Autonomous Solution for Design of Curriculum

S.A.D.I. Samarasinghe

08/10012

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

Dissertation submitted to the Faculty of Information Technology, University of Moratuwa, Sri Lanka for the partial fulfillment of the requirements of the Degree of MSc in Artificial Intelligence.

September 2010

Declaration

I declare that this dissertation does not incorporate, without acknowledgment, any material previously submitted for a Degree or a Diploma in any University and to the best of my knowledge and belief, it does not contain any material previously published or written by another person or my self except where due reference is made in the text. I also hereby give consent for my dissertation, if accepted, to be made available for photocopying and for interlibrary loans, and for the title and summary to be made available to outside organization.

S.A.D.I. Samarasinghe …….

Name of Student Signature of Student

Date:

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

Supervised by

Prof. A.S. Karunananda …….

Name of Supervisor(s) Signature of Supervisor(s)

Date:

Dedication

To my Family

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

Acknowledgements

I have great pleasure in writing this acknowledgement on the completion of this project for my M.Sc. degree in Artificial Intelligence. I would like to make this an opportunity to pay my honor and gratitude to everyone who helped me by guiding and advising me throughout the development of this project.

First and foremost, I would like to express my sincere appreciation to my supervisor Prof. Asoka S. Karunananda, for his continued support and genuine interest throughout the implementation of the project. He has always shown faith in my abilities by sharing responsibilities and opportunities with me.

My heart felt gratitude goes to Prof. Asoka S. Karunananda, as the Project Coordinator, Coordinator of MSc AI, and the Director of Postgraduate Studies.

I would also like to express my gratitude Mrs. Dilini T. Kulawansa, for her guidance and for providing me with necessary information for my project.

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

I would also like to thank Miss Umesha Weerakkody and Mrs Nilupa Liyanage for their advices, hard questions and friendship.

I would like to thank my parents for their support, encouragement, and for believing in me and for their loving and unselfish care given for my sons during this project.

I would also like to thank my husband Nalaka for his continuous encouragement and unlimited patience.

Last but not least, I would like to thank all the parties who supported me in various manners to make this project success.

Abstract

Curriculum design is a major research challenge in the rapid changing world of knowledge. The curriculum represents the expression of educational ideas in practice and it includes all the planned learning experience of a school or educational institution which is interconnected with each other. Therefore curriculum design is complex process which takes place by negotiation within committee of experts in the field. Due to the interconnectivity of its different aspects it is time consuming task to design curriculum within a complex environment. As per these reasons conventional software solutions were not able to automate the process of curriculum designing to meet dynamically changing requirements in a complex environment. However some modern approaches proposed intelligent solutions for the area of curriculum development. These solutions were limited to few areas in the curriculum and do not provide better solution within the complex environment. Therefore this system provides an autonomous solution for curriculum designing within an interconnected environment with the use of ontology and multi-agent technology.

This solution mainly focuses on curriculum developers in higher education. The user can input a curriculum and upon the request curriculum agents such as credit agent, subject agent, prerequisites agent are created and agents obtain knowledge through the curriculum ontology. Agents communicate and negotiate with each other and autonomously produce the well balanced curriculum according to the given input. The system consists of two major modules for user interaction, process formulation. The User Interaction module has been designed to interact with the user and this module is mainly process with the Request Agent. Process Formulation is based on MAS module and it has several resource agents such as Credit Agent, Pre-Requisite Agent, Subject Agent and the message space. When the Request Agent sends requests through the message space, related agents are activated and attend the specific task. Curriculum ontology provides the knowledge needed to create a well balanced curriculum. The entire multi agent system is developed based on the Java Agent Development Environment. Ontology is developed using Protégé ontology editor. The system has been evaluated using curriculums in the Faculty of Information Technology, University of Moratuwa.

Keywords- *Multi Agent System, Ontology.*

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

Contents

	Page
Chapter 1 – Introduction	**01**
1.1 Introduction	01
1.2 Background and Motivation	01
1.3 Solution to curriculum design	02
1.4 Aim	03
1.5 Objectives	03
1.6 Resource Requirements	03
1.7 Structure of the Report	04
1.8 Summary	05
Chapter 2 – State of the art in Curriculum Design	**06**
2.1 Introduction	06
2.2 Conventional Approaches in Curriculum Design	06
2.3 Modern Approaches in Curriculum Design	09
2.4 Problem in brief	13
2.5 Summary	13
Chapter 3 –Theoretical foundation of Autonomous Curriculum Design	**14**
3.1 Introduction	14
3.2 Multi Agent Systems	14
3.3 JADE	17
3.3.1 Content languages and Content Ontologies	18
3.3.2 GUI enabled agent in JADE	19

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

3.3.3 Agent Behaviors 19
3.4 Ontology 20
3.5 Protégé ontology 21
3.6 Summary 22

Chapter 4 –Approach to Design Curriculum 23

4.1 Introduction 23
4.2 Users 23
4.3 Input 24
4.4 Curriculum Designing Process 24
4.5 Output 25
4.6 Features 25
4.7 Summary 26

Chapter 5 – Design of Curriculum Design System 27

5.1 Introduction 27
5.2 Top Level Architecture 27
5.3 User Interaction Module 28
5.4 MAS Module 29
5.4.1 Request Agent 29
5.4.2 Resource Agents 29
5.4.3 Curriculum Ontology 30
5.4.4 Message Space 31
5.5 Summary 32

University of Moratuwa, Sri Lanka.
Electronic Theses and Dissertations
www.lib.mrt.ac.lk

Chapter 6 –Implementation of Curriculum Design System **33**

6.1 Introduction 33

6.2 Creating the curriculum design system 33

6.3 Implementation of User Interaction Module 34

6.4 MAS Module 35

6.4.1 Implementation of Request Agent to interact with user interaction module 35

6.4.2 Implementation of Agent classes 36

6.4.3 Agent Communication 37

6.4.4 Add behaviors to the agents 37

6.5 Implementation of Curriculum Ontology 39

6.5.1 Defining an application specific ontology 39

6.5.2 Defining knowledge for the curriculum ontology 41

6.6 Massage Space 42

6.7 Processing a module in a curriculum 42

6.8 Summary 44

Chapter 7 –Evaluation **45**

7.1 Introduction 45

7.2 Evaluation of Autonomous solution for Curriculum Design 45

7.3 Summary 47

Chapter 8 –Conclusion and Further Works **48**

8.1 Introduction 48

8.2 Conclusion 48

8.3 Further Improvements 50

8.4 Summary 50

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

References **51**

Appendix A **54**

Appendix B **57**

Appendix C **66**

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

List of Figures

Page

Figure 5.1: System Architecture for Autonomous Curriculum Design 28

Figure 5.2: Curriculum Ontology 31

Figure 6.1: Agent Execution flow chart with Behaviours 38

Figure 6.2: The Message Space 42

Figure 6.3: Main GUI in Curriculum Design System 43

Figure A.1: Operation on Module Agent 54

Figure A.2: Operation on Credit Agent 54

Figure A.3: Operation on Level Agent 55

Figure A.4: Operation on Design Agent 55

Figure A.5: Operation on Prerequisites Agent 56

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

List of Tables

	Page
Table 2.1: Advantages and Limitations in selected areas	12
Table 3.1: Characteristics of ACL message	17
Table 7.1: Result obtain from the questionnaire	46

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk