Dragan Ranđelović[*]

INNOVATIVE WEB BASED SUPPORT FOR E-GOVERNANCE IN SOCIOLOGICAL, ECONOMICAL AND BIOLOGICAL SYSTEMS[**]

This paper proposes a novel approach to facilitate and foster e-government optimization and automation through the use of advanced information retrieval methods and techniques, and advanced Web technologies, as well. The approach suggested in this article aims to consider interactive processes which are simple, effective, and based on the user's needs and capabilities, rather than the government's organizational structure or government business models. It should create the opportunity to evaluate and eliminate redundant or unnecessary processes as well as to reduce costs and cycle times by transitioning from the processes mainly based on human-related work to automated and more intelligent processes.

Keywords: web technologies, text normalization, data mining, multi-criteria decision making

1. Introduction

This paper aims to describe one innovative web based support for governance in many fields of human life, especially in e-Government as most important for citizenship. Problem was researched and one solution developed as a prototype which solves advanced answering tasks on one place through the authors work on the project of Ministry of education, science and technological research Republic of Serbia with similar name. Further research author has recently proposed as project idea for FP7-ICT-2013-10 European commission (EU) call and in this way conceptual grid-kernel solution also as a nucleus for develop of many different Web applications that allow automated interaction with users in terms of answering the questions, based on existing knowledge base and structured and unstructured data in the form of documents.

The rest of the paper is organized as follows. Section two gives basics of web based support for e-government in two subsections and that, challenges and

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[*]   Professor Dragan Ranđelović, PhD, Academy of Criminology and Police Studies, Belgrade, e-mail: dragan.randjelovic@kpa.edu.rs

objectives of proposed framework in first and concept of solutions in second. In section three are given related works in web based support for governance while section four, in two sub sections is dedicated to technological enablers that will be used in development and deployment of the architectural components and to plan of projects realization, as well. The paper is ending with conclusion.

2. Web based support for governance basics

Innovative methods in technology of Web-based e-Government help citizens, small and medium enterprises (SMEs) and they are deployed in government institutions   in many areas of everyday life. Building and subsequent use of such systems is in the status of low-level accumulation of experiential knowledge which is in contrast to the requirements and many documents that establish the strategy of development in this area as are different EU strategies adopted for each ten years research of EU.

2.1. Challenges and objectives of framework

Challenges and objectives for develop solution of e-Government support come from:
- Societal drivers, that include, but not limited to, the lack of transparency in e-government systems and involvement of citizens especially minorities and young people in policy making;
- Economical drivers are manifold, but in general they ask technological and organizational help for economic growth;
- Medical drivers come from many biological challenges that faced up the world in a form of global warming, unknown viruses etc..
- Focus of proposed solution and projects idea is on:
- Exploring and testing new approaches, methods and techniques to extract, interpret and exploit information from unstructured multilingual and/or multimedia sources, yielding actionable knowledge;
- Developing and testing in realistic operating conditions new algorithms and software frameworks to analyze, interact and visualize extremely large volumes of data in real time;
- Supporting SME's developing innovative applications in structured and unstructured digital content management and, particularly, in the reuse of open data.

Concrete target objectives come due to the combined effect of globalization and European integration. Therefore there is a growing need for effective solutions that support multilingual business and inter-personal communication, and enable people accessing digital services in Europe's languages.

2.2. Concept of solution

There are three possible groups of users:
- Citizens,
- SME's, and
- Government whose communications with the kernel of solution is shown in Figure 1.

Figure 1. *Solution's concept*

It is all about data that should be found at the right -time and -place. In order to have it data is acquire from different sources and technologies like social networking, crowd sourcing, information retrieval, data mashup, etc., and store into analytical data warehouse after text preparation and before data mining and decision making.

As a result data base consists of knowledge for concrete application that triggered data acquisition. In order to realize desired features, solution is based on several advanced Web technologies for capturing than storing and preparing data for further analyzing using data mining as well as other multi-criteria decision making techniques.

