FSIS - AN INFORMATION SYSTEM BASED ON THE MODERN TECHNOLOGIES OF DATA ACQUISITION AND DATA PROCESSING IN FOOD INDUSTRY

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In order to keep up with technological development in the food industry, and to facilitate the access for a wide range of users to information regarding the potential hazards they are exposed to, due to consumption of food improved with additives, whose effects on long-term are often unknown, it was considered to be useful the development of an information system on food safety in Romania. Creating this system involved data acquisition from official data providers in the food and health fields. The acquisition has been done both manually, as well as using a web crawler exclusively developed by the authors in order to fulfill the objectives of the proposed information system.

Keywords: Automatic data acquisition, web crawling/web spidering, web portal, food additives, food packaging

1. Introduction

We live in the information age and more than ever, there is an incredible demand for novelties. The computer represents an indispensable tool alongside with all the other associated communication facilities, especially the internet which has become a socio-technological phenomenon vital for many of us. It influences not only part of our lives, but it is manifested in all its areas representing an inexhaustible source of information for a wide range of users.

As we all know, food plays a very important role in human health, but, unfortunately, forced by the fast pace of daily life, most people have given up paying due attention to it, often ignoring the possible harmful effects associated

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with the consumption of food "improved" with a range of extremely dangerous additives and whose long-term effects are often unknown.

It is beginning to be increasingly obvious the fact that food manufacturers are interested mostly in extending the shelf life of foods without taking into account the health impact of the substances used for this purpose.

Food safety represents a priority both at EU level [1], as well as in Romania, in this respect a series of measures being already taken such as: the harmonization of national legislation with the European legislation, the introduction of new food processing technologies and the creation of authorized institutions for monitoring and process control in the food industry.

In order to help achieving the EU requirements, it was considered necessary to create an open-ended information system dedicated to food safety assessment at national level by objectively treating both the importance of using, and the unwanted effects of these "controversial" substances, as food additives [2] are considered today.

Another novelty was represented by the development of a web crawler designed for automatic data acquition from authorized websites in the food and health fields.

The implementation of FSIS information system

The main steps followed for the implementation of Food Safety Information System (**FSIS**) are:

- The involvement of the decision-makers regarding food safety at national and European level (European Food Additives Database [3], European Food Safety Agency [4], the Romanian National Sanitary Veterinary and Food Safety Authority – ANSVSA [5], Romanian National Statistics Institute [6], and National Institute of Public Health [7]).
- Stakeholder awareness and consensus, an indispensable step to avoid suspicions that block food safety data sharing.
- It is essential the knowledge of the ongoing projects and programs, the conventions and the agreements in force, the existing databases regarding food safety.
- Identification of data needs and data collection necessary for the network.
- Creating the fundamental databases and metadata within the network.

2. System structure

FSIS (Food Safety Information System) represents an integrated set of components for collecting, storing, and processing data, as well as for delivering information to a wide range of users [8] using the World Wide Web network. It consists in four interconnected modules (fig. 1). The first three namely: Data acquisition module, Database module and Health Impact Assessment Module, which are sending information to the fourth module, the web portal.

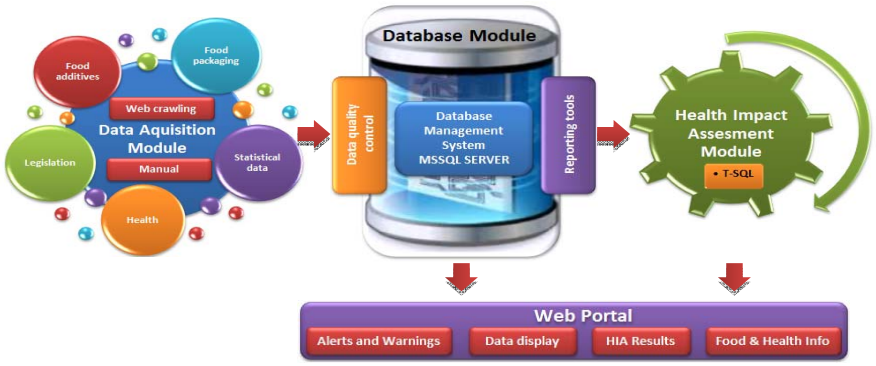

Fig. 1. The structure of the proposed information system

3. Data acquisition module

The main activity of an information system is data acquisition. Therefore, for creating FSIS, we had to gather information from various fields like: food additives, legislation regarding food safety at European level and national level, data regarding food packaging, and last but not least, information about health indicators.

