ANNOTATIONS OF THE PUBLICATIONS INCLUDED IN THE DOCUMENTS FOR THE PROCEDURE

1. *Stoyanov, S., Valkanov, V., Popchev, I., Stoyanova-Doycheva, A., & Doychev, E. (2014). A model of context-aware agent architecture. Comptes Rendus de L'Academie Bulgare Des Sciences, 67(4), 487–496., ISSN: 13101331*

   The paper provides a general description of a model for context-aware agent architecture (C3A). The approach adopts the definition of context and context-awareness given by Dey. The C3A model aims at creating smart virtual spaces. Furthermore, the applicability of the model is demonstrated by development of an agent-oriented application – AjTempura.

2. *Stoyanova-Doycheva, A., E. Doychev, V. Valkanov, "Refactoring Learning Environment with Design Patterns", Engineering Sciences, Journal of the Bulgarian Academy of Sciences, vol.2, 2014, ISSN 1312-5702*

   This paper describes an extension of the Refactoring Learning Environments (rLE) for the application of design patterns. It allows the restructuring of an object-oriented code in order to improve it while covering more than one class. The paper presents a short overview of the refactoring learning environment architecture and explains how it is extended for the new goals. Several examples of design patterns are included, which are applicable for the refactoring agent.

3. *A. Stoyanova-Doycheva, E. Doychev, S.Stoyanov, Digital Library in Virtual Education Space, Applied Science Journal, Vol 1(1), November 2016, Applied Science University, Kingdom of Bahrain, ISSN 1764-2210*

   The article presents the architecture of the digital library in the Virtual Educational Space (VES). The three layers of the digital library are described - electronic resources, operational agents and an intelligent assistant who manages the digital library and who has a connection with the environment of the VES. More attention has been paid to the operational agents who service and use electronic resources. The implementation of an agent for generating and validating UML ontology tests is described in detail.

4. *S. Stoyanov, V. Valkanova, A. Stoyanova-Doycheva, E. Doychev, V. Valkanov, K. Gramova, Virtual Education Space, Applied Science Journal, Vol 1(1), November 2016, Applied Science University, Kingdom of Bahrain, ISSN 1764-2210*

   Distributed eLearning Centre (DeLC) developed in the Faculty of Mathematics and Informatics aims at delivery of electronic education services and teaching content, personalized and customized for each individual user. Virtual Education Space (VES) is a successor to DeLC. In this paper, general characteristic and the architecture of VES are presented. Problems related to the implementation and modeling of the space are considered as well.

5. *S. Stoyanov, A. Stoyanova-Doycheva, T. Glushkova, E. Doychev, J. Todorov, A reference architecture of internet of things ecosystem, Vol 7 No 1 (2018): Computer Sciences and Communications, ISSN: 1314-7846*

   Summing up the experience of building Virtual Education Space, this paper presents a reference architecture known as Virtual Physical Space (ViPS). ViPS is being developed as a Cyber-Physical-Social-Space. Our goal is for the reference architecture to be adaptable for a variety of Internet of Things ecosystems in different domains such as smart cities, smart environment and agriculture, and intelligent medicine. This paper presents the first version of ViPS's general reference architecture and its core components.

6. *Stoyanov, H. Zedan, E. Doychev, V. Valkanov, I. Popchev, G. Cholakov and M. Sandalski, Intelligent Distributed eLearning Architecture, V. M. Koleshko (Ed.), Intelligent Systems, InTech, March, 2012, 978-953-51-0054-6, Hard cover, 366 pages, pp. 185-218*

   One of the main characteristics of the eLearning systems today is the 'anytime-anywhere-anyhow' delivery of electronic content, personalized and customized for each individual user. To satisfy this requirement new types of context-aware and adaptive software architectures are needed, which are enabled to sense aspects of the environment and use this information to adapt their behavior in response to changing situation. In conformity with [Dey,2000], a context is any information that can be used to characterize the situation of an entity. An entity may be a person, a place, or an object that is considered relevant to the interaction between a user and an application, including the user and the application themselves. Development of context-aware and adaptive architectures can be benefited from some ideas and approaches of pervasive computing. Pervasive computing is a new paradigm for next generation distributed systems where computers disappear in the background of the users' everyday activities. In such a paradigm computation is performed on a multitude of small devices interconnected through a wireless network. Fundamental to pervasive computing is that any component (including user, hardware and software) can be mobile and that computations are context-aware. As a result, mobility and context-awareness are important features of any design framework for pervasive computing applications. Context-awareness requires applications to be able to sense aspects of the environment and use this information to adapt their behaviours in response to changing situations.

