QR CODES CONTENTS TRANSLATOR via GOOGLE TRANSLATOR

By

Tengku Nurul Hidayah Bt Tengku Ishak

11246

Dissertation submitted in partial fulfilment of
the requirements for the
Bachelor of Technology (Hons)
(Information & Communication Technology)

SEPTEMBER 2011

Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

QR Codes Contents Translator via Google Translate

By

Tengku Nurul Hidayah Bt Tengku Ishak

A project dissertation submitted to the
Information Communication Technology Programme
Universiti Teknologi PETRONAS
in partial fulfillment of the requirement for the
BACHELOR OF TECHNOLOGY (Hons)
(INFORMATION & COMMUNICATION TECHNOLOGY)

Approved by,

(Mr. Hilmi Bin Hasan)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
September 2011

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

(TENGKU NURUL HIDAYAH BT TENGKU ISHAK)

ABSTRACT

This document will explain on the enhancement on the current QR code reader application. QR or Quick response is a two dimensional barcodes that contains information such as text, URL or other types of data. QR code is a mobile barcodes that can be read using mobile phone. It can be generated using free sources on the websites such as zxing or users can choose to download the mobile barcodes application into their mobile phone. The generated QR codes can be decode using the QR codes reader where the reader is available in web based tools or a phone application that can be run using in the mobile phone. However, the current QR codes reader application did not include translator as one of its function. It will decode the contents of the QR codes immediately after it is scanned using mobile device. Therefore, Google Translate will be added as a new feature of the current QR code reader. The objectives of this enhancement are to utilize the usage of the Google Translate and also to enhance the current QR code reader for a better life in future. Two types of methodologies are used which are research methodology and waterfall methodology in order to develop this application. The application will be linked directly to the Google Translate that enable users to do the language selection and translate the content of the embedded message using the language that they chosen.

ACKNOWLEDGEMENTS

I would like to acknowledge the advice and guidance of my supervisor, Mr.Hilmi bin Hasan who is always helping me in completing this project. I also would like to thank to my friends Nur Adawiyah and Mohd Syafiq Fauzan who are also under the same supervision of Mr Hilmi. Even though we are not in the same scope of project, thank you for the advice, support and suggestions that has been given to me. Special thanks go to my beloved sister, Tengku Azizah bt Tengku Ishak, who is helping me through the development process. Without your guidance in developing this project especially on the coding part, it would be hard for me to ensure the successfulness of building the project's prototype.I would like to thank my family members, especially to my mother,Hasnah bt Ibrahim and my father Tengku Ishak bt Tengku Jusoh for supporting and encouraging me to complete this project.

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION

1. 1 PROJECT BACKGROUND

QR codes contents translator via Google translate is a mobile phone application that is created to provide users with easiness to translate the embedded messages regardless the time and place. QR or Quick Response codes is a two dimensional barcodes that is invented by Toyota's subsidiary called Denso Wave which is located in Japan. It is capable of holding a bit more data than a standard UPC codes. QR code is a readable code where it can be read using the QR barcodes readers and mobile phone's camera. Previously, QR codes are mainly used for tracking parts in vehicle manufacturing. However, for nowadays, QR codes can be broadly found in commercial tracking applications and convenience- oriented applications that are aimed at the mobile phone users which also known as mobile tagging. It is also used in artworks, marketing and entertainment area.

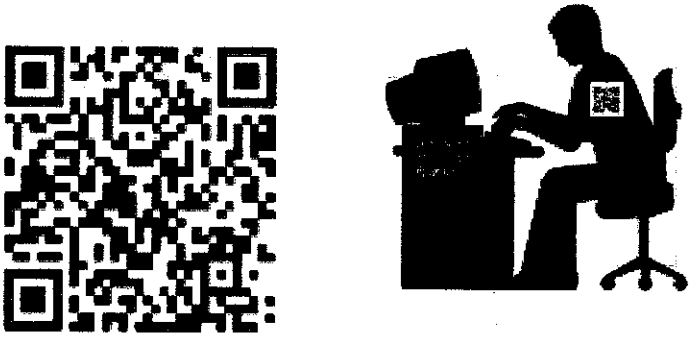


Figure 1 – QR codes

QR codes content can be URL, messages, images and also details in personal information. It may contain various data types such as numeric, alphanumeric, binary, and kanji. It is generated using its own generator where the generator can be a web based generator or a mobile phone application. The example of web based QR codes generator is Zxing. Zxing also known as zebra crossing is an open source and multi format of one dimensional and two dimensional barcodes image processing library that is implemented in Java. Using Zxing, user can have a clear view on the QR codes on how it is being encoded and decoded. It also plays a role as a manipulating platform for users, so users can get experience on how to the generator functioning. Zxing also have its own decoder to decode the content of QR codes and it also can be found in mobile phone application. For the generators that are based on mobile devices, users can download the application using website. Examples of the applications are i-nigma and kaywa. QR codes that are generated can be in various figures and shapes. Figure below shows the example of the generated QR code.

Usually, QR codes generator providers will have their own readers. Not all type of phones can support the QR codes readers. Different types of readers will support different types of operating system and mobile phone brand. Therefore, users need to ensure the compability mode of the readers before downloading it. This is because the camera device that is used as a scanner is embedded with special features to act as a reader and only certain phone will have these features.

1.2 PROBLEM STATEMENTS

1.2.1 PROBLEM IDENTIFICATION

All of the current QR codes readers provide users with same and common functions where it will decode and displays the hidden contents of QR codes. However, the providers did not realize that the reader did not come with a translator. Users are not being able to choose and read the hidden message using the desired language. The message that is display will be in the language that is used during the encoding process. Usually, English is used as the default language in QR codes generators. However, not all people can understand English well. From the research that has been done, the codes can be generated using multiple languages such as Thailand and Japan. Unfortunately, the readers did not provide the same function like the generator. The concept of using phone camera as a scanner is an intelligent idea and convenience to user, but what will happen if users confronting difficulties in understanding the display language especially if the language used to embed the messages using mother tongue language. It may cause problems to user.

1.2.2 SIGNIFICANT OF THE PROJECT

By enhancing the current QR codes reader system, it will add the heterogeneity into the reader's features. User can choose either to use the reader with the translator or not. Adding translator into the QR codes reader's features will help user to have a better understanding on the message's language. In order to enable the translation in multiple languages, the reader will be linked directly to the Google Translator. After user scanned the image, user will be able to choose the type of language for the translated hidden messages. If user did not choose any language, it will be set to the default language which is the language that is used to generate the content. Google translator will act as a communicator between user and the reader.

The new version of Google translator nowadays is much better in term of translation compare to the older version it has. It is now able to give an accurate and adequate translation upon user's request, whether the request consists of a word or a sentence. Based on the research that has been done, the current version of Google translator has the capability to satisfy user's request by giving an accurate result. Using Google translator as a translator for QR codes reader, it will help users to have a better understanding on the hidden messages in the QR codes.

1.3 OBJECTIVES

- To enhance the current system of QR codes reader that will contribute benefits to the society.
- To develop a system that utilizes the usage of Google Translator and will help society to accomplish their daily activities.
- To translate the contents of the QR code image using Google Translate.

1.4 SCOPE OF STUDY

In order to complete this project, a study on QR codes and Google Translate needs to be done. QR codes are one of the 2D mobile barcodes that can be read using mobile phones. Mobile barcodes are encoded images and can display digital information such as contact information, messages, URL, calendar events or an image when it is decoded using barcode reader. Smartphone's camera can be used as a scanner to decode the image in order to show the hidden information. There are various type of 2D mobile barcodes such as Data Matrix, Cool-Data-Matrix, Aztec, Upcode , BeeTag and others.

