

國立交通大學

資訊科學與工程研究所

碩士論文

一個採用 QT SDK Framework 的跨平台中文學習系統

A Cross Platform Mobile Learning System Using

QT SDK Framework



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中華民國一百年六月

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碩士論文

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摘要

目前行動學習科技的發展與接受度日益增加，已經有多樣且豐富的行動學習科技應用程式，而這些應用程式已經從傳遞學習發展到幫助學習者進行溝通並學著"在任何地方學習中文"。在中文語系國家國際學生面臨著許多問題，主要都涉及到語言本身，因此，爲了達到專業的中文能力行動學習中文已經開始扮演一個重要的角色。這個研究針對中文是第二語言的國際學生開發了一個中文行動學習系統。這個系統開發採用了 QT SDK 框架，能使得系統在一般手機與智慧型手機都能夠使用，並且帶給使用者相同的使用經驗。在本研究中設計了一個實驗，讓交通大學的國際學生試用研究中所開發的系統，初步的結果顯示學生使用該系統進行學習的結果是有效的、學生對使用該系統進行學習的態度是正面的並認爲系統是可用的。

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ABSTRACT

Today, the development and acceptance pace of Mobile Learning Technologies are increasing rapidly as there are abundant applications for mobile learning technologies in education from the ability to convey learning modules to facilitating learners to communicate and learn “on-the-go”. Mobile Chinese Learning has become to play a role in the attainment of Chinese Proficiency; therefore, International Students face many issues mainly related to the Language itself.

This project explains the development of a mobile learning system for learning Chinese as a second language for International Students. **QT SDK Framework** was used to develop the system that works on smart mobile phones as well as cellular phones. The System was tried out by the International Students at National Chiao Tung University and experiments were conducted. It showed that students had a possible attitude towards learning and the system was effective and usable.

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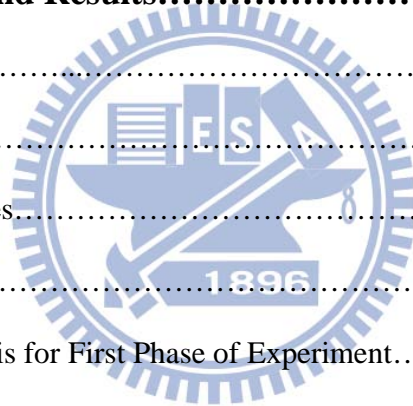
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CHAPTER 1: INTRODUCTION

1.1 Preface

Mobile Technologies have the power to make learning more available and accessible; therefore, the capabilities of mobile devices such as mobile phones have improved in recent years. Since the use of mobile phones and handheld devices among students has dramatically increased, implementing mobile learning in academic instructions is of common interest; therefore, Chinese Language Learning has begun to be used for this initiative for international students to learn.

In the context of mobile learning in terms of social practices, Tom Anderson, Wu-Yuin Hwang and Ching-Hua Hsieh [14] stated that Students who wish to learn a new language come with the assumption that they will benefit from participating in real activities that occur in the context of the environment providing a way for learners to construct a new understanding of the language and Language learners may have the great advantage of learning a language in a Country in which it is spoken; however, it is the assumption that many do not maximize the affordances of the environment.

In addition, for reference, there are currently 269 international students at National Chiao Tung University which means that there are still aforementioned issues in that adaptation into a Chinese-speaking environment and the language barrier continues to be a difficult task to learn. The Chinese Language itself is difficult and sometimes disheartened international students to follow their studies that are taught in Chinese in an academic environment; therefore, learning strategies that employs these students to learn is required and as a result, Mobile Learning is suited to satisfy this need.

Many researches and projects have continued to use mobile learning as a conventional way to applying knowledge [6] [25]. In addition, Mobile Phones has also been used for learning especially for Chinese Language Learning [12] [14]. Furthermore, Jo Colley and Geoff Stead [2] showed that learning materials is needed and that developing these innovative learning materials presents a clear perspective on the learning goal.

1.2 Motivation

David Parsons [5] indicated that developing a successful mobile learning system depends on the imaginative use of the mobile environment; therefore, mobile devices have become more pervasive in our everyday lives and using these devices for learning becomes more convenient.

In addition, the system will use mobile phones such as cellular phones and smart phones to satisfy the requirements of international students in enabling them to achieve better

learning and interaction within the main scope; therefore, this can be accomplished where the system would test the students' learning skills of Chinese language learning through variety of interactive games. This system would allow the international students to get more interactive with it.

1.3 Problem Scope

Even though, teachers cannot be with their students for long in a classroom when learning Chinese in a traditional classroom environment, there are problems that could result from these international students to not reach their potential to learn Chinese. Problems related to this kind of traditional classroom setting for learning Chinese is that

1. Students will feel discourage to learn after classroom therefore abandoning the learning materials that was been taught in Chinese.
2. Language is still becoming the biggest barrier between teachers and international students; therefore, these students become restrained from actively learning.
3. Less encouragement to speak and learn Chinese in a classroom environment.
4. Less motivation to speak and learn Chinese in a classroom environment.

1.4 Solution

In order to solve these problems, an independent mobile learning system is used to allow international students in understanding and learning more about the Chinese language. This system can test the students' skills by answering questions and using their intellectuality to solve common word and phrase problems. In addition to testing the students' learning skills in the Chinese language, the system allows them for faster translation of any given word "on the go" regardless of the place and time.

1.5 Methodology

Mobile devices have become to be used popularly for educational purposes; therefore mobile learning is impracticable without the usage of the mobile devices. The general capability that combines the mobile devices is their mobility, convenience, portability and ease of use. Smart phones as well as cellular phones will be commonly used for methodological purposes for this research because of its characteristics.

In general, cellular phones are mainly used for voice communication and sending and receiving of text messages (SMS); however, the limitation of cellular phones are low memory capacity and low data transfer. However, cellular phones can also be used for internet access such as WAP or GPRS technologies.

Smart phones are another mobile device that would also be used during this research. Smart phones are hybrid because they combine both the cellular phone and personal digital assistant (PDA) abilities and they use Symbian, Windows Mobile or other operating system. Smart phones have the potential to be successful in mobile learning education; therefore, Mobile devices do influence the learning process through interaction, portability and immediate communication which is why they will be used for this research.

1.6 Outline of the Thesis

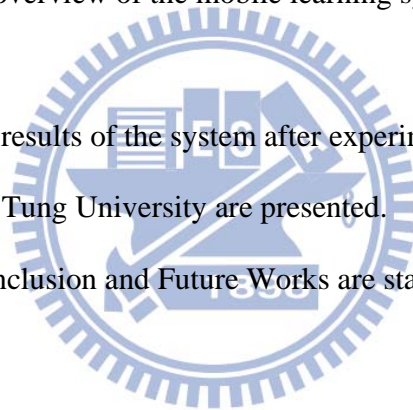
This thesis is divided into five chapters. Following is a concise description of the content of each chapter:

1. In Chapter 2, the background of developing the system in relation to mobile learning systems as well as the related works are introduced.

2. In Chapter 3, an overview of the mobile learning system and its major components are given in details.

3. In Chapter 4, the results of the system after experiments with the International Students at National Chiao Tung University are presented.

4. In Chapter 5, Conclusion and Future Works are stated.



CHAPTER 2: BACKGROUND

This chapter will present the background of this research. Furthermore, it will give an introduction to the framework being used as well as in-depth information of mobile learning systems in general. Related works will also be presented as well.

2.1 MOBILE LEARNING SYSTEMS

Mobile Learning Systems has continued to be used for educational purposes; however, it is very important when it is implemented and used. It is noted that Mobile Learning Systems depends on the type of mobile devices as well as the type of wireless communication services that is used to access learning materials.