   One of the main goals of the Distributed eLearning Centre (DeLC) project is the development of such an architecture and corresponding software that could be used efficiently for on-line eLearning distance education. The approach adopted for the design and development of the system architecture is focused on the development of a service-oriented and agent-based intelligent system architecture providing wireless and fixed access to electronic services and electronic content. This chapter provides a general description of the architecture for two types of access - mobile and fixed. Furthermore, we present the Calculus of Context-aware Ambients (CCA in short) for the modelling and verification of mobile systems that are context-aware.

7. *S. Stoyanov, H. Zedan, E. Doychev, V. Valkanova, A. Stoyanova-Doycheva, V. Valkanov, Context-Aware E-Learning Infrastructure, E. C. Prakash and A. Ravindran (eds), "The ICT*

Age", Cambridge Scholars Publishing, 2016 ISBN (10): 1-4438-8714-5 ISBN (13): 978-1-4438-8714-4

Within this chapter is presented a service- and agent-oriented infrastructure created to support the delivery of context-aware education services and teaching content provision, known as Distributed eLearning Centre (DeLC),. The current state of DeLC and its ongoing transformation into a Virtual Education Space are described in detail. Furthermore, various formal tools for support of context-aware behavior of DeLC and VES are discussed. Calculus of Context Aware Ambients (CCA) will be used for modeling and verification of DeLC and VES infrastructure. Security and Context-Aware Flow (SC-Flow) will be used for the specification and implementation of scenario-based management in both infrastructures. Tempura will be applied for processing temporal dependencies in these scenarios.

8. *V. Valkanov, A. Stoyanova-Doycheva, E. Doychev, S. Stoyanov, I. Popchev, I. Radeva, "AjTempura – First Software Prototype of C3A model, Proc. Of the 7th International Conference Intelligent Systems (IS`14), 24-28 sept. Warsaw, Poland, Vol.1 Mathematical Foundations, Theory, Analyses, pp. 427-435 ISBN: 978-3-319-11312-8,DOI: 10.1007/978-3-319-11313-5_38*

   The paper provides a general description of a model for context-aware agent architecture (C3A) and first steps in AjTempura creation vie C3A model. The approach adopts the definition of context and context-awareness given by Dey. The C3A model aims at creating of smart virtual spaces. The applicability of the model is demonstrated by development of an agent-oriented application.

9. *K. Gramatova, S. Stoyanov, E. Doychev, V. Valkanov, Integration of eTesting in an IoT eLearning ecosystem - Virtual eLearning Space, BCI '15, September 02-04, 2015, Craiova, Romania, In ACM International Conference Proceeding Series (Vol. 02-04-September-2015). Association for Computing Machinery. https://doi.org/10.1145/2801081.2801086, ISBN: 978-1-4503-3335-1*

   This paper presents the functionality and overall architecture of an eTesting system designed to operate as an integrated part of a virtual eLearning space. The eTesting system provides distant eTesting facilities available to all registered users (e.g. students, educators, test content authors and all others involved in the testing process). An overview of the IoT paradigm is made. The authors' vision of an IoT eLearning ecosystem is described. The possibilities for integrating the presented eTesting system as a proactive unit in an IoT eLearining ecosystem are analyzed and examined. The conceptual approaches adopted by the eTesting system are analyzed in the context of the goal IoT integration. An architecture specifying the integration of RESTful web services with an assessment BDI agent system managing the eTesting processes are explained. Finally, an overview of the proposed eTesting system is provided in the aspect of its compatibility and integration within the virtual eLearning space.

