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WEB-BASED SOFTWARE SYSTEM FOR PROCESSING BILINGUAL DIGITAL RESOURCES

Abstract

The article describes a software management system developed at the Institute of Mathematics and Informatics, BAS, for the creation, storing and processing of digital language resources in Bulgarian. Independent components of the system are intended for the creation and management of bilingual dictionaries, for information retrieval and data mining from a bilingual dictionary, and for the presentation of aligned corpora. A module which connects these components is also being developed. The system, implemented as a web-application, contains tools for compilation, editing and search within all components.

Keywords: aligned corpus, concordance, data mining, dictionary entry, digital dictionary, search tool, web-interface, web-application.

1 Introduction

This paper aims to present a demo version of a modern software system under current development that is intended to manage bilingual digital resources with Bulgarian as one of the paired language. On the one hand, the system has four independently usable components (modules), but on the other hand, these components are linked at the high system level, so interactions between them are possible. Each module has its own user interface. The development of this complex software was carried out step by step and the system was upgraded permanently in the course of time. The implemented system will serve as a specialized platform for the maintenance of first Bulgarian-Polish digital resources (Dimitrova, Koseska, 2013). These resources were created in the frame of the joint research project “Semantics and Contrastive linguistics with a focus on a bilingual electronic dictionary” (between IMI-BAS and ISS-PAS) under the supervision of L. Dimitrova and V. Koseska. A modern dictionary writing system with Bulgarian as a source language and independent second language was created as a component of the software system. The information stored in the dictionary database is well-systematized, so

its usability to a web-based search tool for information retrieving is ensured. Such a tool has its own user interface and contains new instruments for searching and representing the information stored in the dictionary database. The retrieved information is formalized according to the search criteria and can be used in everyday life, education (for language learning), human communication, for research and statistical purposes, etc. The next step in the system development comprises the realization of functions for presentation of bilingual corpora. The web-application (module “Corpus”) uses the same technologies as the dictionary writing module and was thus easily realized. The next step is the implementation of a function that connects the two modules “Corpus” and “Dictionary” (module “Connection”).

A user can search in parallel in the dictionary and/or corpus and the search results will be displayed in a systematized and formalized way. The dictionary and the corpus modules have separate database.

The software system for processing of Bulgarian digital resources recognizes two different user groups. The first user group consists of the “administrators” — people who manage the system data, while the second group consists of the so-called “end-users” (or casual users) — people who use the data. The administrators have different authorization rights to access: to the management system or to the different modules (see 5.1 Super Administrator & Administrator Functions).

2 Creation and Management of Bilingual Online Dictionaries (module “Dictionary”)

The main system functions for the creation and management of a bilingual online dictionary include the creation of a modern online dictionary using web-technologies and the provision of possibilities for extending and enrichment of the dictionary entries. This is the reason to separate components in the dictionary web-application in two parts — an “administrative” part or a “dictionary management system” and an “end-user” part intended to perform user requests through a user-friendly interface.

The dictionary management system implements the following general functions:

- adding (compiling) a new entry;
- modifying an existing entry: adding/changing/deleting elements and attributes;
- deleting an entry;
- entry search based on various features: element/attribute existence, their value;
- alphabetical sorting of entries.

Access to the dictionary management system is possible after a check of the user authentication is performed. The administrator is then redirected to a web-page where he/she can insert new dictionary entries. To illustrate how the administrative part works, we present two examples that show the steps for the addition of a new entry: the Bulgarian verb “**разделям**” /*to divide*/ and the noun “**прах**” /*dust*/. Bulgarian verbs form a group of the richest POS with a lot of specific characteristics that are usually not specified in ordinary bilingual dictionaries.

Административен панел- корпус
Корпус

[Задаване на речникова статия](#) | [списък- български думи](#) | [списък- преводни думи](#) | [съкращения](#) | [страници](#) | [помощ](#) | [докладвани думи](#)

Въвеждане на глагол

Индекс за омоним	<input type="checkbox"/>		
Заглавна дума *	<input type="text" value="разделям"/>	търси в списък с думи	
2 л. ед.ч. сег. време *	<input type="text" value="-ш"/>	Спрежение на глагола	<input type="text" value="III"/>
Св. / несл. вид на глагола *	<input type="text" value="несл. вид"/>	Преходен / непреходен глагол	<input type="text" value="преходен"/>
Събитие / състояние	<input type="text" value="състояние"/>		