Georgieva, Smrikarov and Georgiev [4] stated that Mobile Learning Systems can support synchronous education [4] whereby these systems allow students to have communication with teachers in real time and also other students while it can also support asynchronous education whereby the students will not be able to communicate with the teachers and students in real time; furthermore, email or SMS are the only reliable tools to communicate asynchronously.

Systems for on-line mobile learning, off-line mobile learning is also indications for Mobile Learning Systems [4]. Systems for on-line mobile learning need communication between the system and the mobile devices of users permanently while Systems for off-line

mobile learning, the mobile devices of the users have the learning materials uploaded and there is no cause for wireless communication between the system and the mobile devices. Furthermore, Systems which allows both on-line and off-line mobile learning [4] allows some parts of the Learning materials to be accessed online while the remaining materials can be accessed offline; therefore, the mobile device's memory must be uploaded with these materials.

Mobile Learning Systems can also depend on the user's location. For on-campus location [4], it can be accessed inside the universities, schools, and companies while for off-campus location [4], it can be accessed outside the universities, schools and companies. For example, cellular phones and smart phones are ideal for this kind of location because of its mobility.

Mostakhdemin- Hosseini and Mustajarvi [1] indicated that Mobile Learning Systems has its important features which includes that it allows users to have access to learning materials independent from time and place, allows any kind of users to have access to the system. Furthermore, it allows users to have access to resources in different formats such as picture, video and text and these materials can be reused regardless. Mobile Learning systems can also allow users to carry out functions defined as an education component and it offers flexible environment in which other services and components can be added [3].

Furthermore, Mobile Learning Systems [1] consists of three domains which are usability, wireless technology and e-learning system. In figure 1, usability is important

because the services in these mobile devices must be validated when involved in the mobile learning system; however, the type of mobile device, the features of the mobile and the mobile content design are critical for its usability. Different considerations should be issued out when developing a mobile learning system that include whether the system should have a long or short content materials; furthermore, the types of services that it will offer such as voice, text and picture and lastly, the features and characteristics of these services whether the text will require a bigger screen size or smaller screen size.

For the wireless network [1], it depends on the wireless network infrastructures, capabilities and the cost and it must be taken under consideration that the cost of the services will greatly be influential when developing a mobile learning system. E-learning [1] is also a domain when developing a mobile learning system because of its platform as well as the types of e-learning materials being selected will greatly influence its development.

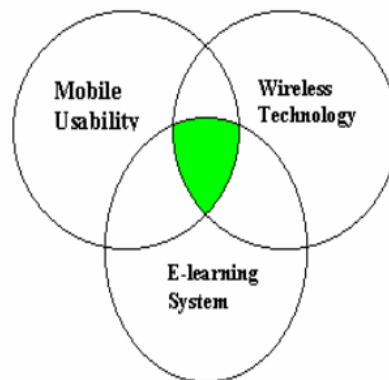
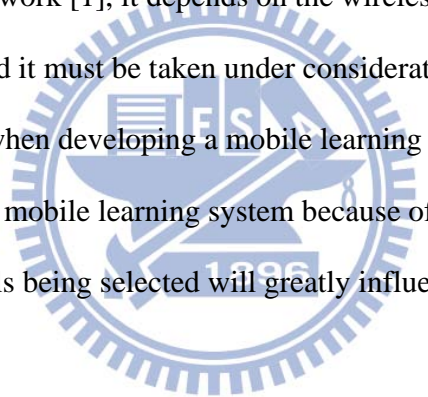


Figure 1: The domain of a Mobile Learning System (Hosseini, Mustajarvi)

2.2 QT SDK FRAMEWORK

2.2.1 Introduction to QT

QT is a cross-platform application and UI Framework. The QT framework [9] was developed by Haavard Nord and Eirik Chambe-Eng in 1995 and was publicly available at that year. 3 years later, the company called Trolltech was formed in 1994. In 1996, the KDE project was started by Matthias Ettrich which led to the development of a GUI based framework. During the following year in 2001, QT added support for MAC OS X and in 2005, all platforms were released. In 2008, Nokia acquired Trolltech and was called Nokia, QT Development Framework. Currently, QT has about 840 classes. QT is implemented in C++ and also has Java bindings as well.

QT can be seen from embedded devices to desktop applications. Currently, QT has currently risen to popularity and has been used by several companies such as Google, Canon, and Oracle.



Figure 2: Industries where QT is used.

There are three editions of QT currently available which include GUI Framework that is a commercial entry level GUI edition, Full Framework which is a complete commercial edition and Open Source which is a complete Open Source edition.

2.2.2 Characteristics of QT

In general, QT has a **faster and built-in advanced user interface** [20] such as GUI Functionality which contains vast library of standard widgets and dynamic layout engine, advanced 3D visualization that it can be integrated with OpenGL and OpenGL ES. In addition, QT contains Powerful graphics canvas that allows developers to build advanced UIs with zoom, rotation and full interaction as well as Widget stylesheets that allows developers to customize UI with only few lines of CSS code. Furthermore, QT contains Advanced paint engine that utilizes transparency, alpha blending and anti-aliasing as well as SVG that allows developers to display and create SVG (1.1/1.2 Tiny) content with support for animations.

QT can build **high-performance applications** [20] such as powerful multi-threading functionality which contains intuitive, object-oriented threading API, Easier parallel programming whereby it allows simple way of utilizing multi-core architecture, Efficient container classes that has fast container classes, Graphics processing unit(GPU) acceleration with OpenGL / OpenGL ES and achieving high performance and low footprint on embedded Linux and Windows CE.

QT builds **connected applications** [20] that includes Seamless database integration that has broad support for all major database drivers, Network Communication that provides client

and server socket abstraction for common protocols, XML that works with XQuery and Integration with other technologies that includes ActiveX, SOAP and CORBA.

QT has a **rich user experience** [20] such as QT Webkit Integration that allows online content and services to blend into native applications and Phonon Multimedia API that abstracts existing frameworks on each platform. Furthermore, another characteristic of QT includes **integrated tools to boost productivity** [20] such as QT creator which is a cross platform IDE used for QT development and Powerful GUI layout and forms builder that allows developers to rapidly build and preview functional UIs.



2.2.3 QT Architecture

QT has several modules that are used for software development.

