

# SAVINGS IN THE CONSUMPTION OF ENERGY AND WATER AT HOME USING DOMOTICS SYSTEMS

MATI Orlando Arzola Garza  
Facultad de Ingeniería Mecánica y Eléctrica  
Monclova, Coahuila, 25750, México

y

MAI Alicia Guadalupe Valdez Menchaca  
Facultad de Ingeniería Mecánica y Eléctrica  
Monclova, Coahuila, 25750, México

## Coautores:

Ing. Olga Maricela Preciado Martínez, Ing. Angel Zarate Martinez  
Facultad de Ingeniería Mecánica y Eléctrica  
Monclova, Coahuila, 25750, México

## Student:

Juan José Cepeda de la Rosa  
Estudiante de la Carrera de Ingeniero en Sistemas Computacionales  
Facultad de Ingeniería Mecánica y Eléctrica  
Monclova, Coahuila, 25750, México

## 1. ABSTRACT

For purposes of this project Information Technologies and Automation systems were applied to the home, focused on the improvement of life quality by increasing the levels of commodity, security, and comfort, while ensuring the efficient use of energy and natural resources. This system works under the control of a personal computer; in this way, users do not have to keep on the watch of the diversity of autonomous devices, which have their respective programming and indicators located at different spots.

The system is based on its software. Additionally, the system utilizes a personal computer, a PLC with its respective module, Visual Basic, PHP, and Java Script. A domotics system is formed by a central unit that manages several different peripheral elements destined to perform domestic services.

**Keywords:** demotechnic technology, information technology, efficiency, energy, and natural resources.

**Work Areas:** Computer science and the electric and electronic fields.

## 2. INTRODUCTION

The configuration of home automation systems, also known as domotics systems, is directly related to the transmission procedures of information that allow the dialog among such peripherals and the central unit. For purposes of this project, home automation will be referred to as domotics.

A domotics system can work in an either centralized or decentralized form. For the centralized form, the global functioning of the system depends on the programming that is introduced into the domotics power station. On the other hand, in decentralized systems each element is smart and it programs itself. Thus, the

evidence suggests that the domotics field offers a wide variety of options. Nonetheless, the areas in which most efforts have been put into are those for security purposes, the automation of domestic chores and comfort, and the energy consumption of communication systems.

- The improvement of comfort
- To provide more security
- New forms of communication
- Reduction in costs for energy consumption

Terminals (heating system radiators, appliances, illumination sources, etc.) usually are conventional equipments to which intelligence and communication capabilities have been added through an interface. The field elements comprehend the entire group of sensors that allow the conversion of a physical magnitude into an electric signal and the actuators or command elements that are capable of transforming an electric signal into an action on the physical environment.

All the field elements send and receive signals through a communications network or domotics bus to communicate among themselves and the central unit in charge of managing the interchanges of information. These control signals are codified in a determined form (protocols of communication) and that is the reason why some elements are needed to pass on the bus signals and, at the same time, to pass the bus signals to exit signals and the actuators such as: relays, switches, etc. These elements usually are named differently, for example, input and output modules, couplers, interfaces, etc.

The domotics term comes from the union of the words *domus* (house in Latin) and *tica* (automatic in Greek, which means “it works by itself”). Thus, by domotics it is understood that it is being talked about a group of systems that are capable to automate a home by providing managing services such as control of electric energy consumption, security, comfort, and communication that could be integrated through internal and external communication networks that are either wired or wireless. The control of these services could be programmed to work from either inside or outside the house. In general, domotics could be defined as the integration of technology in the smart design of a home (Wikipedia, 2008).

Absolute convergence means that the telecommunications technology will eventually be present at every home. Recently (Levy 2001), the Newsweek article: “Focus on Technology,” proposed a vision of what future homes will be like. It highlighted a large-ultra-high-definition-flat-screen-TV capable to handle video, Internet, and pictures. The same article further proposed the vision of the use of home appliances such as the refrigerator and the washer machine connected to a network that would provide the user with

the relationship of washing cycles or the food inventory at his will. Finally, the aforementioned vision also included an example of what wireless sound systems and musical instruments would look like in the not too distant future.

Thanks to the evolution of large integration memories, personal computers, and complex application software in the mid nineties, there has been an increment in the use of diverse application systems in several fields of study. The fields of study that have benefited the most are the following: manufacturing, health sciences, and others.

It is important to highlight that the instrumental and control systems had their respective individual loop controls replaced by distributed control systems, which are able to handle the complex systems even of oil plants. On the other hand, this movement was not successful due to the high costs implied by them and the maintenance difficulties required by them, including their limited availability.

