

Active Knowledge Engineering Laboratory



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The Active Knowledge Engineering Lab activities include investigations that are about discovering, externalizing, expressing, representing, sharing, exploring, configuring, activating, growing and managing enterprise knowledge as well as designing new programming platforms based on mentioned above principles. This year we have been focused on the following topics.

1. Filmifications of Methods and Data

Existing systems of symbols and notations are usually very abstract and there is a great gap between the form and meaning of data/knowledge. Our long-term education, in an essential part, is reduced to training our brain for being 'encoding-decoding' machine bridging this gap. The abstractness mentioned and bridging operations are sources of serious mental and physical problems for a great variety of people and, especially for disabled and elderly. Our aging society is also becoming information society. So, the above-mentioned aspect of our environment is becoming crucial. That is why our research is to develop a new environment with lesser level of abstraction and with the better quality of people life.

Our general program is cyber-infrastructure including high-performance computing. We are also thinking about active knowledge being developed by humanity and undertaking research efforts in visual (multimedia) languages and tools, parallel and distributed systems. In a great part, our research and development are based on an idea of self-explanatory components in a cyberFilm format. A cyber-Film is a set of color stills supported, if necessary, by text, voice/sound and special links. Each still is to represent a view (some features) of objects or processes. Each cyberFilm is to represent a multiple view (an extended set of dynamic and/or static features) of objects or processes. The more accurate and relevant views are used, the greater adequacy is reached. The idea of cyberFilms is used for the specifi-

cation of information resources and programming operations with the resources, as well as for the representation of multimedia messages and implementation of human-computer interfaces. The idea of equal opportunities to all individuals in the use of information resources is used to create a right set of cyberFilms and methods of their adaptation. We lead four clusters of projects related to filmification of methods and data: 1) Active Knowledge Studio for teachers, students, and programmers, 2) Semantic Surfaces in Ambient Living Environments for elderly, 3) Virtual objects, haptic interface and 3D printers for people doing fast prototyping, and 4) WWW-based software for users involved in multimedia programming and distance learning.

2. Human-Computer Interaction in Games and Education

Experimenting with human behavior via human-computer interaction is a challenging and interesting topic with many open problems. Primarily we are focused on understanding and modeling human behavior via the development of artificial intelligence (AI) systems for computer games and simulations. In particular, we are using annotated recordings of soccer and tennis matches to model the behavior of opponents. Other projects include the analysis of human language polarity and grammar by using methods of corpus linguistics and visualizing text structure. Our goal is to simplify understanding of human language properties and thus assist language education.

3. Human-centric Software Design Patterns

The main goal of the project is in research and development of the multi-purposed Methodology allowing creation of service-oriented systems via integration of software and information components designed by different groups of developers. The set of applications is developing based on the original Virtual-Model-View-Controller (V-MVC) design pattern that is an integration of two well-known approaches: Service-Oriented Architecture (SOA) and the Model-View-Controller (MVC).

We are designing a system allowing numerical computer Tsunami simulations for crucial coastal areas. It supports so-called hybrid bathymetry that combines natural and artificial underwater objects. It also should include the tools allowing the user to manipulate with these objects. Research is in designing a public server client/server infrastructure as well as a structure of tsunami data to be stored and assembled. We are designing high-resolution digital Bathymetry of Fukushima Coast and Modeling Scenarios based on sources of the Japanese Great Earthquake. It includes computational experiments with the program modules, modify them as well as design visualizations of tsunami wave propagation.

Service-Oriented LEGO-Robot Programming Components allow developing

WEB-based applications for Robot Control System, visualization of robot activities and data. It includes designing a prototype for the LEGO Robot Control scanning system including possibilities to specify operations for the internal robot program and data exchange. Hardware and software should be created using familiar LEGO parts and blueprints for faster assembly.

