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Digital Imaging for Active Knowledge Semantic Surfaces

[1] Organization

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[2] Progress of the Research

This year we have focused on employment of 3D and multimedia aspects of interfaces involved in computer-based supportive systems and related to interactions between objects and people. These aspects are based on a wider perspective of “visualizing the invisible” where (in addition to specific code images and optical devices) 3D, tangible and multimedia forms and formats play a fundamental role.

Education is one of important applications for our research. Within its framework, a new learning environment has been proposed, where 2D kanji, their parts, and corresponding edge encoded cards are integrated with 2.5D and 3D versions of kanji and kanji parts to support developing new forms of educational tools and materials. These forms allow incorporating new tangible associations as well as other associations that might have positive influence on children’s perception and memorization. Learning of kanji is a complex process that requires significant time and effort for understanding fundamentals of kanji construction, developing adequate writing skills, retention of proper meaning and language use, etc. Research performed is related to earlier stages of kanji learning where basic understanding of kanji composition takes place and tangible associations are being established. Written kanji are essentially flat and thus resemble alphabet characters and numerals but in contrast to them many kanji and kanji components are derived from, and thus directly associated with existing physical artifacts and notions. For novice kanji learners, however, it is usually very hard to analyze and map kanji and kanji components to existing artifacts. We attempt to facilitate this process by introducing various tangible kanji representations and bringing flat, written kanji back to the tangible 3D world where learners can get proper touch and feel of them.

Other research results, related to Technology enhanced learning (TEL), show how and by which methods multidisciplinary, interdisciplinary, and pandisciplinary educational content can be created, and how its presentation in different forms can be organized. Tangible interfaces based on digitally enhanced physical objects, including printed documents, combined with animation based interfaces demonstrating processes of geometrical object creation are a practical way for developing novel educational environments.

Programming in pictures could further enhance the development of new educational materials and dedicated content in such environments. In fact, programming in pictures is an approach where pictures (images) and moving pictures are used as super-characters for representing features of computational algorithms. Within this approach some "multidimensional data spaces" are traversed by "fronts of computation" and necessary operations are performed during these traversal processes. Generic pictures of the algorithmic super-characters are used to compose compound pictures (called algorithmic CyberFrames) defining algorithmic steps. Compound pictures are

assembled into special series to represent some predefined algorithmic features. The series are assembled into Algorithmic CyberScenes and an Algorithmic CyberFilm. The generic and compound pictures are developed and acquired in algorithmic super-character galleries where supportive pictures of embedded clarity annotations are also included.

Our results show how this technique can be used for creating new information resources and new educational materials for teaching courses on algorithms and programming.

Among other considerations and results obtained within the project, educational framework for verification of object-oriented programs, methods for localization encoding in the bulk of physical objects by laser-induced damage, and an environment for sound localization experiments and automation should be mentioned.

During the project period several visits for presentations and research meetings at Shizuoka University have been accomplished, and a few researchers from outside of Japan have participated.

[3] Results

(3.1) Research results

Results obtained within the scope of this project have been presented at four International conferences and published in corresponding Proceedings. In addition, two papers have been published in journals and one more has appeared as a book chapter. International collaboration with researchers from Bulgaria and Canada has been essentially enhanced and a new basis for continuing joint research activity has been established.

(3.2) Future work

We are planning to use the potential of our results obtained within the project during the previous years.

We will consider extensions of the tangible 2.5D kanji based constructions to true 3D Kanji. While in the virtual world such constructions a fairly straightforward dividing a physical 3D Kanji into parts may be difficult. We will be studying, therefore, different possibilities to design and create 3D models of tangible Kanji that are essentially different from the previously known 3D Kanji and can be physically disassembled and assembled in the 3D space.

The educational framework for verification of object-oriented programs will also be considered. We plan to put the focus on project-based learning and related verification approaches. Examples of errors that are difficult to localize by dynamical verification methods will be presented.

The plan of our continuing collaboration will also include various interface layers that connect the users and information resources representing semantic of virtual objects or content of educational materials.