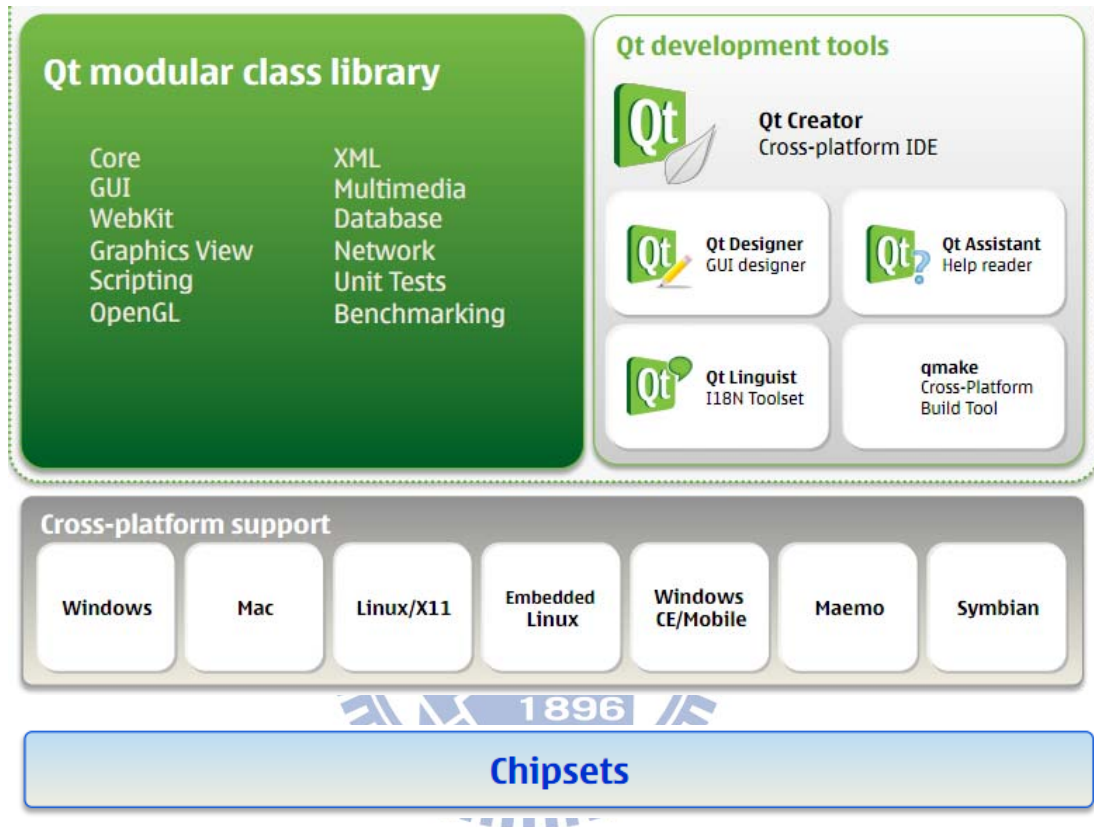


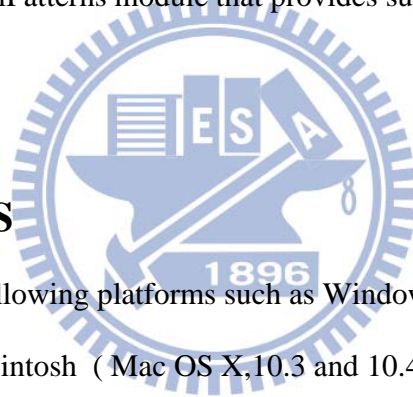
Figure 3: Architecture of QT

QT Architecture consists of [21] QT Core module that contains the core non-GUI classes that includes QT's signal and slot mechanism. It also includes threads, regular expression, shared memory and user and application settings; QT GUI module that contains the majority of GUI classes; QT Multimedia module that implements the function of low-level multimedia; QT Network module that contains classes for writing UDP and TCP clients and servers; QTOpenGL module that contains classes that enable the use of OpenGL in rendering 3D graphics;

QTOpenVG module that a plugin that supports OpenVG painting; QTScrip module that scripting engine that is ECMAScript based and standardized in the ECMA-262 specification and ISO/IEC 16262;QTSql module that contains classes that integrate with open-source and proprietary SQL databases. it also includes data models for database tables that can be used with GUI classes;QTWebkit module that provides a WebKit-based layout engine as well as classes to render and interact with web content;QTXml module that implements SAX(Simple API for XML) for reading data from an XML document and DOM(Document Object Model) interfaces which represent and interact with objects in HTML, XHTML and XML documents to Qt's XML parser;QTXmlPatterns module that provides support for XPath, XQuery and XML validation.

2.2.4 PLATFORMS

QT supports this following platforms such as Windows (Windows 7, Vista, Server 2003, XP, 2000, NT4),Macintosh (Mac OS X,10.3 and 10.4),Linux / X11 (Linux, Solaris, HP-UX, IRIX, AIX, many other Unix Variants),Windows CE (Windows CE 5 and higher, Windows Mobile 5 and higher),Embedded Linux, Symbian and Meego.



2.3 QT Creator

QT Creator is a cross-platform integrated development environment and is the basis for the QT SDK. Furthermore, it provides [22] support for desktop and mobile used for building and running QT applications for desktops and mobile devices as well as C++ and JavaScript code editor that supports editing C++. In addition, it contains an integrated UI designer that builds UIs from Qt widgets and develop animated UIs with the QML language as well as project and build management tools that generates all the necessary files needed when importing an existing project or creating a new project. QT Creator also contain Simulator for mobile UIs that tests Qt application for mobile devices in an environment and support for version control that integrates with the most popular version control systems including Git, Subversion and Mercurial.



Figure 4: QT Creator

2.3.1 Software Development with QT Creator

During software development, QT creator can be used for the following purposes effectively and it includes creating new or opening existing projects, building and running the projects or applications, programming, debugging and tweaking the build.

2.4 MOBILE DEVELOPMENT ENVIRONMENT AND TOOLS

Nowadays, the development environment tools for mobile devices are commonly used and they consist of Java 2 Platform Micro Edition (J2ME), Microsoft NET Compact Framework, Opera AJAX Platform and Palm OS Developer Suite. These development tools mostly target the mobile environment.

- **2.4.1 Java 2 Platform Micro Edition (J2ME)**

The Java 2 Platform, Micro Edition (J2ME) provides a robust and flexible environment for applications running on consumer devices, such as mobile phones, PDAs and TV set-top boxes, as well as a broad range of embedded devices. J2ME includes Java virtual machines and a set of standard JAVA APIs defined through the Java Community Process.

J2ME architecture comprises a variety of configurations, profiles, and optional packages that developers can choose from, and combine to construct a complete Java runtime environment that closely fits the requirements of a particular range of devices. It includes optional packages such as CLDC (Connected Limited Device Configuration) or CDC (Connected Device Configuration) and an associated profile and these optional packages

offer standard APIs for using both existing and emerging technologies such as database connectivity, wireless messaging, multimedia, Bluetooth and web services.[3]

- **2.4.2 Microsoft NET Compact Framework**

The .NET Compact Framework is a hardware-independent environment for running programs on resource-constrained computing devices such as Pocket PC, mobile phones, automotive computing devices, and custom- designed embedded devices built with the Windows CE .NET operating system. This framework is part of the .NET Framework class library, contains classes exclusively designed for it, and inherits the full .NET Framework architecture of the common language runtime. The .NET Framework has the following functionalities that include running programs that are independent of hardware and operating systems, supporting common network protocols, connecting seamlessly with XML Web services, providing developers with a model for targeting their applications and components to either a wide range or specific category of devices. Furthermore, it provides benefits of design and optimization of limited system resources and obtains optimal performance in generating native code using just-in-time (JIT) compilation. [3]

- **2.4.3 Opera AJAX Platform**

The Opera Platform SDK is used for developing and running Web based applications on mobile phones. This framework is divided into three parts the Application Player, the Application Framework and Applications.

The Application Player is an extended version of the Opera browser and can be seen on mobile phones and personal computers. The Application Player enables Web applications

to have user interactions through information such as messaging, calendar, email and game. Furthermore, the application player acts as a host for the Application Framework. The Application Framework runs above the Application Player and provides interaction between Web applications as well as writing for client-side applications. It is mostly written in JavaScript. The Application Framework also offers developers predefined UI elements, such as menus and dialogs, messaging system and storage data for faster and easy application development.

