Medical News Aggregation and Ranking of Taking into Account the User Needs

Nataliya Antonyuk[0000-0002-6297-0737][1], Lyubomyr Chyrun[0000-0002-9448-1751][2], Vasyl Andrunyk[0000-0003-0697-7384][3], Andrii Vasevych[0000-0003-4338-107X][4], Sofia Chyrun[0000-0002-2829-0164][5],Aleksandr Gozhyj[0000-0002-3517-580X][6], Irina Kalinina[0000-0001-8359-2045][7],Yuriy Borzov[0000-0002-0604-0498][8]

[1-2]Ivan Franko National University of Lviv, Lviv, Ukraine
[1]University of Opole, Opole, Poland
[3-4]Lviv Polytechnic National University, Lviv, Ukraine
[5]IT Step University, Lviv, Ukraine
[6-7]Petro Mohyla Black Sea National University, Nikolaev, Ukraine
[8]Lviv State University of Life Safety, Lviv, Ukraine

nantonyk@yahoo.com[1], chyrunlv@gmail.com[2], vasyl.a.andrunyk@lpnu.ua[3], andriy.vasevych@gmail.com[4], chyrunsofia@gmail.com[5], alex.gozhyj@gmail.com[6], irina.kalinina@gmail.com[7], uob1968@gmail.com[8]

Abstract. The purpose of this work is to develop an intelligent information system that is designed for aggregation and ranking of news taking into account the needs of the user. The online market for mass media and the needs of readers, the purpose of their searches and moments is not enough to find the news is analyzed. A conceptual model of the information aggression system and ranking of news that would enable presentation of the work of the future intellectual information system, to show its structure is constructed. The methods and means for implementation of the intellectual information system are selected. An online resource for aggregation and ranking of news, news feeds and flexible settings, a list of available sources of information, compliance with specified media and personal aggregation results are designed. Object of research is processes of aggregation of news and intelligent ranking of necessary news according to the needs of the user. Subject of research is methods and means of aggregation and ranking of news and building an information system that implements them.

Keywords. Medical News, News Aggregation, Content Ranking, User Needs, Intelligent System, Content Analisis, Data Mining, Context Filtering, Bayesian Clustering, Bayesian Networks

1 Introduction

We live in the age of information - the time of unrestricted access to information resources, the time when the amount of information published by various sites, news

feeds and other sources increases exponentially [1]. Every day, thousands of electronic newspapers publish tens of thousands of articles on various topics. Each of them may be potentially interesting to a particular reader [2]. An overabundance of news sources creates a situation in which a person can spend more time searching for news of interest to himself than when reading these news [1-3]. A significant number of news aggregation algorithms are designed to overcome the excess information, allowing a person to read immediately what is interesting [4]. Like information retrieval systems, news aggregation systems allow the user to find the information he needs. Since the needs of an individual user can vary significantly in different people, the system of aggregation of news should be tailored to a particular person [5]. The main distinguishing feature of media aggregators from other sources of information is the unique ability to provide the most up-to-date information, regardless of the time of day and its volume [6]. At the moment, it's easy to find out what happened at the other end of the globe in a matter of minutes or even seconds [7]. An entirely new space has emerged that destroys all possible boundaries [8]. This unique opportunity gives us modern means of communication, means of information transmission, including radio, television, telephony, e-mail and the global Internet network with its practically unlimited possibilities [9]. Meanwhile, along with an unprecedentedly large potential for informing the society, there were the same opportunities in scope for its misinformation [10]. The news aggregator solves the problem of fake publications in the media, in particular, makes it possible to filter out unreliable news sources [11]. The Internet combines visual, audio, print and video representation of data and provides any necessary information at any level of users interested in it [12]. It involves dialogue, feedback, and not a monologue that is typical of print media, radio and television [13]. There are many similar open and paid systems. Realized specifically for the general public or for one or another media [14]. Many of those information systems do not have a wide-ranging functionality for flexible news feed set-ups, which is mostly often demanded by regular users [15]. It is this system that will have a functional enough to solve this problem and offer a multifunctional service to users [16]. The system will be implemented as a free software product under an open distribution license, and this approach will ensure its further development [17].

