

# Using Formal Concept Analysis to Leverage Ontology-Based Foot Acu-Point Massage Knowledge System

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**Abstract.** The main purpose of this paper is to show the use of FCA to support the building of ontology-based Traditional Chinese Acu-Point with foot massage serving as an example. This knowledge-sharing platform may make expert's foot massage knowledge clearer, may connect with average people, and may provide patients with an opportunity to participate in and become knowledgeable of the whole prescription for his/her illness.

**Keywords:** Ontology, Formal Concept Analysis, Foot Massage, Information Retrieve.

## 1 Introduction

Given the striking progress of web service technology associated with the continuing rapid growth in knowledge management [7], it is imperative that we reduce the knowledge gap which exists between the patient and physician by using the medical knowledge sharing platform and by retrieving self symptoms, and as well as, through patients' themselves spontaneously learning medical knowledge. This may improve the interactive condition through the process of interrogation enquiry.

How to make information retrieval mechanism- friendly is always an important issue for system building and the creation of a User-Interface field. However, the way we use it to retrieve the information is still rife with problems [2]:

- User has to figure out the exact subject and keywords he/she would like to retrieve.
- The scope of retrieving is limited the same concepts but expressed by difference semantics are hard to find out with keyword searching.
- The accuracy of the retrieval results are difficult to establish.

How should information retrieval (IR) be set to more closely compare with the users' mindset in order to help the retriever more easily find the knowledge and to execute the function included in the system. The main objective of this study is to adopt formal concept analysis (FCA) to effectively break the restriction of IR, and to exploit the intention of the document by building a support structure and inter-document relationship automatically.

## **2.1 Using Ontology in Knowledge Retrieval**

Ontology applied to knowledge retrieval definitely changes the strategy from a pull style to a push style [2]. Formerly the retriever inserted a certain keyword for looking up the information in the system, which is a kind of pull style of knowledge retrieval; at present, ontology concepts which provide the vocabulary for expressing personal interest profiles for information push service automatically deliver knowledge and information for the categories a user is interested in [1][8].

This study uses Formal Concept Analysis, FCA, as the mathematical principle to bring the benefits of FCA to a menu and folder hierarchy structure under an "user-unconscious" state. Because of the preceding, we can construct the menu settings more logically, and place the relative documents and knowledge so that all the information about foot acu-point massage is in the correct logical locations in the system.

## **2.2 Formal Concept Analysis**

Formal concept analysis was originally developed as a field of applied mathematics based on the mathematization of concept and concept hierarchy, but after more than a decade of development, it has been applied in many quite different realms such as psychology, sociology, anthropology, medicine, biology, linguistics, computer sciences, math etc. From the philosophical point of view, a concept is a unit of thought, and is an idea for reinvigorating connections to our general culture by interpreting the theory as concretely as possible [6].

With the FCA advantage of the main ideas being quickly understood by formal lattices, linguists often characterize datasets by using distinct features, such as semantic components, phonemes or syntactical; or the terms of schema [9], linguistic applications often involve the identification and analysis of features, which were responded to by the participants, which explains the extraction schema from the interview of adopting new information technology more easily, therefore, the reason this study adopts formal concepts of FAC as an automatic technique to elicit the attributes of dependency schemas extracted from the documents and foot acu-point massage references.

### 3 Implementation the FACMKS

In this section, we will introduce the Foot Acu-Point Massage Knowledge System, FACMKS, in more detail, by following three principle steps. While put foot acu-point massage in practice of IR, usually involves the three steps listed below: (1)extracting a set of index terms that describe each collected document [5], (2)relating the document-terms generated from the step before with each other by concept lattice (3)visualization of the concept lattice constructed by step (2) to a structure diagram [4]. The outcome of each step may profoundly affect the overall effect of the application [2].

