



# Intelligent Role in Optimizing the Energy Consumption of Buildings and Comfort in Buildings

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Available online at: [www.isca.in](http://www.isca.in), [www.isca.me](http://www.isca.me)

Received 1<sup>st</sup> December 2013, revised 7<sup>th</sup> February 2014, accepted 6<sup>th</sup> May 2014

## Abstract

*Everyone with each idea and taste demands peace within himself. This issue must be provided for every person, at least at his/her home and place of residence. Inside home can be an unfailing source of happiness, joy and peace, provided that some of the finer details which have an important effect on the human mind and spirit are considered. However, we can contribute this happiness, joy and peace in the building by using technological advances and new technologies in the areas of building. Using this technology, in addition to creating the ideal an appropriate conditions and increasing the comfort in building, can cause energy consumption reduced. Control intelligent systems have highly flexible structures that can easily be adapted to different needs. In this paper, the benefits of intelligent buildings, that is, convenience, comfort, security and energy savings which are the four major goals of intelligent houses for inhabitants of residential buildings in Iran are studied.*

**Keywords:** Technology, Intelligent Houses, Comfort, Security, Energy-Consumption

## Introduction

Energy consumption in few past decades has delirious increased<sup>1</sup>. Due to same reason, energy consumption countries have taken steps to save energy and better use of available energies<sup>2</sup>. Optimizing energy consumption means selecting patterns, choosing methods and policies and applying them in accurate energy consumption which is optimum in the viewpoint of national economy and guarantees the continuation of energy and continuation of human's survival<sup>3</sup>. Thus, applying strategies that can contribute to reduction of energy consumption in this section leaves considerable economical effects. Today, we witness using new technologies in buildings which result in reduction of energy consumption and financial savings<sup>4</sup>. Intelligent houses make the life easier. By atomization of usual affairs, people can save the time and money. Also, they can reduce the overall costs of buildings by precise control of them<sup>5</sup>.

The most important issue that should be considered in Iranian residential buildings is the method of construction of these buildings. We can somehow create an optimum and compatible with nature architecture by considering the architecture taken from climate. But in some places, the compatible with nature architecture is not completely responsible for comfort needs of a residential building in Iran and to compensate this lack of responsibilities of these climate strategies, we can use new technologies in buildings. One of these strategies is the use of intelligent management system in Iranian residential buildings. Intelligent management system by applying the modern

technologies is seeking to create ideal conditions accompanied with optimum energy consumption in buildings. This system in addition to supervise different sections of the building and create proper conditions with presenting concurrent services, causes optimization of energy consumption, improvement of the level of efficacy and utility of existing devices in the building. In this system, the energy is consumed accurately, and in addition to conservation of produced energy, the ways of saving and utility are shown<sup>6</sup>.

**Statement of problem:** The increasingly consumption of energy and the optimistic and sometimes uncompensated effects of immethodical consumption of energy on environment from one side and the increase of its cost in recent years from other side have caused the authorities and consumers to look for finding ways to save energy and accurate way of use. Therefore, the accurate designing of Iranian residential building should be so that the function of different components of building is in balance with each other and in optimum conditions, the unwanted consumptions are reduced and a favorable environment is created.

**Objective and Importance:** The objective of intelligent houses is to develop the ways which create the abilities for Iranian residential houses and by making homogenous theses houses with their owners, positively response the needs and demands of the owners, and create a safe and joyful environment with saving in energy consumption.

**Review of literature:** There are some researches in this field that we can mention the following:

Villa Sera is an independent structure that controls the energy by solar panels, gathers the rain water, and uses its grey water to irrigate the plants, has greenhouse sections with appropriate temperature, modern air conditioning for organic agriculture and growth of the plants. Creating a small world such as this not only reduces the rate of produced carbon but also contributes the environmental systems. Its architecture has been created using elements of steel and glass to make a modern, roomy and of course strong building. This building is independent and intelligent.



