

Study and Comparison of Technologies in Home And Building Electronic Systems by Fuzzy Logic

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Abstract. Nowadays, there exist in market many systems of automation, energy management and security for housings and buildings (domotics systems). In many occasions the engineer find difficult to decide what system to choose due to the multiple factors that have to be taken into account in the decision. This work considers the most outstanding factors for the decision taking, which constitutes the input variables of a Fuzzy model developed in order to help in that decision, where the output variables measure the grade of adaptation of the system to the home. A high number of rules are defined to develop the inference and to generate the appropriate output values. The proposed model is developed with the Fuzzy Logic Toolbox of MATLAB, and is evaluated on ten different cases, which are presented in order to show the methodology, the behaviour of the model and the results.

Key words

Home automation, fuzzy logic, electrical engineering code

1. Introduction

In general, automation, energy technical management, and security in housings and buildings system

installations are known as domotics (word that derives from Domus –house in Latin– and Robotics), in the case of individual housings such as typical houses, or inmotoc in case that the installation refers to buildings (we will refer both as domotics for simplicity).

Last February of 2007 the Spanish Government, by its Ministry of Industry, Tourism and Commerce has published inside the Technical Guide of Application of the Spanish Electrical Engineering Code of Low tension (REBT from its Spanish name “Reglamento electrotécnico de Baja Tensión”) the document GUIDE-BT-51: "Installations of automation, energy technical management, and security in housings and buildings " in which the nets that compose the installation of a housing or building are defined. The following nets can be distinguished (Figure 1):

- Net of Information technologies.
- Television Net
- Phone Net
- Domotics control Net (integrated inside the electrical net).

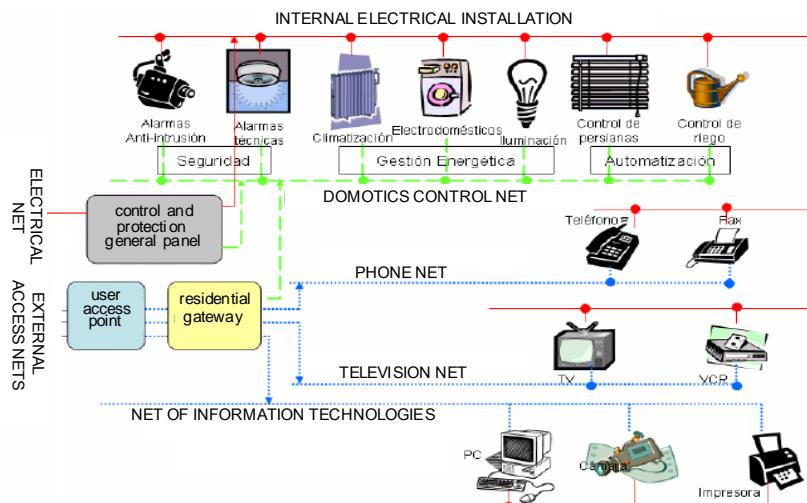


Fig. 1. Nets that compose the installation of a housing or building.

The domotics net is regulated by the REBT in its Instruction Technique-51 (IT-51), dealing with electrical security and electromagnetic compatibility control; it should be integrated within the electrical power net and coordinated with the rest of the nets with which it is related. The mentioned net can be implemented by means of specific wire or through carrier waves coupled to the electric net.

2. Fuzzy model and methodology

Diverse solutions exist in market for the development of domotics installations by using any of the tree different architectures presented: centralized, decentralized, and semi-decentralized.

A study and comparative of the different types of existent solutions in market have been developed in order to help to decide which is the most appropriate solution in each case, depending on the characteristics of the domotics installation to design and on the recommendations of the REBT-IT-51.

The methodology used to carry out the comparative of systems is based on fuzzy logic. A fuzzy model has been designed, validated, and employed, using MATLAB and its Fuzzy Logic Toolbox.

The work also includes the study and analysis of the most outstanding factors for the decision of the most suitable installation and its characteristics. As factors for the decision taking the following ones (Table 1) have been considered for buildings and semidetached houses; the input factors considered for houses are very similar (Table 2).

For every input variable a domain is defined, as well as the associate membership function. As output variables the following ones (Table 3) are considered in both cases (buildings and houses). In the same way the output variables are defined, with three triangular functions named “non-advised”, “advised”, and “highly advised”.

Table 1. Factors considered for the choice of the most suitable domotics installation in buildings and semidetached houses

number of housings
number of rooms per housing
building age
number of functionalities
number of external measures
estimated cost per housing
design and planning time
implementation and start-up time
extension possibility
maintenance
user age
supervision
external control of the installation

Table 2. Factors considered for the choice of the most suitable domotics installation in houses

number of buildings
number of rooms per building
building age
number of functionalities
number of external measures
estimated cost of the building
design and planning time
implementation and start-up time
extension possibility
maintenance
user age
supervision
external control of the installation

Table 3. Output variables of the fuzzy application

bus system
carrier current system
centralized system
decentralized system
mixed system
preprogramable system
SMS
telephone
Internet
touchscreen
PC

The developed fuzzy model has been evaluated by applying it on 10 different significant cases, and checking that the results agree with the results obtained after a detailed analysis without the use of the application. The selected 10 cases are: a.- Semidetached b.- Small building c.- Medium building d.- Big building e.- Rural house f.- Hotel in a city g.- Office building h.- Museum i.- Shopping centre j.- Temple or church

3. Conclusions

A fuzzy model has been developed in order to allow deciding and quantifying the best system to use in a domotics or inmotics installation. The model has been developed and validated with the Matlab fuzzy logic toolbox, and has been tested with 10 significant cases based on different types of buildings and housings, obtaining the expected results. We are working in order to improve the factors to considered as input, as well as the inference rules, which constitute the “intelligence” in the calculation of the output variable values, the results.

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