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Virtual Call Center

Dragan Savić, Sara Stančin, Grega Jakus, Sašo Tomažič
University of Ljubljana, Faculty of Electrical Engineering

Abstract: **A call center is a centralized workspace, primarily intended for receiving requests by the telephone. A virtual call center implementation provides for call center services, where call center agents are not necessarily available through fixed telephone lines and they are not necessarily located at the call center premises while communicating with users. Virtual call center agents can be available through any terminal, such as cell phone, traditional PSTN (Public Switch Telephone Network) telephone, VoIP (Voice over IP) smartdevice, etc. The calling user experiences the virtual call center service in the same way as if he or she would be calling a classic call center. The functionality of the virtual call center comprises the basic functionality, typical for the classic call center and additional functionality. Only a few commercial call centers support mechanisms for extending the possibilities of the basic product. Virtual call center implementations using an open source IP Personal Branch Exchange support fewer functionalities but are at the same time more easily and efficiently extendable and in such a way adaptable to different call center's requirements.**

1. INTRODUCTION

A call center is a centralized workspace, primarily intended for receiving requests by the telephone. Requests are usually made by customers that need support regarding a service or a product that is offered by the company. Call centers are an important part of many companies, since they represent one of the ways for companies to stay in contact with their customers.

The operators in a call center are called agents. A typical work station is equipped with a computer and a telephone set, which are connected to a telephone exchange and a supervision station. Several call centers can be connected into a corporate information network. Beside voice calls, some other means of interaction are also supported, such as short text messages (e.g. SMS, Short Message Service) and e-mail.

Today, many call centers operate from India, mostly because of skilled manpower and low costs [1].

A virtual call center implementation provides for call center services, where call center agents are not necessarily available through fixed telephone lines and they are not necessarily located at the call center premises, while communicating with users. Rather than being bounded to the call center location, agents can be available through different terminals (cell phones, traditional PSTN (Public Switch Telephone Network) or VoIP (Voice over IP) telephones and smartdevices, etc.) no matter what their current location is. Agents can therefore use private telephones and answer incoming call center calls from home, to name just one of the possiblitites. From the caller point of view, their user experience is similar as in the case of a classic call center.

As the existence of common call center premises becomes obsolete, implementing a virtual call center can reduce operating expenses of the call center service. Further expenses reduction can be achieved if traffic measuring is supported by the virtual call center. Using traffic measuring, situations when significantly less or significantly more incoming calls are arriving

than expected can be recognized. When such a situation occurs, agents can be easily activated or deactivated, as they are not bounded to a specific location.

In this paper, we introduce some of the possible interactive call center implementations in the mobile domain. The functionalities of the introduced solutions include the basic ones, which are usually a part of a classic call center, as well as additional functionalities, which are intended for adapting the service to individual mobile subscriber's needs. The functionalities of a mobile virtual call center are compared with the functionalities of the solutions that are currently available on the market.

A virtual call center can have different architectures and can therefore be incorporated in the mobile operator's core network differently. One among many possible implementations of the virtual call center is presented and tested.

2. VIRTUAL CALL CENTER FUNCTIONALITY

The virtual call center service appears transparent to the calling user: one calls and experiences the service in the same way as if he or she would be calling a classic, location-based call center. In a virtual call center, agents and calling users can communicate through a voice calls, video calls, conference calls, e-mails or text messages. The interactive call center service enables the user to choose a preferred agent or a group of agents. Preferred agents can also be automatically appointed to a user's incoming call. This is usually done considering known calling user habits, if they are available. For example, if the calling user already has a history at a specific virtual call center, and it can be established that during most of this user's calls, the user chose the same agent, that same agent can be automatically appointed for this user's next call. Before the determined agent is automatically appointed to the user's incoming call, it must be established, that the agent is actually available. When operating a classic call center, the agents are usually using fixed call center telephones. On the other hand, while operating a virtual call center, the agents could be using their own, private mobile phones for work purposes. It is therefore necessarily to maintain status information about all virtual call center agents. Agents usually register in a virtual call center by sending a short message or by making a call to a dedicated number. Once their status changes to 'available', they can be appointed to user's incoming calls. The agents are available until they check out from the virtual call center.

As illustrated in Figure 1, a particular agent can belong to multiple agent groups. These groups represent different services that are supported by the virtual call center. An important functionality of a virtual call center is therefore to distinguish between different groups to which one agent can belong to, so the incoming calls can be efficiently handled. The agent must be informed with which group the incoming call is associated before answering the call.

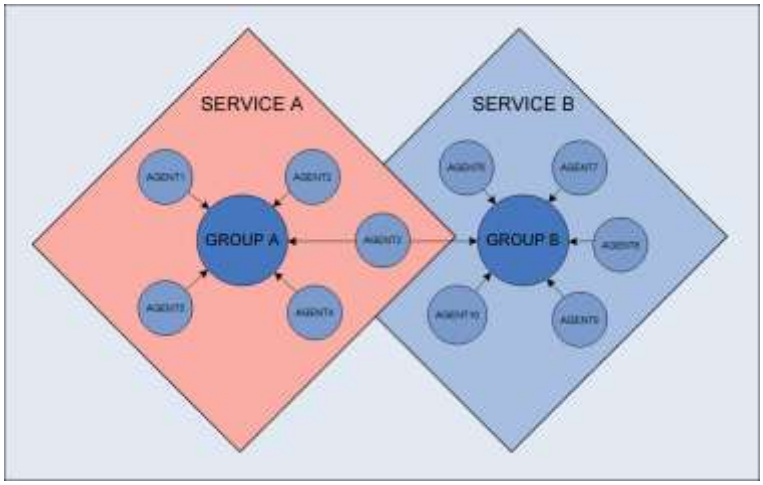

Figure 1: In a virtual call center agents are usually organized in groups. A group of agents can consist of only one agent and one agent can belong to multiple groups

After the appropriate agent has been chosen, the calling user's call is placed in a call queue. The queue can be implemented as a classic call queue or as a virtual call queue. In the first case, the connection with the user remains in an idle state until an agent is appointed to the user's incoming call. In the second case, the user can be repeatedly informed about the approximate waiting time for an available agent or can be called back, when an agent becomes available. The purpose of a virtual queue is to improve the overall user experience. Because the user is informed about the approximate waiting time, and even if he or she does not choose to be called back, he or she is less likely to complain about a possible long waiting time.

When a user chooses to be called back, the connection with him or her is terminated but the call itself keeps the position in the virtual queue as if the connection with the user was still open. The call back can be initiated when an agent becomes available or at a specific time in the future. This specific time is determined by the user using the interactive functionalities of the call center (Interactive Voice Response - IVR or telephone keypad - Dual Tone Multifrequency - DTMF). The call is initiated from the call center and the user is connected directly with an available agent.

As described, an incoming call can be placed to a joint agent group queue or to a specific agent queue. Because of this, the virtual call center must implement call queues on the agent group level as well as on the single agent level. Calls waiting in queue of a single agent have priority over calls waiting in the group queue.

Another important functionality of a virtual call center is the possibility to provide for user privacy by hiding his or her telephone number from the appointed agent. At the same time however, the appointed agent must be aware of the virtual call center user identity in order to identify a user that has already called before in order to appropriately accommodate his or her needs. The virtual call center user identity is defined without regarding the user's telephone number or personal information.

3. AVAILABLE SOLUTIONS AND THEIR FUNCTIONALITY

We have examined and compared 20 solutions that are available on the market [3]-[22]. The majority of the examined call centers is primarily intended for the establishment of the so-called help desks in small, medium or big companies. Beside voice calls, almost all of the products support VoIP and other means of interaction (fax, short text messages, voice mail etc.).

One of the important functionalities of a call center is Automatic Call Distribution (ACD). ACD enables distribution and routing of incoming calls to a particular agent or a group of agents. Routing can be based on different queuing mechanisms or given rules. All of the compared systems offer such functionality.

Interactive Voice Response (IVR) is an interactive technology, which enables automatic detection of voice and other audio commands. A typical IVR application is the playback of a pre-recorded or dynamically generated audio content, which guides the user through the menus [3] – [15], [17], [20] – [22].

Automatic Speech Recognition (ASR) enables call routing towards a company department based on the caller's response in natural language. Speech recognition is often combined with the techniques of Natural Language Processing (NLP) [4], [5], [9], [11], [22].

An important routing mechanism is also skill-based routing (SBR) [2]. SBR routes the call towards the most competent agent for a certain domain instead of choosing the first available agent. SBR is therefore a sort of upgrade of ACD [3] - [7], [11] - [15], [19] - [21].

The introduced concept of the virtual queue that allows the customer to receive a call-back instead of waiting for an available agent is supported by most of the examined call centers [3], [4], [6], [8], [10], [12], [14], [15], [18] - [20].

Another important functionality, which is implemented in almost all of the examined call centers, is reporting. Reports enable managers the evaluation of the call center performance. The reporting usually includes:

- real-time and historical reports,
- identification of immediate concerns and long-term trends,
- efficiency of performance of agents and system components in time periods,
- etc.

Some of the call centers also offer mechanisms for the extension of the functionality (e.g. API – Application Programming Interface, scripting etc.), which is an important feature when choosing a suitable product [3], [6], [8], [10] - [12], [15], [22].

4. VIRTUAL CALL CENTER ARCHITECTURE

A virtual call center can have various implementations. In this section we examine one specific realization of a virtual call center, the realization with an IP-Private Branch Exchange (PBX). This choice is financially affordable as a couple of IP-PBXs are publicly available without charge. An architectural example of such a virtual call center is illustrated in Figure 2. A virtual call center can, for example, also be implemented as a web service by including a service delivery platform (SDP) and Parlay/ParlayX gateways as illustrated in Figure 3. This

solution has a couple of advantages over the first one: it is a long-term solution; it is more scalable and implemented according to standards; it usually also includes more extensive functionalities. However, this implementation of a virtual call center is more extensive and is as well significantly more expensive. Both solutions enable SIP (Session Initiation Protocol) call center agent and user connections.

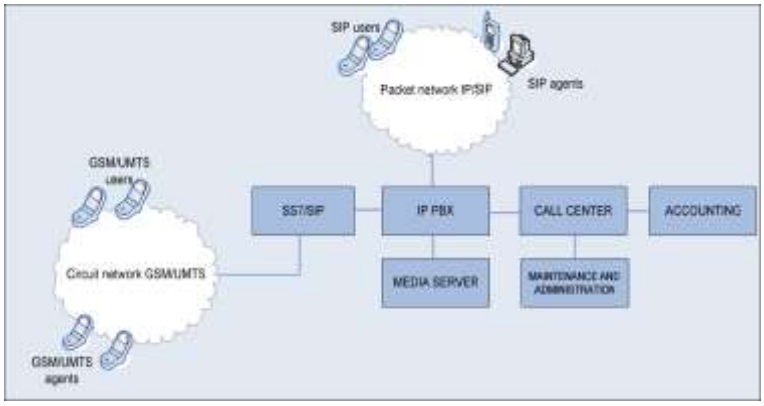

Figure 2: Virtual call center realization with an IP-PBX.

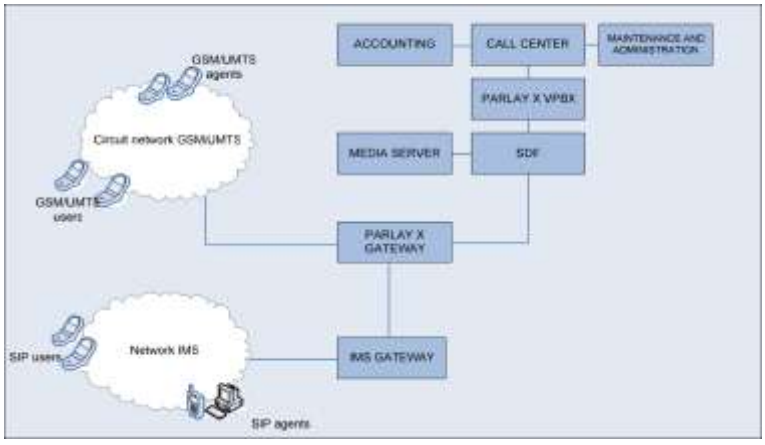

Figure 3: Virtual call center realization with a Service Delivery Platform (SDP) and a Parlay/ParlayX gateway

The IP-PBX based virtual call center services usually depend on the possibilities of extending the IP-PBX functionalities. For testing the possibilities of a virtual call center realization with an IP-PBX unit, we used a freely and publicly available IP-PBX - Asterisk.

Asterisk already supports call center functionalities by implementing call queues. After the incoming call has been queued, arbitrary music is played to the calling user. The system distinguishes between two types of agents: static and dynamic. Static agents are available at all time while dynamic agents can be dynamically added or removed from the system. A particular agent can be appointed to an incoming user call in different ways:

- ringall – call all registered agents until one answers,

- roundrobin – registered agent are called circularly,
- leastrecent – the agent that answered the previous incoming user call is called,
- fewestcalls – the agent that has answered the fewest incoming user calls is called,
- random – registered agents are called randomly
- rrmemory - registered agent are called circularly with additional logic for memorising and considering which agent committed a call last.

Two scenarios were taken into consideration for testing purposes. During the first testing scenario, only local SIP users were included. During the second scenario we have also connected PSTN network users to the IP-PBX Asterisk using a SIP trunk provided by a local mobile operator as illustrated in Figure 4.

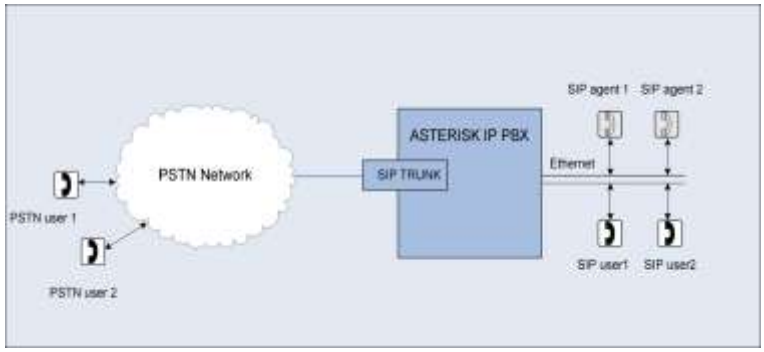

Figure 4: The environment for testing the possibilities of a virtual call center realization with an IP-PBX. The first and the second test scenarios included SIP and PSTN users respectively

We have tested the possibilities of implementing new call queues, IVR user interaction and audio play-back as well as virtual call center agent log in and log out. In the first scenario, SIP users were calling one of the two possible call queues directly. PSTN users from the second scenario accessed the queues by calling the IVR, which had been given a public number. After the connection was established, a pre-recorded audio file was played to the user, which was then able to choose between the two possible call queues by using the telephone keypad (DTFM interaction).

