AN INTEGRATED UUM WEB-BASED ELECTRONIC TICKETING SERVICE FOR EXPRESS BUS SERVICE PROVIDER

A thesis submitted to the Graduate School in partial fulfilment of the requirements for the degree

Master Of Science IT (Management)

Universiti Utara Malaysia

by

Yeoh Choon Hiang

(c) Yeoh Choon Hiang, May 2003/04. All rights reserved.

Fakulti Teknologi Maklumat
(*Faculty of Information Technology*)
Universiti Utara Malaysia

PERAKUAN KERJA KERTAS PROJEK
(Certificate of Projek Paper)

Saya, yang bertandatangan, memperakukan bahawa
(I, the undersigned, certify that)

YEOH CHOON HIANG

calon untuk Ijazah
(candidate for the degree of) **MSc. INFORMATION TECHNOLOGY**

telah mengemukakan kertas projek yang bertajuk
(has presented his/her project paper of the following title)

AN INTEGRATED UUM WEB-BASED ELECTRONIC TICKETING SERVICE FOR EXPRESS BUS SERVICE PROVIDER

seperti yang tercatat di muka surat tajuk dan kulit kertas projek
(as it appears on the title page and front cover of project paper)

bahawa kertas projek tersebut boleh diterima dari segi bentuk serta kandungan dan meliputi bidang ilmu dengan memuaskan.
(that the project paper acceptable in form and content, and that a satisfactory knowledge of the filed is covered by the project paper).

Nama Penyelia Utama
(Name of Main Supervisor): **NORIDA MOHD. DARUS**

Tandatangan
(Signature) : Nyd

Tarikh
(Date) : 14 JANUARI 2004

PERMISSION TO USE

In presenting this thesis in partial fulfilment of the requirements for a post graduate degree from Universiti Utara Malaysia, I agree that the University Library may make it freely available for inspection. I further agree that permission for copying of this thesis in any manner, in whole or in part, for scholarly purposes may be granted by my supervisor or, in their absence, by the Dean of the Graduate School. It is understood that any copying or publication or use of this thesis or parts thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to Universiti Utara Malaysia for any scholarly use which may be made of any material from my thesis.

Requests for permission to copy or to make other use of materials in this thesis, in whole or in part, should be address to:

Dean of Graduate School
Universiti Utara Malaysia
06010 UUM Sintok
Kedah Darul Aman

ABSTRAK

Tradisi pembelian tiket bas yang tidak menggunakan IT dalam proses pembeliannya adalah tidak berkesan dari segi kosnya. Dengan wujudnya evolusi teknologi Internet, cara pembelian tiket yang baru telah diperkenalkan—pertiketan elektronik. Internet telah membolehkan perkhidmatan pembelian tiket jenis ini berlaku 24 jam setiap hari di mana jua selagi tiket masih ada. UUM telah diperlihatkan berpotensi untuk menawarkan perkhidmatan e-tiket kepada para penuntutnya. Dengan itu, satu sistem integrasi pertiketan elektronik UUM yang berasaskan jaring UUMET telah dibangunkan untuk menyokong idea ini. Sistem UUMET merupakan suatu aplikasi yang dirangkakan khas kepada para penuntut UUM bagi membolehkan mereka membuat pembelian tiket bas ekspres tanpa perlu menghadirkan diri ke kaunter tiket. Projek ini hanya memfokuskan pembangunan sistem prototaip UUMET yang menyokong transaksi pembelian elektronik tiket kepada para penuntut UUM sahaja. Sistem UUMET terdiri daripada satu pangkalan data yang dibangunkan dengan menggunakan MySQL, pelayan Apache sebagai pelayan jaring, dan PHP sebagai pelayan aplikasinya. Metodologi yang digunakan ialah sistem pembangunan berasaskan objek yang menggunakan *Unified Modeling Language*—iaitu *Unified Approach*. Pembangunan sistem prototaip UUMET mengaplikasikan kesemua model fasa kitaran pembangunan sistem iaitu penganalisaan, perangkaan, pembentukan prototaip, dan pengujian ke atas sistem prototaip. Ujian ke atas sistem prototaip UUMET adalah berdasarkan pengujian beasaskan senario yang mengaplikasikan strategi pengujian kotak hitam dan dijalankan di dalam persekitaran hidup yang tidak sebenar.

