CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

This chapter will discuss about the project background, problem statement, project objective and the scope of the project. The project is about the simulation study of electromagnetic-energy harvester based on simple beam-mass system. Energy harvesting is the process of capturing minute amounts of energy from one or more of these naturally-occurring energy sources, accumulating them and storing them for later use. Vibration energy harvesting is the technique that can be used to harvest the energy from vibrations and vibrating structures, a general requirement independent of the energy transfer mechanism is that the vibration energy harvesting device operates in resonance at the excitation frequency. Transduction mechanism such as electromagnetic is requires in order generating electrical energy from motion. Vibration energy is suited to inertial generators with the mechanical component attached to an inertial frame with acts as fixed reference.

Particularly, we consider a simple harvesting system in which the electromagnetic transduction is limited to a finite element interval over the displacement of the inertial mass. Thus, when the harvesting masses move outside this region no energy conversion occurs. A simple design of an electromechanical energy harvesting device is proposed and modeled by a single degree-of-freedom system. Finite-element method is used widely in industry and it can be used to simulate the response of a physical system to structural loading, and thermal and also the electromagnetic effects. Based on this method we can solve the underlying governing equations and the associated problem-specific boundary conditions.

As our everyday life is getting more and more complexes and energy sources more important, some alternative ways to generated energy is become the main idea of energy harvesting. Nowadays, vibration-based energy harvesting concept has received much attention in recent years. There are many intentions in micro-electromechanical (MEMS) where its applications are wide range in areas. One of the examples that had always been used is the medical implants and embedded sensors in building and similar structures. In kinetic energy generator, mechanical energy in the form of vibrations present in the application environment is converted into electrical energy. Kinetic energy is typically converted into electrical energy using electromagnetic, piezoelectric or electrostatic transduction mechanisms.

The amount of energy generated by this approach from electromagnetic is depends fundamentally upon the quantity and form of the kinetic energy. It is available in the application environment and the efficiency of the generator and the power conversion electronics. The design of the mechanical system should maximize the coupling between the kinetic energy source and the transduction mechanism and will depend entirely upon the characteristics of the environmental motion. In the case of electromagnetic energy harvesters, increasing the generated power density is accomplished by using multiple degrees of freedom, optimizing coil geometry and dimensions, or simply designing the generator to operate at high frequencies.

A few researches finds that the amount of money spent on energy harvesters will be USD0.7Bn, with several hundred developers involved (Happich, 2011). The majority of the value this year is in consumer electronic applications, where energy harvesters have been used for some time. In 2011, 1.6 million energy harvesters will be used in wireless sensors, resulting in $13.75 million being spent on those harvesters. The analysis is shown the Figure 1.1 which represents millions of US dollars. Furthermore, the vibration energy harvesting technique is becoming a higher market value. Energy harvesting devices produced by MEMS technologies will be mainly thermal thin-film technology whose production will start industrially in 2012 as shown in Figure 1.2. Other mechanical vibration MEMS harvesters will take longer time to be adopted due to cost challenge.

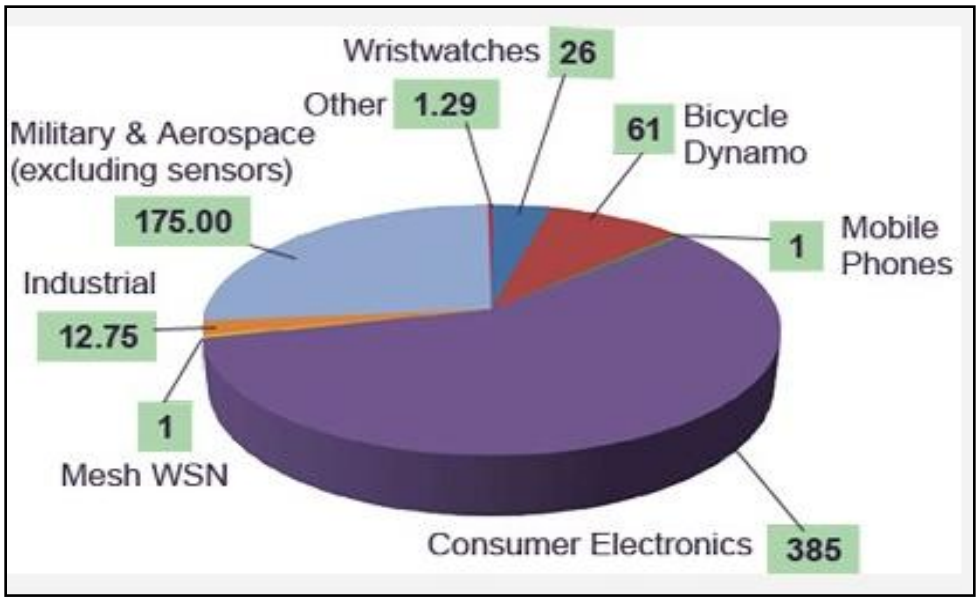

Figure 1.1: The Energy Harvesting Market in 2011 $0.7Bn

Source: Julien Happich of IDTechEx 2011

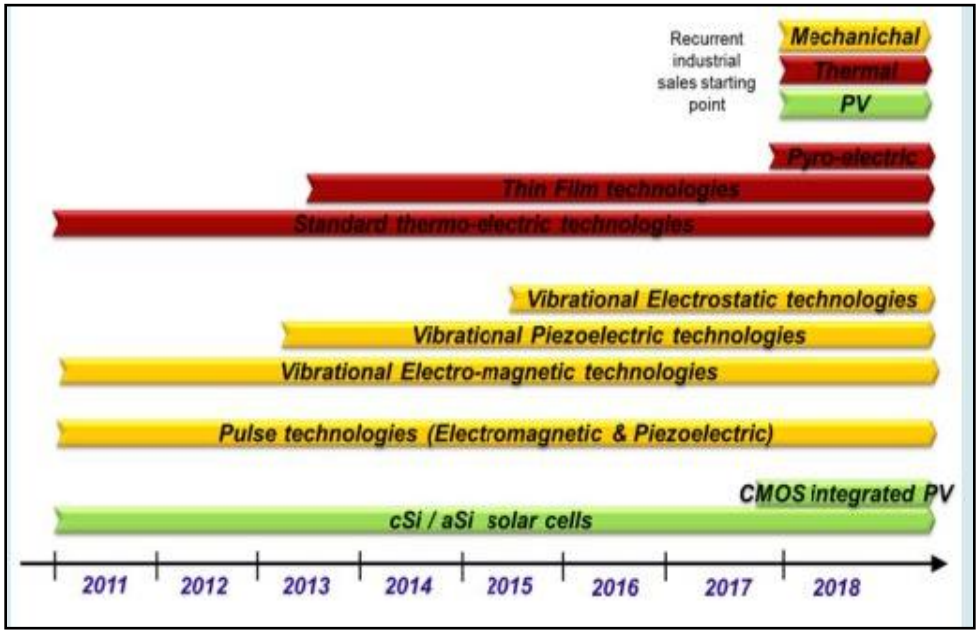

Figure 1.2: The Energy Harvesting Technologies Time to Market

Source: http://www.i-micronews.com/reports/Emerging-Energy-Harvesting-Devices/1/330/