Research on the Smart Psychological Medical Model from the Perspective of "Internet +"

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Abstract: The world is in the midst of the torrent of digital revolution, and its important sign is the use of cloud computing and artificial intelligence. In recent years, the field of mental health has been exploring a more systematic, intelligent and individualized service system. In this paper, an intelligent psychological medical system is proposed by using the new technology. First of all, the paper expounds the overall framework of the intelligent psychological medical model. Secondly, it introduces the operation process of the online consultation sub-system, the medical treatment sub-system and the tracking management sub-system, as well as the possible technical means and advantages. Based on digital technology, the system mines and analyzes user data, integrates expert resources, and covers the entire process from online consultation, offline medical treatment, and daily monitoring.

1 INTRODUCTION

Smart mental health care is a branch of smart medical care, which refers to the use of new-generation Internet of Things, cloud computing and other information technologies to manage, select and optimize things related to mental health construction, so that people can obtain an increasingly personalized mental health service experience (Shatte, Hutchinson, & Teague 2019; D' Alfonso, 2020).

Since the reform and opening up, China's mental health service has achieved tremendous development. However, there are still many problems such as shortage of medical resources, low treatment rate of mental illness, and lack of individual mental health knowledge (Li et al., 2012). The construction of the mental health service system is also in its infancy, and it is difficult to meet the needs of the society (Huang & Zheng, 2015). Scholars and clinicians have been committed to building a systematic and intelligent mental health service system that can meet the needs of the public (Qu et al., 2017). Big data, artificial intelligence have great potential to redefine our diagnosis and understanding of mental illness (Bzdok & Meyer-Lindenberg, 2018). In recent years, with the development of information technology, more and more industries have begun to explore the "Internet +" model, and the field of mental health is no exception (Peng, Xi & Zuo, 2017, Li et al., 2013). For example, online psychological testing, remote psychological counseling and some mental health service APP, have brought a lot of convenience to people. However, on the one hand, the construction of psychological community has problems of low information sharing (Bennett & Bennett, 2000) and lack of expert guidance. On the other hand, online psychological medical treatment also has problems such as imperfect system design and personal information leakage. Therefore, in the new era of the Internet, it is of great significance to build a smart psychological medical system based on the "Internet +" concept.

Starting from the three time periods before, during and after the outpatient clinic, this study constructed a systematic and comprehensive intelligent mental health care model, in order to provide individuals with more convenient and efficient mental health services.

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2 OVERALL SYSTEM FRAME DESIGN

The intelligent psychological medical system designed in this paper includes three functional modules, namely online consultation sub-system, medical treatment sub-system and tracking management sub-system. The overall structure of the system is shown in Figure 1.

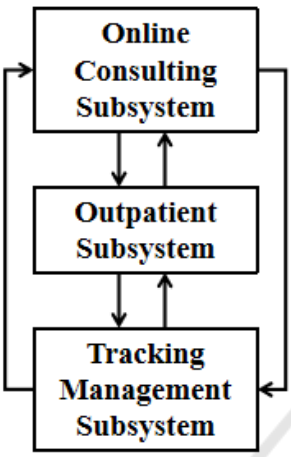

Figure 1: The overall framework of the smart psychological medical system.

If users need psychotherapy services, they can first conduct evaluation and consultation through the online consultation sub-system. If you need to see a doctor offline, you can choose a convenient medical institution online to initiate an appointment. The medical sub-system has functions such as registration information and medical record inquiry, which is convenient for mental health doctors to manage patient information. After seeing a doctor, the doctor can understand the patient's treatment effect through the tracking management sub-system, and the patient can report their own situation to the doctor at any time. In addition, the three subsystems are not one-way, but are linked to each other and can be cycled multiple times.

3 ONLINE CONSULTING SUBSYSTEM

The online consultation subsystem has both a web version and a WeChat applet version, which is convenient for users to use. Considering the particularity of mental health diseases, online consultation function is designed in this system, which is different from making a online prescription and other telemedicine modes. This is a supplement and auxiliary to psychological counseling, but also plays a role in popularizing psychological knowledge, providing network support and guidance for patients with psychological diseases.

3.1 Subsystem Structure

The online consultation subsystem includes four functional modules, which are psychological consultation, psychological assessment, user management and knowledge base management.

Psychological consultation interface, users need to input symptoms for consultation, including emotion, cognition, behavior and physical response four dimensions. The system will recommend consulting methods for users according to the symptoms or users can also choose independently. The psychological assessment function is a supplement to the self-assessment of symptoms. The results are deduced by inference machine and summarized and recorded in the user information base. There are three ways of consultation: psychiatrist online consultation, psychotherapist online consultation and computer aided decision making.

For the convenience of psychiatrists and psychotherapists, the system records the counseling information, evaluation results and psychological counseling process in user files. At the same time, the system analyzes the recorded archive information, generates statistical reports and feeds back to users.

