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Research Paper

Rule Based Expert system for the selection of a Bridge site

ENGINEERING

KEYWORDS : Expert, heuristic, Rule base, Certainty factors

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ABSTRACT

This paper describes a rule based expert system for the selection of a bridge site for river crossing bridges among alternative proposed sites. An Expert System is an intelligent interactive program which should emulate an expert and provide an advice that requires vast experience in a particular domain. To develop a fully efficient expert system an attempt is made to include the heuristic, qualitative, quantitative knowledge and the knowledge gain from the experts in this domain, in the knowledge base. In this study the knowledge in the knowledge base is represented using production rules and provides the mechanism of forward chaining. The uncertainty in the selection of a best site is handled using Stanford model of Certainty factors

Introduction

Artificial Intelligence is a branch of computer science, which includes programming the computer systems to create a simulation in the processes of problem solving. It involves building computational techniques for executing tasks that initially require intelligence when performed by humans.

Before a bridge can be built, the first step is the selection of the site. The selection of site for a bridge is usually governed by engineering, economic, social and aesthetic considerations. The existing roadway or railway alignments may also govern the bridge site to be selected in which case the choice is very limited .On the other hand, in the case of a new alignment, the consideration of providing maximum commercial and social benefits is also not to be ignored. For river crossing bridges in rural areas, usually a wider choice may be available. To the extent possible, it is desirable to align the bridge at a square crossing and sometimes, a skew crossing has to be provided in order to avoid costly land acquisition or sharp curves on the approaches. In selecting a site, care should be taken to investigate a number of probable alternative sites and then decide on the site which is likely to serve the needs of the bridge at the least cost.

The present rule based expert system is developed with an intention to select the best site among alternative sites which

intern explains the reason behind the selection, like an expert in this domain. The behavior of the expert system completely depends on the knowledge in the knowledge base of an Expert System (ES).

In order to build an efficient ES the knowledge in the knowledge base is created using production rules. All types of Knowledge required for the selection of bridge site is included in the knowledge base of the expert system. The uncertainty caused behind each rules is handled by Stanford model of Certainty Factors.

FEATURES OF GCLisp

Golden Common List Processing (GCLisp) is an extremely attractive programming language. GCLisp provides tools which are straight-forward and powerful. When a program causes an unexpected error, the listener drops into a debugger environment. In the debugging environment, the stack can be examined frame-by-frame, lexical variables can be inspected, and normal LISP forms can be evaluated. It also has the option of viewing stack information in brief, moderate, or deep levels of detail. The error handling and debugging facilities provided by the programming languages will significantly affect the speed with which an application can be developed. GCLisp however opens a window that provides the programmer with a description of the problem and where it occurred.

eg: "UNBOUND VARIABLE "A" or "UNDEFINED FUNCTION "A".

GCLisp provides similar feedback. This is extremely helpful for debugging applications. GCLisp provide a function tracing and backtracing facilities. GCLisp, in addition, provides a STEP function. This allows tracing by single steps through the execution of a function. At each level, the STEP function dynamically displays the bindings of variables and returned functions. This has proven to be the single most powerful debugging tool in any of these LISP environments.

Some important functions of GCLisp used in the present research are presented below;

1) Atoms and lists
2) Procedure name
3) Predicates
4) Combining predicates
5) List constructors
6) List selectors
7) Simple sequencing
8) Conditional primitives
9) Making little procedures
10) Printing using FORMAT

SYSTEM DESCRIPTION

The basic architecture of the expert system is mainly composed of user interface, knowledge base, inference engine, knowledge acquisition facility and working memory. All these components are developed to suit the overall present as well as future requirements to select the best bridge site.