Such as, like how to organize queries about domain knowledge related articles or to understand the principles introducing system retrieval as constructed by the integrated software tool, Protégé. As we mentioned in the previous section, ontology could be seen as defining the set of concepts and the relationships between the concepts; such relationships facilitate knowledge-acquisition tools designed to be domain-specific, which allows domain experts to easily and naturally embed their knowledge of the zone. The resulting knowledge base can then be used as a problem-solving method to answer questions and to solve problems regarding the key point, according to the features of this study, Protégé [9]. This application is the end product which is created when the knowledge base is used in solving an end-user problem employing appropriate problem-solving, expert-system, or decision-support methods. Moreover, there are four strong points which can be achieved by Protégé,

- The modeling of an ontology of classes describing a particular subject
- The creation of a knowledge-acquisition tool for collecting knowledge
- The entering of specific instances of data and creation of a knowledge base, and
- The execution of applications. These characteristics being concluded are the reason we adopt Protégé to construct the framework of Search Data Management subsystem (SDM).

SDM is the core of the TCM knowledge retrieval platform for the building of foot acu-point massage ontology by Protégé for SDM; this design makes SDM have the capability for handing ambiguous information queries from the different users.

The functions of searching for specific news and for searching foot acu-point massage knowledge are providing users with a retrieving mechanism. By inserting the keyword that the user is interested in, the system will return the relative foot acu-point massage news report, article or documents.

#### 3.1 Extracting a Set of Index Terms

There are many techniques that could improve the effect of a retrieval knowledgebase that we have discussed, but the knowledge itself always plays a major role in the knowledge system. It would be useless, if there were nothing in the knowledge sharing

platform, in the event of the latest technology being adopted. Emphasizing the source of knowledge itself is always the best policy for information retrieval system building.

With the Protégé application being developed for the creation of the ontology based system, in this step, we centre on creating the slots for each information item such as documents, clinical experience etc., with these slots also known as roles in description logics and relations in FCA construction and other object oriented notions. It also in some other formalism is called 'attributes'.

This study using foot acu-point massage related domain knowledge from literature, documents, CD etc., and creating foot massage, Foot massage ontology by the integrated software Protégé, the process of setup interfaces are as the lower diagram represents. For instance, Traditional Chinese foot acu-point argues that there are twenty four reflexology zones in human feet [5], Foot reflexology is "pressure therapy" and involves applying focused pressure to certain known reflex points located in the foot to cure or prevent disease, these section are adrenal gland, arm, bladder, brain, chest (lung), colon, diaphragm, ear, elbow, eyes, face, fallopian tubes, etc. as following figure shows.

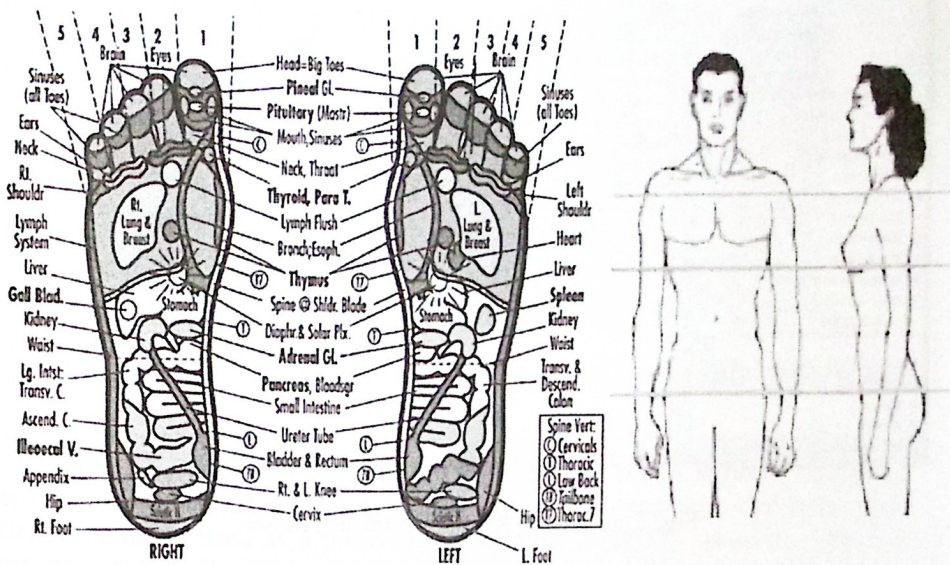


Fig. 1. Foot reflexologies mapping to different part of human body.

