

Web-Based Management System for Customer Interaction in E-Trade with Adaptive Interface

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Abstract

The paper presents a modeling of mechanisms for determining consumer priorities in the e-trade market and the development of models, methods and information technologies on this basis that ensures the implementation of effective mechanisms for managing interaction with customers of e-trade enterprises. The main focus is to research the mechanisms of formation and identification of consumer priorities in the e-trade market and the development of artificial intelligence technology that can be used to study complex patterns of interaction in e-trade and be the basis for developing of modern customer information management technologies.

Keywords

E-trade, modeling, consumer priority, CRM information technology, intellectual analysis, clustering, artificial intelligence.

1. Introduction

Today it is impossible to imagine the modern development of the economy without the widespread implementation and full use of digital technologies. The pace of digital innovation is growing every year, and, accordingly, the number of Internet users is increasing.

Hootsuite Global Digital research shows that on average, more than a million new users of the global Internet are added every day. In January 2021, the number of active Internet users was 4.66 billion people. This is 316 million (7.3%) more than at this time last year (2020). According to research for 2021, the global Internet penetration is 59.5% [1]. The need to develop e-trade is one of the innovative sectors of the national economy, the development of which directly depends on the level of implementation of information and communication technologies. Businesses have the opportunity to increase their profits by creating web-based representations with the presentation of their e-services.

The problem of finding effective mechanisms for determining consumer priorities in e-trade

using information technology is very relevant. This task is especially relevant in the current context of the COVID-19 pandemic, war state, when e-trade is constantly growing, and e-trade itself becomes an effective and reliable channel for economic activity and an important factor in ensuring socio-economic and social development.

The object of research is the mechanisms of formation and identification of consumer priorities in the e-trade market, interaction processes, business processes and information flows in e-trade. The subject of research is the theoretical-methodological and organizational principles of functioning of e-trade enterprises, methods, models and information technologies of interaction management in e-trade. Among the main tasks of the article is the development of technology for determining consumer priorities in e-trade, taking into account the consumer profile and a set of personal customer characteristics using intellectual data analysis and artificial intelligence methods and on this basis the development of web-based management system for customer interaction in e-trade [3–7].

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2. The Ukrainian E-Trade Development in the Context of COVID-19 and War State

The processes of the COVID-19 pandemic and martial law in Ukraine have become factors in accelerating the development of e-commerce systems in order to survive e-commerce enterprises in these difficult conditions. The rate of growth of e-commerce systems in Ukraine is constantly increasing, the number of electronic orders for goods increases by approximately 25–30%, and the turnover in hryvnias is by 40–60%. The digital transformation of the economy changes the generally accepted ideas about how business is structured, how consumers receive services, goods, and how business structures should adapt to these challenges and regulate them. In 2021–2022, the coronavirus pandemic significantly motivated customers around the world to make purchases without leaving their homes. Nowhere has there been more unprecedented and unpredictable growth than in the digital and e-commerce sectors, which have flourished amid the COVID-19 crisis. Against the background of a slowdown in economic activity, COVID-19 led to a surge in e-commerce and accelerated the digital transformation of society. Businesses and consumers are increasingly “moving to digital markets. Statistics show that a total of 59% of respondents said they will invest more in e-commerce channels in the near future as a result of COVID-19. Companies in these categories are more likely to do it in the following areas: consumer electronics (78%); packaged food and beverages (77%); baby care products (75%); personal hygiene products (74%) [8].

In the United States, the B2C e-commerce industry is expected to hold on to the global pandemic accelerated sales in 2022, with big retailers, including Amazon and Walmart, set to benefit from the growing online shopping trends among consumers in the country. While the growth in sales declined in 2021, the total purchases remained far above the pre-pandemic levels [9].

Another important factor with the surge of the COVID-19 pandemic was cybercrime, which grew more than any other criminal activity. The FBI notes that cybercrime reports have quadrupled during the COVID-19 pandemic.

These problems are described in more detail in [2].

