Research Article

Designing Online Psychological Consultation Expert System Using Human-Computer Interaction

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Traditional online psychological consultation expert system has low efficiency. It is because of limited human-computer interaction and lack of intelligence. As a result, an expert system for psychological consultation is needed. Therefore, in this paper, we design an online psychological consultation expert system based on human-computer interaction. Using human-computer interaction technology, the basic principles of the system’s design are formulated. The design is used to build a psychological consultation expert system framework suitable for numerous applications. Human-computer interaction knowledge is imported into the system to determine the consultation process based on fuzzy set. To complete the online psychological consultation preset, the adjustment of human-computer interaction accuracy is determined. Moreover, a psychological state of the user in human-computer interaction is achieved using the expression of psychological counseling results. Comparing the simulated psychological consultation process, the results show that the design system is 30% more efficient than the traditional consultation system. The consulting success rate is more than 20%. The comprehensive consultation time is shortened, and its effectiveness is proved.

1. Introduction

The expert system is a computer system composed of a knowledge base, inference engine, and database. Its purpose is to make judgments, explanations, and perceptions of problems in a specific field. The expert system can provide intelligent decision-making and assistance to solve the problems and explain the solution processes. It can also be called the “Intelligent Knowledge Base System (IKBS)” [1]. The first expert system was founded in 1956 by Allen Newell, Herbert Simon, and J.C. Shaw. Since then, many expert systems have also been established, but in the early days, most of them were prototype systems of a research nature. After the 1970s, the high-level and software development tools for artificial intelligence and expert systems have gradually begun to develop. A number of knowledge representations and calculation methods have also been extensively studied, which has led to changes in the construction and development of expert systems. Since the late 1980s, the expert system had gradually separated from laboratory research and was widely used in various industries, which included the following: the cotton production management expert system developed by Hal. Lemmon in 1986; the expert system architecture [2] based on neural network proposed by Gallant in 1988; the ESIM irrigation management expert system developed by Srinivasan et al; an agricultural drift expert system developed by S. Saputro in 1991; the underground mining production management system developed by R.L. Grayson, G. M. Watts, and others of the US Bureau of Mines in 2000. The expert systems have achieved very good results in practical applications. There are also many applications of expert systems in medicine and psychology. Since the 1970s, it has been raised to research “medical diagnostic expert systems.” Stanford University first developed high performance and functional MYCIN system in 1974, which is used to help physicians diagnose and treat infectious diseases. In the period of nearly 30 years since then, both domestic and foreign countries have invested enormous power in research and development and have made some progress.

At present, the domestic research results in this field include Hebei University of Medicine’s Shenzhen City Psychological Counseling Expert System XLZXV1.1 in 1995 and Hua Xia Saco Clinical Psychological Evaluation and Diagnosis System developed and launched in 2003 by Huake
2. Overall Design of Psychological Consultation Expert System

This section discusses the design principle of the proposed system and the implementation of the expert system module.

2.1. Design Principle. Human-computer interaction fuzzy sets can be simply defined as a set with fuzzy boundaries. Assuming that X is a domain, the elements can be denoted as x. In classical set theory, X’s sharp set A is defined as a function \( f_A(x) \), called the Eigen function of A:

\[
f_A(x): X \rightarrow 0, 1, \tag{1}
\]

where \( f_A(x) = \begin{cases} 
1, & \text{if } x \in A, \\
0, & \text{if } x \notin A.
\end{cases} \tag{2}
\]

This set maps the domain of X to two elements. For any element x of domain X, if x is an element of set A, the feature function \( f_A(x) \) is 1. If x is not an element of set A, the feature function \( f_A(x) \) is zero. In fuzzy theory, fuzzy set A of domain X is defined as function \( u_A(x) \), which is called the membership function of set A:

\[
u_A(x): X \rightarrow [0, 1], \tag{3}
\]

where if x is completely in set A, \( u_A(x) = 1 \); if x is not in set A, then \( u_A(x) = 0 \); if x part is in set A, then \( 0 < u_A(x) < 1 \). This set allows the use of possible consecutive values. For any element x of the domain X, the membership function \( u_A(x) \) is equal to x and is the degree of the element in the set A. The degree of the value of 0 to 1, in the said membership, is also known as the membership value of the element x in the set A [7]. In order to express the result of the consultation in the psychological consultation expert system, the set is represented by a function, and the elements in the set are mapped to the degree of membership. The classic membership functions in the psychological consultation expert system are trigonometric functions and trapezoidal functions.