In both testing scenarios, virtual call center agents logged in or logged out from a specific call queue by calling the queue's number followed by an asteriks sign '*'.

5. CONCLUSION

We have introduced some of the possible implementations of the interactive call center in the mobile domain. The functionality of the virtual call center comprises the basic functionality, typical for the standard call center. However, the virtual call center implementation provides for call center services, where call center agents are available through different types of communication devices and are not necessarily located at the call center premises. For this reason, the basic functionality must be extended.

The examination of available call centers has led us to the conclusion that their functionality is quite complete. But unfortunately, from further insight we have concluded that

only a few commercial call centers support mechanisms like API libraries and scripting in order to extend the functionality of the basic product. At the same time, virtual call center implementations using an open source IP Personal Branch Exchange do not support such complete functionality but are more easily and efficiently extendable and adaptable to different call center's requirements.

REFERENCES

[1] L. V., Subramaniam, Call Centers of the Future, "i.t." magazine, February 2008, pp. 48–51, http://lvs004.googlepages.com/callcenters.pdf

[2] Beyond ACD – The advantages of skill based routing in today's contact centers, Nortel, http://www.nortel.com/solutions/ccvp/collateral/nn103640-030703.pdf, accessed 15. 12. 2009

[3] Five9 Virtual call center, http://www.five9.com/virtual-call-center- software/release7.htm, accessed 15. 12. 2009

[4] Zeacom Contact Center, http://www.zeacom.com/Contact-Center/, accessed 15. 12. 2009

[5] Interactive Intelligence Contact Center, http://www.inin.com/ProductSolutions/Pages/Contact -Center.aspx, accessed 15. 12. 2009

[6] ConnectFirst Call Center, http://www.connectfirst.com/call-center- management-products.html, accessed 15. 12. 2009

[7] Trix Box Pro (CCE), http://www.trixbox.com/products/trixbox-pro, accessed 15. 12. 2009

[8] Elastix, http://www.elastix.org/, accessed 15. 12.2009

[9] Asterisk, http://www.asterisk.org/, accessed 15. 12.2009

[10] Vici Dial, http://www.vicidial.com/, accessed 15. 12.2009

[11] Cisco Unified Contact Center Enterprise, http://www.cisco.com/en/US/products/sw/custcosw/ps1844/index.html, accessed 15. 12. 2009

[12] Aspect CallCenter ACD, http://www.aspect.com/eprise/main/server9/content/1200ContactCenterSoftware/2100Architecture/3200UnifiedIP/4100Inbound/5200AspectCallCenterACD/5200AspectCallCenterACD, accessed 15. 12.2009

[13] Contactual OnDemand Contact Center, http://www.contactual.com/en/Call-Center/Call-Center-Technology/Hosted-Call-Center/, accessed 15. 12. 2009

[14] Oracle Contact Center Anywhere 2008 Overview, http://www.promero.com/pdf/oracle_contact_center_ anywhere_2008_overview.pdf, accessed 15. 12. 2009

[15] Genesys CIM Platform Overview, http://www.genesyslab.com/products/customer_interaction_management_platform, accessed 15. 12. 2009

[16] Atos Virtual Call Center, http://ngin.es.atosorigin.com/en-es/soluciones/ngin/enterprise_services/virtual_call_center, accessed 15.12. 2009

[17] Computel, klicni center CTE32, http://www.computel.si/slovene/prod02.htm, accessed 15. 12. 2009

[18] IskraTel SI3000 Call Server, http://www.iskratel.com/en/control/products/call_server/default.aspx, accessed 15. 12. 2009

[19] OnState Virtual Call Center, http://www.onstate.com/virtual-call-center, accessed 15. 12. 2009

[20] Nortel Contact Center Portfolio, http://products.nortel.com/go/product_content.jsp?segId=0&parId=0&prod_id=9381, accessed 15.12.2009

[21] Avaya Call Center, http://www.avaya.com/usa/product/call-center, accessed 15. 12. 2009

[22] Callfinity Context Call Center Suite (Callfinity C3S), http://www.callfinity.com/call_center.htm, accessed 15. 12. 2009

Neural Communicator

Dejan Lacmanović, Milan Kojadinović, Zlatibor Veljković,
Vanja Zavišin, Goran Nikolić
Technical Faculty "Mihajlo Pupin" – Zrenjanin
Djure Djakovica bb, 23000 Zrenjanin, Serbia
Phone: (381) 23-550 543 Fax (381) 23 550 520

Abstract: **Neural Communicator is a software application, specially designed for people that suffer from medical conditions that disable them from communicating. Neural Communicator is based on simple redistribution of menu elements for easy selection. The elements are redistributed until single element is placed in every menu cell. For input consumer BCI (Brain Computer Interface) device is used which enables hands free computer/user interaction by detecting brain waves. The Application enables patient`s usage of numerous communication services, like sending and receiving SMS, Windows Live Messenger and alternative communication technique by using Microsoft Speech. Neural Communicator enables Book Reader service, that lists books from a remote server and simple web browsing with Web Browser plug-in. Presented solution brings new opportunities to a group of people that deserves special protection (of their rights) and care. By simple communication, patients are given a chance to connect with others and participate in social life.**

1. INTRODUCTION

Importance of communication in our everyday lives is undisputable. Whole world as we know it is based on communication and knowledge that we transfer with each other. Communication is what societies are based on, what civilization and whole human kind is based on.

If there was no communication, question is, what would world look like today?

When communication is disabled, individual that suffers from such conditions is not in a position to experience all the benefits that communication gives, such as expressing thoughts, feelings and exchanging knowledge. Special situation is when there is no possibility of using modern communication technologies like computers, mobile phones and others.

This paper aims at presenting solution for disabled individuals in such medical conditions that disable them from communicating. By using cheap biotechnology devices and some clever software design, simple solution is built that enables communication and much more with extendible architecture for individuals with extreme disabilities.

2. PROBLEM OVERVIEW

Numerous medical conditions can affect patient's ability to communicate. Disabilities that combine disabled motor and speech abilities are most common case of these medical conditions.

Possible medical conditions are amputations and different forms of paralysis. Paralysis can be caused by inflammatory processes, vascular failures, degenerative diseases, cancer and injuries of brain structures, injury of the spinal cord and peripheral nervous system. Cause can also be diseases that affect muscle system like inflammatory processes and degenerative diseases. One of the most common symptoms of these disorders is loss of motor functions, which can be manifested as weakness (paresis) or complete loss of all muscle function or group of muscles. Weakness or loss of muscle function can affect only one extremity (monoparesis or monoparalysis), it can affect one side of the body (hemiparesis or hemiplegia), upper or lower extremities (paraparesis or paraplegia) or all extremities (quadriparesis or quadriplegia). In addition, patients in certain conditions suffer from loss of their autonomous body functions (breathing etc). Severity of patient's condition depends of the injury degree or progress of illness.

Speech ability can be affected on level of brain structures, peripheral nervous system and on a level of organs in charge of speech.

When motor and speech disabilities are combined disabled individual is in such medical condition where communication is not possible. It can be divided in two levels where communication is completely not possible, or where person has difficulties communicating; when there is some form of communication but it is hard to understand because of nature of disease (e.g. cerebral palsy).

Patients in this kind of conditions have their quality of life negatively affected by their medical condition, not being able to move, do their daily routines, or not being able to participate in social activities. Patients fall into depression, characterized by lethargy, irritability, sleep disturbances, low self-esteem, and withdrawal. Since they cannot communicate with others, and cannot actively socialize, patients fall into an even worse situation, followed with complete refusal of cooperation and communication.

3. SOLUTION – HARDWARE

BCI is an acronym derived from the name of devices that were used in Neural Communicator project, which stands for Brain Computer Interface [1]. Year 2009 was marked by biotechnology and couple of consumer BCI (Brain Computer Interface) devices that reached the market. BCI devices are also known as "mind readers" even though they don`t read thoughts. The Brain Computer Interface devices use electrodes that detect brain waves that are used as actions for computer input. The brain waves are result of thoughts and mental state of a user. Device used for Neural Communicator project detects eye movement, jaw muscle contractions as well as alpha and beta brain waves; it is done with EOG (electro oculograph), EMG (electro myograph) and EEG (electro encephalograph) functions. BCI acts like HID (Human Interface Device), so it gives 10 actions for computer input. User interacts with computer completely hands free [2].

One more thing that made BCI perfect for use in this project was that it doesn`t require any surgery unlike neural prosthetics. This way unnecessary risky surgery is avoided, as well as postoperative procedures and transplant rejection drugs. A patient`s already threatened health remains saved from possible infections (the most common cause of death for these illnesses), so it is better prepared if a breakthrough procedure is found to fix the current condition.

Device that was used (OCZ Technology Neural Impulse Actuator Game Controller) for this project was not precise and had certain level of error and noise. To clear unwanted signal, and make device more usable, it was modified with medical grade ECG electrodes (electro cardiograph). By modifying the device, error and noise level decreased by 70% and device usability increased. Modification raised the ergonomy of the device, since headband that was used before modification did not fit every user's shape of forehead.

4. SOLUTION – SOFTWARE INPUT MECHANISM AND USER INTEFACE

When designing software for disabled individuals it is important to make the software adapted to patient's special needs as much as it is possible. Neural Communicator was completely designed according to this requirement [3].

Since level of disability can differ from case to case, application had to be adaptable to different levels of disability. Software selection mechanism was designed in such a way that it can be used with just one action for hardest cases of disability. If patient is capable of performing more actions, user interface is adapted according to user's capabilities [4].

User interface consists of two rows that are highlighted alternately and automatically; user does not control the highlighting. Beside rows, user interface consists of columns as shown in Fig. 1. Numbers of columns depends of number of actions that user is capable of performing, or is most comfortable with. For e.g. if one action is chosen, user interface will consist of two rows and one column. If three-action user interface is chosen, user will be presented with two rows and three columns, one for each action. Highlighted row is the active row, and user selects cell that is active in column that is assigned to preconfigured action.

Fig. 1. Main menu – 3 column actions

For three actions, user can choose one of six cells. If every cell contained one function user would easily choose one that he desires. However, since six functions or characters is not enough for everyday communication as a solution for implementing complete alphabet and multiple functionalities every cell was designed to contain groups of functions or symbols.

When cell that contains group of characters and functions is selected, contents of selected cell are redistributed to six new cells. Process is repeated until every cell contains single element for single selection.

For up to thirty-six elements, six in every cell, user is capable of reaching every element in just two steps as shown in Fig. 2.

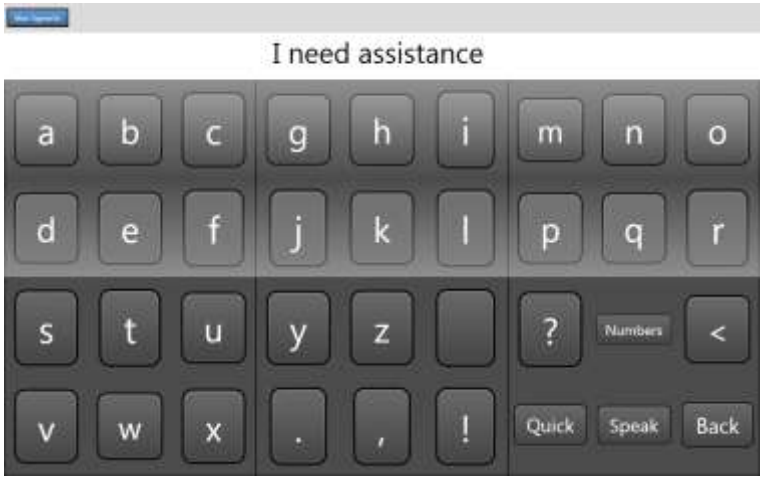

Fig. 2. Input text menu – 3 column actions

Neural Communicator user interface allows the user to quickly and easily select the desired element. User interface is consisted of three vertical functional segments.

Top segment is reserved for status messages related to Neural Communicator's plug-ins. For e.g. top segment informs user of sending of SMS, new SMS that is received, status of Windows Live Messengers and others.

Central segment can be reserved for four functionalities. When using plug-ins that require text input central segment is used as text box that collects characters that user selects. When Web Browsing plug-in is selected, central segment is used as web browser. Third functionality is related to Book Reader plug-in. In this mode, central segment is used for displaying books list. Fourth functionality is reserved for chat history that is used in Windows Live Messenger plug-in.

Bottom segment is assigned with input menu. As described in input mechanism section, it contains characters and functionalities related to plug-in that is used. It is updated dynamically, so every plug-in is assigned with its functions and characters.

5. SOLUTION – SOFTWARE TECHNICAL ARCHITECTURE AND PLUGINS

Neural Communicator is based on plug-in architecture. Number of functionalities that application can give is unlimited because of easy development of new plug-ins. Building new plug-ins requires knowledge of only four functions that respond to application core.

Neural Communicator was built by using following technologies:

- Microsoft Visual C# 2008
- Microsoft .NET Framework 4.0
- Microsoft .NET XML Web Services
- Messaging Toolkit
- MSNPSharp
- Microsoft Windows 7
- Microsoft Speech
- Microsoft Windows Presentation Foundation

Application consists of core plug-in that hosts functionality plug-ins.

Plug-ins that originally come with application are:

- Speech plug-in
- SMS plug-in
- Windows Live Messenger plug-in
- Book Reader plug-in
- Web Browsing plug-in

Everyday communication may differ in its range, for e.g. by just communicating with speech every human's communication ranges as far as his voice reaches. Communicating by using modern communication technologies extends users communication range as far as technology can reach.

To cover communication of different range three basic plug-ins were built. For short-range communication Speech plug-in; for telecommunication by using GSM technology, SMS plug-in; for Internet communication, Windows Live Messenger plug-in was built.

Speech plug-in is based on Microsoft Speech technology. It is basic plug-in for augmentative and alternative communication. Speech plug-in uses Neural Communicator's basic input mechanism for text input. Text that is entered is processed with Microsoft Speech and synthesized for speech replacement when Speech functionality is selected in input menu. Communication in this form plays important psychological role for every user that suffers from muteness or has difficulties speaking. Patient is given a chance to communicate with people in his nearest surrounding.

