Exambrev - Integrated System for Patent Application

Attila ASZALOS, József DOMOKOS, Tamás VAJDA, Sándor Tihamér BRASSAI, László DÁVID
Department of Electrical Engineering, Faculty of Technical and Human Sciences, Sapientia University, Tîrgu Mureș, e-mail: aszi.atti@hotmail.com; domi@ms.sapientia.ro; vajdat@ms.sapientia.ro; tiha@ms.sapientia.ro; ldavid@ms.sapientia.ro
Manuscript received October 1, 2010; revised October 30, 2010.

Abstract: In this paper we present the design and development of a patent application, examination and evaluation system based on the JEE platform. In the Introduction part of the paper we present the necessity of a patent application system, and various organizations dealing with patent data and classification.

The second section of the paper presents the architecture of our system and its functionalities, which include online patent request registration, reduction of the time required for the application examination by automatic and semiautomatic verification of the formal aspect of a patent application. The system helps the inventors in the International Patent Code assignment procedure and provides the possibility for the domain experts to search for similar technical solutions in the Romanian State Office for Inventions and Trademarks (OSIM), the European Patent Office (EPO) and the World Intellectual Property Organization (WIPO) databases and using the Google Patent Search engine. This considerably speeds up the patent examination process.

The final part of the paper presents the results of the IPC suggestion algorithm, both execution time and qualitative evaluation of it. It also includes the resulting execution times of the search in the above presented patent databases.

In this article we have made an overall description of the system and we have focused on the description and results of the IPC suggestion algorithm and on the search process in the above mentioned patent databases.

Keywords: Patent application, patent search, evaluation and examination system, IPC suggestion.

1. Introduction

Worldwide patent applications are growing at an average rate of 4.7% per year, according to the 2007 edition of the World Intellectual Property Organization (WIPO)'s Patent Report [1]. The patent examination procedure has
two stages: formal verification which follows all the formal procedural steps and verifies if applications are patentable and the evaluation stage which checks the grade of novelty and innovation of the patents [2], [3]. To reduce the patent examination time and increase the quality of the evaluation, despite that the number of the patent applications are growing, there are two possibilities: to increase the number of employments of the State Office for Invention and Trademarks (OSIM) or to reduce the amount of work required for registration, formal verification and evaluation by using an online integrated system. The following paragraphs of this section present similar existing systems.

OSIM [4] is a specialized government body that has exclusive authority in Romania in the field of protection of industrial property. Taking into consideration the special economic importance of the industrial property and the need of a competitive management of information in the field of industrial property, the OSIM has developed a system of services by which offers to the large public useful information concerning industrial property, processed by highly competent specialists such as to facilitate correct economic decisions to be taken. It pays special attention to the promotion of the industrial property.

From 2006, OSIM offers the possibility to register on-line to the epoline® system, for the following types of patents:

- patents filed according to the European Patent Convention (CBE/EPC), through OSIM as the national office;
- patents filed according to the Patent Cooperation Treaty (PCT), through OSIM as reception office;

In the present it is not possible to register online the Romanian national patent. On the OSIM web page you can find important information about online registration for the above mentioned patent application such as: important announcements, details about the services, information about how to register on-line, software for registration of the patent request at OSIM, recommendations, assistance for clients who want to register on-line an invention and some details about this page services.

EPO [5] provides a uniform, coherent application procedure for individual inventors and companies from 38 European countries. It is the executive body of the European Patent Organization and is supervised by the Administrative Council. The main role of the EPO is to grant European patents.

The EPO carries out researches and substantive examinations on a continuously growing number of European patent applications and international applications filed according to the Patent Cooperation Treaty. In the case of European patent applications, the Office gives the option of an accelerated procedure. The Office examines also oppositions against already granted European patents.
Publication of the invention is very important to the European patent system. The public can obtain copies of the patent documents from the European Publication Server. The European Patent Register provides details of the status of patent procedures at the EPO. All the EPO's patent documents are available to the public through the free Esp@cenet service on the Internet. The EPO also provides a wide range of other products for searching patent databases.