добавяне на други грам. категории за думата *

Значение на полски

№ група на точни значения *	Значение на полски *	Преходен/ Непреходен глагол	Сфера на употреба	Стилистично значение	Латинско значение	
<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	добави
1	rozdzielać	transitive				изтрий
1	dzielić	transitive				изтрий
1	rozłączać	transitive				изтрий

Деривация/фразеологии/примери на думата

Вид *	Фраза *	Сфера на употреба	Стилистично значение	Значение на полски *	
<input type="text" value="phr"/>	<input type="text" value="мненията се ~т"/>	<input type="text"/>	<input type="text"/>	poglądy, zdania są p	добави
<input type="text" value="der"/>	<input type="text" value="~м се"/>	<input type="text" value="aux"/>		rozdzielać się, rozłączać się, dzielić się, rozchodzić się	изтрий
<input type="text" value="phr"/>	<input type="text" value="пътницата ни се ~т"/>			drogi nasze się rozchodzą	изтрий

Запази

Figure 1 “Administrative (control)” panel — adding data for new entry with headword Bulgarian verb “разделям” /to divide/

[речник](#) | [корпус](#) | [за проекта](#) | [поддръжка](#) | [вход - регистрация](#)

Български -> Полски

приведи

а	б	в	г	д	е	ж	з	и	к	л	м	н	о	п
р	с	т	у	ф	х	ц	ч	ш	ъ	ь	ю	я		

- разделяне
- раздигам
- раздразвам
- раздразнение
- раздразнителен
- раздразням
- раздразням

разделям, -ш несл. вид, състояние, преходен, III спрежение; rozdzielać, dzielić, rozłączać transitive; ~м се aux. rozdzielać się, rozłączać się, dzielić się, rozchodzić się, **пътницата ни се** ~т drogi nasze się rozchodzą, **мненията се** ~т poglądy, zdania są podzielone

Търсене в БГ-ПЛ корпус за:

разделя разделям разделяш

Произведение:

Figure 2 “End-user module” — translations of the Bulgarian word “разделям” to Polish

Административен панел - корпус
Корпус

създаване на речникова статия | списък - български думи | списък - преводни думи | съкращения | страници | помощ | докладвани думи

Въвеждане на съществително име

Индекс за омоним

Заглавна дума * [Търси в списък с думи](#)

Форма за мн. число *

Род/ мн. ч.*

Неизменяемо съществително (indecl.)

добавяне на други грам. категории за думата *

Значение на полски

№ група на точни значения*	Значение на полски*	Род/мн.ч.	Сфера на употреба	Стилистично значение	Латинско значение	
<input type="text" value="2"/>	<input type="text" value="prochy"/>	<input type="text" value="pl"/> (szczątki ludzkie)	<input type="text" value="-----"/>	<input type="text" value="arch"/>	<input type="text"/>	добави
1	kurz	m				изтрий
1	pył	m				изтрий
1	proch	m				изтрий

Деривация/фразеологии/примери на думата

Вид*	Фраза*	Сфера на употреба	Стилистично значение	Значение на полски*	
<input type="text" value="phr"/>	хвърлям~ в очите на	<input type="text" value="-----"/>	<input type="text" value="-----"/>	sypię komuś piasek	добави
eg	въглищен ~			pył węglowy	изтрий
eg	~ за пране			proszek do prania	изтрий
eg	~ за глава			proszek od bólu głowy	изтрий

[Запази](#)

Figure 3 “Administrative (control)” panel — adding of the Bulgarian noun “прах” /dust/

речник | корпус | за проекта | поддръжка | вход - регистрация

Български -> Полски

[преведи](#)

а б в г д е ж з и й к л м н о п
р с т у ф х ц ч ш щ ъ њ я

прахосвам
 прахосване
 прахосмукачка
 прахуляк
 прахен
 пращец
 пращинка

прах, прахове m kurz, pył, proch m; proszek m; prochy pl (szczątki ludzkie)
 arch въглищен ~ pył węglowy, ~ за пране proszek do prania; ~ за глава
 proszek od bólu głowy, хвърлям- в очите някому sypię komuś piasek w oczy

Търсене в БГ- ПЛ корпус за:
 прах прахове

Произведение:

Figure 4 “End-user module” — translations of the Bulgarian word “прах” to Polish

3 Retrieval Information and Data Mining Tool (module “Search”)

The web-search tool uses the database of the implemented already dictionary with Bulgarian fixed as source language, and Lang2 as target one. This tool provides just a new way of searching in the dictionary database depending on the user request. The needed information is displayed in a well-systematized list. To connect this module a simple interface was created and attached to the dictionary database. This interface differs from the dictionary interface because of the specific of the user request: the end-user module is free for access. It is not necessary to have user-name and password to use the full functionality of the tool. There is an extra feature implemented for registered users: the tool can save different search criteria and filters (most preferable or usable for the user).

