Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.
A Reusable Peer-to-Peer Conversation Tool for Online Second Language Learning

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Information Science in Computer Science

at Massey University, Palmerston North, New Zealand.

Jun Ye
2008
Abstract

To support extramural learning, Johnson (2005) has proposed the Learning Computer concept, which aims to provide a learning appliance that can be used for studying university courses at any time, from anywhere, and by anybody who might have only basic software and hardware, dial-up Internet connection, and little computer literacy. Lonely extramural students need extra support for interactions and collaboration in learning, especially in second language learning that requires intensive oral language practice between the students and the tutor.

This research project was a trial to extend IMMEDIATE (the prototype of the Learning Computer) to a second language extramural course. To meet the requirements of long distance conversation in such a course, a synchronous/asynchronous bimodal approach was conceptualised based on a review of e-learning, communication, and VoIP technologies. It was proposed that the prototype should automatically adapt to either synchronous mode or asynchronous mode according to different levels of Internet connection speed. An asynchronous conversation mode similar to Push-to-Talk (PTT) was also proposed.

A VoIP SDK was investigated and used in the prototype for fast development. IMMEDIATE messaging protocols have been extended in the prototype to control call procedures and the asynchronous conversation mode. An evaluation of the prototype which was conducted to assess its usability, functionality and integrity of the prototype demonstrated that users can conduct telephone-like synchronous conversation efficiently at high connection speed. Although the PTT-like asynchronous mode has a time lag problem, especially when two users are both at low connection speed, it is still a good way for novices to practise second language oral skills. The evaluation has given strongly support to the feasibility and effectiveness of the bimodal approach for applying IMMEDIATE in second language extramural learning.
Acknowledgements

This project has been carried out with support and help from many people.

Firstly, I would like to thank Dr Russell Johnson, my supervisor, for the time and patience he has put in to helping me through this master’s project. Under his consistent supervision and guidance, I carried out this research project from conceptualisation, prototyping, and evaluation to thesis writing, during which I became familiar with the research field, became confident to do research, and learnt how to write a thesis.

I would like to acknowledge the support from the staff of Computer Science, IIST, Massey University.

I also appreciate my friends for their help in the evaluation and encouragement in the whole study procedure.
Publication

The publication associated with this research is:

Ye, J & Johnson, R. 2008: An embedded bimodal tool to enable second language learners to practise conversation online over unreliable Internet connections. Paper presented at the 5th International Workshop and Conference on Technology for Innovation and Education in Developing Countries (TEDC 2008), Kampala, Uganda.
Contents

Chapter 1  Introduction  1
1.1  Background  1
1.2  Requirements for Extramural Second Language Learning  3
1.3  Research Objective and Methodology  4
1.4  Summary  5

Chapter 2  An Initial Conceptual Model  7
2.1  Immediate Learning  7
  2.1.1  E-learning Systems  7
    2.1.1.1  Adaptive Learning Systems  8
    2.1.1.2  Learning Management Systems  10
  2.1.2  Information Appliance  11
  2.1.3  Requirements of Immediate Learning  13
2.2  The Learning Computer  15
2.3  Communication Dimension  18
  2.3.1  Communication Ways  18
  2.3.2  Communication in E-learning  21
2.4  Toward an Initial Conceptual Model  22
2.5  Summary  24

Chapter 3  Voice over IP  27
3.1  Internet  27
  3.1.1  Internet Protocols  28
  3.1.2  IP Address and Routing  30
  3.1.3  Internet for Residential Users  31
3.2  VoIP Concepts  32
3.2.1 Audio Signal Processing
3.2.2 Speech Coding
3.2.3 Quality of Service
3.2.4 VoIP Protocols
3.3 Summary

Chapter 4 Towards a Specification
4.1 A VoIP SDK
4.1.1 Requirements of a VoIP SDK
4.1.2 A Peer-to-Peer VoIP SDK
4.1.3 The Threshold of Low Speed and High Speed
4.2 Synchronous / Asynchronous Conversation
4.3 The specification of the Prototype
4.4 Summary

