-applications, i.e. the Featured food fact, the Daily needs calculator, and the Unit Conversion. These applications cannot be accessed in the same time because there are three different links and they are located side by side on the web page.

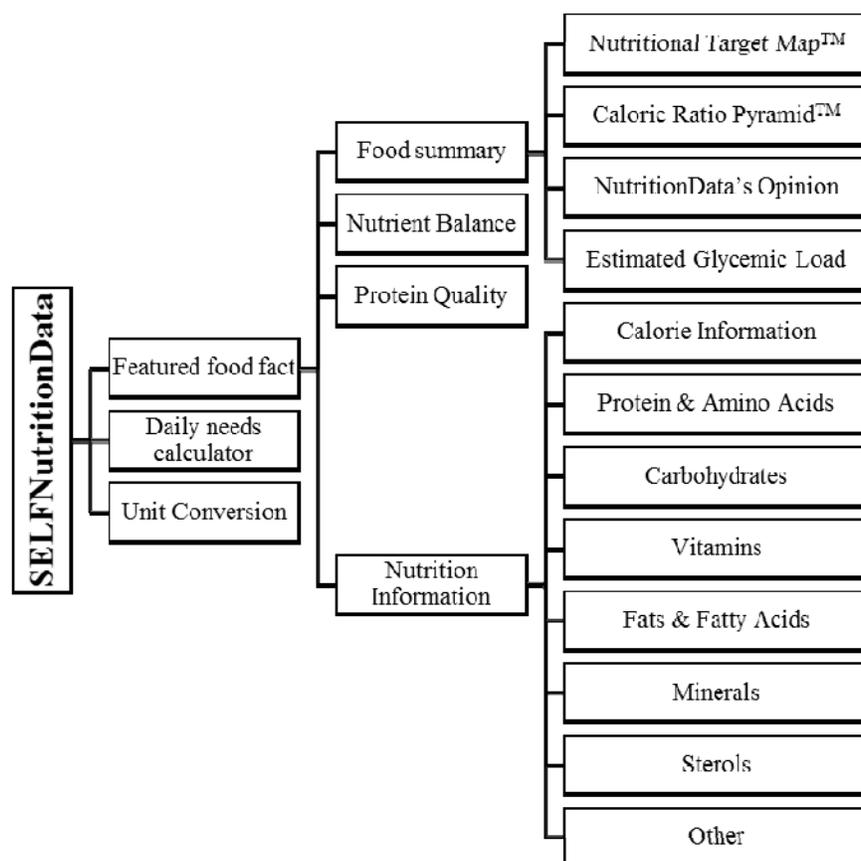
The Featured food fact is organized in four main categories. Two out of the four categories are complex categories which comprise four or more indicators (figure 1).

The *Food Summary* contains four sub-categories:

- The Nutritional Target Map<sup>TM</sup> is based on computing of Fullness Factor, an indicator that has values between 0 and 3.3. The closer value is to 3.3, the more essential nutrients per calorie the food has;
- The Caloric Ratio Pyramid<sup>TM</sup> shows what percentage of the calories in a food come from carbohydrates, fats, and proteins, and alcohol. The background of the percentages for each of the four caloric substances is colored differently, i.e. gray for alcohol, green for carbohydrates, red for fats, and blue for proteins;
- The NutritionData's Opinion is express by three indicators, such as weight loss, optimum health, and weight gain. Each indicator has a 5 stars scale. The NutritionData's Opinion provide additional information about the "the good" and "the bad" components of the food;
- The Estimated Glycemic Load is an indicator with the values between 0 and 250. The recommended value is 100/day or less.

The *Nutrient Balance* is expressed by the Completeness Score with values between 0 and 100. It is a relative indicator of how a complete the food is with respect to dietary fiber, protein, vitamins, minerals, saturated fat, cholesterol, and sodium.

The *Protein Quality* highlights if the nine essential amino acids are in the proper proportions. The Amino Acid Score is used to measure the Protein Quality. If the score is 100 or higher, than the food contains the complete proteins and vice versa.



