## Active Knowledge Engineering Laboratory

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Active Knowledge Engineering Lab

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. 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 and Natural Language Parsing

Experimenting with human behavior via human-computer interaction is challenging and interesting topic with many possible problems. Our research interests include: - Artificial intelligence systems for computer games; - Virtual experiments based on human-computer interaction; - Understanding and modeling human behavior. Natural language processing is a challenging branch of modern artificial intelligence. Its applications include text analysis, machine translation, computer-assisted language learning, grammar checking, and information retrieval. Our current research is mostly focused at parsing, i.e. at analysis of language sentences in order to discover dependencies between individual words

3 Human-centric Software for Multi-resolution High-performance Tsunami Modeling and e-Learning

The main goal of the project is in research and development of the multi-purposed Programming Platform via integration of software and information components designed by different groups of developers. The set of applications will be developed based on the original Virtual-Model-View-Controller (V-MVC) design pattern that is an integration of two well-known approaches: Service-Oriented Ar-

chitecture (SOA) and the Model-View-Controller (MVC). Based on this approach, the main components of the SOA-based High-Performance Tsunami Modeling System are designing. Main components of the Service-Oriented Architecture (SOA) for the Tsunami Wave Propagation Modeling are developing by adaptation of the MOST (Method of Splitting Tsunami) software package. This year research is devoted to developing the Tsunami Modeling System components named Application Engines that are functioning at the Model layer. Accordingly, we are distinguishing the following main application engines: Tsunami Wave Propagation/Inundation, and Impaction Engines each of which reflects a corresponding stage of modeling process (tsunami wave propagation, inundation and impaction). We are also developed the Tsunami Visualizing Engine (TVE) allowing to transform the digital results of modeling to the human-centered data representation.

The other subsystem is the e-Learning Arena allowing personalizing the use of exercises and test materials as a tournament as well as reducing the teacher ' s efforts. The e-Learning arena can also be considered as a variety of learning services consumed by different types users: Teachers, Students, Judges, etc. associated with the Objective as a project class with Course and Tournament as the two main variants. The way of assembling of the services was investigated in a web-based tool called Wiki Gloss. Wikipedia Miner is used to extract the content to feed the glosses from Wikipedia, taking advantage of the vast content and diversity of topics that are already available, as well as languages. This approach offers a potential reusability of services not only in diverse applications that can take advantage of glossing, but also provides the content in different languages.

## Refereed Journal Papers

[mozgovoy-01:2014] T. Kakkonen E. Sutinen M. Mozgovoy V. Klyuev M. Munezero, C. Montero. Automatic Detection of Antisocial Behavior in Texts. *Informatica*, 38(1):3–10, 2014.

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[vazhenin-01:2014] K. Hayashi, A. Vazhenin, and A. Marchuk. Application Engines in VMVC-based Tsunami Modeling Environment. *Frontiers in Artificial Intelligence and Applications*, 265:464–475, 2014.

Currently, Service-Oriented Architecture (SOA) may be considered as a state of the art approach for the complex software design and implementation because of high-level of operability and reusability of system components. Accordingly, we are applying the SOA-patterns to the creating the Tsunami Wave Propagation Modeling Environment because of complexity and versatility of tsunami modeling methods and tools. Our approach is followed an original Virtual Model-View-Controller pattern (VMVC) that is an adaptation of the traditional MVC to SOA. It is demarcating a Functional (View) and an Implementation (Model) task by inducing an Integrator (Controller) that encapsulates non-functional activities such as security, reliability, scalability, and routing. The presented paper is devoted to developing the Tsunami Modeling System components named Application Engines that are functioning at the Model layer. Accordingly, we are distinguishing the following main application engines: Tsunami Wave Propagation/Inundation, and Impaction Engines each of which reflects a corresponding stage of modeling process (tsunami wave propagation, inundation and impaction). We are also focusing on the developing the Tsunami Visualizing Engine (TVE) allowing to transform the digital results of modeling to the human-centered data representation.

