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Information model of Web-gallery taking into account user's interests

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Abstract. Web-galleries which take into account user's interests can reorganize the structure of its content according to user's interests and peculiarities of their behaviour. Each Web-gallery encompasses expositions that to some extent reveal defined thematic categories. Each exposition contains exhibits which not always fully reveal its content. Exhibits that poorly reveal the content of exposition distract users and distort their interpretation. This paper describes software architecture of Web-gallery in which user's interests and interaction of components are taken into account.

Key words: Web-gallery, user's interests, linguistic variable, database.

INTRODUCTION

Modern Web-galleries contain large amounts of multimedia data, which are usually presented to users in the form of individual themes of expositions. User formulates a task of obtaining information, information system processes it and returns the result. Most information systems work exactly on this principle, so a user receives both required and redundant information. This situation is a consequence of absence or imperfectness of Web-galleries presentation methods. In order to avoid large redundancy of information or significantly reduce its number it is necessary to adaptively change the structure of Web-gallery content. One of this methods is to create Web-galleries considering features of behaviour and user's interests.

Aim of the article is to analyze the data flow in Web-gallery considering the user's interests and develop architecture of this Web-gallery.

MODELING WEB-GALLERY INFORMATION FLOW CONSIDERING THE USER'S INTERESTS

Standard Web-gallery features include filling, building, displaying and searching. It is characteristic of such Web-gallery that content is partially or fully structured, gallery themes arise as a result of covering certain events; Web-gallery viewing time is unlimited, it is actually limited by the availability of personal viewing time of the user; gallery filling is manual, with one exhibit at a time; building of the gallery is done by the classical scheme: the name of a new exposition and its themes is given, all the exhibits that somehow belong to a given theme are selected from gallery database and attached to a new exposition; galleries and expositions are displayed in the form of groups of equal objects; search is implemented only by keywords.

Standard Web-gallery features are not targeted at an individual user which is a significant shortcoming because a user has to spend more time finding relevant information.

In the Fig. 1 an architecture of software for Web-gallery creation considering user's interests is shown [6].

According to the problems which arise in the process of Web-gallery building considering user's interests consists of the following components:

- *component of gallery filling* allows to increase the volume of gallery content using a single method for adding new exhibits,
- *component of gallery display* uses the principles of displaying galleries, which are based on the phases of user's functional state, the level of performance and interests [8, 12],
- *component of search* locates exhibits by a given keyword or natural language queries, and records all user requests to be used in user's interests analysis [1, 2, 4, 15, 19],
- *component of the gallery building* uses algorithms of the structural organization and reorganization of

gallery as an additional component of building a gallery including user's interests, which helped implement the mechanism of content adaptation to user's interests taking into account influence factors, confidence and lack of interest rates [7, 12, 13, 20],

- *component for determining user's interests* uses algorithms for identifying user's interests, influence factors, confidence and lack of interest rates. This component includes a component for processing fuzzy time parameters that handles queries submitted in natural language [10, 13, 14],
- *component of gallery content consolidation.* This component uses XSLT-structure rules of bring the structure of XML-files of certain museum systems into a single data structure [5, 9, 11, 16, 18].

This approach provides the possibility to use Web-galleries as a valuable Web 2.0 means [3, 6, 17].

The main processes that take place during the organization Web-galleries considering user's interests include (Fig. 2):

- *check the status of the user* – a process by which the system indicates that a user is what he claims to be, based on the information known to both parties,
- *determine user's interests.* By this process user's interests are identified and reidentified by analyzing areas of his interest, visiting information and performed searches,
- *create gallery*. In this process creation of gallery is realized considering user's interests,
- *display gallery*. This process provides gallery display taking into consideration level of efficiency of the user and his interests,
- *consolidate exhibits.* Using this process, you can fill database with new exhibits from external museum systems.

Based on areas of interest, marks of exhibits, expositions, themes and search queries general user's interests are determined. Using these interests, the system creates new or rebuilds the existing galleries adapted to the user's interests. The change of user's interests restarts the process of determining user's interests, creating and displaying galleries, thus improving the content of galleries. In addition, to increase the number of exhibits in gallery database the process of consolidating exhibits from other systems is used [11, 13].