3. Interface Adaptation based on Cyberentities

Interfaces provide software products management and communication of users with the program. The advantages of using software products aimed at improving the usability of interfaces include: simplifying the perception of the software product business logic by a specific user; flexibility of the information presentation model; improving the performance of the interface. Dynamic change should be understood as a change in the display of the interface (adaptation), because of the execution of scenario based on the user behavioral portrait [10–13].

A criteria set $CR = \{cr_1, \dots, cr_{|CR|}\}$ that will change, that is, adapt to the user, $Fact = \{fact_1, \dots, fact_{|Fact|}\}$ is this is a factors set that will influence the choice of one or another criterion. Based on the factors identified in advance that influence the interface, the criteria for building the interface will change. Interface adaptation is been from specific observational data, that is, factors, to a general model that includes many changing criteria.

So, you can build a function Φ that reflects the adaptation process:

$$\begin{aligned} & \Phi(cr_1(fact_1, \dots, fact_k), \dots, cr_m(fact_k, \dots, fact_F)) = \\ & = \theta_0 + \sum_{i=1}^m \theta_i cr_i \sum_{F=1}^k (fact_1, \dots, fact_F) + \\ & + \sum_{i=1}^m \sum_{j=1}^m \theta_{ij} cr_i cr_j \sum_{F=1}^k (fact_1, \dots, fact_F) + \\ & + \sum_{i=1}^m \sum_{j=1}^m \sum_{k=1}^m \theta_{ijk} cr_i cr_j cr_k \sum_{F=1}^k (fact_1, \dots, fact_F) + \dots \end{aligned} \quad (1)$$

Software requirements:

The software product must provide: collection and storage of information about users of the involved web application; pseudo-identify users based on the collected data; automate the adaptation of pseudo-identified user interfaces.

The software product must match the following requirements:

1. Controlled collection of information on users of the web application.
2. Creation and support of databases of received information.
3. Pseudo-identification of web application users based on the collected information.
4. Automated adaptation of the user interface of the web application based on the

data collected and processed by the software product.

Fig. 1 shows the interaction scheme of the software complex.

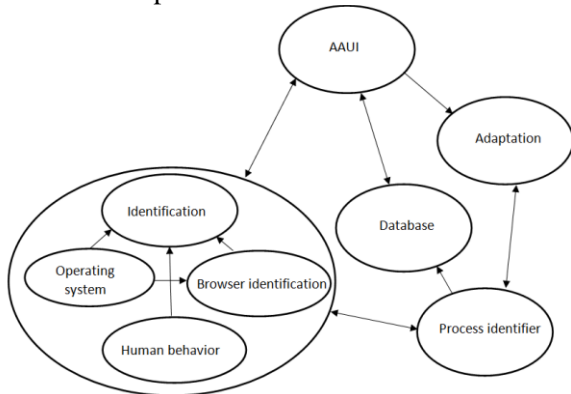


Figure 1: The interaction scheme of the software complex

“AAUI is Automatic Adaptation User Interface” is the initial module from which interaction with the components of the software product, “Identification” is implements the formation of an entity from the collected information about the object that has shown activity, “Operating system” is collection of information about the software of the active user, “Browser identification” is responsible for collecting information about the software involved in interaction with the final software product, “Human behavior” is provides a check for the possible past presence of a pseudo-deanitized object, “Adaptation” is the block is responsible for the embedded software adaptation implemented on the basis of the resulting imprint of the pseudo-deanitized object of interaction with the final product, “Database” is the block is responsible for saving the analyzed information, pseudo-deanimation tokens and interface adaptation rules, “Process identifier” is the block is responsible for matching the identification of existing interaction objects.

Fig. 2 show a block diagram of modulation when using a software product.

“LOG IN” block is displays the user’s visit to the service; “Set token” block is displays the generation of an identifier by the “AAUP” software system, the generation of an identifier occurs in parallel with the collection of additional data for stricter user identification.