3. Related work

One of the most important goals of e-government, clearly defined in EU i2010[1]1 and 2020 Horizon strategy[2], is the interaction of state, regional and local administration with the citizens and SME's in order to use the growing number of services such as:

- sociological consultations with such services as collaborative complaints and suggestions procedures to the administration, choice of education and future career etc.;
- consultations related to various fields of agriculture, healthcare, environmental protection, etc.;
- economical consultations in different economic areas of life (investments, financial crisis, instability of markets...).

Development of such complex systems is not easy and relies on research in many fields of computer science, mathematics, artificial intelligence, as well applications-related problems (e.g. economy, medicine, society, emergency management, etc.), etc.

Power gives an excellent briefing of decision support systems (DSS) history from late 1960's up to 2000.[3] Since then a significant movement from mainframe-oriented DSSs to client-server architectures with thin clients and then to Web-based DSSs[4]. In studies[5] the explicit definition of Web-based DSSs is given, with clear distinct what they are not. In addition, these studies cover the opportunities that Web bring to DSSs, such as increasing access to both structured and unstructured data, provide better knowledge base, adding new value to data warehouse, etc.

Papers[6] deals with possible architectures for Web-based DSS while in reference[7] with decision support and business intelligence systems.

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[1]   1 http://ec.europa.eu/information_society/eeurope/i2010/index_en.htm

[2]   http://ec.europa.eu/research/horizon2020/index_en.cfm

[3]   Power D. J.: *A Brief History of Decision Support Systems*, available online at: http://dssresources.com/history/dsshistoryv28.html, 2012

[4]   Zhang S., Goddard S.: "A software architecture and framework for Web-based distributed decision Support Systems", *Decision Support Systems*, No. 43/2007, 1133-1150

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[6]   Nestić S., Stefanović M.: "Komponente i klasifikacija DSS – koncept Web baziranih DSS sistema", *5th International Quality Conference*, Kragujevac, 19-21 May 2011, A-257-A264; Chen H., Zhang X., Chi T.: "An Architecture for Web-based DSS", *6th WSEAS International Conference on Software Engineering, Parallel and Distributed Systems*, Corfu Island, Greece, 16-19 February, 2007, 75-79

[7]   Turban E., Aronson J.: *Decision Support and Business Intelligence Systems*, Prentice Hall, New Jersey, USA, 2007

In the meantime Web itself has growth to an extreme pool of human knowledge. New social technologies known also as Web of humans or Web 2.0 transforms Web from a distributed knowledge repository to a media that allows people-to-people communication and form so-called collective intelligence that may be harness in many applications including decision support in e-Government.

More authors found that DSSs help in decision making in small and medium uncertain data and poorly structured or unstructured problems at all levels of government, but they are the most significant to it's higher levels and as such are complex and have many different implementations what we can see in reference.[8] It leads to multiple-criteria decision making (MCDM) and multi-attribute research and author deals in particular with multi attribute theory (MAUT) trough the possible classifications of different methods of individual and group decision making in the papers.[9] The roots of MCDM are given in reference.[10] The findings of all these studies are:

1) There is Web based software that may assist to apply MCDM;
2) The significant growth of MCDM penetration to many research areas and its usage;[11]
3) there is a Nobel(Nobel) prize in economics awarded 2002 to Daniel Kaneman (Daniel Kahnehman) for his work on behavioral aspects of decision making, etc.

In group of papers[12] author consider applications of different algorithms which enable different possibilities of multi-objective optimization.

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[8]   Voss A., Roeder S., Märker O.: "Optimizing Cooperation in Spatial Planning for e-Government", *Knowledge Management in Electronic Government , Lecture Notes in Computer Science*, Vol. 2645/2003, 239-249

[9]   Zhang R., Lu J., Zhang G.: "A knowledge-based multi-role decision support system for ore blending cost optimization of blast furnaces", *European Journal of Operational Research*, Vol. 215, No. 1, 2011, 194-203; Doumpos M., Zopounidis C.: *Multicriteria Decision Aid Classification Methods*, Kluwer Academic Publishers, Massachusetts, USA, 2002

[10]   Wallenius J. *et al.*: "Multiple Criteria Decision Making, Multi-attribute Utility Theory: Recent Accomplishments and What Lies Ahead", *Management Science*, Vol. 54, No. 7, July 2008, 1336-1349

[11]   http://expertchoice.com/; Dyer J. *et al.*: "Multiple Criteria Decision Making, Multiattribute Utility Theory: The Next Ten Years", *Management Science*, Vol. 38/1992, 645-654

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In the papers[13] is described the answering system for interactive communication e-government with citizenry in the field of suggestions and complaints.

How to combine multi-attribute decision theory and adaptive techniques to enhance individualized instruction in intelligent learning environment (ILE) are given in reference,[14] which aims to help new users to master the skills of computer use.

Applications of intelligent Web-based e-government in the health and economy sector in the Republic of Serbia are given next two references:

- Reference[15] applying electronic documents in development of the healthcare information system Republic of Serbia and
- In paper[16] one doctor-client application.
- In the next two papers are given applications:[17]
- In the economy in the field of investment and
- Planning of agricultural development, respectively.

In the work[18] is given the application of security service to the citizens within them all the possible methods of implementation multi-attribute decision based on evolutionary algorithms integration.

Paper[19] presents a general discussion about e-government and paper[20] complex perception of DSS anticipated to design new services tailored to citizens in

for Multiobjective Optimization: Formulation, Discussion, and Generalization", *5th International Conference on Genetic*, Illinois, USA, 17-21 July 1993, 416-423

[13] Victor M. *et al*.: "Web Management of Citizens' Complaints and Suggestions", *12th International Workshop on Groupware – CRIWG 2006*, Valladolid, Spain, 20 Sep 2006, Lecture Notes in Computer Science, Springer Verlag 2006; Ruiz V. *et al*.: "Complaints and suggestions web-based collaborative procedure", *International Conference on E-Government, EGOV'05*, 2005, 336-342

[14] Kabassi K., Virvou M.: "Multi-Attribute Utility Theory and Adaptive Techniques for Intelligent Web-Based Educational Software", *Instructional Science*, Vol. 34, No. 2, 2006, 313-158

[15] Jovanović M. *et al*.: "Applying electronic documents in development of the healthcare information system in the Republic of Serbia", *ComSIS*, Vol. 6, No. 2, 2009

[16] Spasojević M., Kojić N.: "Pacijent–doktor servis web aplikacija u asp.net", YuINFO, 2010

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[19] Meo P. D., Quattrone G., Ursino D.: "A decision support system for designing new services tailored to citizen profiles in a complex and distributed e-government scenario", *Data & Knowledge Engineering*, Vol. 67/2008, 161-184

[20] Schellong P. A., Girrger P.: *Government 2.0 in beta phase -An Analysis of e-Participation and Web 2.0 Applications of Germany's 50 largest Cities and 16 Federal States*, Harvard

a complex and distributed e-government created using new web 2.0 technologies in Germany.

In reference[21] is given basis of text normalization and in works[22] are given clustering methods of text mining in an advanced answer systems. In reference[23] is given one approach of web based intelligent DSS and in papers[24] are presented techniques of data-warehousing, data-mining and multi-criterion decision making.

References[25] are dedicated to different statistics techniques which use in proposed solution is mandatory.

4. Architectural framework overview

Proposed kernel grid-solution based on Web technologies is applicable in:
- Different systems for support of better up to date using e-Government
- Systems for support complaints and suggestions web based procedures in governance and public services

Such, so called, advanced e-Government and public services systems are intended to help interested in to make decisions between those are citizenry, SME-s and other organizations which demand to participate and collaborate in different institutions of local and state governments by means of mentioned different possible applications and prevent and theirs agitation if are not satisfied with received answers or if they haven't received answers.