10. *Stoyanova-Doycheva, E. Doychev, V. Ivanova, V. Valkanova, S. Stoyanov, DiLibS Platform for a Virtual Education Space, Proceedings of the 2015 Balkan Conference on Informatics: Advances in ICT, BCI '15, September 02-04, 2015, Craiova, Romania, In CEUR Workshop Proceedings (Vol. 1427, pp. 10–18). CEUR-WS., ISSN 00001994*

The Distributed eLearning Centre (DeLC) developed at the Faculty of Mathematics and Informatics aims at the delivery of electronic education services and teaching content, personalized and customized for each individual user. In this paper are presented some general characteristics and the architecture of VES (Virtual Education Space), a successor to DeLC. In addition, the core of a space called DiLibS platform is considered.

11. *I. Kehayova, P. Malinov, V. Valkanov, E. Doychev , "Architecture of a Module for Analyzing Electronic Test Results", IEEE 8th International Conference on Intelligent Systems, Hotel Hemus, Sofia, Bulgaria, September 4-6, 2016, CFP16802- ISBN 978-1-5090-1353-1*

    This article presents the use of intelligent agents in analyzing the results of electronic tests, based on IMS Question & Test Interoperability (QTI) standard. The results of the analysis show the average score of the conducted test, sections of the study material and questions of the test that hinders students. The aim is to support the educational process by creating a personal assistant which is of service to teachers. The personal assistant is a part of a virtual learning space which consists of autonomous components with reactive, interactive and proactive behavior and are capable of maintaining different mental levels.

12. *Emil Doychev, Asya Stoyanova-Doycheva, Stanimir Stoyanov and Vanya Ivanova, Agent-Based Support of a Virtual eLearning Space, ICCCI 2016, Halkidiki, Greece, 28-30 September, 2016, In Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*

    This paper provides an overview and presents the architecture of a virtual space supporting eLearning. Various types of assistants are examined as well which are implemented as rational BDI agents supporting the operation of the space. Furthermore, development of the space as an IoT ecosystem is considered. The DeLC 2.0 portal is presented as an entry point to the virtual space resources without the use of personal assistants

13. *Jordan Todorov, Emil Doychev, Daniela Orozova, and Asya Stoyanova-Doycheva, An IoT multi-agent assistant in the virtual educational space, AIP Conference Proceedings, 2018, 2048, 020038 (2018), doi: 10.1063/1.5082056*

    The paper explains the transition of our original personal assistant Learning Intelligent System for Student Assistance (LISSA) to the IoT multi-agent assistant that has a significant part in our newly developed concept of Virtual Education Space (VES). The new assistant contains a more meaningful role in the space and now includes different profiles allowing it to specialize in different types of users and different purposes.

14. *T. Glushkova, J. Todorov, E. Doychev, S. Stoyanov, Implementing an internet of things eLearning ecosystem, AIP Conference Proceedings 2018, https://doi.org/10.1063/1.5082045, 020027-1-020027-8*

    This paper presents an e-learning environment known as Virtual Education Space implemented as an Internet of Things ecosystem. The integration of virtual and physical worlds is a distinctive feature of closely related Cyber-Physical Spaces, Cyber-Physical-

Social Spaces, and Internet of Things. Building e-learning systems that exploit the integration of the virtual with the physical world would extend the possibilities for adapting and personalizing of the content and services, especially for disabled learners. The basic components of the space are described in more detail. Furthermore, the usage of the space is demonstrated for implementing a scenario for learners with special needs.

15. *S. Stoyanov, A. Stoyanova-Doycheva, T. Glushkova, E. Doychev, Virtual Physical Space – An Architecture Supporting Internet of Things Applications, 20th International Symposium on Electrical Apparatus and Technologies (SIELA), 3-6 June 2018, DOI: 10.1109/SIELA.2018.8447156*

    The Internet of Things (IoT) is an extension of the Internet into the real physical world in which physical entities (things) are interconnected. It defines an ecosystem composed of things that can sense the environment's changes, analyse these changes based on a shared gained knowledge and act or make plans accordingly for achieving a personal or a shared goal.