SMS plug-in utilizes GSM technology to send SMS. For this functionality, Messaging Toolkit is used as software part of a solution. Plug-in requires usage of GSM modem or mobile phone that when connected to PC has GSM modem abilities. SMS plug-in enables two-way communication by sending and receiving of messages. User is presented with status of SMS plug-in on status bar where user is informed while software is sending the SMS, when SMS is sent, delivered and when new SMS is received. After receiving notice of new SMS user may choose SMS plug-in from new menu and Read SMS option. New messages are listed and selection is done exactly like selection of any element. New message consists of information relevant to SMS, like sender name, number, date, and time when it was sent. For sending of new SMS, user chooses SMS plug-in from main menu and Write SMS in SMS plug-in menu. Next step is selecting contact from address book. After that user inputs text for message and chooses Send functionality from input menu. Feature of SMS plug-in that brings Neural Communicator accessibility to next level are quick messages. In urgent situations it is relevant for disabled individual to be able to send most common messages to people that can bring help, like doctors, nurses and family members. Most common quick messages are "I need help", "I

am hungry", "I am in pain" etc. Quick messages can be customized according to patient's preferences.

Windows Live Messenger plug-in brings communication of disabled individuals to next level. By using Windows Live Messenger plug-in, patients can connect with their friends and family through this popular messaging client. Development of this plug-in is based on MSNPSharp .Net library. Windows Live Messenger plug-in adapts user interface for intuitive usage. Just like in original application, user interface is split into history segment, and text input segment. User selects contact that he wants to start conversation with after entering Chat submenu in main menu. Plug-in is configured in such a way that Windows Live Messenger user account is logged in right after the application is started. Status bar informs user of WLM account signing in, and status button changes color and text to 'signed' in after process has finished. Status bar also informs user of new messages that are received, so that the user can enter Chat submenu and see who he got messages from and continue conversation if he desires. Only the most important functions of WLM were implemented into this plug-in so that the application could stay simple and accessible as much as it is possible.

Two other groups of plug-ins that were built for Neural Communicator are intended to give certain types of content to disabled individuals. Book Reader plug-in and Web Browsing plug-ins give new edge to Neural Communicator. Beside importance of communication, project recognizes importance of education, intellectual entertainment and keeping disabled individuals intellectually challenged.

Book Reader plug-in (shown in Fig. 3) is fine example of putting .Net XML Web Services to use. Plug-in lists the e-book collection that is located on a remote Internet server. User can browse this list by multiple categories, by genre, author or title. After selecting book that he wishes, it is streamed from remote server and presented in tabs that are assigned to each chapter. Each tab contains text box with text from a chapter. This is where Microsoft Speech technology is used once again. The text from a book is synthesized, and the current paragraph that is being read is highlighted in blue box. Importance of this plug-in is undisputable. Besides reading books for entertainment, users can choose educational books where they can develop themselves as individuals.

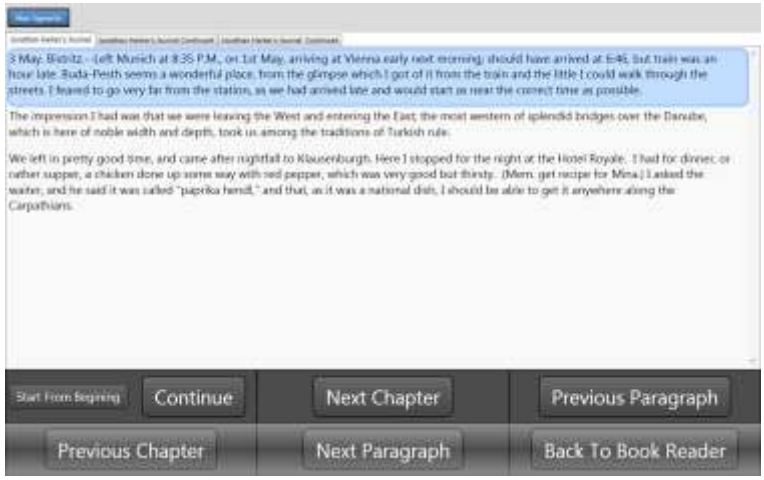

Fig. 3. Book Reader plug-in – 3 column actions

Second type of content plug-ins is unique in its own way. It is Web Browsing plug-in. What makes it different from other plug-ins is that it has its own plug-ins. Web Browsing plug-in is also based on .Net XML Web Services. Plug-ins basic functionality contains most common functions that are used on every web site, like Go, Stop, Refresh, Back, Forth, Enter address and others. Generic commands that were listed enable basic browsing of many websites. Problem appears on websites that have specific functions that are not listed in most common functionalities, generic functionalities. For example, Facebook or rich Internet multimedia applications like Bing Maps (shown in Fig. 4). On these websites user cannot reach website specific functionalities and extra accessibility is needed.

Fig. 4. Bing maps plug-in – 3 column actions

Extra accessibility is obtained by developing plug-ins for Web Browsing plug-in. These plug-ins contain information about special functionalities that certain websites have.

If disabled individual visits website that has additional functions that are not covered by generic functions, status bar gives notice about existing plug-in with additional functions, of course if plug-in for that website exists. If plug-in does not exist, development is quite easy, and it can be developed with basic programming knowledge. When status bar informs user of new or updated plug-in for specific website, user can install it from input menu that is located on bottom of screen. After installing, a new plug-in, input menu is presented with new functionalities. For e.g., when Facebook plug-in (shown in Fig. 5) is installed user can select website specific functionalities to change his status, to send messages, read messages, reply to wall posts, read other people's wall posts and others.

Fig. 5. Facebook plug-in menu – 3 column actions

Another great example of usage of this plug-in with rich multimedia Internet applications is Bing Maps. The Bing Maps contain functions that cannot be controlled with generic functionalities of Web Browsing plug-in. Installing plug-in with new functionalities gives user a chance to use full potential of the Bing Maps. Disabled individual can browse maps, enter coordinates, rotate globe, zoom in, zoom out, pan, change view. The two websites that were listed are just an example of possibilities. Development of this plug-ins does not require advanced programming; it can be done by any web developer. Fig. 6 depicts the plug-in that enables user to search images on www.bing.com.

Fig. 6. Bing images plug-in – 3 column actions

User is given a chance to experience all the wealth that Internet gives, education, socialization, entertainment and many others.

6. FURTHER DEVELOPMENT

Neural Communicator is competition projects developed for participating in Software Design category at Microsoft Imagine Cup 2010 where it ranked second on world finals in Warsaw, Poland. Since project Neural Communicator is constantly developed, in Warsaw, team TFZR presented version 2.0 of this application. That was the result of developing new input methods for this application.

Further development goals that are planned are adapting Neural Communicator to other BCI devices and developing special plug-ins for using their full potential. Flexible design of Neural Communicator does not limit the application to BCI devices. Application can be used with any device that gives discrete signals that can be used as computer input. Next level of accessibility is gained with this option since different levels of disability consider different conditions. For e.g. patient with pharesis might be more comfortable with some other kinds of devices, or patients whose condition does not allow usage of BCI devices.

Development of media player plug-in is also one of the goals for further development, but it was not put as primary objective since Book Reader and Web Browsing had bigger educational value.

Giving possibility for education to disabled individuals is great opportunity for their professional development. The next step for plug-in development is building text editor and implementation of *software development environment* that would allow writing books or coding to patients that would lead to possible employment or self-employment, which would connect them further to social flows.

Previous version of Neural Communicator had built-in accessibility features for disabled individuals that are also blind or have poor eyesight. One more goal for further development is implementing this feature into new version of application.

7. CONCLUSION

Neural Communicator brought new perspective to paralyzed people and people with extreme disabilities. They are given new opportunities to communicate in a modern way, to take active role in communication by being first to initiate conversation, chat or SMS. Use of this software in rehabilitation therapy improves patients overall health condition, prolonging their life and just by doing that gives them time to live long enough for breakthrough medical discovery that will fix their health problem permanently.

Software design of Neural Communicator is based on plug-in architecture that allows easy implementation of any new functionalities, and quick input actions that is core system of the software. Software solution is hardware input independent, which greatly expand possibility of use a new BCI devices that will come to the market in near future. Current solution mainly use three input actions, but any number of input actions is possible, which means with better BCI, the software is ready to work even better.

REFERENCES

[1] J. Clausen, “Man, machine, and in between”, Nature, Vol. 457 Issue 7233, S. 1080-1081, 2009.

[2] Lebedev, MA; Nicolelis, MA, "Brainmachine interfaces: past, present and future", Trends in neurosciences 29, 2009.

[3] Millar, Sally V. & Scott, J. What is Augmentative and Alternative communication? In Augmentative Communication in Practice: an Introduction (ISBN 1-898042-15-2), ed. Allan Wilson; CALL Centre, University of Edinburgh, 1998

[4] Beukelman, David R.; Mirenda, Pat, “Augmentative and Alternative Communication: Management of severe communication disorders in children and adults”, (2 ed.) Baltimore, MD: Brookes Publishing, 1999.

Shared Domain Knowledge and its Influence on the Success of Application of New Technologies and Solutions

Ljerka Luić, Dejan Glumac
B4B Ltd., Ulica Grada Vukovara 271
10000 Zagreb, Croatia
ljerka.luic@b4b.hr, dejan.glumac@b4b.hr

Abstract: **The present moment is characterized by a permanent development of new technologies and solutions which presuppose a global knowledge. In this matter, the decision maker's shared knowledge of the domain and its usage has a strong influence on the success in its practical business application. The designed model consists of four constructs (shared domain knowledge, attitude, planning and financing). The model is a result of a statistical analysis of the scientific research of the strategic planning of an integrated business-information system (SP-IBIS). The research participants were 61,6% of the university and other higher education institution managers of the Republic of Croatia. It was proven that shared domain knowledge is the most influential factor for long-term alignment, for strategic decision-making on the application of new technologies and solutions, and which can be initially used when applying other solutions - such as WSN application in healthcare.**

Keywords: **academic managerialism, model, new technologies and solutions, shared domain knowledge, strategic planning.**

1. INTRODUCTION

In times when we witness new business trends, ever growing global knowledge based on information is implied, as well as vigorous interfusion of all information society elements with the activities of higher education as a whole. Analysts of these relationships more and more stress the development of the theory of academic capitalism, by which they explain the process of integrating higher education institutions into the new economy. Ever larger demands that are placed before university management in terms of overall management of all business segments, aiming at managing the complete business in the most efficient manner, assume utilisation of modern ICT technology and solutions that enable integrated monitoring of all business information being utilised for reaching operative, tactical, strategic and financial decisions. Viewed from the aspect of scientific research, the study of information system strategic planning is by no means simpler, especially if the fact that the discipline is as yet insufficiently researched within information science is taken into account, as well as that it is quite young, since the initial works date from the 80s of the preceding century.

With the introduction of the Bologna process in the higher education of the Republic of Croatia, optimization of the use of available resources has become an acute issue: budget funds, own revenue, personnel, space and equipment, and especially the optimization of the distribution of funds by introducing financing based on overall amount. Therefore, it is necessary, in order to develop and manage such a complex system as the single business and

information system of the university, to conceive a single information strategy as the link between academic strategy and information system strategy. The complexity of the process requires specific forms of strategic conception, planning and management of activities, and, finally – strategic profiling of the university. Each new contribution to advancing knowledge, financing, attitude and planning aiming at improving the success of university becoming information enabled, which in turn makes possible more efficient use of budget funds, surely does have full social justification as well.

2. KNOWLEDGE SOCIETIES IN EDUCATION

While economists tend to think of 'knowledge society' as a global economy, other social scientists tend to think of it as a smaller level social collective. Thus, a knowledge society may exist on at least four levels: a global, national or cultural system, a social organization like a professional society, and a smaller community. A knowledge society is generally defined as an association of people with similar interests who try to make use of their combined knowledge.

Of course, knowledge societies are not new, but what is new is that there has been a quick rise with them and they are much more visible now. Their rise follows digital networks which make them possible without members cohabiting in the same region while the technology enables accessing and sharing the knowledge that emerges from the knowledge economy. Unless the educational unit devotes particular attention to knowledge-related activities, it is not particularly useful to call it a knowledge society. When an educational group invests considerable effort toward sharing and producing new knowledge, then it can be called a knowledge society. Communities of practice, typically groups of teachers that work with each other to improve their teaching, are good examples of knowledge societies, especially those that use all the tools, electronic and other, to facilitate their goals. [1]

3. THE DEVELOPMENT OF AN INFORMATION SOCIETY (HOW TO MEASURE PROGRESS?)

The information society is a society in which the making, distribution and handling of information represents a significant economic and cultural activity. The root of these activities is in the information-communication technology (ICT) which is actually the tool for setting the changes in motion.

The research of the degree to which an information society is developed contains the indicators, Figures 1. and 2. [2][3], which measure the degree of development of the information society of European Union (eEurope, i2010):

- the internet indicators
    - citizens – access and usage of Internet
    - business subjects – access and usage of ICT
    - costs of Internet access
- modern public services in the Internet
    - e-Government
    - e-Education

- e-Health(care)

- dynamic business environment
  - on-line buying and selling
  - the readiness to accept electronic business activities

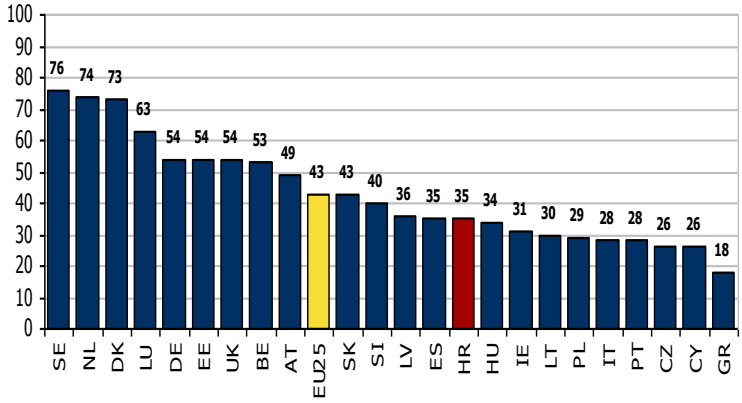

Fig.1. Internet indicator – citizens

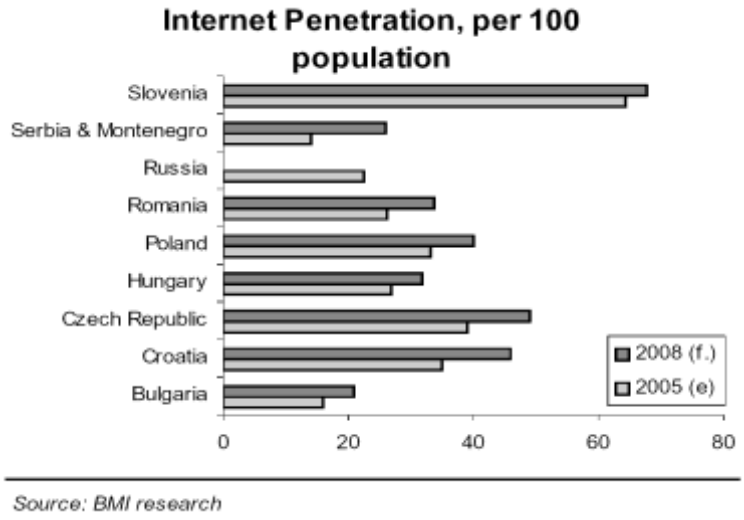

Fig.2. Number of Internet users pro 100 citizens in the region

Despite a mainly positive attitude toward it, the potentials of electronic business activities in the EU countries are not sufficiently utilized. Major obstacles to a further expansion of electronic business activities are: preference of personal communication, insufficient acceptance of electronic business activities in the area, lacking employee knowledge and their mistrust of information technologies, insufficient level of awareness of national standards, laws and regulations in connection with the electronic business activities.