Opera Platform applications are advanced Web applications that interact with the phone's functionality through the Opera Platform DOM interface such as calendar, messaging which is provided by the Application Player and can communicate with servers using XMLHttpRequest through web services.[23]

• **2.4.4 Palm OS Developer Suite**

Palm OS Developer Suite joins compilers, debuggers, simulators, PalmSource SDKs, and related tools into an integrated development suite that addresses a developer's tool needs. Palm OS developer suite simplifies the development of wireless, multimedia, and enterprise applications for Palm OS by providing developers with a single, integrated tool chain based on the highly successful, open source Eclipse IDE. The Palm developer suite includes the following tools such as Palm Simulators, Wizards, Palm OS Protein C/C++ Compiler and Integrated Debugger; Palm OS Resource Editor which is a visual resource editor that creates and edits XML resource description (XRD) files for Palm OS applications , Update Manager which makes it easy to install new features into development environment without having to

perform a complete download and install and Palm Source Installer which builds the product installers quickly.[3]

2.4.5 Eclipse Mobile Tools For Java

Eclipse Mobile Tools for Java is an extension of the existing Eclipse framework used to support mobile devices Java application development. Furthermore, it also extends Eclipse platform to enable developers to develop, debug and deploy mobile java applications to emulator and real devices. This framework can be extended by tool vendors and tools which can be used by third-party developers. The extension point of Eclipse mobile tools for Java are Device Management, GUI Builder Management, Build Management, Security Management and Deployment Management. [24]

- **2.4.6 Netbeans IDE Bundle For Java ME**

Netbeans IDE Bundle for Java ME is a tool for developing applications that run on mobile devices generally mobile phones and can also include PDAs (Personal Data Assistant) and Java Card. Furthermore, Netbeans IDE Bundle for Java ME comes with the latest Java ME SDK 3.0 which supports both CLDC (Connected Limited Device Configuration) and CDC (Connected Device Configuration) development; thus, it can be easily integrated through third-party emulators for a robust testing environment. Netbeans IDE Bundle for Java ME can create, test and debug applications for MIDP (Mobile Information Device Profile) , CLDC (Connected Limited Device Configuration) and CDC (Connected Device Configuration).[25]

2.5 QT SDK Framework for Mobile Development

QT SDK Framework is a cross-platform development that is assigned to develop Symbian and maemo platforms for mobile devices. The Characteristics of QT SDK Framework for Mobile Development [15] includes simple Installation whereby QT SDK can be installed from packages which is why it is a easy setup but not a complicated one for mobile development, Complete Tool Chain that allows you to find everything that is needed to get your applications fully tested and deployed them on mobile devices, Rapid Development that contains powerful and intuitive tools such as QT Designer and also on-device debugging used to accelerate through development.

QT SDK Framework also has the Power of QT APIs that allows developers to do less with more with QT Mobility as well as it have one code line, many devices that using the QT SDK Framework allows developers to create applications for Symbian, Maemo and Meego devices. Furthermore, it has a lightweight Simulator that allows applications to work on any QT enabled device quickly and easily, Remote Compiler whereby Developers can compile their QT applications to any platform from any computer and Smart Installer that allows QT developers to download Qt and Open C/C++ components as the applications are installed.

Nokia QT SDK IDE

There are several tools that is needed to integrate Nokia QT SDK and it include QT Creator IDE, Symbian Development Environment, Maemo Development Environment and QT Simulator.

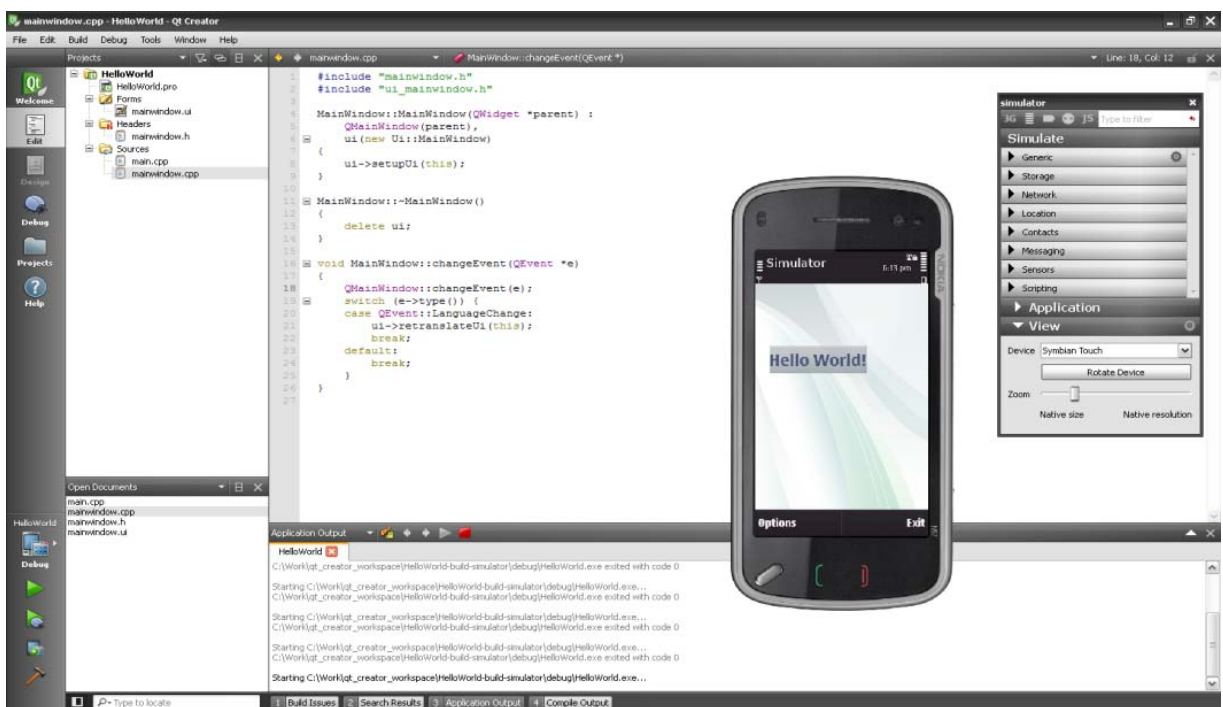


Figure 5: Nokia QT SDK Framework For Mobile Development

2.7 Related Works

In this section, we introduce related researches in relation to this project that is directed towards mobile learning and Chinese Language Learning.

2.7.1 Design and Implementation of a mobile-game based system to Support Chinese Language Speaking For International Students in a Chinese Environment:

This research involves the use of mobile devices to motivate learners to learn Chinese and to promote interaction among international students and their environment through language and information dependency. This system uses mobile devices and the students at National Tsing Hua University are the participants for this research. Furthermore, it uses scenario-based fulfilling activities whereby they are being encouraged to learn Chinese through mission tasks. CPMS (Cross Platform Map System) are integrated into the system as a location points and obtaining information throughout the scenario study. Participants are given clues using the mobile devices to find a place within the campus map and through this map; players can find the right location. Once in a specified place, they must perform a task whereby these tasks and clues are given in English but the vocabulary and phrases needed to complete the tasks are given in Chinese. After a task is completed, the system will question participants to verify the task they completed and they must visit all the spots in a circuit to move to the next level. By doing this, it has an implicit characteristics of games which should be fun and entertaining.[11]

2.7.2 A Mobile Environment for Chinese Language Learning

This research presents the requirements needed for mobile environment to make communication between teacher, learner. System and users surrounding and proposes a mobile environment on PDA for foreigners to learn Chinese. The scenario-based evaluation discusses that in a scenario-based design, actor, goal, setting, object and human actions are the only way to deduce the structure or appearance of software and one of the important conditions to reach successful design is the early participation of target users and these target users are the foreign spouses in Taiwan that attend Chinese Language classes. The system architecture consists of two main user interfaces on the PDA being used: city map and frequently used sentences.

The former urges people to deliver information actively in the virtual space and share their feelings and thoughts about the real world. Once they approach the locations where tags exist, system will inform them by non-compulsory notifications, the later help learners search for the practical sentences quickly to communicate with local people under various kinds of situations. Collocating with the sentence marker, each learner can establish personalized sentence depository according to the frequencies she has marked. [13]

2.7.3 The Study of a Mobile Collaboration Learning System for Chinese Language Learning

This research presents Student Partner, a mobile learning system designed specifically to promote collaboration among Chinese Language Learners with capabilities including GPS, camera, messaging and recording. The main system of Student Partner is divided into four frames: the top left frame holds categories for accessing learning content. Once a category has been selected, subcategories appear in the right frame and content appears in the central frame. As the mobile device can connect with GPS, it allows learners to annotate maps of the area with audio, video, text, and photos that they create.

Learners can share their experiences with one another. A teacher can assign homework that includes information gathering. The wireless capabilities of the mobile device on which Student Partner runs allow information to be transmitted to a screen and to other users. This allows learner to collaborate with other learners and to interact with teachers outside class hours.

