UNIVERSITI PUTRA MALAYSIA

COLLABORATIVE VIRTUAL ENVIRONMENT SYSTEM FOR DISTANCE EDUCATION IN MATHEMATICS

EVGENY SHATOKHIN.

FSKTM 2004 4
COLLABORATIVE VIRTUAL ENVIRONMENT SYSTEM FOR DISTANCE EDUCATION IN MATHEMATICS

By

EVGENY SHATOKHIN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the degree of Master of Science

December 2004
Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

COLLABORATIVE VIRTUAL ENVIRONMENT SYSTEM FOR DISTANCE EDUCATION IN MATHEMATICS

By

EVGENY SHATOKHIN

December 2004

Chairman: Hj Ismail Bin Abdullah, PhD
Faculty: Computer Science and Information Technology

Distance Education today is available in most countries of the world. After appearance of Internet distance education became more available and convenient because Internet is known as the largest information network and nowadays Internet is present almost in every home. Forms of Distance education can be categorized as: asynchronous and synchronous. Synchronous distance education environment can be virtual class or other virtual environment (e.g. online chat, video conferencing) where educator and educated communicate in real time. Asynchronous – email, web forum.

Research presented in this thesis focuses in synchronous distance education in mathematics. The main question studied in this research is how to design learning environment for distance education in mathematics. To address this question such research areas as Computer Supported Collaborative Learning (CSCL) and some other related works are studied. CSCL is related how group of people separated by distance can learn in virtual environment collaboratively. Based on the best practices
of CSCL and related works in area of distance education in mathematics, we
developed concepts and presented a way which can be used to design an
environment for distance education in mathematics. Designed environment is used
to develop software prototype.

Software prototype developed in this project named SynDiMath which is stands for
Synchronous Distance Mathematics. It allows synchronous collaboration through
Internet of group of participants and teachers by giving them right to use shared
resources such as workspace for writing Mathematical formulas, whiteboard for
drawing and fast sketching of problem, chat and computational engine. Mathematica
software developed by Wolfram Research (Mathematica 5.0, 2003) is used as
computational engine. Developed software allows each client (student) to have two
separate workspaces. First workspace called “groupspace” where group of students
together with teacher may discuss Mathematical ideas and solve problems. Second is
a personal workspace called “notepad” where student may work on personal
assignments and have one to one discussion with teacher. Discussion can be saved
as step-by-step history and reused in future with other group of students or single
student as a lesson or tutorial. Alternatively content of discussion can be saved in
HyperText Markup Language (HTML). In case of HTML content is static web page
that can be included into website.
Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PELAKSANAAN PERSEKITARAN MAYA KOLABORATIF UNTUK PENDIDIKAN JARAK JAUH DALAM MATEMATIK

Oleh

EVGENY SHATOKHIN

Disember 2004

Pengerusi: Hj Ismail Bin Abdullah, PhD
Fakulti: Sains Komputer dan Teknologi Maklumat


Penyelidikan yang diterangkan dalam tesis ini memfokuskan kepada pendidikan jarak jauh serentak dalam matematik. Persoalan utama dikaji dalam penyelidikan ini ialah bagaimana mereka bentuk persekitaran pembelajaran bagi pendidikan jarak jauh dalam matematik. Bagi menjawab persoalan ini bidang penyelidikan seperti Pembelajaran Kolaboratif Berbantukan Komputer (PKBK) (Computer Supported Collaborative Learning (CSCL)) dan kajian-kajian yang berkaitan dikaji. PKBK atau
CSCL ialah mengenai bagaimana sekumpulan manusia yang berada berjauhan boleh belajar secara kolaboratif. Berdasarkan amalan terbaik PKBK atau CSCL dan kajian-kajian yang berkaitan, kita membangun konsep dan mempersempahkan cara yang dapat digunakan bagi mereka bentuk sebuah persekitaran untuk pendidikan jarak jauh dalam matematik. Persekitaran reka bentuk digunakan bagi membangun sebuah perisian prototaip.