- safe information infrastructure

- the experiences of Internet users with the safety of their information

- broadband
  - the indicator of the number of broadband users

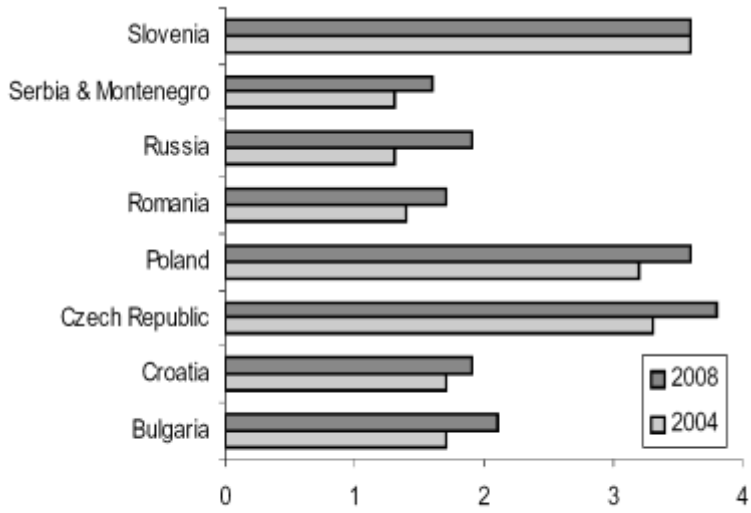

Fig.3. Portion held by information sector in the GNP (Gross National Product)

All sectors of economy depend on the information technology. The usage of information technology is the main influential factor of the efficiency of business activities, and therefore also of the growth of productivity, Figure 3. [4].

For example, Croatia needs to reform its business and administrative processes and simultaneously implement the information technologies. When it comes to information technology and its usage, all sectors of economy, excluding tourism, banking and B2B communication, are falling behind.

The size of information market is one of the factors of information society development, and thereby of the development of a knowledge society. Figure 4. [5] gives a comparative presentation of the countries in the region.

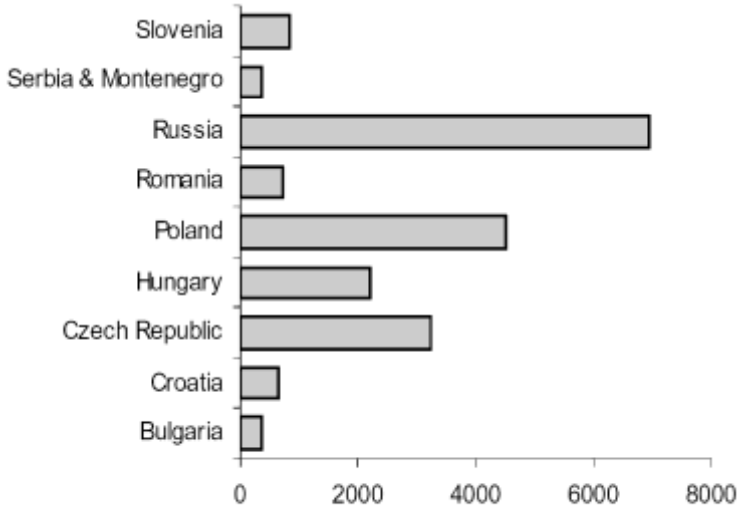

Fig.4. The size of information market

For instance, information society in Croatia is predicted to grow from 672 million US$ in 2005 to 984 million US$ by 2010. It is expected that the private sector investments in information technologies will be increased and the market will become consolidated.

4. DISCERNING PROBLEMS

Business and information systems of higher education possess certain specific characteristics, when contrasted to other business systems. These do not obtain information merely to manage the university, but to manage other components and members of the university community too. Because of the high degree of autonomy of individual components, they must be flexible enough, on account of the great range of users, they must be usable, reliable, efficient, maintainable and secure, and their use simple. However, most university business and information systems of today do not sufficiently meet required preconditions. Most frequent disadvantages are insufficient coverage of university information requirements and lack of connectivity between individual business components, as well as between its members.

Because of specific characteristics and complexity of the university business and information system, the requirements and expectations from management, administrative staff, academics and students are far more complex in comparison with requirements in other organisations, especially those profit-oriented.

Also, high levels of the independence of individual components, departments and employees within the university exercise strong influence on strategic planning of the university business and information system, as well as regular and frequent changes in university administration (the election of chancellor, vice-chancellor, dean), which entail different approaches in planning, developing, constructing and implementing the integrated business and information system.

4.1. The Subject, purpose and Goals of the SP-IBIS

Taking into account the challenges of 'the fourth era', that organisations of higher education are exposed to as well, the work effect of which also by and large depends on the potential of their information systems and their degree of integration, it is necessary to conceive and develop the IBIS strategy (as the link between academic strategy and information system and business strategy). Society as a whole and academic public in particular, expect from the university to enable achieving numerous academic, scientific, business and social goals that do not have equal importance, nor are independent.

It is the complexity of the links between goals mentioned in particular that requires specific forms of strategic conceiving, planning and managing the activities which should result in them being achieved. [6]

5. STRATEGIC PLANNING

5.1. Strategic Business Planning

Business planning determines how overall funds and resources of an individual business system will be engaged. It also determines which organizational and technical changes need to be implemented in order to realise desired goals. Plans, including those strategic, are efficient if they achieve their purpose at optimal cost, as measured by money, time but degree of employee satisfaction as well.

Even though specific steps in the formulation of the strategy are different, the overall process of business strategic planning can be, at least in terms of notions, divided into four phases, which include situation appraisal, strategy formulation, strategy implementation and strategic management.

During the overall process and within each phase, it is necessary to ensure total quality management in order for mistakes to be brought down to minimum.

Success of implementing business strategy by and large depends on plan quality, its adoption and change management – which are why strategy control is crucial. Control i.e. supervision as a function of strategy management represents measuring and correcting actions with the purpose of fulfilling organisational goals and corresponding plans. In order to reap success, it should be shaped to indicate deviations at critical points, in an objective, flexible and cost-effective manner, suitable to organisational culture, as well as to point to corrective actions. Controlling strategy means ensuring the system to achieve its goals regardless of changes in its environment – it means ensuring efficient implementation of the strategic plan and monitoring of its realisation per envisioned steps.

The complexity of strategy control stems from the fact that its results are visible but long-term, and since the very survival of the business system depends on these, it is necessary to react as fast as possible. [7]

5.2. Information System Strategic Planning

Information system of a business system is exceptionally important for its survival and business, which is why its strategic planning is as equally important as strategic planning of a business system.

Based on this premise, the development of contemporary information systems is, as can be expected, a demanding and broad organisational and financial endeavour in case of each business system, that must be strategically planned pursuant to the business strategic plan.

Information Strategy

Information strategy acts as the link between business strategy and information system strategy. It addresses the issues of which information are required and where, in order to support key, primary tasks or key goals of the business strategy. It also questions the suitability of critical assumptions in the background of the business strategy, in the context of changeable environment and perception.

It is important to discern that the influence of information technology must be appraised already when shaping long-term business strategy – and not as an independent factor when selecting the technological foundation of the information system. Accordingly, the development of information technology has but intermediary impact on IT strategies that will be selected by management in order to achieve strategic goals. Guidelines for information strategy stem from the business strategy, it being the foundation for shaping business technology and shaping the information system, which will support this business strategy.

Furthermore, the IT strategy must stem from information strategy, taking into account the nature of information technology as the technical infrastructure of business. [8]

5.3. Integrated Planning of Business and Information Strategy

In discussions on the so-called 'fourth era', where work effects of any organisation will by and large depend on the potential of its information system, the role of IS/IT is recognised as an integral role in most business processes and operations. During previous eras, strategies of the information system were directed at selecting the best cluster of IS/IT investment, and managing these investments until the successful completion of the implementation.

Depending on results gained by appraising the impact and dependency on effects of IS/IT on the business system, it is possible to determine four types of business and information systems constructed based on contemporary information technology. (1) Supporting information system that is useful but not critical as well for business success. (2) Operative information system that success of current business hinges upon. (3) Prospective information system that could impact the success of future business. (4) Strategic information system that is critical for the future business strategy.

Except for positioning the information system given its significance for a certain business system, and before the very creation of the strategic plan, it is necessary to define input and output parameters that can, as can be expected, influence the planning process of the integrated business and information system, such as: *outer business environment* (economy, competition), *inner business environment* (existing business strategy, success, goals, resources, organisational culture), *inner IS/IT environment* (existing IS/IT and the level of their inclusion in business, existing applications, maturity of the organisation, common knowledge), *outer IS/IT environment* (trends of the development of information system and technology and their use in partner organisations), *strategies of managing the IBIS* (common strategy elements for the overall organisation, ensuring consistent policy), *strategy of IBIS development* (manner in which each business function will develop and the single planned business and information system applied), *strategies of IBIS selection* (standards for the manner and procedures of

selecting and implementing IS/IT) and *approaches, tools and techniques* (formalised methods, techniques and approaches to IBIS planning). [9]

6. MANAGING HIGHER EDUCATION

It no longer seems universities are 'elitist' institutions in charge of transferring the values of rationality and intellectual rigour between generations, but are organisations that have been assigned the role of meeting the requirements of a mass audience in the contemporary industrial economy. Such a transformation from the 'Platonic academy' into a more urbane and commercial 'shopping mall' left profound consequences for the way contemporary observers portray the university.

6.1. Organization Models

The university by and large stops being an institution that serves but public good. Contemporary trends in economy and politics influenced the transformation of the university from an academic institution to a market-oriented institution, implying changes in the organisation of the University of today. The influence of the central state authority, especially that coming from the relevant ministry, is a factor that significantly impacts the type and form of university organisation, and is primarily defined by the degree of university financial autonomy and the degree of the authority of its central administration (the chancellery). Apart from this, enforced rationalisation of the administrative structure of the university additionally contributes to stronger state supervision, which still retains bureaucratic characteristics. Such an organisational form is based upon hierarchical management structure, with traces of the organisation virtual aspect mirrored in the existence of managerial teams responsible for tactical and strategic planning, which decrease the role and authority of academic councils and their influence on reaching key business decisions and creating policies. However, academic influence and the responsibility for issues of teaching and scientific research is still strictly in the hands of academics, while the responsibility for managing resources is transferred to departments, which points to larger autonomy of university management.

In contemporary conditions, the university organisation resembles more and more the characteristics of a corporative organisation, where individual departments and components are starting to be responsible for managing resources assigned to them, and are approached as cost or profit centres, especially when more aggressive approach in promoting counselling services and research results is assumed. [10]

6.2. Academic Managerialism

Attractiveness of the university concept as a corporation partly stems from the changing nature of the contract between the state and universities. In earlier times, the state was convinced universities produce students and scientific research for which, even though these do not always directly contribute to economic development, can at least be said that they add value to individual and social wealth of the country.

However, the experience of more developed countries indicates that, during the early 1980s, states started redefining their contracts with universities. By designing performance indicators, introducing external verification of teaching and scientific research, and changes in

the manner of financing the university, the state has, through the investment council, effectively created a market out of higher education that is being managed. Since then, universities must, more than before, compete for resources. Moreover, since the emphasis was placed on producing students and scientific research that have direct impact on economy, institutions, departments and individual academics were under ever growing pressure to seek financing for their work in the private sector. The intention is creating a system the goals of which can be monitored and controlled more easily, and the final products of which, students and scientific research, can be targeted more directly.

Managerialism in higher education is based on the assumption that the institution and the system it is subordinate to can specify the goals that can also contain the goals of basic units. Furthermore, it assumes that the possibility of determining and controlling the realisation of goals can be hierarchically distributed. Its moral justification is that finished products of higher education need, and sometimes must, be determined and judged by something out of its scope, from the viewpoint of social – rather than intellectual needs. It is therefore to be expected that the universities of less developed countries as well, but also all those that wish to develop and thrive, must adopt the principles of business planning, and that those that do not permanently and efficiently plan will find in time they are vulnerable to outside forces that jeopardise their existence in the final analysis. It seems managerialism is an omnipresent force at many universities of today. Universities now do not resemble the institutions of colleagues and bureaucrats of old times. Likewise, even if only because information can never be devoid of value, they neither resemble cyber models.

Insufficient resources and complex and fast changing nature of requests placed before higher education institutions imply that sound management requires different structures and styles from those that are traditionally given to academic democracy. Universities must act quickly to attract financing; they also must reach tough decisions on priorities and undertake unpleasant steps in order to control costs. [11][12]

7. IMPORTANT INSIGHTS OF THE SP-IBIS RESEARCH UNDERTAKEN WITH MANAGEMENT OF HIGHER EDUCATION INSTITUTIONS IN THE REPUBLIC OF CROATIA

The dilemma on who constitutes top management level, as viewed from the aspect of elective positions, was non-existent, so chancellors, vice-chancellors, deans and vice-deans were defined with no additional analysis as the primary respondent cluster. Taking into account the fact that the business and information system is primarily based on financial processes, and by and large relies on organization and human potential that make an important segment of strategic envisioning, it was estimated that research must also include management members in permanent positions; i.e. general secretaries and heads of finance and accounting.

The final sample based on previously stated stratification was composed using the Sumsion typology and was seen dually, through the prism of legal entities, 73 public institutions in the higher education system of university character, and 365 natural persons from stated institutions, aiming at the creation of a representative i.e. statistically significant sample. Out of 73 institutions, 45 of them accepted to participate in research i.e. 61.6%. Out of 7 chancellor offices, 6 participated in research, and out of 66 faculties – 38.

The first insight from the research conducted points to the fact that the management of higher education institutions, when it comes to strategic planning of the integrated business and information system, exhibits the greatest interest for the topic of aligning the business and academic information systems, followed by use of information and communication technology, while their interest is least directed at planning the development of the integrated information system. Even if not the highest, a significant part of management hold the influence of applying the ICT does not impact the success of their institution's current work, but that it is critical for their work and business in future.

Furthermore, most of management actually recognise ICT as a necessity for the integration with European higher education and as a necessity for implementing the Bologna process, while they recognise themselves as leaders of future projects of implementing information technology in their institutions.