**Fig. 1.** The web architecture of SELFNutritionData application

Source: Made by author based on the SELFNutritionData, 2018

The *Nutrition Information* contains eight sub-categories and the amount of the substances from these categories is express in both g/mg and Percentage Daily Values:

- Calorie Information. It expresses the calories for overall food and for the carbohydrate, fat, protein and alcohol content;
- Protein & Amino Acids. It outlines the protein contain other 19 nutrients, including the essential amino acids: tryptophan, threonine, isoleucine, leucine, lysine, methionine, cystine, phenylalanine, tyrosine, valine, arginine, histidine, alanine, aspartic acid, glutamic acid, glycine, proline, serine, and hydroxyproline;
- Carbohydrates. It underlines the total carbohydrates, the dietary fiber, the starch and six sugars content;
- Vitamins. It describes the content for 14 vitamins (water-soluble and fat-soluble vitamins): vitamin A, vitamin C, vitamin D, vitamin E, vitamin K, thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, choline, and betaine;
- Fats & Fatty Acids. It comprises the total fat, saturated fat, monounsaturated fat, polyunsaturated fat, total trans fatty acids, total trans-monoenoic fatty acids, total trans-polyenoic fatty acids, total Omega-3 fatty acids, and total Omega-6 fatty acids content;
- Minerals. It includes the content for 11 minerals: calcium, iron, magnesium, phosphorus, potassium, sodium, zinc, copper, manganese, selenium, and fluoride;
- Sterols. It refers to the cholesterol and phytosterols content;
- Other. It comprises the alcohol, water, ash, caffeine, and theobromine content.

The SELFNutritionData uses the USDA's commodity database for the Nutrition Information category and the Institute of Medicine's Food and Nutrition Board' recommendations for the distribution of amino acids for computing the Protein Quality category.

The main advantages of the SELFNutritionData web application are as follows: (i) the Nutrition Information category contains the most important macronutrients and micronutrients of foods, (ii) each category is clearly delimited in the web page, (iii) there is additional information available for each sub-category which describe it, etc. Instead, the disadvantages refer to: (i) the Featured food fact, the Daily needs calculator, and the Unit Conversion applications cannot be accessed simultaneously by the user, (ii) the user must install Flash player to view the graphic representation of some features, (iii) the energy value of the food expressed in calories and joules is not mentioned, etc.

### **The Nutrition Value Application**

It comprises two sub-applications, i.e. the Nutrition calculator and the Body Mass Index (BMI) calculator (figure 2). These applications are working distinctly in two web pages, like the SELFNutritionData application.

The *Nutrition Calculator* encloses the following 9 sub-categories:

- Nutrition facts. It includes the number of calories, total fat, total carbohydrate, dietary fiber, sugar, protein, vitamin A, vitamin C, calcium and iron of the food. The first six nutritional items of information are expressed in both g and Percentage Daily Value, and the following four nutritional items of information are expressed only in Percentage Daily Value. It may include additional nutritional information depending of the food, such as cholesterol for meat;
- Calories by source. It is represented by two charts. The first chart is a pie chart which highlights the calories by source (from carbohydrate, fat and protein, and alcohol) in percentage. The second chart is a bar chart that shows the percentile of foods in the database;
- Vitamins. It contains the amount and Percentage Daily Value for 9 vitamins, i.e. niacin, pantothenic acid, riboflavin, thiamin, vitamin A (including other 6 provitamins), vitamin B12, vitamin B6, vitamin E (including four tocopherols and four tocotrienols), and vitamin K;
- Carbohydrates. It encloses the carbohydrate, fiber, and six sugars (fructose, galactose, glucose, lactose, maltose, and sucrose);
- Fats and fatty acids. It comprises both pie chart and list with information about fats and fatty acids. The pie chart presents the fatty acids by type, i.e. the weight of saturated, monounsaturated and polyunsaturated fatty acids. The list includes the fat, 13 saturated fatty acids, 14 monounsaturated fatty acids, 17 polyunsaturated fatty acids, and two trans fatty acids.
- Minerals. It incorporates 11 nutrients: calcium, copper, fluoride, iron, magnesium, manganese, phosphorus, potassium, selenium, sodium, and zinc;
- Proteins and Amino Acids. It contains only the protein content;
- Sterols. It includes only the cholesterol content;
- Other. It contains the ash, caffeine, dihydrophyloquinone, menaquinone-4, theobromine, and water.