Mobile Barcodes allow users to encode and decode all kinds of information that is easily accessible through the Smartphone. The common use of mobile barcodes is to request information, service, or content from web sites. It might be the details of a promotion, discount voucher, music track or even a game. Mobile barcodes are a pull technology which is a permission-based way for a user to engage with an advertiser or the developer. Mobile barcodes can be used in marketing, entertainment, artwork, and also in advertising area.

Google Translate is one of the API applications that are provided by Google.To enable the translation services, this application need to be linked to the Google Translate using the Google Translate API. Google Translate API is an AJAX API that was introduced by Google Inc. It is a library for translating words or sentences from one language to another language using Google Translate database. The API works for the same languages that are available in Google Translate and enable users to display the translation of the desire text without have to link to an external translation services. There are two versions of these API which are version 1 and version 2. Version 1 is a free version that can be used by users. However, due to some economic burden cause by extensive abuse, version was officially deprecated on May 2011. Therefore, version 2 was introduced by Google Inc on 1st December 2011. Version 2 providing users same services like version 1 but it is a paid service.

The targeted audiences for this application are specifically for Smartphone users especially for the travelers and tourists. By using this application, it will help users to interpret the hidden messages in the barcodes. Having the ability to know the contents of the codes might helping users in performing the daily activities and indirectly will make users to gain experiences and knowledge on new things.

CHAPTER 2: LITERATURE REVIEW

QR Code is two-dimensional barcode which is categorized in matrix barcode that can store data information. QR stands for "Quick Response" as the creator intended the code to allow its contents to be decoded at high speed. It is introduced in Japan by Denso Corporation in 1994[1]. Although initially used for tracking parts in vehicle manufacturing, QR codes are now used in a much broader context, including both commercial tracking applications and convenience-oriented applications aimed at mobile phone users known as mobile tagging [2]. QR code is a way of encoding more information than a traditional bar code. And most importantly, it contains information that can be easily decoded at high speed [3-4]. QR codes are unique, i.e. to be used only one time [5]. It can be published on a printed media such as newspaper, magazines, websites and even on billboards.

Due to this ability, QR code can be distributed to any places with the targeted users. QR codes can be generated using the QR code generator. The generator can be in a web based tools or in mobile phone application. Same concepts go to the QR codes reader. QR codes can be manipulated by users themselves.

Developing a QR code reader in a mobile phone application for a Smartphone did not become an obstacle for a developer. This is because QR reader software is available for most mobile platforms. Many Android, Nokia, and Blackberry phones come with QR code readers pre-installed [6-7]. Mobile phones can now be enabled to read a variety of 2D mobile barcodes. These include QR codes, Data Matrix, Cool-Data-Matrix, Aztec, Upcode, Trillcode, Quickmark, shotcode, mCode and Beetagg [8].

QR codes technology also being used widely in the world such as in mobile marketing area. In the internet marketing world there is a phrase that is used over and over which is 'your list is the most valuable business asset you have'. It is really no different in the bricks and mortar marketing world, either. You need to quantify your customer list. This is where the QR code comes in and it is deceptively easy to use. All you need is make your code, print it out on a large piece of paper, and tape it to the window next to your door(facing the street). Right above the QR code, tape another page that has a big red arrow pointing at the QR code. A caption above the arrow should state something like the following: " Below is our QR code. You can scan this with your smart phone. Simply download an app called a " QR code reader" (all the smart phones can get this app) and then open the app and center the QR code you see below in the frame. We will be using this to send you periodic coupons and discount offers." You can configure your QR code to send them to a web page that is specifically designed for their mobile phone, which ask them to enter enter their email and all of the email list will be stored into your database [9].

The current QR code reader only offering users with the common usage of a reader which is execute the application, scan the image, processing the image, decode the code and display the contents of the QR code. This can be proved by the statement that is found in through the research that has been done. The application processor works for displaying of the menu and preview in the display and computing of code recognition and decoding in real-time. With these systems, the user can control the position of the camera and decide the capture timing. The processing flow is as follows:

1. **Execute the barcode reader application** - The application processor is changed into barcode reader mode by user menu selection.
2. **Capture from embedded camera device** -The source images are captured by the embedded camera device via the camera interface, and these image are sent to two units, the DSP for image processing and the LCD controller for displaying the user preview.
3. **Process the image in DSP** - The code is detected and processed in the DSP from the captured source image, and the processed image in this phase is output as the normalized size and binarized image of the code area.
4. **Decode the code** - The processed code data in the previous phase is decoded in the host CPU, and the decoded code is derived to the application software.
5. **Display the results** -The host application displays the decoded results [10].

By adding Google translator as a new feature of the QR code reader, indirectly contributing in giving benefits to user in term of gaining new knowledge and experience.

Currently, there is no related search work that has been done on the QR code reader via Google Translator. However, there are research that has been done on the QR code and barcode using mobile phone interaction. Current mobile phones implement various new kinds of applications such as taking photos, and movie shooting by using embedded camera devices, and this progress also depends on the camera device technology. For example, 30% of mobile phones in Japan have embedded camera devices at 2003, and some of those have more than over mega-pixel range image sensor cameras. Also, the embedded camera devices can be used as new input interfaces such as for symbol recognition. In Japan, most mobile phones, with camera devices support symbol recognition, such as of EAN barcode and QR-code (2D barcode), and these

code symbols are used for easily accessing phone provided network services by reading URLs or such address characters [10-11].

New opportunities in mobile phone interaction have emerged with the integration of cameras into the phones. By analyzing the video stream captured by the camera, using simple image processing on the phone, it is possible to estimate the movement of the device [12].

Now mobile phones can implement many kinds of application such as taking photos and movie shooting by using embedded camera devices. So an interesting approach is capturing bar-codes with their camera and decoding them with software running on the phone. Recently, the mobile industry began to pay more attention to barcode applications in m-commerce because 2-D barcodes not only provide a simple and inexpensive method to present diverse commerce data, but also improve mobile user experience by reducing inputs [13]. Previous research work has shown that recognition of 2D barcode is a researching hotspot and very difficult in various condition. These conditions include highlight spots, show projection, low contradiction, non homogeneous lighting, and various mixed condition. Ohbuchi et al [14] presented an algorithm capable of the real-time recognition of barcodes on a mobile phone [15]. Since commercial camera phones with a QR code reader became available in 2002, a wide variety of QR code application for mobile devices has been devised by not mobile-content-providing companies but also general users of applications in Japan, resulting in their widespread use [16].

CHAPTER 3: METHODOLOGY

Methodology is a framework or method that is implemented to structuring, planning and controlling the process of building an application or a system. For this project, there are two types of methodologies that are being used which are research methodology and waterfall methodology.

3.1 RESEARCH METHODOLOGY

Research methodology is different from Software Development Life Cycle (SDLC) methodology. Research methodology is a method that is used during the research implementation. This methodology emphasize on the each methods that are related to the project's research.

3 types of research methodologies that are used:

- **Survey and Questionnaire**

  The purpose of survey and questionnaire is to measure the awareness of the QR code reader among people and also get their opinion on the enhancement of the current QR code readers
- **Testing on the current QR code application**

  Testing on the current QR code is implemented in order to understand on how its works and to test whether the enhancement of the current reader is applicable or not.

- **Testing on the ability of the Google Translator**

  Google Translate needs to be tested to prove the ability that it has. Previous version of Google Translate is unable to translate a long sentence and unable to give a correct definition of words. Therefore, testing is done on the latest version of Google Translate to prove the ability, efficiency and effectiveness of the current version

3.1 WATERFALL METHODOLOGY

Waterfall methodology is one of the methodologies under the Software Development Life Cycle (SDLC). It contains five phases which are planning, analysis, design, implementation and maintenance. Each of these phases has its own functions in developing an application or a system.

Phase 1: Planning on the development of the QR codes contents translator project

On the planning phase, the plan on the development activities and timeline to develop the application is prepared. A proper plan and a backup plan will be done that will act as a guide for the next step and also as a backup if any failure occurs.

