International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 5 Issue 5 ǁ May. 2017 ǁ PP. 46-50

Research on Multidimensional Expert System Based on Facial Expression And Physiological Parameters

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ABSTRACT: ES (expert system) is a branch of the field of artificial intelligence ， which is the most important and the most active. It is a kind of computer intelligent system with a large number of special knowledge. It is provide d knowledge and experience by one or more experts in some fields. This expert system simulates the decision-making process of human expert through deductive reasoning and judgment. Through the investigation of several large hospitals, there is not an expert system for clinical application. The general medical diagnosis expert system knowledge base is based on the parameters of vital signs, The accuracy of medical diagnosis is very difficult to improve. When the facial expression was embedded in the construction of knowledge base, whole system is closer to the process of clinical diagnosis. The result shows that this method achieves higher diagnosis accuracy rate. The reasoning process of the system mainly includes two parts : Firstly through the video and digital image processing technology to get facial features, the inference as before; Secondly, the inference in the previous step is associated with the physiological parameters from the database and make the final diagnosis result.

Keywords: Expert system; image processing; physiological parameters; data base; medical diagnosis

I. INTRODUCTION

Expert system is also called Knowledge-based System. The mid 1970s, the development of expert system succeed.As a pioneer of the expert system, Professor E.A.Feigenbaum at Stanford University defined Expert system as an intelligent computer program. It uses knowledge and reasoning to solve complex problems which can be only solved by experts. It use the specialized knowledge and the expertise provided by experts to simulate the decision-making process. The application of medical diagnosis allow more patients to enjoy the specialist treatment .In recent years, There are many medical diagnosis expert system based on computer technology and medical system, The current medical diagnosis system mainly has the following 4 types: medical expert system for medical consultation expert system, teaching auxiliary medical expert system, Clinical diagnosis and treatment expert system and Medical diagnosis expert system based on automatic medical diagnosis. However, the expert system which can be applied to the actual clinical diagnosis is very few. Even some systems are put into operation, the accuracy of the diagnosis results are barely satisfactory. Why do those expert systems have a high misdiagnosis rate, there are two main aspects: First, the knowledge base is not complete, the limited number of professional doctors participate in the development of expert systems and provide limited diagnostic experience; Secondly, the structure of knowledge base is not complete. The diagnosis of many diseases requires not only the data of the instruments but also observe the state of the patient. Such as expression, skin color, eyes, etc.. In order to improve the accuracy of the whole medical diagnosis expert system, The expert system is to add expression data in the knowledge base and reasoning process.

1 Expert system summary

1.1 steps to establish expert system

As early as possible to establish an expert system is the key to the successful establishment of expert system. Starting with a simple expert system and gradually expanded into a fully functional expert system.

The establishment of an expert system consists of three steps:

1. Design initial knowledge base.
2. Development and testing of prototype.
3. Improvement and induction of knowledge base.

The structureis Fig.1-1.