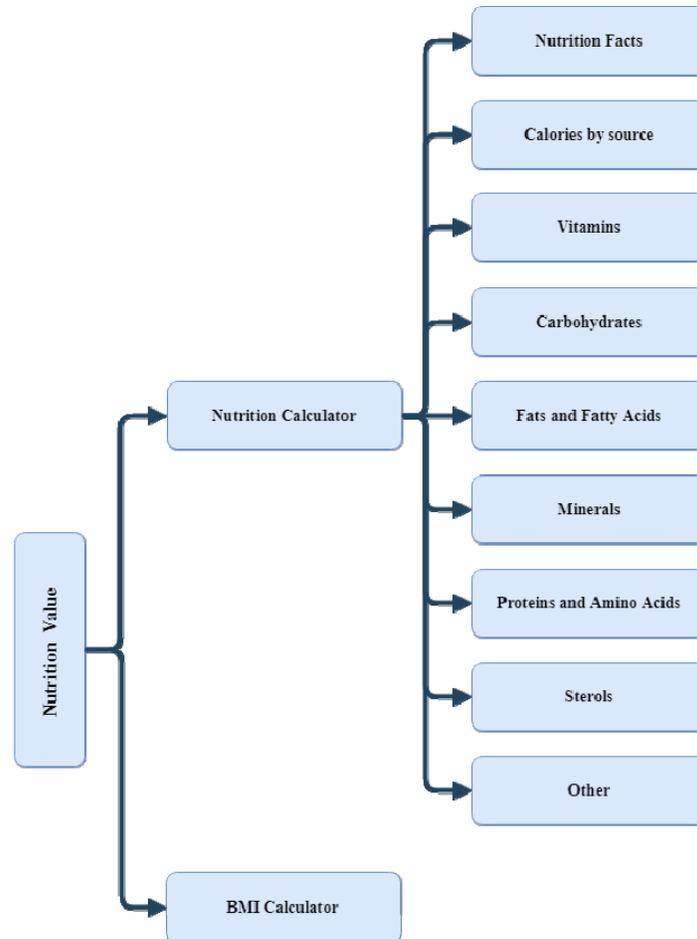
The Nutrition Calculator uses the database from USDA National Nutrient Database for Standard Reference.

The *Body Mass Index Calculator* computes the BMI as a ratio between body weight (kg) and square of body height (m). The result of BMI is presented on a graph scale with four levels:

- Underweight with a BMI smaller than 18.5, colored in blue;
- Normal with a BMI between 18.5 and 25, colored in green;

- Overweight with a BMI between 25 and 30, colored in yellow;
- Obese with a BMI over 30, colored in red.

The main advantages of the Nutrition Value application are: (i) the food can be searched by vitamin, mineral, macronutrient, and amino acid; (ii) the pie chart of the calories of food by source is highly expressive; (iii) the content of fats and fatty acids is described in depth. The disadvantages of the application are as follows: (i) the Nutrition Calculator and the Body Mass Index Calculator applications are not connected; (ii) the bar chart that highlights the percentile of foods in the database is irrelevant; (iii) even if the title of the category is protein and amino acids, there is no information available about the type and amount of amino acids.



**Fig. 2.** The web architecture of Nutrition Value application

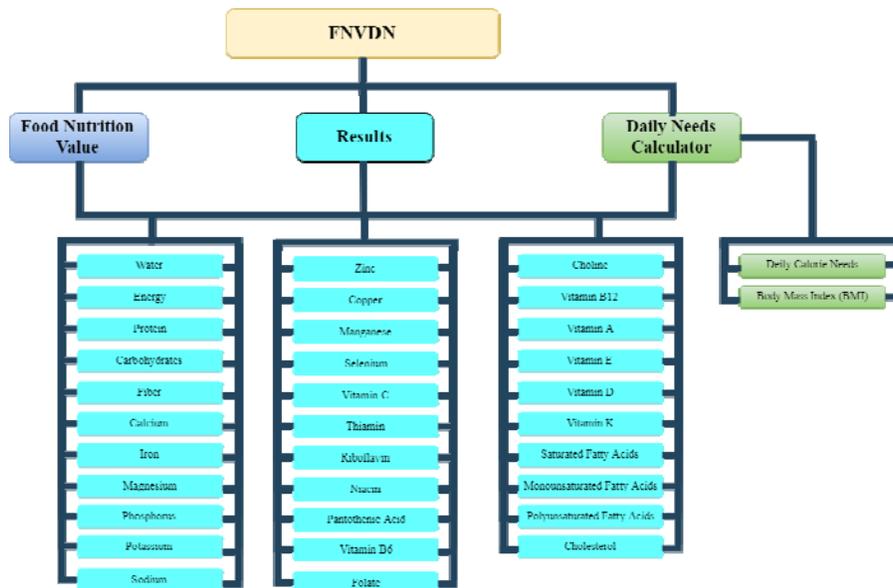
Source: Made by author based on the Nutrition value, 2018