Knowledge base adopts frame - production structure. Frame system reflects the classification of users' psychological problems, while production system adopts rule-knowledge representation. The frame structure is divided into two levels. The first-level framework is subdivided into depression, obsessiveness, fear, anxiety, addiction and mental disorders. The secondary framework is defined according to the causes of psychological abnormalities, such as study pressure, poor parent-child relationship, etc. The framework is divided as shown in Table 1. The framework is mainly composed of slot set, social relations and behavioral information.

Table 1: Knowledge base framework division method.

The primary framework	The secondary frame
Depression	Poor parent-child relationship
	Communicative difficulty
	…
Anxiety	Academic pressure
	Working pressure
	…
…	

3.2 System Reasoning Method

Considering that most of the information provided by users is incomplete and inaccurate, knowledge processing and reasoning methods in the consulting system must be able to deal with this uncertainty. Bayesian method is a method that can be used to establish uncertain inference.

The basic formula of Bayesian is shown in Equation (1):

$$p(H|E)=\frac{p(E|H)\times p(H)}{p(E|H)\times p(H)+p(E|-H)\times p(-H)} \quad (1)$$

As shown in the formula (1): p(H) represents the prior probability of event H occurring. p(E|H) is the probability that event H will occur after event E is known to occur. p(-H) represents the prior probability that event H does not occur. p(E|-H) is the probability that event H does not occur after event E is known to occur.

The factual argument for defining knowledge k is pH, the membership probability is G(k), and the weight is V(k→r). The relation is shown in formula (2):

$$pH = G(k)\otimes V(k\to r) \quad (2)$$

When there are multiple arguments (denoted by E_1, E_2, ..., E_n) and multiple assumptions (denoted by H_1, H_2, ..., H_m), these assumptions and arguments are mutually exclusive and complete. Considering the problem of computational difficulty, ignoring some small arguments (Yang 2018), formula (3) is deduced:

$$p(H_i|E_1E_2\cdots E_n)=\frac{p(E_1|H_i)\times p(E_2|H_i)\times\cdots\times p(E_n|H_i)\times p(H_i)}{\sum_{k=1}^{n} p(E_1E_2\cdots E_n|H_k)\times p(H_k)} \quad (3)$$

In advance, psychological counseling knowledge and expert experience are obtained through data mining techniques, and valid data are classified through machine learning (Louie et al. 2017), and then the probability of each event is scientifically defined. In the inference process, the user first inputs symptoms and psychological evaluation results, and in the matching process, the Bayesian method is used to improve the accuracy of the inference results.

4 OUTPATIENT SUBSYSTEM

The medical sub-system is designed based on the "WeChat" platform. If the user needs to go to the offline to see a doctor, they can directly jump to the consultation sub-system from the online consultation sub-system to make an appointment. Of course, the medical sub-system also accepts direct online appointments or offline registrations. The whole process of consultation is shown in Figure 2. It is divided into three parts, the first is the guide module, the second is the consultation module, and the third is the payment module.

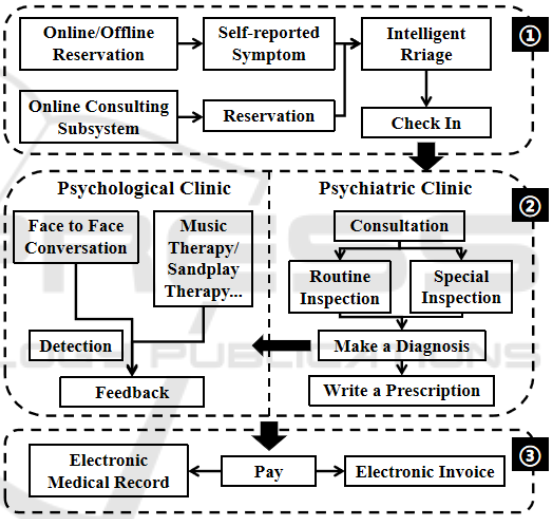

Figure 2: Full flow chart of medical treatment.

4.1 Guide Module

Relying on the official information portal, patients will get an exclusive QR code after successfully making an appointment and binding their medical insurance card. This QR code can realize the medical business content of each link such as check-in, payment, medicine collection, and query results. At the same time, it also reduces the sluggish process caused by the loss of various magnetic cards and documents, and the privacy leakage that may be caused by scanning various unofficial QR codes, which is convenient for unified management.

Intelligent triage can help patients who lack medical expertise find the department they need to see precisely. It is based on the patient's self-

reported symptoms and online assessment results. Users who are transferred from the online consultation sub-system will be automatically assigned to the department corresponding to the disease with the help of the intelligent triage system, and the road map of the hospital will be attached. Users who register offline or make direct online appointments need to conduct pre-examinations such as symptom briefing online, and then use the intelligent triage system for triage. After arriving at the hospital's consultation area, scan the code and sign in, the user will be guided to see the doctor according to the doctor's duty table. The intelligent triage system also has a designated appointment function for expert clinics. Returning patients will be given priority to recommend the doctor who consulted before.