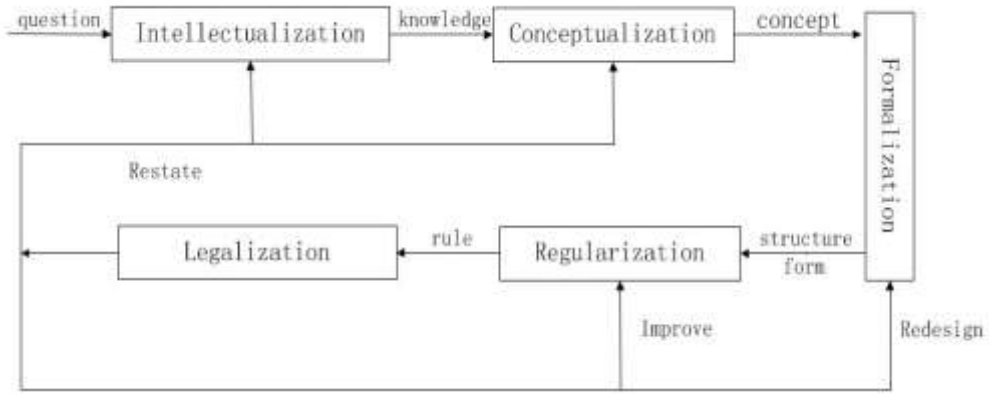

Fig.1-1 The system software architecture

1.2 the overall structure of expert system

The expert system is an intelligent computer program system that contains knowledge and reasoning. However, this kind of intelligent program is essentially different from the traditional computer application. Its internal knowledge base contains a lot of expertise and experience in a field of expert level. The system can use knowledge base and problem-solving methods to deal with problems in the field of expertise. The knowledge of solving the problem in the expert system constitutes a separate knowledge base. Knowledge in traditional computer programs is implicit in programs and data structures. Conventional computer applications are difficult to have as strong as the expert system has a strong adaptability and flexibility. The expert system can effectively use the effective experience and expertise accumulated by experts for many years to solve the problem of experts who need to solve problems by simulating the thinking process of human experts. The expert system has become a widely used system . Its technology is still growing and growing. Therefore, its structure has not yet a fixed form. The general structure of the expert system consists of modules such as knowledge base, dynamic database, reasoning machine, knowledge management, symptom input, interpreter and human-computer interaction. The system is shown in Figure Fig.1-2.

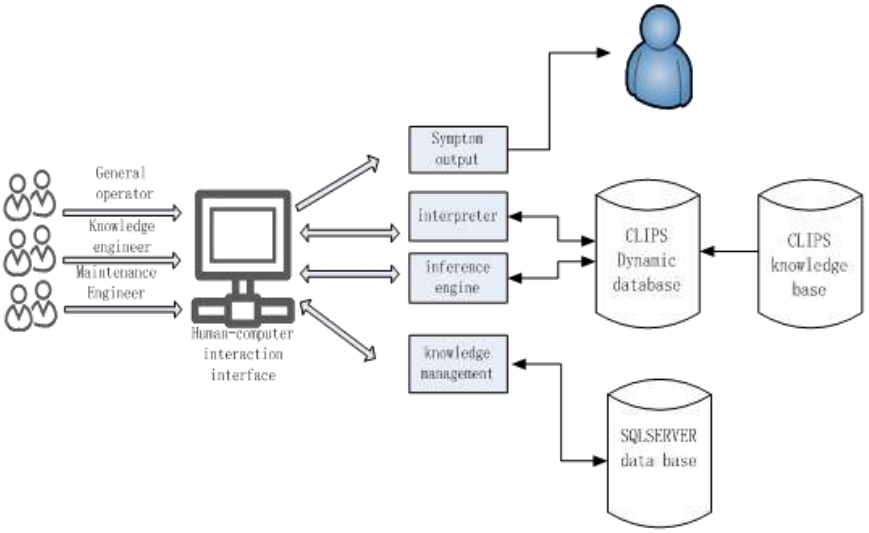

Fig.1-2 The system software architecture

II. IMAGE PROCESSING TECHNOLOGY

Face facial expressions contain complex inner emotions and it is an important way to communicate with people. In recent years, it has been a hot topic in the field of computer vision, human-computer interaction and pattern recognition. The main part of the process of image processing is as follows:1、Extract the main component of the image, positioning the face, eyes, mouth and so on ;2、Grayscale processing 3、Binarization 4、Get face parameters.

2.1 Using PCA algorithm to locate

In this paper, a principal component analysis method （PCA，Principal Component Analysis）is used

to locate the sampled image. The PCA transforms the raw data into a set of linearly independent data by linear transformation.It can be used to extract the main feature components of data and dimensionality of high dimensional data. This transformation causes the original data to be represented by feature data with less dimensionality without reducing the amount of intrinsic information contained in the original data and then using Euclidean distance method to obtain the positioning results.

2.1.1 principle of PCA

（1）Find the average of the training samples, Take the vector Ψ of the X column vector

$$\psi = \frac{1}{75}\sum_{i=1}^{75}\chi_i \qquad (2\text{-}1)$$

（2）Find the difference between each sample and the mean

$$\phi_i = \chi_i - \psi \qquad (2\text{-}2)$$

（3）Find Covariance matrix of training samples

$$A = (\chi_1 - \psi, \chi_2 - \psi, \cdots \chi_{75} - \psi) \qquad (2\text{-}3)$$

$$S = \frac{1}{75}\sum_{i=1}^{75}\phi_i\phi_i^T = \frac{1}{75}A\,A^T \qquad (2\text{-}4)$$

dimension is N×N.

