

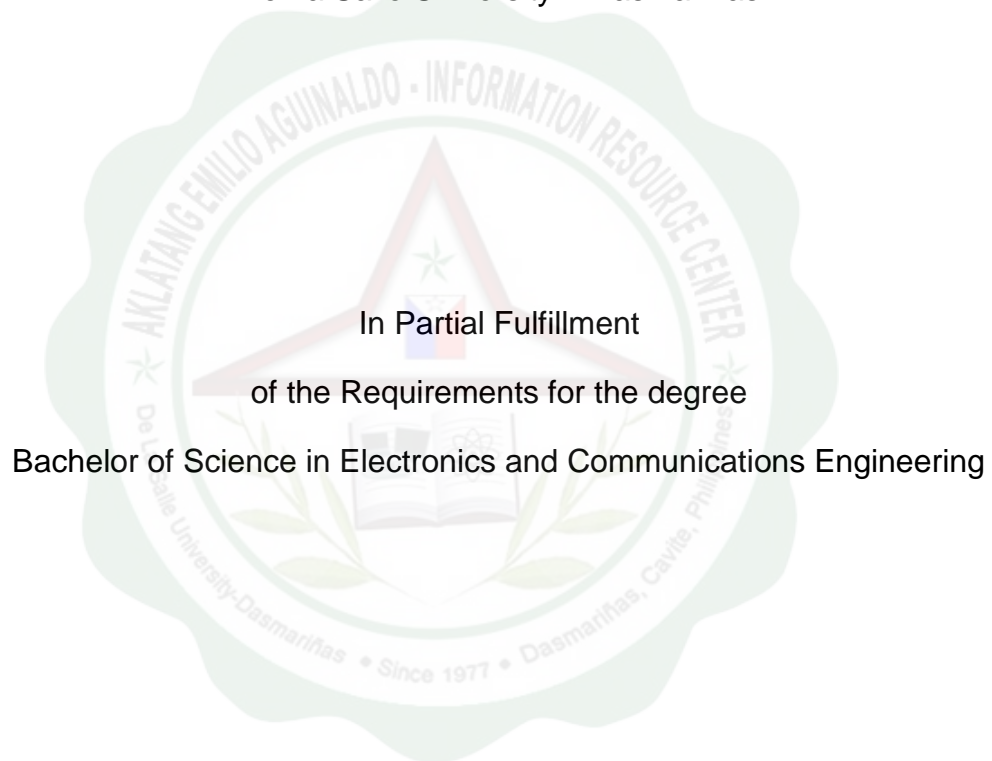
**Piezoelectric Technology-Based Seismic Sensing
Device for Earthquake Magnitude Detection**

A Research Study

Presented to the Faculty of

College of Engineering, Architecture and Technology

De La Salle University – Dasmariñas



In Partial Fulfillment

of the Requirements for the degree

Bachelor of Science in Electronics and Communications Engineering

ACUZAR, MANUEL LITO C.

GARCIA, MARK CHRISTIAN V.

LAGERA, BONN ARIEL J.

VALDEZ, PATRICK JEREMY O.

MAY, 2011

TABLE OF CONTENTS

Approval Sheet	i
Table of Contents	ii
List of Figures	iv
List of Tables	v
Acknowledgment	vi
Abstract	vii
Chapter I	
1. THE PROBLEM AND ITS BACKGROUND	1
1.1 Introduction	1
1.2 Background of the Study	2
1.3 Statement of the Problem	3
1.4 Conceptual Framework	4
1.5 Significance of the Study	5
1.6 Scope and Limitations of the Study	6
1.7 Definition of Terms	7
Chapter II	
2. REVIEW OF RELATED LITERATURE AND RELATED STUDIES	10
2.1 Foreign Literature	10
2.2 Local Literature	19
2.3 Foreign Studies	23
2.4 Local Studies	26
2.5 Relevance to Present Study	28
Chapter III	
3. RESEARCH METHODOLOGY AND PROCEDURE	29
3.1 Research Method	29
3.2 Design Procedure and Consideration	30