Checking visit is check for a possible past visit by the user to the service:

- In the case of identifying a user “User identified”, the “Analysis behavioral characteristics” of the behavioral

characteristics collected on the basis of the software product interface objects programmed to track changes, the application of personal settings “Involvement settings” and subsequent monitoring of changes in potentially changeable settings of the “Tracking status changes” are monitored. All changes to the tracked web interface settings are saved “Saving the latest user settings” to the database at each stage of their implementation.

- If the user visits the “User not identified” web service for the first time and no identification matches are found, the specified changes by the user are tracked and the “Saving changes made by the user” is further saved at the stage of their implementation.

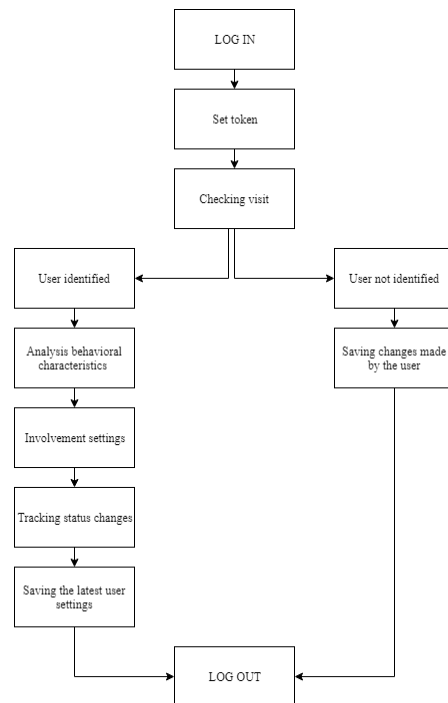


Figure 2: The scheme of modulation applied software product

4. Management System for Customer Interaction in E-Trade

An online store selling handmade goods was created to test the technology of intelligent interface customization.

Several types of UML diagrams will be schematically depicted below, each of which models the subject area from different perspectives. The online handmade goods store is the main object of the simulation, so all diagrams will be created based on the main component.

Fig. 3 show a diagram of the options for using the developed web resource. The web resource was created according to the classical online stores scheme and has all the necessary functionality: a catalog, a shopping cart, an online order, an authorization system.

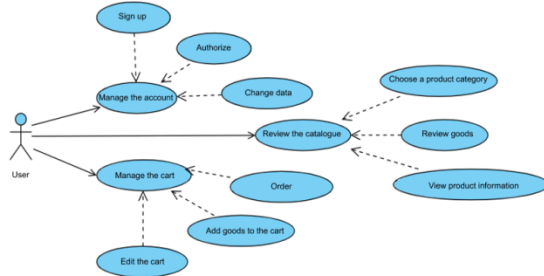


Figure 3: UML-diagram of precedents (options of use)

Fig. 4 show the UML class diagram that formed the basis for creating a web resource. It contains classes: Catalog, Category, Product, Website, User, and Order.

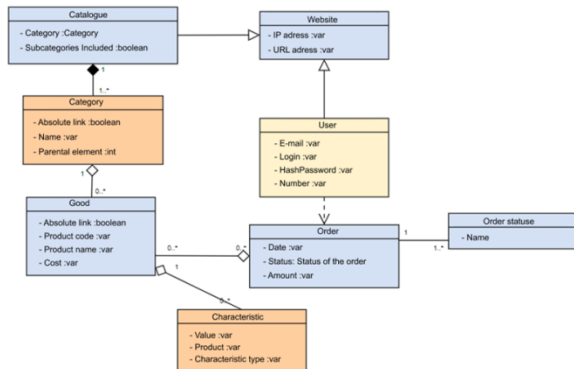


Figure 4: UML class diagram

Fig. 5 show the sequence of user actions from the moment he entered the site and until the order acceptance. At the top of the diagram, the roles of users are indicated: Client, Administrator, as well as functional modules which the client interacts with: Product catalog, Cart. After entering the site, the client interacts with the product catalog. The result is the added to the necessary products. At the stage of the client interaction with the Cart module, the order is placed. At the final stage, the Administrator who carries out the final confirmation of the order is included in the scheme [14].