The epoline® is an EPO package of software with online services that allows users to create and apply electronically for patents at the Intellectual Property Office and other national and international offices, including the EPO and WIPO. The epoline® is a high security system based on smart cards.

To join the system, one should make two steps: first, to get an EPO smart card, then to fill in online an IPO (Intellectual Property Organization) enrolment form and submit.

This service has a series of advantages. It is a user-friendly application that helps inventors to build their applications and forms with a validation option that helps users to make applications and forms right even when doing this for the first time. Security of sending the documents is ensured, there are no postal delivery delays or postage costs. The sender receives an immediate filing receipt after sending the forms.

WIPO [1] is a specialized agency of the United Nations. It is dedicated to develop a balanced and accessible international intellectual property system, which rewards creativity, stimulates innovation and contributes to economic development in regard to the public interest.

WIPO was established by the WIPO Convention in 1967 for the protection of intellectual property worldwide by collaboration with other international organizations and cooperation among states. Its headquarters are in Geneva, Switzerland. WIPO considers that intellectual property is essential to the economic, social and cultural growth of all countries. Thus its objective is to promote the effective use and protection of intellectual property (IP) worldwide.

WIPO provides services for the owners and users of intellectual property, such as international registration services, thus a single application has to be filed that is valid in multiple countries. IP classification systems of WIPO are used for registering IP and making it easy to search in IP databases and registries. WIPO's Arbitration and Mediation Centre offers resolution services for private parties involved in international intellectual property disputes [1].

PATENTSCOPE® Search Service is a service that makes possible for users to search in all international patent applications published, starting from the first one that was published in 1978 to nowadays, and has a special part for the latest information and documents available online.

In this article we present an Integrated Patent Examination Expert System (EXAMBREV) developed as a web application considering the Java EE
platform, which helps the applicants to accomplish the entire registration procedure of a patent request and verifies the formal correctness of the patent application form. Our system’s other functionalities include the management of civil servants and expert users, the presentation of the application for evaluation through a web interface. Our translator unit is a helping hand for experts for searching similar technical solutions in a wide range of different language patent databases and the Romanian Patent Database. Our system will also help the management of the OSIM to see in which field to employ new domain experts in the future.

The outline of the paper is as follows. Section 2 presents our system architecture and describes the tasks and functionalities of each subsystem. Section 3 presents the results of the execution time of various algorithms used by the system, Section 4 contains the conclusions. The final part of the paper presents the acknowledgements and references.

2. Technical information

A. System overview

The architecture of our system is presented in Fig. 1. Our system has two main modules divided in multiple subsystems. The first module is called Interfaces and data preparation module which manages the patent requests, common users (UCOM), expert users (UEX), civil servants (UFUNC), applicants (UAPP), administrators (UADM), civil servant managers (UFUNCM) and expert managers (UEXPM) and also prepares some initial data for the Expert system module (SIEXP). The second module is the Expert system module (SIEXP) which gives the world wide novelty of a technical solution proposed by an inventor and contains the legal and procedural database. In this paper the Interfaces and data preparation module and especially the search methods for similar technical solutions in the online patent databases are presented.

The deployment diagram shown in Fig. 2 illustrates the connections between the different subsystems of the Interfaces and data preparation module and their deployment on the used servers. As we can see, all the subsystems communicate with the system database through JPA (Java Persistence Application Programming Interface) which communicates with the database through the JDBC API (Java Database Connectivity API).
Figure 1: EXAMBREV system architecture.

Figure 2: The deployment diagram of the EXAMBREV system.
B. The SISTORIC subsystem

The SISTORIC (SS-1) subsystem has two main functionalities [6]:

- the management and storage of the information regarding a technical solution proposed by an inventor;
- the automatic formal verification of the patent application.