Perisian prototaip yang dibangun dalam projek ini dinamakan SynDiMath singkatan untuk “Synchronous Distance Mathematics”. Ia membenarkan kolaborasi secara serentak (synchronous) melalui sekumpulan peserta dan guru dengan membenarkan mereka menggunakan sumber yang dikongsi bersama seperti ruang kerja (workspace) bagi menulis formula matematik, papan putih bagi melukis atau menggambar masalah, chat dan enjin komputasi. Perisian Mathematica yang dibangun oleh Wolfram Research (Mathematica 5.0, 2003) digunakan sebagai enjin komputasi. Perisian yang dibangun membenarkan pelajar mempunyai dua ruang kerja berasingan. Ruang kerja pertama yang dinamakan Ruang Kumpulan (groupspace) di mana sekumpulan pelajar dengan guru boleh berbincang idea matematik dan menyelesaikan masalah. Ruang kerja kedua yang dinamakan Pad Nota (notepad) di mana pelajar boleh bekerja secara bersendirian dengan membuat tugas peribadi dan boleh berbincang satu dengan satu dengan guru. Perbincangan boleh disimpan dan digunakan kemudian dengan kumpulan pelajar yang lain sebagai tutoran atau pembelajaran lain. Sebagai alternatif kandungan perbincangan boleh disimpan dalam HyperText Markup Language (HTML). Dalam kes HTML kandungan adalah statik dan boleh dipaparkan dalam laman web.
ACKNOWLEDGEMENTS

I am very grateful for the advice and support of my supervisor, Dr. Haji Ismail Abdulah and to my supervisory committee Dr. Suncheleev Rustem and Dr. Bekbaev Ural for feedback and for keeping me focused in my research. The comments and time given by Dr. Mikhail Alexandrov have greatly improved and clarified this work. Finally, I would like to express my deep appreciation to my mother, Natasha, for her encouragement through my graduate studies, and to all of my friends, especially to my dear lovely girlfriend Jennifer!
I certify that an Examination Committee met on 30th December 2004 to conduct the final examination of Evgeny A. Shatokhin on his Master of Science thesis entitled “Collaborative Virtual Environment System for Distance Education in Mathematics” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

ROZITA JOHARI, PhD
Lecturer
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Chairman)

MD. NASIR SULAIMAN, PhD
Associate Professor
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Internal Examiner)

RAHMITA WIRZA O.K. RAHMAT, PhD
Lecturer
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Internal Examiner)

ABDUL RAZAK YAAKUB, PhD
Professor
Faculty of Quantitative Sciences
Universiti Utara Malaysia
(External Examiner)

GULAM RUSUH RAHMAT ALI, PhD
Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 22 AUG 2005
This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of Supervisory Committee are as follows:

**HJ ISMAIL BIN ABDULLAH, PhD**  
Faculty of Computer Science and Information Technology  
Universiti Putra Malaysia  
(Chairman)

**SUNCHEEEV RUSTEM, PhD**  
Assoc. Professor  
Faculty of Science and Environmental Studies  
Universiti Putra Malaysia  
(Member)

**BEKBAEV URAL, PhD**  
Assoc. Professor  
Faculty of Science and Environmental Studies  
Universiti Putra Malaysia  
(Member)