Foot reflexology is based on the premise that our nerve zones or reflex points go from the bottom of our feet to the top of our head, encompassing all vital organs on the way. A trained reflexologist can put pressure on different meridians or energy lines on the sole and side of the feet to determine the cause of illness.

After identifying those reflexologies knowledge in foot massage domain, we set reflexology as kind of a super-class and then locate the detail region which can be treated as a sub-class of the super-class. Chinese foot massage says that foot reflexology is based on the premise that human nerve zones or reflex points go from the

bottom of our feet to the top of our head, encompassing all vital organs on the way, and focused pressure to certain known reflex points located in the foot can cure or prevent disease, therefore, when the study build up the foot acu-point massage ontology, we also set curative illness effect as a super-class, too. The Study adopted the integrated software tool -- Protégé to model of foot acu-point massage ontology of classes describing a particular subject, as following figure two shows is the interface of protégé software.

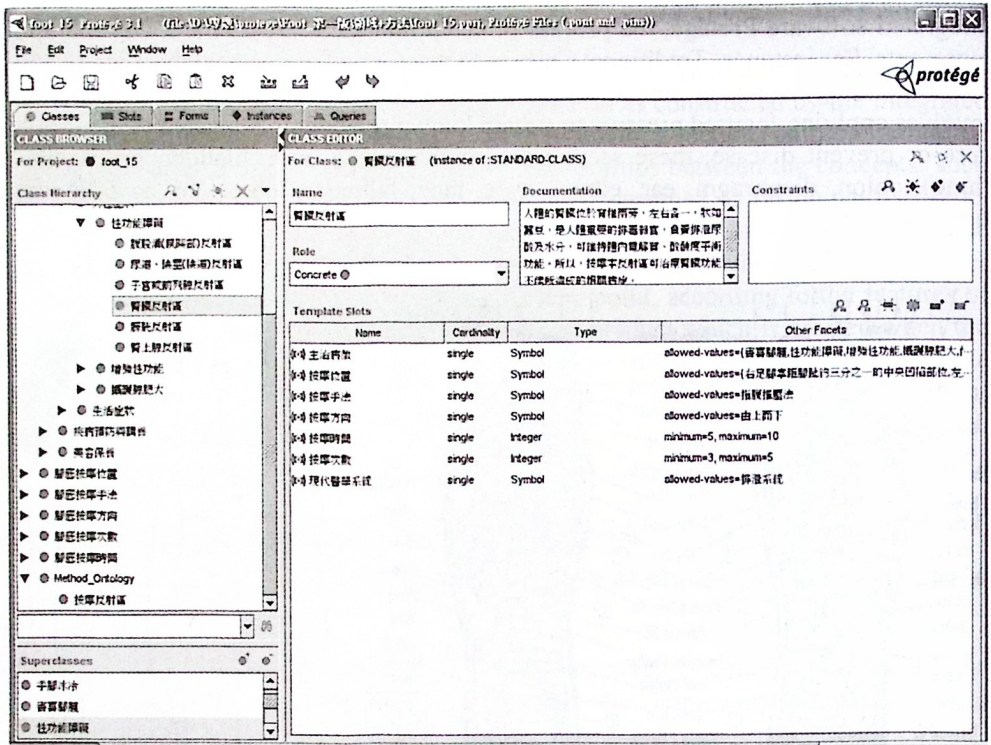


Fig. 2. Interface of Protégé constructing classes

As we reach the lowest level, where the scope narrows and becomes more specific, we find the class where the slots for foot acu-point massage are set. Slots are roles in description logics, and relations in FCA construction. Some FCA research label attributes as slots, which is the characteristic part of an object. For example, the kidney reflexology zone is described in terms of seven slots, which are massage techniques, curative illness effect, massage direction, position of reflexology zone, massage therapy, massage frequency and medical system. Different reflexologies may bring out a different nature and may be provided with different characteristics, such as massage different reflexology zones curing for different kinds of illness, or sometimes, massage certain reflexology zones could relax or reduce the painful of the illness, of course with the different massage frequency and techniques, these feature are be described in the

slot of the class. And massage techniques can also separated as stroking, rotation, pivoting, kneading and finger walking five sub-classes, the different part are displayed in Figure three and four.