Depending of the user requirements multiple criteria for search are permissible for the search procedure. The “Retrieval Information and Data Mining tool” performs two types of search 1) tag search and 2) lemma search. According to the information filled in the user request the tool performs both types of search or the combination between them.

Tag search is carried out when the user enters only one characteristic of a group of words, specified by language or linguistics information, for example, “phrase”, “derivation”, “transitive/intransitive” for verbs, etc. It is also allowed for user to enter an expression that join two characteristics, for example, “phrase” and a list of words, “phrase” and a given “POS”.

Lemma search is carried out when the user enters a given lemma or its “part” (some sub-string, for example, a syllable). If the user enters an initial syllable or a final syllable of a given lemma (so called “rhyme”), a Rhymer procedure will produce result as a dictionary of “rhymes”. In this case the Rhymer procedure retrieves information for the rhymes of a corresponding word. We recognize two types of rhymes: head-rhyme and end-rhymes. Words with head-rhyme have the same initial syllable. Words with end-rhyme have the same final syllable. The implemented function “lemma search” is useful for creation of a “rhyme” dictionary.

The example below shows how the combination between lemma and tag search works. The tool is searching for all words starting with “прах%” (dust%). The wildcard symbol is used to substitute one or more than one characters. The user can narrow down the lemma search results if he/she adds some more search criteria, like “display only the nouns with male/female/neuter gender” or “display only transitive verbs expressing state”, i.e. tag search. Tag search is carried out when the user filters the groups of words pointing any classifying characteristic.

After the search has been performed the system displays the results as a list of dictionary entries which fulfill the criteria entered by the user. The listed words are hyperlinks that are references to the corresponding dictionary entries.

4 Web-presentation of Bilingual Corpora (module “Corpus”)

The module “Corpus” is a technological tool implemented as a web-based application for the presentation of bilingual aligned corpora with Bulgarian as one the two paired languages (Dimitrova & Dutsova, 2013). The web-based corpus application can also be used for producing concordances, for developing bi- and multilingual lexical databases and different kinds of digital dictionaries, for the retrieval of lan-

guage information, in contrastive studies or other linguistics research (Dimitrova & Garabík, 2011; Garabík, Dimitrova & Koseska, 2011). The next description focuses on the software tool and user interface.

information retrieval tool | back to dictionary | login |

Insert search criteria
 npax%
 Use wildcard character ("%") to substitute a character or characters in a string.
 Use semicolon character (";") to enter multiple search criteria.

search Clear form

Verb

Verb conjugation I II III

vi vp

State Event

Transitive Intransitive

Phrases Examples Derivations

Noun

Noun gender f m n

Name only in singular

Name only in plural

Nouns with the same plural form

Phrases Examples Derivations

Adjective

Female form

Male form

Neutral form

Phrases Examples Derivations

Figure 5 User request form for searching for and extracting of words

information retrieval tool | back to dictionary | login |

Results:

Noun start with npax Phrases Examples [Save your search criteria](#)

Alphabetical filter [A](#) [Б](#) [В](#) [Г](#) [Д](#) [Е](#) [Ж](#) [З](#) [И](#) [Й](#) [К](#) [Л](#) [М](#) [Н](#) [О](#) [П](#) [Р](#) [С](#) [Т](#) [У](#) [Ф](#) [Ц](#) [Щ](#) [Ъ](#) [Ь](#) [Ю](#) [Я](#)