**AINI IDERIS, PhD**  
Professor/Dean  
School of Graduate Studies  
Universiti Putra Malaysia

Date: 08 SEP 2005
DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

EVGENY SHATOKHIN
Date: 11/04/2004
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>2</td>
</tr>
<tr>
<td>ABSTRAK</td>
<td>4</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>6</td>
</tr>
<tr>
<td>APPROVAL</td>
<td>7</td>
</tr>
<tr>
<td>DECLARATION</td>
<td>9</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>14</td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS</td>
<td>19</td>
</tr>
<tr>
<td>CHAPTER 1</td>
<td>21</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td></td>
</tr>
<tr>
<td>1.1 Introduction</td>
<td>21</td>
</tr>
<tr>
<td>1.2 Problem Statement</td>
<td>24</td>
</tr>
<tr>
<td>1.3 Objectives</td>
<td>27</td>
</tr>
<tr>
<td>1.4 Scope</td>
<td>27</td>
</tr>
<tr>
<td>1.5 Thesis Contribution</td>
<td>27</td>
</tr>
<tr>
<td>1.6 Thesis Structure</td>
<td>28</td>
</tr>
<tr>
<td>CHAPTER 2</td>
<td>29</td>
</tr>
<tr>
<td>LITERATURE REVIEW</td>
<td></td>
</tr>
<tr>
<td>2.1 Computer Supported Collaborative Learning</td>
<td>29</td>
</tr>
<tr>
<td>2.2 Collaboration in Virtual Environment</td>
<td></td>
</tr>
<tr>
<td>2.2.1 Same Place Same Time</td>
<td>30</td>
</tr>
<tr>
<td>2.2.2 Different Time Same Place</td>
<td>31</td>
</tr>
<tr>
<td>2.2.3 Same Time Different Place</td>
<td>31</td>
</tr>
<tr>
<td>2.2.4 Different Time Different Place</td>
<td>32</td>
</tr>
<tr>
<td>2.3 Concepts and Best practices of CSCL</td>
<td>32</td>
</tr>
<tr>
<td>2.3.1 User Interaction</td>
<td>33</td>
</tr>
<tr>
<td>2.3.2 User Awareness</td>
<td>34</td>
</tr>
</tbody>
</table>
2.3.3 Critical Thinking
2.3.4 Visualization
2.3.5 Computation
2.3.6 Knowledge Domain
2.4 Education Theory Based Design Methods
2.4.1 Domain Centered Design
2.4.2 Learner Centered Design
2.5 Patterns Based Design Methods
2.5.1 Collaborative Learning Patterns Design
2.5.2 Model-View-Controller Architecture Based Design
2.6 Review of Existing Synchronous Education Software
2.6.1 Elluminate v’Class
2.6.2 Mathematica Based Synchronous Education Tool
2.6.3 Comparison of the Introduced Products

CHAPTER 3

METHODOLOGY

3.1 Main Research Diagram
3.2 Functional Requirements
3.3 From Class Environment to Virtual
  3.3.1 Flexible Approach for User Interaction
  3.3.2 Support for Awareness in Virtual Environment
  3.3.3 Facilitating Critical Thinking in Mathematics
  3.3.4 Educational Content Creation and Reuse
3.4 System Design
  3.4.1 Use Case Diagrams
  3.4.2 Server Architecture
  3.4.3 Client Architecture
3.5 User Interface Design
3.6 Communication
  3.6.1 Network Layer Protocol
  3.6.2 Application Layer Protocol
3.7 Security Design
3.8 Mathematical Engine Integration
3.9 Integration with 3rd Party Web based Groupware
3.10 XML Mapping to Database Schema
3.11 Data Flow Diagrams for Server and Client
3.12 Sequence Diagrams and Pseudocode
  3.12.1 Login Sequence
  3.12.2 Quit Sequence
  3.12.3 Add Element Sequence
  3.12.4 Add Math Element Sequence
  3.12.5 Move Element Sequence
  3.12.6 Edit Element Sequence
  3.12.7 Replace Element Sequence
  3.12.8 Replace Math Element Sequence
  3.12.9 Delete Element Sequence
  3.12.10 Raise Hand Sequence
  3.12.11 Hand Down Sequence
  3.12.12 Change Access Sequence
  3.12.13 Undo/Redo Sequence
  3.12.14 Save Sequence
  3.12.15 Load Sequence
  3.12.16 Clear Screen Sequence
3.13 Utils Package
  3.13.1 Message Classes
  3.13.2 Server List Element
  3.13.3 Chat Element
  3.13.4 Text Element
  3.13.5 Drawing Element
  3.13.6 Mathematica Element
  3.13.7 ConfigReader Class
  3.13.8 MD5 Class
3.14 Server Classes Design
3.15 Client Classes Design
3.16 Coding
3.17 Installation
### CHAPTER 4