The second principal insight confirms that management occupying elective positions give significantly greater importance to systematic approach to constructing IS, which includes project planning and is primarily based on getting existing processes and information flows in order, when contrasted with management occupying permanent posts who all but do not register these activities, which points to the fact that management occupying elective posts primarily see themselves and state officials from the relevant ministry in defining strategic goals of new IS is justified.

The following insight points to the fact that the planning mechanism for investments into IS/IT in larger universities is represented more than in smaller universities. As viewed from the aspect of financing source, it can be said most money from the state budget is spent on IT equipment, followed by system and application programmes and training IS/IT users. Speaking of own revenue as financing source, means are equally distributed to all parts necessary for the construction of the information system. Also, results received point to the fact managers' opinion, in case of those occupying elective posts, is significantly more represented in decisions connected to the issues of implementing information technology in their institutions, when contrasted to those managers occupying permanent posts, the reason for which should be sought in their disproportionate representation (2/3 in contrast to 1/3), but in sufficient levels of required knowledge as well, for which it was established they do not possess.

Speaking of the perception of expected results, elective management significantly recognise shortening the time intervals for reaching business decisions as one of the results of implementing information technology. Also, they are more skilled in computer use in comparison to permanent management. The frequency of computer use in everyday work in both respondent groups is at an enviable level, even though it is still mostly at an operative level according to the opinion of a decisive majority.

Analysing the previous insights in a complete manner, it can be said strategic conceptions of the utilisation of information sources are significantly more present on larger universities than in smaller ones, which implies the assumption that management of larger universities are more inclined to strategic planning of integrated business and information systems.[13]

8. CONCLUSION

The principal insights point to the fact that higher education institution management, speaking of strategic planning of the integrated business and information system, exhibit the greatest interest for the topic of aligning the business and academic information systems. They hold that the impact of implementing ICT is critical for their work and business in future and necessary for integrating with European higher education. Further, gained results point to the fact that elective post managers' opinion is significantly more represented in decisions connected to the issues of implementing information technology in their institutions, in contrast to those managers occupying permanent positions.

REFERENCES

[1] http://ec.europa.eu/information_society/eeurope/i2010/index_en.htm, 03.05.2010.

[2] http://www.e-hrvatska.hr/, 03.05.2010.

[3] http://www.e-hrvatska.hr/, 03.05.2010.

[4] http://www.idccroatia.hr/, 03.05.2010.

[5] http://www.idccroatia.hr/, 03.05.2010.

[6] Anderson, R.: Implications of the information and knowledge society for education, Springer, International Handbook of Information Technology in Primary and Secondary Education, 5-22. (2008)

[7] Reich, B.H. & Benbasat, I.: Measuring the Information Systems – Business Strategy Relationship. In: Galliers, R.D. & Leidner, D.E. (eds).: Strategic Information Management: Challenges and Strategies in Managing Information Systems. Elsevier Butterworth-Heinemann, Oxford. (2000)

[8] Lederer, A.L. & Burky, L.B.: Understanding top management's objectives: a management information systems concern, Journal of Information Systems, 49-66. (1989)

[9] Nelson, K.M. & Cooprider, J.G.: The contribution of shared knowledge to IT Group performance, MIS Quarterly, 409-432. (1996)

[10] Tiwana, A.: The knowledge management toolkit, (2nd ed.), Prentice-Hall PTR, New Jersey, 24-32. (2002)

[11] Baranović, M. et al.: Higher Education Information System, Croatian Ministry of Science, Education and Sports, Zagreb, Croatia, 15-17. (2003)

[12] Webster, F.: Theories of the information society, (2nd ed.), Routledge, London, 32-46. (2002)

[13] Luić, Lj.: Strategic Planning of Integrated Business-Information Systems - Model Design Example of Higher Education, Doctoral thesis, University of Zagreb, Faculty of Humanities and Social Sciences, Croatia, Zagreb. (2009)

Organizational readiness for CRM software implementation

Miodrag Ivković[1], Dušanka Milanov[2], Branko Markoski[1]
[1]Technical faculty "Mihajlo Pupin", Zrenjanin
[2]Faculty of sciences, Novi Sad

Abstract: **Customer relationship management is one of the fastest growing processes of the modern economy. Altough many companies implement CRM solutions, the case is that such projects often have high failure rates. This paper describes key factors that influence the failure and also crtieria for organizational readiness for implementing CRM solutions. It also presents the results of the research that was carried out in 15 firms to assess current situation when it comes to organizational readiness for CRM software implementation in Serbia.**

1. CRM SOFTWARE IMPLEMENTATION

The essence of modern marketing and successful business lies in satisfying customer's needs in a better way than competitive companies do. That makes customer relationship management one of the most important processes in today's market and can lead companies to desired long-term results. CRM business strategy is based on the use of information and communication technologies in order to give the companies wide, reliable and integrated view of their customers, by using techniques and processes for gathering information to help estimate different strategic options. Implementation of CRM strategy is based on precisely defined procedures and modern technologies, with professional and educated staff capable to manage those procedures.

CRM technology consists of these following elements [2]:

- Procedures – provide efficient execution of transactions, with prerequisite that company has implemented appropriate management standards for process definition;
- Databases – management of customer relationships depends on the information that company has about clients, therefore the storing and connection of the data is crucial;
- Call centers – one of the most efficient communication channels from customer's point of view;
- Reporting – uses and analyzes customer data in order to get information needed for decision making processes, as for the tracking and retention of customers.

CRM software was originally created to support company's sales department and its related processes. Today, along with other software modules like ERP (Enterprise resource planning) applications, it has evolved in one integrated solution for managing all kinds of business data. Advantages of using such solutions are [2] (1) having a consistent business solution which connects front and back office applications, (2) effectively controlling the costs and duration time of implementation project.

According to [4], current CRM solutions can be:

- CRM Point Solutions – applications created for some business areas or market segments (e.g. small businesses);
- CRM Suites – software packages created for managing client interaction;
- Enterprise Application Suites - complete information systems with embedded CRM software.

Structure of CRM software is made out of three components [3]:

- Operational CRM – part of CRM software which supports and automates business processes related to customer interaction (call centers, direct sales, internet marketing); information for every interaction is stored in database so that complete customer profile is always available;
- Collaborative CRM – a CRM component that supports exchange of customer information through different company sections in order to improve customer satisfaction and loyalty;
- Analytical CRM – component which should give insight in customer's needs, allow customer segmentation and numerous analysis regarding their behavior, all based on information stored in company databases; this is the most complex component of CRM system which helps creating unique and complete customer profile using detail data analysis and expert knowledge.

2. PROBLEMS IN CRM SOFTWARE IMPLEMENTATION

Competitive market in today's modern economy contributed to CRM development and investments in its strategies, tools and infrastructure. Although these investments are one of the biggest in the market today, studies show high failure rates when it comes to implementation of CRM solutions. From user's point of view, there are up to 50% unsuccessful implementation projects [9].

According to gathered experiences, one of the main reasons of failure is lack of strategic planning which has to precede implementation itself; others include lack of organizational integration and customer orientation, technological problems and often poor design and planning. Big barriers can be unclear goals, collecting wrong customer data, misuse of technology tools as well as inability to integrate people and processes.

According to [1], seven most common mistakes that can lead to unsatisfying outcome are: (1) observing CRM initiative as purely technological; (2) lack of customer oriented approach; (3) underestimating the importance of customer "life cycle"; (4) inadequate support of company management leaders; (5) neglecting the importance of change management; (6) unsuccessful representation of business processes, and (7) underrating the difficulties related to collecting and integrating customer information.

Successful implementation of CRM program depends on four critical factors [5]:

1. Organizational readiness of a company – includes overall analysis of company development according to relevant criteria;
2. CRM change management – refers to strategic and organizational changes to come;

3. CRM project management – refers to staff support and dedication to project necessary to manage customer oriented CRM systems.

Accordant to Global Competitiveness Report [10], for the past few years Serbia was ranked around 90th place among 130 countries, regarding CRM development in national economy. It shows that business strategies and quality of business environment have to be adopted to a greater extent. Although CRM technologies are more and more present in Serbian market, and there are number of companies offering CRM solutions, they still aren't widely present in majority of small and medium enterprises.

Statistical office of the Republic of Serbia published the study regarding usage of ICT's in 2009. The data shows that 10.1% of enterprises uses CRM software for analyzing customer information for marketing support, and 12.9% uses it for collection, storing and sharing customer data. Analyzing enterprises based on their size gave following results:

- 36.8% of big companies has CRM software;
- 26.1% of medium enterprises implemented CRM solutions, and
- 10.2% of small enterprises have this program.

Analyzing companies based on their field of business shows that banks and insurance companies use CRM the most (71%), followed by companies from traffic and communications sector (24.8%).

Every company strives to one goal – identify and retain customers and make higher profit. CRM can help achieve that goal, but often the most important question is overlooked – is CRM for every company? This paper describes organizational readiness as one of the most important criteria for successful CRM implementation, as well as its application in small enterprises in Serbia.

3. ORGANIZATIONAL READINESS FOR CRM

One of the common mistakes when it comes to CRM implementation is thinking that any company can introduce this strategy and immediately expect good results. The fact is that some level of organizational readiness has to be present. That can be estimated based on five criteria described in this section.

3.1. Estimating the readiness (K0)

According to numerous research studies, if the company's business processes satisfy majority of the following claims, K0 criteria is fulfilled and CRM implementation can be considered:

- There is a large number of people in sales and service department in direct contact with customers (more than 10);
- Environment is very collaborative, i.e. customer interaction requires data from different departments;
- Company products are very complex and require a high degree of customization and personalization;
- Customer relationships are very important in terms of making profit;
- Company has a large number of customers;
- Customers can communicate with the company through different channels;

- Communication with large groups (or all customers) are frequent and across multiple channels;
- There is a need to personalize the communication with customers using these channels.

The goal of this analysis is to clarify the situation of the individual company, and not to specifically place it in a category based on mathematical precision. If more than 3 claims are true, company can begin implementation of the CRM project. Otherwise, some simpler solutions should be considered, e.g. contact managers.

3.2. Customer maturity (K1)

Customer oriented company approach shows if and to what degree has company evolved from product-based to customer-based model. Most of the companies have data which shows the costs of making and shipping of certain product, as well as the overall income related to sales. However, customer data are often neglected, and in those cases following should be taken into consideration:

- Customer segmentation;
- Comparing certain processes to competitive;
- Talking to existing customers;
- Identifying the most profitable customers;
- Identifying the reasons of losing old customers;
- Promptly answering customer questions.

3.3. Process maturity (K2)

Effort that companies put in CRM implementation is directly related to process maturity in sectors of sales, marketing and customer support. Customer support and order management are, by definition, more process oriented because of the nature of job itself (tasks and goals that are measurable). On the other hand, sales and marketing procedures are not so mechanical and well defined so there is a great possibility of improving the flows of business processes in these sectors. According to [8], software process maturity levels can be applied to identify and define organizational process levels:

1. Initial level: Process improvement is not possible until it is under statistical control; there are various stages of control and the first includes achieving basic predictability of schedules and costs.
2. Repeatable level: The organization has achieved stable processes with repeatable level of statistical control by including strict commitment, cost, schedule and change management.
3. Defined level: The organization has defined processes which became the base for stable implementation and better understanding; at this point, advanced technology can be introduced.
4. Managed level: The organization has laid the foundation for continuous improvement and optimization.

In order to evolve when it comes to process maturity, the organization should try to:

- Define the sale cycle duration time;
- Define the delivery duration time;
- Improve the quality of answering customer's first call (first call resolution).

3.4. Information system maturity (K3)

By developing customer relationships and processes, the company also evolves when it comes to (information) systems:

- Transactional systems evolve from simple automation to modules with the same interface;
- ERP systems enable modeling and automation of many basic processes;
- Decision support systems are becoming part of business processes.

3.5. People / motivational maturity (K4)

People are a driving force of the company; they make processes and systems possible. They are not going to take CRM philosophy spontaneously but have to be motivated to embrace new technologies. Motivational psychologist Maslow explained in his "hierarchy of needs" triangle how motivation is based on personal and environmental prerequisites. This can be applied to create hierarchy of needs necessary to accept CRM. The idea of this theory is that people would be more motivated if: (1) their job description is relevant related to CRM; (2) they are satisfied with the job; (3) there is optimal work environment; (4) their job position is secured.

4. RESULTS OF ORGANIZATIONAL READINESS RESEARCH

During 2010. the research was conducted in 15 Serbian companies regarding their current status and readiness to implement CRM. It included 8 enterprises from Belgrade, 5 from Vojvodina and one from Svetozarevo and Gornji Milanovac. Results of their K0-K4 criteria fulfillment are given in this section.

K0 criteria: Organizational readiness to implement CRM solution was present in 10 enterprises and they were later asked about fulfillment of other criteria. Their answers regarding organizational readiness are given in Figure 1:

Claim	YES	NO
There is a large number of people in sales and service department in direct contact with customers (more than 10)	3	12
Environment is very collaborative	6	9
Company products are very complex and require a high degree of customization and personalization	2	13
Customer relationships are very important in terms of making profit	14	1
Customers can communicate with the company through different channels	11	4
Communication with large groups (or all customers) are frequent and across multiple channels	4	11

There is a need to personalize the communication with customers using these channels	4	11
Company has a large number of customers	15	0

Figure 1. Results of the K0 criteria fulfillment

K1 criteria: Customer maturity assessment should answer the question if there is unique customer identification between at least two of the following systems: sales, acquisition, payment, support. Results are that 5 companies have unique identification and 5 do not.

K2 criteria: This answer should define if the company achieved process maturity of level 2 (stable processes with repeatable level of statistical control); the answers are given according to sectors:

- Marketing: YES – 3, NO – 7;
- Sales: YES – 7, NO – 3;
- Acquisition: YES – 7, NO – 3;
- Payment: YES – 6, NO – 4;
- Support: YES – 1, NO – 9.

K3 criteria: Information systems maturity gives answers to the following questions:

- Is there a database that connects customers and products?
  YES – 7, NO – 3;
- Are sales and ordering processes connected, i.e. there is no double entry of the data?
  YES – 6, NO – 4;
- Is customer support process related to either one of the sectors of sales, ordering and payment?
  YES – 2, NO – 8.

K4 criteria: Assessment should answer the question if company staff is motivated enough to embrace CRM concepts and tools and is CRM generally important for their jobs. Results are: YES – 8, NO – 2.

Score and conclusion:

- 1-7 points:
  Company is still not ready for CRM because of poor customer, process and systems maturity. It would be more useful to concentrate on process improvement using simpler tools.
- 8-14 points:
  Company is ready for CRM but is on medium stage of customer, process and systems maturity. That means it should be invested in further development and expected results will be tangible after few years.
- 15-21 points:
  Company is fully prepared for CRM implementation in every way, even when it comes to people working there. Here CRM can be considered as a logical extension of company evolution and results can be expected in one to two years.

