Active Knowledge Engineering Laboratory

Alexander P. Vazhenin
Professor

Rentaro Yoshioka
Senior Associate Professor

Maxim Mozgovoy
Associate Professor

Thanh Trung Pham
Visiting Researcher

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. Filmfications 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 cyberFilm 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. A cyberFilm 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 specification 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 multipurposed 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.

Refereed academic journal

[mozgovoy-308-004-01:2016] M. Mozgovoy Y. Kobayashi, M. Munezero. . Analysis of Emotions in Real-time Twitter Streams. *Informatica*, 40(4):387–391, 2016.

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[mozgovoy-308-004-02:2016] M. Mozgovoy C. B. Ali C. S. Montero, H. Haddad. Detecting the Likely Causes behind the Emotion Spikes of Influential Twitter Users. *Lecture Notes in Computer Science*, 2016.

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[vazhenin-308-004-01:2016] Naohito Nakasato Alexander Vazhenin Stanislav Sedukhin Kentaro Sano, Fumiya Kono. Stream computation of shallow water equation solver for FPGA-based 1D tsunami simulation. *ACM SIGARCH Computer Architecture News*, 43(4):82–87, 4 2016.

MOST (Method Of Splitting Tsunami) is widely used to solve shallow water equations (SWEs) for forecasting tsunami generated by an earthquake. Toward 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 GFlops at 200 MHz.

[vazhenin-308-004-02:2016] Alexander Vazhenin Thanh-Trung Pham. Enhanced Integration Support for Reliability Prediction. *Frontiers in Artificial Intelligence and Applications*, 286:71–84, August 2016.

This paper presents RMPI-SerComp that offers enhanced integration support into service composition frameworks for RMPI, a recent model-based software reliability prediction technique. Our approach enables service composition frameworks to achieve a systematic consideration of service reliability during composing, without the need for any specialist knowledge of the underlying prediction method. Via a case study, we validate the applicability of our approach by utilizing RMPI-SerComp to integrate the reliability prediction capability into a service composition framework.

[vazhenin-308-004-03:2016] Andrey Marchuk Kensaku Hayashi, Alexander Vazhenin. Source Data and Bathymetry Editor in Tsunami Modeling Environment. *Frontiers in Artificial Intelligence and Applications*, 286:235 – 245, August 2016.

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.

Refereed proceedings of an academic conference

[mozgovoy-308-004-03:2016] M. Mozgovoy A. Moriyama. Assessing Similarities in Soccer Team Tactics. In *Proceedings of the 2nd International Conference on Applications in Information Technology (ICAIT)*, pages 54–55, 2016.

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[mozgovoy-308-004-04:2016] M. Mozgovoy A. Moriyama. Classification and Clustering in Soccer Analytics. In *Proceedings of the 47th International Conference on Control Processes and Stability*, pages 576–582, 2016.

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[mozgovoy-308-004-05:2016] M. Mozgovoy H. Yamaguchi. Analysis of Emoticons in a Japanese Twitter Corpus. In *Proceedings of the 2nd International Conference on Applications in Information Technology (ICAIT)*, pages 116–117, 2016.

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[mozgovoy-308-004-06:2016] M. Mozgovoy Y. Kobayashi. Realtime Analysis of Tweet Streams with EmoTwitter. In *Proceedings of the 2nd Interna-*

tional Conference on Applications in Information Technology (ICAIT), 2016.

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[mozgovoy-308-004-07:2016] A. Chisler Y. Volkova E. Pyshkin, M. Mozgovoy. Striving with Online Addiction with a Self-Control Chrome Extension. In *IEEE Symposium Series on Computational Intelligence*, 2016.

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[mozgovoy-308-004-08:2016] I. Umarov M. Mozgovoy, M. Purgina. Believable Self-Learning AI for World of Tennis. In *IEEE Computational Intelligence in Games*, pages 247–253, 2016.

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[mozgovoy-308-004-09:2016] V. Klyuev M. Purgina, M. Mozgovoy. Developing a Mobile System for Natural Language Grammar Acquisition. In *The 14th IEEE International Conference on Dependable, Autonomic and Secure Computing*, pages 322–325, 2016.

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[mozgovoy-308-004-10:2016] M. Mozgovoy M. Park, M. Purgina. Learning English Grammar with WordBricks: Classroom Experience. In *Proceedings of the 2016 IEEE International Conference on Teaching and Learning in Education*, pages 220–223, 2016.