2 Methods and means of solving the problem

Group and context filtering. Most approaches to solving the problem of information filtering can be divided into two main categories: Contextual (Content Based Filtering, CBF) and Groupware (Collaborative Filtering, CF) [18-21].

CBF's approach is based on the assumption that news that is interesting to the user is similar to those that were interesting to him before [22]. The CF approach, in turn, tries to find users similar to the one and then recommends to the user that information that seemed interesting to similar users [23]. A large number of studies have recently been conducted to combine these two approaches. Such approaches are called hybrid.

Context Filtering. The CBF system deals with similarity calculations, between fresh news and user profiles [24-29]. The most common and simple method in this category is keyword matching. Based on this simple method, systems like vector space model were developed that allow better filtering and searching of information.

Group filtering. The collaborative filtering task is to predict the benefits of elements for a particular user, based on the user preferences database of other users [30-35]. Consider two types of collaborative filtering: memory-based and model-based. Memory-based algorithms operate over the entire database to create recommendations. Model-based, on the contrary, uses a database to study or customize a model, which is then used in the formulation of recommendations. Collaborative filtering systems often vary by feature: they operate by implicit or explicit means of expressing user interests. Explicit methods mean that the user deliberately describes his needs, usually based on a discrete integer scale. Implicit methods mean the interpretation of user behavior or choice to determine preferences. Implicit ways of expressing interests can be based on viewing information (for Internet applications, for example), shopping history (for stores), or other templates for access to information. Despite the type of available preference data, collaborative filtering - algorithms need to cope with data deficiencies. Normally, we do not have a complete set of preferences for all item names. It can not be assumed that the absence of some element is a coincidence, since users are inclined to express preferences for those elements that were viewed by them, and therefore they are interested [36-41].

Memory-based algorithms. In general, the task of collaborative filtering is to predict the user's preferences based on the custom base of preferences [42]. The database consists of users, so a set of preferences (votes) v_{ij}, which corresponds with the user i of element j. If I_i denotes the set of elements on which user i has defined its estimates, then you can make an average rating User i as [43]:

$$\overline{v}_i = \frac{1}{|I_i|}\sum_{j \in I_i} v_{ij} \quad . \tag{1}$$

In memory-based collaborative filtering, the user's evaluation algorithms, which we denote as a, are predicted based on incomplete information about it and the set of weights calculated on the basis of the user database. Assume that the predicted p_{aj} estimate by a user of element j is the weighted sum of ratings of other users [44]:

$$p_{aj} = \overline{v}_a + \kappa \sum_{i=1}^{n} w(a,i)(v_{ij} - \overline{v}_i) \quad , \tag{2}$$

where n is the number of users in the *collaborative filtering* database with non-zero weights. Weights $w(a,i)$ can reflect the distance, correlation or similarity between each user i and the current (active) user a. Next, we will consider the details of various collaborative filtering algorithms that relate weighting. There are other possible characteristics of memory-based collaborative filtering, but in this work we restrict ourselves to the wording described above [45].

Correlation. The general formulation of collaborative filtering statistical methods (as opposed to verbal or high-quality annotations) first appeared in the context of the GroupLens project, where the Pearson correlation was the basis for weighting [46]. Correlation between users *a* and *i* is expressed as:

$$w(a,i) = \frac{\sum_j (v_{aj} - \overline{v}_a)(v_{ij} - \overline{v}_i)}{\sqrt{\sum_j (v_{aj} - \overline{v}_a)^2 \sum_j (v_{ij} - \overline{v}_i)^2}}, \quad (3)$$

where the sum of *j* is spent on the elements for which both users (*a* and *i*) have determined their estimates.