The operation of a human-computer interactive fuzzy set is as follows: in the late nineteenth century, the classical set theory, developed by Georg Cantor, describes how distinct sets interact, and these interactions are called operations. The four operations are as follows: complement, containment, intersection, and union. The following is the principle of operation of the psychological consultation expert system.

2.1.1. Complement. Distinct set (who does not belong to the set?), fuzzy set (operation element do not belong to the degree of set)’? The complement of a set is the opposite of the set. If A is a fuzzy set, its complement A is as

\[
u_A(X) = 1 - u_A(X). \tag{4}
\]

2.1.2. Containment. A distinct set (which set belongs to another set?) and a fuzzy set (how much does the element not belong to the set?) are included. Similar to the Chinese box or Russian matryoshka, a set can contain another set. Smaller sets are called subsets. In a distinct set, all subset elements belong to a larger set with a membership value of 1. However, each element belongs to a subset in a fuzzy set with a lower degree than a larger set. The membership values of the elements of the fuzzy subset in the subset are smaller than the values of the membership values in the larger cluster.
2.1.3. Intersection. A distinct set (which elements belong to two sets simultaneously?) and a fuzzy set (how much does the element belong to both sets?) are included. In the classical set theory, the intersection of two sets contains elements that are common to both sets. However, in the fuzzy set, the elements may belong to two sets in part. The degree of membership is also different for the two sets. Therefore, the degree of membership of each element in the fuzzy intersection is relatively low. The fuzzy operation of creating the intersection of fuzzy sets \( A \) and \( B \) on field \( x \) is

\[
u_{A \cap B}(x) = \min[u_A(x), u_B(x)] = u_A(x) \cap u_B(x),
\]

where \( x \in X \).

Union: A distinct set (which elements belong to two sets?) and a fuzzy set (to what extent the elements belong to two sets) are included. The union of the distinct set is composed of all the elements that belong to two sets. In the fuzzy set, the union is the reverse operation of intersection, which is composed of two elements with a large concentration of membership. The fuzzy operation for creating the union of fuzzy sets \( A \) and \( B \) on field \( x \) is

\[
u_{A \cup B}(x) = \max[u_A(x), u_B(x)] = u_A(x) \cup u_B(x),
\]

where \( x \in X \).

In order to adapt to different description objects, a variety of different operators are defined according to actual conditions, and these operators define the operation of fuzzy sets. For example, the fuzzy operation of the algebraic sum of fuzzy sets \( A \) and \( B \) on algebra and domain \( X \) is formulated as follows:

\[
u_{A + B}(x) = u_A(x) + u_B(x) - u_A(x) \times u_B(x),
\]

where \( x \in X \).

Distinct sets and fuzzy sets have the same properties. Distinct sets can be considered as special cases of fuzzy sets. The psychological consultation expert system is designed with the following properties: exchangeability, integration, distributivity, idempotence, identity, self-multiplying, transitivity, and De Morgan’s law.

2.2. Construction of Consulting Module. The expert system for online psychological consultation is composed of four parts: database, model base (knowledge base), inference engine, and human-machine field. The database receives, stores, provides, and modifies data for its management system; the model library stores, extracts, and modifies the management system; the inference engine is the core execution mechanism of the expert system, and it is actually a program for interpreting knowledge, that is, explaining and executing knowledge found by a certain strategy according to the semantics of knowledge and recording the results in the appropriate space of the database. The human-machine interface is a part of the interaction between the user and the system [8]. In order to solve a certain problem, the user issues instructions through the man-machine interface, and the database management system stores the data into the database or modifies the database according to the instructions. The model library management system extracts the model from the model library according to the user’s instruction and extracts the data from the database. The relevant data are calculated and reasoned [9]. The composition of the online psychological consultation expert system is shown in Figure 1:

The functions and roles of the various modules in the consulting architecture are as follows:

2.2.1. Databases. Databases are used to store expertise provided by domain experts. This specialized knowledge includes field-related book knowledge, common sense knowledge, and exploratory knowledge acquired by experts. The problem solving of the expert system is to use the expertise provided by experts to simulate the thinking mode of the expert. The quantity and quality of knowledge base will become the key factor of the system performance and problem-solving ability in an expert system [10]. Therefore, the establishment of the knowledge base is the central task of constructing the expert system. The model base is used to store the initial data, solution state, intermediate result, hypothesis, goal, and final result of the problem-solving.

