Preface

Wireless networks are playing vital role in current emerging technological era by providing ease and access in multi daily life applications. Among the many challenges in wireless networks is the finite battery power in the nodes affecting the shorter lifetime of wireless nodes and thus the network life. Wireless nodes are normally powered by battery and the finite battery power shall impede the performance of wireless networks. Numerous techniques related to energy aware routing, clustering, scheduling, energy aware MAC routing protocols and data aggregation have been proposed to address energy efficient issue and focus to increase the lifetime of wireless networks. Though few of them provide better solution up to simulations and assumptions only, the stated energy efficiency issue still requires major attention. Possible solutions such as battery replacement, higher battery capacity, and low transmission range could mitigate such issues but they need to compromise on other factors such as cost, reliability and energy usage. In fact one of the promising alternatives to address such situations is to look into power recharging techniques for wireless nodes, in particular the energy harvesting approaches. Energy harvesting is the process of hunting energy from the environment such as solar, wind or other sources such as body heat, foot strike, frequency harvesting or vibration, and converting it into electrical energy. Proper harvesting rate can enhance the performance of the network and extend the lifetime of the entire networks.

Biological inspired algorithms are now becoming a new paradigm to look for naturally inspired solutions for self-healing mechanism to address energy issues in wireless networks. Biologically-inspired solutions use natural selection mechanisms to provide promising factors for sustainable energy management in energy harvesting. This proposal draws attention to the energy harvesting and transmission mechanism in wireless networks from the technological perspective with respect to the nature inspired solutions in energy harvesting. The advancement of wireless technology in the current trend is increasingly influenced and inspired by the biological norm.

The ultimate objective of this volume is to provide the academic and industrial communities with recent advances in technological development, application and impact of technologies for sustainable energy and environment. The objective of this book is two folds. The first objective is to encourage more research in energy harvesting and transmission technologies. The second objective is to publish the excellent research been conducted at this moment of time. Specifically, we seek to explore new possibilities based on biologically-inspired solutions for sustainability in the context of energy and environment.
ORGANIZATION OF THE BOOK

This book consists of 14 peer-reviewed invited chapters authored by several international researchers around the world. Book is divided into the following three sections:

Section 1: Introducing Biologically-Inspired Computing and Its Perspectives
Section 2: Presenting Energy Harvesting in WSN and Its Perspectives
Section 3: Exploring and Illustrating the Current and Future Trends in Combining Biologically-Inspired Computing with Energy Harvesting in WSN and Energy Transmission

Section 1 entitled “Introducing Biologically-Inspired Computing and Its Perspectives” is to specify is strictly about biologically-inspired computing. The second section focuses on energy harvesting and wireless transmission and leaving the third part open to general chapter submissions including merging of biologically-inspired computing and energy harvesting.

A brief description of each of the chapters follows:

SECTION 1: INTRODUCING BIOLOGICALLY-INSPIRED COMPUTING AND ITS PERSPECTIVES

Chapter 1: Applications of Vibration-Based Energy Harvesting (VEH) Devices

This chapter reviews present usage of vibration-based energy harvesting (VEH) devices and applications. The evolution of energy resources and advance in electronic technologies has resulting the need of self-sustainable wireless/portable electronic devices in current modern society. VEH mechanism is suggested in this chapter as the solution for the bottleneck. Various consideration of creating an optimal vibration energy harvesters are suggested through an analytical model of a mechanical transducer. Useful applications and usages of VEH are presented and some suggestions for improvement are also given.

Chapter 2: Biologically-Inspired Wireless Power Transmission System – A Review

This chapter gives an overview on Wireless Power Transfer (WPT) systems and the existing biologically-inspired architectures which could be used to optimize the efficiency of the systems. In general, wireless power transmission could be categorized into near-field and far-field mechanisms. At present, one of the most immediate issues to be solved is the relatively low efficiency in a WPT system.

Chapter 3: Energy Harvesting Methods for Internet of Things

This chapter presents the review of various energy harvesting mechanisms, current application of energy harvesting in IoT domain and its future design challenges. Internet of Things (IoT) has becoming a central theme in current technology trend whereby objects, people or even animals and plants can exchange information over the Internet. IoT can be referred as a network of interconnected devices such
as wearables, sensors and implantables, that has the ability to sense, interact and make collective decisions autonomously.

**Chapter 4: Analysis of Energy Loss in Superconducting Waveguides**

In this chapter, the characteristics of the propagation of waves in superconducting waveguides are investigated. To compute the propagation constant, the complex conductivity of the superconductor is incorporated into the set of characteristic equations which describes the propagation constant of waves in the waveguide. The result suggests strongly that superconducting waveguides can be applied in receiver systems to minimize the loss of propagating signals.