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[mozgovoy-308-004-11:2016] M. Ward M. Purgina, M. Mozgovoy. MALL with WordBricks – Building Correct Sentences Brick by Brick. In *CALL In a Climate of Change: Adapting to Turbulent Global Conditions – Short Papers from EUROCALL 2017*, pages 254–259, 2017.

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[mozgovoy-308-004-12:2016] E. Pyshkin M. Mozgovoy. Using Image Recognition for Testing Hand-drawn Graphic User Interfaces. In *Proceedings of the 11th International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies (UBICOMM)*, pages 25–28, 2017.

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[mozgovoy-308-004-13:2016] M. Mozgovoy M. Purgina. Visualizing Sentence Parse Trees with WordBricks. In *Proceedings of the 3rd IEEE International Conference on Cybernetics*, pages 1–4, 2017.

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[mozgovoy-308-004-14:2016] T. Ito T. Rikimaru G. Mola Bogdan, M. Mozgovoy. Believability Assessment for Fighting Game AI. In *Proceedings of GameOn'2017 Conference*, pages 87–89, 2017.

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[mozgovoy-308-004-15:2016] H. Yamaguchi M. Mozgovoy. Generating AIML Rules from Twitter Conversations. In *Communication Papers of the 2017 Federated Conference on Computer Science and Information Systems (FedCSIS)*, pages 59–61, 2017.

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[mozgovoy-308-004-16:2016] M. Ward M. Purgina, M. Mozgovoy. Learning Language Grammar with Interactive Exercises in the Classroom and Beyond. In *Proceedings of the 9th International Conference on Computer Supported Education*, pages 470–475, 2017.

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[vazhenin-308-004-04:2016] Fumiya Kono Naohito Nakasato Alexander Vazhenin Stanislav Sedukhin Kohei Nagasu, Kentaro Sano. Parallelism for High-Performance Tsunami Simulation with FPGA: Spatial or Temporal? In *Proceedings of the 2016 IEEE 24th Annual International Symposium on Field-Programmable Custom Computing Machines (FCCM)*, pages 30–30. IEEE, 2016.

To carry out fast but accurate tsunami simulation after a major earthquake, we have developed an FPGA-based custom computing machine for high-speed but low-power tsunami simulator. We design a stream processing element (SPE) which is hardware based on pipelining and data-flow for tsunami computation. This paper presents design-space exploration for spatial and temporal parallelism of SPEs.

[vazhenin-308-004-05:2016] Alexander Vazhenin Miray Watanabe, Yutaka Watanobe. Architecture for Hybrid Language Systems. In *Proceeding of the 2016 IEEE International Conference on Computer and Information Technology (CIT)*, pages 134–139. IEEE, 2016.

An architecture for hybrid language systems is presented. A hybrid language has features of both textual languages and visual languages. Textual languages are computer-oriented and are geared toward storage, syntax analysis, and editing. On the other hand, visual languages are human-oriented and are geared toward expressive power, understandability, direct manipulation, and learning cost. Although a hybrid language system has the advantages of both textual and visual languages, general architectures to develop the corresponding programming environment considering real-time processing, synchronization, and multiple platforms have not yet been proposed. In the present paper, an architecture for hybrid language systems that support the development of new hybrid languages and the corresponding programming environments is presented. Implementation methods based on this architecture is demonstrated, and a case study is presented.

[vazhenin-308-004-06:2016] A. Vazhenin G. Meguro. WWW-based System for LEGO Robots Control. In V. Klyuev A. Vazhenin E. Pyshkin, editor, *Proceedings of the 2nd International Conference on Applications in Information Technology (ICAIT2017)*, pages 46–49. The University of Aizu, The University of Aizu Press, October 2016.

This article proposes a WEB-based LEGO Robot control system with JAVA technologies. This work is based on the original Virtual-Model-View-Controller design pattern, and focused to exchange data between server and robot. The designed system can manage the robot and reflects the collected data by robot to the client on web page.

[vazhenin-308-004-07:2016] A. Vazhenin G. Meguro, K. Abe. Visual Learning Tool for Lego Robots Programming. In A. Vazhenin E. Pyshkin, V. Klyuev, editor, *Proceedings of the 2nd International Conference on Applications in Information Technology (ICAIT2017)*, pages 50–53. The University of Aizu, The University of Aizu Press, October 2016.