Phase 2: Analysis on the QR codes contents translator project

During this phase, the analysis and research regarding on QR code will be done. The research on what is QR codes, how does it works, the importance of QR codes and why does we need to enhance it will be analyze. The searching and reading process on the journals, books, conferences ,web sites and related search works that are related to the QR code will be implemented. On this phase, deep understanding on the current system of QR code should be established in order to get a clear view on the project. All of the details regarding to the current QR code reader and generator should be analyze.

The tools and platforms that are required to develop the application such as the type of phone and operating system and the programming language to build the application that will be used also should be determined. The current QR code application and current version of Google Translator is tested.

Phase 3: Design the QR QR codes contents translator project

For design phase, the design on the graphical user interface (GUI) and algorithm of the source code of the new application is implemented and determined.

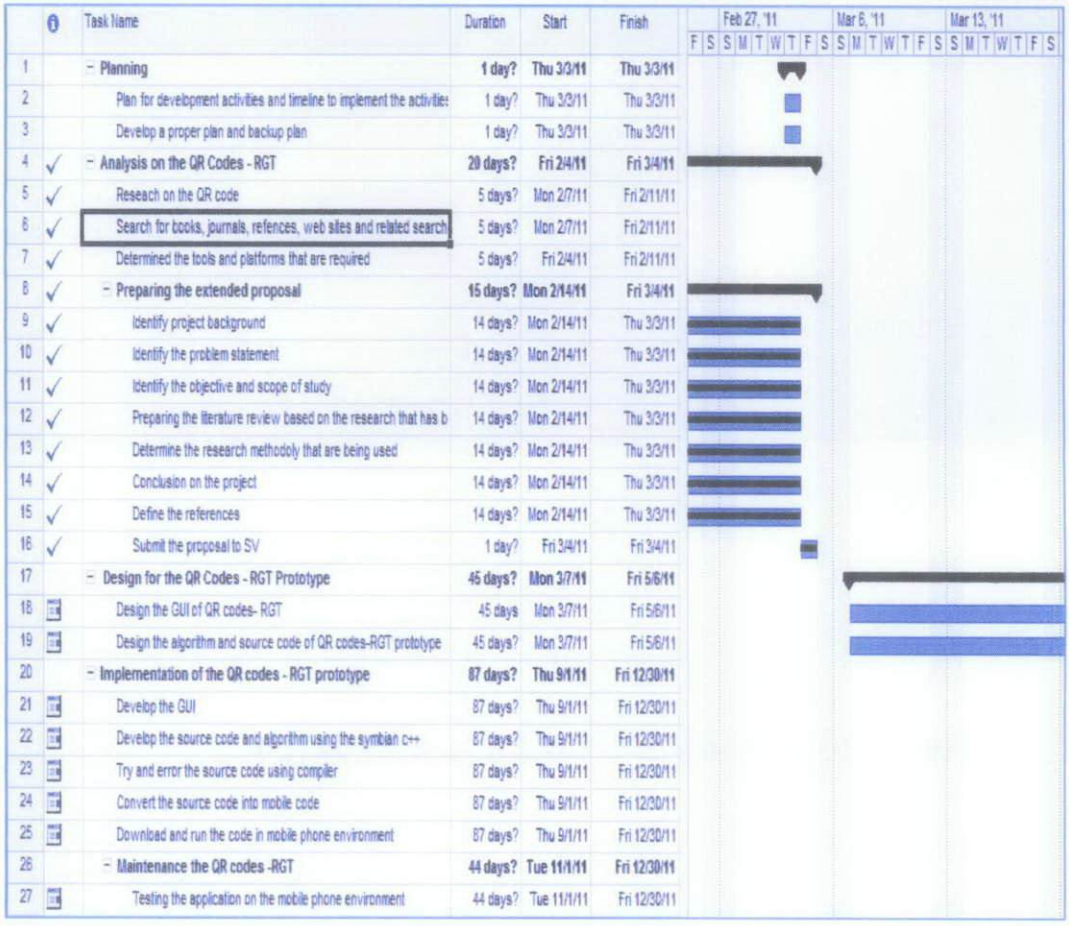
Phase 4: Implementation of the QR codes contents translator project

During this phase, the algorithm and source code along with GUI of the QR codes-RGT prototype will be build using the programming tool. Try and error process will be done using the compiler. If there is no errors occur after being tested in the compiler environment, the source code will be converted into a mobile code that can be downloaded and executed in mobile phone environment. This mobile code will be run as an application in the mobile phone.

Phase 5: Maintenance on the QR codes contents translator project

In this phase, a continuous testing will be done for a month in live environment in order to make sure that the application working fine and smoothly and also to ensure that there are no failures and errors occur.

3.2 PROJECT ACTIVITIES, KEY MILESTONES AND GANTT CHART OF THE PROJECT



	Task Name	Duration	Start	Finish
1	- Planning	1 day?	Thu 3/3/11	Thu 3/3/11
2	Plan for development activities and timeline to implement the activities	1 day?	Thu 3/3/11	Thu 3/3/11
3	Develop a proper plan and backup plan	1 day?	Thu 3/3/11	Thu 3/3/11
4	- Analysis on the QR Codes - RGT	20 days?	Fri 2/4/11	Fri 3/4/11
5	Reseach on the QR code	5 days?	Mon 2/7/11	Fri 2/11/11
6	Search for books, journals, refences, web sites and related search	5 days?	Mon 2/7/11	Fri 2/11/11
7	Determined the tools and platforms that are required	5 days?	Fri 2/4/11	Fri 2/11/11
8	- Preparing the extended proposal	15 days?	Mon 2/14/11	Fri 3/4/11
9	Identify project background	14 days?	Mon 2/14/11	Thu 3/3/11
10	Identify the problem statement	14 days?	Mon 2/14/11	Thu 3/3/11
11	Identify the objective and scope of study	14 days?	Mon 2/14/11	Thu 3/3/11
12	Preparing the literature review based on the research that has b	14 days?	Mon 2/14/11	Thu 3/3/11
13	Determine the research methodoly that are being used	14 days?	Mon 2/14/11	Thu 3/3/11
14	Conclusion on the project	14 days?	Mon 2/14/11	Thu 3/3/11
15	Define the references	14 days?	Mon 2/14/11	Thu 3/3/11
16	Submit the proposal to SV	1 day?	Fri 3/4/11	Fri 3/4/11
17	- Design for the QR Codes - RGT Prototype	45 days?	Mon 3/7/11	Fri 5/6/11
18	Design the GUI of QR codes- RGT	45 days	Mon 3/7/11	Fri 5/6/11
19	Design the algorithm and source code of QR codes-RGT prototype	45 days?	Mon 3/7/11	Fri 5/6/11
20	- Implementation of the QR codes - RGT prototype	87 days?	Thu 9/1/11	Fri 12/30/11
21	Develop the GUI	87 days?	Thu 9/1/11	Fri 12/30/11
22	Develop the source code and algorithm using the symbian c++	87 days?	Thu 9/1/11	Fri 12/30/11
23	Try and error the source code using compiler	87 days?	Thu 9/1/11	Fri 12/30/11
24	Convert the source code into mobile code	87 days?	Thu 9/1/11	Fri 12/30/11
25	Download and run the code in mobile phone environment	87 days?	Thu 9/1/11	Fri 12/30/11
26	- Maintenance the QR codes -RGT	44 days?	Tue 11/1/11	Fri 12/30/11
27	Testing the application on the mobile phone environment	44 days?	Tue 11/1/11	Fri 12/30/11

Figure 2 – The Gantt chart of The Project

3.3 TOOLS REQUIRED

- Developer kit : Java NetBeans 6.1 IDE
- Google Translator
- Smartphones

For the first question, only 28.6 % are familiar with the QR code. And only 24.4 % are responding yes as the answer of the second question. Only 8 people which equivalent to 19.0% is answering yes to for the third question. Figure 4 illustrate the chart of the first question. And figure 5 shows the percentage for the question number 2, meanwhile figure 6 shows the pie chart of the third question.

