Interactivity Oriented System Architecture for the 21st Century Classroom: the New Smart Classroom

Thesis By

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CERTIFICATE OF ORIGINAL AUTHORSHIP

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Student:

Date:

Dedication

To those who have been by my side during this long and challenging work, offering me guidance and support with every obstacle that appeared, they have never stopped with their support, prayers and love.

Humbly, I dedicate this work with gratitude to my

Father & Mother

Also with deep appreciation to

My Wife

who has been a constant inspiration.

And to my dear daughter

Ghazl

for her future -may it be bright and happy.

And most importantly my praise and thanks to

Almighty Allah

Always.

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Abstract

The Smart Classroom is now a typical feature in education emerging from Information Communications Technologies (ICT) and the constant introduction of new technologies into institutional learning. The aim of the Smart Classroom is that users develop skills, adapt and use technologies in a learning context that produces elevated learning outcomes. However, research has shown that the use of ICT in the classroom is often confused or poorly adapted to the learning setting. The main goal of this research is to design Smart Classroom solutions particularly modelling, that address key limitations of system architecture design, technologies and practice. Applications of very recent technologies, such as AR, Haptics, Cloud and IoT/WSNs are investigated. The expected outcomes involve: improving the design of systems architecture; an improved selection and use of devices; improved teaching skills deployment. An extended model of the Smart Classroom is developed. A quality measurement tool for the validation of the system architecture is constructed to evaluate the model and its assumptions. Devices are also assessed measuring interactivity, usability and performance attributes, as well as, an assessment of teaching skills used in the ICT context. Finally, an innovative model of the Smart Classroom architecture that integrates an effective and practical pedagogic approach is proposed.

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Glossary

Acceptability

The system architecture quality factor that influences user preferences, acceptance and tolerance for a given solution.

Archimate Modelling Tool

A UML based modelling architecture language tool that supports the description, analysis and visualisation of system design architecture within and across system domains in an obvious way.

Augmented Reality - AR

Augmented Reality is a mixture of both the virtual and real worlds. It is characterised here by the superimposition or projection of computer-generated images or virtual reality onto real-world elements. AR enhances the real image using digitised content and information by creating a virtual overlay scene. It may also have three-dimensional expressions.

Extended Technology Acceptance - ETAM

ETAM plays a key role in the introduction of the advanced ICT tools and a specific training program to accept the use of advance technology for higher ICT tools acceptance. A key research contribution.

Haptics

It refers to a technology that uses touch to control and interact with peripherals.

Human Machine Interaction - HMI

The interaction behaviour between the user and the machine occurring in two directions.

Information Communications Technologies - ICT

Tools and resources that establish and create communication, disseminating, storing and managing information.

Interactivity

The communication process that involves users / machines in certain established channels for obtaining or exchanging data/commands between the internal and external objects.

Internet of Things - IoT

Refers to the network of physically embedded technologies that work to communicate, sense or interact with their internal or the external environment based on IP address.

Machine to Machine Interaction - MMI
It refers to the communication between machines (devices) by using ad hoc channels, such as wired and wireless communication; and thus can be executed via IoT, WSN and middleware.

Smart teaching and learning pedagogy
An approach that represents a cooperative teaching and learning method(s) using ICT advanced equipment among learners.

System architecture
Applies to the software that processes information between system users. Moreover, it also defines a conceptual model that represents the structure, behaviour and views of the proposed system.

Smart Classroom
A physically built room equipped with audio-visual Information Communications Technologies (ICT), tools that may capture human motion, utterance and gesture. The equipment allows the teacher to instruct both local and remote students.

Teaching and learning pedagogy
The teacher-student realtionship forming a direct flow of information the teacher is a sender of information to the student; the student is the receiver of that information. It also involves the pre-setting of the teaching and learning environment that incubate pedagogical materials, tools and resources.

Technology Acceptance Model - TAM
It refers to the information system theory, developed by Davis (1986) that consists elements lead to model how users derive to accept technology. These elements involve: perceived usefulness; perceived ease of use; attitude toward using technology; and behavioural intention.

The Open Group Architecture Framework - TOGAF
An enterprise architecture framework offering a high level approach to introduce system architecture design. Moreover, the TOGAF framework is used for designing, planning, implementing, and governing the information technology architecture enterprise.

Unify Modelling Language – UML
A general modelling language that provides a reflected visual design of the system.

Usability
The system architecture quality factor that determines user perception of a given solution fitness for the designated role or purpose.

Wireless Sensor Network - WSN

A wireless network system consists of spatially distributed autonomous devices using sensors for monitoring and distributed data in a particular network environment.

Related Publications

During the investigation progression, there are several research achievements have been approved reflected the research outcomes. Therefore, papers had been developed and participated in various publish areas involve the following:

Book Chapters

Alenazy, W. & Chaczko, Z. 2015, 'Augmented Reality and the Adapted of Smart Grid Monitoring for Educational Enhancement', G. Borowik, W. Jacak, Z. Chaczko & F. Gaol L (eds), Studies in Computational Intelligence, Springer International Publishing, Page(s) 353-370, Heidelberg, Germany, ISSN: 1860-949X.

International Journal Papers

Alenazy, W.,, Chaczko, Z. and Chan C.Y. (2016), “Middleware-based Software Architecture for Interactions in the Smart Learning Environment”, Communications of the IBIMA, Vol. 2016 (2016), Article ID 979834, DOI: 10.5171/2016.979834.

Alenazy, W. and Chaczko Z. (2016), "Modelling Gesture Recognition Systems", Journal of Software & Systems Development, Vol. 2016 (2016), Article ID 557104, DOI: 10.5171/2016.557104.

Conference Papers

Alenazy, W., Chaczko, Z., Chan, C.Y. & Carrion, L. (2015), 'Haptic Middleware Based Software Architecture for Smart Learning', Computer Aided System Engineering (APCASE), 2015 Asia-Pacific Conference on, pp. 257-63.

Alenazy, W., Chaczko, Z., Tran, A. & Carrion, L. (2014), 'Augmented Reality Based Remote-Lab for Monitoring', paper presented to the ITHET, IEEE Xplore, York, England, 11 -13 September.

Alenazy, W., Chaczko, Z., Carrion, L. & Mu, M. (2014), 'Development of an Expert System to Assist in Resource Management', ITHET, IEEE Xplore, York, England, 11-13 September.

Alenazy, W. & Chaczko, Z. (2014), 'The extended technology acceptance model and the design of the 21 century classroom', Computer Aided System Engineering (APCASE), Asia-Pacific Conference, IEEE Xplore, South Kuta, Indonesia, pp. 117-21, ISBN: 978-1-4799-4570-2.

Extended Abstract

Alenazy, W. & Chaczko, Z. (2014), 'The Extended Technology Acceptance Model and the Design of the 21 Century Classroom', In Proceedings of the 2nd Asia - Pacific Conference on Computer Aided System Engineering, APCASE (2014) Extended Abstracts, 10th -12th February 2014, South Kuta, Bali, Indonesia, page(s) 102-103, APCASE Foundation, ISBN: 978-0-9924518-0-6.