Research on Pain Information Management System Based on Deep Learning

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Abstract. The hospital accelerates the construction of the "trinity" of electronic medical records, smart services, and smart management, and the construction of hospital information standardization is an important part of hospital construction and hospital development, because information technology can improve overall work efficiency and standardize technical processes., reduce management costs, enhance the image of the hospital and other benefits. Pain management information system is a postoperative analgesia management system based on deep learning for clinical information processing and wireless network, with wireless comprehensive pain assessment, interactive patient pain education, wireless comprehensive pain follow-up, individualized patient self-controlled analgesia, wireless Real-time PCA monitoring, analgesic equipment maintenance, wireless analgesic sign monitoring, simple airway management and first aid, pain information management and analysis, and branch hospital quality control management and other functions.

Keywords: Deep learning · Internet of Things · Pain Management

1 Introduction

Promoting the high-quality development of hospitals is an inherent requirement for the reform and development of public hospitals in the new era. In 2021, the "Opinions on Promoting the High-quality Development of Public Hospitals" issued by the General Office of the State Council (Guobanfa [2021] No. 18) proposes to lead the new trend of high-quality development of public hospitals and promote electronic medical records, smart services, and smart management "Trinity" smart hospital construction [1]. At present, all regions are actively exploring smart hospital construction plans in order to better improve the quality and efficiency of medical services. However, during the "14th Five-Year Plan" period, how to promote the construction of smart hospitals to achieve the high-quality development goals of public hospitals has become a hot topic in the current hospital management circle. This paper analyzes the connotation and construction ideas of smart hospitals, and explores the key issues in the construction of smart hospitals in combination with actual needs, so as to provide decision-making basis for the planning, construction and development of smart hospitals under high-quality development [2].

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At present, most of the tertiary hospitals in my country have completed the construction of clinical diagnosis and treatment, beneficiary services, clinical management, operation management and other systems based on the hospital information platform, and started a new round of smart hospital construction, focusing on building pre-hospital, in-hospital, and post-hospital systems. The online and offline integrated convenient medical service system has vigorously developed Internet medical care, and the smart hospital service network has begun to take shape. This paper focuses on the subject of pain, introduces computer artificial intelligence, and builds a deep learning model through the mining and processing of clinical data to carry out informatization construction of pain information management [3–5].

2 Research Status

The current status of pain control Theoretically, almost 95% of acute pain, 80%-85% of cancer pain and 50%-60% of chronic pain can be effectively controlled by existing drug treatment, which does not include other Some treatments, but not the case. Acute pain, especially postoperative pain, although highly effective analgesic drugs and high-tech analgesic techniques have been developed and applied in clinics, foreign literature reports that 50% to 70% of postoperative pain cannot be relieved most effectively [6]. According to survey results, the proportion of people suffering from chronic pain accounts for 30% of the total population in developed countries, and more than 1/2 of patients with moderate to severe chronic pain in the United States have not received adequate analgesic measures. Zhao Jijun conducted a pain survey on more than 5,000 outpatients. It was found that 40% of the patients had pain symptoms, and more than 50% of them had pain as the main symptom. Although a considerable number of patients had taken some analgesic measures, more than 50% of the patients still suffered from the physical and psychological distress caused by pain. Affect the quality of life of patients [7–9].