2.2.2. Inference Engine. In the context of a specific control strategy, the current information in the integrated database is identified and selected in the knowledge base to solve the current problem. In the expert system, since the knowledge base is often incomplete and inaccurate, the reasoning process generally uses inaccurate reasoning.

2.2.3. The Interpersonal Interaction Interface. It is the knowledge acquisition process. In the knowledge base construction of expert systems, it is used to partially replace knowledge engineers for automatic acquisition of specialized knowledge to realize self-learning of expert systems and improve the knowledge base [11]. According to the user’s questions, the conclusion, solution process, and current state of the system are explained, which can facilitate the user to understand the problem of the system and increase the user’s trust in the solution. In the process of improving the knowledge base, it is convenient for experts and knowledge engineers to find and locate the errors in the knowledge base and for professionals or beginners in the field to learn from the problem-solving process. The system converts the information input by the expert or user into an internal form acceptable to the system and converts the information output by the system to the expert or user into an external structure that is easy for humans to understand [12]. The overall module and process design of the online psychological consultancy expert system are shown in Figure 2.

It includes the following sections:

- **Personal Information Collection Module.** The personal information collection module needs to collect basic personal information and personal psychological status information and is automatically obtained by the system during the human-machine conversation [13].
includes attributes, such as name, age, major, grade, and family status, which are used to create personal information models. The psychological state information mainly refers to the counselor’s current psychological activity and psychological state, as a database of expert systems. Inference Engine. The inference engine is the core of the entire expert system. It is based on the personal information database acquired by the personal information acquisition module and the knowledge base of the psychological domain, inferentially diagnoses the psychological type of the consultant, and obtains an overview of the personal mental state. It can be a mixture of psychological types.

Psychological Test Module. According to the possible psychological type of the consultant, through a series of psychological tests, the individual mental state details are set up, the types of psychological problems and their severity are determined, and the psychological solutions are given.

Psychological Answering Module. Using the process of human-machine conversation, the psychological problems of consultants are analyzed, and the necessary answers are given.

3. Implementation of Psychological Consultation Expert System

This section discusses various components of the proposed system from the implementation aspects of the expert system module.

3.1. Human-Computer Interaction Knowledge Import. The main research content of the knowledge acquisition is to extract the attributes of the user’s psychological activity, classify the psychological state rationally, and establish the mental state model. By analyzing the general psychological characteristics of the user group and combining some actual investigation results, the user’s mental health problems are divided into 301 psychological description attributes, 24 psychological states, and eight mental state models [14]. Each mental state model corresponds to a set of description attributes and their psychological testing methods. Figure 3 is a classification structure diagram of the user’s mental state model.

The psychological consultation expert system is based on a man-machine dialogue. The computer imitates the human expert’s diagnosis of the counselor: the diagnosis of the disease consists of five parts: knowledge acquisition, knowledge representation, knowledge base, inference engine, and human-computer interaction interface. Knowledge acquisition is the extraction of knowledge for solving domain-specific problems from the source of knowledge that possesses the knowledge and is converted into a specific computer representation [15]. Knowledge sources include human experts, textbooks, databases, and human experience. Psychological consultation expert system includes production representation, predicate logic representation, semantic web representation, frame representation, and so on. According to the knowledge-based system itself in the classification role, the consultation and acquisition methods can be divided into active consulting acquisition and passive consulting acquisition. According to knowledge-based systems, working methods for acquiring knowledge can be
classified into two types: nonautomatic knowledge acquisition and automatic knowledge acquisition [16]. Since the classification and definition of psychological consultation knowledge in the online psychological consultation expert system based on human-computer interaction is not yet clear and standardized. The acquisition method of psychological consultation knowledge adopts the passive knowledge acquisition method introduced in the first classification, as shown in Figure 4.