ABSTRACT

Conventional bus ticketing transactions without IT supported are not cost-effective nowdays. With the evolution and emergence of Internet technology, there comes a new way of ticketing transaction—electronic ticketing. Internet provides this type of ticketing services available online 24-hour, day and night, and anywhere as long as the ticket is still available. UUM is seen to have the ability to occupy this electronic ticketing services to its students. An integrated UUM web-based electronic ticketing (UUMET) system was developed to support this idea. The UUMET system is specially designed to UUM student to enable them to make express bus ticket purchase without having to travel to the ticket counter. This project focused only to the development of a prototype for the UUMET system that support the electronic ticket buying transaction to the student of UUM. UUMET system comprises of a database that is built using MySQL database application software, Apache server as the web server, and PHP as its application server. The methodology used is object-oriented system development using the Unified Modeling Language—the Unified Approach. The development of the UUMET prototype system applied all phases of the system development life cycle model namely analysis, design, prototyping, and testing of the prototype system. The UUMET prototype system is tested using the scenario-based testing applying the concept of black-box strategy done in a non-real life environmental.

ACKNOWLEDGEMENT

Many individuals contributed to this report, by offering advice in refining concepts, by sharing expertise, and by reviewing and commenting on draft versions of particular sections.

The author appreciates the lively discussions with Cik Azida and have benefited from her experiences in systems analysis and design, especially in the area of use case modeling concept.

The author gratefully acknowledge those who took time to comment on draft versions and to work with us on revisions

Most especially, many thanks to Puan Norida Mohd. Darus, the project supervisor, for her insightful and timely comments. Reviewing a large document which applies new techniques to a complex and evolving subject area was surely tedious and time-consuming, and appreciates her diligence.

TABLE OF CONTENT

	Page
PERMISSION TO USE	
ABSTRAK	i
ABSTRACT	ii
ACKNOWLEDEGEMENT	iii
TABLE OF CONTENT	iv
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF ABBREVIATIONS	xii
CHAPTER 1: INTRODUCTION TO UUMET SYSTEM	1
1.0 Introduction	1
1.1 Problem Statement	2
1.2 Objective of the Project	2
1.3 Project Scope	2
CHAPTER 2: LITERATURE REVIEW	3
2.0 Introduction	3
2.1 Electronic Ticket	5
2.2 Electronic Ticketing	6
2.3 Basic Service Trading Mechanism	8
2.3.1 Purchase Transaction	9
2.3.2 Ticket Issuance	10
2.3.3 Ticket Consumption	10