3.3 Research Instruments	37
3.4 Data Gathering Procedure	38
3.5 Statistical Tools / Treatment Data	38
Chapter IV	
4. RESEARCH FINDINGS	40
4.1 Presentation of Data	40
4.2 Computations	43
4.3 Data Gathered	46
4.4 Interpretation of Data	58
Chapter V	
5. SUMMARY, CONCLUSION AND RECOMMENDATIONS	63
5.1 Research Summary	63
5.2 Research Conclusion	64
5.3 Research Recommendation	65
Appendices	
Appendix I – Piezoelectric Specification	67
Appendix II – PIC18F4520 Data Sheet	69
Appendix III – TL071 Data Sheet	128
Appendix IV – VIBRATION METER VB-8213	138
Appendix V – Recommended Piezoelectric Material	140
Appendix VI – PROTON IDE Code (A/D Converter Source Code)	142
Appendix VII – Materials and Expenses Report	145
Appendix VIII – Actual Prototype Images	147
Appendix IX – Certificate of Testing	151
Appendix X – Gantt Chart	153
Appendix XI – Certificate of Proofreading and Editing	154
Bibliography	159
Curriculum Vitae	164

LIST OF FIGURES

Figure 1.1 – Seismic Device Flow Chart	4
Figure 2.1 - Atomic distortion of Piezoelectric material	11
Figure 2.2 – Piezoelectric Loading	12
Figure 2.3 – Piezoelectric Material Equivalent Circuit Model	14
Figure 2.4 – Piezoelectric Material Applications	16
Figure 2.5 – Distribution of earthquake epicenters from 1975 to 1995	18
Figure 2.6 – Seismic Sensor	25
Figure 3.1 – Schematic Diagram of Seismic Sensing Circuit	31
Figure 3.2 – Schematic Diagram of Seismic Sensing Device	34
Figure 4.1 – X-axis vs. Motor Input Voltage	58
Figure 4.2 – Y-axis vs. Motor Input Voltage	59
Figure 4.3 – Seismic G and Grms vs. Motor Input Voltage	60
Figure 4.4 – Actual G and Grms vs. Input Motor Voltage	61

LIST OF TABLES

Table 2.1 – Piezoelectric Material Constant	15
Table 2.2 – PHIVOLCS Earthquake Intensity Scale (PEIS) & Peak Ground Acceleration (PGA)	19
Table 2.3 – PHIVOLCS Earthquake Intensity Scale (PEIS) & Complete Description	21
Table 4.1 – Data Gathered through Testing and Computations (Trial 1)	46
Table 4.2 – Data Gathered through Testing and Computations (Trial 2)	47
Table 4.3 – Data Gathered through Testing and Computations (Trial 3)	48
Table 4.4 – Data Gathered through Testing and Computations (Trial 4)	49
Table 4.5 – Data Gathered through Testing and Computations (Trial 5)	50
Table 4.6 – Data Gathered through Testing and Computations (Trial 6)	51
Table 4.7 – Data Gathered through Testing and Computations (Trial 7)	52
Table 4.8 – Data Gathered through Testing and Computations (Trial 8)	53
Table 4.9 – Data Gathered through Testing and Computations (Trial 9)	54
Table 4.10 – Data Gathered through Testing and Computations (Trial 10)	55
Table 4.11 – Data Gathered through Testing and Computations (Average)	56
Table 4.12 – Mean, Standard Deviation & Z-Test of Data Gathered through Testing and Computations	57

ABSTRACT

Title : Piezoelectric Technology-Based Seismic Sensing Device for Earthquake Magnitude Detection

Researchers : ACUZAR, Manuel Lito C.
GARCIA, Mark Christian V.
LAGERA, Bonn Ariel J.
VALDEZ, Patrick Jeremy O.

School : De La Salle University- Dasmariñas

College : College of Engineering, Architecture and Technology

Pages : 174

Year : 2010-2011

Earthquakes occur all over the world everyday. Most of the time, we never hear about them and even feel them but they happen. Once in a while, a really large earthquake will occur causing damaging effects to the areas they act upon. Earthquakes and their resulting aftershocks can be devastatingly destructive. This includes damage/s to buildings and in worst cases the loss of human life. The effects of rumbling produced by earthquakes usually lead to the destruction of structures such as buildings, bridges, and dams. It can also trigger landslides. The aim of this study is to look for an alternative sensor that is comparative to the seismograph, for the latter is costly and complex in circuitry.

The research analyzes how piezoelectric works as a vibration sensor used to measure and determine G and Grms values. This research also concentrates on how to develop a seismic sensing equipment that is low-cost and simple in circuitry. It focuses on piezoelectric film sensors in experimental and simulation method needed for detecting seismic signals. Using a vibrating platform that is run by a motor, the researchers conducted a miniature model of an earthquake that was scaled prior to the real life earthquake. The goal of this study is to obtain reading-based from the vibrations produced by the motor. The seismic sensing circuit is driven with piezoelectric film transducers, which tell the corresponding G and Grms values measured in actual and interpreting the corresponding magnitude by the LCD.