4.2 Consultation Module

During the psychiatric consultation, the patient re-reported the symptoms, and the doctor recorded it on the doctor side of the medical treatment sub-system, and judged whether routine or special examinations were needed. After getting the inspection report, the doctor makes a diagnosis, and a computer-aided diagnosis is generated. If the two judgments are the same or close, the diagnosis will be confirmed after combination. If the two differ too much, send the information to an online expert for another judgment. The advantage is that the accuracy of diagnosis can be improved through manual diagnosis, computer assistance and third-party judgment.

If the patient makes an appointment for psychological consultation or therapy, the system will monitor the patient's facial expressions, body movements and other indicators through the equipment during the interview, music therapy and sand table therapy, so as to understand the therapeutic effect.

4.3 Payment Module

After the consultation, the doctor bills directly in the medical sub-system, and the patient scans the QR code to pay, which saves the time of queuing for payment in the payment area, which really brings speed and convenience to the patient (Yang, Gao & Yu 2019). The system is connected with the medical insurance information and the data of the third-party payment platform in real time, so that patients can pay part of their own expenses through the third-party platform, and the medical insurance patients can verify and pay the insurance fee through the electronic medical insurance channel.

After completing the payment for the consultation, the patient can directly obtain the consultation electronic bill and electronic medical record on the mobile phone. The medical sub-system is equipped with an electronic invoice storage column and a historical medical record column, which is convenient for patients to view and download at any time. This setting reduces the use of paper on the one hand, and avoids the loss of invoice and medical record information on the other hand.

5 TRACKING MANAGEMENT SUBSYSTEM

Tracking and observing users' physical conditions after treatment can facilitate doctors to diagnose their conditions more accurately. Daily monitoring can also achieve early detection and early treatment of physical and mental diseases. As a branch of the intelligent psychological medical system, the tracking management subsystem needs not only the support of WeChat program, but also wearable devices, which are connected through Bluetooth. The specific functions are shown in Table 2 below. The main functions of the subsystem are "monitoring", "consulting" and "community".

Table 2: The list of functions of the tracking management subsystem.

The main function	Sub-function
Monitoring	Current physical condition
	History record
	Early warning
Consulting	Online consultation
	Re-visit appointment
	Customer service
Community	Psychological knowledge
	Typical case
	Tree hole
	Mutual aid square

5.1 Monitoring Module

The "Monitoring" interface can view the current physical status, including heart rate, blood pressure, and can measure the health index through physical indicators. This data is provided by wearable devices such as iWatch. According to different medical conditions, users also need to fill in the medication feeling and psychological self-assessment form on

time, and can feedback to the doctor when necessary.

Past data is saved in the history folder, allowing users to view trends by week, month or year. When an indicator reaches the warning line, the system will automatically remind the user to avoid untimely medical treatment.

5.2 Consulting Module

The consultation module has three functions, which are online consultation, follow-up appointment and customer service.

Online consultation can provide graphic consultation and voice emergency. Monitoring data can also be easily transmitted to the consultation window. Patients can book a re-visit appointment online. After periodical medication or psychotherapy, the treatment can also be ended through online consultation. The consultation module also sets up an official customer service column, and users can solve their own problems through online or telephone Q&A and email feedback.

5.3 Community Module

The community module is divided into four functions, namely psychological knowledge, typical cases, tree holes and mutual aid square.

The program will push common knowledge related to psychology and typical cases of mental illness every day, in both text form and video, to help users increase their knowledge reserves. Users can earn points by reading articles, watching videos, or answering questions, which can be exchanged for prizes. Users can post what they want to say but can't say in the "tree hole", this place is completely confidential, not open to the public, and can be used as a trash can for bad emotions. The Mutual Aid Square is where users look for help. Users can write down their little troubles here and wait for others to answer them. Users can also create small communities to welcome friends with the same experience.

6 CONCLUSIONS

The smart psychological medical system innovatively adopts the whole process mode of online consultation, offline treatment, and long-term tracking. The online counseling sub-system recruits experts to provide psychological counseling and psychological assessment. Design knowledge base using framework-production structure. Finally, the Bayesian method of data accumulation is used to realize the uncertainty inference of the pattern. By building a closed loop from guidance, consultation to payment, the medical treatment sub-system optimizes the medical treatment process and provides digital, intelligent and convenient outpatient services. The tracking management subsystem combines dynamic monitoring, online consultation, remote management and community building to provide users with personalized, precise and systematic mental health services.

The smart psychological medical model makes full use of the technological advantages of the "Internet +" era and the knowledge and skills of psychology and psychiatry experts. It has the advantages of high coherence and strong scalability, and can play a positive auxiliary role in the implementation of smart medical treatment and smart psychology.

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