Similarity of vectors. In information retrieval area, the similarity between two documents is usually measured through a comparison with the word-frequency vector document and the calculation of the cosine of the angle between two vectors of frequencies. We can use this formalism in the collaborative filtering task, where evaluations will play the role of the words frequency. Note that by following this algorithm, measured ratings indicate positive feedback, and negative reviews are not counted, and invaluable items get a zero estimate. Accordingly, weights are expressed as

$$w(a,i) = \sum_j \frac{v_{aj}}{\sqrt{\sum_{k \in I_a} v_{ak}^2}} \frac{v_{ij}}{\sqrt{\sum_{k \in I_i} v_{ik}^2}}, \quad (4)$$

where the factors in the denominator serve to normalize ratings so that users who rate more actively than others will not be more like the others. Other schemes of normalization are also possible. The method can be supplemented by the "default estimation" scheme, which allows you to expand the set of user-evaluated elements. Another important addition may be the use of so-called inverse frequency estimates. When searching for text documents, the comparison of documents is based on the frequency vectors of individual words, with each word having a weight reflecting its specificity, so that the commonly used vocabulary has a lower priority. A similar pass can also be used in collaborative filtering by introducing a new user evaluation of *a* element *j*: $\overline{v}_{aj} = f_j v_{aj}$, where $f_j = \log \frac{n}{n_j}$ [47].

Model-based methods. From the probabilistic point of view, the collaborative filtering task can be considered as calculating the mathematical expectation of the value of the estimate based on the available information about the user [48]. For an active user, we want to anticipate ratings for items that have not yet been viewed. If we assume that the estimates are integers in the range from 0 to *m*, then we get:

$$p_{aj} = E(v_{aj}) = \sum_{i=0}^{m} Prob(v_{aj} = i \mid v_{ak}, k \in I_a) i, \quad (5)$$

where $Prob(v_{aj} = i \mid v_{ak}, k \in I_a)$ is the likelihood that the active user will evaluate the element *j*, precisely, for such a value, provided that there is an observation of the estimates made.

Bayesian clustering. Let *C* takes a small discrete set of values denoting clusters of users [49]. We divide users into clusters, and we will consider their advantages through conditional probabilities:

$$Prob(C = c, v_1, ..., v_n) = Prob(C = c) \prod_{i=1}^{n} Prob(v_i \mid C = c) \quad . \tag{6}$$

Bayesian networks. The method of learning the Bayesian network is to form such a network that each node of it is an element to be evaluated [50]. Each node has a finite set of states - estimates of the corresponding element. In this model, the training algorithm of the bay network defines the best predictors for each element, such that it becomes possible to construct a decision tree, which, depending on the state of the root element, determines the high probability of the value of the sheet element.

In general, the Bayesian method, as well as the correlation method, work faster than others, respectively, sharing the primacy among different sets of data [51].

3 Statement and substantiation of the problem

A conceptual model is a system that uses concepts and ideas to formulate a given presentation. Conceptual modeling is used in many industries, ranging from sciences to socio-economic theory to software development. Using the conceptual model to represent abstract ideas, it is important to distinguish conceptual model from conceptual model. That is, the model is actually a matter for itself, but this model also contains the notion that such a model represents - which model is, unlike what is a model. Without deep immersion in philosophy, recognizing these differences between the model itself and what it represents is crucial to understanding the proper use of conceptual models in the first place. Then, one should not be surprised that conceptual models are often used as an abstract representation of real-world objects.To develop a conceptual model for aggregation and ranking of news, it is necessary to set out the output and input data typical for the development of this system. Input - data coming from the outside of the system [52]:

- User registration data is you must enter your name, last name, email address and password. The password must be confirmed, and validation is made on it;
- Data for authorization is the user must enter the password and email address of the mail. To authorize in the admin panel, you must enter the same data, but the administrator;
- Data for search is entered in a text format in the specified search field;
- News source is the administrator must add information about the source of news, its rating and reliability of this online media.
- Review is the text information entered by the user to the selected news.