(4)Find Orthogonal Normalized Eigenvector of Matrix $V = A\,A^T$

$$\mu_i = \frac{1}{\sqrt{\lambda_i}}A\,\upsilon_i \qquad (2\text{-}5)$$

(5) λ_i, υ_i as Eigenvalues and eigenvectors of S , $i \in (1, p)$, $p < 75$,Create " Feature face " space for:

$$\zeta = (u_1, u_2, \cdots u_p) \qquad (2\text{-}6)$$

(6)Find the difference matrix for each training sample and the average face and Mapped to ζ space

$$\Omega_i = \zeta^T\phi_i \qquad (i = 1,2,\ldots,75) \qquad (2\text{-}7)$$

（7）Using European distance, Calculate the European distance of each sample in the training sample and sample set

$$\delta_c = \min_{i,j}\{\,|\Omega_j - \Omega_i|\,\} \qquad (i, j = 1,2,\ldots,75) \qquad (2\text{-}8)$$

When δ_c taking the minimum value, The input image is classified as the c image.

2.2.2 Image Grayscale Processing And Binarization

PCA processed images need to be denoised and then collected color images need to be grayed out. This is because the black and white photo data volume is small, compared to color photos easier to achieve real-time algorithm. On the other hand black and white photographs are photographs of untreated light. Therefore, from the image processing point of view, this special filter without the image covered by the information more valuable. Second, image binarization is a common method of using grayscale transform to study gray-scale images。That is, a certain threshold is set to divide the pixel of the gray scale image into a pixel group larger than the threshold value and a pixel group smaller than the threshold value. Finally,

the resulting binarized image is removed by minimizing the connected domain processing. Through the above steps, you can get the eye, nose, mouth and other parts closely related to the face parameters. The result is Fig.2-1

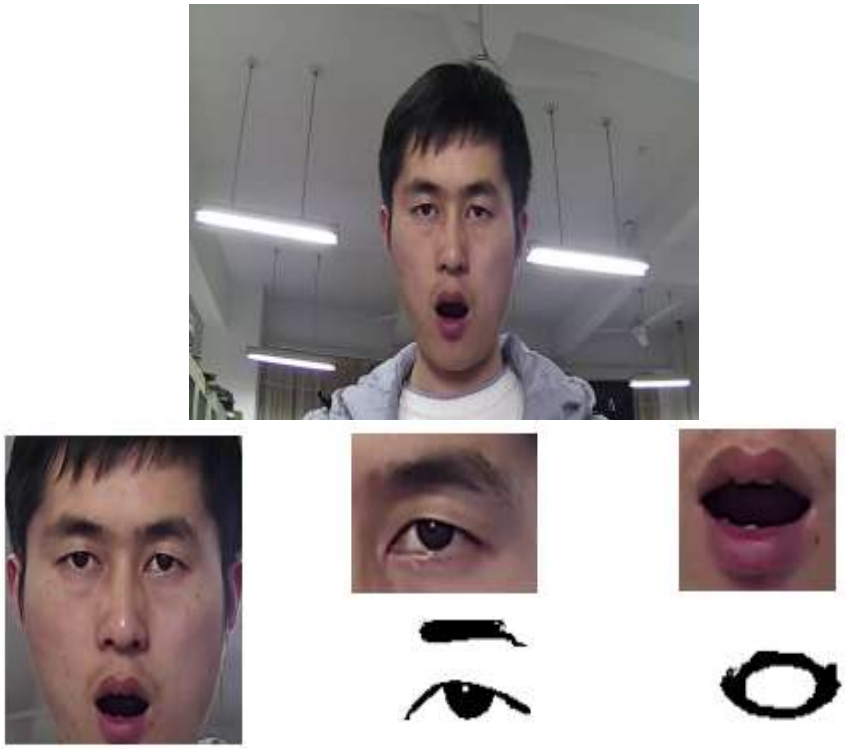

Fig.2-1 The system software architecture

2.3 Get face parameters

By capturing the face, using the original color histogram to get the face color. Use the eyes, mouth and other local binarized picture to obtain the opening of eyes, mouth and other parts .

