UTM.28/ 13.11/1/4 Jld. 4 ( )

30 Jun 2008

Pustakawan
Perpustakaan Sultanah Zanariah
UTM, Skudai
Johor

Saudara,

PENGKELASAN TESIS SEBAGAI SULIT/TERHAD
-Tesis Sarjana Sains (Keusahawanan Teknologi Maklumat)
- Nama Pelajar : RAJA NORASYIKIN BINTI HJ RAJA ALI
- Tajuk : EARTHQUAKE AND STRUCTURAL MONITORING SYSTEM (EnSMS)

Sukacita dimaklumkan bahawa tesis yang tersebut di atas bertajuk Earthquake and Structural Monitoring System (EnSMS) memohon dikelaskan sebagai terhad untuk tempoh tiga (3) tahun dari tarikh surat ini, memandangkan ia mempunyai nilai potensi untuk dikomersilkan di masa hadapan.

Sekian, dimaklumkan.

Terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Yang benar,

PM SAFIE BIN MAT YATIM
Penyelia Projek
Fakulti Sains Komputer & Sistem Maklumat
Universiti Teknologi Malaysia

EARTHQUAKE AND STRUCTURAL MONITORING SYSTEM (ENSMS)

RAJA NORASYIKIN BINTI HJ RAJA ALI

A project report submitted in fulfillment of the requirements for the award of the degree of Master of Science (IT Entrepreneurship)

Faculty of Computer Science and Information Systems
Universiti Teknologi Malaysia

JUNE 2008

ABSTRACT

One main problem of earthquake prone countries is to own an earthquake sensor system. This is due to the expensiveness of the said item. Besides, the system itself is quite complicated and makes early detection of earthquake difficult. As such, a multi fuction and user friendly device has been invented under the project called Earthquake and Strustural Monitoring System (EnSMS). The system are complete with combinations of two devices namely seismograph for seismologist use and accelerograph widely used by building engineers. The new system is far cheaper than earlier available devices. Furthermore, its simple programming language and huge information storage could appeal to a wider usage of the device not only as a tool for earthquake detection but also a telecommunication channel to engineers and public.

ABSTRAK

Salah satu masalah yang sering dihadapi oleh beberapa negara yang sering dilanda gempa bumi ialah memperolehi alat dan sistem kesan gempa bumi mereka sendiri. Ini adalah kerana harga alat dengan sistem yang lengkap terlalu mahal untuk dibeli dan dipasang di Negara masing-masing. Selain daripada itu sistem mengesan gempa bumi yang ada di pasaran kini terlalu komplikasi sehingga menyukarkan beberapa pihak untuk memahami dan mengetahui kesan gegaran itu lebih awal. Oleh itu satu sistem yang lebih mesra pengguna dan pelbagai fungsi telah dibina. Sistem ini juga menggabungkan dua alat kepada hanya satu alat dengan satu sistem yang lengkap iaitu sismograf yang digunakan oleh sismologis dan asselerograf yang digunakan oleh jurutera bangunan. Projek ini dinamakan "*Earthquake and Structural Monitoring System* (*EnSMS*)" atau "Sistem Memantau Gegaran Gempa Bumi dan Struktur Bangunan" dan telah dibangunkan bagi tujuan penjimatan kos berbanding produk sedia ada, memberi faedah bersama kepada beberapa syarikat yang terlibat dalam pembangunan aplikasi ini sepeti Syarikat Telekomunikasi serta projek ini juga cuba untuk memberi amaran awal kepada pengguna atau masyarakat setempat. Dengan mengunakan pangkalan data yang ringkas dan bahasa pengaturcaraan yang mudah, diharapkan sistem ini mampu memberi faedah kepada sismologis, jurutea dan juga orang ramai.

TABLE OF CONTENTS

CHAPTER 1

PROJECT OVERVIEW

1.1 Introduction

On 26 December 2004, a large earthquake of 9.0 on the Richter scale occurred west of Aceh in Sumatra, Indonesia. The epicenter was located at latitude 3.1ºN and longitude 95.5ºE, about 680 kilometers northwest of Kuala Lumpur and 590 kilometers west of Penang. This earthquake has generated a massive and disastrous Indian Ocean-wide tsunami that struck the coasts of a number of countries in the region with high "tidal" waves. This unprecedented tsunami had killed hundreds of thousands of people in several countries bordering the Indian Ocean. A total of 76 persons have been killed and many properties were destroyed along the northwest coastal areas in Peninsular Malaysia particularly the coastal areas of Penang, Kedah, Perlis and to a lesser extent Perak and Selangor.

This project will provide both earthquakes monitoring system and consultancies services. I offered my monitoring system, namely "EnSMS", that is an earthquake and structural monitoring system that utilizes a satellite for sending its information or data to related party.

The target customers for EnSMS are very wide because it covers the requirements for not only earthquake monitoring but also structural monitoring as well. Therefore this system is required for related parties in charged on public safety such as Malaysian Meteorological Department (MMD) for informing the public regarding earthquake activities, Public Works Department for monitoring their

critical facilities (such as hospital, power plant, long span bridges), Department of Irrigations and Drainage (DID) for monitoring their dams, and private sectors such as oil company for monitoring their offshore platform (PETRONAS, EXXON-Mobile, SHELL, BP), the owners of high-rise buildings, KESAS, PLUS, universities, research centers, and consultancy companies related to earthquake engineering.

The uniqueness of my systems are, it's was a combination of a sensor, namely SEER-SAG® that could record the ground motions in all three directions and has combined both instruments for earthquake monitoring (seismograph) and structural monitoring (accelerograph). While the current problems have separated the instrument for earthquake monitoring and structural monitoring and they are able to detect only one direction of earthquake movements. Therefore, the uniqueness of our system could reduce cost significantly.

As more and more high-rise buildings and large costly structures are built and being built in Malaysia, there has been a growing concern among engineers and authorities in Malaysia regarding seismic risk to critical structures and facilities. One of the problems today preventing most of the countries in the world from obtaining sufficient number of seismological instruments in their countries is the great cost to purchase/install the instruments. Therefore, i believed that my system could answer to the problems and limitation faced by this problem. With low in price, Malaysia is expected to install more seismic stations to improve the nationwide earthquake observation network, and therefore able to have an excellent database of earthquake data and increase the safety of certain critical facilities that would have catastrophic consequences, such as power plants, chemical factories, offshore platforms, and large dams.

1.2 Background of Problem

There are two types of common seismic instrument used to obtain earthquake ground motions data: seismograph and accelerograph. Seismograph is an instrument that records displacements. Seismograph is required by seismologist to predict the location and the size of the earthquake (most commonly in Richter scale). Government institution such as Malaysian Meteorological Department (MMD) requires this equipment for monitoring the earthquake activities. Hence, after the earthquake occurs, MMD can immediately process the observational data and quickly announce information on location, magnitude through media as well as to other related institutions and to prepare the action plan if there is a possibility of potential hazard situation.

Accelerograph is an instrument that record ground or structures acceleration due to earthquake effects. One of the purposes of this equipment is to monitor the acceleration occurred on particular structures and gives a warning if the acceleration has exceeded the design capacity. This function is very useful for a control system for certain critical facilities such as power plants (especially nuclear power plants), chemical factories, offshore platforms, and large dams. This control system is required for those particular facilities to decide appropriate actions such as shutdown the operation or evacuate the people.

Accelerograph is also used by scientist or researcher for analyzing the earthquake hazard and risk and then implements the results into design code or disaster management plan. These results are very useful to minimize or mitigate the effects of future earthquakes to their countries. An excellent database of earthquake data is required in order to carry out the depth study on seismic hazard and risk assessment, and to get the excellent results of the study. To have an excellent database of earthquakes parameters and ground acceleration, sufficient number and appropriate type of seismic instruments especially accelerograph are needed. For example, Japan is operating a network made up of about 180 seismographs for continuous earthquake monitoring and 1000 accelerographs.

There is no doubt that every country should have of both seismographs and accelerograph not only for informing the location and the size of the earthquakes but also as a control system for certain critical facilities as well. Usually, it requires at least three units for each type of seismograph and accelerograph for each site to detect the motion of earthquake i.e. two for horizontal direction (N-S and E-W) and one for vertical direction. As more and more high-rise buildings and large costly structures are built and being built in Malaysia, there has been a growing concern among engineers and authorities in Malaysia regarding seismic risk to critical structures and facilities. In other hand, Malaysia still requires a large number of this instrument to cover its large area in West and East Malaysia.

One of the problems today preventing most of the countries in the world from obtaining sufficient number of seismological instruments in their countries is the great cost to purchase/install the instruments. Beside that, the approach of the most seismic-instruments available today is complicated. Although simple seismic instruments have been developed, usually they are able to detect only one direction of earthquake movements. Moreover, the instrument could utilize only as seismograph or accelerograph (SEER Group, 2007).