[vazhenin-02:2014] An.G. Marchuk, K. Hayashi, and A.P. Vazhenin. Transboundary realization of the nested-grid algorithm for trans-pacific and regional tsunami modeling. *Bulletin of Novovosibirsk Computer Center, Mathematical Modeling in Geophysics*, 18:35–47, 2015.

Thegrid-switchingalgorithmforthetsunamipropagationcomputation from the initial source to the coastline that uses scale switching has been developed. Computations are carried out on a sequence of grids with various resolutions where one is embedded into another. Tsunami wave parameters are transferred from a larger domain to the embedded smaller one by means of the boundary

conditions. Using the method proposed, the numerical simulation of tsunami generated by a model ellipsoidal source located in the middle of the Pacific was carried out.

## Unrefereed Papers

[vazhenin-03:2014] F. Kono, N. Nakasato, K. Hayashi, A. Vazhenin, and St. Sedukhin. OpenMP parallelization of tsunami propagation simulation by MOST and its estimation. *IPSJ Research Report on High-Performance Computing (HPC)*, 2014-HPC-146(24):1–6, 2014.

MOST(Method Of Splitting Tsunami) is widely used to solve shallow water equations for tsunami propagation caused by an earthquake. We evaluated the performance of a parallel version of MOST. We have ported the original code written in FORTRAN into C++ for applying various parallelization techniques such as OpenMP, OpenCL and MPI on several parallel architectures. In this report, we present the performance evaluation using OpenMP on a multi-core CPU system and the many-core (Intel Xeon Phi) system.

[vazhenin-04:2014] R. Cortez and A. Vazhenin. Virtual-MVC framework to support collaborative development of Service-Oriented E-learning components. *IEICE Tech. Rep*, 114(525):19–24, 2015.

The integration of Cloud Computing with e-Learning technologies allows changing the educational landscape by scaling the resources including Massive Open Online Courses (MOOC). SOA have been mostly adopted for enterprise integration. However, its adoption for e-learning solutions is still an open area especially for medium and small groups of developers. In this work we demonstrate a service-based methodology, and its corresponding framework to develop service-oriented e-learning components. The proposed methodology called a Virtual Model-View-Controller is enhancing the well-known Model-View-Controller design pattern. Accordingly, the controller is realized as an Enterprise Service Bus allowing decoupling between the View and the Model. The Model is represented as a repository of atomic services that are exposed via the controller. The benefits of this framework are facilitating and supporting collaborative development of e-learning services that can be adopted in different applications scenarios.

## Refereed Proceeding Papers

[mozgovoy-02:2014] A. Lagunov N. Gerasimov, M. Mozgovoy. Semantic Sentence Structure Search Engine. In *Proceedings of the 4th International Workshop on Advances in Semantic Information Retrieval*, pages 255–259, 2014.

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[mozgovoy-03:2014] J. Brine R. Efimov, M. Mozgovoy. CALL for Open Experiments. In *Proceedings of the 6th International Conference on Computer Supported Education*, pages –, 2014.

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[rentaro-01:2014] Rentaro Yoshioka Keiko Igarashi, Saki Seino. Symbols and Rules for a Self-Explanatory Machine Model. In *International Technology, Education and Development Conference (INTED2015)*, pages 4636–4644. IATED, March 2014.

A web-based service to facilitate learning of artwork is presented. The service is based on the idea of “Active Knowledge (AK)”, a format of knowledge that prompts its active reuse and creation of new knowledge. Using this service, users can study artworks through data prepared in AK format and create new knowledge by adding their own findings, impressions and comments. In the paper, details of the AK format and functions of the service and their relation to the learning process are presented. Especially, the service is oriented to life-long learning by adults regardless of their interests in art and also to art education for children.

[rentaro-02:2014] Rentaro Yoshioka Keiko Igarashi, Saki Seino. Symbols and Rules for a Self-Explanatory Machine Model. In *2014 IEEE 8th International Symposium on Embedded Multicore/Manycore SoCs (MCSoc)*, pages 49–54. IEEE, September 2014.