This article proposes visual learning tool for Lego MINDSTORMS EV3 using LEJOS firmware. It has an icon- based style of introducing robot activities with on-line reflection of corresponding code. This allows beginners to enjoy and make EV3 programs. The designed tool can launch and control the robot actions and check/debug them even if a program isn't complete. It also enabled that a client operates on the web page and moves a robot through a server.

[vazhenin-308-004-08:2016] J. Brine G. Bateson, A. Vazhenin. A Graphical Interface for Awarding Incremental Points for Digital Badges in an English

Villiage Reward System. In *INTED2017 Proceedings: 11th International Technology, Education and Development Conference Valencia, Spain. 6-8 March, 2017.*, pages 2060–2067, Valencia, Spain. 6-8 March, 2017, March 2017. IATED, IATED.

This paper describes the design and implementation of a graphical interface for awarding small numbers of points to students rapidly and repeatedly. The points accumulate and contribute toward digital badges which are used as the mechanism for recording and recognizing achievements in an English village project at a university in Japan. Hitherto, standard grading interfaces in leading open-source Learning Management Systems (LMSs), such as Moodle, have not been suitable for awarding incremental points for two main reasons. First, there is the difficulty of locating a student in a vertical list of names that is ordered alphabetically and potentially spans several pages. Second, in order to award incremental points in systems that only store a total number of points, it is necessary for the teacher to perform some mental arithmetic when awarding points and increase the current total by the incremental amount.

Research grants from scientific research funds and public organizations

[vazhenin-308-004-09:2016] Alexander Vazhenin. Service-oriented Infrastructure for Tsunami Education and Digital Badges support for English Learning Management System, 2015-2017.

Academic society activities

[vazhenin-308-004-10:2016] Alexander Vazhenin, 2016.

Member

[vazhenin-308-004-11:2016] Alexander Vazhenin, 2016.

Member

[vazhenin-308-004-12:2016] Alexander Vazhenin, 2016.

Member

[vazhenin-308-004-13:2016] Alexander Vazhenin, 2016.

Member

[vazhenin-308-004-14:2016] Alexander Vazhenin, 2016.

Member

[vazhenin-308-004-15:2016] Alexander Vazhenin, 2016.

Co-chairman of the 9th IEEE International Conference on Ubi-Media Computing

[vazhenin-308-004-16:2016] Alexander Vazhenin, 2016.

Program Committee Member of the Federated Conference on Computer Science and Information Systems, FedCSIS 2016

Advisor for undergraduate research and graduate research

[rentaro-308-004-01:2016] Genki Makiguchi. Graduation Thesis: Analysis of User Interface Design Guidelines from Decision Support Perspective, University of Aizu, 2016.

Thesis Advisor: Yoshioka, R.

[rentaro-308-004-02:2016] Kenta Bashomatsu. Graduation Thesis: Design of UI Component Library Oriented to Informed Decision Support, University of Aizu, 2016.

Thesis Advisor: Yoshioka, R.

[rentaro-308-004-03:2016] Mariko Tanaka. Graduation Thesis: User Interface Based on Simple Motions of 3D Objects, University of Aizu, 2016.

Thesis Advisor: Yoshioka, R.

[rentaro-308-004-04:2016] Yurina Hoshi. Graduation Thesis: Multiple-view of Behavior: Analysis of Programming Contest Logs, University of Aizu, 2016.

Thesis Advisor: Yoshioka, R.

[rentaro-308-004-05:2016] Tatsuya Ishii. Graduation Thesis: A Method for Identifying 3DKanji from Digital Image, University of Aizu, 2016.

Thesis Advisor: Yoshioka, R.

[vazhenin-308-004-17:2016] Masaru Usui. Graduation thesis, Undergraduate, March 2017.

Recent robotics studies ways how the robot can use the WWW-space more conveniently. Accordingly, the presented research is devoted to design and evaluate features of stand-alone and WEB-based robot control approaches based on the same robot behavior. We designed and compare two kinds of applications using LEGO MINDSTROMS EV3. Accordingly, advantages and disadvantages are analyzed for both types of approaches. Based on the same robot program, a comparison between two approaches was implemented. In addition, some improvements of the LEGO robot sensors usage were also provided.

[vazhenin-308-004-18:2016] Ryotaro Ishikawa. Graduation thesis, Undergraduate, March 2017.