Headword	BG phrases/ examples	Lang 2 (PL) phrases/examples
пpax	1. вѣглицен пpax 2. пpax за пранѣ 3. пpax за главa 4. хвѣрлям пpax в очите нѣкому	1. pył węglowy 2. proszek do prania 3. proszek od bólu głowy 4. sypię komuś piasek w oczy
<p>пpax, пpaxовѣ <i>m</i> kurz, pyl, proch <i>m</i>; proszek <i>m</i>; prochy <i>pl</i> (szczątki ludzkie) <i>arch</i> вѣглицен <i>~</i> pył węglowy; <i>~</i> за пранѣ proszek do prania; <i>~</i> за главa proszek od bólu głowy; хвѣрлям <i>~</i> в очите нѣкому sypię komuś piasek w oczy</p> <p>Hide details</p>		
пpaxуляк	---	---

<< < [Page: 1/1] > >>

Figure 6 Bulgarian nouns starting with “пpax%”, appearing in phrases and examples of dictionary entries

(control)” panel has a very simple interface and offers the possibility to the user to add, edit, delete from and search within the corpus database.

The web-based end-user interface is bilingual. Only the possibility to search-by-word is given to the end user. The user can choose the input language (Bulgarian or Lang2 — Polish, in this case). The search is performed in the primary language selected by the user. All pairs of aligned text where the searched word has been found are listed in a table. In order to show the word in a better context, we display the previous and next pair together with the target pair as well. Fig. 8 shows the end-user query for searching for the Bulgarian word “търпак” /dust/ and the resulting concordance with this word in the corpus — aligned texts from S. Lem’s “Return From the Stars” (Dimitrova, Koseska, 2009).

5 Web-application for Connecting Dictionary and Corpus (module “Connection”)

The web-application developed for the joint use of the “Dictionary” and “Corpus” tools was easily implemented. Autonomous user interfaces had been previously developed for each component. Each component is separately accessible and has its own internet address. The need to develop a common user interface arose with the idea to create a common system which processes digital bilingual resources with Bulgarian. The “end-user” part of the web-site in the linking modules features common access, and users will be able to search with it in both databases — that of the dictionary and of the corpus. Search in both Bulgarian and Lang2 words are possible. This component has a relatively simple structure: mirror Bulgarian and Lang2 versions, hyperlinks to the “end-user” part of the web-site of the dictionary and corpus and several additional sections — “about the project”, “maintenance”, and “entry”. The “Home-page” module consists of a query form with a text field where the user can enter the word of his information search and choose where to search via a check-box. If the user searches for the translation correspondence of the word entered (in the dictionary database), the screen will display the dictionary entry whose headword is this given word. If instead the user searches for the given word in the corpus database, the screen will display the concordance of the given word. A dual search option is also provided that will display the information present in the dictionary and corpus databases on the same screen: the dictionary entry and pairs of aligned texts where the word occurs.

Since the user interface of the “Dictionary” and the “Corpus” has a two-way connection for switching between the systems, the user is provided with the following possibility: if the query result in any component is “nil”, the user could start a corresponding search in the other software system by a button click. A small sub-window will appear, displaying the results of the second search, for example, if the first search was in the dictionary, the sub-window will display the results from the secondary search in the corpus and vice versa. The new tool will not have its own “administrative (control)” panel. Every component “Dictionary” and “Corpus” has different structures and specifications, so joining them into a single “administrative (control)” panel would create a complex structure accessible via a complex interface and create difficulties for the user.

речник | корпус | за проекта | поддръжка | вход - регистрация

Български -> Полски

прах

Търсене в речник Търсене в корпус (произведение:)