**RESULTS AND EVALUATION**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Results</td>
<td>115</td>
</tr>
<tr>
<td>4.1.1 Instructor and Student Framework</td>
<td>116</td>
</tr>
<tr>
<td>4.2 Network Performance Evaluation</td>
<td>122</td>
</tr>
<tr>
<td>4.2.1 Local Area Network Environment Performance</td>
<td>122</td>
</tr>
<tr>
<td>4.2.2 Internet Environment Performance</td>
<td>122</td>
</tr>
<tr>
<td>4.3 Usability Evaluation</td>
<td>125</td>
</tr>
<tr>
<td>4.3.1 Questionnaire</td>
<td>125</td>
</tr>
<tr>
<td>4.3.2 Results</td>
<td>129</td>
</tr>
</tbody>
</table>

### CHAPTER 5

**CONCLUSION AND FUTURE WORK**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conclusion</td>
<td>135</td>
</tr>
</tbody>
</table>

**REFERENCES / BIBLIOGRAPHY**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPENDICES</td>
<td>145</td>
</tr>
<tr>
<td>Questionnaire</td>
<td>145</td>
</tr>
<tr>
<td>Class Sources</td>
<td>148</td>
</tr>
<tr>
<td>System Installation</td>
<td>149</td>
</tr>
</tbody>
</table>