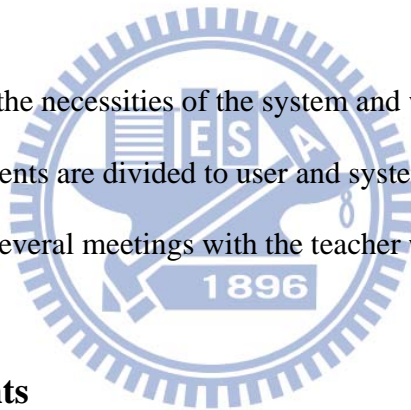
As the availability of teachers could be limited, assistants can be selected. A phone call, text message, or entry on a form could alert others that there was a request for more information. The learners could collect data that represented things in the world that they were not sure about. They could send this information to others for discussion and clarification. This information could be in the form of photos, videos, sound clips, or text and it could be geocoded with data from GPS [14].

CHAPTER 3: SYSTEM OVERVIEW AND IMPLEMENTATION

This chapter discusses the requirements, use cases and the architecture of the system according to the problems and solutions shown in the previous chapter. The system shall be designed and tested at National Chiao Tung University particularly catering to the International Students.

3.1 Requirements

This section shows the necessities of the system and what the user expects from the system to do. The requirements are divided to user and system requirements/components. Both were described after several meetings with the teacher who assisted with the project.



3.1.1 User requirements

The users of the system are the students; however, to a lesser degree of the teachers as well. The user requirements were distinguished as following:

Students

- Translate any word or phrase at any particular place or time.
- Solve particular words and phrases in a given type of puzzle using different contexts in any given translation.
- Answer and solve questions in any given translation.

3.1.2 System Requirements

The system requirements are that each user must have a cellular phone or a Smartphone in order for the system to be functional which is why a mobile phone is required; hence it has to be a Nokia based cellular phone or Smartphone because of its capabilities. Furthermore, internet connection particularly wireless LAN connection is needed also for the system to be functional; hence, its access technology has to be online.

3.2 Use Cases

This diagram shows the use case for a student based on user requirements and system specifications as well. A use case depicts the interaction a user has with the system.

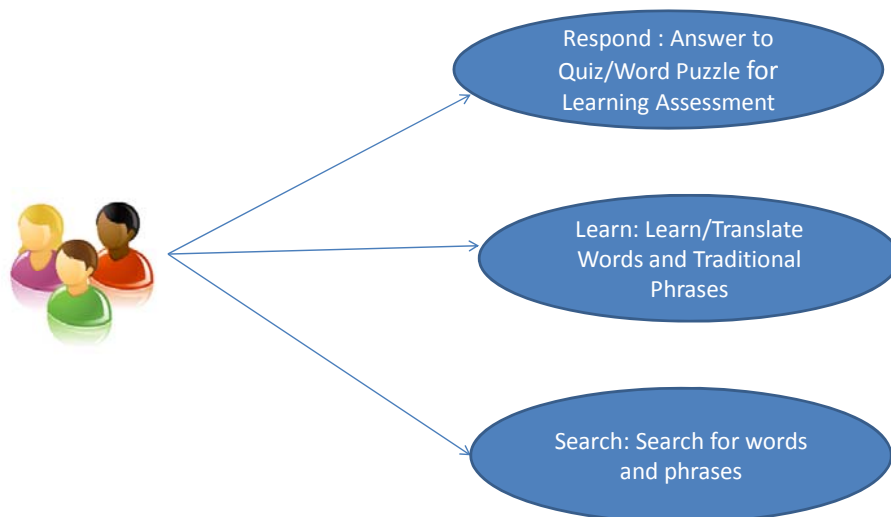


Figure 6: Use Case of a Student

3.3 System Architecture

3.3.1 Main Components

The architecture of the mobile learning system is divided into three major components which are the Translation Engine, Word Search Puzzle and Multiple Choice Quiz Engine. However, a communication technology is required for this system to be functional.

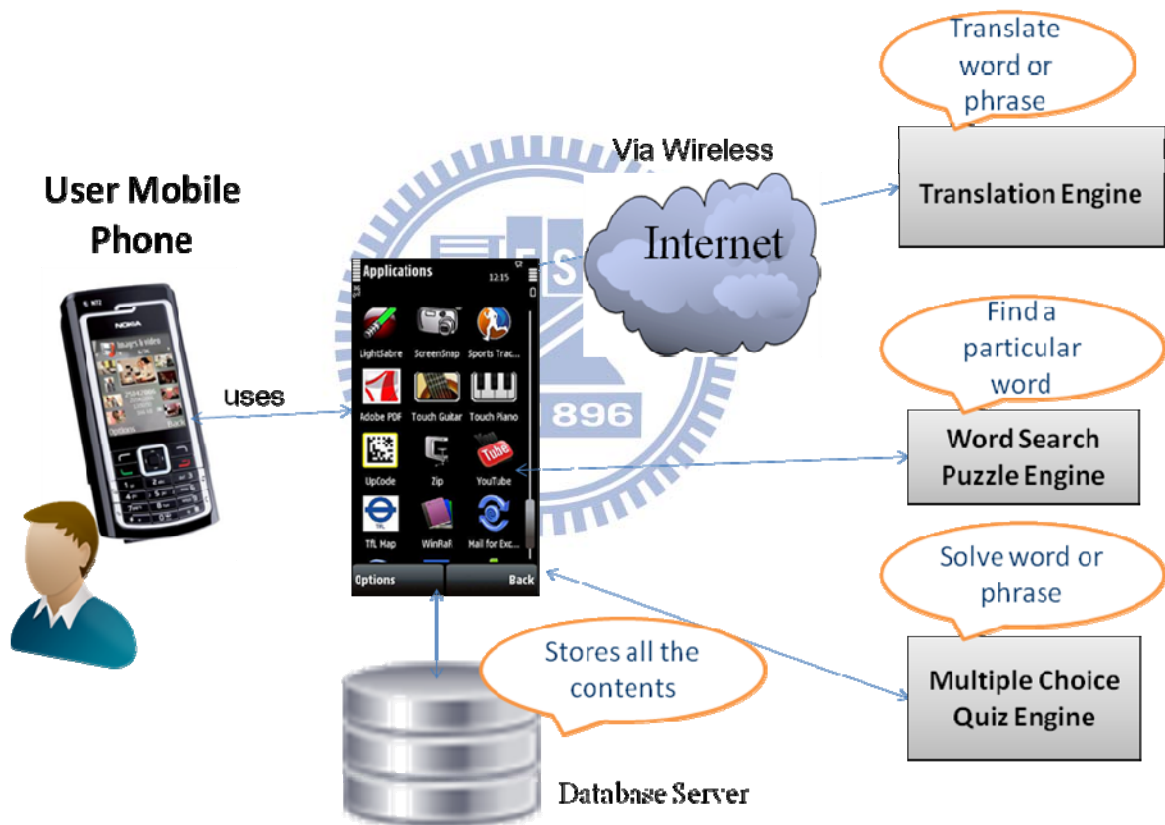


Figure 7: System Architecture.



Figure 8: Main Menu of the Application

3.3.2 Translation Engine

The objective of the translation engine for this system is to translate any given word or phrase with the only mode of English to Traditional Chinese Translation. Traditional Chinese is the official Language of Taiwan. The translation engine of the mobile learning system was implemented using the core source of "**google translate**" which is a free statistical machine translation service provided by Google; therefore, an internet connection is needed. In any scenario, the user will enter any word he or she wants to convert, the default setting for the translation mode is English to Traditional Chinese; therefore, a user can convert from an English word or phrase to a Traditional Chinese word or phrase.