While making assessment of the results, it should be noted that the research was conducted on a small sample and for the purpose of student practice and experience gain. However, some basic and general conclusions can be made based on this research sample. The results showed

that 2 of the companies are completely ready for CRM implementation, 4 of them are also in position to consider it but with constant investments in organizational develompent, and the last 4, mainly because of poor process definition and infrastructure, have to seek some simple solutions for now.

Further research in this area should include bigger relevant sample and cooperation with software companies that develope these solutions, as well as with companies that have already implemented them, in order to determine more precise criteria regarding organizational readiness. It is also possible to conduct further research of relevant samples in the commercial sector and make appropriate statistical analysis of acquired results.

5. CONCLUSION

Customer relationship management combines business strategy and existing technology in order to identify, attract and maintain long term customer relationships; it gives new values created as a result of interaction between business organization and its customers. CRM demands knowledge of strategic management and internet technologies that should provide new possibilities for identifying, forming and preserving profitable customer relationships.

CRM is not for every company and therefore assessment of customers, processes, infrastructure and employees has to be the first step towards implementation of the new solution. During this research it became clear that members of the staff and even executives in most cases think that CRM is just a software needed for process automation. Having this in mind, conclusion is that education of the employees in small and medium enterprises is one of the first and very important steps necessary for CRM acceptance, followed by organizational and technological improvements.

REFERENCES

[1] Bryan Foss, Merlin Stone, Yuksel Ekinci, What makes for CRM system success – or failure?, Palgrave Macmillan, 2008.

[2] Francis Buttle, Customer relationship management, Elsevier Ltd, 2009.

[3] William G Zikmund, Raymond McLeod, Faye W Gilbert, Customer relationship management, Leyh Publishing, 2003.

[4] Jill Dyche, The CRM Handbook :A Business Guide to Customer Relationship Management, Addison-Wesley, 2002.

[5] Michael Gentle, The CRM project management handbook, Kogan page, 2003.

[6] Patricia Sorce, Relationship marketing strategy, Rochester Institute of Technology, 2002.

[7] Sundip R. Doshi, CRM:The key to superior business performance, Montgomery research, 2008.

[8] Humphrey Watts, Managing the software process, Addison-Wesley, 1995.

[9] http://www.gartner.com

[10] http://www.weforum.org

Rationalization in Teaching Informatics using Multimedia Educational Software

Dijana Karuović, Dragana Glušac, Dragica Radosav
Technical Faculty "Mihajlo Pupin"
Djure Djakovica bb, Zrenjanin, Serbia
glusacdragana.zr@gmail.com

Abstract: **At Technical Faculty "Mihajlo Pupin" in Zrenjanin in subject Projecting of educational computer software much software are developed as additional literature in the teaching of IT. Motives for the creation of educational software in teaching informatics reflected in the fact that computers are an important part of modern society, knowledge of computers is economically justified, educational software enriching the teaching of informatics, so that the study of many areas of teaching becomes interesting and effective. The paper presented some of the software realized for the needs of IT in primary and secondary schools.**

Keywords: **educational software, tutorial, teaching, informatics**

1. INTRODUCTION

To gain access to user interface design of multimedia educational software (MES), it is necessary to understand the methodology of design. In this regard, it is necessary to choose a good team that will create the software, and it includes experts in the field which is processed in the software, IT professionals, educators, top designers...

At Technical Faculty "Mihajlo Pupin" in the subject Projecting of educational computer software for various types of users has been realized. The results of project [1] were educational software that has been donated to the elementary and secondary schools in Zrenjanin municipality.

2. EDUCATIONAL SOFTWARE

Each educational software must meet certain criteria relating to: design of the screen (a screen should not contain too much information and new concepts, should not appear overly colorful and clutter the screen by images, text, animations, which can be distracting user but at the same time need to be interested), exposure to substances should be adapted to a given range of users (by content, and visual), content must be adapted to the computer literacy of users (no extra information in terms of the vast and lack of clear navigation).[2]

A quality educational software must include easily accessible Help, navigation buttons should be placed always in the same spot, so the user have no need to search them on the screen, must provide feedback, may not be linear organized, must allow the user to "jump" and self-selection of content with a large number of simulations and software components in which

the user, independently, changing the various parameters will be involved in the creation of content and run conclusions.

The advantage of educational software is that they allow individuality in learning, in the sense that the user chooses the order of the adoption of content and time for testing knowledge.

Further, for example, the user may, during the adoption of content, at any time, if had same questions, through links, "went" on the screen on which an unknown concept clearly processed and by its clarification, "return" on adoption of content. Educational software provides an opportunity for individual progress even in the traditional classroom teaching. This is very important for talented students who will not have to "wait" other students, but will advance faster than others. Similarly, this principle enables distance learning because students can adopt the contents from their house which were prepared by teacher. Teachers can easily evaluate students' knowledge. Necessary part of educational software is a quality test or a game which checks students' knowledge. Students may solve tests several times, and teachers will simply walk through the classroom, review tests and evaluate their knowledge.

The disadvantages of such software are inadequate training of teachers for the use and development of educational software. Also, expensive technology and insufficient financial strength of our schools to introduce these, methods of work may pose a serious problem. Furthermore, the problem is in the content, too. Who and how the materials are presented have to be checked. These shortcomings can be successfully solved very easily by all, forward, listed advantages.

2.1. Educational Software Design

Any educational software must be realized according to the following stages, [3]: selection of content that will be presented on a computer, gathering the necessary literature and material in print and electronic form, processing of materials and design (preparation for programming), programming, evaluation of educational software (testing and updating), creating program documentation (educational software catalog).

In the design of user interfaces for the presentation of educational content as part of educational software the following is necessary to examine: the ability of users, experience in the design, including research and development, methods for content presenting on the computer, interaction and communication, validation by the user and test performance.

2.2. Educational Software Evaluation

Evaluation of educational software is very important and not an easy task. There are several techniques for educational software evaluation. During the process of educational software evaluation should be considered two aspects: the technical issues of the software, and educational characteristics of the software. Evaluation methodology that was developed within the project Ermes [5] is to identify the characteristics of educational software that are classified into the following categories: educational characteristics, technical features, usability and content.

These categories can be divided into sub-categories. For example, educational characteristics consider: user types, pedagogical characteristics...

The evaluation process involved: users (evaluate: quality and content presentation, user interface, interaction types, knowledge testing), teachers (evaluate: content quality and compliance with material and age of users for which the software is created), parents (can

independently evaluated software for their child) and administrators (evaluate: technical features, errors in software...).

In the process of evaluation, these participants may indicate the advantages and disadvantages in other categories, although they are not specialized in them. For example, user can indicate an error in the software and warn administrator.

Furthermore, categories present during the evaluation of MES are: way of presenting learning materials, multimedia elements as carriers of information, user interface, interaction types - how the user uses the information (multiple choice, answering questions, establishing a feedback ...), ways of giving instructions.

3. EDUCATIONAL SOFWARE CREATED AT TECHNICAL FACULTY "MIHAJLO PUPIN"

At Technical Faculty "Mihajlo Pupin" in Zrenjanin in subject Projecting of educational computer software and Multimedia Systems, students adopt the basic concepts of development of MES. At the end of semester students have to develop its own application. All software is, technically, perfectly made and can be classified into several categories. There are software related solely to the material, which includes processing of one teaching unit or theme related to a course within an academic year or completely. In its collection Technical Faculty "Mihajlo Pupin" has (in the category of software that handled a teaching subject):

1. For the course geographic: "Egypt", "France", "Italy", "Greece", "Australia", "Dominican republic", "Hungary", "Czech Republic ", "Switzerland", "Earth's spheres", "Volcanoes and earthquakes", "Deserts",...
2. For the course mathematics: "Linear Equations", "The basic functions of mathematics", "Prism and pyramid", "Pyramid in geometry", "Addition",...
3. For the course physics: "Conservation laws", "Newton's laws", "Motion and force", "Nuclear Energy"...
4. For the course history: "History of Rome", "Ancient Egypt", "Battle of Berlin", "Serbian Empire",...
5. For the course biology: "Skeleton of Man" "Respiratory System", "Insects", "Marine Mammals"...
6. For the course Serbian language: "The Words Types", "Phonological Development", "Comparison of adjectives ",...

There are, further, software for elementary or secondary school, related only to material that is processed in the schools:

- "Environment and Society for grade III",
- "Physics for class VIII",
- "Serbian language and literature for high school grade III",
- "Teaching art for high school grade III",...

The software that are educational but not related to the curriculum of primary and secondary schools, are also interesting: "Cats," "School shooting", "Traffic signals", "History of Music "...

There are general type software like: "National park Đerdap", "Vojvodina Museum", "Solar Energy", "Fruška Gora Monasteries", "Railroad History", "Secrets of the Universe",...

At Technical Faculty “Mihajlo Pupin” in Zrenjanin, the entertainment software type are realized, too: “It’s all about jazz”, “Samurai Way “, “Predators”, “Boonton”, “Parachuting “, “Flowers”,...

There is a lot of software for the youngest users: “My family”, “Funny mathematics”, “Fairytales”.

Fig. 1. Part of the educational software “Fairytales”

Educational simulation type software has the largest values. For example, users had to create their own circuit, and each wrong step is a sign to exit the program. Such software are the most important in areas at risk and where we are not able to really experiment. They represent a huge financial savings, and users are given the opportunity to virtually experiment without fear that their experiment could threaten someone. Such experiments enable us educational software: “Electrical installation”, “Electric power “.

4. EXAMPLES OF EDUCATIONAL SOFTWARE IN TEACHING INFORMATICS

Software in teaching computer science, which were implemented in the form of seminars and dissertations as part of the subject educational computer software at the Technical Faculty "Mihajlo Pupin" can be classified into several categories. Software requirements in the use of educational software includes running on platforms Windows 9x, Windows NT, Windows 2000, Windows Me i Windows XP.

Developed software meet the needs of teaching information technology in all 4 grades of high school and these software covers the entire curriculum in one school year. Software covering only a teaching unit were also developed:

- "Algorithms",
- "Microprocessor Architecture",
- "Hard drives",

- "PC Hardware",
- "Internet technology" ...

Fig. 2. Part of the educational software “Algorithms”

Tutorials are the special group of educational software developed at Technical Faculty “Mihajlo Pupin” in Zrenjanin: “Tutorial for 3D Studio MAX”,” Tutorial for Macromedia Director “,” Tutorial for Delphi”...

Fig. 3. Part of the educational software “Delphi tutorial”

There are simulation software, too: “The architecture of computer systems”, “Computer Systems”, “Microprocessor Architecture“...

Another division of computer software in teaching could be made on the basis of subject matter, the software that handled software and hardware educational software.

Fig. 4. Part of the educational software "Comp. architecture"

5. CONCLUSION

Modernize teaching means rationalize the conduct of the teaching process, make the work more efficient, align it with modern technological needs of society.

There is a need to adopt the concept of e-teaching in our society, which has already reality in the countries in the region. Providing the opportunity for children to use modern technology in the form of educational software in teaching from the earliest period of his education make great strides to prepare youth for active continuous self-education in the future.

Of particular importance in the design and evaluation of MES are a way of presenting learning materials, multimedia elements as carriers of information, user interface, forms of interaction - the way users use information (multiple choice, answer questions, establish a feedback .. .), ways of giving instructions.

Educational software should enable users to manage the process of learning, to adapt their learning abilities and needs, to better and easier learn lessons and to apply the acquired theoretical knowledge in practice.

REFERENCES

[1] Projekat IT.1.22.3215.A, Ministarstvo za nauku i tehnologiju Srbije, 2002-2004. Sistem učenja na daljinu baziran na Internet tehnologijama uz korišćenje multimedijalnih obrazovnih softvera,

[2] Nadrljanski, Đ.: "Obrazovni softver - Hipermedijalni sistemi", Tehnički Fakultet "Mihajlo Pupin" Zrenjanin, 2000.

[3] Radosav D: Obrazovni računarski softver i autorski sistemi, Tehnički fakultet "Mihajlo Pupin" Zrenjanin, 2005.

[4] dr D., Radosav, D., Naumov: Multimedijalne enciklopedije i obrazovni softveri, Zbornik radova XVIII međunarodnog simpozija Informacione i komunikacione tehnologije u Sarajevu, 26.-28.11. 2001., str. 27-33

[5] Giovanna Avellis, Anthony Finkelstein: How to Annotate Educational Multimedia with Non-Functional Requirements, Educational Technology & Society 5(2) 2002 ISSN 1436-4522, pp.119-127

Security Threats and Methods for Web Forms

Zlatko Čović[1], Biljana Radulović[2]
[1] Subotica Tech – College of Applied Sciences/Department of Informatics
Marka Oreškovića 16, 24000 Subotica, Serbia
chole@vts.su.ac.rs
[2] Technical Faculty "Mihajlo Pupin"
Djure Djakovica bb, Zrenjanin, Serbia
bradulov@tfzr.uns.ac.rs

Abstract: **This paper delivers some basic information about the security of web forms from web bots (robots). Possible threats are described and the article gives a list of some methods which can be used to protect web forms. The emphasis is on the CAPTCHA (Completely Automated Public Turing test to tell Computers and Humans Apart) method that is most often used method. At the end of paper you can find one implementation of security methods using PHP and MySQL technologies.**

Keywords: **captcha, form, security, web bots**

1. INTRODUCTION

This paper offers some basic information about the security of web forms. The second part of the paper explains the notion of web bots, their division and possible threats. Following that some methods of protection against web bots will be named, while the fourth section describes the technique of web forms focusing on the Captcha (Completely Automated Public Turing test to tell Computers and Humans Apart) method. Section five deals with the limitations of the application of the Captcha method. The seventh section gives information about Captcha implementations. A way to avoid these methods is described in the last section of the paper.

2. WEB BOTS

Internet bots, also known as web robots or simply bots, are applications which start automated processes via Internet. In most cases, bots execute simple structured repeating tasks. These tasks are executed many more times than an average human is capable of. Bots are used when collecting and feeding data from the Internet. In this process automated scripts seek, analyze and file information from the web server.

2.1. Type of Bots and Possible Threats

Bots can be implemented in situations in which answer sending is very important, for example, gaming bots, auction-site-robots and chat bots. In these examples bots have to send faster answer than man.

The biggest usage of bots is on web pages which contain forms to enter and send data. Web forms of user registration, blog services, comment sending, voting, polls, guest books, contact forms, web shops and other. A simple guestbook can become a real nightmare for webmasters.