Figure-1

Three-dimensional view of Villa Sera, Designer: Hakan Gursu



Figure-2

Three-dimensional view of Villa Sera, Designer: Hakan Gursu

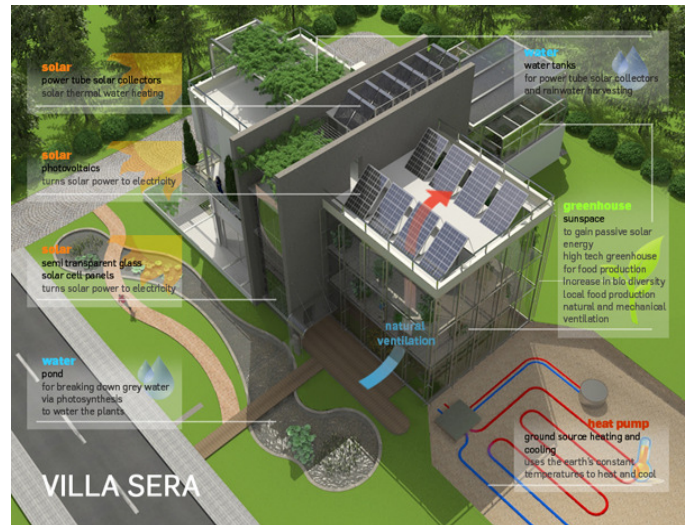


Figure-3

Villa Sera How to Operate, Designer: Hakan Gursu



Figure-4

A view of a greenhouse Villa Sera, Designer: Hakan Gursu

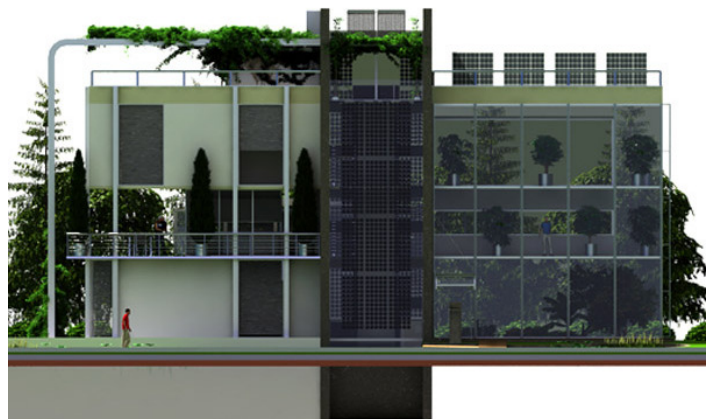


Figure-5

The main facade of the Villa Sera, Designer: Hakan Gursu

There's an increasing awareness on the environmental problems facing our planet and eventually our everyday lives. The individual efforts to reduce the carbon footprint to conserve the resources may seem ineffective to many people, but the minor changes we make in our micro-cosm is a valuable contribution to the macro-cosm of our planet as a whole. Villa Sera aims to set up a valuable micro-cosm using the natural sources effectively and develop an understanding that the individual efforts have a valuable impact on our planet earth. Villa Sera uses solar energy with photovoltaics to produce electricity and power tube solar collectors to heat water. Ground source heat pump is used for low temperature floor heating system. The pond is for breaking down grey water via photosynthesis to water the plants. Rainwater is collected from the roofs via rain harvester system. The water consumption is reduced by using water efficient WCs and composting toilets, aerated low flow spray taps and shower heads. Low energy appliances and compact fluorescent light bulbs are used. The Greenhouse is a Sunspace designed to gain passive solar energy and also as a high tech greenhouse for food production. The distribution of heat from the sunspace is accomplished through ceiling and floor level vents, windows, doors and fans. There are shutters for ventilation on the roof of the green house under the photovoltaic panels to regulate the heat in the greenhouse. By the perfect conditions provided, the food production in high tech greenhouse increases the bio diversity allowing to plant trees and plants. There's also another green house located on the garage providing more space for local food production. The flexible floor plans of villa sera give a provision for high quality of space, beauty and light with inbuilt flexibility to adapt to changing user requirements<sup>7</sup>.

## Methodology

The present research is mainly analytical that the most part of its information has been collected using library studies. First, the strategies of designing Iranian residential buildings using development of technology and modern technologies are analyzed, and then we dealt with description of this technology in buildings.