3.2. The Establishment of Interactive Fuzzy Sets.

Determining the fuzzy interaction set includes the composition of the fuzzy interaction set and the expression of the fuzzy interaction set. The fuzzy interaction set is composed of the interaction fuzzy set C of the psychological state Ci, the interactive fuzzy set Cij of the psychological state, and the set of illness fuzzy S. In many cases, using some common distribution function as a membership function to determine the expression of fuzzy interaction sets is the easiest way. Based on the experience of experts in the field of psychology and the computational complexity, the following membership functions were selected: semitrapezoidal distribution and triangular distribution, where the semitrapezoidal distribution is suitable for expressing "very light" and "very small" types of interactive fuzzy variables. Amity is used to express "light" in the system. The base variable is $x$, the domain is $X$, and $X$ is defined as $R^+$. A function expression is as follows:

$$u_A(x) = \begin{cases} 1, & 0 \leq x \leq a_1, \\ \frac{a_2 - x}{a_2 - a_1}, & a_1 \leq x \leq a_2, \\ 0, & x > a_2. \end{cases} \quad (8)$$

The triangular distribution is suitable for expressing an interactive fuzzy variable A with a "symmetric" uncertainty distribution, such as "medium." It is used to express "moderate degree," whose basic variable is $x$, the domain is $X$, and $X$ is defined in $R$. Function expression is as follows:

$$u_A(x) = \begin{cases} \frac{a_2 - x}{a_2 - a_1}, & a_1 \leq x \leq a_2, \\ \frac{a_3 - x}{a_3 - a_2}, & a_2 \leq x \leq a_3. \end{cases} \quad (9)$$
The semitrapezoidal distribution is suitable for expressing "larger" types of interactive fuzzy variables. It is used to express "heavy" in the system. The base variable is \( x \), the domain is \( X \), and \( X \) is defined at \( R^{10} \). Function expression is as follows:

\[
u_A(x) = \begin{cases} 
1, & 0 \leq x \leq a_1, \\
\frac{a_2 - x}{a_2 - a_1}, & a_1 \leq x \leq a_2, \\
1, & x > a_2.
\end{cases}
\]  

3.3. Determination of Users’ Psychological State in Human-Computer Interaction. The user’s psychological state in human-computer interaction is important in the psychological consultation expert system. There are two reasons for incorporating knowledge into the computer through this data structure: the expert system shell is designed for a certain type of knowledge representation, such as rules or

\[
<\text{Proposition}> ::= \sim<\text{Proposition}>
\]
\[
\{\text{AND}<\text{Proposition}>\}
\]
\[
<\text{Proposition}> ::= <\text{string}, \text{value}>
\]
\[
<\text{Consequent}> ::= <\text{string}, \text{value}>
\]
\[
<\text{Psycho knowledge}> ::= <\text{string}, \text{value}>
\]
\[
<\text{rule}> ::= <\text{string}, \text{value}>
\]
\[
<\text{Proposition}> ::= <\text{string}, \text{value}>
\]
\[
<\text{rule}> ::= <\text{Proposition} > \{\text{AND}<\text{Proposition}>\}
\]

In the previously mentioned rules, Proposition is the previous item (input), and Consequent is the post item (output). The former can be composed of multiple parts. The computation between the previous parts here is programmed to operate. The ANDO AND operation conform to the actual process of psychological counseling. That is, the consultant can use different factors to judge the illness. Calculate multiple parts and get a single value, the post-item. Both the preceding and following terms consist of the string and the numeric value. The string represents the language variable, and the value represents the value of the language variable. This completes the establishment of an interactive fuzzy set.
logic; the way an expert system expresses knowledge affects the development of the system. Knowledge representation is the process of symbolization and formalization of knowledge. The knowledge representation method studies the programming process of the system. In general, different representations can be used for the same kind of knowledge. In turn, a knowledge representation model can express a variety of different knowledge. However, when solving a problem, different representation methods have completely different results. So far, there is no universal and perfect knowledge representation model. Knowledge representation has not yet been perfected. In the expert system, knowledge representation methods include first-order predicate representation, production representation, semantic network representation, frame representation, and characteristic representation.

