

Abstract

Expert systems technology derives from the research discipline of Artificial Intelligence in Computer Science. This involves handling tasks such as diagnosis of malfunctions, interpreting data and structural analysis over a selected domain. Most expert systems are based on structured or formal domains where knowledge is well defined.

However, there are many domains in the real world that contain of tacit knowledge. Tacit domains are subjective and cause problems in knowledge modelling. The difficulty of tacit knowledge modelling is that it presents problems in knowledge classification and further analysis of its classification. In this context, research into incorporation of tacit knowledge within expert systems is of great importance. This thesis was undertaken with the aim of designing and developing an approach to modelling tacit knowledge for expert systems. It proposes an approach for bringing tacit knowledge into expert systems, a procedure of modelling tacit knowledge and how to evaluate the model using a real world application.

As a case study of modelling tacit knowledge for expert systems we have used the classification of humeral constitutions in Ayurvedic medicine as a case study. According to Ayurvedic medicine, recognition of constitution type is an important component in medicine for diagnosis of diseases.

The model proposed in this thesis utilises of a statistical technique and artificial intelligence techniques. The artificial intelligence consists of two interdependent modules namely, fuzzy logic and expert system. Principal components analysis has been considered for a statistical technique, which is used as pre-processing for designing the tacit knowledge modelling mechanism.

The postulated framework for tacit knowledge was used to emulate the expert system domains with tacit knowledge. In doing so, three hypotheses were formulated namely, *tacit knowledge of experts can be acquired via questionnaire and informal interviews, statistical techniques of principal component analysis (PCA) can be used to identify preliminary dependencies in acquired tacit knowledge and fuzzy logic with PCA as the input can be used for developing a model for modelling of tacit knowledge*. The first hypothesis was tested by constructing a questionnaire using the tacit knowledge of an expert. A system, facilitating the tacit knowledge modelling in expert systems was designed to test the other hypotheses.

The system developed for testing the hypotheses emulated a domain expert where tacit knowledge is involved in classification and reasoning. The question/answer scenario of the expert system was developed incorporating the tacit knowledge modelling mechanism. The system consisted of two modes namely, developer and general user. The developer mode facilitates for a knowledge engineer the modelling of a selected tacit domain where knowledge has been acquired from the

domain expert. In this process, questions acquired from a domain expert were considered as inputs for the system and modelled tacit knowledge as the output of the system. The general user mode acts as a facilitator for a user, based on an already modelled tacit domain. In this process, answers to a questionnaire were considered as inputs to the system and classification and reasoning as outputs of the system.

The thesis describes a tacit knowledge modelling mechanism that was introduced to the system. The mechanism was directly integrated with the *inference engine*, *user interface* and the *knowledge base* of an expert system. The principal component analyser was used for reducing dependencies directly integrated with the *user interface*, whereas the fuzzy logic module was used for knowledge classification in terms of fine-tuning directly integrated with the *inference engine*. The *knowledge base* was used to represent domain knowledge in terms of fuzzy rules. Further, dynamic rules update mode, which was directly integrated with *knowledge base*, allowed the user to add rules at run time.

The evaluation of the expert system for domains with tacit knowledge was enabled by comparison of the system with a human expert. A system emulating an Ayurvedic expert was developed in this regard as a case study. The system was evaluated using a group of laymen and an Ayurvedic expert. Each layman was allowed to interact with the system and an Ayurvedic expert alternatively, followed by filling in a questionnaire. The conclusions drawn by analysing the

questionnaire responses supported our aim to develop a model for expert systems for domains with tacit knowledge. It has been examined if the system was capable of exploring the effects of tacit knowledge modelling, with the conclusion that it matched expert to system to the extent of seventy seven percent. Thereby we can express as seventy seven percent, the success of the work on the basis of the evaluation. Further, it showed a novel approach to knowledge classification, which is considered to provide an objective assessment. The Reasoning process used enables one to enhance the modelling of tacit knowledge. Ultimately it is concluded as a success by achieving the aim and objectives of the thesis.