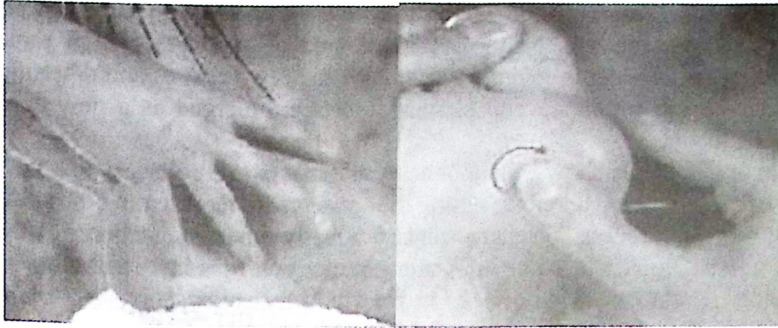


Fig. 3. Stroking technique and pivoting technique.

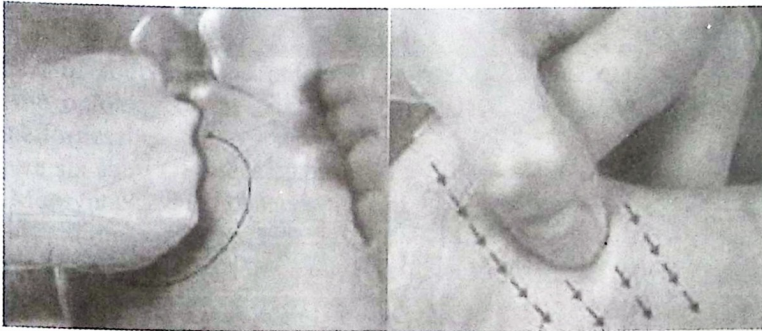


Fig. 4. Kneading technique and finger walking technique.

The slot curative illness effect, indicates results caused by massaging certain acu-points on foot and being able to treat all the different parts of the body through the feet, due to the fact that reflexology zones to all these different part exit in the feet, reflexology offers itself as a potential treatment for nearly all disorders. The slot massage therapy frequency represents how often and how much time should be spent to accomplish each round of massage therapy. The slot massage direction of massage specifies the direction for applying pressure. The slot massage technique, is the style of massage specifying the manner in which a massage therapist treats a patient, such as stroking, rotation, pivoting, kneading and finger walking which are mentioned before. Every foot reflex acu-point zone is a setup slot in Protégé for modeling ontology structure. Reflex acu-point zone is described by different slots in every aspect. Furthermore, building the relationship and constructing concept lattices must be based on these slots which belong to each reflex acu-point zone, as in the following steps.

### 3.2 Concept lattice Construction

Ontology describes the concepts in certain domains, and the relationship that exists between those concepts. In this section we will map the concepts into the appropriate classes. Classes are interpreted as sets that contain instances, with the construction of links between the concepts by the related degree of attributes which ranks each different concept, in order to find the common parts of two classes and determine their relationship. Furthermore, several similar objects are merged as a new concept in representing them.

As Figure five below shows, the foot acu-point massage ontology which we built is both large and complex. Therefore, setting the concepts for representing the sub-class is necessary. In this process, seven concepts gradually emerge and become the main essence of the foot acu-point massage ontology: "Massage technique class", "Reflexology class", "Massage direction class", "Medical system class", "Curative illness effect", "Massage frequency class", and "Massage therapy".