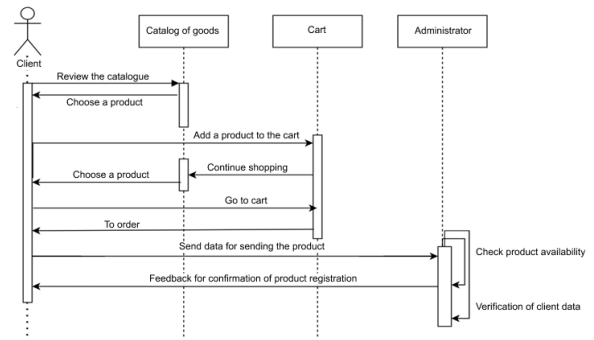


Figure 5: UML sequence diagram without registration and authorization

Fig. 6 show the catalog page fragment of the developed online store. Here is the site header, which contains logo, contact information, main menu of the site. The left column contains the filter block, and the products are presented on the right.

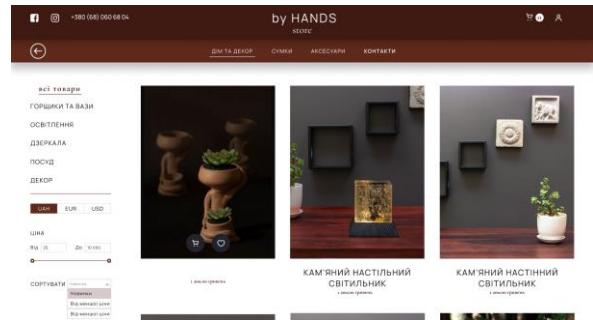


Figure 6: System for customer interaction in e-trade

5. Interface Adaptation for Application Solution

The main advantages of the software system are the applied model of identification of anonymous users of final software products for the further use of a dynamic identifier in order to automatically adapt the interface to the identified user. "AAUI" is a server-side software product written in the PHP scripting programming language.

The software product provides:

- Software product administration (managing the list of active identification filters, changing, editing, creating adaptation rules).
- Storage and processing of information about users.
- Ensuring the storage of information about sessions.

The data source is the database. It stores all information about pseudo-deanonymized users and rules for dealing with established groups.

End-users interact with the software system through primary interaction with the interface.

The server application “AAUI” interacts with the user of the web application at the moment of his stay and interaction with the latter's interface. The level of absorption of collected information about the visitor is set by the administrator of the software system.

The main source of data storage is the database. It stores information about the received entities of pseudo-deanonymized users.

The free MySQL relational database management system is used to store information. The structure of the database is developed on the basis of the developed user identification methodology. The implementation of the user pseudo-identification system is interesting in this product. We will consider the interaction between parts of the software product using the following code parts as an example:

```

App: :before(function($request){
    $url_lang = Request::segment(1);
    $cookie_lang = Cookie::get('language');
    $browser_lang = substr(Request::
:server('HTTP_ACCEPT_LANGUAGE'), 0, 2);
    if(!empty($url_lang) AND in_array($url_lang,
Config::get('app.language')))
    {
        if($url_lang != $cookie_lang)
        {
            Session::put('language',
            $url_lang);
        }
        App::setLocale($url_lang);
    }
    else if(!empty($cookie_lang) AND
in_array($cookie_lang, Config::get('app.
languages')))
    {
        App::setLocale($cookie_lang);
    }
    else if(!empty($browser_lang) AND
in_array($browser_lang, Config::get('app.
languages')))
    {
        if ($browser_lang != $cookie_lang)
        {
            Session::put('language',
            $browser_lang);
        }
        $timezone = Auth::user()->timezone;
        $datetime = $this->asDateTime($value);
        DB::table('essences *')->insert(
        ['langcode' => $browser_lang) 'votes' -
> 0]
        ['date' => $datetime + $timezone) 'votes'
=> 0]
    );
}

```

The block for obtaining information about user-set languages, time zone, in listing is presented.