Therefore, these situations set the grounds for a new control Microsystems trend specifically made to be used in all industrial processes. As a consequence of this new trend, nonetheless, there arose a monopoly issue among control systems manufacturers whom, although they all were indeed only one manufacturer, created different brands for the existing diversity of instruments and systems. This new trend led to the isolation of the system sub-processes.

The issues listed above generated an additional increase in costs and problems within the industrial field. Thus, it became necessary for the implicated international instrumental associations to work with a standard to ease the interconnection of the systems, all with the aim of coming up with *Open Systems*. All of this gave birth to the “*Fieldbus*” standards in order to ease the physical interconnection and the HART communication protocol. Today, there exists a large number of individual field instruments such as: smart Masoneilan valves (3) and smart Rosemount transmitters (4). These individual field instruments have the option of being monitored and calibrated through the HART communication protocol.

Today’s programmable logic controllers (PLC’s) have been developed with the open system concept, open software, and open communications; and they all are capable to handle the TCP/IP protocols to ease their intercommunication through the Internet. All these technological advancements make possible the interconnection of geographically distant systems in topologies of WAN networks (Cleveland, 2000). Furthermore, these technical achievements facilitate the overseeing of processes, individual instruments, or systems among the company’s headquarters and the applications of any of its branches regardless their location in the world.

### Objective:

The main objective is to use technology to optimize the consumption of energy and natural resources at homes.

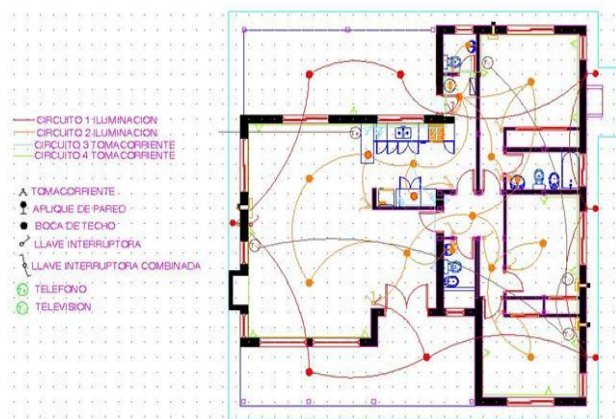
### 3. METHODOLOGY

Due to the obvious need that homes, companies, and public institutions have to reduce their electric energy consumption, water, and other services that require the use of electricity, we realized that the main issue of “high energy consumption that directly affects the costs of operation in the interiors of homes, companies, and institutions,” is primarily the result of the lack of an energy-saving-culture.

### Development

The central ideal of our project is mainly based on a technically feasible economic solution that would help reducing unnecessary expenses in the consumption of energy and natural resources.

The designed model shows simple techniques with a basic design. The first step of the model reviews the entire electrical wiring system and the hydraulic distribution of the home. After the entire electrical wiring diagrams have been identified, it is necessary to proceed to identify the circuits where each switch, contact, and/or valve is energized.



Then, a study about the entire home consumption of water and electrical energy is done so as to select the contacts, switches, and valves that are involved, this with the purpose of implementing the controls that are in need of implementation.

After the study is completed, the hours of consumption of the home are analyzed. Then, the

thresholds to turn on and off the circuits, along with the ones to open and shut the water valves, are defined.

The next step is to install and configure the programmable logic controller within the central area of the power source, where all other electric circuits of the home are distributed at. Then, it is necessary to connect each circuit that is involved in this process to the output card of the programmable logic controller. Finally, the basic parameters of each circuit get configured, which is done prior to the initial analysis.

### *Fragment of the Control Program in the Server*

```
Sin título - Bloc de notas
Archivo Edición Formato Ver Ayuda

Public Function ValorDec(Exp As Integer)
Select Case Exp
Case 0: ValorDec = 1
Case 1: ValorDec = 2
Case Else: ValorDec = 2 ^ Exp
End Select
End Function

Public Sub LeePalabra(DireccionPalabra As String)
Dim word As String
Dim i As Integer
Dim bl_succ As Boolean

word = ""
Set ASABSERIAL1 = New ASABSERIAL
ASABSERIAL1.Adapter = 2
ASABSERIAL1.Errorchecking = 1 'CRC mode.
ASABSERIAL1.CommSettings = "19200,N,8,1" "9600,N,8,1"

ASABSERIAL1.Function = SLC500ReadWord
ASABSERIAL1.MemStart = DireccionPalabra ' "B3:196" ' Starting Address
ASABSERIAL1.Memory = 1 ' Number of 16 bit words

ASABSERIAL1.Refresh2

'MsgBox Asabserial1.ResultString & " " & Asabserial1.Result
wait (1)

If ASABSERIAL1.Result = 0 Then ' Test transaction result.
word = ASABSERIAL1.GetDatawordM(0)
End If

'MsgBox Asabserial1.ResultString & " " & Asabserial1.Result
wait (1)

'Text4.Text = word
Response.write "<br><b><font color='red'>" & word & "</font></b><br>"
Set ASABSERIAL1 = Nothing
Exit Sub
```

The entire system works under the control of a personal computer with a Visual Basic interface that utilizes a serial communication tool of the computer connected to the programmable logic programmer. This takes the need away from users to be keeping on the watch of the diverse autonomous equipments, which have their own programming.