3.1. Automatic data acquisition

Nowadays, internet offers a wide range of information regarding food safety, and collecting it requires the creation of programs or scripts.

Therefore, for data acquisition related to food additives, packaging and legislation, it has been created a focused web crawler, in order to simplify and streamline the data collection that the system requires. Data have been downloaded from the European database [3] dedicated to food additives.

The main steps taken in order to develop the acquisition module have been: the achievement of the acquisition parameter files, parsing files and data extraction from the web pages saved locally.

In order to obtain the information available online in a more coherent manner, it was necessary to create acquisition files for each group of the collected additives.

Parameterization files contain among other information, EEC (European Economic Community) encoding and internal encoding of the additive and the group to which it belongs.

The next step of automatic data acquisition module was browsing and analyzing the text files, and identifying important string with a parser script. A parser is a component of an interpreter or compiler, which identifies the structure of the input text and brings it into a form suitable for further processing.

In this case, parsing was used to extract files described above from the acquisition parameter, the necessary data (descriptors), in order to send data requests to the site "https://webgate.ec.europa.eu" [3].

The last step is represented by the acquisition and data saving. This is achieved using an automated program (post.php). The program loads the descriptors and sends them as a HTTP request to the target server [3]. The next action is being represented by the contents capture. This is done by extracting the presets elements from the website pages saved locally.

The script contains serialized data, access data to "webgate.ec.europa.eu" portal and also access data to local databases where the collected information is going to be saved. These procedures are explained broadly below:

- The procedure for including data generated by the parsing script:
  include_once("parser.php"), where:
  parser.php – is the parsing script created for acquisition files.
- The procedure for sending data request to the established address and data saving:
  function do_post_request($url,$data), where:
  $url= https://webgate.ec.europa.eu/sanco_foods/main/
  $data –represents the acquisition parameters.
- The procedure for connecting to the MSSQL database:
  $link =mssql_connect('PC\SQLEXPRESS', 'username','password');
  if (!$link || !mssql_select_db ('AditiviAlimentari', $link)) {
  die('Unable to connect or select database!');}

3.2. Manual acquisition

Part of the information has been collected manually, from the main official data providers. Therefore, data regarding food additives, food categories, the legislation related to food industry, were collected from European Food Additives Database [3], European Food Safety Agency [4], and The Romanian National Sanitary Veterinary and Food Safety Authority (ANSVSA) [5]. On the other hand,

food consumption data and health information were collected from the Romanian National Statistics Institute [6], and National Institute of Public Health [7]. Data acquisition can also be made by users and manufacturers from food industry that can upload various data about the foods they produce and the materials they use for packaging into designated forms. As a result of the introduction of this information in the system, and by processing the data collections, and after testing the interactions in the laboratory, the system will send warnings regarding the incompatibilities that may occur between packaging and food.

4. Database

In order to make data management more efficient and effective, and for identifying food-health connections using specific indicators, we thought it would be useful to create a major database, as a source of information for a wide range of users, which aims to centralize as much data reference as possible on: food in general (categories and food consumption at national level), food additives (the list with their European encoding, their properties and the major groups they are divided in), food packaging (types, categories, along with a list of the dangerous additives contained in food packaging) (fig. 2).