**Definition of intelligent building:** An intelligent building, by definition, is a construction that, by using a few basic elements including structure, used systems, services, management and their internal relations, creates an appropriate and economical environment. In an intelligent building, the most of actions which are done by habitants unconsciously and by habit are done by intelligent systems which results in saving the time and human resource. By another definition, an intelligent building is a construction which has a developed communicative infrastructure, and all of the systems of this building can be controlled and monitored using computer facilities centrally, and habitants of this building, in addition to using advanced services of intelligent building, considerably save the energy, and experience the life in a luxury and comfortable environment. The concept of intelligent building is the introduction of a kind of trade and strong interchange, and

without information fault among different parts of building. The term "different parts of building" includes all parts and components that have a role in administrating the building. These parts include structural and mechanical establishments, control of access and coming and going, security systems, management systems, lightness, maintenance and services, local network, and management of energy. In 1988 an architect named Atechin presented a definition about the intelligent buildings. He said, an intelligent building is a building which is aware of events that occur at its inside and outside and can take the best and effective decisions in confronting these events and to create a favorable environment for its users at the same special time. In this definition, in addition to the ability of acquiring the information as a system input and also the abilities of responding as a system output, the factor of time has also been included<sup>8</sup>. The definition which is presented for an intelligent building in the United States is as following: an intelligent building is a building which including a dynamic and economical environment by integrating four main elements, that is, systems, structure, services, and management and their relations<sup>9</sup>.

**The types of intelligent buildings:** All intelligent buildings use the automation technology. However, based on the objective, the intelligent buildings can be divided into two types: a usual intelligent building is designed such that the most works are done automatically, such as turning on the lights, creating security affairs, and opening and closing windows. A green intelligent building uses technologies that have less damage for environment, for example, using sunlight as the source of energy, and recycling water<sup>5</sup>.

**What is Building Management System?:** Building management system (BMS) refers to a set of hardwares and software's that are installed to control and direct the main and critical parts of an integrated building. The duty of this set is to monitor and command different parts of building so that the function of building elements is in balance with each other and in optimum conditions, the unwanted consumptions are reduced, and a safe, favorable environment is created. This system makes the management and control of building situation possible by automatic control of lights, control of coming and going (entrances and exits), control of cooling and heating, announcement and extinguishing of fire, control of installations and rational relation of these systems<sup>10</sup>. Thus, we can say that an intelligent building is a building that all its controlling sub-systems are designed and performed in a predefined framework appropriate with the building usage<sup>11</sup>. Generally, an intelligent building is a building which is equipped to a strong communicative substructure which can react continuously to environment situations and make itself compatible with them and allow the inhabitants to use the available sources effectively and increase their security and comfort. The intelligent building design has caused to save energy considerably and also to make its management easy. Computer systems are increasingly used in this system<sup>12</sup>.

**The main components of intelligent buildings:** An intelligent building includes various components that provide the necessary conditions for optimum control of building in connection and cooperation with each other. These components are as following:

The first part in a building intelligent control system, like other computer-based parts, is the inputs of the system which their duty is to receive information from different sensors<sup>8</sup> and other input instruments that among them, we can refer to security sensors, the temperature and quality detection sensors, and system control sensors, and also touch screen monitors<sup>13</sup>. The second part in a building intelligent control system is the processing system, data analysis, and archiving data that the duty of this system is the process of different data received from input instruments based on predetermined scenarios and with demands of system user. The third part in a building intelligent control system is the outputs of the system that their duty is to perform the produced commands by processing unit to building controlled unit. The fourth part is the system time considerations which cause the taken decisions occur on time. The fifth part is the ability of system learning in order to be able to take the best decision to optimize energy consumption and to create the comfort for inhabitants by using analysis of past information and predicted needs in building control scenario.

**The advantages of intelligent buildings:** The intelligent building technology provides the various and wide facilities that each person can enjoy all or a part of it based on his/her taste and interest. By using this technology, all instruments and equipments of the inside of building are shown on a screen based on the place properties and user's needs, and can be controlled and managed there. The unique property of this technology is the creation of coordination and integration among all systems that have been seen singularly and thereby makes the designing, installation and use of these systems possible in a wide range. The main advantage of this system, in addition to creating more comfort and security, is the saving in energy consumption. The main philosophy of the intelligent building technology has been founded based on centralization of the user and his/her needs and gives his/her today and future needs a simple and appropriate response, and has the capability of being compatible with following technologies<sup>14</sup>.