2.4 Example of Implementation 11

2.4.1 Swiss Railways 11

CHAPTER 3: METHODOLOGY 13

3.0 Introduction 13

3.1 Object-Oriented Analysis 15

3.1.1 Identifying the Actors 17

3.1.2 Developing a Simple Business Process Model 18

3.1.3 Developing Use Cases 18

3.1.4 Identifying Classes 20

3.1.5 Identifying Relationships and Multiplicity 22

3.1.5.1 Identifying Super-Sub (Generalization or Specialization) Relationships 23

3.1.5.2 Identifying the Aggregation/A Part-of Relationship 24

3.1.6 Identifying Class Attributes 25

3.1.7 Identifying Class Methods 26

3.1.8 Developing the UML Class Diagram 26

3.2 Object-Oriented Design 27

3.2.1 Designing Classes 28

3.2.1.1 Refining Attributes 28

3.2.1.2 Designing Methods 29

3.2.2 Designing the Access Layer 30

3.2.3 Designing the View Layer 31

3.2.3.1 Macro-Level UI Design Process— Identifying View Layer Objects 31

3.2.3.2 Micro-Level UI Design Process 32

3.3 Prototyping 32

3.4 System Testing 33

3.4.1 Testing Strategy 34

3.4.2 Developing Test Cases 34

CHAPTER 4: SYSTEM MODELS AND DESIGN OF UUMET SYSTEM 36

4.0 Introduction 36

4.1 Object Oriented Analysis 36

4.1.1 Identifying the Actors 37

4.1.2 System Requirements Specification 38

4.1.2.1 Problem Statement 38

4.1.2.2 Assumption 38

4.1.3 The Simple Business Process Model 39

4.1.4 Developing the Use Cases 40

4.1.5 Identifying Classes 44

4.1.6 Identifying Associations and Multiplicity 45

4.1.7 Identifying Super-Sub (Generalization/ Specialization) Relationships 46

4.1.8 Identifying the Aggregation/A Part-of Relationship 46

4.1.9 Identifying Class Attributes 46

4.1.10 Identifying Class Methods 47

4.1.11 Developing the UML Class Diagram 47

4.2 Object-Oriented Design 49

4.2.1 Designing Classes 49

4.2.1.1 Refining Attributes 49
4.2.1.2 Designing Methods 51
4.2.1.2.1 UUMStudent Class—authenticateStudent() Method 51
4.2.1.2.2 UUMStudent Class—retrieveStudent() Method 51
4.2.1.2.3 Ticket Class—browseTicket() Method 52
4.2.1.2.4 Ticket Class—retrieveTicket() Method 53
4.2.1.2.5 ExpressBus Class—retrieveExpressBus() Method 54
4.2.1.2.6 TransportRegistration Class—retrieveTransportRegistration() Method 54
4.2.1.2.7 Ticket Class—buyTicket() Method 54
4.2.1.2.8 Ticket Class—updateTicket() Method 56
4.2.1.2.9 Student Class—updateStudent Account() Method 56
4.2.1.2.10 TicketingTransaction Class—createTicketingTransaction() Method 56

4.2.1.2.11 StudentAccount Class—checkAccountBalance() Method 57
4.2.1.2.12 StudentAccount Class—retrieveStudentAccount() Method 57
4.2.2 Designing the Access Layer 58
4.2.2.1 Creating an Access Classes for the UUMET System's Classes 58
4.2.2.2 UUMET System Database Schema 62
4.2.3 Designing the View Layer 63
4.2.3.1 Macro-Level UI Design 64
4.2.3.2 Micro-Level UI Design 64
CHAPTER 5: SYSTEM TESTING AND RESULTS 66
5.0 Introduction 66
5.1 Developing Test Cases 66
5.2 Results 67
CHAPTER 6: DISCUSSION AND CONCLUSION 68
6.0 Introduction 68
6.1 Significance and Contribution 68
6.2 Limitation and Recommendation 69
6.3 Conclusion 69
REFERENCE 70
APPENDIX 74

LIST OF TABLES

	Page
Table 1: UUMET System's Classes	45
Table 2: Class Matrix for Business Layer Class of UUMET System	45
Table 3: Business Layer Class Associations and Multiplicities of UUMET System	46
Table 4: Business Layer Class Attributes of UUMET System	47
Table 5: UUMET System's Classes and Attributes after Refining Process	50
Table 6: UUMET System Use Cases and Scenarios	66
Table 7: Test Cases for the UUMET System	67