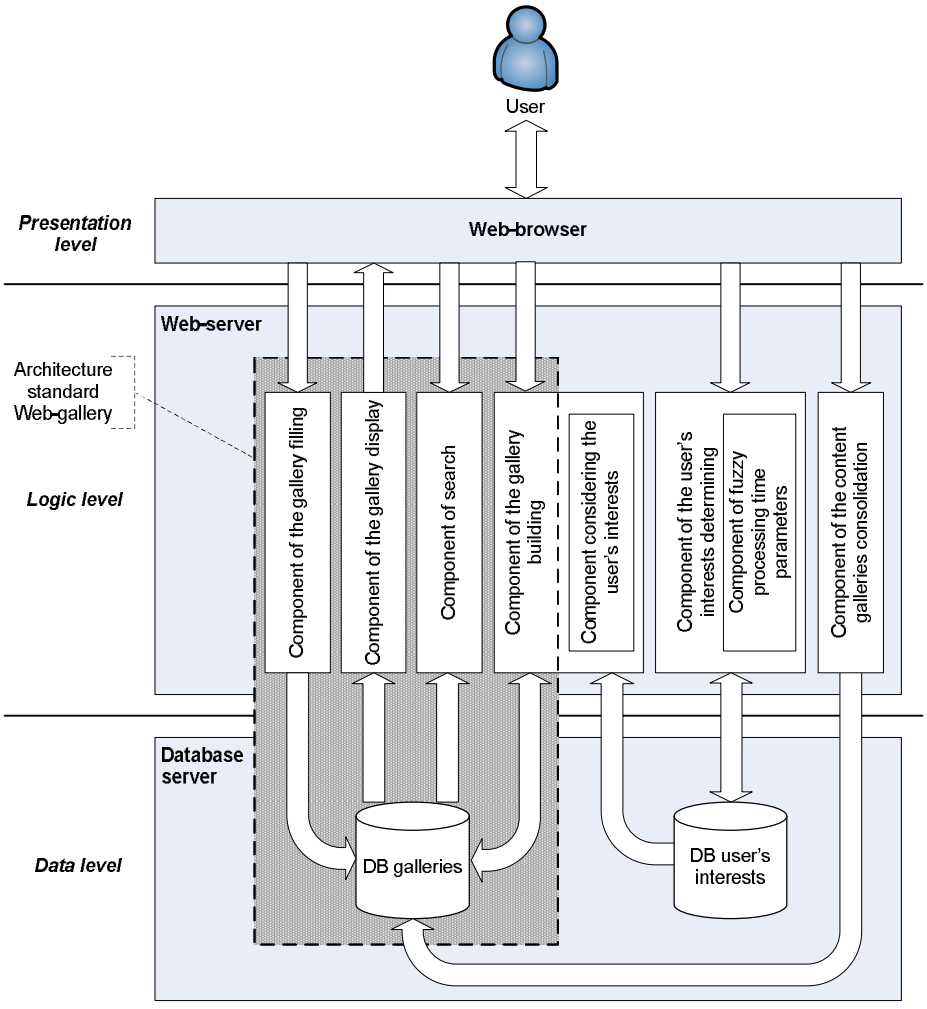

Fig. 1. Architecture of software for Web-gallery creation considering user's interest

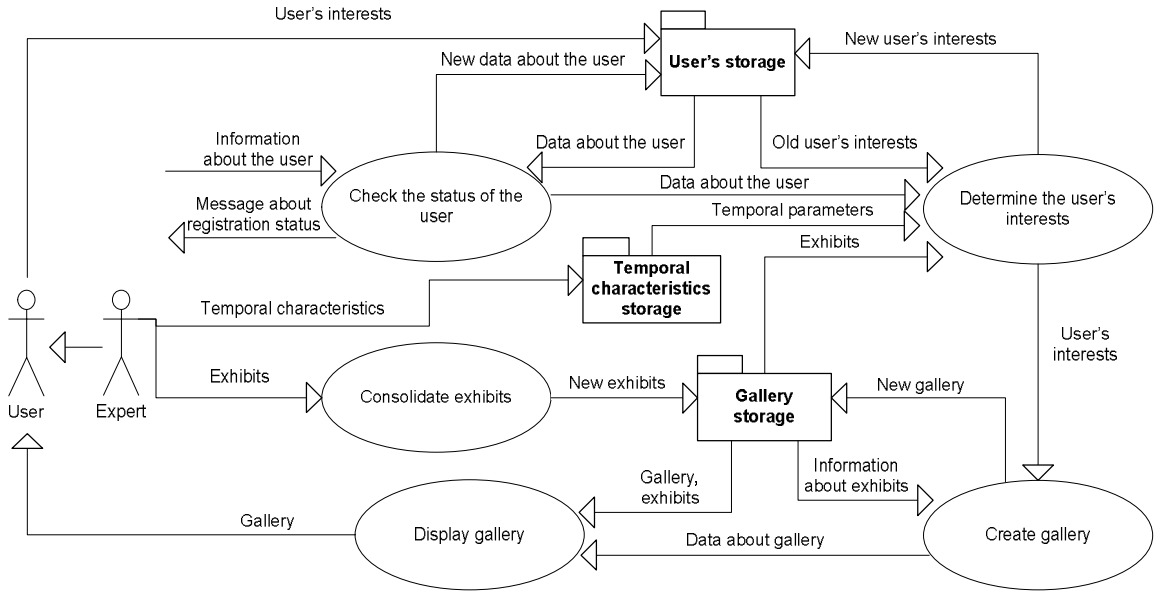

Fig. 2. Use-case diagram of Web-galleries considering user's interests

Determining user's interests is the most important task of the software because of the accuracy of determining user's interests influences the accuracy of the system performance – level of interest to the gallery. Determining user's interests is based on areas of interests, evaluation of exhibits, expositions and themes viewed, searches made [10].