**BIO DATA OF THE AUTHOR**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>150</td>
</tr>
</tbody>
</table>
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Explains appearance of CSCL.</td>
<td>29</td>
</tr>
<tr>
<td>2.2 The 2-dimensional CSCL space.</td>
<td>30</td>
</tr>
<tr>
<td>2.3 Key learning quality relationships.</td>
<td>35</td>
</tr>
<tr>
<td>2.4 The domain centered model of computer mediated learning.</td>
<td>39</td>
</tr>
<tr>
<td>2.5 Learner centered design.</td>
<td>41</td>
</tr>
<tr>
<td>2.6 Model-view-controller.</td>
<td>43</td>
</tr>
<tr>
<td>2.7 The elluminate’s vclass client.</td>
<td>45</td>
</tr>
<tr>
<td>3.1 Main research diagram.</td>
<td>47</td>
</tr>
<tr>
<td>3.2 Class education environment.</td>
<td>49</td>
</tr>
<tr>
<td>3.3 Scheme of interaction within a class.</td>
<td>50</td>
</tr>
<tr>
<td>3.4 Server – client architecture with Mathematica engine.</td>
<td>53</td>
</tr>
<tr>
<td>3.5 Super-user’s actions and relationship to system.</td>
<td>54</td>
</tr>
<tr>
<td>3.6 User’s actions and relation to system.</td>
<td>55</td>
</tr>
<tr>
<td>3.7 Server components of the system.</td>
<td>56</td>
</tr>
<tr>
<td>3.8 Notebook front-end.</td>
<td>58</td>
</tr>
<tr>
<td>3.9 Client components.</td>
<td>60</td>
</tr>
<tr>
<td>3.10 Server interface.</td>
<td>61</td>
</tr>
<tr>
<td>3.11 Students’ interface.</td>
<td>61</td>
</tr>
</tbody>
</table>
3.12 Teacher's interface.
3.13 Serialization process.
3.14 Mathematica communication.
3.15 XML file syntax.
3.16 Login section.
3.17 Server dataflow diagram.
3.18 Client dataflow diagram.
3.19 Login sequence diagram.
3.20 Login pseudocode (client).
3.21 Login pseudocode (server).
3.22 Quit sequence diagram.
3.23 Quit pseudocode (client).
3.24 Quit pseudocode (server).
3.25 Add element sequence diagram.
3.26 Add element pseudocode (client).
3.27 Add element pseudocode (server).
3.28 Add math element sequence diagram.
3.29 Add math element pseudocode (client).
3.30 Add math element pseudocode (server).
3.31 Move element sequence diagram.
3.32 Move element pseudocode (client).
3.33 Move element pseudocode (server).
3.34 Edit element sequence diagram.
3.35 Edit element pseudocode (client).
3.36 Edit element pseudocode (server).
3.37 Replace element sequence diagram.
3.38 Replace element pseudocode (client).
3.39 Replace element pseudocode (server).
3.40 Replace math element sequence diagram.
3.41 Replace math element pseudocode (client).
3.42 Replace math element pseudocode (server).
3.43 Delete element sequence diagram.
3.44 Delete element pseudocode (client).
3.45 Delete element pseudocode (server).
3.46 Raise hand sequence diagram.
3.47 Raise hand element pseudocode (client).
3.48 Raise hand element pseudocode (server).
3.49 Hand down sequence diagram.
3.50 Hand down pseudocode (client).
3.51 Hand down pseudocode (server).
3.52 Change access sequence diagram.
3.53 Change access pseudocode (client).
3.54 Change access pseudocode (server).
3.55 Undo/redo sequence diagram.
3.56 Undo/redo pseudocode (client).
3.57 Undo/redo access pseudocode (server).
3.58 Save sequence diagram.
3.59 Save pseudocode (client).
3.60 Save access pseudocode (server).
3.61 Load sequence diagram.
3.62 Load pseudocode (client).
3.63 Load pseudocode (server).
3.64 Clear screen sequence diagram.
3.65 Clear screen pseudocode (client).
3.66 Clear screen pseudocode (server).
3.67 Present relationship between message classes.
3.68 Server list class.
3.69 Chat class.
3.70 Text element classes.
3.71 Drawing element classes.
## LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSCL</td>
<td>Computer Supported Collaborative Learning</td>
<td>2</td>
</tr>
<tr>
<td>SynDiMath</td>
<td>Synchronous Distance Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>ABC</td>
<td>Atanasoff-Berry-Computer</td>
<td>21</td>
</tr>
<tr>
<td>PDA</td>
<td>Personal Digital Assistant</td>
<td>21</td>
</tr>
<tr>
<td>PC</td>
<td>Personal Computer</td>
<td>21</td>
</tr>
<tr>
<td>WWW</td>
<td>World Wide Web</td>
<td>22</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communications Technology</td>
<td>25</td>
</tr>
<tr>
<td>CAI</td>
<td>Computer Aided Instruction</td>
<td>38</td>
</tr>
<tr>
<td>DCD</td>
<td>Domain Centered Design</td>
<td>38</td>
</tr>
<tr>
<td>TCD</td>
<td>Teacher Centered Design</td>
<td>38</td>
</tr>
<tr>
<td>LCD</td>
<td>Learner Centered Design</td>
<td>40</td>
</tr>
<tr>
<td>CLP</td>
<td>Collaborative Learning Pattern</td>
<td>42</td>
</tr>
<tr>
<td>UP</td>
<td>Unified Process</td>
<td>42</td>
</tr>
<tr>
<td>MVC</td>
<td>Model-View-Controller</td>
<td>42</td>
</tr>
<tr>
<td>WYSIWIS</td>
<td>“What You See Is What I See”</td>
<td>43</td>
</tr>
<tr>
<td>WYMIWIM</td>
<td>“What You Model Is What I Model”</td>
<td>44</td>
</tr>
<tr>
<td>UML</td>
<td>Unified Modeling Language</td>
<td>52</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>TCP/IP</td>
<td>Transmission Control Protocol/Internet Protocol</td>
<td>52</td>
</tr>
<tr>
<td>API</td>
<td>Application Program Interface</td>
<td>57</td>
</tr>
<tr>
<td>GUI</td>
<td>Graphic User Interface</td>
<td>59</td>
</tr>
<tr>
<td>HTML</td>
<td>HyperText Markup Language</td>
<td>66</td>
</tr>
<tr>
<td>.NET</td>
<td>Microsoft Framework</td>
<td>70</td>
</tr>
<tr>
<td>JLink</td>
<td>Mathematica API Interface</td>
<td>70</td>
</tr>
<tr>
<td>XML</td>
<td>Extensible Markup Language</td>
<td>71</td>
</tr>
<tr>
<td>SQL</td>
<td>Structured Query Language</td>
<td>71</td>
</tr>
<tr>
<td>ADSL</td>
<td>Asymmetric Digital Subscriber Line</td>
<td>122</td>
</tr>
<tr>
<td>LAN</td>
<td>Local Area Network</td>
<td>122</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