One of the main characteristics of the Domotics System is the capability to relate different elements and obtain a large versatility and variety in the decision making process. It is also quite easy to relate the functioning of the air conditioning system with the operations of other appliances, the automation of windows, etc. It is worthy of mentioning that in the scope of this project we did not utilize sensors, which would make it better; nonetheless, their implementation is feasible. The monitor of the personal computer displays the monitoring station, making it easy for the user to be informed of his home situation. Furthermore, if the user should wish to modify something, he would only have to click on a reduced number of keys.

- PLC RSLogic500 software

*Picture of the cameras that are installed in the home.*



This design could have its scope increased depending on its needs; in other words, it is meant to grow in a modular shape, given that other variables are controlled. Also, users would only need to take a look at the PC's monitor to know the temperatures of inside and outside the home, information of whether or not the AC is connected and when the house's yard was last irrigated, whether or not the ground is humid, etc. Additionally, the same control and overseeing possibilities that are available locally may be obtained through the Internet from another PC anywhere in the world.

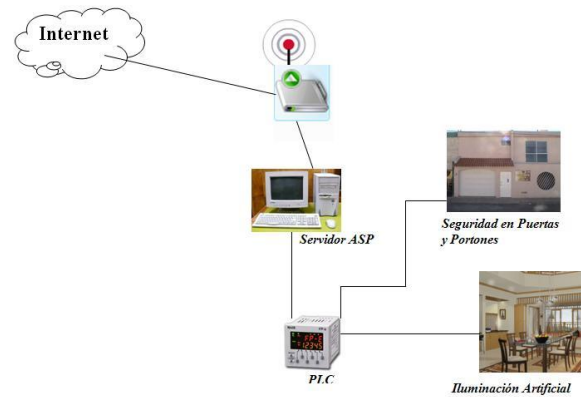
This system could be of great advantage for frequent travelers, for houses destined for weekend use, beach houses, etc. Today's personal computers are very potent, fast, and reliable machines. Therefore, if we connect them to uninterrupted energy sources, forced CPU ventilation, extended-life batteries, automated monitor shutting down systems, etc., we would have an ideal platform for domotics applications capable of working for many years free of hassle and at a reasonable cost.

Upgrading to this system is very simple because it is only necessary to upload new and better versions of the system onto your equipment. The entire logic of the working process of the system is based on the software and not on the equipments that are already installed. Thus, any already existing installation could benefit from newer versions of this system without too much difficulty.

**Requirements:**

- A PC
- PLC RSLogic500
- A rack for port modules
- 1 module of 16 port
- Connection to the Internet
- Visual Basic 6.0
- Visual Basic a-b serial

**General Diagram**



**4. RESULTS:**

After the prototype was installed, we observed that the savings in energy consumption were significant, up to 30%, which helped get value for the investment very easily with the savings of the very first year.

The system allows controlling the turning off and on scheduling of any appliance, AC, or lamp that is connected to any of the existing electric circuits.

All savings are directly related to the level of control we want to configure them to be, which allows avoiding the misuse of energy and resources of our home.

**5. CONCLUSIONS**

This project is primarily oriented to the saving of energy and resources by using Information Technology.

Large, medium, and smaller organizations, even homes, could use this prototype. This investment pays itself off within a reasonable amount of time. The potential savings are those related to energy consumption, private security, and maintenance personnel.

Our results suggest that the scope of the convergence of the computer and communication systems predicted by Saito (1997) has already been exceeded because our results indicate that not only those two systems can converge, but that all the Information Technologies, automation and control systems, and basically every system used for daily life can indeed converge and be integrated to the Internet.

The determining factors for the technological development dynamic increase very rapidly. The

individual and social impacts augment in a way that, at least within two decades, life styles do change dramatically. What is next, though, is to determine how human beings, their organizations, and society in general will react to these changes. Furthermore, it is also imperative to come with practical ways help society to get adapted to these changes and the preservation of our environment.

## 6. SUPPORT

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