The function of automatic localization adaptation of the web application based on the collected data is presented in listing:

```

public function handle($request, Closure $next)
{
    if(!\Session::has('locale'))
    {
        \Session::put('locale',
        \Config::get('app.locale'));
    }
    $usersrule = DB::table('data')-
>select('rule', 'rule')->get();
    if
    (checkrule($usersrule)==Config::get('app.
locale'))
    app()-
>setLocale(\Session::get('usersrule'));
    return $next($request);
}

```

6. The Protection of Confidential Data

To solve the problem of storing structured information cross the Internet in local storage and fragments of information transferred to the browser from the site visited by the user, the paper proposed a method of storing the JSON web key in a local variable inside the closure. In this case, the token cannot be obtained during an XSS and CSRF attack on the partition from when the token is stored in LocalStorage or a cookie, because it is stored in memory, and placed it in local storage given an advantage in saving data, so that now the private keys not became public. Every time an attacker tries to gain privacy using access token, he will spend more time to find and get the token along with other methods of saving access token, so this method can be better than storing token in LocalStorage or cookie.

In addition, this method allows you to protect the user's storage data even when the web resource is accidentally closed. Suppose the user exits the current session, closes the browser tab. Now, when the user enters the application again, the system looks like this (see Fig. 7):

1. If there is no JWT in memory, the silent update workflow [15, 16] is started.
2. If the refresh token is still valid (or has not been revoked), a new JWT is sent [17].

In this way, it is possible to maintain the client's authorization inadvertently at the end of the life of the access token.

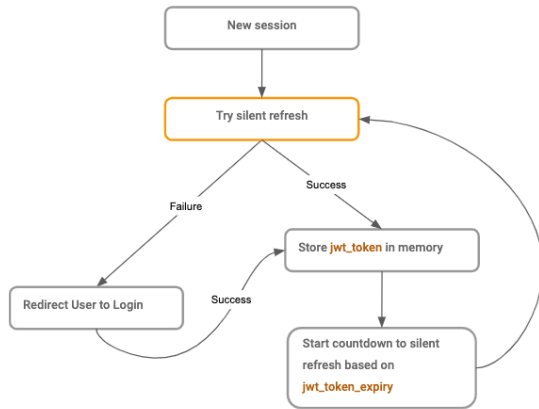


Figure 7: Workflow diagram

7. Conclusions

The aim of the article is to model mechanisms for determining consumer priorities in the e-trade market and to develop models, methods and information technology for managing interaction with customers of e-shops based on intellectual data analysis and artificial intelligence methods.

The article aims to solve the complex problem of finding effective mechanisms for determining consumer priorities in e-trade based on modern methods, models and information technologies. The study is especially relevant in the current context of the COVID-19 pandemic, war state when e-trade is constantly growing, and e-trade itself becomes an effective and reliable channel for economic activity and an important factor in ensuring socio-economic and social development [18–20]. The main idea of the article is a modeling of mechanisms for determining consumer priorities in the e-trade market and the development of models, methods and information technologies on this basis that ensures the implementation of effective mechanisms for managing interaction with customers of e-trade enterprises. The main focus of the article is to study the mechanisms of formation and identification of consumer priorities in the e-trade market and the development of artificial intelligence technology that can be used to study complex patterns of interaction in e-trade and be the basis for developing of modern customer information management technologies. Among the main tasks of the article is the development of technology for determining consumer priorities in e-trade, taking into account the consumer profile and a set of personal customer characteristics using intellectual data analysis and artificial intelligence methods and on this basis the

development of web-based management system for customer interaction in e-trade.

The presented software development is aimed at automated adaptation of interfaces to the needs of users. The software product provides pseudo-identification of users (building a database of anonymous users and rules based on their presence in web applications). The main advantages of the software system are the applied model of identification of anonymous users of final software products for the further use of a dynamic identifier for the purpose of automatic adaptation of the interface to the identified user.

Prospects for further development include increasing the number of identification markers to increase the probability of user identification, implementing embeddability in content management systems, and optimizing data loss.

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