According to Romanian State office for Inventions and Trademarks we had to deal with three types of patents:

- EPC (European Patent Convention);
- PCT (Patent Cooperation Treaty);
- Romanian national patent.

We have implemented for now the management system for the Romanian national patent. The application is accessible from the Internet through a web browser and makes possible to submit online patent requests. The data of a patent application is stored in a relational database management system, a MySQL database.

The software subsystem provides the following features [7]:

- Applicant user registration;
- Civil servant user registration;
- Expert user registration;
- Account activation for the above users;
- Online patent application;
- Editing patent application information;
- Editing account information;
- Patent application list;
- Semiautomatic IPC code assignment.

In the registration process the user starts the registration and fills in all the required personal information and specific user information. In the case of the expert users the specific information is the list of the IPC categories in which he has knowledge. After the data validation process the system sends an activation email to the registered person, containing a link to the activation page. The account of the user will be accessible after clicking the link in the received email and activating his account. In the case of the civil servant and expert users after the activation procedure their account must be confirmed. This can be done by the civil servant manager or the expert manager. These manager type users are promoted from the civil servant users by the administrator. If a civil servant is promoted to manager his account gets confirmed automatically. The user’s personal information is saved in the database.

The login process is different for almost every user type, although there is a common part too. In the common part of the login process the system checks
the username, password and the activation status of the account. If the username and password are matching and the account is activated the applicant and expert users can login. If the expert user’s account isn’t confirmed he has limited accessibility in the system and can only change the list of the categories he is expert at. The civil servant users can log in only if their account is confirmed.

The patent application process consist in filling of the online application form which is the same used at OSIM in present. This process is divided into 4 steps, because this way the amount of required data on one page isn’t too large and if there are validation errors, the user can correct them more easily.

C. The SICLAS subsystem

The SICLAS (SS-2) subsystem contains the IPC suggestion algorithm which can be used by the applicants to find the appropriate IPC categories for their invention [8], [9]. After the patent application is submitted by the applicant he is asked to select the IPC categories in which the invention should be categorized. At this step the applicant can describe his invention by keywords in Romanian or English and ask for a list containing the suggested IPC categories. If the keywords are given in Romanian, the subsystem’s translator unit automatically translates them into English. The API used by the translator unit is the Google Translate API.

Before we describe the logic of the IPC suggestion algorithm, we present the database diagram extract containing the tables used for the storage of the IPC categories. Fig. 3 shows the tables representing the 5 IPC levels: sections, classes, subclasses, main groups and subgroups. These tables contain the IPC codes and their description of every IPC level. The one-to-many relationships between the tables illustrate the hierarchical organization of the IPC levels.

![Database diagram](image)

Figure 3: Database diagram extract of the IPC category tables.

We can define the goal of the IPC suggestion algorithm as determining a list of appropriate IPC categories for an invention described by keywords. The algorithm can be split into 3 sections: initialization, search and result
propagation. The list of coefficients initialized in the first section and their initialization values are shown in Table 1.

Table 1: The IPC suggestion algorithm coefficients and their initialization values.

<table>
<thead>
<tr>
<th>Section (ps)</th>
<th>Class (pc)</th>
<th>Subclass (psc)</th>
<th>Main group (pmg)</th>
<th>Subgroup (psg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>25</td>
<td>20</td>
<td>15</td>
<td>10</td>
</tr>
</tbody>
</table>

The search section of the algorithm contains 6 steps. In the following these will be presented in detail. For a better understanding of the algorithm we introduce two result sets, A and B, which will contain the temporary and final search results. In the first step we search on all IPC levels for IPC categories of which description contains at least one of the given keywords. These categories are inserted into result set A. This step is shown in Fig. 4.

Figure 4: Keyword search mechanism on all IPC levels and building of the result set A.

In the 2nd step we take the subgroups from result set A, insert them into result set B and calculate a suggestion value for them. The general form of the calculation formula is given in Eq. 1:

\[
SgVal = NoOfKwdsInIPC \cdot Desc \cdot IPCLevCoef + OldSgVal
\]  

(1)

In this step the old suggestion value is 0, the IPC level coefficient is 10, and the number of keywords in the IPC category description is calculated for every record. Fig. 5 shows the graphical representation of this step.