Summary of Achievement

Refereed academic journal

[mozgovoy-308-004-01:2015] M. Mozgovoy M. Purgina. A. Danielewicz-Betz, H. Kaneda. Creating English and Japanese Twitter Corpora for Emotion Analysis. *International Journal of Knowledge Engineering*, 1(2):120–124, 2015.

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[mozgovoy-308-004-02:2015] M. Mozgovoy E. Sutinen. M. Munezero, C. Montero. EmoTwitter - A Fine-Grained Visualization System for Identifying Enduring Sentiments in Tweets. *Lecture Notes in Computer Science*, 9042(2):78–91, 2015.

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[mozgovoy-308-004-03:2015] V. Volkov E. Pyshkin, M. Mozgovoy. Models and Metamodels for Computer-Assisted Natural Language Grammar Learning. *International Journal of Social, Management, Economics and Business Engineering*, 9(1):60–66, 2015.

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[vazhenin-308-004-01:2015] R. Cortez and A. Vazhenin. Virtual Model-View-Controller Design Pattern: Extending MVC for Service Oriented Architecture. *IEEE Transactions on Electrical and Electronic Engineering*, 10(4):411–422, 2015.

In the framework of Service-Oriented Architecture (SOA), the initial stage of application's development is a complex task due to the upfront costs, software redesign, and specialized skills. The focus of the study is on the formalization of a Virtual Model-View-Controller (Virtual-MVC) design pattern to simplify the development of service-oriented applications for medium and small-sized enterprises. The Virtual-MVC pattern facilitates the implementation of service-oriented applications by abstracting the complex integration logic and service interface design from the developer's tasks. The main changes introduced by the Virtual-MVC pattern are the total decoupling of the View from the Model, whose links are reorganized within an enhanced Controller based on the Enterprise Service Bus. The Controller is reinforced with Dependency Injection for service virtualization. In this paper, the description of a Virtual-MVC based programming framework is formalized, and a standard functional classification

of MVC related patterns is proposed for comparison. The Virtual-MVC pattern is implemented into a software development framework, along with its corresponding programming strategy. The evaluation is performed through a study in a software engineering course at the university of Aizu, where services were designed following the Virtual-MVC programming approach. The results indicate a reduction of development complexity, while it enforces service design principles.

[vazhenin-308-004-02:2015] K. Hayashi, A. Vazhenin, and An. Marchuk. Service-Oriented Tsunami Modeling: VMVC-Based Functional Engines. *Communications in Computer and Information Science*, 513:376–390, 2015.

Lessons learned from the Great Japanese Earthquake and Tsunami provide direction to research and emergency management communities on how to develop tools, models, and methods for mitigating impact for such devastating event both locally and globally. The solution of this problem is that it is more effective to integrate the applications and services rather than rebuilding because redevelopment is a costly affair. The presented paper demonstrates an approach for developing the service-oriented Tsunami Modeling Environment as a framework of the original Virtual Model-View-Controller (VMVC) design pattern. It is based on decoupling of the view from the mode. The Model-View link is redirected within an enhanced controller as a virtual layer for distributed and service-oriented applications. This allows the programmers to concentrate on building new functionalities and services without bothering on how the services will be exposed, consumed, and maintained. To simplify the structure of services, the Model is represented as a set of application-oriented components named Engines. We are describing the main Tsunami Modeling Functional engines allowing to model each stage of a tsunami process including tsunami wave propagation over the deep ocean water, inundation of these waves on the coast area, and impact on the coast object. We are also describing in detail the Tsunami Visualizing Engine (TVE) showing the modeling results in a convenient multimedia form. For each engine, we are showing its functionality and corresponding services that are provided by it.

[vazhenin-308-004-03:2015] K. Sano, F. Kono, N. Nakasato, A. Vazhenin, and S. Sedukhin. Stream Computation of Shallow Water Equation Solver for FPGA-based 1D Tsunami Simulation. *ACM SIGARCH Computer Architecture News*, 43:82–87, 2015.