Output is data that is received by the user after processing by the system or other external entities. The source data includes: various types of user search results, in which there are keywords, a general news feed, and a rating for each publication. For authorized users, the opportunity to receive a personal news feed is another source information provided by the user system based on intelligent selection based on user preferences.

The purpose of the work is to develop an intelligent system that will be used to aggregate and rank news based on user preferences. This system is a web-resource that provides the following basic functions:

- searching for medical news on keywords;
- search for news about the location of the user;
- viewing and selecting the right medical news sources;
- reviewing the rating of publications;
- leaving feedback on a particular medical news or source;
- means of administering the aggregator of medical news;

To develop this web resource, client-server architecture is considered, it is considered one of the architectural software templates and carries an important concept for the development of network applications, and also provides for the exchange of data between them and interaction. It includes the following essential components: a set of servers, a set of clients and a network.

Appointment of the system. This resource is designed to aggregate and rank medical news based on the needs of the user, and in order to facilitate the choice of the user, the system will generate a personal medical news feed, but only for registered users. The user will be able to search for the receipt and search for medical news by keywords, put filters on the search results, receive medical news that is next to him, that is within a certain radius. To improve the results of the medical news feeds, the user will be able to leave feedback, this will be one of the factors influencing the subsequent selections of medical news publications.

Place of application of the system. The system will be useful for readers of the online media who do not want to spend time searching for the medical news they need and to hang out the pre-selected set. This system will help the user to find medical news on the keywords, filter the results by the specified type. A registered user is also able to post reviews about individual medical news. And on the basis of his assessments get a more interesting for him a selection of medical news.

Justification, development and implementation of the system. To date, Ukrainian Internet media have already had a significant and very interesting way of development. Publishers, through trial and error, accumulated experience, the market was strong and developed along with the improvement of new technologies. As a result, today we see high-tech multimedia media with great services and wide opportunities. And one can safely assert that this is just the beginning. Currently, many media experts are seeing a great future in the online media market. Instead of the expected decay of print media, convergence occurs: many publications that want to develop and receive new interactive capabilities go online. There is also a reverse trend: convergent not only the Internet with print editions - has it also connected to television.

Expected effects from the implementation of the system. Like information retrieval systems, aggregation systems will allow the user to quickly find the information he needs. Since the needs of an individual user can vary significantly in different people, the system of aggregation of medical news should be tailored to a particular person. The main distinguishing feature of the aggregator of the Internet media from other sources of information will be a unique opportunity to provide the most up-to-date information, regardless of the time of day and its volume.

4 Algorithm for choosing medical news sources to show to user

The task of finding medical news sources interesting to the user is complicated by the number of sources. In order for the algorithm given in the previous section to collect statistics for all agencies, it would have been necessary for decades. In order to overcome this problem, group filtering algorithms were used in this paper. Accordingly, the best way with the task of group filtering medical news is to handle the Memory Based algorithm with weights equal to the correlation of the user vectors. In general, Memory Based methods are characterized by the possibility of effective implementation on the database, which is also the advantage of this algorithm for systems with a large number of users.

Consider the algorithm described by the following two formulas:

$$p_{aj} = \overline{v}_a + \kappa \sum_{i=1}^{n} w(a,i)(v_{ij} - \overline{v}_i), \tag{7}$$

$$w(a,i) = \frac{\sum_j (v_{aj} - \overline{v}_a)(v_{ij} - \overline{v}_i)}{\sqrt{\sum_j (v_{aj} - \overline{v}_a)^2 \sum_j (v_{ij} - \overline{v}_i)^2}}. \tag{8}$$

So, at the beginning of each custom session, we have v_a, the vector of explicit user ratings and the vector p_a, obtained using the group filtering algorithm. You must select k sources that will be shown to the user (Fig. 1).

