

課題番号 : P-5

Imaging Devices and Digital Imaging of Semantic Surfaces in Active Knowledge Management

[1] Organization

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Participants:

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Toru Aoki (Research Institute of Electronics, Shizuoka University, Japan)

Kamen Kanev (Graduate School of Informatics, Shizuoka University, Japan)

[2] Progress of the Research

This year we have focused on considering the development of multi-media and multi-modal interface layers, including an imaging layer, to connect users and information resources representing the semantics of virtual or physical objects and the content of educational material, with reference to some common abstractions.

In particular we have:

- considered problems and applications of laser techniques for creating layers of marking in 3D objects;
- tested possibilities of different encoding schemes for the creation of semantic layers on generic objects and environments;
- developed applications combining augmented reality and marked objects;
- defined a modeling framework and an integrated environment for the development of applications based on surface coding;
- progressed in the study of integration between annotations and surface-based interaction.

[3] Results

(3.1) Research results

Results obtained within the scope of this project have been presented at various International conferences and published in corresponding Proceedings. International collaboration with researchers from Bulgaria, Canada, Ukraine and Italy has been successfully continued.

Professors Mirenkov and Watanobe have progressed on the development of an environment for the production and usage of active knowledge with particular reference to scientific and parallel programs. They have proposed the approach of

Programming in algorithmic pictures (a-pictures), where pictures and moving pictures are used as super-characters for representing features of computational algorithms and data structures. Within this approach some “data space structures” are traversed by “fronts of computation” and/or some “units of activity” are traversed by flows of data. There are compound a-pictures to define algorithmic steps (called Algorithmic CyberFrames) and generic a-pictures to define the contents of compound pictures. Compound a-pictures are assembled into special series to represent some algorithmic features. The series are assembled into an Algorithmic CyberFilm. The generic/compound a-pictures and their series are developed and acquired in special galleries of an open type where supportive pictures with embedded clarity annotations are included.

The *AIDA modeling/programming language (AIDA stands for Animation and Images to Develop Algorithms) and its Filmification modeling (F-modeling) environment have been defined and several programs in a-pictures have been produced. A special attention is paid to *AIDA programs as information resources which perception, comprehension and cognition depend on interaction with, at least, a few different but mutually supplementing features of a-pictures. Data/knowledge acquisition is based on clusters of different views and acquisition can be oriented to enhancing user’s ability within works on developing application models, corresponding algorithms and programs. The language is extended to define super-characters related to space structures for imitating some physical regions (shapes) in 3-D space and (computational) activities in time on structure nodes, and to diagram structures for representing connections between a set of activity units and specifying a partial order of the activity execution. The sets of the super-characters are open and adding new ones is implemented as a special knowledge/experience acquisition to support various modeling techniques and applications.

Related work on 3D objects has found applications to the area of 3D Kanji, where Professor Yoshioka provided sample 3D models of selected Kanji characters. The main theme of the research conducted under the supervision of Professors Kanev and Mirenkov was to facilitate and enhance the learning of Kanji. For this purpose an experimental educational environment in which students select and combine various physical components to build correct Kanji and

develop better understanding of kanji structure was developed.

Further work on the notion of augmented surfaces has been conducted principally by Professors Kanev, Mirenkov and Bottoni. Augmented surfaces are a novel paradigm for supporting interaction, where information is coded on the surface of a physical object, from which it can be read and used for different purposes.

For practical applications, along with traditional print-based methods, we are exploring laser-based technologies for permanent digital enhancement of physical objects with different material properties. Advanced methods for surface engraving and undersurface and volumetric laser marking are being developed in collaboration with Dr.Gnatyuk and team members from other Cooperative Research Projects.

In this line, a novel software architecture has been proposed by which object producers and application designers can independently define the information to be added on surfaces, as well as computational activities to be started upon identification of a coding. Moreover, the architecture also offers the possibility for the end user to choose to set the type of activities to launch as well as to select a specific activity when more than one is available.

This architecture is connected to the proposal of a framework for the construction of collaborative services, based on a technique for coding content generated both by authoritative organizations and by users on interactive supports. In particular, users can interact in an enriched and focused way with paper documents and object labels, both in desktop and mobile settings.

This offers the possibility of combining immediate access to online information from physical support with creation and retrieval of annotations, while keeping in focus the context of their creation, thus creating a collaboration space by extending the ways of interacting with documents and objects and the way in which these allow seamless access to both centralized and distributed information.

With reference to the possibility of using identifiable objects in combination with graphical user interfaces, Professor Bottoni and his collaborator Michele Ceriani have proposed a graphical environment for the creation of interactive multi-touch applications, possibly enriched with tangible objects, and able to react to different types of events, and supporting different types of visualization.

With reference to the integration of user annotations in semantic contexts, Professor Bottoni and his collaborator Hamjad Hawash have proceeded in the line of supporting the annotation activity by the definition of groups related to semantic domains, so as to keep collaborative activities focused on the group's interests.

