UNIVERSITI TEKNOLOGI MARA
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PIEZOELECTRIC BASED ENERGY HARVESTING INTERFACE CIRCUIT

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ABSTRACT

This study focused on solving the issue of conventional power plant that require large space, immovable, polluting and expensive by employing abandoned energy produce by mechanical vibration in the environment. The piezoelectric based energy harvesting interface circuit is the main focus of this study and as it produce low voltage, the study include the investigation of Direct Current – Direct Current (DC-DC) converter topologies to improve the outcome. The piezoelectric energy harvesting prototype include piezoelectric transducer, rectifier, converter, Arduino Uno microcontroller and water wave tank. A boost converter with variable duty cycle was designed to improve the output voltage range from 1.5 V to 6 V. The size of piezoelectric transducer disc used in this study varies from 20 mm, 27 mm and 35 mm. The outcomes from the energy harvesting device was determined through measurement using digital multimeter and oscilloscope. It was found that higher duty cycle produce higher output. The combination of large boost converter duty cycle, 0.845, and large size of piezoelectric transducer, 35 mm, has produced the highest output. The measured input voltage and output voltage were 0.94 V and 6.4 V per tap respectively. The calculated output energy was 4.5 mJ per tap. The prototype piezoelectric energy harvesting circuit has successfully produce the output voltage in the range of 1.5 V to 6 V.

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TABLE OF CONTENTS

CHAPTER 1
INTRODUCTION

1.1 OVERVIEW

This chapter is about the introduction of this project of piezoelectric based energy harvesting interface circuit. The background of the project, problem statement, objectives, the scope of the project, and the significant of the project are explained in this chapter. The organization of the thesis is explained at the end of this chapter.

1.2 PROJECT BACKGROUND

Electrical power that had been used around the world is commonly harness energy from conventional power sources i.e: coal, natural gasses, petroleum and hydroelectricity. All of these conventional energy sources are non-renewable, contributed a lot to world pollution as well as greenhouse effect except for hydroelectric. These energy sources are being used excessively until reserves have been maximally depleted. The effort to exploit their resources has become more challenging.

Power plant based on conventional sources are large in size and requires a lot of space [1]. Due to these reasons, the usage of conventional power source lose it reputation. Presently, the researchers are turning to non-conventional sources or renewable energy sources such as wind, solar, biomass, and tidal energy. Besides, the interest in utilizing ambient waste energy has gradually increased such as abandoned heat and unwanted mechanical vibration. This process has been considered for electronic devices with low power requirement and is known as energy harvesting [2].

Energy harvesting (EH) is a method which captures and obtain various unemployed ambient energy sources. Then, EH converts it to electrical energy to recharge batteries. The harvested energy is generally very small if compared to the energy harvested from renewable energy sources. Unlike power station that fixated at one place, a portable solution can comes from small scale sources and ready to be used