The main advantages of intelligent buildings can be summarized as following: Saving the energy consumption: energy consumption management in an intelligent building has an important effect on saving energy consumption. Making dependant the light and ventilation system to the presence of the user and the optimum planning for room temperature in different hours of day and night are of the signs of this energy consumption management<sup>6</sup>. Comfort: intelligent building provides more comfort for its inhabitants by using automation and taking the responsibility of some routine works. On the other side, in order to create the intended space in an intelligent building, just a pointing with a finger is enough in order the task

of precise setting of environment is undertaken by scenarios<sup>6</sup>. Security: in critical conditions including firing, flooding, robbery, the intelligent building alarms that can have an important role in preventing events or progress of them<sup>6</sup>. Facility in building management: the system of integrating the above infrastructures and creating a rationale connection among components of emergency power distribution systems, system receiving information of the consumption rate and functions of different parts of building to take appropriate decisions, the possibility of changing the method of energy distribution and facilities in special times and critical situations.

**Awesome Ways to Take Advantage of Smart Home Technology:** In our ever-changing hi-technology world it seems like everyone is turning to "smart" technology. From the phone and tablet you carry in your pocket to controlling your home's heating and air conditioning while away on vacation on a tropical beach, smart technology is everywhere. If you have been trying to figure out what smart home technology is and how you can take advantage of it – here are 10 simple ways to enjoy the innovation in your home. Whether you are looking to save energy, time, and money or you just want to become more efficient in your home's day-to-day operations, take a look at these ideas that may transform your home and lifestyle forever.



**Figure-6**  
**From your interiors to the exterior – smart home technology can transform your lifestyle<sup>15</sup>**

**How smart home technology can help your home lifestyle:** Smart technology is a way of connecting your home through innovative technology to control and give homeowners an "on-demand access to various systems throughout your home. From video, data, telephone, wireless, security, climate, lighting and other home lifestyle factors that affect you and your family's daily life. Smart home technology can help your home run more efficiently while also helping family members live in total comfort while at home or away<sup>15</sup>.

**Innovative controls in your kitchen:** Your kitchen has always been “command central” when it comes to cooking, entertaining, enjoying family discussions and more. You will be surprised how smart technology pairs with your favorite appliances, faucets, and cooktop surfaces can be controlled through smart technology. Many homes have their smart tablet or keypad built into the wall in the kitchen to have access of other parts of the home. While many homeowners prefer the on-screen directions of their refrigerator that can access the internet, can play music, or they can watch their favorite cooking television program—right on the screen of their refrigerator<sup>15</sup>.

**Saving energy and controlling safety in the kitchen:** Many homeowners think that smart technology is only for people who want to have a remote control to everything! On the contrary, many smart home technologies actually help keep your family safe while saving you water and energy in the kitchen. Induction cooktops are one of these examples that produce heat that only heats the cookware when the metal comes in contact with the induction cooktop surface. This means a safer kitchen to work in, and less heat being generated for comfort while cooking<sup>15</sup>.

**Smart home convenience wherever you are:** While the kitchen has many amenities for your smart home tastes, all homeowners should assess their lifestyle, to see what amenities would best fit their home and family. If you’d like to control music, lighting, visual entertainment throughout your home, temperature or security systems, you can hire total smart home consultants who can walk you through the benefits of different configurations. While you may think that a smart phone activated security system is overkill, you may reconsider if you have school-aged children that come home from school before you come home from work, or if you travel often. Assess what smart home functions will work best for you<sup>15</sup>.

**Controlling your faucets and bathing experience in a smart bathroom:** There aren’t too many homeowners who don’t love total comfort and relaxation in their bathrooms. Smart home technology is the perfect way to be able to not only control your bathing experience while lounging in the tub, but you can also control your shower’s temperature, spray, steam, audio, and lighting of your shower, all at the touch of a button. If you share your bathroom, why not program each users favorite settings and have your favorite music cued through sound tile speakers? That’s what smart home technology can offer in your bathing routine<sup>15</sup>.