LIST OF FIGURES

	Page
Figure 1: Basic Service Trading Using E-Ticket Mechanism	9
Figure 2: Components of Online Ticketing	11
Figure 3: The Processes and Component of the UA	15
Figure 4: An UML Class Diagram Structure	26
Figure 5: The Architecture of UUMET System	33
Figure 6: The UUMET System Context Model Diagram	37
Figure 7: Activity Diagram for UUMET System.	40
Figure 8: The Use Case Model for UUMET System	41
Figure 9: Sequence Diagram for Login Use Case	42
Figure 10: Sequence Diagram for Browse Ticket Use Case	43
Figure 11: Sequence Diagram for Buy Ticket Use Case	44
Figure 12: Sequence Diagram for Check Account Balance Use Case	44
Figure 13: An UML Class Diagram for UUMET System Classes	48
Figure 14: An Activity Diagram for UUMStudent Class— authenticateStudent() Method	52
Figure 15: An Activity Diagram for Ticket Class— browseTicket() Method	53
Figure 16: An Activity Diagram for Ticket Class— buyTicket() Method	55

Figure 17: An Activity Diagram for StudentAccount Class—
checkAccountBalance() Method 57
Figure 18: The Data Model for UUMStudent Class and
StudentAccount Class 58
Figure 19: The Data Model for StudentAccount Class and
TicketingTransaction Class 59
Figure 20: The Data Model for StudentAccount Class and Ticket Class 60
Figure 21: The Data Model for Ticket Class and ExpressBus Class 60
Figure 22: The Data Model for Ticket Class and TransportRegistration Class 61
Figure 23: The Data Model for TransportRegistration Class and
ExpressBus Class 62
Figure 24: The UUMET System Database Schema 63
Figure 25: An Interface Structure Diagram for UUMET System 65

LIST OF ABBREVIATIONS

CA – Certification Authority

CERN – a collective of European high energy physics researchers

e-business – electronic business

e-commerce – electronic commerce

EDI – electronic data interchange

e-mail – electronic mail

e.g. – for instance

etc. – et cetera

e-ticket – electronic ticket

e-ticketing – electronic ticketing

GUI – graphical user interface

HTTP – Hypertext Transfer Protocol

i.e. – for example

IT – Information Technology

NCSA – National Center for Supercomputing Applications

OCL – object constraint language

OOA – object-oriented analysis

OOD – object-oriented design

SSL – Secure Sockets Layer

UA – Unified Approach

UI – user interface

UML – Unified Modeling Language

UUM – Universiti Utara Malaysia

UUMET – Universiti Utara Malaysia Electronic Ticketing

UUMETDB – Universiti Utara Malaysia database

vs. – versus

W3C – W3 Consortium

WWW – World Wide Web

CHAPTER 1

INTRODUCTION TO UUMET SYSTEM

1.0 Introduction

Nowadays, Universiti Utara Malaysia (UUM) has been seen to have the IT and the Internet to support their daily activities. Unfortunately, there are still some weaknesses found where these technologies are not fully utilized for its student advantages. One of the problems identified that this project is focused on is the conventional way of buying the express bus ticket still in practice. As according to Zwass (1999), the conventional bus ticketing services are transactions that are not supported with IT. This type of ticketing are conducted using media like paper, telephone or fax. Conventional ticketing even seems to be popular and is in practices up to today, but with the evolution of Internet, there has evolved the needs to change from conventional ticketing to electronic ticketing (e-ticketing).

The UUM Electronic Ticketing (UUMET) system is a web-based application specially designed to UUM student to enable them to purchase express bus ticket without having to travel to the ticket counter. Unlike conventional ticketing services, the e-ticketing services are like other IT-supported business transactions. It uses media like electronic mail (e-mail), EDI, WWW and other Internet services to support its functions (Chesher & Kaura, 1998). This web-based application enables the express bus service providers to store their ticket for sale in an integrated database. Student wishes to buy the ticket may access UUMET system and buy the ticket online at anywhere and anytime, as long as the ticket is still available.

UUMET system comprises of a database that is built using MySQL database application software, Apache server as the web server, and PHP as its application server.