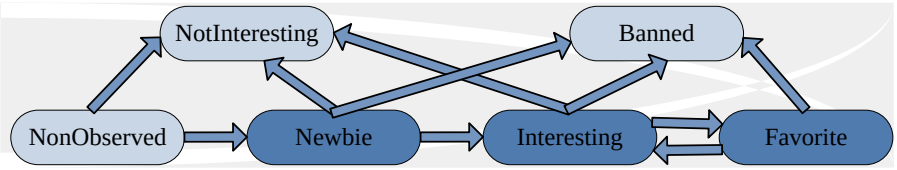

Fig. 1. All medical news sources from the point of view of this user are in one of the states shown

The source, about which the user does not know anything, is in the NonObserved state. The Newbie group has a fixed size and comes with NonObserved sources that have received the highest ranking by the group filtering algorithm. What got into the

group Newbie gets $v_{a,i}$ equal $\bar{v}_a$.

In the state of Newbie channels are within 4 sessions after getting into it, in which they were displayed. This time should be enough for the user to evaluate the content. After the end of the 4 sessions, the source passes either to the interesting or to the NotInteresting, depending on the amount of interest to it from the user. In the state of Interesting are those channels that are of greatest interest to the user. From it the stream passes to the state of NotInteresting in the event of a fall in the value of interest in it. I will be banned and favorite will be issued as a result of explicit user actions (by pressing the buttons add to favorite and ban). In these states the channel is located regardless of what the algorithms give it. The display algorithm works as follows: preferred and interest channels are displayed whenever they have medical news. If there is not enough of these channels, channels are added in the state of Newbie.

5 Client-server interaction architecture

Web applications are a type of program built on the client-server architecture. The client-server model is a program structure that distributes tasks and loads between resource providers and services, servers, and those who send a request ie a client. Essentially, clients and servers are software. As a rule, they are located on different computers and exchange data on a computer network using network protocols, but sometimes the client and the server can be on the same computer. The server host runs one or more server programs that distribute their resources between clients. The client asks for the content of the server, but does not transmit anything. Servers are waiting for requests, and customers initiate communication sessions with them. Customer requests are handled on a server - where the Database is located and the Database Management System (DBMS). This gives you the advantage of not having to send large volumes of data, and the query is optimized in such a way that it consumes a minimum amount of time. All this increases the system performance and reduces the waiting time for the result of the request. When performing queries, the server significantly increases the security of data, since data integrity rules are determined in the database on the server and are unique to all applications that use this database.

Customer functions:

- Initialization of the server request;
- Processing of the results of requests received from the server;
- Representation of the results of the request to the user in the form of a user interface.

Server functions:

- Receiving requests from the client;
- Processing requests;
- Execution of requests to the Databases and their optimization (Fig. 2);
- Sending results of client requests;
- Providing security (Fig 3);

- Providing stability to multi-user mode of operation.