## **Developing the FNVDN Application**

Considering the disadvantages of the previous two applications and the objective to design an application which integrates the calculation of both nutrition value of food and human's daily needs for the main macronutrients and micronutrients, the Food Nutrition Value and Daily Needs (FNVDN) Application was developed.

## The Architecture of FNVDN Application

The architecture of FNVDN application contains three components: the Food Nutrition Value, the Daily Needs Calculator, and the Results. As figure 3 shows, the Results comprises the values for both Food Nutrition Value and Daily Needs, i.e. the content of the following 32 nutrients (including the energy) of food: water, energy, protein, carbohydrates, fiber, calcium, iron, magnesium, phosphorus, potassium, sodium, zinc, copper, manganese, selenium, vitamin C, thiamin, riboflavin, niacin, pantothenic acid, vitamin B6, folate, choline, vitamin B12, vitamin A, vitamin E, vitamin D, vitamin K, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, and cholesterol. Additionally, the Results category computes the daily calorie needs and the body mass index (BMI) according to the person's sex, age, height, weight, and activity.

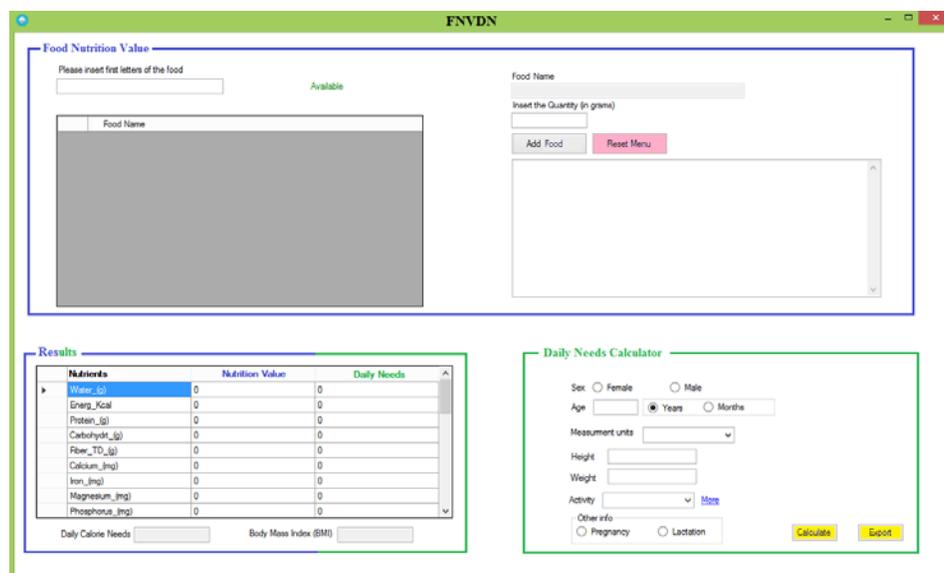


**Fig. 3.** The architecture of FNVDN application

*Source:* Made by author based on the design of FNVDN application

The FNVDN application was developed in the Visual Studio (for Windows) environment by using the C# programming language. It is an autonomic application which can run on any PC with Microsoft Window XP version or higher. The FNVDN application comprises an executable file, which is used to start the application, and other ten support files, including the databases files used to compute the nutritional value of food, the human's daily needs, the daily calorie needs, and the body mass index from the Results category.

The figure 4 shows the user interface of the FNVDN application which starts by clicking on the executable file. Furthermore, the figure 4 highlights the correlation between the three categories as it is described in figure 3.



**Fig. 4.** The FNVDN application

Source: Made by author

The Food Nutrition Value category has a blue border, the Daily Needs Calculator category has a green border and the Result category has a two color border (blue border for the information that represent the output of Food Nutrition Value category and green border for the information that are the output of the Daily Needs Calculator category).