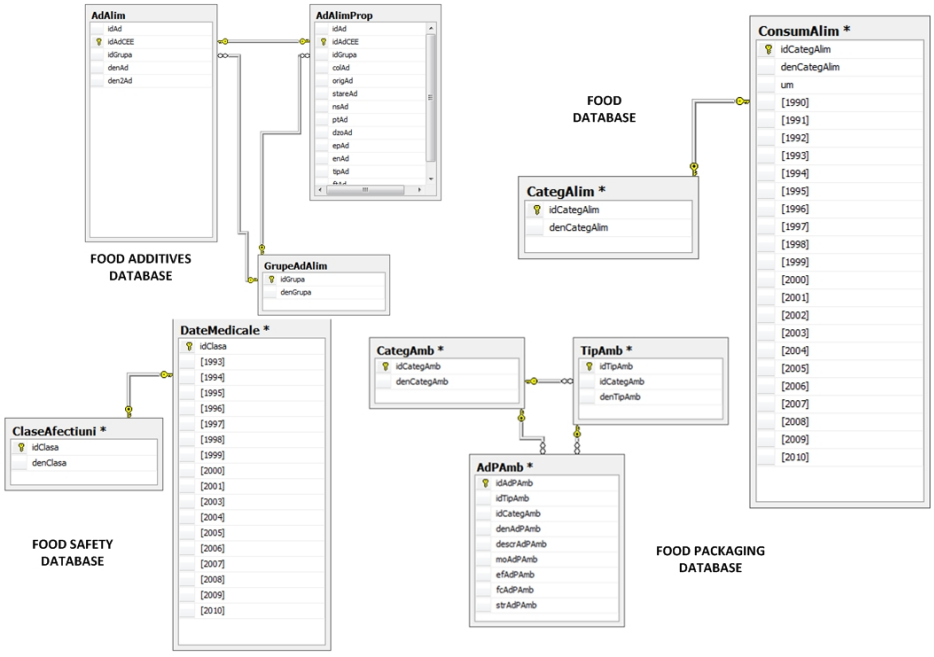

Fig. 2. FSIS Database

The database should also contain information regarding the possible chemical interactions that may occur between food and the additives contained in it, or the ones present in the packaging materials.

Microsoft SQL Server Express database management system [9] was used to implement the primary structure of the FSIS database.

The FSIS database module offers the possibility for future improvement by allowing the addition of other information related to food industry. For example, in the future, the system should also contain data on raw material suppliers and processors related to food and packaging industry, in order to achieve food path from farm to fork. Thereby, if any problem occurs in food processing, the system can alert, in a timely manner, food safety actors and other manufacturers that use the same raw material that proved to be contaminated, and thus should avoid selling consumers non-compliant products.

This should also help food manufacturers to implement Hazard Analysis and Critical Control Point (HACCP) [10] system that is useful for performing in good conditions and to obtain safe products. In other words, HACCP is a structured system used to identify and prevent food safety problems in production, processing and distribution. The system has become mandatory or recommended by governmental organizations around the world, including the European Commission, the U.S. Department of Agriculture (USDA), etc. [11].

Fig. 3. FSIS Portal

5. Web page

In order to simplify the access of a wide range of users to information regarding food safety, we created a web portal entitled "Food Safety Information System" - FSIS, which should also represent a milestone for all food manufacturers, because it offers all kind of useful data regarding food and food packaging.

FSIS offers users the possibility to visualize data and use interactive applications on food additives, food packaging and food safety.

The web page developed in this paper has been created using DotNetNuke [12] Platform and Microsoft Visual Web Developer Express [13]. It has also been created for groups of users and with different access levels. Therefore, food manufacturers and those from packaging industry have access to a wider range of information, and they have the ability to insert data into the system, while consumers have limited access, meaning that they can only view certain information. The system also allows communication between users expanded *via* a discussion forum, message or mail.

6. Conclusions

FSIS is a modular, complex, multilevel portal which involves the decision-makers regarding food safety at national level**.** It offers everyone interested in finding out more about the things we are eating today, the possibility to access data regarding the interactions that may occur between food, food additives and packaging materials, along with their impact on human health. It also represents a reliable source of information, due to the fact that all data have been acquired from the main official data providers from food and health fields.

One of the most important qualities of FSIS is that it offers users the latest data in the field due to the permanently databases updates, using web crawling technology. On the other hand, the system enables the transmission of alerts to manufacturers and to the food safety actors, if any problems occur with raw materials, therefore consumers would not get non-compliant products.

Also, the system offers useful information in order to help food manufacturers to implement HACCP (Hazard Analysis and Critical Control Point).

Food Safety Information System can be improved in time, because it allows the addition of new features such as statistical models like: automatic calculation of theoretical maximum consumption (TMDI), and automatic calculation of estimated daily intake (EDI), in order to make the health impact assessment.

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