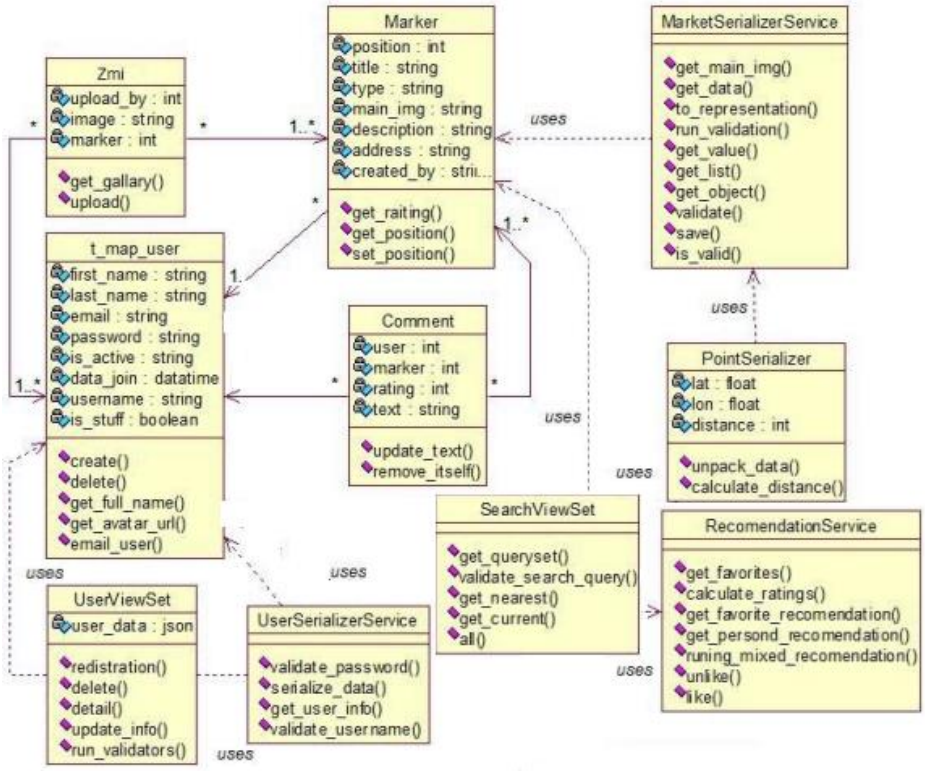

Fig. 2. Database scema

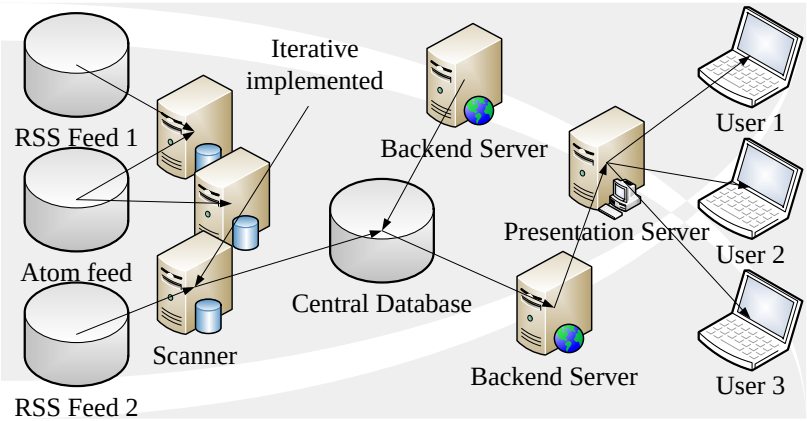

Fig. 3. Providing security

6 Productivity

Software development has evolved over the years, from manual testing, but in those times the requirements were much lower, the sites were text and downloaded in a few minutes. Therefore, the Web developer had much less incentive to pre-test. But rates have grown as ecommerce gains momentum in the world of web development. Therefore, testing began to be conducted in the development environment. But with the growth of applications began to automate and test. Developers began to write automated tests. In the end, testing has matured to such an extent that it has spread beyond the simple set of test modules and integration tests in the playback style. Organizations began to build increasingly sophisticated, thin test cases.

To date, the rates for applications have become higher than ever.

The tests of the program have long been de facto standard. Since the applications became too complicated for manual testing, test frameworks were created to automate testing. And any good code starts with writing tests. But this does not let you know how the application behaves in the real environment. Testing the performance of web applications fixes it. Performance testing is a form of software testing that focuses on how the system works under a certain load. Performance testing should give organizations the diagnostic information they need to identify and troubleshoot.

The slow work of apps affects paid subscribers, and new subscribers become less influential on revenue. Most often, the problem of performance is very difficult due to the fact that it is difficult for developers to reproduce such "bugs". Performance issues do not directly affect the behavior of the software. Rather, they are related to how the software reacts to the chaotic world of environments in which the application is launched. Therefore, it is necessary to conduct performance testing.

Usual QA testing is to observe how the app handles one person. To produce the test, you need to simulate the harsh conditions, so you can detect how behaving the application under heavy load, so-called load testing.