A generic, self-explanatory model for programming devices and machines is presented. The machine model defines both the structural composition and its behavior using a set of four visual languages. In this paper, the basic symbols for the four languages are presented. The symbols are positioned according to predefined layout rules to specify the machine features. Each symbol is designed to represent its meaning as directly as possible. The underlying data structure of the machine model is also described. The model can be used to acquire knowledge related to machine development and be reused by enthusiasts and students.

[rentaro-03:2014] Rentaro Yoshioka Shota Furuya, Katsuki Yanai. An Analysis Tool for a Programming Contest for High-School Students. In *2014 IEEE 8th International Symposium on Embedded Multicore/Manycore SoCs (MCSoc)*, pages 132–137. IEEE, September 2014.

Owing to the rapid growth of the modern information society, it is necessary to educate young people who are responsible for the future of the Information Technology (IT). A programming contest is a competitive learning that is intended to improve skills and enhance knowledge of the IT. In Japan, programming contests for highschool students play an important role in information education but analyses of their effect and role in the education system has been scarce. In this research, an analysis framework based on a survey of programming contests is proposed and a corresponding analysis tool for evaluating and analyzing a programming contest is created. The summary of the survey, the details of the framework and the tool are explained in this paper.

[rentaro-04:2014] Rentaro Yoshioka Hidehito Sawai. A Format for Work Specification. In *2014 IEEE 8th International Symposium on Embedded Multicore/Manycore SoCs (MCSoc)*, pages 123–127. IEEE, September 2014.

A format for work specification is developed. It is a format to specify and annotate activity performed by people. Through this format, people may specify the target, objective, and intended results of an activity. The format improves the completeness of specification by using a predefined set of elements. In addition, it improves understanding through efficient access to required knowledge. Moreover, it improves correctness of specification by consistency and dependency checking. In this paper, we introduce the definition of the work, contents of the format, description method of the contents and candidate icons of language to specify it. In addition, to demonstrate and evaluate the format, an example specification of agriculture work is presented.

[vazhenin-05:2014] R. Cortez, A. Vazhenin, and J. Brine. Automatic Glossing Services for E-learning Cloud Environments. In *2014 IEEE 8th International Symposium on Embedded Multicore/Manycore SoCs (MCSoC-14)*, pages 128–131, Aizuwakamatsu, Japan, September 2014. IEEE sponsored, University of Aizu, IEEE Publisher.

In language learning scenarios, the use of glossing technique has a positive effect on incidental vocabulary acquisition as a by-product of reading. However, the preparation of materials that include glosses can be a time consuming task for the teacher. Automatic glossing tools have gained interest to help reduce such

efforts, and to provide a better experience using electronic documents. Most glossing tools are still developed following a monolithic approach for a specific system or language due to its complexity. As e-Learning platforms are moving from monolithic applications to service based platforms suitable for Cloud environments, the tools as well should be designed following Service-Oriented principles. This work focuses on the design of automatic glossing services suitable for Cloud environments. The development follows an original Virtual-Model-View-Controller design pattern for the creation of loosely coupled components. The services are assembled in a web-based tool called Wiki Gloss. Wikipedia Miner is used to extract the content to feed the glosses from Wikipedia, taking advantage of the vast content and diversity of topics that are already available, as well as languages. This approach offers a potential reusability of services not only in diverse applications that can take advantage of glossing, but also provides the content in different languages.

[vazhenin-06:2014] S. Ito, H. Tan, P. Cortez, S. Bhalla, AP.Vazhenin, and Junya Terazono. Digital Data Refinement for the Area of Crater on the Moon. In Proceedings Editor A. Szakal, editor, *46th Lunar and Planetary Science Conference (2015)*, pages 1–2, The Woodlands, Texas, March 2015. NASA.