MOST (Method Of Splitting Tsunami) is widely used to solve shallow water equations (SWEs) for forecasting tsunami generated by an earthquake. Toward

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development of a power-efficient and high-performance computing system for 2D tsunami simulation, we conduct feasibility study on stream computation of 1D SWE solver with FPGA. We analyze an original code and design a stream algorithm with techniques of kernel fusion, shift buffering for streamed stencil-data access, and cascading processing elements for a longer pipeline. We implement a deep pipeline with at most 744 stages of 4 SPEs on 28 nm Stratix V FPGA, which achieves 82.4 GFlop/s at 200 MHz.

Refereed proceedings of an academic conference

[mozgovoy-308-004-04:2015] I. Umarov. M. Mozgovoy, A. Yamada. Developing Trainable Bots for a Mobile Game of Tennis. In *Proceedings of the Game-On International Conference on Intelligent Agents and Simulation*, pages 62–64, 2015.

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[mozgovoy-308-004-05:2015] M. Mozgovoy A. Yamada. Towards Self-Learning AI for the Videogame of Tennis. In *Proceedings of the International Workshop on Applications in Information Technology (IWAIT)*, pages 79–80, 2015.

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[mozgovoy-308-004-06:2015] M. Mozgovoy C. Vatter. Data Mining in Forensics: a Text Mining Approach to Profiling Criminals. In *Proceedings of the 46th International Conference on Control Processes and Stability*, volume 2, pages 542–548, 2015.

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[mozgovoy-308-004-07:2015] M. Mozgovoy A. Yamada. Communication Between Two Digital Agents in Geometry Friends. In *Proceedings of the 46th International Conference on Control Processes and Stability*, volume 2, pages 549–554, 2015.

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[rentaro-308-004-01:2015] Rentaro Yoshioka Hidehito Sawai. An Interface to Elicit and Express People’s Experiences: For Visits to Places. In *10th International Technology, Education and Development Conference*, pages 1329–1336. IATED, March 2016.

A model and language for an interface to elicit and express knowledge related to a person's experience is considered. In this method, an experience is considered as a combination of an activity and resulting emotion, in which emotion can be described as a set of individual impressions regarding constituting events and objects. To support users in expressing emotions, a set of multi-view symbols based on a predefined classification of objects and events are provided. While experience is a wide concept, in particular, this paper focuses on visits to places. This method supports and encourages users to recollect, analyze, and build understanding of one's own experience using a standard expression. Users are able to compare own experience with others and reuse them for one's future activities. In this paper, the developed classification and symbols as well as user interfaces to express and browse experiences is presented.

- [vazhenin-308-004-04:2015] Sh. Takano, K. Hayashi, A. Vazhenin, and An. Marchuk. Hybrid Tsunami Modeling Infrastructure: Tsunami Source Data and Bathymetry Editor. In *International Workshop on Applications in Information Technology (IWAIT-2015)*, pages 21–24, Aizuwakamatsu, Japan, October 2015. University of Aizu, University of Aizu.

The important part of the tsunami science is focused on studying the considerable influence of natural geographical objects, like islands and coast bathymetry, on the tsunami waves. Currently, such investigations are mostly implementing by physical modeling allowing obtaining good results on impacting submarine barriers on tsunami wave propagation but actually very expensive. We are designing a system allowing numerical computer simulations for crucial coastal areas supporting so-called hybrid bathymetry that combines natural and artificial underwater objects as well as tools allowing the user to manipulate with them. The paper describes the main features the original Bathymetry and Tsunami Source Data Editor that allows tuning/editing bathymetric and tsunami source data by including/removing artificial barriers as well as specifying their placement, shapes and sizes.

- [vazhenin-308-004-05:2015] K. Hijikata, I. Lubashevsky, and Alexander Vazhenin. Digital Data Refinement for the Area of Crater on the Moon. In *International Workshop on Applications in Information Technology (IWAIT-2015)*, pages 1–2, Aizuwakamatsu, Japan, October 2015. University of Aizu, University of Aizu.