**Water savings made easy with smart home technology:** While enjoying your bathroom is one topic, enjoying the savings on your monthly water bill is another. Instead of dreading your water usage each month, take advantage of smart water fixtures that use less water but have larger water droplets to produce a more luxurious experience? One example are Delta Brizo brand faucets that offers a H2Okinetic® shower heads that sculpt the water into a unique wave pattern, creating the

feeling of more water without using more water. Other faucets can turn on and off automatically by motion and the temperature of the water can be seen by a color LED light indicator before putting your hands under the water. These smart technologies ensure a better and safer user experience and less water wasted – all at once<sup>15</sup>.



**Figure-7**  
**Control your ultimate bathing experience while still saving water<sup>15</sup>**

**Cooling and heating your home the smart way:** Your daily home can use a lot of energy for cooling and heating to keep your family comfortable in all seasons and climates of the world. In order to do this without costing a fortune for fluctuations of outdoor air temperatures, your home can have smart technology that helps you control and monitor your energy usage with thermostats such as the Nest learning thermostat. It “learns” your family’s lifestyle and connected to a Wi-Fi connection enables homeowners to control settings from any internet enabled smart device. Register your email and home location and you will get monthly energy usage reports sent to you directly to see how you compare with other homeowners in your city<sup>15</sup>.

**“Smart” heating and cooling through architecture and design:** Other creative ideas for helping homeowners with heating and cooling doesn’t involve innovative electronics but rather placement of windows and doors and the position of your home can help take advantage of nature’s seasons and temperature changes naturally. A passive house is designed to maximize its ability to heat itself in winter and cool itself in summer. This is designed by careful consideration of a home’s site and how the sun moves across the sky, where the trees and other vegetation are located, where the winter winds come from, etc. This “smart” technology of this Passive House is an example of using the Earth’s resources and adapting our home’s to work with nature<sup>15</sup>.



Figure-8

Passive Homes are built with “smart” architectural design orientation to cool/heat effectively<sup>15</sup>

**Smart innovation on its way into home design:** Many smart home ideas are out in the commercial world but haven't been adapted for residential use, but the reality isn't far into the future. Coffee tables that enable you to control your home, surf the internet, and entertain your guests are already being used in hotels, casinos and hospitality industries. Samsung has the SUR40 Microsoft Pixel Sense that isn't available to consumers yet but enables guests to watch tv, control smart appliances and more. The ideas are vast for how many different areas of your home smart technology will touch in the upcoming years<sup>15</sup>.



Figure-9

Smart technology like this innovative coffee table are in the near future for homeowners<sup>15</sup>

**Automation in every part of your home:** While smart technologies are used for saving energy, water and adding safety, there are other factors that homeowners love, automation. Similar to the science fiction movies that we all fell in love with years ago, today many of those futuristic amenities

have come to life. From automating your interior shades and exterior awnings from your bedroom to controlling your pool temperature, lighting and music before your guests arrive – all at the touch of a finger is mind-blowing. In this new era, smart home technology is fast and ever changing. Try these 10 ideas in your home and see how your lifestyle changes for the better<sup>15</sup>.

## Conclusion

By increasingly development of technology, we continuously witness the advent of new technologies in various fields. Iranian building industrial is not an exception for this rule, and progressively continues to development and optimization in line with the needs of the building inhabitants. One of the relatively modern building technologies is to make buildings intelligent. By applying optimized intelligent systems of energy consumption and using them, energy is always consumed rationally. Thus, utilizing intelligent systems reduce the costs of building maintenance and also increase the utilization and energy saving. Intelligent control systems have a high flexibility that can easily match them with different needs. Building intelligent system, in addition to the role it has in optimizing energy consumption, provides the comfort and welfare, and we can be promising that in today modern and busy life, it can be an appropriate solution to create more convenience and accelerate the routine affairs. In smart homes, other applications such as control, Multimedia, watering plants, feeding pets is also defined.

In addition to their usual contacts in these systems can also improve the quality of life for disabled and elderly people can also help. Smart homes can be found in the following packages are under control: Control the temperature. Control of lighting. Control of natural light (blinds and shutters to open and close automatically). Audio and video systems. Fire Alarm Systems. Systems and security protection. Water plants and animal feed.

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