In the 3rd step we advance upwards in the IPC’s hierarchical organization to the level of the main groups. We take those main groups from A, which does not have subgroups in result set A, insert them into result set B, and calculate their suggestion values with the Ec. 1. This is illustrated on Fig. 6 as the “i” substep. The second substep “ii” consists of updating the suggestion values of those subgroups in result set B, which belong to the main groups in the result set A. The updated value is calculated using the formula given in the Ec. 1.
The following steps from 4 to 6 are similar to the steps already presented. We continue to advance upwards in the IPC’s hierarchical levels, insert the IPC categories without subcategories in result set B along with their suggestion value, and finally update the suggestion value of those categories in result set B which had parent categories in result set A. All of the steps and the algorithmic language of the suggestion algorithm were presented in detail in [9]. One more step, the 4th, of the algorithm is presented in Fig. 7.

From the first version of the algorithm to the final version there were made some changes in the technical realization of it, in order to achieve better execution times. The necessity of this optimization was presented in [10], but
there weren’t presented the results of it. Section 3 presents a comparison between the execution times of the non-optimized and optimized version of the suggestion algorithm.

D. The SICOST subsystem

The SICOST (SS-3) subsystem is responsible for Expert user (UEXP) data management [6], [8]. This subsystem also takes the IPC code given to a patent application by SS-2, and outputs it to the civil servant manager helping him to choose 3 expert users for this domain.

This subsystem also provides a web interface for the expert users to search the following online patent databases:

- WIPO database;
- EPO database;
- Romanian Patent Database.

All of the above databases can be searched online from the esp@canet webpage. In our system we give the option to the expert to search these databases by keywords or by IPC code.

When the expert searches by keywords we build a URL with the required request parameters for the esp@canet webpage and execute it. The response given by esp@canet has a fixed structure containing an HTML table with the results of the search. This HTML table is parsed by us using a HTML parser and the results are organized in a list containing the following information: the title of the invention, the link to the page presenting the invention in detail, the inventors, the applicants and the IPC code of the invention.

If the expert chooses to search in the patent databases by IPC code the process is similar to the search by keywords, the difference is in the construction of the URL. It takes different request parameters with the value of the IPC code given by the expert.

Our system also provides the possibility for the experts to search with the Google Patent Search Engine.

The results of these searches are presented to the expert immediately after the expert submits the search and help him in finding similar technical solutions.

The detailed description of these search mechanisms was presented in [10], where wasn’t presented the fact, that these mechanisms are implemented in two versions; a single- and multi-threaded version. The multi-threaded version of the search mechanism was implemented as an optimization of the execution time of the search mechanisms. In section 3 we present the results and comparison of the execution time of the two versions of the search mechanisms.
E. IFS-SIEXP subsystem

The IFS-SIEXP (SS-4) subsystem is the special interface for the SIEXP module [6], [8], [11]. It makes data transfer between the Interfaces and data preparation module and Expert system module. It also communicates with UEXP, UCOM and UINV via a Web interface. This is the login point to the Web application for registered users.

3. Results

In the first part of this section there is presented a comparison between the execution times of the optimized and the non-optimized IPC suggestion algorithms. This is followed by the qualitative results of the previously mentioned algorithm. The execution time of the similar invention search mechanism and the comparison of the two versions (single and multi-threaded) of the search are presented in the second part of this section.

A. Results of the IPC Suggestion Algorithm

Table 2 shows the execution times of the IPC suggestion algorithm. The execution times were measured with the SQLyog software, which measures the execution time of every executed query.