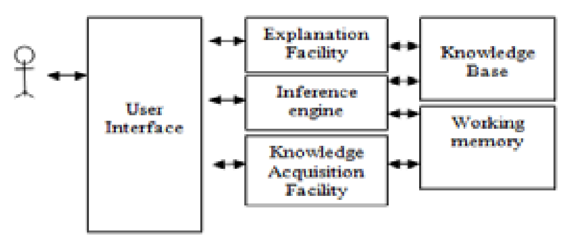

Figure 1. Architecture of Expert System

Knowledge Acquisition

Knowledge acquisition is a method of learning. The mind is like a blank slate at birth. It doesn't contains any knowledge neither the objective, nor empirical universe, or of itself. Therefore, a human mind after acquiring knowledge becomes a knowing subject. A knowledge acquisition facility is an optional component of an expert system. This facility of the expert system updates knowledge about the

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problem domain arising out of improvements in the overall knowledge, research, modifications of codes, etc.

knowledge base

Knowledge in the knowledge base is represented as production rules. These rules are developed using conditional primitives, access procedures, predicates, sequencing and other functions of GCLisp. Production rule is quite powerful for representing all types of knowledge including heuristic as well as control knowledge.

A bridge can be constructed over all the sites under investigation using modern sophisticated structural engineering techniques. However in some sites, this may lead to loss of economy in construction and maintenance, and may have serious problem to bridge users. Care should be taken to investigate a number of probable alternative sites and then decide on the site which is likely to serve the needs of the bridge at the least cost.

As the entire set of proposed sites can be used to construct the bridge, the measure of belief and disbelief of all the sites to be investigated are initially set at the same value of 0.01. The measure of belief and disbelief of a factor on the choice of a bridge site is also taken 0.01. The value of MB and MD continuously increases with the measure of belief and disbelief considering the influence of different factors elicited during interaction with the user.

USER INTERFACE

The user interface of an application is the important factor in system development. The input to the expert system is in the form of friendly interaction with the user. The expert system interacts to elicit detailed information of all the alternative sites proposed in the survey work to recommend one among them as the best bridge site.

The expert system interacts to elicit detailed information of all the alternate sites proposed in the survey work . Hence the expert system asks the user to mention the number of sites to be investigated; which may be more than one. The expert system first queries the user for the site number 1, regarding detailed information about all the factors related to social and economic survey, technical survey and topographical survey. The help may be activated and displayed automatically during user interaction or by demand or as a result of a wrong response by the user for a query. All question scenarios are provided with facilities check to the correctness of the response by the user .The systems are provided with necessary programs to repeat the question under consideration with a clear warning about the mistake, if the response is wrong .The system proceeds to the next part of a question scenario only after successful interaction in respect of the question under consideration. All the necessary information required for the decision making is collected in the user interface.

INFERENCE INGINE

The data collected during interaction with the user are collected dynamically in the working memory. The inference engine in the present study works on the principle of forward chaining, where the data in the working memory are made to match with the conditions in the antecedent part(s) of the rules. The consequent part(s) of the rules is provided with procedure to evaluate the measures of belief (MB) and disbelief (MD) of normal as well as uncertain factors on the choice of bridge site. After successful evaluation of measures of belief and disbelief of all the bridge sites, which qualify using data in the working memory, the certainty factors (CF) for all the bridge sites are calculated using Stanford Model of Certainty Factors.

The system lists the selected sites in the order of their Certainty Factors, as soon as the system completes the evaluation of measures of belief and disbelief for all the factors. Also it list the site(s) which cannot be considered for the selection.

WORKING MEMORY

Working memory is also sometimes called context, is nothing but a workspace for a problem generated by the inference engine, from the information provided by the user. Many hypothesis and facts are established during the reasoning process. These are stored in the working memory. The information available in the working memory is used for continuing with the inference process using the knowledge contained in the knowledge base. Working memory automatically created in GCLISP, as and when the program is loaded using the LOAD, commands of the language.

The expert systems of the present work has separate files for storing knowledge, and the knowledge can be easily updated through interaction using the facility of help and explanations.

CONCLUSION

In the present study an expert system for the selection of best bridge site has been developed using AI language as GCLISP. The different types of knowledge required for selection of a bridge site have been incorporated in the knowledge base. The present Rule Based ES ,

- Recommends the list of bridge site(s) in the order of preference based on certainty factors.
- It also suggests the site not suitable for the construction of bridge.

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