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AN EXPERT SYSTEM FOR INJURED VITAL ENERGY CHANNELS DIAGNOSING

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Abstract. In this report an expert system AKU for diagnostics in acupuncture is described. The injured vital energy channels can be diagnosed using three independent methods: inquiring, Ryodoraku test and Akabane test. The inquiring is constructed as a set of trees whose internal vertices are questions while the leaves are the symptoms of diseases. The production rules describe the correspondence between the symptoms and the state of vital energy "qi" in the channels. AKU is realized by IBM PC computer and used for acupuncture treatment. The program is coded in Turbo Prolog.

Key words: acupuncture, medical diagnostics, vital energy channels, expert systems.

Introduction. According to Chinese medicine a vital energy "qi" is circulating in human body through twelve regular channels, eight extra channels and fifteen collaterals (Essentials, 1980). Interiously they connect with the internal organs and exteriously with the body surface where the acupunc-

ture points are distributed. When the human body is affected by a disease, treatment is possible by puncturing the corresponding points which regulate the "qi" and blood in the channels. The main problem of an acupuncture specialist is to define the injured regular channels.

Methods of diagnostics. Here we describe an expert system AKU, which diagnoses injured channels using three independent methods: inquiring (and inspectation), Ryodoraku test and Akabane test. AKU also defines a state of vital energy in the injured channels–deficiency ("yin") or excess ("yang") of "qi". Using some methods of diagnostics allows us to compare the results and make the final diagnosis more accurate.

The inquiring can be represented as a set of graphs (trees) whose internal vertices are questions. There are 16 trees in all with such roots as HANDS, LEGS, PAINS, DIGESTION, MENTALITY etc. According to the answer of a patient we move forward with the tree and give new questions to make a symptom of disease more precise. The trees of the questions are built so as to prevent elimination of any symptom. Almost 200 of production rules describe the correspondence between the sense of symptoms placed in the leaves of the trees and the state of energy in the channels. Since the initial data (symptoms) have the property of uncertainty, the inquiring system makes diagnosis for each channel in probability terms, such as "qi is normal", "there exists some probability of deficiency/ excess of qi", "there is established a large probability of deficiency/excess of qi".

RYODORAKU system automatizes diagnosing based on the Ryodoraku test (Portnov, 1987). By measuring electroconductivity and/or temperature at certain points of human body, we obtain the initial data for this system. Its output

is a table of vital energy levels in all regular channels with the injured channels marked out. The table depends on the characteristics of a measuring instrument which is used for testing. For this reason a possibility of "coordinating" the table according to the concrete instrument and concrete units of measurement is realized. Mathematical realization of the table allows us to make its "coordination" using only 3–4 characteristics of the given instrument.

Akabane test is realized like Ryodoraku except that we are to measure a patient's sensitivity to heat. Diagnosing injured channels becomes very simple when using this test.

Realization. AKU is realized by IBM PC computer and used in acupuncture diagnosis and treatment. The program is coded in Turbo Prolog. A user's work with AKU imitates the work of an acupuncture specialist. For each function which system *AKU* is able to execute, it makes a color window on a computer screen proposing a menu of possible commands. Every time choosing one of the proposed commands the user moves toward the "window tree" and thus he can realize all necessary operations. Besides executing the standard functions of expert systems (making an expertise, generating explanations, modifying knowledge etc) AKU also controls the case index of patients.

Conclusions. AKU suggests a reliable instrument for acupuncture specialists to make the diagnostics more efficient and accurate. The given expert system may be developed in the following ways:

1) suggesting new methods of diagnostics;

2) using time relations to analyse cases of patients;

3) creating a module for analysing collected statistic data, making conclusions and modifying the program.

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