A new type non-symmetric diffusion problem is considered and the corre-

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sponding Brownian motion implementing such diffusion processes is constructed. As a particular example, random walks with internal causality on a square lattice are studied in detail. By construction, one elementary step of a random walker on the lattice may consist of its two succeeding jumps to the nearest neighboring nodes along the x- and then y-axis or the y- and then x-axis ordered, e.g., clock- wise. It is essential that the second fragment of elementary step is caused by the first one, meaning that the second fragment can arise only if the first one has been implemented, but not vice versa. In particular, if for some reasons the second fragment is blocked, the first one may be not affected, whereas if the first fragment is blocked, the second one cannot be implemented in any case. As demonstrated, on time scales much larger than the duration of one elementary step these random walks are characterized by a diffusion matrix with non-zero anti-symmetric component. The existence of this anti-symmetric component is also justified by numerical simulation.

[vazhenin-308-004-06:2015] K. Hayashi, A. Vazhenin, and An. Marchuk. Trans-Boundary Realization of the Nested-Grid Method for Tsunami Propagation Modeling. In *The Twenty-fifth International Offshore and Polar Engineering Conference, 21-26 June, Kona, Hawaii, USA*, pages 741–746, Kona, Hawaii, USA, June 2015. International Society of Offshore and Polar Engineers, International Society of Offshore and Polar Engineers.

The algorithm for computing tsunami propagation from the initial source to the coastline that uses switching of computational grids has been developed. Computations that use Method of Splitting Tsunami (MOST) are carried out on a sequence of grids with various resolutions where one is embedded into another. Tsunami parameters are transferred from the larger domain to the embedded smaller one by means of boundary conditions. The 4-stage algorithm was used for numerical modeling the far-field tsunami propagation to the Sanriku coast harbors. The grid resolution decreases from approximately 4000 m in deep water down to 17 m near a coastline that provides a detailed tsunami description. Using of modern computer architecture and in parallel computations on several computers can significantly shorten the time of computations.

[vazhenin-308-004-07:2015] J. Brine, E. Kaneko, Y. Heo, A. Vazhenin, and G. Bateson. Language Learning beyond Japanese University Classrooms: Video Interviewing for Study Abroad. In M. Guarda

S. Thouesny Fr. Helm, L. Bradley, editor, *Critical CALL - Proceedings of the 2015 EUROCALL Conference, Padova, Italy*, pages 91–96, Dublin, Ireland, August 2015. EUROCALL, Research-publishing.net.

In 2014, the University of Aizu was accepted for participation in Japan's national Top Global University initiative (TGU). In this paper, we describe our use of video interviewing to prepare Japanese students for our Global Experience Gateway study abroad TGU project.

[vazhenin-308-004-08:2015] Mirai Watanabe, Yutaka Watanobe, and Alexander Vazhenin. Modeling Tools for Social Coding. In Hamido Fujita and Guido Guizzi, editors, *Proceedings of the 14th International Conference on Intelligent Software Methodologies, Tools and Techniques,, SoMet 2015, Naples, Italy, September 15-17, 2015.*, volume 532 of *Communications in Computer and Information Science*, pages 399–410, Naples, Italy, 2015. Springer International Publishing.

In recent years, the social coding paradigm has become commonly used in software development, taking advantage of version control systems and tracking functions. However, most social coding platforms do not provide modeling tools which support the creation of documents for corresponding products. In the present paper, we propose modeling tools for social coding. The tools are based on hybrid editors, where different experts on a project team can use the correct input methods to modify some features of software components. These editors allow users to manipulate both a visual construct in a high-level representation and the corresponding texts in the low-level format. Some advantages of these approaches are also discussed through a case study and its evaluation.

Research grants from scientific research funds and public organizations

[vazhenin-308-004-09:2015] A. Vazhenin. Grant-in-Aid for Scientific Research (Basic), Issue Number: 15K00103 , Japanese Ministry of Education, Culture, Sports, Science and Technology, 2015-2017.