[4] Publications

(1) Kanev, K., Oido, I., Yoshioka, R., Mirenkov, N., Employment of 3D Printing for Enhanced Kanji Learning, In *Proceedings of The Joint International Conference on Human-Centered Computer Environments HCCE 2012*, Aizu-Wakamatsu, Japan, March 8-13, 2012, pp.165-170.

(2) Watanobe, Y., Yoshioka, R., Mirenkov, N., Programming in pictures: a way toward reliable software, In *New Trends in Software methodologies, Tools and Techniques,* IOS Press, 2011, pp.183-197.

(3) Watanobe, Y., Yoshioka, R., Mirenkov, N., Cognitive aspects of programming in pictures, *Modern Approaches in Applied Intelligence*, LNAI 6704, Part 2, Springer, 2011, pp. 11-20.

(4) Boytchev, P., Kanev, K., Nikolov, R., Technology Enhanced Learning with Subject Field Multiplicity Support, In *Proceedings of The Joint International Conference on Human-Centered Computer Environments HCCE 2012*, Aizu-Wakamatsu, Japan, March 8-13, 2012, pp.39-44.

(5) Kimura, S., Ueda, M., Kanev, K., Dynamic Solidification in a Square Cavity Cooled from the Top and Periodic Heating at the Bottom, In *Proceedings of the Int. Conf. Automatics and Informatics'11*, Sofia, Bulgaria, October 3-7, 2011, pp.195-199.

(6) Kimura, S., Ueda, M., Kanev, K., Time-dependent Solidification in a Square Cavity with a Temperature-modulated Liquid Layer Cooled from Above, *Information Technologies and Control* (accepted).

(7) Kanev, K., Kimura, S., Collaborative Learning in Dynamic Group Environments, Book chapter in "Distance Education Environments and Emerging Software Systems: new Technologies", Qun Jin (Ed.), IGI Global, 2011, pp.1-14.

(8) Ranaweera, R., Cohen, M., Endo, S., iBaton: Conducting Virtual Concerts Using

Smartphones, In *Proceedings of The Joint International Conference on Human-Centered Computer Environments HCCE 2012*, Aizu-Wakamatsu, Japan, March 8-13, 2012, pp.179-183.

(9) Nishimura, K., Cohen, M., iMedia Players for Accessibility, In *Proceedings of The Joint International Conference on Human-Centered Computer Environments HCCE 2012*, Aizu-Wakamatsu, Japan, March 8-13, 2012, pp.184-189.

(10) Weerasinghe, P. K., Cohen, M., Rhythm of Music Animating Virtual Environment Models, In *Proceedings of The Joint International Conference on Human-Centered Computer Environments HCCE 2012*, Aizu-Wakamatsu, Japan, March 8-13, 2012, pp.200-202.

(11) Vazhenin, D., Mirenkov, N., Vazhenin, A., Movie-based representation of reduction operations in numerical computing, *Knowledge-Based Systems*, 24, 2011, Elsevier, 977-988.

Travelling report

Name:	Nikolay Mirenkov
Affiliation:	School of Computer Science and Engineering, The University of Aizu
Period of time:	August 29, 2011 – September 2, 2011
Destination:	Shizuoka University, Japan
Purpose:	To carry out a joint research and project organization meetings and to schedule future research activities.
Name of receiver:	Prof. Kamen Kanev

Name:	Pavel Boytchev
Affiliation:	Faculty of Mathematics and Informatics, Sofia University
Period of time:	March 6, 2012 – March 14, 2012
Destination:	Shizuoka University, Japan
Purpose:	To carry out a joint research, plan the future collaboration, and participate and report obtained results at The Joint International Conference on Human-Centered Computer Environments HCCE 2012.
Name of receiver:	Prof. Kamen Kanev

Name:	Nikolay Mirenkov
Affiliation:	School of Computer Science and Engineering, The University of Aizu
Period of time:	March 8, 2012 – March 13, 2012
Destination:	Shizuoka University, Japan
Purpose:	To plan the future collaboration, coordinate the ongoing research, and participate in The Joint International Conference on Human-Centered Computer Environments HCCE 2012.
Name of receiver:	Prof. Kamen Kanev