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. In particular the Project Leader Professor Bottoni travelled to Hamamatsu in November 2013, where he was joined by the former Project leader Professor Mirenkov to carry out joint research with Professor Kanev and devise schemes for further collaboration. In this occasion, a CRP workshop was held, with presentations by Professors Bottoni, Mirenkov, and Gnatyuk. Professor Bottoni's visit was partially sponsored by CRP and partly by the Italian Ministry of Foreign Affairs, under a scheme for promoting research exchanges between Italy and Japan (namely between Professor Bottoni and Professor Kanev), which was promoted starting from the CRP collaboration. Also starting from the CRP collaboration, Professor Kanev has been awarded a grant for a three-month visit to Sapienza University of Rome. The Ministry of Foreign Affairs scheme has also sponsored the visit of Miguel Ceriani to Shizuoka University, starting on March 27th.

(3.2) Future work

We will progress in the lines discussed above leveraging on the results of this year

[4] Publications

- (1) P.Bottoni, K.Kanev, N.Mirenkov, "Constructing collaborative services through augmented documents and objects", *Proc. VINCI 2013*, pp.1-10, 2013.
- (2) P.Bottoni, K.Kanev, "Towards a flexible architecture for interaction with augmented surfaces", *Proc. UMEDIA-HC 2013*.
- (3) D.Avola, P.Bottoni, A.Hawash, "Users-Groups Matching in an Annotation System: Ontological and URL Relevance Measures", to appear in *Proc. CSIT 2014*.
- (4) D.Avola, P.Bottoni, A.Hawash, "Groups-Users Matching in an Annotation System Using Ontologies", poster presented at *CHIItaly 2013*.
- (5) P.Bottoni, M.Ceriani, "A Dataflow Platform for In-silico Experiments Based on Linked Data", *Proc. DNIS 2014*, pp.112-131.
- (6) K.S.Zelenska, S.E.Zelensky, L.V.Poperenko, S.G.Rozouvan, K.Kanev, V.Mizeikis, V.A.Gnatyuk, "Thermal mechanisms of laser marking in transparent polymers with light-absorbing microparticles", *Journal of Physics: Conference Series*, to appear.
- (7) V.A.,Gnatyuk, O.I.Vlasenko, S.N.Levytskyi, K.Kanev, V.,Mizeikis, T.Aoki, S.VGagarsky, L.V.Poperenko, K.S.Zelenska, A.O.Statsenko, "Features of laser-induced damage and creation of marking centers in digital material processing", *Journal of Physics: Conference Series*, to appear.
- (8) M.Ceriani, P.Bottoni, S.Valentini, "A user interface to build interactive visualizations for the semantic Web", demo at *ISWC 2013*
- (9) Y.Watanobe, N.Mirenkov, "Hybrid intelligence aspects of programming in *AIDA algorithmic pictures, *Future Generation Computer Systems* (Elsevier B.V., 2014)
- (10) Y.Watanobe, N.Mirenkov, "Diagram scenes in *AIDA", *Proc. IEEE 12th Int. Conf. on Intelligent Software Methodologies, Tools and Techniques*

Travelling report

Name: Nikolay Mirenkov
Affiliation: School of Computer Science and Engineering, The University of Aizu
Period of time: November 12, 2013 – Nov 17, 2013
Destination: Shizuoka University, Japan
Purpose: To carry out joint research and participate in the Cooperative Research Workshop “Imaging Devices and Digital Imaging of Semantic Surfaces in Active Knowledge Management” giving a talk titled “Imaging Aspects of *AIDA Programs Based on Active Knowledge Acquisition”.
Name of receiver: Prof. Kamen Kanev

Name: Paolo Bottoni
Affiliation: Department of Computer Science – Sapienza University of Rome
Period of time: November 7, 2013 – Nov 16, 2013
Destination: Shizuoka University, Japan
Purpose: To carry out joint research, participate in the Cooperative Research Workshop “Imaging Devices and Digital Imaging of Semantic Surfaces in Active Knowledge Management” at RIE giving a talk titled “A Model for Interaction through Augmented Surfaces”. Prof. Bottoni also conducted a special session titled “Possibilities for Joint Research Collaboration and Exchanges between Sapienza University of Rome and Shizuoka University” where all interested participants had a possibility to discuss opportunities for establishing contacts with potential research partners at Sapienza University of Rome.
Name of receiver: Prof. Kamen Kanev

Name: Nikolay Mirenkov
Affiliation: School of Computer Science and Engineering, The University of Aizu
Period of time: December 11, 2013 – Dec 19, 2013
Destination: Shizuoka University, Japan
Purpose: To carry out joint research and participate in the 16th International Conference on Humans and Computers held on December 17, 2013 (Hamamatsu) making a presentation entitled “Social and Educational Aspects of 3D Printing”.
Name of receiver: Prof. Kamen Kanev