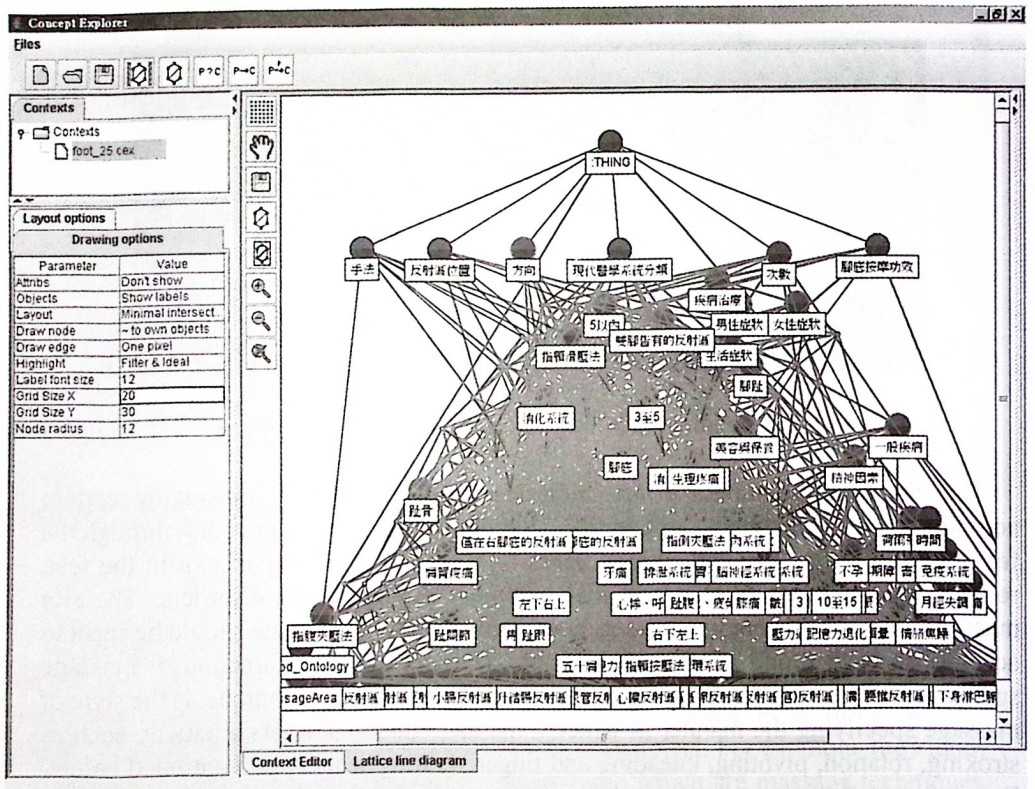


Fig. 5. Concept lattice of foot acu-point massage knowledge Ontology

Although the diagram above is difficult to read, its purpose is to show the result which was built via formal concept analysis. By setting the attributes and concepts through the use of mathematics, and making the facts more objective and reasonable, it

is not difficult to reassure people or for a beginner to understand, and let the people practice self-treatment, although reflexology is best given by a fully trained practitioner to obtain the maximum benefit from the treatment, it is also a method which can be used to a certain extent for self-treatment. Many people find the therapy from this foot acu-point massage knowledge sharing platform, which stimulates the reflexology zone by different massage techniques. Furthermore, it makes the constructed data-base cheaper and diminishes the need for experts.

### 3.3 Queries Outcome Visualization

By using the relationship between the concepts constructed in step2, users are allowed to view certain foot massage domain information in which they are most interested. Although this diagram may show only a partial Hasse diagram for foot acu-point massage domain, when selected by a user it will provide them with adequate general information concerning certain reflexology zone.

After constructing the ontology of certain domain data set up by the experts and builders, ontology is described by an accredited standard text format, the Extensible Markup Language, XML [3], which is generated by Protégé, while we finish the construction of foot massage ontology. It will simultaneously and automatically translate the ontology of the domain information to a webpage, answering users' questions effortlessly.