Chapter 5 Prototyping
5.1 An IMMEDIATE-based Approach
5.1.1 Messaging in IMMEDIATE
5.1.2 Messaging in the Prototype
5.1.2.1 Folders on the Server
5.1.2.2 Database
5.1.2.3 Call Message Types
5.1.3 Inheritance from IMMEDIATE
5.1.3.1 CallClient
5.1.3.2 CallManager
5.2 Call Procedures
5.2.1 User Registration
5.2.2 Call Invitation
5.2.3 Call Teardown
5.2.4 User De-registration
### References

### Appendix A  Client Application

<table>
<thead>
<tr>
<th>A1</th>
<th>The main part of the definition of TPLCVoiceFrame class</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>The TimerTimer event in TPLCVoiceFrame class</td>
</tr>
<tr>
<td>A3</td>
<td>The cccStatusEvent event in TPLCVoiceFrame class</td>
</tr>
<tr>
<td>A4</td>
<td>The btTalkClick procedure in TPLCVoiceFrame class</td>
</tr>
<tr>
<td>A5</td>
<td>The ActConnectExecute procedure in TPLCVoiceFrame class</td>
</tr>
<tr>
<td>A6</td>
<td>The cccConnectionEvent event in TPLCVoiceFrame class</td>
</tr>
<tr>
<td>A7</td>
<td>The main part of the definition of plcVoiceMember class</td>
</tr>
</tbody>
</table>

### Appendix B  Server Application

<table>
<thead>
<tr>
<th>B1</th>
<th>WAR FTP Daemon 1.80 – Screenshots</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2</td>
<td>The main part of the definition of TVoIPServer class</td>
</tr>
<tr>
<td>B3</td>
<td>The ccsRegistration event of TVoIPServer class</td>
</tr>
<tr>
<td>B4</td>
<td>The processCallList procedure of TVoIPServer class</td>
</tr>
<tr>
<td>B5</td>
<td>The ccsConversationAccepted event of TVoIPServer class</td>
</tr>
</tbody>
</table>

### Appendix C  Evaluation

<table>
<thead>
<tr>
<th>C1</th>
<th>User Testing Steps for the Laboratory Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td>Information Sheet</td>
</tr>
<tr>
<td>C3</td>
<td>Participant Profile</td>
</tr>
<tr>
<td>C4</td>
<td>Short Questionnaire</td>
</tr>
<tr>
<td>C5</td>
<td>Final Questionnaire</td>
</tr>
<tr>
<td>C6</td>
<td>Interview Question Outline</td>
</tr>
<tr>
<td>C7</td>
<td>Case Study</td>
</tr>
<tr>
<td>C8</td>
<td>Log File Examples</td>
</tr>
</tbody>
</table>
Figures and Tables

**Figures**

- Figure 2.1 Learning Components in Two Learning Modes 16
- Figure 3.1 The Four-layer TCP/IP Model 28
- Figure 3.2 Data Packaging in Different Layers of the TCP/IP Model 30
- Figure 3.3 Computers Accessing Internet via Dialup Connections 32
- Figure 3.4 Audio Signal Transmission 34
- Figure 3.5 IP Header for VoIP packets 37
- Figure 4.1 Procedure of Call Setup in Conaito 44
- Figure 4.2 Two Peer-to-Peer Conversation Modes 45
- Figure 4.3 Relationship between the Prototype and Conaito SDK 46
- Figure 4.4 PTT-like Asynchronous Conversation 48
- Figure 4.5 Initial User Interface for Asynchronous Conversation 49
- Figure 5.1 Status Change Message among Group Members 54
- Figure 5.2 Stop Talking Message in Asynchronous Conversation 54
- Figure 5.3 Messaging in IMMEDIATE 56
- Figure 5.4 Control Message in the Prototype 57
- Figure 5.5 Folder Structure on the Server for the Prototype 57
- Figure 5.6 Table *VoIPUser* 58
- Figure 5.7 Message Types in the Prototype 59
- Figure 5.8 Message Head Format 60
- Figure 5.9 Relationship between the Prototype and IMMEDIATE 61
- Figure 5.10 CallClient Classes 61
- Figure 5.11 Interface of CallManager 63
- Figure 5.12 Main Events & Message Types in Call Procedures 64
- Figure 5.13 System Procedure for Call Invitation 67
- Figure 5.14 User Interaction Flow Chart for Bimodal Conversation 70
- Figure 5.15 Control Messages for Asynchronous Mode 71
- Figure 5.16 System Messaging when Both Users at Low Speeds 72