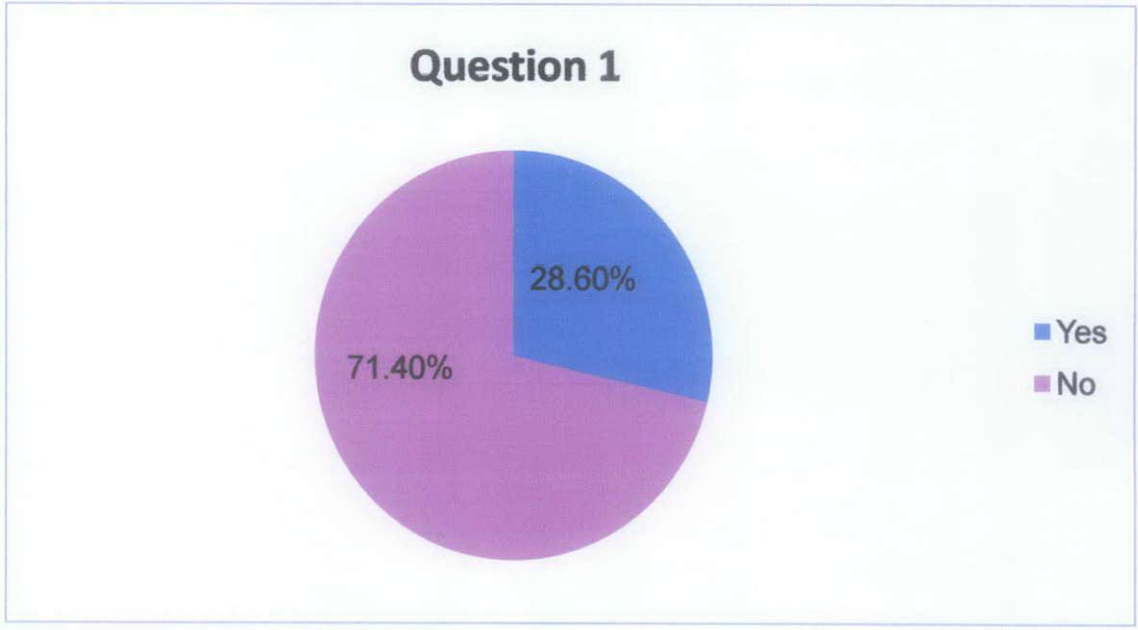


Figure 4

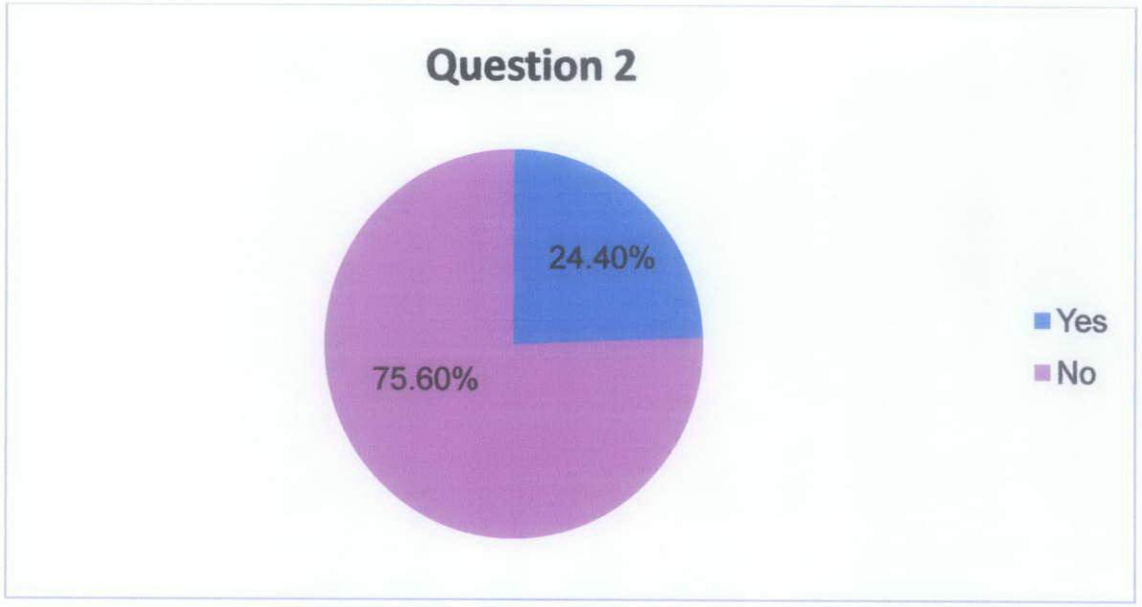


Figure 5

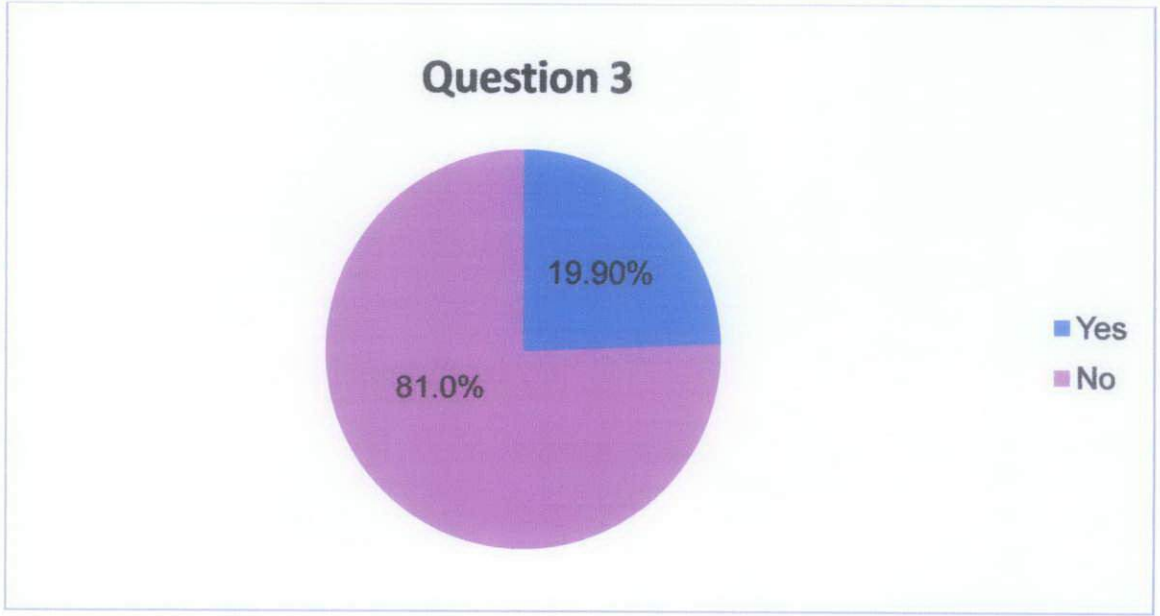


Figure 6

For question number 4, only 19.0 % say yes, meanwhile for question 5, 22.0 % choose yes as the answer. 48.8 % agree to add Google Translator as a new feature to the current QR code. Figure 7 shows the graph for each of these questions.