Figure 9: Translation Engine in QT SDK Framework

3.4 Word Search Puzzle

Word Search Puzzle is another component of the mobile learning system that was implemented. Word Search Puzzle is very interactive and entertaining as well. This component of the system is divided into three categories:

- English to Traditional Chinese Word Search Puzzle
- Pinyin to Traditional Chinese Word Search Puzzle.
- Traditional Chinese to English Word Search Puzzle.



Figure 10: Main Menu of Word Search Puzzle

3.4.1 English to Traditional Chinese Word Search Puzzle: In this system, an English word is given on top of the word search puzzle and the user must find the corresponding meaning inside the puzzle which consists of traditional Chinese characters. After the user completes this type of puzzle, a congratulatory message is shown signaling that the user completed the puzzle successfully. If the user does not complete the puzzle, it must be redone over from the beginning.



Figure 11: English to Traditional Chinese Word Search Puzzle

3.4.2 Pinyin to Traditional Chinese Word Search Puzzle: Pinyin is the official system to transcribe Chinese characters into the Roman alphabet to teach in Taiwan. In this scenario, a Pinyin character is given on top of the word search puzzle and the user must find the corresponding meaning of the pinyin character inside the puzzle which consists of traditional Chinese characters. After the user completes the puzzle of finding the meaning from pinyin to traditional Chinese, a congratulatory message is shown signaling that the user completed the puzzle successfully. If the user did not complete the puzzle, the puzzle must be done over for successful completion.



Figure 12: Pinyin to Traditional Chinese Word Search Puzzle

3.4.3 Traditional Chinese to English Word Search Puzzle: In this scenario, the traditional Chinese character is given on top of the word search puzzle and the user must find the corresponding meaning of the traditional Chinese character inside the puzzle which consists of English words. After the user completes the puzzle of finding the meaning from traditional Chinese to English characters, a congratulatory message is shown signaling that the user completed the puzzle successfully. if the user did not complete the puzzle, the puzzle must be done over for successful completion.

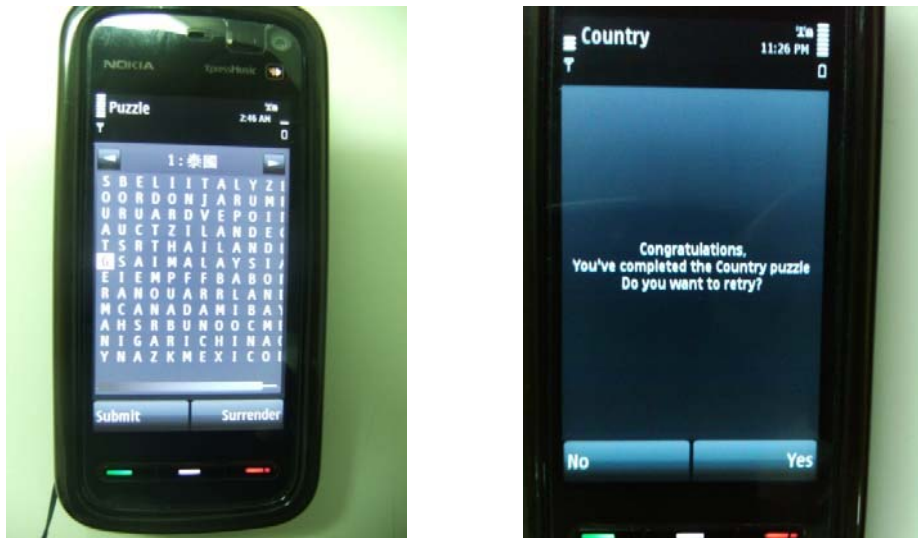


Figure 13: Traditional Chinese to English Word Search Puzzle.

3.5 Multiple Choice Quiz Engine

The last component of the system is the multiple choice quiz engines. This engine consists of two categories:

- English to Mandarin Multiple Choice Quiz Engine
- Mandarin to English Multiple Choice Quiz Engine.



Figure 14: Main Menu of Multiple Choice Engine.

3.5 .1 English to Mandarin Multiple Choice Quiz Engine: When the user selects this mode from English to Mandarin to complete some multiple choice questions, the user must select what type of mode he or she wants to answer. The two types of mode used in the format of the quiz engine is either **Easy** or **Difficult**. When the user selects whatever mode he or she selected, the user starts to answer the following multiple choice questions. There are 10 questions in each lesson whereby the English characters are shown and the user must find the corresponding answers in Mandarin Characters which are shown as options that the user must complete. After the user completes the multiple choice questions, a congratulatory message is shown indicating that the user completed the multiple choice questions successfully. If the user did not complete the multiple choice questions, it must be done over for successful completion.



Figure 15: English to Mandarin Multiple Choice Quiz Engine

3.5.2 Mandarin to English Multiple Choice Quiz Engine: When the user selects this mode from Mandarin to English to complete some multiple choice questions, the user must select what type of mode he or she wants to answer. The two types of mode used in the format of the quiz engine is either **Easy** or **Difficult**. When the user selects whatever mode he or she selected, the user starts to answer the following multiple choice questions. There are 10 questions in each lesson whereby the Mandarin characters are shown and the user must find the corresponding answers in English characters which are shown as options that the user must complete. After the user completes the multiple choice questions, a congratulatory message is shown indicating that the user completed the multiple choice questions successfully. If the user did not complete the multiple choice questions, it must be done over for successful completion.

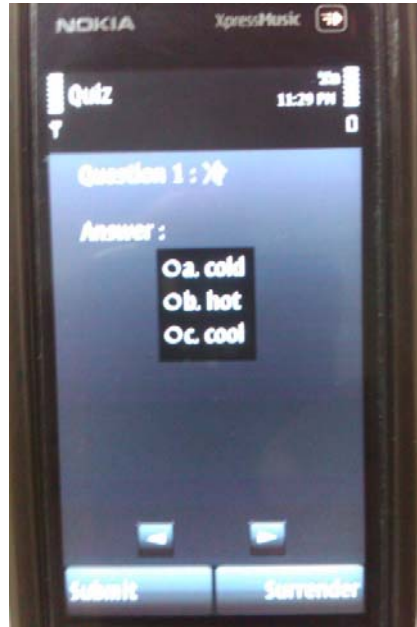
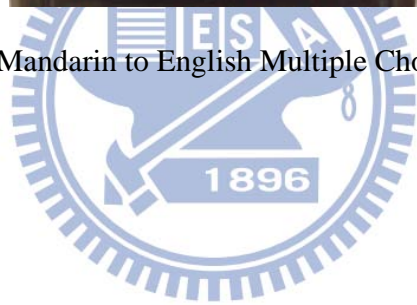


Figure 16: Mandarin to English Multiple Choice Quiz Engine



CHAPTER 4: EXPERIMENTS AND RESULTS

This chapter discusses the experiment methods and the final results. Furthermore, many steps during these experiments were conducted for 4 months to test the usability of the system. During the testing, there were some problems that occurred and solutions were made for continuous reliability and availability for the users.

4.1 Method

4.1.1 Participants

30 International Students, 10 females and 20 males at National Chiao Tung University were selected and participated in these experiments because they have a basic level of the Chinese language while some of these participants had beginner level of the Chinese Language.

4.1.2 Experiment Procedures

There were 2 experiments that were conducted. The first experiment was conducted for 6 weeks from March 11 to April 22 2011 while the system was still at its development and implementation stage. Majority of the international students at National Chiao Tung University selected for these experiments had a Nokia-based mobile phone at their possessions. During that period of 6 weeks, these international students used the mobile learning system for their everyday use of learning. Each of the students spent about 15-20 minutes solving the puzzles and answering the multiple choice questions. After the 6 weeks expired, they were given survey questions to evaluate the mobile learning system during its

implementation stage; furthermore, they also gave comments about the system and what modifications were needed.