The attribute of the knowledge representation is that the user’s psychological activity description attribute is the most basic psychological activity description factor in the psychological counseling field, represented by the set $\Omega$ [17]. It is to summarize 301 psychological description attributes, such as interpersonal relationships, ideals, postgraduates, and academic degrees. The type of mental state is the type of mental state used to describe the characteristics of the user’s psychological phenomena, which is the main factor that describes the mental state model. By summing up the 24 types of mental states, set $X$ is recorded. Suppose the power set of the mental description attribute set $\Omega$ is $\xi(\Omega)$. There is a mapping relationship between the set $\xi(\Omega)$ and $X$. The mapping relationship is a proposition function $f$, that is, $f: \xi(\Omega) \rightarrow X$. Among them, $X$ = {character problem, social adaptability, lack of self-evaluation, true attitude of communication, emotional problems, escapism, habit formation, overstretch, environmental factors, thoughts and mentality, mental stress, adaptation to new environment, life habits, family factors, psychological facts, love problems, sexual behaviors in love, personal and psychological problems in love, outlook on life, prospects, employment problems, lack of self-confidence, exams, intense learning attitudes, educational issues). The mental state model is the psychological state model. It is the psychological state type used to describe the features of a certain type of psychological disorder in psychological problem counseling. It is the basis for the classification of psychological disorders. According to the summary of eight types of mental state models, the mental state model set is recorded as $Y = \{Y_1, Y_2, Y_3, Y_4, Y_5, Y_6, Y_7, Y_8\}$, where $Y_1$, $Y_2$, $Y_3$, $Y_4$, $Y_5$, $Y_6$, $Y_7$, $Y_8$ respectively: lack of interpersonal skills, lack of self-confidence, emotional out of control, poor self-care ability, poor adaptability, personal emotional confusion, feelings of despair, employment, life, learning problems, and other eight types of psychological state model. Similar to the relationship between description attributes and mental state types, there is also a certain logical relationship between mental state types and mental state models. Assuming that the power set of the mental state type set $x$ is $\xi(\Omega)$, there is a mapping relationship between the set enthalpy ($\Omega$) and $Y$, which is a proposition function $g$, that is, $g: \xi(\Omega) \rightarrow Y$.

The proposition functions $f$ and $g$ are defined as follows.

**Definition 1.** The proposition function $f$ is a logical extraction function. For $f: \xi(\Omega) \rightarrow X$, set $\Omega' \in \Omega$ and $x' \in X$, so that $x' = f(\Omega')$. Then, this formula can be written as follows: $x' = d_1 \lor d_2 \lor \ldots \lor d_m$, where $\Omega' = \{d_1, d_2, \ldots, d_m\}$.

**Definition 2.** The proposition function $g$ is a logical conjunction function. For $g: \xi(X) \rightarrow Y$, set $X' \in \xi(X)$ and $y' \in Y$, so that $y' = g(X')$. Then, this formula can be written as follows: $y' = x_1 \land x_1 \land \ldots \land x_m$, where $X' = \{x_1, x_2, \ldots, x_m\}$.

The proposition functions $f$ and $g$ satisfy the following properties: property 1 is set according to the definition of the proposition function $f$, supposing that the set of independent variables that have a mapping relationship with $x_1, x_2, \ldots, x_m$ are $\Omega_1, \Omega_2, \ldots, \Omega_m$, respectively, satisfy $\Omega_1 \cap \Omega_2 = \psi$, where if $f \neq j$, $0 < i < j < m + 1$, $\psi$ represents an empty set.

For example, the psychological state model $Y_7$ is “confused about the future, employment, and life,” and the mental state type “outlook on life,” “future employment problem,” and “lack of confidence” are recorded as $X_1, X_2$, and $X_3$, respectively. There are four propositional formulas (also known as rule).