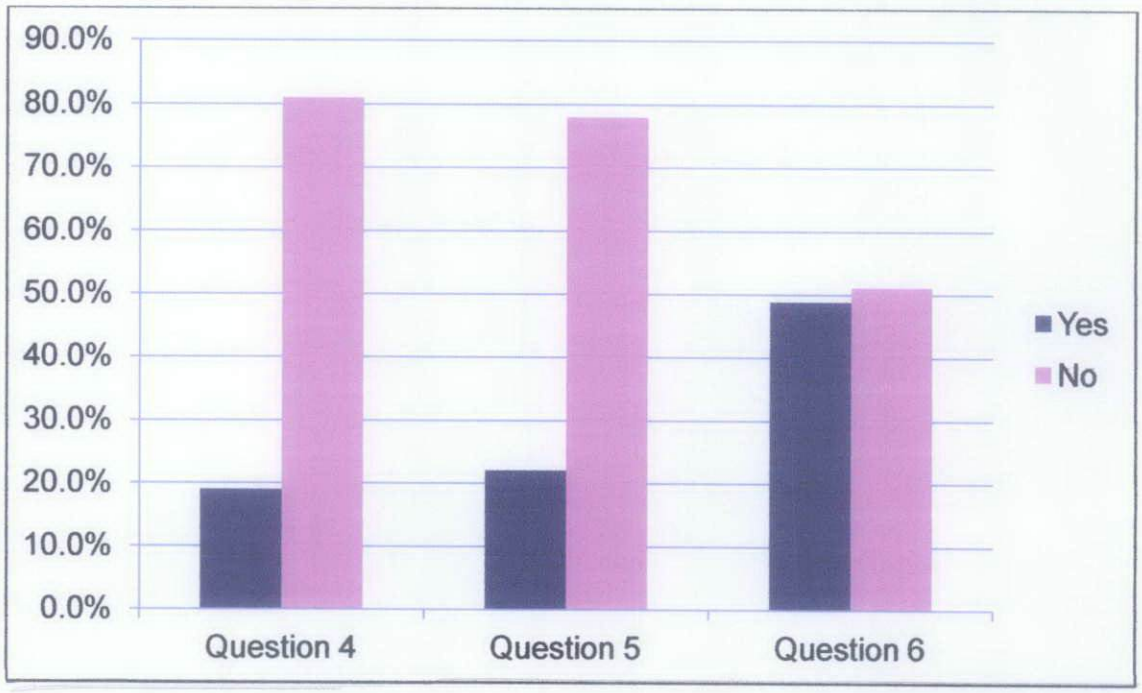


Figure 7

Only 24 people are response to the question number 7, while the remaining 18 people choose to skip the question. Out of 24 people, only 5 people are agreed with the statement. While 18 people are disagreed due to the lack of knowledge on the QR codes. Most of them did not know about QR code and the function that it has. Figure 8 describes the graph of question 7.

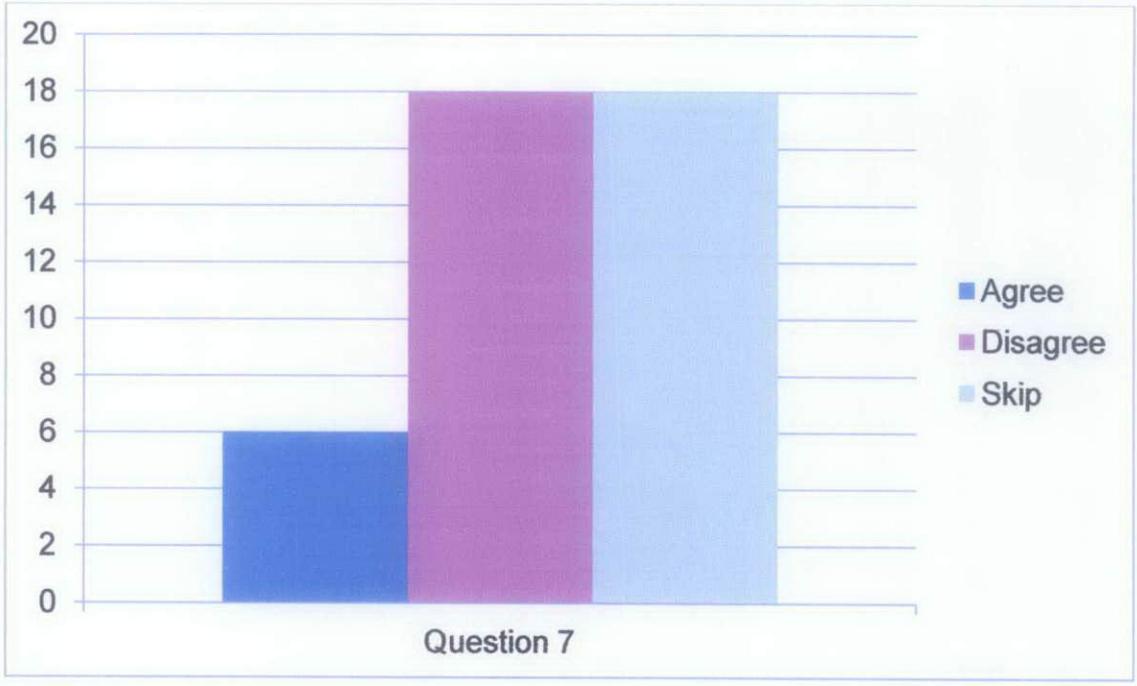


Figure 8

From the data that has been analyzed, the people who are answering no to each question is because they did not get expose to the development of QR code. This situation same goes to those who are chose to skip the question.

4.2 FINDINGS

The current QR code process involving:

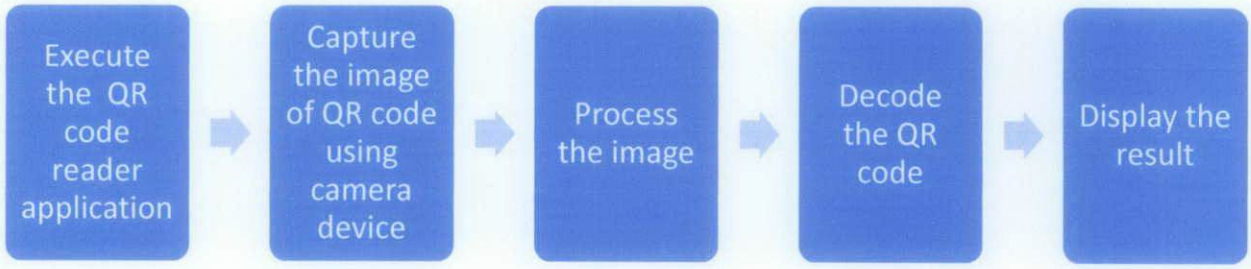


Figure 9

The function of the current QR code reader is only to decode or read the embedded message and display the result. By adding Google Translate to the reader, it will add a new and special feature to the current system. Google Translate will act as a medium for the enhancement of the current reader. After adding the Google Translate, the process or architecture of the reader will be affected and changed. Figure 10 shows the changes on the process after Google Translate is added.

