Abstract

Expert system for the diagnosis of pathologies in structural elements.

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This work starts from the growing demand of expert inspectors, who are dedicated to the pathology diagnosis in buildings. There are many causes that can explain this growing need. One on these is the recently rise of buildings’ construction. Another cause is the rising demand of quality required by the buildings’ users. Moreover, there is a bigger concern for the security of the buildings, deeply rooted in the society.

The main aim of this work is to evaluate the viability and the real possibilities about the development of software which would be dedicated to help in diagnosis of the buildings’ pathologies. In order to support the conclusions related with this objective (and that are extracted and presented in this document), it’s decided to develop a little expert system, for demonstration purposes.

First of all, to achieve this expert system, it’s necessary to do a collection of information about the most important affectations of the buildings. More particularly, this dissertation is focused to the pathologies that affect structural elements or are directly caused by the wrong behaviour of the structural elements. It should be said that the sort of structures used in the development are the most used nowadays. So, most of the pathologies considered here are those who affect building’s structures of concrete and masonry (it is located in the building’s partitions and facades). However, the developed program allows the diagnosis of other kinds of building’s structures, although they aren’t as usual, so they aren’t studied in depth.

The pathologies that have been considered are explained and classified according to the affected material. So, the pathologies of the concrete’s elements, and the pathologies associated with the masonry, are those that have been taken into account, essentially.

At another level, with a more superficial treatment, the pathologies that affect the metallic elements and wood elements have been considered.

After, there is a presentation of the expert systems which are a programming method. The expert systems belong to the artificial intelligence applications’ group, and they are studied since 1960’s decade. However its use hasn’t reached to the building activities’ area yet. For this reason, this work tries to open a way to introduce this programming method in this economic field.

There is an analysis of its different components and an explanation about the way of working of the expert system. Ending the presentation of this kind of software, there are three important topics to be studied: the knowledge representation, the inference method, and the uncertainty treatment.

For the developed expert system, the knowledge representation is made through objects and values. These objects are related among them with the use of production rules. Inference uses backward chaining, and the uncertainty is represented with two levels of confidence with the final results. This way, it’s possible to do without the numerical methods.

Moreover of justifying the knowledge’s codification that is used, also the method that has been followed for the expert system’s development is explained. This procedure goes from the delimitation of the problem to solve, to the implementation of the software. The choice of the adequate development tool is a very important step in this procedure. This tool should adapt to the programming necessities. After to compare many possibilities, Acquire is selected, due to it contains all the functions that are required for this work, also it is a simple program and it’s specially suitable to develop little expert systems.

To establish how to codify the information is another important step to develop an expert system. This codification should be suitable to the Acquire’s tools and its capacities. In short, it can be said that it has been opted to introduce the knowledge using three types of objects: input objects, auxiliary objects, and conclusion objects. The auxiliary objects give internal organization to the expert system, and make it more rigid. This rigidity reduces the program inference’s freedom, but allows show a more transparent software to the user. The information’s codification is summarized in the first annex. There are the symptoms that characterize each pathology which can be diagnosed by the program.

Test the program is one of the lasts steps in the development procedure. These tests are detailed at the end of the work. The most tests have given positive results, although these results must be studied carefully, and the considerations made about the expert system running must be considered.

So, when the program has been plenty developed, there are presented his general characteristics: it can diagnose more than 200 pathologies using approximately 900 objects, and the application of more than 1200 rules. Moreover, the aspects that can be improved to obtain a more efficient program oriented to commercial use are detailed at the end of the work.