Bots analyze (x)html code of web page searching for data in the form. The important data are the name of the input fields and main attributes of the form (method and action). After getting these data, bots create random values for input fields. They send them to the address that is found in the action attribute. In this way they load the database with undesirable data. If the web server has a rather weak performance, bots can admit disaffirmation of web server, which cannot accept and execute large number of requests

Web bots are used for providing information of e-mail addresses from web sites. There are called e-mail bots.

These bots utilize errors which often appear in the process of web design, when web designers put the e-mail addresses on a web page as plain text or as a content of href attribute of (x)html tag <a> like web@web.com.

The other application of e-mail bots is with web sites which offer the opening of free email accounts. Bots use the afore described process analyzing the form and registering a large number of free account which can later be used for sending spam messages (spam bots) [2].

3. METHODS OF PROTECTION

3.1. The Image Method

With this method the e-mail address is shown through an image, mostly in gif or png format. To enable the sending of an email by a click on the image it is necessary to create a script on the server side which shows the contact form to enter the contents of the email. After entering the content the form is sent to the address which is fed on the server side, and by this, invisible to the client side, as well as not accessible for bots.

3.2. Method of Replacing AT and DOT

The method is applied with captions on the screen, where the @ sign is replaced by the letters AT and the sign for a full stop is replaced by the word DOT [2]. To make it more difficult to read the e-mail address, spaces are placed between the words. For example:

```
something@something.com se is replaced by
something AT something DOT com
```

Bots which have more developed algorithms are capable of finding the email address which a great degree of exactness.

3.3. The JavaScript Method

There are several ways of hiding the address from JavaScript on screen, but the idea is the same, namely to break up the e-mail address to several parts which will be connected again from the JavaScript code. The lack of this method means that the e-mail address is available only to surfers who have the JavaScript supported within their web browsers.

Example of JavaScript method of hiding the e-mail addresses:

```
<script language="JavaScript" type="text/javascript">
  <!--
    var string1 = "something";
    var string2 = "@";
```

```
  var string3 = "something.com";
  var string4 = string1 + string2 + string3;
  document.write("<a href=" + "mail" + "to:" + string1 +
    string2 + string3 + ">" + string4 + "</a>");
//-->
</script>
```

Listing 1. JavaScript method of hiding the e-mail addresses

4. FORM PROTECTION

The greatest danger from bots is the unmonitored usage of forms. Mostly these are forms to enter some data (user registration, giving comments ...). For the protection of such forms web programmers apply several techniques. Each of these techniques is based on a single fact: humans can read, the PC cannot.

4.1. The Random Numbers Method

Besides the standard entry fields, the form for entering data has several fields where the user can enter the results of some arithmetic operations. The caption with such a field could be: "Enter the sum of the numbers A and B" where A and B is randomly generated numbers. If the user does not enter the correct sum, the data are not sent for further processing. It would be helpful if the operation too could be randomly generated.

The advantage of textual interpretation of the task is a good solution because it requires the creation of universal bots which could be capable of 'answering' the majority of world languages and include a dictionary for each of them.

4.2. The Contact Form Method

In order to avoid the direct writing of the email address on a web site, it is possible to create a contact form. This form has a field for entering the name, e-mail address and a message of the user. The data are sent in script which is carried out on the server side. The script accepts the data, checks if the request is valid i.e. if it came from the contact form, and with the help of a built-in function (in PHP mail function) sends the letter to the owner of the website.

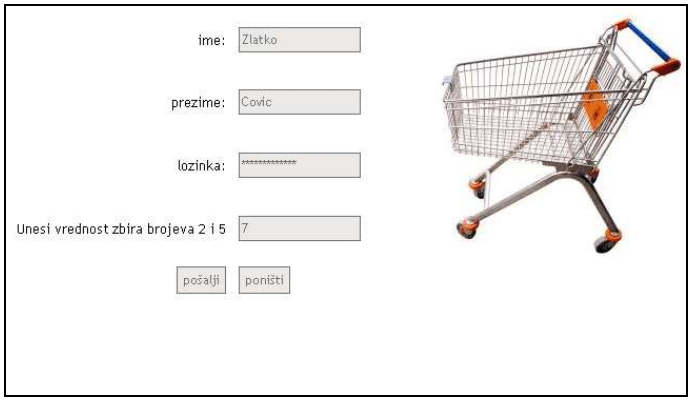

Fig. 1. Use of the additional field for entering the sum

4.3. The security code method

Web bots are scripts driven by the PC. Unlike the human eye, bots do not have the possibility of visually viewing the web form. This advantage has to be made use of when projecting the security of the form. The easiest form can be described as follows: the web form contains an entry field for entering the security code from the picture. The code on the picture is a randomly generated number. In the case of an incorrect code the script does not process the data and redirects the user to a page to re-enter the newly generated code.

Fig. 2. shows an example of the use of the security code method on the site of 'Gmail' when registering a new user. This technique is the most popular and most widely used with web programmers of today. This method is called Captcha.

Fig. 2. Application of security code on the site of www.gmail.com

4.4. The Captcha method

Captcha is short for "Completely Automated Public Turing test to tell Computers and Humans Apart " – the acronym also reminds one of the term "to capture". This term was defined in the year 2000 by the experts Luis von Ahn, Manuel Blum, Nicholas J. Hopper of the Carnegie Mellon University, and John Langford from IBM. The Captcha technology enables the differentiation between the user demands of humans and the computer generated demands on the web.

This technique is a simple verification system consisting of the following:

1. computer generated images with security codes of numbers and letters. In most cases the .png, .jpg and .gif image formats are used which have a background image. On the background image there are lines and circles. The signs in the image are distorted and show in different colors.
2. the fields on the web forms for entering the code are generated images
3. program server script, most probably written in PHP programming language which checks the validity of the entered code.

When the user enters the code from the image by clicking on the 'submit' button, the data are sent to the server script. The script accepts the data and checks the validity of the entered security code. If the expected code is entered, the user is redirected to the protected web page, otherwise he is redirected to the form again. The form generates a new image with a new security code, expecting the user to enter the correct code.

Fig.3. shows various examples of Captcha images on different web sites.

	www.yahoo.com When registering a new user
	www.pogodak.rs When adding a new record

Fig. 3. Examples for application of the captcha method

The greatest level of security is reached when the signs in the image are shown deformed, twisted with a background images or in color. The background image has to contain curves which partly cover the code or text generated within the image. Showing signs in one line ought to be avoided.

The server script has to use sessions and for the period of the variable session set up an encrypted security code and encrypted data of the user's web browser and IP (Internet Protocol) address. After receiving the data from the form the server script compares the entered value with the value from the variable session. It also checks the IP address from which the request came and the web browser type. An example of a created image with text can be seen in Fig. 4.

Fig. 4. Generated image with text

4.5. Ez Gimpy

Yahoo's system for web form protection is called EZ-Gimpy. Gimpy is based on the recognition of words shown in a chaotic order. The task is to identify three words of the circa seven words shown in the incorrect order.

It is not known to the wide public that the Gimpy has been busted, computer programs have been developed that can recognize text in its images with a 92% correctness. Still, they are not used because instead of developing such computer programs it is much easier to just select another web site which does not use such protection.

Fig. 5. Example for the Ez-Gimpy system

5. LIMITATIONS OF THE CAPTCHA METHOD

The Captcha method is based on reading text or some other function of visual monitoring. This poses a problem for blind users, users with weak eye sight, or people who have a difficulty differentiating between colors to enter such protected pages. The alternatives are found in the field of speech recognition of the security code. The form next to the textual field for entering the code has the option of listening to the audio file of the generated code. Such types of forms are used more and more. An example for such an audio file can be seen on the page www.gmail.com when registering for an email account.

6. HOW TO BEAT THE CAPTCHA METHOD

Although this method is portrayed as the ideal solution to web protection from bots, the human factor of carelessness can diminish this aspect of protection.

6.1. Session ID

Web programmers forgot one important detail when they try to implement Captcha method on their web sites. It is about session ID. How does the session work?

When the user sends a request to the web server, the web server recognizes this new request and starts a new session. When the session is started, the web server assigns a unique ID which is sent to the client. Session ID is usually kept in the form of a cookie on the client's computer. The client's computer forwards that ID to the web server every time when the web browser requests a new page. The server uses this ID for getting all data registered to a session [4]. When the sessions are closed, all session data are deleted, Fig.6 represents the interaction between the client and web server during a session launching and using variables connected to the session.

Usage of session variables in PHP happens in three steps:

1. Session launching with *session_start()* function
2. Registering session variables
3. Usage of session variables

This mechanism is used by most programmers, but for the Captcha method it is vital to set an expiration time for the session. Session duration may vary from server to server. The problem with the Captcha method is that after input of security code, the session variable is not destroyed, it remains live until expiration. An additional failure in this method is that the security code in session variable is not sent in encrypted format, but as plain text. With the renewed usage of session ID of a known code from the image it is possible to create an automated request to the web form.

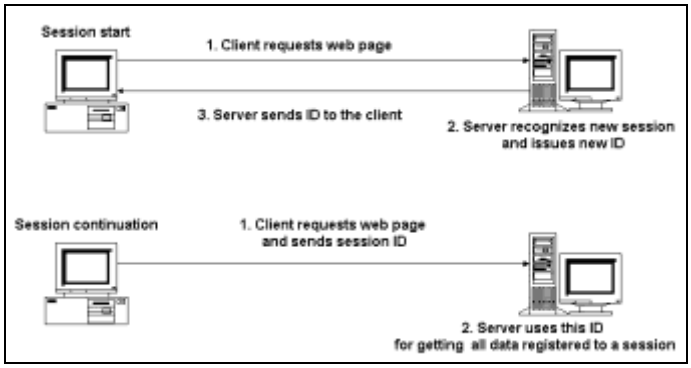

Fig. 6. Interaction between client and server during session launching

Session ID can be taken in the following way:

manual steps:

1. connecting to the web page which contains form with Captcha method
2. writing down session ID and security code

automated steps:

1. sending session ID and security code more times

For example:

```
POST /script.php HTTP/1.0
Cookie: PHPSESSID=329847239847238947;

// this is session ID that we wrote down

Content-Length: 49
Connection: close;

name=bob&email=bob@fish.com&captcha=plaintext

// this array contains information of user and security code that we
have wrote down
```

User data can be modified for every new request.

In this way it is possible to generate several hundred requests while the session exists. After session expiration the mentioned steps need to be repeated to get the new data.

6.2. OCR bots

The OCR (Object character recognition) technique is implemented in some intelligent versions of bots. They can recognize characters from image with great accuracy. In Fig. 7 we can see the generated images and the results of character recognition for them which are made with OCR bots.

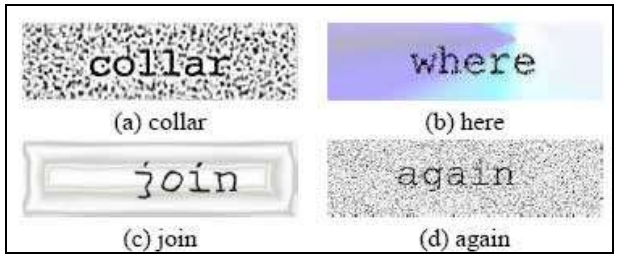

Fig. 7. Result of character recognition made with OCR bots

7. CAPTCHA IMPLEMENTATIONS

If you are not so familiar with Captcha programming but you understand the basics of web programming you can still use this security technique in your web site by choosing one of free captcha implementations-variations.

The first well-known implementation is reCAPTCHA. reCAPTCHA is a free CAPTCHA service that helps to digitize books, newspapers and old time radio shows. reCAPTCHA improves the process of digitizing books by sending words that cannot be read by computers to the Web in the form of CAPTCHAs for humans to decipher. More specifically, each word that cannot be read correctly by OCR is placed in an image and used as a CAPTCHA. This is possible because most OCR programs alert you when a word cannot be read correctly.

Each new word that cannot be read correctly by OCR is given to a user in conjunction with another word for which the answer is already known. The user is then asked to read both words. If they solve the one for which the answer is known, the system assumes their answer is correct for the new one. The system then gives the new image to a number of other people to determine, with higher confidence, whether the original answer was correct [5].

Fig. 8. Use of reCAPTCHA on a web form

Ajax Fancy Captcha is a jQuery plugin that helps you protect your web pages from bots and spammers. It differs from classic Captchas in so far as you do not have to enter the text or to calculate some mathematical operations, you just have to drag and drop the correct image for the random generated word. In figure 9 users should drag the clock image into the circle.

The basic design and its elements are easy to change and customize.

Fig. 9. Use of AJAX Fancy Captcha on a web form

8. CONCLUSION

This paper presents basic information about security of web forms from web bots (robots) with special emphasis on the Captcha method which is the most often used method. Although it contains some restrictions, in combination with other techniques it makes a good choice for security. Modern bots have algorithms which successfully conquer the Captcha method. Most web sites contain their own forms of Captcha implementation, and currently it is rather difficult for the creators of web bots because they have to create a new bot for every web site.

In order for one web form to be secured it is necessary to be able to see all aspects of possible threats. It is recommended to use alternative solutions such as listening to the audio file of the generated code. However, one should not use a wide range of security techniques, it is enough to use one or two methods, because the aim of the web sites is to be user friendly.

REFERENCES

[1] Greg Mori, Jitendra Malik "Recognizing Objects in Adversarial Clutter:Breaking a Visual CAPTCHA",CVPR 2003

[2] Zlatko Čović, Livia Sedmina, "Security of web forms," Proceedings of the SISY 2007, pp. 197-200, IEEE Catalog Number : 07EX1865C, ISBN: 1-4244-1443-1, Subotica 2007

[3] Captcha project, http://www.captcha.net

[4] Zlatko Čović, „Elektronsko poslovanje – priručnik za vežbe", Viša tehnička škola Subotica, 2003, pp. 61-62

[5] reCAPTCHA project, http://www.google.com/recaptcha

[6] Ajax Fancy Captcha – Jquery plugin, http://www.webdesignbeach.com/beachbar/ajax-fancy-captcha-jquery-plugin

Software Algorithm Solution for Power Distribution Networks Analysis and Control

Slobodan Jovanović
The Metropolitan University , The Faculty of Information Technologies,
Belgrade, Serbia, www.metropolitan.edu.rs
e-mail: slobodan.jovanovic@fit.edu.rs

Abstract: **This paper presents a novel application of the Maclaurin-Newton load flow method. A new inversion load flow formulation, with a complex inversion Jacobian, is successfully applied to simulate load flows of power distribution systems. An inversion admittance matrix is utilized as a complex inversion Jacobian for the solution of the distribution system load flow equations.**

Keywords: **Jacobian matrices, Load flow analysis, Matrix inversion**

1. INTRODUCTION

The standard Newton load flow method consists of iteratiive solutions of the Jacobian equation by triangular factorizations [1]:

$$J\Delta x = -f(x^n) \qquad (1)$$

where x is vector state variable and f(x) nonlinear vector function and Δx is correction of x in n-th iteration .