1.1 Introduction

Over past few decades there has been a sudden trend toward new technology. The first computer was developed in 1937 (ABC computer), and by 1982 over 3.2 millions of computers were sold each year (Gary et al., 2001). Electronic devices such as computers, hand phones, digital cameras, PDA’s etc, which could hardly be found in one of thousand houses in 1970, nowadays can be seen in almost every office, house, school and university. As computers appeared on more and more of people’s desks, the demand for certain previously unheard and unwanted products literally soared. Examples for such products are various software applications that allow PC holders to utilize their computers in the most effective ways.

In 1989 Tim Berners Lee invents an Internet-based hypermedia enterprise for information sharing, which later named as World Wide Web (WWW). With an infinite library of resources and data accessible on WWW via Internet, more that 125 million users are making use of Internet for a variety of reasons, some of which include following:

- sending messages (e-mail)
- accessing information, such as news, maps, airline schedule, stock market data, etc.
- online shopping
• online education

• meeting or conversing with people around the world

• accessing sources of entertainment and leisure, such as online games, magazines, etc.

Some of the above possibilities became widely available only with introduction of Internet and WWW. For example, previously the only way used to examine batch of students was to set specific date, time and place of examination; gather all students in auditorium (lecture hall, etc); issue examination paper and let the students work on the paper and submit it. Now, with emergence of online education, the entire process is so much flexible. For example student studying for TOEFL examination, can prepare and take examination at any date and time suitable for him. All that the student needs to do, is to come to any authorized examining centre (like British Council), take an online test and results can be knows almost immediately.

Here is another example on use and importance of online education. Many universities now besides the normal and part-time courses, opening special courses that are based on distance learning. Such courses allow students enrolling from any part of the world. Online students will be given lectures to study, their instructor can be contacted through Internet in case any doubts or questions arise, and at the end of such course student will write an examination and receive a certificate. With introduction of online education, you may study a course that has not yet been conducted in your country/region and receive the original qualifications for it. From the examples we can see the uses and great benefits offered by online education.
Online education can be implemented through the Virtual Environment. The examples of virtual environments available are online tutorials, online courses, tutoring systems, digital video/voice conferencing and groupware. This thesis will concentrate on use of Groupware virtual environment in assisting online education. Groupware is the application software that allows a group of distance separated people to communicate and share virtual resources.

There are many difficulties faced by institutions that tried to use Groupware to run their online courses. The issue is that online courses that may need to use groupware vary from literature and language to mathematics and engineering. As you can imagine, the requirements to the Groupware used during a lecture on Mathematics highly different from those features necessary for teaching language. Any chat or messaging capabilities would be sufficient for teaching English online. But for Mathematics, features such as special displays of formulas, computations of equations, plotting of graphics, matrix manipulations, etc. will be necessary in order to teach and learn mathematics online.
1.2 Problem Statement

Since the invention of Internet many aspects of our life have been changed. Today we often hear terms like Virtual Office, Virtual Library, Virtual Showroom and others related to Virtual Environment. Distance education can be implemented through the concept of Virtual Environment. It is available in many forms. Most important to mention are: online courses, online tutorials, intelligent tutoring system, digital video/voice conferencing and groupware.

Collaborative Software or as it often called Groupware which allows group of distance separated people to solve problems collaboratively by sharing virtual workspace and tools. One of the examples of Groupware can be Collaborative Writing Software which allows editing of one document by group of distance separated people. Another example is White Board Groupware which allows group of people to share virtual white board.

Groupware, as well as video conferencing, provides real-time interaction between participants (usually it is done through text-chat or voice-chat, but also may be a video conferencing). The main idea of groupware is to make work more productive by sharing resources and tools amongst participants. Video of participants in case of Groupware comes at second place and usually used to support social part of group work. Different types of Groupware can be used to assist distance education. For example Collaborative Writing Software can be used in distance language education or White Board Groupware can be used to explain some of the geometry concepts.