**SECTION 2: PRESENTING ENERGY HARVESTING IN WSN AND ITS PERSPECTIVES**

**Chapter 5: Different Resources Consumption of Renewable Energy**

Renewable Energy Sources and Climate Change Modify Minimization offers a good estimation on the chapter for the technological, scientific, environmentally friendly, financial and also societal aspects of this factor connected with six renewable energy (RE) options for the minimization connected with weather adjust. This functioning chapter on environmentally friendly Energy Solutions and Local climate Change Minimization presents an assessment on the literature for the scientific chemical, technological, environment, economic in addition to social areas of the contribution connected with six environmentally friendly energy (RE) sources on the mitigation connected with climate alter.

**Chapter 6: Solar Powered Smart Street Light with Maintenance Service System**

Advancement of technology brings advantages to human race to certain extent. Thanks to the invention of solar panel, solar energy is able to become a renewable energy source that can be applied to various applications. Considering the increase of electricity consumption every year in Malaysia, solar powered street lighting system is proposed in order to reduce the burning of fossil fuels to generate electricity, hence reducing air pollution.

**Chapter 7: Harvesting Energy from Microbial Fuel Cells – Powering Wireless Sensor Networks Operating in Wastewater Treatment Plants**

Microbial Fuel Cells (MFC) are the main topic of this chapter. Different types of electrochemical devices are presented and their typical power output is compared with other energy sources, providing a framework for the uses and applications of MFC technology. Following an historical approach of how this technology came to be, a more detailed description of some aspects of a typical microbial fuel cell is then brought forward.
Chapter 8: Modelling Formalisms for Green Transportation Systems

In this chapter, we consider discrete event systems modeled via a state space representation. The model objective is the avoidance of a given set of states, or equivalently the fact that certain predicates, specified in terms of states are always false. We address the state space controlled Petri Nets and a technique to reduce the complexity of these nets, by taking into account the fact that the complexity of the considered nets depends mainly on the representation of the control design, respectively on the forbidden sets of places.

Chapter 9: On the Decision Criteria for “Greening” Information Systems

The impacts of climate changes are significantly influencing the approaches of organizations and governments to use resources, develop appropriate environment-friendly strategic frameworks and adopt a holistic approach to understand their operating environment. These impacts can be seen in the search for energy effective solutions, outsourcing processes and engaging into partnerships and alliances. At the same time, governments have been stepping up policy and legislative initiatives, assessment frameworks, and engagement in international conventions to cut carbon emissions and promote sustainability.

Chapter 10: A Biologically-Inspired Computational Solution for Protein Coding Regions Identification in Noisy DNA Sequences

This paper presents a peculiar biologically inspired solution for coding regions identification based on wavelet transforms with notion of a peculiar indicator sequence. DNA signal noise has been reduced considerably and exon peaks can be discriminated from introns significantly. A comparative analysis performed over datasets commonly used for protein coding identification revealed the outperformance of proposed solution in power spectral density estimation graphs and numerical discrimination measure’s calculations.


This presents an outline of each application of the protocol and an idea of how these features could be adapted into future research area in self-healing wireless sensor networks in terms of energy aspect. The self-healing characteristics are mainly derived from biologically-inspired mechanisms for autonomic behavior. Autonomic behavior systems are characterized into four functional systems as self-configuration, self-healing, self-optimization and self-protection. This survey mainly focuses on self-healing characteristics from the biologically-inspired perspectives as well as non-bio-inspired perspectives.
Preface

SECTION 3: EXPLORING AND ILLUSTRATING THE CURRENT AND FUTURE TRENDS IN COMBINING BIOLOGICALLY-INSPIRED COMPUTING WITH ENERGY HARVESTING IN WSN AND ENERGY TRANSMISSION


Advancement in low power electronics helped a lot but the use and maintenance of conventional batteries with a limited life span cannot address the power supply problem effectively in a long run. Harvesting energy from ambient environment is an effective alternative both in terms of power and cost, which can helps sensor networks to live longer. This chapter mainly focuses on different possible energy sources available in ambient environment and current technological mechanism to harvest energy for WSNs.

Chapter 13: Green Energy in Data Centers

The green computing concept can be achieved by using several methods adopted by researchers including renewable energy, virtualization through cloud computing, proper cooling system, identifying suitable location to harvest energy whilst reducing the need for air-conditioning and employing suitable networking and information technology infrastructure. This paper focuses into several approaches used by researches to reduce energy consumption at data centers while deploying efficient database management system. This paper differs from others in the literature by giving some suitable solutions by looking into a hybrid model for green computing in data centers.

Chapter 14: Exploring Current Trends of Energy Harvesting

Mostly Batteries are the main source of energy for many of these mobile systems, embedded systems and remote system applications. There is a requirement for Energy harvesting which is a method of extracting energy from the nearby environment called Environmental energy which can be used as supernumerary to electrochemical battery. Studies are being conducted to harvest energy from solar, wind, thermal, tidal and other mechanical sources which have limited lifespan. This paper serves as a study to identify various sources of energy available for harvesting centered on various technical papers available and present the work carried out by investigators in identifying them.

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