Търсене

Речник	Корпус												
<p>прах, прахове <i>m</i> kurz, pył, proch <i>m</i>, proszek <i>m</i>; <i>prochy pl</i> (szczątki ludzkie)</p> <p><i>awch</i> въглищен ~ pył węglowy, ~ за праше proszek do prania, ~ за глава proszek od bólu głowy, хвърлям - в очите някому sypię komuś piasek w oczy</p>	<p>5 резултата: прах</p> <table border="1"> <thead> <tr> <th>ID</th> <th>БГ текст</th> <th>ПЛ текст</th> </tr> </thead> <tbody> <tr> <td>0000000152</td> <td>... облаци от тъмен прах са изключително ...</td> <td>W Apprenous, kiedy pana ojciec przywiózł poprawki, wykryte przez Geonidesa w ostatnim miesiącu przed startem... okazało się, że współczynniki refrakcji w ciemnych pyłach były zbyt niskie... nie wiem, czy panu to coś mówi? - zatrzymałem się niepewnie.</td> </tr> <tr> <td>0000000321</td> <td>... гниещото корито, вдигайки прах с миризма на ...</td> <td>Skoczyliśmy do próchniejącego wnętrza, aż wbił się kurz o zapachu niedowęglonego drewna.</td> </tr> <tr> <td>0000000329</td> <td>.... един път срещ облаци прах премина в тежък забавен</td> <td>Ściana dżungli oddaliła się na dobre i znikła w rozedrganych masach upalnego powietrza, czarny sternik nadawał tempo, w oddali na stepie pasły się antylopy, raz przeszło tam, w obłokach kurzu, zwolnionym, ciężkim kłusem ciągnące stado żyraf; w pewnej chwili poczułem na sobie wzrok siedzącej naprzeciw kobiety i popatrzyłem na nią.</td> </tr> </tbody> </table> <p><< < [3/5 Rezultata] > >></p>	ID	БГ текст	ПЛ текст	0000000152	... облаци от тъмен прах са изключително ...	W Apprenous, kiedy pana ojciec przywiózł poprawki, wykryte przez Geonidesa w ostatnim miesiącu przed startem... okazało się, że współczynniki refrakcji w ciemnych pyłach były zbyt niskie... nie wiem, czy panu to coś mówi? - zatrzymałem się niepewnie.	0000000321	... гниещото корито, вдигайки прах с миризма на ...	Skoczyliśmy do próchniejącego wnętrza, aż wbił się kurz o zapachu niedowęglonego drewna.	0000000329 един път срещ облаци прах премина в тежък забавен	Ściana dżungli oddaliła się na dobre i znikła w rozedrganych masach upalnego powietrza, czarny sternik nadawał tempo, w oddali na stepie pasły się antylopy, raz przeszło tam, w obłokach kurzu, zwolnionym, ciężkim kłusem ciągnące stado żyraf; w pewnej chwili poczułem na sobie wzrok siedzącej naprzeciw kobiety i popatrzyłem na nią.
ID	БГ текст	ПЛ текст											
0000000152	... облаци от тъмен прах са изключително ...	W Apprenous, kiedy pana ojciec przywiózł poprawki, wykryte przez Geonidesa w ostatnim miesiącu przed startem... okazało się, że współczynniki refrakcji w ciemnych pyłach były zbyt niskie... nie wiem, czy panu to coś mówi? - zatrzymałem się niepewnie.											
0000000321	... гниещото корито, вдигайки прах с миризма на ...	Skoczyliśmy do próchniejącego wnętrza, aż wbił się kurz o zapachu niedowęglonego drewna.											
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Figure 9 Result displayed after the search of Bulgarian word “прах” /dust/ via the component “Connection” in both repositories of data in Bulgarian — corpus and dictionary

5.1 Super Administrator & Administrator Functions: the super administrator has to be able to create new users or delete existing users. The super administrator has to determine access rights for a given user. From the “administrative (control)” panel of the “Dictionary” or “Corpus”, it must be possible to create new users (including administrators) who have simultaneous access to “administrative (control)” panels in both components. The administrator of any tool has to have access to the “administrative (control)” panel and “end-user” part of the web-site of the other components: that is, access has to be provided from the “administrative (control)” panel of the “Dictionary” to the “end-user” part of the web-site and the “administrative (control)” panel of “Corpus” and vice versa. The administrator has to be able to change personal data for access to the “administrative (control) panel — user password and email address. If the administrator has access rights for both the “Dictionary” and “Corpus” components, any such changes have to be logged in both locations.

5.2 User Interface Functions allow users to search in parallel or in circuit in the dictionary and/or corpus; to display the search results in a synthesized way; to facilitate the user to effectively use the system; to use not only Bulgarian but also every second language loaded in the lexical database; the provide access to a virtual keyboard that facilitates the entry of Bulgarian and Lang2 words; to give

the possibility for user registration via a given prompt; as well as to provide access to additional functionalities, some of which could be developed in the future.

5 Conclusion

The main idea behind the realization of the system described here is to enhance the possibilities for gathering extensive linguistic knowledge about natural languages and the Bulgarian language in particular. We conclude stating that the web-based software system for the processing of bilingual digital resources is a complex application of several independent modules that can be used separately or in parallel. This system, still in the stages of an experimental tool, is intended for research purposes, but it will be applicable in everyday life for educational and translation purposes. The structures and functionalities of the tools described here are not finalized yet, thus allowing for further changes and extensions.

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