**Rule 1:** blind comparison $\lor$ unexpected $\lor$ social relationship $\lor$ interpersonal relationships $\lor$ ideal $\rightarrow x_1$, Rule 2: no fixed place $\lor$ Postgraduate $\lor$ Workplace $\lor$ TalentExchange Conference $\lor$ Recruitment $\lor$ resume $\lor$ salary $\lor$ job $\lor$ wage $\lor$ treatment $\lor$ development $\lor$ Employment mentality $\lor$ work experience $\lor$ Education $\lor$ Employers $\lor$ skill $\lor$ Professional knowledge $\lor$ Study $\lor$ abroad $\lor$ Jobhopping $\lor$ Employment forms $\lor$ test $\lor$ competition $\lor$ Workplace $\lor$ Private company $\lor$ boss $\lor$ experience $\lor$ Innovation $\lor$ Lower standards $\lor$ Hot professional $\lor$ area $\lor$ open $\lor$ Strengths $\lor$ Private $\lor$ Working $\lor$ Entrepreneurship $\rightarrow x_2$, Rule 3: fragrance $\lor$ heartbeat $\lor$ desperation $\lor$ bump $\lor$ nichejob $\lor$ career $\lor$ thin $\rightarrow x_3$, Rule 4: $x_1 \land x_2 \land x_3$ $\rightarrow y_7$. Different types of knowledge often have different expression methods. The commonly used knowledge representation methods include first-order predicate logic, semantic network, production rules, and framework theory. The knowledge representation of the system adopts a production rule method. The specific form is as shown previously. This form is similar to the conditional statement in computer programming technology [18].

3.4. Human-Machine Interaction Accuracy Proofreading. A high-performance expert system not only has a lot of expertise but also can select and apply knowledge. As the core of the expert system, the main task of the inference engine is to determine the choice and use of knowledge in the problem-solving process promptly to help improve the system’s proofreading accuracy. The control strategy of the inference engine determines the choice of knowledge, and the reasoning method of the inference engine determines the application of specific knowledge. Reasoning methods include deductive reasoning and inductive reasoning, exact reasoning, and inexact reasoning.
3.4.1. Deductive Reasoning and Inductive Reasoning. Deductive reasoning is why general lesser conclusions are derived from general premise. Deductive reasoning cannot reproduce knowledge. The core of deductive reasoning is a syllogism. It consists of three judgments, two of which are preconditions and the other is conclusions. Deductive reasoning is to conclude individual things from the principle of general principles. The thinking process is from general to individual; the conclusion of deductive reasoning does not exceed the scope of the premise in principle; the connection between the conclusion of deductive reasoning and the premise is inevitable, as long as the premise is true and the form of reasoning is correct, and the conclusion must be reliable. Inductive reasoning is the reasoning that generalizes larger conclusions from less general premises. The thinking process is from individual to general [19]. Inductive reasoning generally reproduces new knowledge. Inductive inference includes complete inductive reasoning, simple enumeration, scientific induction, analogy, and statistical reasoning.

3.4.2. Exact Reasoning and Inexact Reasoning. Exact reasoning means that there is a definite causal relationship between premises and conclusions, and facts and conclusions are all determined. Deductive reasoning is based on mathematical logic. There is a strict and exact causal relationship between the problem facts and the conclusions, and the facts are always determined or accurate. Therefore, deductive reasoning is exact reasoning. As the known data and knowledge used inaccurate reasoning are complete and accurate, the conclusions obtained by reasoning are also correct and reliable. However, there are quite a few subjective judgments of human knowledge that are inaccurate and vague. In addition, facts and information collected for reasoning are often incomplete and inaccurate. Therefore, inference knowledge derived from this knowledge is also often inaccurate. Reasoning based on this inaccurate inference knowledge leads to conclusions called inexact reasoning. In the expert system, inaccurate reasoning is usually used because most of its problems are bad structural problems.

3.4.3. Inference Control Strategy. Inference strategy mainly solves the knowledge selection and application sequence of the entire problem-solving process. It decides what to do first, what to do afterward, doing different work according to the current state of problem-solving, and determining how to act at the abnormal situation that occurred once and so on. At present, the inference strategies used in the expert system include conflict resolution, forward inference, reverse inference, hybrid inference, two-way inference, and meta-control. The burst elimination solution strategy is to solve the problem of how to select a piece of knowledge reasonably from a large amount of available knowledge, and it is a basic reasoning control strategy.