To take care and act about above mentioned situations is under responsibility of the different institutions and organizations also local or state government on higher level. In many situations they are exchanged information with other

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University Cambridge, Massacushetts, USA, 2010

[21] Kajan E., Pljasković A., Crnisanin A.: "Normalization of text documents in Serbian language for efficient searching in E-Government systems" (in Serbian), *ETRAN Conference*, Zlatibor, June 2012, 1-4

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[23] Ranđelović M., Ranđelović D., Suknović M.: "An Approach to Intelligent Web-Based Multi-attribute Decision Support System", *In Proc. 19. Telfor*, 2011, 1511-1514

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[25] Hadživuković S.: *Statistički metodi*, Univerzitet u Novom Sadu 1991; Kempthorne O.: *The design and Analysis of Experiments*, John Wiley & Sons Inc., New York, USA 1952; Cohran W., Cox G.: *Experimental Designs*, John Wiley & Sons Inc., New York, USA 1957

authorities either using direct communication and/or via some common global body. Since the early days of computers various government and scientific organizations collected relevant data, analyzed them and tried to predict what may happen and how to protect particular community. Thinking about that now, we have in mind a lot of available technological opportunities. They are, but not limited, to: Internet and Web that lead to build the efficient and cheaper government systems (known as we still mentioned: e-Government), power of new hardware technologies that are able to store terabytes of data (regardless of their nature, pure text, figures, tables, pictures, code, etc.) and exchange them via very reliable and high speed channels, and make complex calculations over that data either on source or destination computer, etc.

The purpose of this paper is to explain motivation, goals for, and overview of, an intelligent DSS based on Web technologies, and key algorithms that will be used as mechanism for helping decision processes in described situations which can be divided in two basic groups:

- To the first group belong those in which a decisions can be used for reasoning based on known cases (in which group belong a, for example, applications which support suggestions and complaints from citizens).
- Second group that would be carried out using an inference from the known groups of algorithms of machine learning (which group includes all applications in which is presented a choice of one from the group of available options).

For both groups common is interaction between interested in and system which represent connected institutions (governance institutions are best example) and such a system is based on questions issued by interested in and answers provided by system. Questions and answers are accumulated over time into some kind of knowledge base.

The answer in description means set of ranked documents!

4.1. Architecture design

Main issue in scenario described above is to find the most accurate answer to the question given. In classic e-Government systems these answers are provided by so called subject matter experts whose replays may vary from few hours to several days. In addition these answers may not be completed and may lead users to knock on the door of other government office, either classic or digital.

Figure 2. *Road-mapping methodology for proposed DSS*
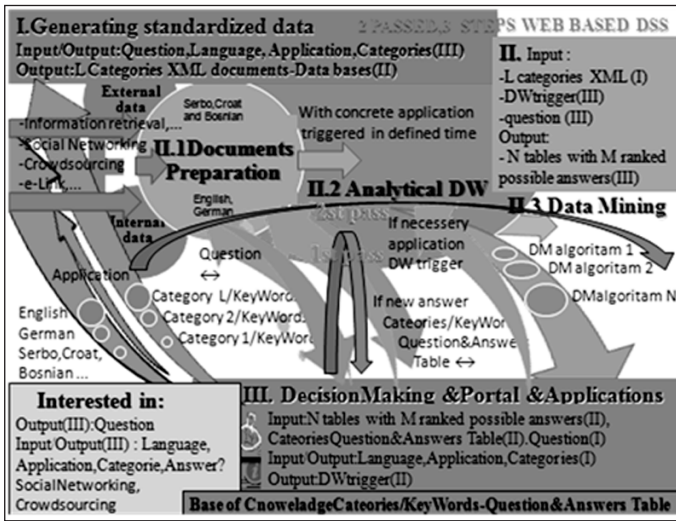
Internet is a place where DSSs given on Figure 2 has the dominant position as the system of questions and answers and using developed applications leads to end-user tools which enable users to solve practical problems in the fields of sociology, biology and economic.

Figure 3. *Three layer architecture of proposed DSS products*
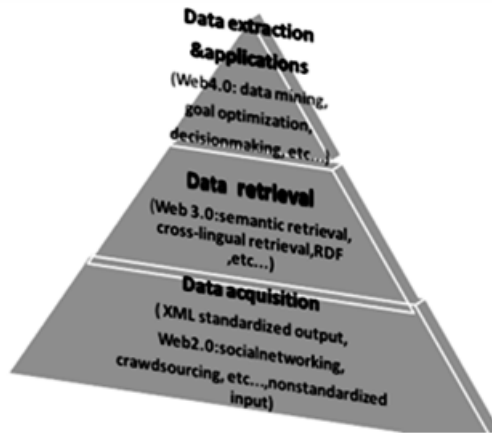
Both classes of applications could have three layer architecture as it is on the Figure 3.

Proposed grid-solution as kernel will be deployed on network of official organizations sites on first level, on cities Web sites on second and on official Ministries Web sites on third which are in natural Internet environment.

Having in mind that the speaking language of population has most important role in mentioned multi-domain Web service named advanced answering systems (AAS) will be solved Serbian, Croatian and Bosnian speaking area i.e. West Balkan countries languages, also German and English as mandatory, but this solution is good ground for develop such systems in all speaking area in EU using cross-lingual applications.

The basic application is two passed with English as one of used languages and one of other for interested in important languages and in maximal three possibly step grid solution in which:

I. Answer is already in existing database of knowledge on the place where the question is loaded or if it is not case in second pass on places in connected grid network.

II. Answer is founded with application work (data capturing, data preparation, data mining, decision making…) on the place where the question is loaded or if it is not case in second pass on other places in connected network.

III. Answer is not founded and must be used additional expert knowledge including using of data mashup and other technologies such as 2D/3D visualization.

It is important to notice that the proposed solution understand two way of data normalization both based on different nature basis of similarity text measurement.

4.2. Work packages and phases of the solution realization

Author planed, as probable realization of proposed project idea, 30 necessary researchers suitable for solving given in three main groups of tasks supported with equal teams under the Figure 2., in three years, with work packages as it is given on Figure 4.

Figure 4. *Block schema of work packages for project idea realization*
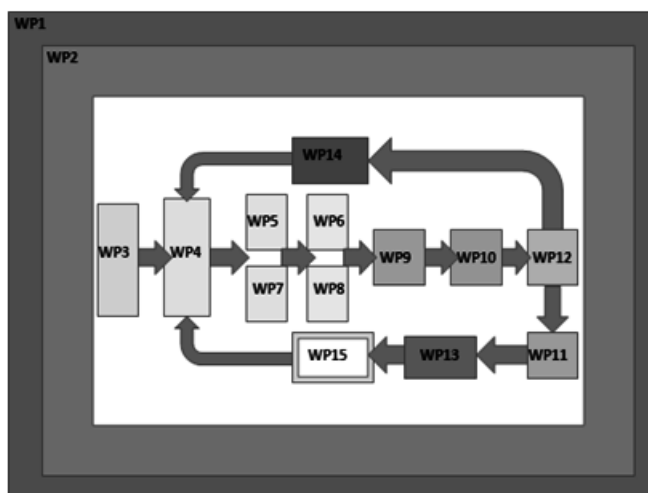
In all phases of duration:

Work Package 1 – Coordination on project, management on project.

Work Package 2 – Research and development management on project, control of project idea definition observing and eventual adaptation through realization.

In phase 1: first year of research development

Work package 3 – Research crowd sourcing, social networking and information retrieval with classical services for solving data capturing in proposed projects.