    This paper presents a reference architecture known as ViPS (Virtual Physical Space) which can be adapted to build IoT applications in various domains.

16. *Jordan Todorov, Irina Krasteva, Vanya Ivanova, Emil Doychev, BLISS – A CPSS-like Application for Lifelong Learning, INISTA 2019 conference, 3-5 July 2019, Sofia, Bulgaria*

    This paper presents a Cyber-Physical-SocialSpace (CPSS)-like application known as BLISS. The system supports a kind of lifelong learning where people who need to be educated have dropped out of school for various reasons but wish to complete their education through individual training. The active components of BLISS called personal assistants are implemented as intelligent agents. The agents' environment consists of three parts – an event-driven BLISS server, a set of personal assistants that will be described in the publication and a School Diary implemented as a blockchain. Furthermore, the reference architecture named Virtual Physical Space (ViPS), used to develop the application, is briefly described.

17. *S. Stoyanov, T. Glushkova, E. Doychev, A. Stoyanova-Doycheva, V. Ivanova, Cyber-Physical-Social Systems and Applications- Part1, LAP LAMBERT Academic Publishing, 2019, ISBN: 978-620-0-31825-1, 101 pages, (Book)*

    This book is an attempt to summarize the research and practical experience of the authors in building distributed systems, with active components are implemented as intelligent agents. 15 years ago, to support e-learning at the Faculty of Mathematics and Informatics at the University of Plovdiv began the development of DeLC (Distributed eLearning Center). DeLC is a distributed environment aiming to support context-aware provision of education services and electronic content. The DeLC architecture may be considered as a graph consisting of separate nodes; each of them models a real education unit, which offer a complete or partial educational cycle.

    Currently, the DeLC has been used in the real education process for years. Although DeLC was a successful project for applying information and communication technologies in

education, one of its major drawbacks is the lack of close and natural integration of its virtual environment with the physical world where the real learning process takes place. The book discusses the transition of DeLC to Virtual Educational Space (VES) and the transition of this virtual educational space to Cyber Physical Social Space, which we call Virtual Physical Space (ViPS). The proposed ViPS reference architecture is adapted for intelligent agriculture.

18. *S. Stoyanov, T. Glushkova, E. Doychev, A. Stoyanova-Doycheva, V. Ivanov, Cyber-Physical Social Systems and Applications- Part2. Applications, Publisher: LAP LAMBERT Academic Publishing (2019-12-23),ISBN: 978-620-0-49831-1, 164 pages,(Book)*

    The book is a continuation of the book: "Cyber-Physical-Social Systems and Applications-Part1" (presented in the list under number 17). The main goal of the authors is to present the adaptation of the created reference architecture of ViPS for different areas. The application in the field of e-learning is shown as the first adaptation, and the realization of an intelligent tourist guide is presented as the second. The tourist guide generates tourist routes for the users, taking into account the characteristics of the tourist sites from the physical world and the preferences of the tourists. The architecture of the intelligent tourist guide is completely adapted to the architecture of ViPS.

19. *А. Терзийск, Е. Дойчев, "An internal authorization system and its application for a trusted access to academic services", Международна конференция „From DeLC to VelSpace", 26-28 март 2014, Пловдив , ISBN: 0-9545660-2-5*

    This article describes the creation and development of an authorization system (Focus), developed for the needs of Plovdiv University over the past 10 years. The architecture and the main advantages of the third version are presented in detail (Focus 3). Some of the services authorized by Focus are briefly described.