In the test environment, you can choose the load for the application, for example, the simultaneous use of the application by a thousand users in the normal operations and measure the behavior of the program. Does it keep track of speed or slows down or even drops? Of course, such testing will not be conducted by a thousand real people. To do this, software is created to help simulate the load.

In addition to stress testing, a stress test and endurance testing are performed.

7 Description of the task realization

The developed software product is called *Intelligent Information System and Medical news Ranking*. The purpose of this product is to help users, based on their preferences, to compile a mix of medical news from different media, usually based on the criteria given automatically.

The aggregate information system and medical news ranking allows the user to automatically scan medical news sites and aggregate algorithms to form a medical news

feed. Since the needs of an individual user can vary significantly in different people, the system of aggregation of medical news adapts to a specific person.

Functional restrictions are imposed on users with outdated versions of browsers, since they do not support the latest standards used to develop this product.

The database of the web service consists of 10 tables. This system was developed as distributed, where one part is responsible for displaying the data, the other for its processing, where the existence of the first without the second does not make sense.

The bulk of the system being developed includes sub-modules for processing, shaping, validating data, and the logic of working with them. Thanks to well-chosen software implementations, software solutions have a high degree of declarative, which provides ease of understanding of executable code and simplifies the development of the system.

Before running the program, you must run the executable web server locally or deploy it on a dedicated server with a static IP address. If we start the site locally, then we need to open a localhost with the port specified in the parameters in the browser. If the site is deployed on a dedicated server, we should open the server address or its domain name in the browser. The entry point in the program can be both the main page and the admin panel page.

The input can include:

- Search data;
- Medical news sources;
- Data for user registration;
- Reviews.

Output data for the system of automation of contextual advertising can be:

- Generated medical news feed;
- Medical news rating;
- User-wanted medical news.

8 Instruction for the user

The Aggregation and Ranking system works as a web page, and in order to take advantage of its capabilities, the user must have a pre-installed browser, which version is not younger than the version released in 2016, in order to go through all the functionality. The web page requires permission to execute JavaScript scripts, since it is completely built on them. The service consists of two parts:

- The component responsible for displaying and working with users, that is, the interface of the system, implemented under the web page;
- A component that acts as the heart of a system that implements the entire functionality, and can connect to other interfaces such as mobile applications.

The service solves the problem of aggregation and ranking of medical news based on user preferences. Provides flexible medical news feed setting. Using the aggregation

service and ranking of medical news will save time in finding the right medical news, as the system analyzes the user's preferences and automatically generates a suitable medical news feed for him. The system also allows the user to flexibly configure aggregation, select medical news sources that he likes to read and type of publication. The service will function correctly with browsers released in 2016 and later. Without permission to run JavaScript scripts, the service will not be able to function. Requirements for the technical characteristics of the device on which this service is used is the same as the requirements of the browser in this device. Necessary Internet connection.

9 Conclusions

In the article an object approach was defined, which allowed to construct diagrams: components, states, sequences, activities, classes, usage options, and design a target tree. By establishing and justifying the expediency of creating this system, connections and necessary external entities are defined in order to achieve the desired results, as well as determined: the purpose of development, the purpose and place of application of the system, the development of a conceptual model (input and output data).

The choice and justification of the methods for solving the problem was made for realization of this intellectual information system of aggregation and ranking medical news Selected and grounded list of various solutions to this problem problems among which: software (libraries, database extensions, frameworks, package managers), systems that significantly accelerate and facilitate development of this system, and in some cases, it is possible to solve all set for development of the task.

This work describes the key features of the system, described the creation of a software product, which such properties as general information, functional purpose, description of the logical structure, input data, call and download, output data. The user manual describes the features of the system and the possibilities of use, the functional limitations that may be imposed on the user due to the non-compliance of the environment. The description of the control example, which demonstrates the realized possibilities of the system of aggregation of medical news, shows the drawings, which confirm this and describes the main way of using the system.

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