The contents of the thesis is for internal user only

REFERENCE:

Definitions: Software testing [Cigital Labs]. Retrieved from http://www.cigitallabs.com/resources/definitions/software_testing.html

Electronic Ticket. Retrieved from http://www.galileo.com/vendors/air/aretkt.htm

IATA - *Electronic Ticketing.* Retrieved from http://www.iata.org/eticket/index

Mapping Objects to Data Models with the UML. Retrieved from www.rational.com

Monash IT Featuring Object Oriented Analysis and Design using UML. Retrieved from http://neptune.netcomp.monash.edu.au/pearcey/courses/UMLFeature.htm

Net.Commerce version 2. Retrieved from http://www.software.ibm.com/commerce/net.commerce/ncver2.html

Net.Commerce version 3. Retrieved from http://www.software.ibm.com/commerce/net.commerce/ncver3.html

Object-Oriented Database. Retrieved from http://www.sei.cmu.edu/str/descriptions/oodatabase.html

Secure Electronic Ticketing on the Internet – Why Internet Ticketing? Retrieved from http://people.cs.uct.ac.za/~dburford/nis/sect4.htm

Scoop Business (1999). *Electronic Ticket Usage Surpasses Paper Ticketing.* Retrieved from http://www.scoop.co.nz/stories/BU9906/S00029.htm

Zurich Project for Railway Ticketing over the Internet. Retrieved from http://www.zurich.ibm.com/pub/hug/PR/ticketing.html

Allamaraju, Darby, F., & Flenner, M. (2001), *Java E-Commerce.* Wrox Press Limited.

Bahrami, A., (1999). *Object Oriented Systems Development using the Unified Modeling Language.* Irwin, United States of America: McGraw-Hill.

Baudoin, C. & Hollowell, G. (1996). *Realizing the Object-Oriented Lifecycle.* Upper Saddle River, NJ: Prentice Hall.

Binder, R.V. (1996). *The FREE Aproach for System Testing: Use-Cases, Threads, and Relations. Objects 6,* no. 2.

Booch, G. (1994). *Object Analysis and Design with Applications.* Redwood, CA: Benjamin Cummings.

Booch, G., Jacobson, I., & Rumbaugh, J. (1997). *The Unified Modeling Language, Notation Guide Version 1.0.*

Booch, G., Rumbaugh, J., and Jacobson, I. (1999). *The Unified Modeling Language User's Guide.* Addison Wesley.

Champeaux, D., Lea, D & Faure, P. (1993). *Object-Oriented System Development.* Addison Wesley.

Chesher, M. & Kaura, R. (1998) *Electronic Commerce and Business Communications.* Berlin, Germany: Springer Verlag.

Choi, E.M. (2002). *Use-Case Driven Test for Object-Oriented System.* Department of Computer Engineering, Dongguk University. Seoul, South Korea.

Coad, P. & Yourdon, E. (1991). *Object Oriented Analysis.* 2nd ed. Eaglewood Cliffs, NJ: Yourdon Press, Prentice Hall.

Coad, P. & Yourdon, E. (1991). *Object Oriented Design.* Eaglewood Cliffs, NJ: Yourdon Press, Prentice Hall.

Cockburn, A. (1997). *Structuring Use Cases with Goal.* Retrieved from http://alistair.cockburn.us/crystal/articles/sucwg/structuringucswithgoals.htm

Copeland, L. (2003). *Sequence Diagram: Testing UML Models, Part 2.* Retrieved from http://www.stickyminds.com

Fowler, M. & Scott, K. (1997). *UML Distilled.* Reading, MA: Addison-Wesley.

Fujimura, K. & Nakajima, Y. (1998). *"General-purchase Digital Ticket Framework", the Proceedings of the 3rd USENIX Workshop on Electronic Commerce.* Boston, Massachusetts.

Hug, M. (1997). *Get a Swiss Railway Ticket over the Internet.* Retrieved from http://www. zurich.ibm.com/News/swissrailway.html

Jacobson, I. (1994). *Object-Oriented Software Engineering: A Use Case Driven Approach.* Reading, MA: Addison-Wesley, Object Technology Series.

Jacobson, I., Ericsson, M. & Jacobson, A. (1995). *The Object Advantage Business Process Reengineering with Object Technology.* Reading, MA: Addison-Wesley.

