VI-104 AN APPROACH TO EXPERT SYSTEM ON CONCRETE STRUCTURE

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Terminology

Deep knowledge. This is knowledge based on established causal knowledge, theory or models rather than empirical relationships or Heuristic.
Domain. Is properly a set of problems that the system can solve rather than an area of knowledge in itself. This distinction is important in understanding what an expert system is supposed to be able to achieve, and is one reason why the term 'knowledge based system' is more useful than 'expert system', which implies general competence.
Heuristic or 'shallow' knowledge. Is empirical knowledge, often an informal shortcut through a number of casual relationships or a summary of engineering judgement without formal or theoretical justification. The best representation of a heuristic is a production rule.
Inference engine. The inference engine is a program designed to utilize the knowledge to reach the desired objective.
Knowledge base. Contains a collection of knowledge pertinent to a particular domain or sub-domain.
Production rule. This is the most common knowledge representation method. A rule of the form IF <pre-condition> THEN <post-condition> can be easily understood and made to fulfil most basic requirements.
Shell. Comprise the usual expert system components (inference engine, knowledge representations, knowledge base editors and user interface facilities), but with no actual knowledge.
User Interface. Use by the inference engine to gather the required data from the user, to present the results and to justify its conclusions.

Expert System

An expert system is a computerized advisory program that attempts to imitate or substitute the reasoning process and knowledge of experts in solving specific type of problems. More precisely, it solves real-world problems requiring an expert's interpretation, employs heuristic knowledge and/or qualitative models of the problem domain, and in this way, draw conclusions emulating the performance of human experts.
In short, an expert system is a computer program competent in an area that would normally be though to require some degree of human expertise. expert system comprise a number of distinct components that distinguish them from other types of program, usually identified as the knowledge base, the inference engine and the user interface.
Human experts are scare and expensive. Once an expert system has been created it is, to some extent, an insurance against the loss of unusual and expensive expertise, and may also be an effective form of dissemination of expertise: transferring expertise from some expert(s) to a computer and then on to other human nonexpert.

Components and characteristics

The basic components of the expert system using the production system, that is the 'if-then' rules are:
- knowledge base for a particular problem domain, used by the system in forms of rules, long term historical information, and facts.

- context which contains all the information describing the problem.
- inference engine to propagate inferences over the knowledge.
- user interface for problem-oriented communications between the user and computer.

Features characteristics of an expert system, which make a distinction over any other kinds of programs are:

-the initiative is always with the system -the system ask for data, performs all the reasoning steps, asks for more information, and in the end comes up with a solution.

-the knowledge base of an expert system contains facts, procedural knowledge, heuristic, and others (e.g. judgement, casual knowledge)

-expert system can use knowledge from authentic sources (human experts) as well as reconstructed sources.

Knowledge acquisition

Knowledge acquisition is the general name given to the process of eliciting, acquiring, and representing knowledge consisting of descriptions, relationships, and procedures in a specialized domain of interest.

Since expert system uses the knowledge to reach conclusions and emulate the performance of human experts, knowledge acquisition is the key point in building a successful expert system source of knowledge: (1) published materials (e.g. textbooks, technical reports, specifications, etc) (2) expert's experience; and (3) field case records.

In the process of knowledge acquisition, first it is define the task domain of the system. For the present purpose, the problem has been limited to diagnosis of concrete bridges.

The second step is the review of published material about the domain. In this case, ACI publications.

The recommended following steps are as follows:

3. Determine the knowledge representation model, (i.e, rule based/case based).
4. Get the causes (hypotheses) and symptoms (evidence) about the domain.
5. Construct the deterministic (nonfuzzy) rules by interview with experts.
6. Define the definition domain of fuzzy truth values of causes and symptoms.
7. Construct the fuzzy rules by interview with experts. Expand the deterministic rules (step 5) to fuzzy rules, that is fuzzy relation matrices and fuzzy weight factors will be evaluated for each deterministic rule.
8. Construct the case base. Collect case data from field records and case study, and construct their similarity relation matrices and important factors.
9. Build a prototype system.
10. Test, analyze, expand and redesign this system.

Present choice

From the problem areas addressed by expert system, which include interpretation, prediction, diagnosis, design, planning, and so on, diagnosis was chosen.

A diagnostic expert system can provide advise in the form "what is wrong with the structure" and can be extended to provide "how to fix" recommendations. For these systems the knowledge base contains all hypotheses. For each of the possible diagnosis hypotheses, the knowledge base contain all relevant prescriptions appropriate for that hypothesis. And the inference strategies appropriate to the task are well known, that is, the use of forward chaining if there are a few symptoms and many possible hypotheses; or the use of backward chaining if is the opposite case.

One of the limitation in expert system is that it works on the basis of the current contents of its knowledge base, that is, the system is static.

Since the system is still in its implementation stage, modifications may be introduced.