Result should be a visibility study how these Web2.0 and other mentioned technologies may be implemented in system and how it will improve documents preparation and latter data mining and decision making.

Work package 4 – Research of portal as a obviously part of future basic kernel application of advanced answering system for communicating with possible interested in with interfaces in Serbian, German and English language as mandatory.

Result should be a visibility study.

Work packages 5.7 – Research techniques for document preparation, semantic retrieval and cross-lingual retrieval using suitable web3.0 technologies.

Result should be a visibility study.

Work package 6.8 – Research of techniques of data-warehousing and data mining algorithms for solving storing and analyzing data for further end processing and decision making.

Result should be a visibility study.

Work package 9 – Research techniques and algorithms of multi-criteria decision making for solving a given tasks in project.

Result should be a visibility study.

Work package 10 – Research techniques and algorithms for solving security component of application.

Result should be a visibility study.

Work package 11 – Analytical research of state in existing biological, economic and social possibly applications based on in work package 1-10 researched solution i.e. prototype in multi-domain Web service named AAS.

Phase 2: second year of research development.

Work package 12 – Implementation researched and developed solution which integrates results obtained in work package 1-10, practically as individual tasks under

Figure 2 which is road-map and groped in work packages as it is given on Figure 4.

Result should be a prototype AAS, ready to be tested.

Work package 13 – Develop one from developed solutions for biological, economic and social applications based on in work package 11 researched and developed solution in the form of finished application ready for implementation with proposed prototype of kernel solution.

Phase 3: third year of research development
Work package 14 – Evaluation prototype developed in work package 12.
Work package 15 – Evaluation of project results in work package 13.

5. Conclusion

Prototype of proposed advanced AAS as grid solution provides to the interested in early responding and high quality answering engine and is the kernel which enables develop of different tools in all fields of work in community. Solution aims to meet the needs of the following target groups:
- Citizens
- Small and medium enterprises (SMEs)
- The government and its ministries as lead users

Proposed solution employs a number of cutting edge ICT tools to enable public administrators to develop policies and strategies for society growth in the light of data captured from the public also state and local government institutions and different independent organization. In particular, considered solution uses social networking, crowd sourcing capturing and also, several Web2.0 technologies and data-warehousing techniques to capture and store, respectively, data from external and internal sources in the form of documents which belongs to categories characterized for each possibly application and each determined with a set of suitable key-words present in its contents.

Next necessary techniques in proposed solution are semantic multilingual information retrieval of documents under given key-words(more than one and not bigger then for example five, more than then mal less from the number of key-words in set of keywords which determine category of question) present in documents, then several Web3.0 technologies for preparing digital documents for further processing of data mining and on the end of such projected procedure for decision making to find best demanded answer.

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Prof. dr Dragan Ranđelović
Kriminalističko-policijska akademija, Beograd

INOVATIVNA INTERNET PODRŠKA
ZA ELEKTRONSKU UPRAVU U SOCIOLOŠKIM,
EKONOMSKIM I BIOLOŠKIM SISTEMIMA

S a ž e t a k

U radu se predlaže novi pristup koji treba da olakša i podstakne optimizaciju i automatizaciju elektronske uprave korišćenjem naprednih metoda i tehnika pretrage kao i naprednih veb-tehnologija. Pristup predložen u ovom radu ima za cilj da razmotri interaktivne procese koji su jednostavni, efikasni i zasnovani na potrebama i sposobnostima korisnika, a ne na organizacionoj strukturi vlade ili njenim poslovnim modelima. On treba da omogući da se ocene i eliminišu suvišni ili nepotrebni procesi, kao i da se smanje troškovi i vreme ciklusa prelaskom sa procesa uglavnom zasnovanih na ljudskom radu na automatizovane i inteligentnije procese.

Ključne reči: veb-tehnologije, normalizacija teksta, traženje podataka, donošenje odluka na osnovu više kriterijuma