Jacobson, I., Booch, G., & Rumbaugh, J.(1999). *The Unified Software Development Process.* Addison Wesley.

Kao, J (2000). *Technology, Opportunities, and Issues of Electronic Commerc,* Stevens Institute of Technology, TM601.

Lemon, G. (2000). *Object Oriented Analysis and Design, OOAD, UML, Classes, Classification: The classification of objects in UML (Classes).* Retrieved from http://www.juicystudio.com/tutorial/ooad/classes.html

Lee, C. (2003). *Class Diagram: Testing UML Models, Part 3.* Retrieved from http://www.stickyminds.com/sitewide.asp?Function=edetail&ObjectType=ART&ObjectId=6211

Malan, R. & Bredemeyer, D. (1999) *Functional Requirements and Use Cases.* Retrieved from http://www.bredemeyer.com

Marick, B. (1995). *The Craft of Software Testing: Subsystems Testing Including Object-Based and Object-Oriented Testing.* Eaglewood Cliffs, NJ: Prentice Hall.

Martin, J. & Odell, J. (1992). *Object-Oriented Analysis and Design.* Eaglewood Cliffs, NJ: Prentice Hall.

Minated, J (1999). *Easy World Wide Web with Netscape.* Indianapolis, Indiana: Que Corporations.

Norman, R. (1996). *Object-Oriented System Analysis and Design.* Eaglewood Cliffs, NJ: Prentice Hall.

Rumbaugh, J., Blaha, M., Premerlani, W., William, Eddy, F., & Lorenson, W. (1991). *Object-Oriented Modeling and Design.* Eaglewood Cliffs, NJ: Prentice Hall.

Salhir, S. (1999). *The Unified Modeling Language (UML) - Two Years After Adoption of the Standard.* Retrieved from http://home.earthlink.net/~salhir/theumltwoyearsafteradoptionofthestandard.html

Scott, W.A. (2001). *The Object Primer: The Application Developer's Guide to Object Orientation and the UML.* Cambridge University Press, New York: SIGS Publication Inc.

Segev, A., Wan, D.& Beam, C. (1995). *Designing Electronic Catalogs for Business Value: Results from the Commercenet Pilot.* Technical Report Working Paper CITM-WP-1005, Fischer Center for Information Technology: U.C. Berkeley.

Shirley, S. (2001). *A Proposed Electronic Ticket Management for Trading Service in Internet.*

Sparks, G. (2000). *An Introduction To Modeling Software Systems Using The Unified Modeling Language: The Business Process Model.* Retrieved from www.sparxsystems.com.au

Sparks, G. (2000). *An Introduction To Modeling Software Systems Using The Unified Modeling Language: The Use Case Model.* Retrieved from www.sparxsystems.com.au

Trower, T., (1994). *Creating A Well-Designed User Interface.* Stanford, CA: University Video Communication.

Troy, V. (2000). *How To Test Programs.* Retrieved from http://www.math.uwaterloo.ca/~tmjvasig/CS134Testing.html

Whitten, J.L., Bentley, L.D. & Dittman, K.C. (1998). *System Analysis and Design Methods.* 4th ed. United States of America: Irwin/McGraw-Hill.

Wilson, W. (2002). *What is e-commerce?* Retrieved from http://www.as400.ibm.com/developer/ebiz/documents/ecommerce.html

Wirfs-Brock, R., Wilkerson, B. & Wiener, L. (1992). *Designing Object-Oriented Software.* Eaglewood Cliffs, NJ: Prentice Hall.

Zhao, J. (2000). *Robust Object Oriented System Analysis.* Retrieved from http://cosulting.dthomas.co.uk

Zwass, V. (1999) *Structure and Macro-Level Impacts of Electronic Commerce: From Technological Infrastructure to Electronic Marketplaces.* K.E. Emerging Information Technology, Kendall: Sage Publications.