20. *Stoyanov S., E. Doychev, A. Stoyanova-Doycheva , V. Valkanova, V. Valkanov, , Education Cluster Supporting eTesting and eLearning in Software Engineering, 2nd Annual International Conference on Web Technologies & Internet Applications, 7- 8 May 2012 Bali Dynasty Resort, Bali, Indonesia*

    In this paper, a university project, known as DeLC (Distributed eLearning Center), is presented briefly. Following the philosophy of DeLC for building more complex structures, an educational cluster is developed consisting of two nodes. The first node is an educational portal which provides various educational services and teaching content. The second node hosts intelligent components, known as "assistants'', they support the portal services in order to increase the efficacy of the whole cluster. The application of educational portal for eTesting and eLearning in software engineering is discussed as well.

21. *Emil Doychev, Asya Stoyanova-Doycheva, Stanimir Stoyanov, Todorka Glushkova, Vanya Ivanova, An IoT Virtual eLearning Space, Transactions on Computational Collective Intelligence, Shpringer, 2019, Editor-in-chief: Nguyen, Ngoc Thanh (to print)*

This paper presents the Virtual eLearning Space implemented as an In-ternet of Things ecosystem. The components of the space inhabit three layers – a sensing layer, an operative and analytical layer, and a cognitive layer, which are described in more detail. One of the advantages of the space is that integrating the virtual world with the physical world of the university campus provides effective support to disabled students. This new opportunity is demonstrated by an example scenario. At the same time, VeLS is enhanced to be a reference architecture that can be adapted for new IoT applications. In the reference architecture, virtualization of "things" is supported by three formal tools – AmbiNet, TNet, and ENet. Future directions are also briefly discussed.

22. *Asya Stoyanova-Doycheva, Katya Spassova, Emil Doychev,Vanya Ivanova, Development of ontology in plant genetic resources, IEEE Conference on Intelligent Systems, IS'2020, Varna, Bulgaria, 26-28 August, 2020 (to print)*

    The paper presents the development of an ontology for plant genetic resources in the Gene bank of the Institute of Plant Genetic Resources in the town of Sadovo. The structure of the ontology and metadata are exhibited along with each of the concepts and properties in order to present knowledge about plant genetic resources using the capabilities and benefits of ontologies. The ontology was developed on the basis of the taxonomy for plant genetic resources and the EURISCO European standard.

23. *Borislav Toskov, Asya Toskova, Stanimir Stoyanov, Emil Doychev, Architecture of Intelligent Guard Systems in the Virtual Physical Space, IEEE Conference on Intelligent Systems, IS'2020, Varna, Bulgaria, 26-28 August, 2020 (to print)*

    The article presents an architecture for creating a guard system built with intelligent software agents that connect with the physical world through a sensor network. The Guard System is part of the Virtual Physical Space (ViPS). In ViPS, it is built as an Internet-of-Things ecosystem consisting of autonomous intelligent components.

24. *Emil Doychev, Pencho Malinov, Nikolaya Velcheva, Zhivko Duchev, A Genbank Architecture, IEEE Conference on Intelligent Systems, IS'2020, Varna, Bulgaria, 26-28 August, 2020 (SCOPUS) (to print)*

    This article represents the view of the authors about the needs and the implementation of a distributed system, among all institutes in Bulgaria, for management of plant genetics resources, according the standards defined by the EURISCO catalogue, and the requirements and needs of the National Coordinator. An infrastructure for the implementation of such a distributed system is presented.

25. *Stoyanova-Doycheva A., Glushkova T., Moralyiska N., Doychev E., A re-engineering approach for extension of the Tourist Guide Knowledge Base, 5th International Conference on Cloud Computing and Artificial Intelligence: Technologies and Applications, November 24-26, 2020, in Marrakesh, Morocco (to print)*

    The paper presents an extension of the knowledge base of the Tourist Guide with comprehensive information about Bulgarian cultural, historical, and natural sites, available in the databases created under the BECC project. To accomplish the task of

enriching the knowledge base, the architecture of the Tourist Guide that was created as a reference architecture of the Virtual-Physical Space (ViPS) is presented and the restructuring process of the components in this architecture is described. In order to use the created databases in the BECC project, we had to re-engineer them on the basis of standards for the presentation of cultural and historical sites such as UNESCO and CCO (Cataloging Cultural Objects).

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