The second experiments was conducted for another 6 weeks from April 29 to June 10 2011 with the full functionality of the system; furthermore, problems were solved by comments made about the system from the international students. The main reason for the second phase of this experiment was to evaluate the usefulness of the system after it was fully developed and compare it to the first phase of the experiments. The students were also given survey questions after the experiment was finished.

4.2 Results

As aforementioned above, Survey Questionnaires and statistical analyses were used to get responses from the international students about the mobile learning system. These survey questionnaires were used to target the usability and effectiveness of the system.

4.2.1 Statistical Analyses for First Phase of Experiment (March 11 to April 22 2011)

Before the first phase of the experiment was conducted, international students were asked what their level of Chinese Proficiency was. Figure 18 shows the responses.

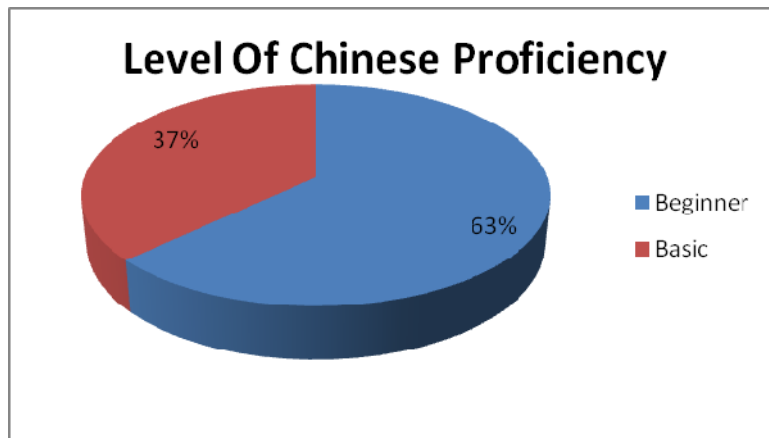


Figure 17: Level of Chinese Proficiency.

In Figure 18, it shows that 63% of the international students at National Chiao Tung University were at the beginner level of Chinese Proficiency while 37% were basic level. The objective of this experiment was only to focus on the beginner and basic level students.

After the first phase of the experiment was completed, the participants were given survey questions to evaluate the system during its developmental stage. These survey questions were used from CSUQ (Computer System Usability Questionnaire (Lewis, 1995)) which was developed by IBM and was designed to evaluate the usability of a computer system. It contains 19 questions, each being a statement that the user has to rate on a (1-7) scale ranging from "strongly disagree" to "strongly agree". The CSUQ were divided into categories of System Usefulness, Information Quality, Overall Satisfaction and Interface Quality. The corresponding questions that comprise the 4 categories of the CSUQ are shown in Table 1 of appendix A. The likert scale for the survey questions is scored from 1 being the lowest to 7 as the highest.

Category	Items
Overall Satisfaction	Questions 1-19
System Usefulness	Questions 1-8
Information Quality	Questions 9-15
Interface Quality	Questions 16-18

Table 1: CSUQ Categories and Corresponding Questions

Overall Satisfaction means the overall perception of the system while System Usefulness defines the trend of the usefulness of the system. Information Quality means assessing the satisfaction with the quality of the information associated with the system while Interface Quality means assessing the satisfaction with the quality of interface associated with the system. Furthermore, the results for overall satisfaction, system usefulness, information quality and interface quality are shown in Table 2 for the first phase of the experiment.

Categories	Average(Out of 7)	Standard Deviation
Overall Satisfaction	3.96	0.58
System Usefulness	3.99	0.46
Information Quality	3.92	0.47
Interface Quality	3.83	0.39

Table 2: Average and Standard Deviation of the First Phase of Experiment

In order for better readability, a percentage diagram was made to distinctly evaluate the numbers during the first phase of the experiment in Figure 18.

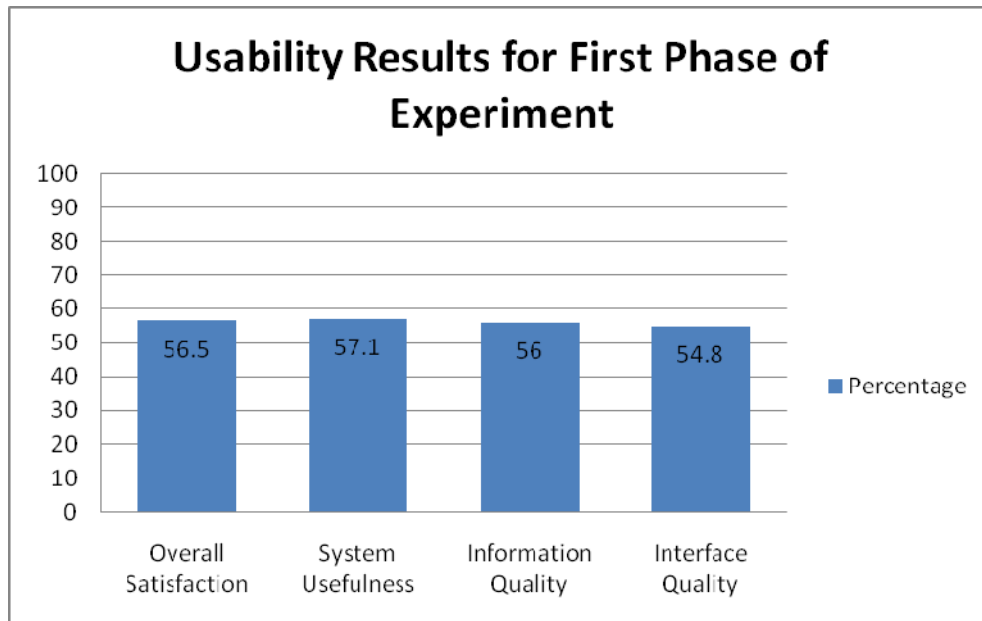


Figure 18: Percentile Usability Results for the First Phase of Experiment.

In the following diagram, it showed that during the developmental stages of the system, the highest category was System Usefulness at 57.1% indicated that the international students in the experiment believed that the system was useful. The second highest category was Overall Satisfaction at 56.5% indicated that the international students in the experiment believed that the interface of the system was clear.

Information Quality was registered at 56% indicated that the international students were satisfied with the information content of the system while Interface Quality was registered at 54.8% which the lowest category as indicated by the international students was believed that the interface was clear and precise. However, knowing that the results displayed at the first phase of the experiment was during the developmental stage of the system, a room

of improvement was needed as indicated that the average category should be at 70% and above for the system to be successful and beneficial for the international students as stated; therefore, a second experiment was performed another 6 weeks after improvements.

4.3 Redesign Issues

After analyzing the statistical data during the first phase of the experiment, it was noted that the system needed to be improved while it was at its developmental stage. Some of the comments noted by the students after the first phase of the experiment was done was that the words in the menu buttons of the system were not identical to some parts of the application, difficulty in using the system and installing the system, the translation engine does not convert the words whether it is from English to Chinese or Chinese to English.

4.4 Statistical Analyses for Second Phase of Experiment (April 29 to June 10 2011)

The system was improved and given to the international students to test for another six weeks. After the second phase of the experiment was completed, the participants were given survey questions to evaluate the system. Furthermore, after analyzing the statistical data for the second phase of the experiment, it showed some improvements in all categories of the system.

The results for overall satisfaction, system usefulness, information quality and interface quality are shown in Table 2 for the second phase of the experiment.

Categories	Average (Out of 7)	Standard Deviation
Overall Satisfaction	5.29	0.64
System Usefulness	5.36	0.58
Information Quality	5.44	0.74
Interface Quality	5.15	0.52

Table 3: Average and Standard Deviation of The Second Phase of Experiment.

In order for better readability, a percentage diagram was made to distinctly evaluate the numbers during the first phase of the experiment in Figure 19.