<table>
<thead>
<tr>
<th>Keywords</th>
<th>Non-optimized (sec)</th>
<th>Optimized (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>METHOD SYSTEM COMPUTER CONTROLLED BICYCLE GEAR SHIFTING</td>
<td>19,312</td>
<td>6,813</td>
</tr>
<tr>
<td>BICYCLE GEAR SHIFTING METHOD APPARATUS</td>
<td>20,984</td>
<td>5,203</td>
</tr>
<tr>
<td>MOUSE RODENT TRAP</td>
<td>2,813</td>
<td>2,860</td>
</tr>
<tr>
<td>ELECTRIC MOUSE RODENT TRAP</td>
<td>6,968</td>
<td>2,718</td>
</tr>
<tr>
<td>HAIR CUTTING DEVICE</td>
<td>26,563</td>
<td>6,562</td>
</tr>
<tr>
<td>EDGE DETECTION IMAGE PROCESSING</td>
<td>2,812</td>
<td>2,047</td>
</tr>
</tbody>
</table>

Average: 13,2420 4,3672

The second and third columns of the table contain the non-optimized and optimized algorithm’s execution times. If we have a look at the difference between the average execution times of the two versions of the algorithm, it is evident that there is a 67.02% decrease in the execution time of the algorithm so the optimized algorithm performs more than 3 times faster.
Table 3: Qualitative results of the IPC Suggestion Algorithm.

<table>
<thead>
<tr>
<th>No.</th>
<th>Section</th>
<th>Class</th>
<th>Subclass</th>
<th>Main group</th>
<th>Subgroup</th>
<th>Suggestion value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G</td>
<td>G06</td>
<td>G06T</td>
<td>G06T00090000000</td>
<td>G06T00092000000</td>
<td>75</td>
</tr>
<tr>
<td>2</td>
<td>A</td>
<td>A22</td>
<td>A22C</td>
<td>A22C00290000000</td>
<td>A22C00290200000</td>
<td>70</td>
</tr>
<tr>
<td>3</td>
<td>A</td>
<td>A22</td>
<td>A22C</td>
<td>A22C00290000000</td>
<td>A22C00290400000</td>
<td>70</td>
</tr>
<tr>
<td>4</td>
<td>G</td>
<td>G06</td>
<td>G06T</td>
<td>G06T00010000000</td>
<td>G06T00011000000</td>
<td>70</td>
</tr>
<tr>
<td>5</td>
<td>G</td>
<td>G06</td>
<td>G06T</td>
<td>G06T00030000000</td>
<td>G06T00032000000</td>
<td>65</td>
</tr>
<tr>
<td>6</td>
<td>G</td>
<td>G06</td>
<td>G06T</td>
<td>G06T00030000000</td>
<td>G06T00034000000</td>
<td>65</td>
</tr>
<tr>
<td>7</td>
<td>G</td>
<td>G06</td>
<td>G06T</td>
<td>G06T00030000000</td>
<td>G06T00036000000</td>
<td>65</td>
</tr>
<tr>
<td>8</td>
<td>G</td>
<td>G06</td>
<td>G06T</td>
<td>G06T00050000000</td>
<td>G06T00055000000</td>
<td>65</td>
</tr>
<tr>
<td>9</td>
<td>G</td>
<td>G06</td>
<td>G06T</td>
<td>G06T00070000000</td>
<td>G06T00076000000</td>
<td>65</td>
</tr>
<tr>
<td>10</td>
<td>G</td>
<td>G06</td>
<td>G06T</td>
<td>G06T00110000000</td>
<td>G06T00118000000</td>
<td>65</td>
</tr>
</tbody>
</table>

Table 3 shows the suggested IPC categories and suggestion values for an existing invention, an algorithm suitable for edge detection in image processing. The following keywords were given as an input for the suggestion algorithm: “edge detection image processing algorithm”. The IPC main group in which the existing invention is categorized is shown in the gray cell of the table. As for the evaluation of the algorithm’s quality, we can state, that having a look at the suggestion values, the correct IPC category is located on the 3rd place. If we have a look at the hierarchical structure of the IPC, we can see that the algorithm determined correctly the section, class and subclass level of the invention even in the first result.