1.3 Statement of Problem

Current problems and limitations faced by the parties related in earthquake monitoring are shown in Figure 1.1:

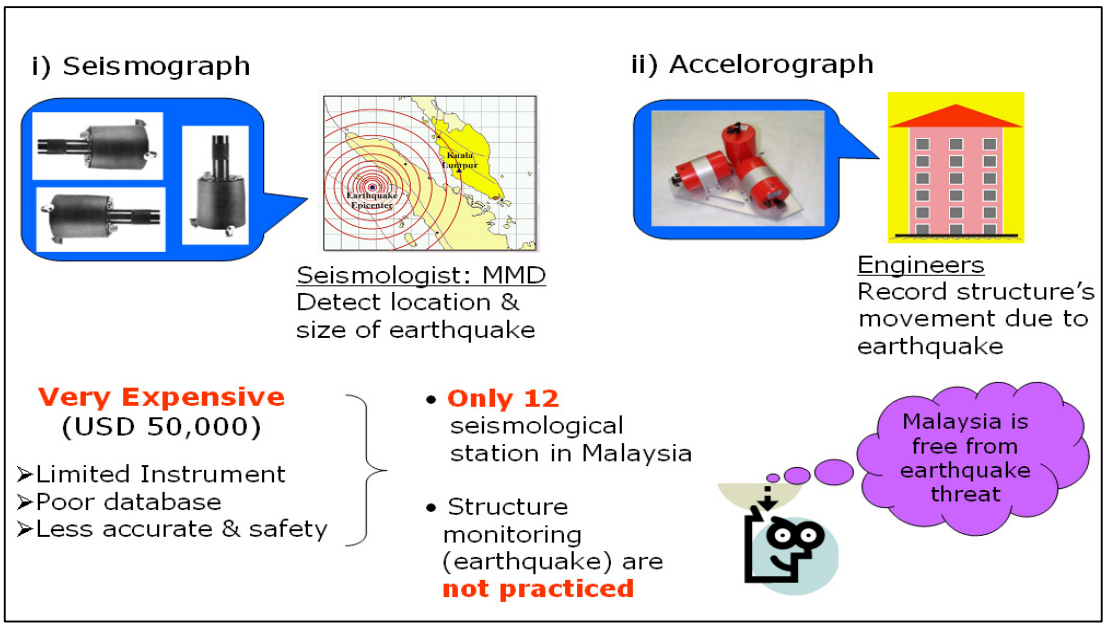

Figure 1.1 Current Problem in Earthquake Monitoring

The existing instruments for earthquake monitoring could utilize only as seismograph or accelerograph. Each type of instrument needs three (3) units to measure 3 component of both displacement (seismograph) and ground acceleration (accelerograph). The lists of current problem due to the above limitations are as follows:

i. High Cost

The cost for purchasing the sensor of both three components accelerograph and seismograph is about USD 50,000.

ii. Limited instruments

The number of earthquake monitoring especially for structural monitoring is very limited. This is due to the owners of building have to spend much money to purchase the instrument.

iii. Poor database

The insufficient number of equipments cause poor database.

iv. Accuracy and safety

Due to lack of database, earthquake analysis should utilize database from other countries. It causes some results might not be reliable to apply in the particular country.

The lack of structural monitoring system also reduces the safety of the building against the earthquake effects.

1.4 Project Objectives

Objectives of these systems for both economical and societies are as follows:

i. To develop a multi functional with a user friendly interface for earthquake and structural monitoring system
ii. To reduce product and maintenance cost specially for government and private sectors which were involved in this problem
iii. To develop a system that can give an alert warning system for registered members via communications device
iv. To develop a prototype system

1.5 Project Scope

i. This system must be a user friendly interface monitoring system
ii. There are three different user will use this system which are non members, members and admin with different functionalities
iii. This system will link with communications company such as telco to give an alert warning system for registered members only

1.6 Conclusion

i. To reduce cost

- The engineers could use the knowledge to anticipate the future problem due to the earthquake effects and to mitigate the possibility of structure failures due to future earthquakes.
- Improving in quality of database could advance the knowledge regarding earthquake effects and it will optimize the design of the structure. This will reduce cost of design.
- Well-maintained structures will deteriorate in longer period.

ii. Benefits few parties that involved in the project

- Communication company (Telekom (M) Bhd, MAXIS, DIGI)
- Hardware and software suppliers
- Private sectors which were related (consultancy services)

iii. Try to assured a public safety

- Proposed system can prevent 'runaway' failure to other component and defect can be monitored continuously.
- Related parties can be alarmed earlier if there is any serious damage occurred, and immediate action can take place.