### The Databases of FNVDN Application

The *Food Nutrition Value* category uses the United States Department of Agriculture's SR28 database with the May 2016 revisions of the food nutrition value (USDA, 2016). The database comprises 32 main nutrition value for 8,790 foods.

Because a database which contains the dietary reference intakes for all nutrients described in SR28 database does not exist, it was designed a new database for the *Daily Needs Calculator* category. The new database includes (Institute of Medicine of The National Academies, 2005a; Institute of Medicine of The National Academies, 2005b; FAO/WHO, 2008; USDA Center for Nutrition Policy and Promotion, 2006):

- The United States Institute of Medicine of The National Academies' Dietary Reference Intakes (DRIs) database for the recommended dietary allowances and adequate intakes for vitamins. Form this database there were selected the values for vitamin A, vitamin C, vitamin D, vitamin E, vitamin K, thiamin, riboflavin, niacin, vitamin B6, folate, pantothenic acid, and choline according to the life stage and sex (infants, children, males, females, pregnancy and lactation);
- The United States Institute of Medicine of The National Academies' Dietary Reference Intakes (DRIs) database for the recommended dietary allowances and adequate intakes for minerals. The following minerals were selected according to the life stage and sex (infants, children, males, females, pregnancy and lactation): calcium, copper, iron, magnesium, manganese, phosphorus, selenium, zinc, potassium, and sodium;
- The United States Institute of Medicine of The National Academies' Dietary Reference Intakes (DRIs) database for the- recommended dietary allowances and adequate intakes for water and macronutrients. The water, carbohydrate, total fiber, and protein content according to the life stage and sex (infants, children, males, females, pregnancy and lactation) were chosen;

- The FAO/WHO’s dietary recommendations on total fat and fatty acids database. Based on the upper level of acceptable for total fat, saturated fat, monounsaturated fat, polyunsaturated fat expressed in percentage of energy, the values in grams for the saturated fat, monounsaturated fat, polyunsaturated fat were computed;
- The USDA Center for Nutrition Policy and Promotion's database on nutritional goals for proposed daily food intake patterns. From this database, the cholesterol level was chosen.

The *Results* category shows the nutrition values based on the food chosen and the quantity indicated in the *Food Nutrition Value* category by the user. Also, in the *Results* category, the human’s daily needs are calculated according to the data entered by the user in the *Daily Needs Calculator* category. Additionally, the Daily Calorie Needs and the Body Mass Index (BMI) are computed.

The Daily Calorie Needs uses the U.S. Department of Health and Human Services’ and U.S. Department of Agriculture’s estimated calorie needs per day, by age, sex, and physical activity level database (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015, p.77-78).

The BMI is computed based on the formulas (1) and (2) according to the measurement unit (LeFever Kee, et.al., 2016, p.335):

- For inch-pound system:

$$BMI = \frac{W}{H^2} \cdot 703 \tag{1}$$

where:

*W* is the person’s weight expressed in pounds;  
*H* – the person’s height expressed in inches.

- For metric system:

$$BMI = \frac{W}{h^2} \tag{2}$$

where:

*w* is the person’s weight expressed in kilograms;  
*h* – the person’s height expressed in meters.

Depending on the values of BMI, the people are classified in 8 categories as it can be noticed in figure 5. The “Normal” category colored in green, as its name suggests, is considered to be healthy weight.



**Fig. 5.** Peoples’ classification according to the values of BMI

Source: Made by author based on Brehm, 2015, p.98; Anisman, 2016, p.184

## The Procedure of Using the FNVDN Application

The procedure in using the FNVDN application is easy, intuitive and it is described as follows:

1. The application starts by clicking the executable file with the  icon. It is mandatory that all the additional files (including the database files) that are part of the application to be in the same folder with the executable file;
2. At startup, the application needs to upload the databases. Thus, near the **Please insert first letters of the food** text box, the message **Wait! Processing!** is shown, up to 10 seconds, in the left side in the Food Nutrition Value category. Because the upload of databases is made automatically at startup, the user does not have to assign manually the databases to the application. During the 10 seconds the application interface is blocked, and the user sees the application running, but he cannot interact with it;
3. After the 10 seconds from the startup, the **Wait! Processing!** message is replaced by the **Available** message. This means that all databases are uploaded, and the application can be used. The **Available** message will remain active in the Food Nutrition Value category as long as the application is opened;
4. The application automatically places the cursor in the **Please insert first letters of the food** text box from the left side in the Food Nutrition Value category. As the name of this text box suggests, the user must write the first letters of the food for which he/she wants to compute the nutrition value and the daily needs;
5. As the user writes the first letters of the food, a list of foods that contains the letters written by the users is shown in the **Food Name** list form in the left side in the Food Nutrition Value category;
6. The user scrolls and chooses the food that is looking for by a single click on it. The name of the food chosen by the user appears both in the **Food Name** text box (in the right side in the Food Nutrition Value category) and in the **Food Name** list (in the left side in the Food Nutrition Value category);
7. The user writes the quantity in grams in the **Insert the Quantity (in grams)** text box and clicks the **Add Food** button. As a result:
  - The name of food and the quantity written in brackets is shown in the box list in the right side in the Food Nutrition Value category (under the **Add Food** and **Reset Menu** buttons);
  - The **Nutrition Value** has been automatically computed and shown in the Results category;

*Note:* If the user does not write the quantity in the **Insert the Quantity (in grams)** text box after choosing the food from the **Food Name** list, the **Input string was not in a correct format.** error message will appear in a pop-up window. In this case, the user must click on the **Reset Menu** button to clear the food added until that moment and to resume the selection from step 4.
8. If the user wants to add a new food, he/she must resume the selection from stage 4. The new food will be added after the previous one in the box list in the right side in the Food Nutrition Value category (under the **Add Food** and **Reset Menu** buttons) and its nutrition value will be added over the data that already exists in the Results category.

*Note:* If the user adds by mistake a food and/or wants to delete it, he/she must click on the **Reset Menu** button. This action will clear the entire list of food added and the user must resume the selection from stage 4;
9. For computing the daily needs, the user:
  - selects the gender;
  - writes the age and chooses the unit of measurement, i.e. years or months (for infants);

- o chooses the unit of measurement for his/her height and weight (metric or inch-pound system). Once a selection is made, the units of measurement will appear automatically in the height and weight text boxes;

- o selects the type of activity. In order to choose the right type of activity, the user can click on the **More** button which opens a pop-up window with additional information about type of activity according with the intensity of the physical activity in day-to-day life;

- o selects other information (only for women);

- o clicks on the **Calculate** button and the **Daily Needs**, **Daily Calorie Needs** and **Body Mass Index (BMI)** are computed in the Result category;

- The user can export the values from the Results category by clicking on the **Export** button. Thus, a pop-up “Save as” window will open, and the user must write the name of the PDF file and choose a location where to save the file.

## Conclusions

The major improvement of FNVDN application against other similar web applications is that it integrates into a single application the computing of both nutrition value of food and daily needs for humans and the results are generated in the same window of application and PDF document (when the results are exported to a document file).

The FNVDN application is easy and intuitive to use because the Food Nutrition Value, the Daily Needs Calculator, and the Results categories are clearly bounded by the different color of the borders, the name of each category is expressive enough for the user to determine the function of the categories, the position of the categories in the window application follows the user’s natural top-to-bottom and left-to-right reading direction. Further, the “Reset Menu” button is colored in pink and the “Calculate” and “Export” buttons are colored in yellow to be easy to spot by the user.

This application can run on any PC which has installed at least the operating system, i.e. Microsoft Windows XP or higher, since the project developed in Visual Studio was exported as executable file and specific additional files. In the case that the user wants to download the values form the “Result” category, the Adobe® Acrobat® Reader version 6 or higher must be installed on PC.

The FNVDN application was developed to be highly adaptive since the databases used to for the Food Nutrition Value, the Daily Needs Calculator, and the Results categories are editable Microsoft Excel files. Thus, any revision of the values in the databases or adding new columns and rows with items into the databases will automatically make changes in the Results category by the settings made in the stage of designing the FNVDN application.

Moreover, the Food Nutrition Value and the Daily Needs Calculator sub-applications are independent of each other, meaning that the user can compute the daily needs without having to

choose a food in order to compute the nutrition value and vice versa is available. The Result category will provide only the information that the user wants to know, and the unnecessary information for user is not shown according to his/her selection and data entered.

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