As figure six shows, Protégé compiled a domain information rule and relationship by the XML syntax, which contains the rule for the foot acu-point massage therapy method. Indeed, linking massage therapy, massage technique and curative effects with each other, and constructing different parts of the experts' clinical know-how into a knowledge- triangle, gives consideration to two or more aspects of health care, and the XML format is compiled automatically by the Protégé integrated software.

Protégé compiles the domain knowledge rule and relationship by XML syntax, which contains the rule of the foot massage therapy method, and includes the connecting curative illness, massage technique and curative effects with each other. This constructs difference aspects of experts clinical knowledge of how to be a knowledge- triangle, which gives consideration for two or more aspects of health care, and presents in the XML format which is automatically compiled by Protégé integrated software.

The outcome of the query displayed through the website return to users themselves may have advantages such as user-friendly feedback by multiple media, and the generation of dynamic results etc., However, FACMKS returns not only relative knowledge of requests, but also shows the whole picture of an FCA nested line diagram, and lets the retriever be aware of the knowledge he/she queried from that location of the whole foot acu-point massage knowledge ontology.



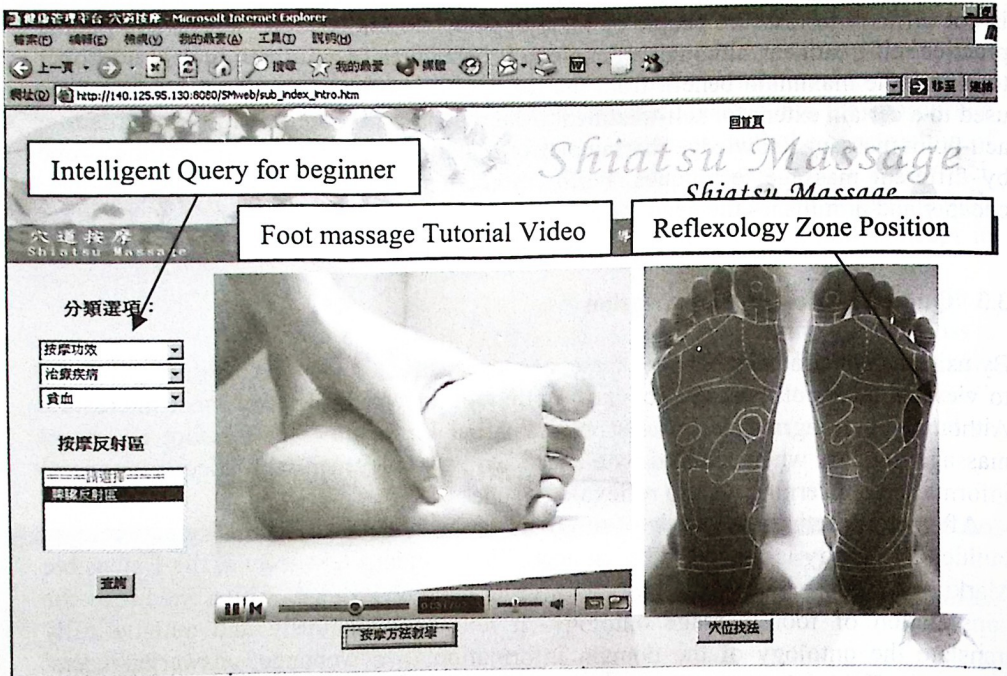


Fig. 6. Interface of “FACMKS” webpage

#### 4 Conclusion

The goal of our developing FCA-constructed retrieve mechanism was to improve the traditional ways of managing information items (such as document, medical science literature) and domain knowledge used in the foot massage clinic, while minimizing the additional effort required from the information retrieve and content management. The above-mentioned also required us to put an emphasis on intelligent query interface—building the hierarchy with flexible information retrieve mechanisms through the ontology concept, which is quite different from before. It formulates user queries accordingly with ambiguities being avoided in the interpretation of both query and reply. Such normalization and retrieval promise precision in search beyond what is possible with the current keyword-based methods. Not having to be aware of the semantics of terms makes things much easier.

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