B. Results of the Similar Invention Search Mechanism

Table 4 and Table 5 contain the execution times of the single- and multi-threaded version of the similar invention search mechanisms and the number of results.

It is important to mention that the table contains only the execution time of the search mechanism, measured with the functions provided by the Java language for execution time measurement and does not include the search setup time. Table 3 shows us that the single-threaded version of the search mechanism was approximately 2 times slower in average, comparing to the multi-threaded version.

The difference between the test cases shown in Table 3 and Table 4 is in the used search providers and search languages. In Table 3 there were used three search providers provided by Esp@cenet plus the Google Patent Search with English keywords. In Table 4 the tests were conducted on the Esp@cenet search providers in English and Romanian languages. Having a look at the average execution times in Table 4 we can conclude that the multi-threaded version of
the search mechanism is approximately 2 times faster than the single-threaded version.

Table 4: Execution times of the two versions of the Similar Invention Search Mechanisms with Esp@cenet and Google Patent Search with English keywords.

<table>
<thead>
<tr>
<th>Keywords</th>
<th>Single (sec)</th>
<th>Multi (sec)</th>
<th>No. of results</th>
</tr>
</thead>
<tbody>
<tr>
<td>METHOD SYSTEM COMPUTER CONTROLLED BICYCLE GEAR SHIFTING</td>
<td>6,233</td>
<td>2,926</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>6,154</td>
<td>2,443</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5,925</td>
<td>2,326</td>
<td></td>
</tr>
<tr>
<td>BICYCLE GEAR SHIFTING METHOD APPARATUS</td>
<td>7,127</td>
<td>4,612</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>7,293</td>
<td>3,088</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7,785</td>
<td>3,010</td>
<td></td>
</tr>
<tr>
<td>HAIR CUTTING DEVICE</td>
<td>14,471</td>
<td>8,346</td>
<td>276</td>
</tr>
<tr>
<td></td>
<td>12,908</td>
<td>6,950</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13,835</td>
<td>7,396</td>
<td></td>
</tr>
<tr>
<td>Average:</td>
<td>9,08</td>
<td>4,57</td>
<td></td>
</tr>
</tbody>
</table>

Table 5: Execution times of the two versions of the Similar Invention Search Mechanisms with Esp@cenet using English and Romanian keywords.

<table>
<thead>
<tr>
<th>Keywords</th>
<th>Single (sec)</th>
<th>Multi (sec)</th>
<th>No. of results</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOUSE RODENT TRAP</td>
<td>6,728</td>
<td>3,971</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>6,960</td>
<td>3,322</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6,643</td>
<td>3,191</td>
<td></td>
</tr>
<tr>
<td>EDGE DETECTION IMAGE PROCESSING</td>
<td>6,691</td>
<td>3,963</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>6,356</td>
<td>3,175</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6,296</td>
<td>3,200</td>
<td></td>
</tr>
<tr>
<td>Average:</td>
<td>6,25</td>
<td>3,08</td>
<td></td>
</tr>
</tbody>
</table>

4. Conclusion

We designed and developed a JEE based integrated system for patent examination. The system will help applicants to make online patent application registration for all three patent types discussed (EPC, PCT and Romanian national patent type). The system also helps OSIM patent evaluator experts management, employers management and patent management.
The main results obtained are the UCOM, UEXP, UINV, UFUNC and patent application registration interfaces. The interfaces were developed considering Java Server Faces technology and PrimeFaces 2.0 technology.

We have developed an algorithm for semiautomatic IPC code assignment for helping the applicants and also the evaluator experts and a patent database search mechanism which speeds up the similar technical solutions search.

The focus in this paper was on the presentation of the results of the optimized IPC suggestion algorithm and the multi threaded similar invention search mechanisms.

Acknowledgements

This project is developed under Partnership in Anterior Domains Program of National Authority for Scientific Research in Romania, project code: 11-076/2007.

References