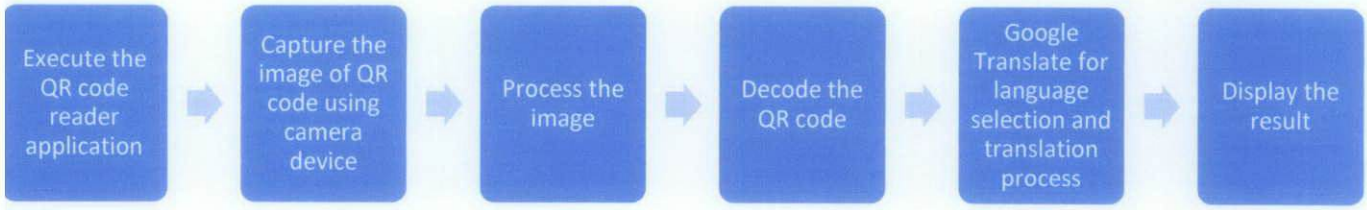
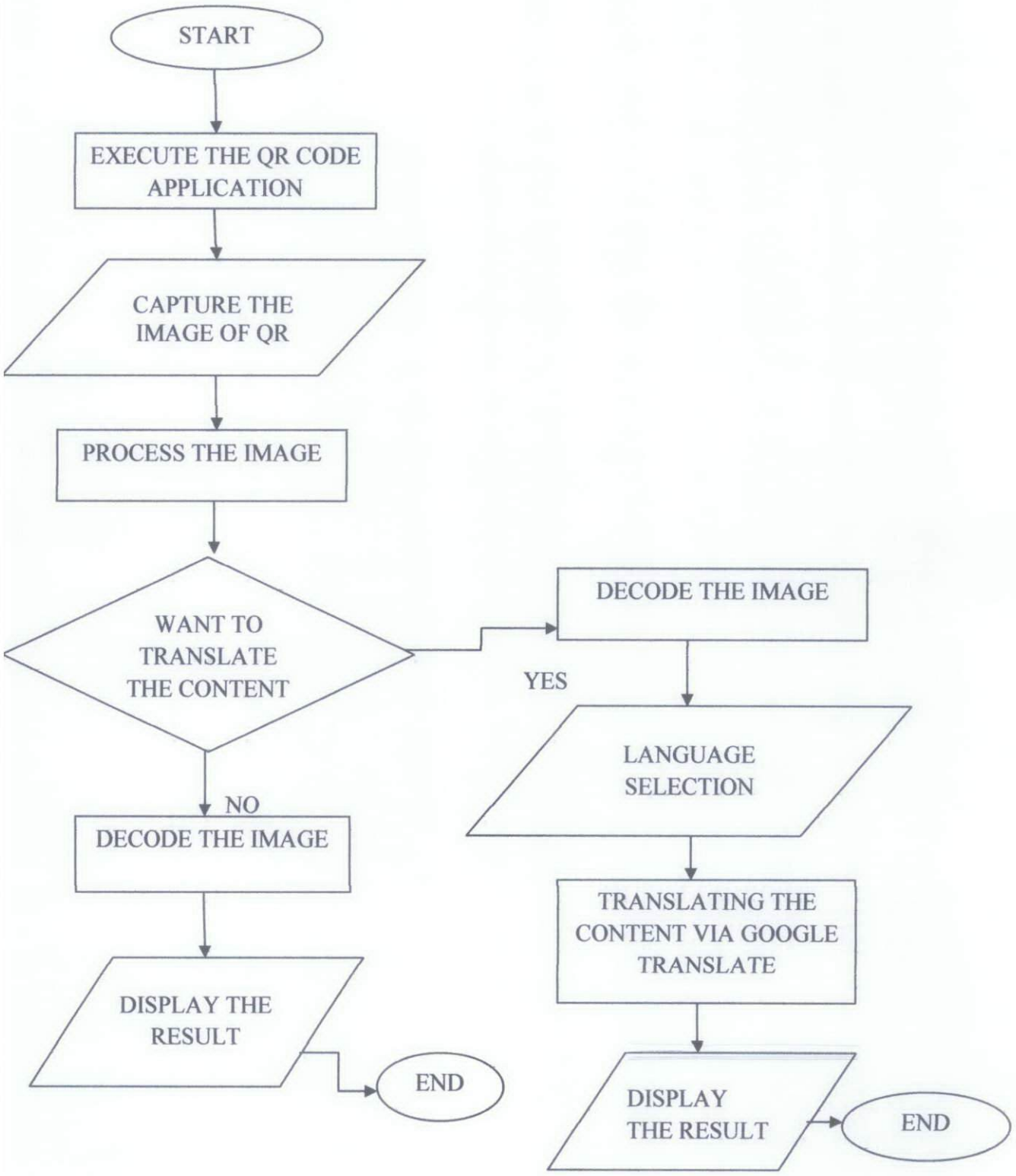


Figure 10

The flow chart below describes the new architecture of the QR code reader:

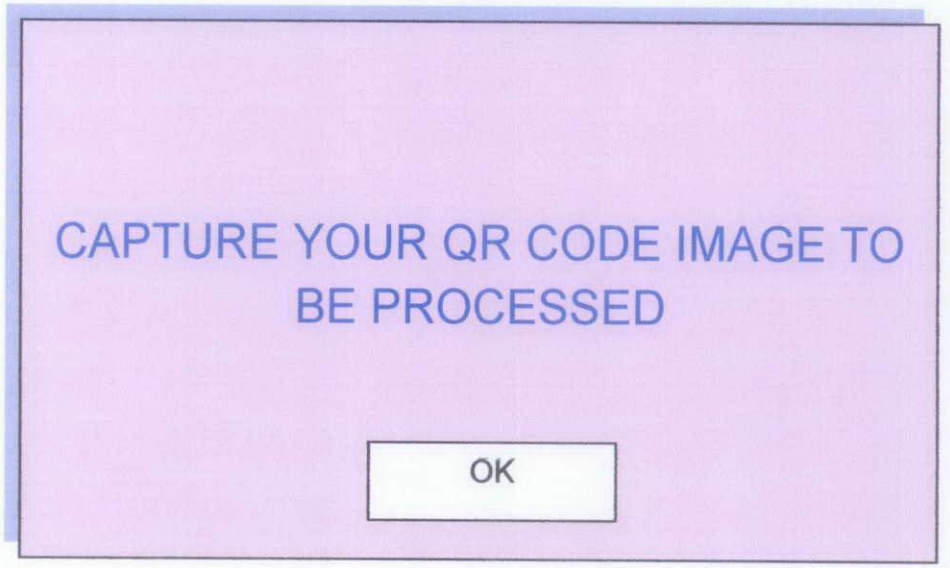


4.3 DESIGN AND PROTOTYPE

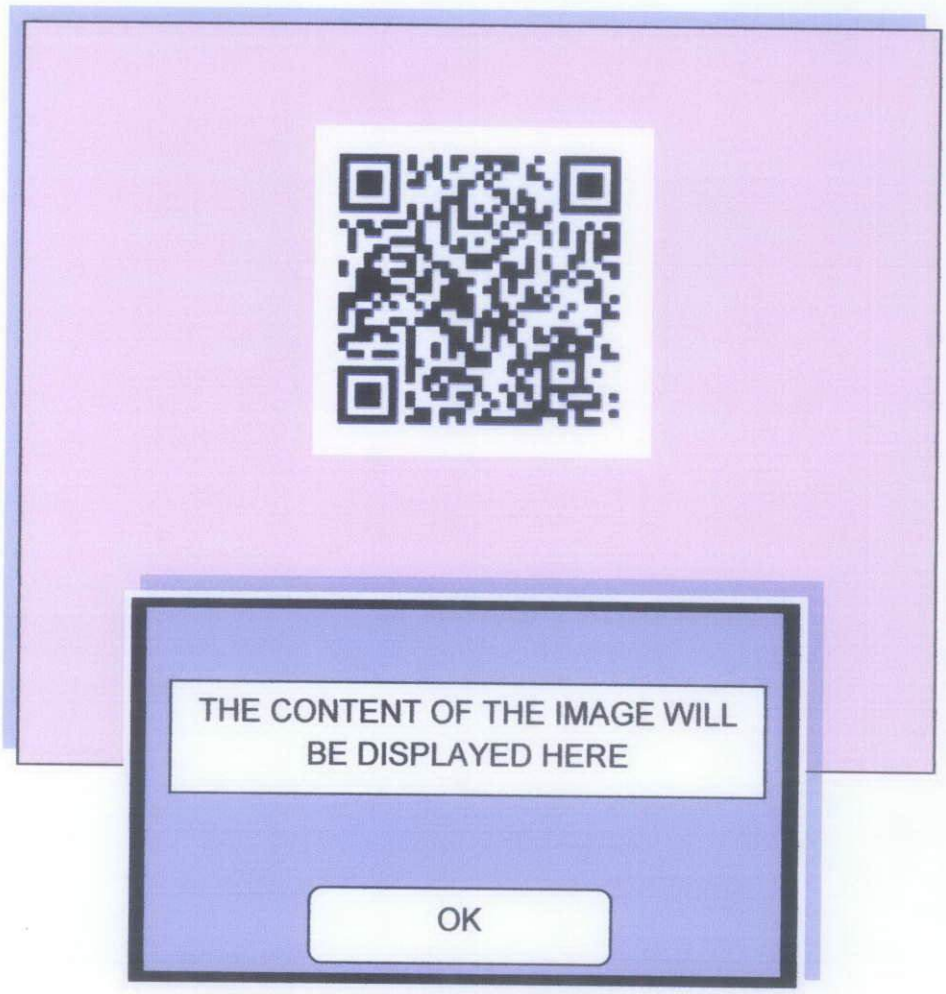
4.3.1 PROPOSED DESIGN

The design and prototype of this application will be illustrated using the new design of the graphical user interface (GUI) for the reader.