Academic society activities

[vazhenin-308-004-10:2015] A. Vazhenin, December 2015.

Summary of Achievement

Member of IEEE, ACM, IEICE, IPSJ, JpGU, EUROCALL

[vazhenin-308-004-11:2015] A. Vazhenin, September 2015.

Program Committee Member of the Federated Conference on Computer Science and Information Systems (FedCSIS2015)

[vazhenin-308-004-12:2015] A. Vazhenin, September 2015.

Program Committee Member of the IEEE 7th International Conference on Awareness Science and Technology (iCAST 2015)

[vazhenin-308-004-13:2015] A. Vazhenin, September 2015.

Program Committee member of the 14th International Conference on Intelligent Software Methodologies, Tools and Techniques, Naples, Italy, September 15-17, 2015

Advisor for undergraduate research and graduate research

[rentaro-308-004-02:2015] Hidehito Sawai. Master Thesis: An Interface to Elicit and Express People's Experiences, University of Aizu, 2015.

Thesis Advisor: Yoshioka, R.

[rentaro-308-004-03:2015] Eimi Kamitsuma. Graduation Thesis: Image Based Identification of 3DKanji Signage, University of Aizu, 2015.

Thesis Advisor: Yoshioka, R.

[rentaro-308-004-04:2015] Daiki Hashimoto. Graduation Thesis: Symbols and Format for Self-explanatory Specification of Feelings, University of Aizu, 2015.

Thesis Advisor: Yoshioka, R.

[rentaro-308-004-05:2015] Masahiro Arai. Graduation Thesis: Service Architecture for Active Reuse of Experiences as Knowledge, University of Aizu, 2015.

Thesis Advisor: Yoshioka, R.

[vazhenin-308-004-14:2015] Kenji Abe. Visual Learning Tool for Lego Robots Programming, University of Aizu, 2015.

Thesis Advisor: A. Vazhenin

[vazhenin-308-004-15:2015] Georges Meguro. WWW-based System for LEGO Robots Control, University of Aizu, 2015.

Thesis Advisor: A. Vazhenin

[vazhenin-308-004-16:2015] Shunsuke Takano. Hybrid Tsunami Modeling Infrastructure: Tsunami Source Data and Bathymetry Editor, University of Aizu, 2015.

Thesis Advisor: A. Vazhenin

Contributions related to syllabus preparation

[rentaro-308-004-06:2015] Software Engineering I

[rentaro-308-004-07:2015] Venture Startup Factory 6 Introductory PBL

[rentaro-308-004-08:2015] Software Studio

[rentaro-308-004-09:2015] Creativity Development

Advisor of a student club or circle

[rentaro-308-004-10:2015] Adviser of the University of Aizu Orchestra Dolce

Contribution related to educational research technology and facility planning management

[vazhenin-308-004-17:2015] Coordinator of the Software Engineering Field of Study of the Graduate School

Other significant contribution toward university planning, management, or administration

[rentaro-308-004-11:2015] Preparation and organization of programming contest as an organizing committee member of PC Koshien 2015

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[rentaro-308-004-12:2015] Preparation of course material and management of an online programming learning system for students admitted by recommendation

[vazhenin-308-004-18:2015] Chair of the Department of Information Technology and Project Management

[vazhenin-308-004-19:2015] Member of the Graduate School Academic Affairs Committee

Did you participate in Public Lectures, and/or Open Campus? (Yes or No) If yes, please describe what you did.

[rentaro-308-004-13:2015] Organization of open-lab during Open Campus event

[rentaro-308-004-14:2015] Organization of open-lab during University Festival

[rentaro-308-004-15:2015] Preparation and organization of University public lecture 'Introduction to Programming and Algorithms for High-school Students'

[rentaro-308-004-16:2015] Preparation and organization of University public lecture 'Basic and Practical Programming for High-school Students'

[rentaro-308-004-17:2015] Preparation and organization of open-online course 'Algorithms and Programming' for PC Koshien participants.