Visual Learning Programming-editor (VLP-editor) has an icon-based style of introducing robot activities with on-line reflection of corresponding code. This allows beginners to enjoy and make EV3 programs allowing to launch and control the robot actions and check/debug them even a program isn't complete. This article is devoted to evaluate the current architecture of TLP-editor made by a prior research as well as to improve its functionality by adding additional functions. Accordingly, a user can make rather complex LEGO-robot programs.

Contributions related to syllabus preparation

[rentaro-308-004-06:2016] Software Engineering I

[rentaro-308-004-07:2016] Venture Startup Factory 6 Introductory PBL

[rentaro-308-004-08:2016] Software Studio

[rentaro-308-004-09:2016] Creativity Development

[vazhenin-308-004-19:2016] Undergraduate Course: Operating Systems

[vazhenin-308-004-20:2016] Undergraduate Course: Software Enginering II

[vazhenin-308-004-21:2016] SCCP Project: Practical application and network defence

[vazhenin-308-004-22:2016] Graduate course: Theory and Practice of Software Engineering I

[vazhenin-308-004-23:2016] Graduate course: Theory and Practice of Software Engineering II

[vazhenin-308-004-24:2016] Graduate Course: Parallel, Distributed and Interenet Computations

Advisor of a student club or circle

[rentaro-308-004-10:2016] Adviser of the University of Aizu Orchestra Dolce

Contribution related to on-campus/off-campus publicity work

[rentaro-308-004-11:2016] Presented PBL activities of UoA at enPiT workshops

Contribution related to educational planning management

[vazhenin-308-004-25:2016] Undergraduate School: Coordinator of the Software Engineering Field of Study

[vazhenin-308-004-26:2016] Graduate School: Coordinator of the Software Engineering Field of Study

[vazhenin-308-004-27:2016] Graduate School: Chair of the IT and PM department

Contribution related to planning administration for research, research conferences, or international research

[vazhenin-308-004-28:2016] Co-Chairman of the 2nd International Conference on Applications in Information Technology (ICAIT-2016), University of Aizu, Aizu-Wakamatsu, October, 2016

Contribution related to educational research technology and facility planning management

[vazhenin-308-004-29:2016] Coordinator of the Software Engineering Field of Study of the Graduate School

Other significant contribution toward university planning, management, or administration

[rentaro-308-004-12:2016] Preparation and organization of programming contest as an organizing committee member of PC Koshien 2016

[rentaro-308-004-13:2016] Preparation of course material and management of an online programming learning system for students admitted by recommendation

[rentaro-308-004-14:2016] Student recruiting activities for the Graduate Department of Information Technologies and Project Management

[vazhenin-308-004-30:2016] Chair of the Department of Information Technology and Project Management

[vazhenin-308-004-31:2016] Member of the Graduate School Academic Affairs Committee

[vazhenin-308-004-32:2016] Member of Graduate School Entrance Examination Committee

Contributions related to regional education

[rentaro-308-004-15:2016] Offered lecture on Information Science at the Takeda Nurses School

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

[rentaro-308-004-16:2016] Organization of open-lab during Open Campus event

[rentaro-308-004-17:2016] Organization of open-lab during University Festival

[rentaro-308-004-18:2016] Preparation and organization of University public lecture 'Introduction to Programming and Algorithms for High-school Students'

[rentaro-308-004-19:2016] Preparation and organization of University public lecture 'Basic and Practical Programming for High-school Students'

[rentaro-308-004-20:2016] Preparation and organization of open-online course 'Algorithms and Programming' for PC Koshien participants.

[vazhenin-308-004-33:2016] During OpenLab and OPen Campus, several applications based on original software design methodology were presented allowing an integration of heterogeneous software components. Visual LEGO Programming Environment allows designing and debugging programs for LEGO robots by users of any level of skill. We showed a LEGO robot hardware as well as several applications designed by our students. Software was demonstrated for Tsunami Wave Propagation Modeling and Forecasting.

Do you have experience of University-Industry collaboration? If yes, please describe your experience. (for UBIC's information)

[rentaro-308-004-21:2016] Developed an Ancient Map Viewing software for museum visitors in cooperation with the Fukushima Museum

[rentaro-308-004-22:2016] Developed an Impression Recording software for museum visitors in cooperation with the Fukushima Museum