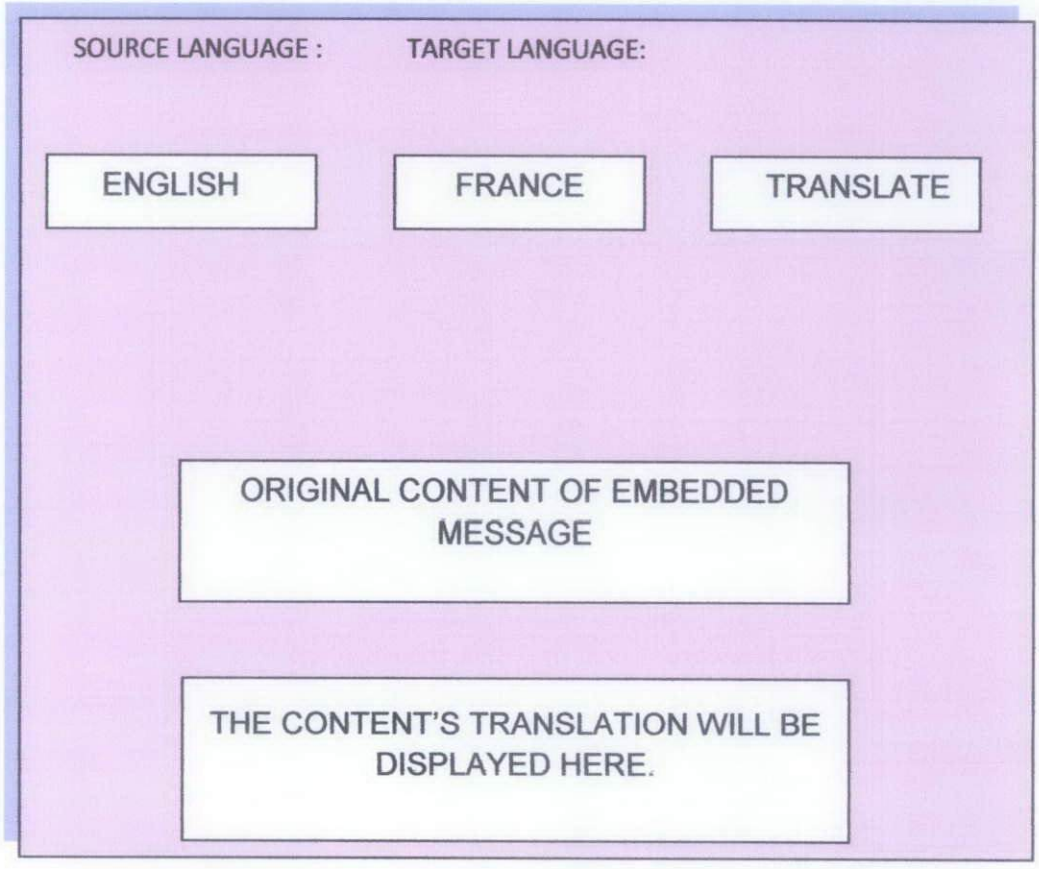
1) When the QR code reader is execute, the reader will asked user to capture the image of the QR code



2) When user scanned the image, the contents of image will be displayed immediately.

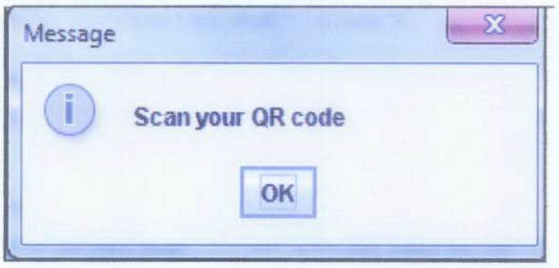


3) After user clicks on the OK button, the interface for the translating function will appeared same like the figure below. User will be able to choose the source language and the target language from the drop down menu. The original embedded message will be displayed in the field text area below the drop down menu. When user clicks on the TRANSLATE, the embedded message will be translated into the target language that user had chose.



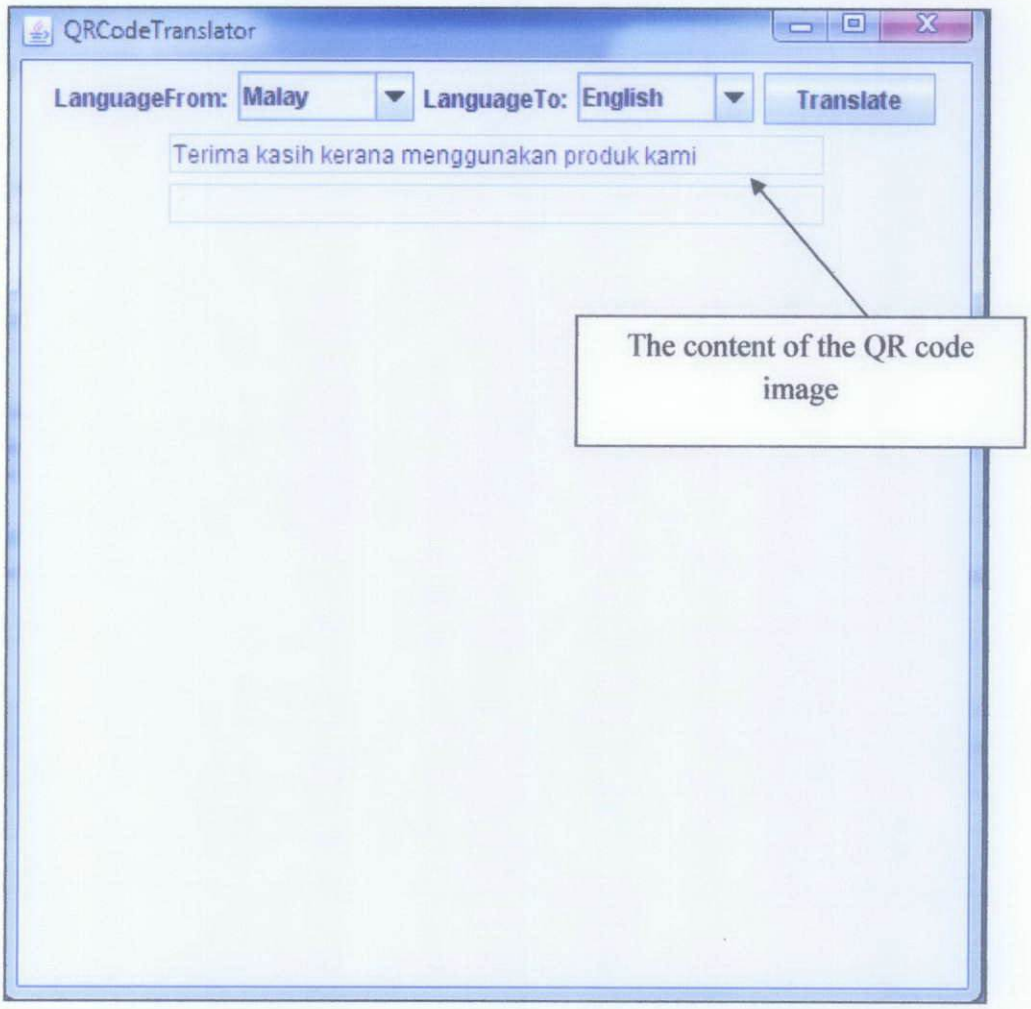
4.3.2 THE PROTOTYPE

The prototype of this mobile phone application was done according to the proposed design that has been made during final year project 1 (FYP1).