3.5. The Expression of Human-Computer Interaction Psychological Consultation Results. The human-computer interaction interface provides a dialogue mechanism between the user and the computer. The interface of the expert system has the following three functions: testing before the completion of the development of the expert system; the consultation of practical problems; modifying the expert system when the answer is found invalid or insufficient. Users can be divided into three groups: domain experts, knowledge engineers, and general staff. Domain experts are experts in a specific field, who help establish, test, and apply an expert system to solve practical problems. Knowledge engineers are computer programmers who obtain knowledge from experts to develop an expert system and apply it to practical problems so as to improve and perfect it constantly. The average user does not develop or perfect the system. The functions of the human-computer interaction interface include the following aspects: ability to understand that people enter facts in certain prescribed languages and ask most systems to specify a specific language for users to use. There is a language compiler in the system that parses and semantically understands the received language and then converts it to an internal representation. Future developments require that the system be able to directly receive natural language or be able to understand people’s words. This requires the system to have functions such as natural language understanding and language recognition. The system can be asked questions by people and the user for facts and evidence during system operation. The commonly used forms are (a) test table; (b) multiple choice; (c) numerical value; (d) Y/N. Another form is when the system finds a fault and asks the expert (such as the wrong information in the knowledge base), which means that the system is learning from outside. It can explain his own work process and conclusion. The expert system must not only solve practical problems at the expert level but also give a detailed explanation of the problem-solving process. Only in this way, the conclusions given are convincing. In addition, in the debugging phase of the system, the interpretation of the conclusions obtained using the simulation data can help designers and field experts easily find out the system’s errors. In order to explain the reasoning process, different systems may use different methods. However, the basic method is generally to use the back-inverse method; that is, the reason for the conclusion is reversed from the current conclusion, and it is pushed back until the most reasonable explanation is given. Regarding teaching professional knowledge, there is some professional knowledge in the systems for users to ask questions and teach users. A man-machine conversation system refers to an intelligent system that uses human language and high understanding technology to realize human-computer interaction. It is also called a “chat robot.” As the ultimate goal of high-level natural language processing, it is difficult for computers to understand human language behavior. However, it is very difficult to construct a man-machine conversation system with unlimited topics. This system is a limited man-machine conversation system based on psychological counseling topics. The implementation of the human-computer conversation system is as follows.
(1) **Lexical Analysis Module.** The most extended keyword matching technique is used to convert sentences in the form of input strings into word strings.

(2) **Syntax Analysis Module.** It uses line graph analysis algorithm (chart algorithm) and converts the sentence in the form of input word string to the form of syntax analysis tree structure.

(3) **Semantic Analysis Module.** It uses the LR analysis algorithm to convert the sentence represented by the input syntax analysis tree into the semantic framework structure form.

(4) **Session Management Module.** It generates the response sentence and shows the output in the human-computer interaction.

### 4. Experimental Analysis

The following comparative experiments are designed to verify the reliability of an online psychological consultation expert system based on human-computer interaction. The exact numbers of psychological consultations are used as experimental subjects and divided into two groups. The online psychological consultation expert system based on human-computer interaction is the experimental group. The traditional online psychological consultation is used as the contract group. Under the premise of controlling a single variable, two sets of consulting efficiency, consulting success rate, and comprehensive working time recorded separately.

#### 4.1. Experimental Parameter Settings

The following table reflects the detailed configuration of experimental parameters in the experimental and control groups. Table 1 is an experimental parameter setting table.

<table>
<thead>
<tr>
<th>Symptoms of expression</th>
<th>Experience group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>Light</td>
<td>Light</td>
</tr>
<tr>
<td>Anxious</td>
<td>Light</td>
<td>Light</td>
</tr>
<tr>
<td>Fear</td>
<td>Severe</td>
<td>Severe</td>
</tr>
<tr>
<td>Confusion of thoughts</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Worry about fainting</td>
<td>Severe</td>
<td>Severe</td>
</tr>
<tr>
<td>Fear of loneliness</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>Light</td>
<td>Light</td>
</tr>
<tr>
<td>Chest tightness</td>
<td>Severe</td>
<td>Severe</td>
</tr>
<tr>
<td>Muscle tension</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

In Table 1, psychological consultation conditions are set for the two groups of experimental personnel, mainly for emotions, concepts, and physical conditions. In order to ensure the fairness of the experiment, the parameters of the experimental group and the control group are always the same.