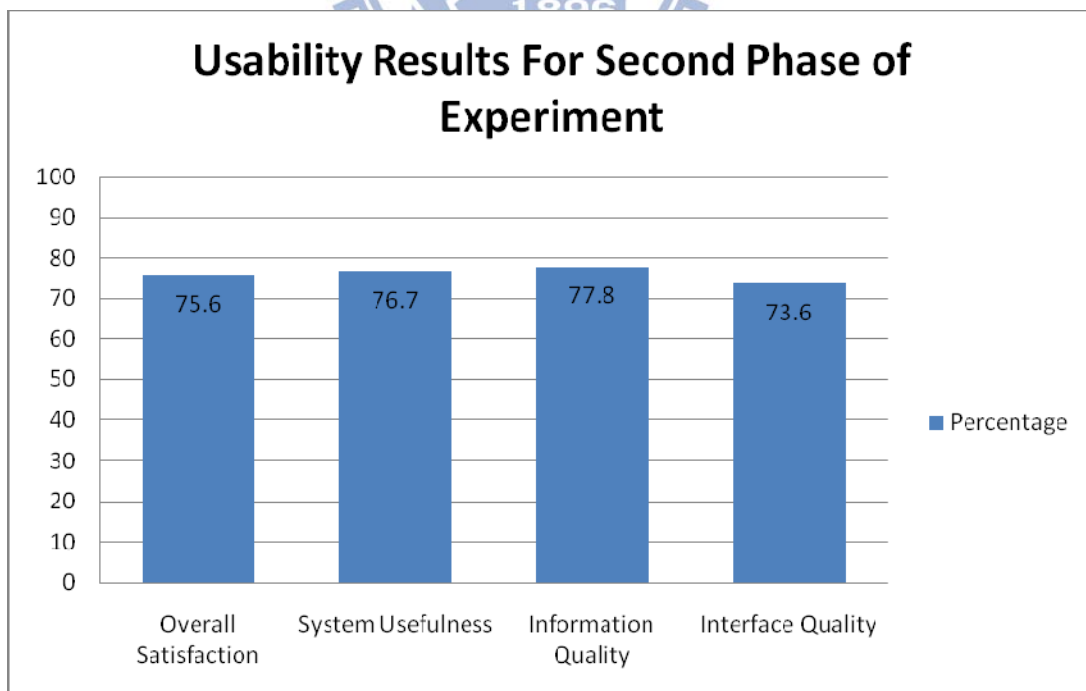


Figure 19: Percentile Usability Results for the Second Phase of Experiment

In the following diagram, it showed some improvements in all categories of the system. System Usefulness was registered at 76.7% which indicated that the international students in the experiment believed that the system was useful, effective and easy for them to learn. Interface Quality registered at 73.6% which indicated that the international students in the experiment believed that the interface of the system was clear and improved.

The overall satisfaction of the system was registered at 75.6% which indicated that the international students were satisfied with the system while Information Quality registered at 77.8 which indicated that the international students believed that the information of the system was clear and precise due to the improvements of adding more lessons contents. The difference between the statistical analysis of both the first and second phase of the experiments showed that there was vast improvement in all aspects of the system. In the end, the main idea behind these experiments was to accomplish the percentile average of 70% and above for the system to be successful and beneficial for the international students as stated.

5. CONCLUSION AND FUTURE WORKS

5.1 CONCLUSION

Mobile learning Systems in the educational development has continued to grow and evolve in Information and Communication Technologies; therefore, it continues to execute and accomplish the mounting demands for constant learning opportunities that facilitates learners especially students to “learn while you are on the go”.

The implementation and realization of a cross-platform mobile language learning system in a QT SDK Framework has shown vast signs in learning. Majority of the International Students at National Chiao University during this research showed positive and encouraging stance towards mobile learning and are keen to learn Chinese using their mobile phones. Furthermore, results from this research showed that this QT-Based Mobile Language learning system could be also employed for learning other languages and Smart Mobile Phones could have a affirmative outcome in learning Chinese as a second language at all levels of Chinese learning for International Students in national Chiao Tung University.

This system provides International Students with effortless and resourceful access to translating any given word at any time; in addition, the different interactive learning games not only assist these International Students learn well but also entertaining. International Students can learn and occupy themselves on the system anytime and anywhere.

Finally, Mobile Chinese Learning is at its preeminent in Hybrid approach when enhanced with Traditional Chinese Learning; additionally, it has showed that this system with its ease and handiness features makes it ideal for International Students to learn.

5.2 FUTURE WORK

The experiments conducted and directed towards the International Students at National Chiao University by the implementation of the system showed great assurance for future alterations. Even though, there was a great reception of the system from the International Students at National Chiao Tung University, experiments shall be performed in other institutions for international students as well in using the system and examine their main attitude towards it.

This system will persist to grow and the future work will include improving the content of the system, creating more assortments of interactive learning options for the system to make it more knowledgeable, code optimization, and Performance enhancement of the system to continuously suit the learners' needs and establishing different frameworks to implement the system. Furthermore, allowing teachers to send their own questions into the system is also considered for future works considering the fact that the experiments was mainly about the students' view of the system.

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AGREE

DISAGREE

6. I felt comfortable using this system.

STRONGLY 1 2 3 4 5 6 7
AGREE

STRONGLY
DISAGREE

7. It was easy to learn to use this system.

STRONGLY 1 2 3 4 5 6 7
AGREE

STRONGLY
DISAGREE

8. I believe I could become productive quickly using this system.

STRONGLY 1 2 3 4 5 6 7
AGREE

STRONGLY
DISAGREE

9. The system gave error messages that clearly told me how to fix problems.

STRONGLY 1 2 3 4 5 6 7
AGREE

STRONGLY
DISAGREE

10. Whenever I made a mistake using the system, I could recover easily and quickly.

STRONGLY 1 2 3 4 5 6 7
AGREE

STRONGLY
DISAGREE

11. The information such as on-line help, on-screen messages and other documentation provided with this system was clear.

STRONGLY 1 2 3 4 5 6 7
AGREE

STRONGLY
DISAGREE

12. It was easy to find the information I needed.

STRONGLY 1 2 3 4 5 6 7
AGREE

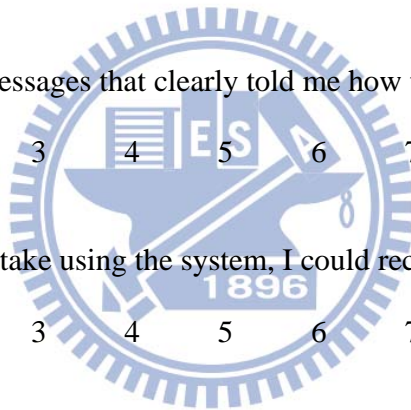
STRONGLY
DISAGREE

13. The information provided for the system was easy to understand.

STRONGLY 1 2 3 4 5 6 7
AGREE

STRONGLY
DISAGREE

14. The information was effective in helping me complete the tasks and scenarios.



STRONGLY 1 2 3 4 5 6 7 **STRONGLY**
AGREE **DISAGREE**

15. The organization of information on the system screens was clear.

STRONGLY 1 2 3 4 5 6 7 **STRONGLY**
AGREE **DISAGREE**

Note: "The Interface" includes those items that you use to interact with the system. For example, some components of the interface are the keyboard, the mouse, the microphone, and the screens (including their use of graphics and language).

16. The interface of this system was pleasant.

STRONGLY 1 2 3 4 5 6 7 **STRONGLY**
AGREE **DISAGREE**

17. I liked using the interface of this system.

STRONGLY 1 2 3 4 5 6 7 **STRONGLY**
AGREE **DISAGREE**

18. This system has all the functions and capabilities I expect it to have.

STRONGLY 1 2 3 4 5 6 7 **STRONGLY**
AGREE **DISAGREE**

19. Overall, I am satisfied with this system.

STRONGLY 1 2 3 4 5 6 7 **STRONGLY**
AGREE **DISAGREE**