In order to avoid triangular factorizations of load flow equations, the Maclaurin inverse matrix series is applied as [2]:

$$(U+P)^{-1} = U-P+P^2-P^3 \qquad (2a)$$

where U is the identity matrix, P is off-diagonal square matrix. If the series is truncated, then

$$(U+P)^{-1} \approx U-P \qquad (2b)$$

By analysing the equations (2a-b), we can conclude that if the elements of the off-diagonal matrix P are not relatively small (compared to U), then the equation (2b) is a less accurate approximation, and this can compromise its use for load flow equations solutions, causing their divergence.

If J is the Jacobian matrix, the inverse Jacobian can be approximated using the Maclaurin inversion (2b):

$$J\text{-}1 = (Jd+Joff)\text{-}1 = (U+Jd\text{-}1Joff)\text{-}1\ Jd\text{-}1 \approx (U\text{-}Jd\text{-}1Joff)Jd\text{-}1 \quad (3a)$$

where Jd / Joff is the diagonal/off-diagonal part of J.

The approximate solution (3a) can be incorporated into the Newton iterative algorithm, $J\Delta x = -f(x^n)$, and hence form the Maclaurin-Newton method:

$$\Delta x = -J^{-1} f(x^n) \approx -(U-J_d^{-1}J_{off})J_d^{-1} f(x^n) \quad (3b)$$

This model (3b) was successfully used in [3] to simulate 400/275 kV transmission. However, when the coupled inversion load flow (3b) is applied for distribution systems it does not work, it diverges regularly, because the off-diagonal elements of J are not small (compared to diagonal), and consequently the approximation (3a) becomes invalid. Also, the decoupled inversion load flow from [3] (used for 400/275 kV) does not work for distribution.

Hence, because both the coupled and decoupled inversion load flow do not converge at all for distribution systems, a theoretical and practical question is how to apply/adapt the Maclaurin-Newton method to be applicable to solve distribution load flow equations. This paper describes a solution to this problem.

A new Maclaurin-Newton formulation is developed, where instead of coupled or decoupled Jacobian, a complex Jacobian equation and a complex inversion Jacobian are formulated, and successfully applied to simulate distribution systems.

2. DISTRIBUTION LOAD FLOW EQUATIONS

A primary distribution network is typically composed of several primary feeders at voltage levels mostly in the range of 4 to 35 kV. Usually, these feeders operate radially (although mesh networks are sometimes applied), and with only one point of power supply (feeding point). The possibility of transferring loads from one feeder to another normally exist in case of failures (single outages).

There is a growing trend among the power utilities to increase the productivity of electric energy distribution. There are several topics in this field, eg. loss minimisation, voltage control, network design, etc. In this context, the load flow solution of distribution networks attracts special attention [4,5].

The models used at medium voltage levels do not allow us to make assumptions that are valid in models for very higher voltages [6]. Distribution networks are characterised by a high resistance/reactance ratio ($r/x>>1$) not found in the transmission networks (where $r/x<<1$). As a result, decoupled load flow models are inadequate, they can not converge for distribution networks.

The standard coupled Newton method including the triangular factorization offers in principle the fastest convergence, but suffers from the difficulty of solving the load flow equations if the starting iteration point is too distant from the solution, resulting in divergence, and hence other methods need to be complementary used [7]. Another shortcoming is the

requirement that the coupled Jacobian matrix has a rank approximately four times that of the Y-matrix, resulting in increased memory space during triangular factorizations.

The distribution inversion algorithm described in this paper implements an admittance matrix inversion as a complex inversion Jacobian. This algorithm is employed for the load flow simulations of distribution networks, and the algorithm was tested, demonstrating very robust convergence.

The inversion complex Jacobian matrix is sparse and represents a mirror image of the original admittance matrix. Consequently, the algorithm requires only very simple and direct calculations, and small memory, and is easy for programming. Finally, it is suitable for both radially- and non-radially operated (mesh) distribution networks, ie. it does not impose such topology limitations.

The following fixed Jacobian load flow with variables in rectangular form can be obtained from the original Newton algorithm by evaluating the Jacobian at the flat start and ignoring some diagonal elements [8,9]:

$$\Delta I_r = -B\Delta V_{im}+G\Delta V_r \qquad (4a,b)$$
$$\Delta Iim= G\Delta Vim+B\Delta Vr$$

where Vim/Vr and Iim/Ir represent imaginary and real voltage and current vector components,respectively, and G/B system conductance/susceptance matrix.

The following equation can be directly obtained from (4a-b)

$$\Delta Ir+j\Delta Iim$$

$$= (-B\Delta Vim+G\Delta Vr)+\mathbf{j}(G\Delta Vim+B\Delta Vr)$$

$$= (G+\mathbf{j}B)(\Delta V_r+\mathbf{j}\Delta V_{im}) \qquad (5a)$$

or

$$\Delta\mathbf{I} = \mathbf{Y}\Delta\mathbf{V} \qquad (5b)$$

where:

V/**I** - complex nodal voltage/current vector (the bold letters indicate complex numbers),

Y = {**Y**ij} = G+**j**B - complex nodal admittance matrix (G = {Gij}/ B = {Bij} = conductance/susceptance matrix), and j -imaginary unit number,

and Δ**V**/Δ**I** is the voltage correction-/the current mismatch-vector.

The equation (5b) represens the Newton load flow equation in complex form (the complex Jacobian equation). Hence, we can introduce a complex Jacobian J, then (5b) becomes

$$\Delta\mathbf{I} = \mathbf{J}\Delta\mathbf{V} \qquad (5c)$$

where

$$\Delta \mathbf{I} = \Delta I_r + \mathbf{j}\Delta I_{im}, \quad \Delta \mathbf{V} = \Delta Vr + \mathbf{j}\Delta Vim \tag{5d,e}$$

and

$$\mathbf{J} = \mathbf{Y} = G + \mathbf{j}B \tag{5f}$$

The complex Jacobian equation (5c) takes the advantage of variables in complex form (V and I - complex vector variables), including the fixed complex Jacobian J = Y.

The system nodal equations are described by

$$\mathbf{I} = \mathbf{YV} \tag{6}$$

If n is the iteration number, and

$$\Delta \mathbf{V} = \mathbf{V}^{n+1} - \mathbf{V}^{n} \tag{7a}$$

and

$$\Delta \mathbf{I} = \mathbf{I}^{n+1} - \mathbf{I}^{n} \tag{7b}$$

then we can apply the following current mismatch vector

$$\Delta \mathbf{I} = (P^{sp} - \mathbf{j}Q^{sp})/\mathbf{V}^{n*} - \mathbf{YV}^{n} \tag{7c}$$

where Psp/Qsp is the scheduled active/reactive power vector, and * -means conjugate complex number, where

$$\mathbf{I}^{n} = \mathbf{YV}^{n} \tag{7d}$$

and

$$\mathbf{I}^{n+1} = (P^{sp} - jQ^{sp})/V^{n*}. \tag{7e}$$

3. DISTRIBUTION INVERSION LOAD FLOW ALGORITHM

The paper [10] describes the implementation of Maclaurin-Newton algorithm fior 135 kV subtransmission networks, however it does not work for distribution networks.

Now we can derive the propiosed distribution inversion load flow algorithm based on the Maclaurin-Newton inversion method.

The complex inverse of **J** = **Y** can be approximated using the Maclaurin inversion (2b) in complex form:

$$\mathbf{Y}\text{-}1 = (\mathbf{Y}d + \mathbf{Y}off)\text{-}1$$

$$= (U + \mathbf{Y}d\text{-}1\mathbf{Y}off)\text{-}1\ \mathbf{Y}d\text{-}1$$

$$\approx (U - \mathbf{Y}d\text{-}1\mathbf{Y}off)\mathbf{Y}d\text{-}1$$

$$= (\mathbf{Y}_d^{-1} - \mathbf{Y}_d^{-1}\,\mathbf{Y}_{off}\,\mathbf{Y}_d^{-1}) \qquad (8)$$

Yd is the diagonal and **Y**off the off-diagonal part of **Y**.

This approximate solution (8) can be incorporated into the iterative equation $\Delta I = Y\Delta V$ (5b), and hence form the distribution inversion load flow algorithm:

$$\Delta\mathbf{V} = \mathbf{Y}\text{-}1\ \Delta\mathbf{I}$$

$$\approx (\mathbf{Y}_d^{-1} - \mathbf{Y}_d^{-1}\mathbf{Y}_{off}\,\mathbf{Y}_d^{-1})\ \Delta\mathbf{I} \qquad (9a)$$

We can rewrite (9a) as

$$\Delta V = Z\Delta I \qquad (9b)$$

where

$$\mathbf{Z} = (\mathbf{Y}_d^{-1} - \mathbf{Y}_d^{-1}\mathbf{Y}_{off}\,\mathbf{Y}_d^{-1}) \qquad (9c)$$

After some manipulations, **Z** can be simplified:

$$\mathbf{Z}_{ii} = 1/\mathbf{Y}_{ii} \qquad (10a,b)$$

$$\mathbf{Z}ij = -\mathbf{Y}ij/(\mathbf{Y}ii\ \mathbf{Y}jj)$$

where:

$\mathbf{Y}ij = \mathbf{G}ij+\mathbf{jB}ij$, $\mathbf{Y}ii = \mathbf{G}ii+\mathbf{jB}ii$ and $\mathbf{Y}jj = \mathbf{G}jj+\mathbf{jB}jj$.

As we can se from (10a,b), the distribution inversion load flow algorithm is very simple and easy for computer programming (no needs for triangular factorizations). The inversion complex Jacobian matrix is sparse and represents a mirror image of the original admittance matrix.

Furthermore, even for high r/x ratios, we have $|Y_{ij}| << |Y_{ii}|$ (because by definition $Y_{ii} = -\sum Y_{ij}$), hence the off-diagonal elements of Y are small compared to the diagonal elements, and consequently the equation (8) is even valid for high r/x, typical for distribution networks. Finally, it is suitable for both radially- and non-radially operated (mesh) distribution networks, ie. it does not impose such topology limitations.

A distribution circuit has a typical structure where only one feeding point is present (eg. a high voltage to medium voltage transformer), and the rest of nodes are nodes with scheduled P^{sp} and Q^{sp} (load nodes, and possibly some cogenerator nodes). For the feeding point we can fix its complex voltage, (ie. we can fix its magnitude and choose its phase angle to be zero) $V_{rs}=V_s^{sp}$, $V_{ims}=0$ (s- supply/feeding point). Also, the supply/feeding point has the role of the slack bus where its P/Q power output is not fixed/scheduled (it is relaxed within certain limits).

For the supply/feeding (slack) point denoted by 's',

$$\mathbf{V}_s = \mathbf{V}_s^{sp}, \qquad (11a,b)$$

$$\Delta\mathbf{V}s = \mathbf{0}$$

and also

$$\Delta\mathbf{I}_s = \mathbf{0} \qquad (11c)$$

(because $\mathbf{I}s$ is not fixed).

And for the rest of nodes P and Q is specified/ scheduled in advance

$$P_i-\mathbf{j}Q_i = P_i^{sp}-\mathbf{j}Q_i^{sp} \ (i\neq s) \qquad (11d)$$

(or alternatively they can be functions of voltage magnitudes).

Hence, in every iteration we are able first to calculate ΔI (current mismatch vector) by using (7c), and then to apply $\Delta V = Z\Delta I$ (9b) to find ΔV (voltage correction vector). By the way, the dimension of Z and ΔV and ΔI can be reduced by one node, by ignoring slack bus columns and rows.

4. IMPLEMENTATION AND TESTING

The proposed distribution inversion load flow algorithm was implemented using FORTRAN programming language.

It is relatively easy to implement and does not need much memory space. The algorithm was implemented using nonparallel computing, however it is an advantage of the proposed method that it is possible to employ parallel computing techniques, in order to improve computation speed.

A 53-node 11kV- distribution network was used to test the performance of the proposed method. System parameters were widely varied, and robust convergence was obtained by the proposed Maclaurin-Newton load flow method .

However, further and comprehensive testing is now going on, and these testing results will be soon reported in a separate paper in one of future issues of e-Society Journal.

5. CONCLUSION

This paper examines the theoretical and practical question of how to apply/adapt Maclaurin-Newton method to be able to solve distribution network load flow equations.

The novel distribution load flow algorithm addressed in this paper utilizes an approximate **Y**-inverse as a complex inversion Jacobian. The distribution inversion load flow algorithm applies the truncated Maclaurin series to approximate the inverse of the complex **Y-** matrix. The method can be used for both radial and mesh distribution systems.

The proposed distribution inversion load flow algorithm was implemented using FORTRAN programming language. A 53-node 11kV- distribution network was used to test the performance of the proposed method.

REFERENCES

[1] P E Crouch, D J Tylavsky, H Chen, L Jarriel, R Adapa, ‘Critically Coupled Algorithms for Solving the Power Flow equation’, IEEE Trans. on Power Systems, pp.451-457, Feb 1992.

[2] J S Chai, A Bose, ‘Bottlenecks in Parallel Algorithms fop Power System Stability Analysis’, IEEE Trans. on Power Systems, pp.9-15, Feb 1993.

[3] S Jovanovic, ‘ Decoupled Inversion Load Flow Algorithm’, IEEE Power Eng. Review, pp.43-44, Oct 1999.

[4] R Caspedes, ‘New method for the analysis of distribution networks’, IEEE Trans. On Power Delivery, pp. 391-396, Jan. 1990.

[5] S Jovanovic, F Milicevic, ’Triangular distribution load flow’, IEEE Power Eng. Review, pp. 60-62, May 2000.

[6] D Rajicic, A Bose, ‘A Modification to the Fast Decoupled Power Flow for Networks with High R/X Ratios’, IEEE Trans. on Power Systems, pp.743-746, May 1988.

[7] H S Huang, C N Lu, 'Vector implementations of fast decoupled and Gauss-Seidel load flows', Int. Journ. Of El.Power &Energy Systems, pp.355-358, Oct 1995.

[8] S Jovanovic, 'Semi-Newton Load Flow Algorithms in Transient Security Simulations', IEEE Trans. on Power Systems, pp 694-699, May 2000.

[9] B Babic,'Decoupled load flow with variables in rectangular form', IEE Proceedings, Pt.C, May 1983, pp.98-102.

[10] S.Jovanovic, 'Maclaurin-Newton algorithms in 132 kv subtransmission security simulations, Electric Power Systems Research, Vol.76, pp. 1084-1086, Feb. 2006;