

Chapter 11

Web-Based Digital Habitat Ecosystems for Sustainable Built Environments

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ABSTRACT

This chapter introduces the Digital Ecosystem (DE) concept and its application in the home environments. DEs are clusters of distributed and diverse digital components, which interact with each other in a self-organising, scalable, and sustainable manner. This could be viewed similar to the interaction of living organisms in a biological ecosystem. The DE concept has traditionally found widespread use in the business environments. However, the concept can well be applied to the home environment, giving rise to the concept of Digital Habitat Ecosystem (DHE). Thus a DHE refers to a cluster of devices for measurement, control, and sensing of environment parameter with the help of Information and Communication Technologies (ICTs). The primary incentive behind this chapter is to show how the DHE concept can be used for maximising the utilisation of vital resources, such as water and electricity, in the home environment and leading to a more sustainable living. Furthermore, the work outlined in this chapter proposes Digital Habitat Ecosystem Architecture (DHEA), which integrates the various digital elements of a home network in a holistic manner. However, there are some current digital system architectures such as Service Oriented Architecture (SOA) available these days; this chapter discusses the shortcomings of the SOA architecture and how the proposed DHEA will rectify the same. In addition, this chapter gives an overview of the static web based model of the home management system, how dynamic DHE varies from those existing models.

DOI: 10.4018/978-1-4666-1972-2.ch011

INTRODUCTION

Global warming phenomenon has, in the last decade or so, become a matter of great concern. Climate change concerns originate from the fact that global warming is expected to gradually, but increasingly, lead to adverse consequences on the earth's ecosystems (Lovins, Lovins & Hawken, 1999). Governments all around the world are planning for the development of technologies to aid with the task of reducing greenhouse gas emissions, and using resources more efficiently. Therefore, there is an urgent need to preserve natural resources. One way to achieve this is to optimise the utilisation of all natural and manufactured resources used in our day-to-day lives. The establishment of smart digital networks, i.e. Digital Ecosystems (DEs), in home environments can be a viable option to tackle this challenging task, because DEs are considered to be robust scalable architectures that can evolve as the system requirements change.

This chapter initially discusses the global warming phenomena and the need for more sustainable practices, with a major focus on reducing the consumption of resources in the home environment. The chapter then introduces the DE concept, and how the authors propose to implement this concept as the Digital Habitat Ecosystem (DHE) in the home environment. The chapter then presents the idea of a Digital Habitat Ecosystem Architecture (DHEA) proposed by the authors to facilitate systematic development of DHEs. Furthermore, the current technologies used in built environments, and newer technologies that will be used to develop DHEs are discussed. The chapter concludes with opportunities for further research and development in this domain.

SUSTAINABLE LIVING

Global warming is gradually, but incessantly, degrading the earth's ecosystems. It has to do with

the way we live, work, use, and pollute. Figure 1 depicts some of the causes and effects of global warming; and furthermore, it suggests strategies and possible solutions.

Fossil fuel burning for electricity generation is one of the most significant contributors to the CO₂ (Carbon Dioxide) emissions in the world. The need to reduce CO₂ emissions has been driving the transition towards small-scale and decentralized generation of power, and as far as possible from renewable sources. However, the uptake of renewable energy systems has been slow and is expected to remain slow due to the inability of these systems to compete with coal-fired generation in terms of the cost of generation. At the same time, humanity keeps polluting the world and depleting its natural resources such as forests, oil, and drinkable water resources at an alarming rate. Therefore, there is an urgent need to preserve natural resources, and one way to achieve this is to optimise the utilisation of natural and manufactured resources in the home environment.

Demand Side Management (DSM) and Energy/Water Efficiency (EWF) are concepts that relate to processes used for managing the consumption of energy, water and other resources by dealing with the quantity and patterns of use. Many countries including Australia are concentrating on DSM technologies to preserve energy (Guo, Zeman, & Li, 2010). DSM is the implementation of policies and measures which serve to control, influence and generally reduce electricity demand.

The use of sophisticated green technologies in the home can provide the means to save our planet from environmental degradation. By minimizing the consumption of resources such as water and electricity, as well as by re-using and recycling end products, we can contribute to Ecologically Sustainable Development (ESD), i.e. development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Water is the most vital resource required for sustaining life. With changing climate and weather

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