The process "Determine user's interests" defines areas of user's interests, analyzes visited galleries, analyzes user's search queries, make a list of user's interests, defines user's interests, fills the database with rules for processing fuzzy temporal characteristics is performed and processes the fuzzy temporal characeristics identified during the analysis of searches queries.

During registration, the user specifies areas of interests using appropriate values of the linguistic variable "Interest". So, each theme defined by the user gets a measure of interest determined using the formula: $A_z \to l_i \in [0;1]$, $z = \overline{1,9}, i = \overline{1,n}$, where A_z – value of the linguistic variable "Interest"; l_i – measure of belonging.

Then the user interest to themes of Web gallery is defined as the set of tuples:

$$IUT = \{(T_1|s_1),(T_2|s_2),...,(T_k|s_k)\},$$

where: T_k – theme, $k = \overline{1,u}$; s_k – user's interest in a theme T_k, $s_k \in [0;1]$.

Addition to areas of interest, using the values of linguistic variable "interest" user evaluates exhibits and expositions.

The software records all moving of the user in the gallery, so that viewed exhibits and expositions and their affiliation to some theme categories can be determined. As a result, the user's interest to exposition exhibits is defined as:

$$IUO(E_i) = \{(O_{i1}|t_1),(O_{i2}|t_2),...,(O_{in}|t_n)\},$$

where: O_{in} – exhibit of exposition E_i; t_n – user's interest of exhibit O_{in}, $t_n \in [0;1]$.

After viewing of exposition the user forms own opinion about it, which is served as user's expositions interests:

$$IUE = \{(E_1|l_1),(E_2|l_2),...,(E_m|l_m)\},$$

where: E_m – exposition; l_m – user's exposition interest E_m, $l_m \in [0;1]$.

After analyzing of the areas of interest, evaluating of viewed exhibits and expositions of gallery general list of the user's interests is formed, on which general user's interests are defined.

The general Web-gallery user's interest in exhibit of exposition is defined as:

$$GIU(O_j,E_i) = IUO(O_j,E_i) + m_{ij}\, l_i \cdot \left(\sum_k r_{ki} s_k\right) - \left| - IUO(O_j,E_i) \cdot m_{ij}\, l_i \cdot \left(\sum_k r_{ki} s_k\right)\right|,$$

where: m_{ij} – measure of exhibition belonging O_j to exposition E_i, $m_{ij} \in [0;1]$, $i = \overline{1,n}$, $j = \overline{1,m}$; r_{ki} – measure of exposition belonging E_i to theme T_k, $r_{ki} \in [0;1]$, $k = \overline{1,u}$.

The values m_{ij} and r_{ki} in the process of basic expositions creation is set by expert.

To determine the general user's interest to exposition the following formula is used:

$$SGIU(E_i) = \sum_j GIU(O_j,E_i),\ i = \overline{1,n},\ j = \overline{1,m}$$

General user's interest to certain exhibit Web-gallery reflects its quantitative assessment on basis which it is possible not only to determine the levels of user's interests, but also affect their precision. Qualitative evaluation exhibits Web-gallery gives grounds for its modification or restructuring, in order to raising the general user's interests to it and Web-gallery in general [6, 14,].

For qualitative evaluation of existing structural elements of Web-gallery by measuring the degree of trust in them, using the coefficient of the user's confidence (ΔFCU):

$$\Delta FCU = GIU - GNIU, \quad \Delta FCU \in [-1;1],$$

where: *GIU* – general user's interests Web-gallery; *GNIU* – general user's disinterests Web-gallery.

In determining of the general Web-gallery user's disinterest linguistic variable "Disinterest" is used.

By using of the user's confidence coefficient permanent monitoring of level of interest each element of Web-gallery is carried out. Depending on the values of this coefficient the system takes certain decisions about the scale reorganization of Web-gallery.

Restructuring of Web-gallery can be made at structural levels of exhibit, exposition and Web-gallery [7]. Therefore, coefficients confidence the user's according to the structural level is defined as follows:

$$\Delta FCU(O_j, E_i) = GIU(O_j, E_i) - GNIU(O_j, E_i),$$
$$\Delta FCU(E_i) = SGIU(E_i) - SGNIU(E_i),$$
$$\Delta FCU(G) = SGIU(G) - SGNIU(G).$$

In the process of adapting of Web-gallery to the user's interests the most important indicator of the level of adaptation is the user's confidence coefficient in the exhibition, because it is based on its values is decided on the future of some exposition – existence unchanged, reorganization or removal.

CONCLUSIONS

In this article the architecture of software for organization Web-galleries considering the user's interests are proposed and information flows of the system are analyzed. Standard Web-gallery is supplemented by user's interests definition component, which includes component of processing of fuzzy temporal parameters that allow to determine the user's interests based on areas of interests, searches and viewing exhibits, expositions and themes; component of building galleries considering the user interests that allow realization of mechanism of content gallery adaptation to the interests of user's with consideration of influence factors, certainty and disinterest factors; component consolidation of content that allowing realization of mechanism for automated consolidating data from XML-documents of different syntactic structures. Such approach to organization of Web-galleries allows adapting the content relevant to the user's interests and also decreases search time for required information.

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