In this paper, we provide possibility that we can define the boundary of crater with much more accurate and global measurement of lunar figure, which is based on lunar height of surface data. It is different with existing way to extract the boundary of crater with image by using pixel data. Various automatic detection technologies include diverse approaches use different type of data from our using data, elevation data. They use and analyze pixel and regularity data. We focused attention on SELENE (KAGUYA) Data Archive publishing various data, for example, spectrum, elevation, particle data, etc. Recently, the systems used published data at this data archive are developed. For example, the lunar feature/name based Kaguya data search system. The pixel data is used in image processing. The pixel data, different type of data from elevation data is used in image processing. This technology is the convenient method to recognize crater and some object on the moon. However, This technology cannot available to use detection of concrete crater boundary because of usage of pixel data. As compared with that, our using data is absolute element excepted for abstractness. Published elevation data is calculated by using range data acquired by LALT (Laser Altimeter) globally satellite's trajectory on the polar orbit. These range data of LALT will enable us for the first time in the world to construct a

global, accurate and precise topographic map of the Moon. For such occasions, detected crater boundary under data can be success show the refinement of crater area.

## Chapters in Book

[mozgovoy-04:2014] M. Mozgovoy I. Umarov. *Creating Believable and Effective AI Agents for Games and Simulations: Reviews and Case Study. In: Contemporary Advancements in Information Technology Development in Dynamic Environments*, pages 33–57. IGI Global, 2014.

[mozgovoy-05:2014] M. Mozgovoy W. Hmlinen, V. Kumpulainen. *Evaluation of Clustering Methods for Adaptive Learning Systems. In: Artificial Intelligence Applications in Distance Education,*, pages 245–268. IGI Global, 2014.

## Academic Activities

[rentaro-05:2014] R Yoshioka, Sept. 2014.

Programming Committee, CCLS Workshop, IEEE MCSoC-14.

[vazhenin-07:2014] A. Vazhenin, 2014.

Member of IEEE, ACM, IEICE, IPSJ, JpGU

[vazhenin-08:2014] A. Vazhenin, 2014.

Program Committee Member of the 13th International Conference on New Trends in Software Methodologies, Tools and Techniques (SoMeT 2014)

[vazhenin-09:2014] A. Vazhenin, September 2014.

Program Committee Member of the Federated Conference on Computer Science and Information Systems (FedCSIS2014)

## Ph.D and Others Theses

[rentaro-06:2014] Keiko Igarashi. Master Thesis: An Architecure for Systems based on Active Knowledge, University of Aizu, 2014.

Thesis Advisor: Yoshioka, R.

[rentaro-07:2014] Chika Adachi. Graduation Thesis: Survey of Knowledge in Growing Crops and its Application to Active Knowledge, University of Aizu, 2014.

Thesis Advisor: Yoshioka, R.

[rentaro-08:2014] Daijiro Hirose. Graduation Thesis: A Multimedia Dictionary based on 3D Kanji, University of Aizu, 2014.

Thesis Advisor: Yoshioka, R.

[rentaro-09:2014] Ayaka Oono. Graduation Thesis: Survey of Knowledge in Regional Culture and its Application to Active Knowledge, University of Aizu, 2014.

Thesis Advisor: Yoshioka, R.

[rentaro-10:2014] Nana Kanno. Graduation Thesis: Programming Courseware for Teachers based on Practical and Familiar Tasks, University of Aizu, 2014.

Thesis Advisor: Yoshioka, R.

[rentaro-11:2014] Fujisaki Tetsuo. Graduation Thesis: Survey of Knowledge in Manufacturing and its Application to Active Knowledge, University of Aizu, 2014.

Thesis Advisor: Yoshioka, R.

[rentaro-12:2014] Saki Seino. Master Thesis: An Architecure for Systems based on Active Knowledge, University of Aizu, 2014.

Thesis Advisor: Yoshioka, R.

[vazhenin-10:2014] Hayato Tan. Calculation of the Area for a Crater on the Moon, University of Aizu, 2014.

Thesis Advisor: A. Vazhenin