#### 4.2. Experiment Process

In order to verify the difference between the online psychological consultation expert system based on human-computer interaction and the traditional psychological consultation system, the online psychological consultation expert system based on human-computer interaction was first set up according to the experimental parameters. The main form interface is set in the use of a human-computer interaction psychological consultation expert system. The main form menu includes four menu items: system management, user management, expert management, and help. Among them, the system management implements the user login system and the user’s permission to use menu items, and the user management realizes psychological consultation. The user clicks on “user login” to pop up the user login form. After the user enters the user name and password and click “OK,” the system judges the authority of each menu item of the main form according to the user name, displays the menu items that can be used, and realizes the management of the user in the system. After the user logs in, click on “Psychological Consultation” to pop up the psychological counseling interface. The counselor enters the symptoms and the degree of mental illness symptoms according to the format provided on the interface. The symptoms of mental illness symptoms are entered as keywords for symptoms of mental illness, and the degree input is mild, moderate, or severe as shown in Figure 5.

After clicking “OK,” the contents input by the consultant are stored in the input fact table and the user psychological counseling data table. After that, the diagnostics window will pop up. Suppose the consultant enters “happy” in performance 1 under emotion. In that case, a pop-up validity check window indicates that performance 1 “happy” is not in the rule table. However, the traditional online psychological consultation uses e-mail consultation, the “chat online” consultation form, and the online meeting consultation form.

#### 4.3. Consultation Efficiency Comparison

The experimental and control groups simultaneously conducted psychological consultations for the same number of patients and recorded the number of psychological consultations at 20, 40, 60, 80, and 100 minutes, respectively. In order to avoid the interference caused by unexpected events on the experimental results, the experiment is mainly based on set parameters. The specific results are shown in Figure 6.

From the analysis of Figure 6, it is shown that, in the online psychological consultation efficiency comparison, with the increase of time, the psychological counseling efficiency of the experimental group has been a relatively stable state, and the consulting efficiency is high. The experimental group psychological counseling efficiency is about 95%. The control group tended to stabilize before the consultation time of 50 minutes, and then, the efficiency increased suddenly and dramatically. The overall consultation efficiency is unstable. The efficiency of psychological counseling in the control group is approximately 75%. Therefore, it can be proved that the online psychological consultation expert system based on human-computer interaction compared with the traditional online psychological consultation system can improve the efficiency of psychological consultation by 20%.

#### 4.4. Consultation Success Rate

The experimental and control groups simultaneously conducted psychological consultation for the same number of patients and recorded the
consultation success rate after 20, 40, 60, 80, and 100 patients are consulted. In order to avoid the interference caused by unexpected events on the experimental results, the experiment is mainly based on set parameters. The specific results are shown in Table 2.

Comparing the data in Table 1, it is demonstrated that, in the online psychological counseling process, with the increase in the number of consultations, the success rate of online psychological consultation expert system consultation based on human-computer interaction has been relatively stable, and the success rate of consultation is relatively high, remaining at about 93%. With the continuous increase in the number of consultations in the control group, the consulting success rate shows an unstable downward trend. The consultation success rate is about 78%. Therefore, it can be proved that the application of an online psychological consultation expert system based on human-computer interaction can effectively improve the success rate of online psychological consultation.

4.5. Comprehensive Consultation Time Comparison. In order to ensure the rigorousness of the experiment, the use efficiency of the first two kinds of consultation systems is set, and the comprehensive consultation times are observed. The results of the comprehensive consultation time experimental demonstration are shown in Figure 7.

Figure 7 represents two kinds of online consultation system comprehensive consultation time. The higher the comprehensive consultation time is, the lower the consulting efficiency is. According to the previously mentioned analysis, it can be concluded that the experimental group is very different from the control group. Considering the overall situation, the experimental group has obvious advantages. In the time axis, if the guarantee of this method is within 20 minutes, the general trend of the rise of the traditional method has been geometrically increased. Therefore, the method is effective.
5. Conclusion

Psychological problems have become one of the major social issues in this era. The resulting psychological consultation has received increasing attention. In this social context, the development of computer and Internet technologies has led to the diversification of forms and methods of psychological consultation. These are in the form of e-mail consultation, “online chat” consultation, and consultation for online meetings. Although these forms do not limit psychological consultation to time and space, counselors must still participate. Therefore, the intelligence of psychological consulting has become the focus of artificial intelligence in the field of computer science. Therefore, using expert system technology to achieve psychological consultation also has a significant practical value and significance.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no competing interests.

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