When the application is run in the mobile phone, it will ask user to scan the QR code image.

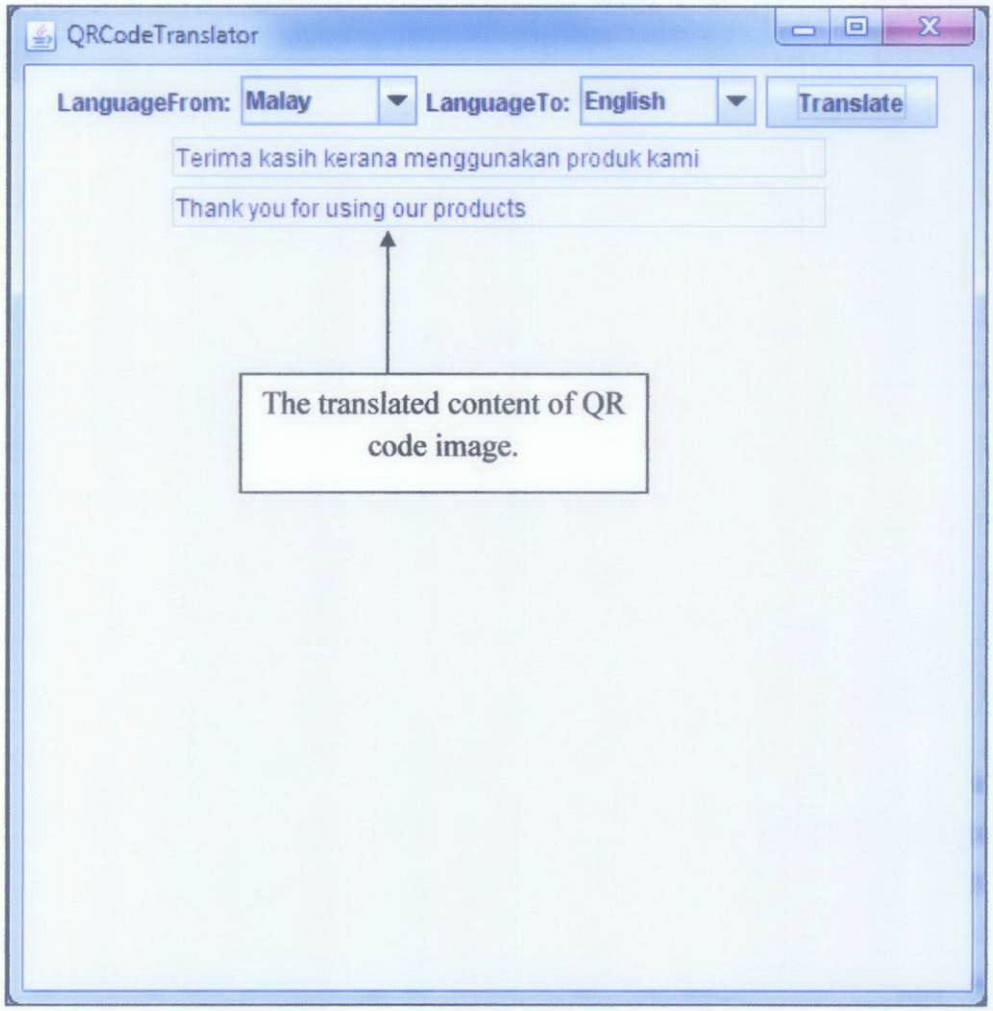
After user scan the image, and click on the OK button, a pop window that is displaying the captured QR code image will appear. Along with the displayed QR code image, the contents of the image will be displayed in a pop up window. User needs to click on the OK button to proceed to the translating function.



The message that is embed into the QR code image will place into the text field area

User is able to choose the source language from the drop down menu

The target language was chose using drop down menu after the source language has been chose.



Clicking on the TRANSLATE button enable the translation for the QR code contents into the target language that has been chosen.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

As a conclusion, the enhancement for the current QR code reader is needed in order to move ahead towards a better future. By using Google Translator as a communication medium to the users will enable learning process to happen. This is because it will enable users to learn different types of languages. It will also help users in performing daily activities that are related to QR code and indirectly will make task to become easier and convenience. By enhancing the current application, users will be able to have a better understanding on the embedded message. Miscommunication also can be avoided between the users of the QR codes and the embedded message in the QR codes image itself. In future, improvement on the application's interface is needed in order to make it more interesting, attractive and user friendly. Not only that, the application will be enhanced to enable more translation services such as Bing translator and Yahoo translator.

REFERENCES

[1] Sutheebanjard, Phaisarn, and Wichian Premchaiswadi. "QR code Generator." *2010 Eigth International Conference on ICT and Knowledge Engineering.* Bangkok, Thailand: IEEE, 2010. 89-92.

[2] Wikipedia,(2011). Retrieved February 28, 2011 from Wikipedia website<http://en.wikipedia.org/wiki/QR_Code >

[3-4] Sutheebanjard, Phaisarn, and Wichian Premchaiswadi. "QR code Generator." *2010 Eigth International Conference on ICT and Knowledge Engineering.* Bangkok, Thailand: IEEE, 2010. 89-92.

[5] Aktas, M.A Asligul. *Analysis Of Current Mobile Marketing Application, Selected Best Practices And Future Development.* Germany: Grin Verlag, 2010.

[6-7] Wikipedia,(2011). Retrieved February 28, 2011 from Wikipedia website<http://en.wikipedia.org/wiki/QR_Code >

[8] Roberts, Bena. *Mobile Barcodes 101 : Understanding Mobile Barcodes.* February 22, 2008. http://www.gomonews.com/mobile-barcodes-101-understanding-mobile-barcodes/ (accessed February 27, 2011).

[9] Weir, Michael. *QR Codes & Mobile Marketing For Small Business Owner.* US: Michael, 2010.

[10-11] Ohbuchi, Eisaku, Hiroshi Hanaizumi, and Lim Ah Lock. "Barcodes Readers using The Camera Device in Mobile Phone." *Proceedings of 2004 International Conference on cyberworlds (CW'04).* IEEE, 2004. 260-265.

[12] Henrysson, Anders, Mark Ollila, and Mark Billinghurst. "Mobile Phone based AR Scene Assembly." *MUM 2005 The Fourth International Conference on Mobile and Ubiquitous Multimedia.* Christchurch New Zealand: University of Canterbury, 2005. 95-102

[13] Yue, Liu, Ju Yang, and Liu Mingjun. "Recognition of QR codes with Mobile Phones." *2008 Chinese Control and Decision Conference (CCDC 2008).* China: IEEE, 2008. 203-206

[14] Ohbuchi, Eisaku, Hiroshi Hanaizumi, and Lim Ah Lock. "Barcodes Readers using The Camera Device in Mobile Phone." *Proceedings of 2004 International Conference on cyberworlds (CW'04).* IEEE, 2004. 260-265.

[15] Yue, Liu, Ju Yang, and Liu Mingjun. "Recognition of QR codes with Mobile Phones." *2008 Chinese Control and Decision Conference (CCDC 2008).* China: IEEE, 2008. 203-206.

[16] Keng T. Tan, Douglas Chai, Hiroko Kato. *Barcodes for Mobile Devices.* New York, US: Cambridge University Press, 2010.