III. SYSTEM DESIGN AND TESTING

System software part is written by the c #, including the user interface, image processing, physiological parameters, expert systems, database connections and so on. Hardware part includes camera, physiological parameter measuring instrument, intelligent rehabilitation nursing robot bed, communication and so on. It is the

Fig.3-1.

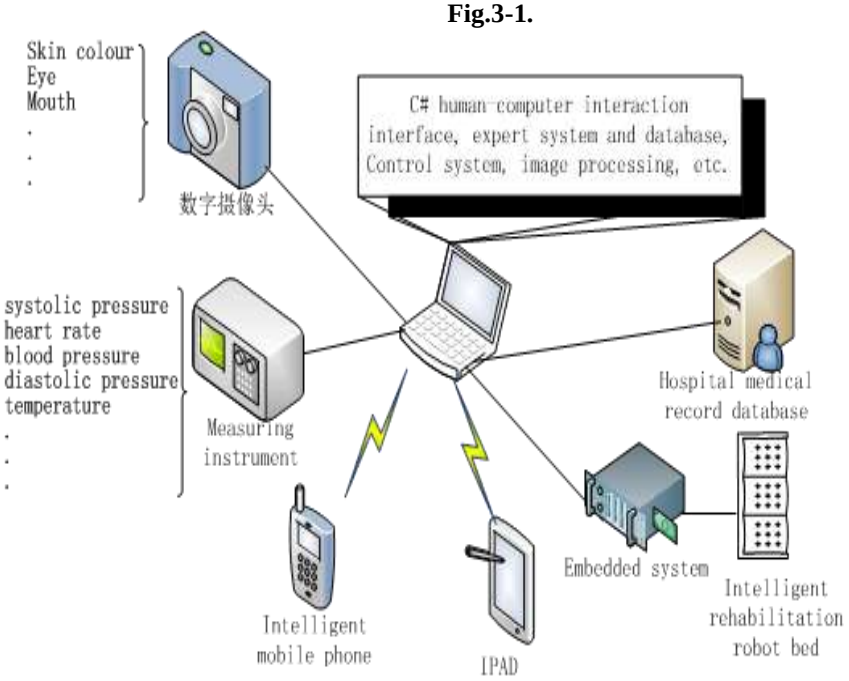

Fig.3-1 The system software architecture

Table 3-1 Face recognition test results

diagnosis method	Number of diagnoses	The correct number of times to diagnose	Accuracy	Identify time
Physiological parameters	150	118	78.6%	203ms
Face parameters + Physiological parameters	150	143	95.3%	325ms

As can be seen from Table 3-1，with the embedding of face parameters, the correctness of diagnosis has been greatly improved. However, due to the image processing process has a lot of calculation, therefore, the required time also increased.

IV. CONCLUSION

Expert system based on face and physiological parameters greatly improves the recognition rate of medical diagnosis. The acquisition of physiological parameters has been very mature technology and equipment, but the acquisition of face parameters are image processing technology. Image processing is a cross-disciplinary interdisciplinary, involving computer, sensor, mathematics, physiology and many other disciplines of application technology. This article uses PCA technology to extract facial features. I believe that with the continuous improvement of image processing technology, more excellent use of the algorithm, access to the face parameters will be more accurate. At the same time, expanding the number of face parameters will make the accuracy of the entire medical diagnostic system more accurate, but also increase the scope of diagnosis of disease diagnosis. Expert system and intelligent rehabilitation nursing robot bed as a system can monitor the basic needs of disabled patients, such as thirst, hunger and urine and so on. As a nursing worker's auxiliary equipment, it can focus on a large number of patients monitoring, reducing the intensity of the work of nurses and it can also use smart phones and other terminal equipment to monitor and operate. From the system test results can be seen, the diagnostic accuracy has been high, but time-consuming also has a lot of increase. Therefore, in the case of guaranteed recognition rate, how to shorten the reasoning time is the next step worthy of research and improvement.

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