Artificial intelligence can use computer systems to simulate the characteristics of human intelligence processes, and can even achieve self-correction through supervised or unsupervised algorithms. These persistence enable it to accelerate the realization of personalized and predictive health care. With the diversification of data sources and the accelerated accumulation of data volume, health care data has the characteristics of multi-dimensionality, complexity and heterogeneity [10, 11]. These health and medical data specifically include imaging data, data acquired by wearable devices, electronic health records, proteomic data, and genomic data. In the face of high-dimensional medical data, many classic machine learning algorithms such as random forest and support vector machine can no longer handle it optimally. Deep learning can use multi-layer complex structures or multiple processing layers composed of multiple nonlinear transformations to process data, and can dig out abstract features at different levels from complex sample data, which enables it to accurately learn from the underlying regularity and pattern characteristics are mined from medical data. At this stage, deep learning has been widely used in the field of health care [12–15]. Affected by the great success of deep learning models in image classification tasks in 2012, deep learning has achieved many remarkable results in medical imaging diagnosis, including the segmentation and classification of different tissues, organs or lesions, etc. In some radiology diagnostic tasks, the performance achieved by deep learning has reached or even exceeded the level of human experts. In recent years, due to the advancement of natural language processing technology, deep learning models have gradually shown excellent performance in the processing of non-image data such as signals and texts. Wearable devices and electronic health records contain a large amount of valuable non-image data, which can be used for patient health monitoring, disease risk prediction or disease diagnosis, which makes deep learning research in these areas gradually increasing. Deep learning can not only diagnose corresponding diseases through conventional imaging data, but also discover new diagnostic directions or provide new insights. For example, retinal image passbands are used to diagnose eye diseases such as diabetic retinopathy, but some studies have found that deep learning models using retinal images can also accurately diagnose Alzheimer's disease, assess cardiovascular disease risk90 and predict gender etc., and this type of work likely represents a new class of scientific discovery methods [16]. In addition, the use of preoperative CT imaging is also helpful for noninvasive EGFR mutation prediction. Recently, deep learning has also achieved great success in micro-level research such as protein structure prediction, RNA three-dimensional structure prediction, and cell internal structure exploration. Research progress in diagnosis, drug development, etc. [17–20].

3 Research Content

The pain management information system is an analgesic management system based on IoT sensors for data collection, hospital information system patient clinical data extraction, clinical information and sign data processing through deep learning models, and often wireless network transmission. With wireless comprehensive pain assessment, interactive patient pain education, wireless comprehensive pain follow-up, individual patient-controlled analgesia, wireless real-time PCA monitoring, analgesic equipment maintenance, wireless analgesic sign monitoring, simple airway management and first aid, pain information Management analysis, as well as functional modules and hardware such as branch quality control management. In the integration of postoperative analgesia management and painless delivery, wireless network technology is used to send the data of patient-controlled analgesia (PCA), pain evaluation, sign monitoring, pain education, and equipment information to a dedicated server, and integrate them through wireless network The platform saves, optimizes, and counts the data, and monitors the patient's analgesic data and the doctor's pain management work in real time on the monitoring platform in the doctor's office, nurse's desk, operating room and other places.

4 Research Steps

4.1 Data Collection

Information collection mainly includes medical history (location, nature, process of pain, inducing factors, aggravating or relieving factors, accompanying symptoms, past history, etc.), physical examination (general examination, cranial nerve, motor nerve, sensory nerve, joint examination, etc.) etc.), laboratory tests, imaging tests, other auxiliary tests, etc.

4.2 Data Fusion

Through the collection and filing of the above data, a large amount of data can be obtained, and big data technology can transmit and store it in the cloud to form a pain knowledge database, providing direction and basis for the diagnosis and treatment of individual targeted pain pathological factors.

4.3 Knowledge Base Construction

Construction of the pain knowledge base: the pain knowledge base is used to store the knowledge in the diagnosis process of pain pathological factors. Including basic information, rules and other relevant information. The diagnosis process of pain pathological factors is carried out by simulating the way of thinking of clinical experts through the knowledge in the pain knowledge base. Therefore, the pain knowledge base determines the quality level of diagnosis of pain pathological factors. In the process of diagnosis and syndrome differentiation, production rules are mostly used. Production rules generally appear in the positive.TEIEN. Mode. When the preconditions are met, the system will derive the corresponding diagnosis and treatment prescriptions. In-depth learning simulates the process of diagnosis by clinical experts based on symptoms, signs, laboratory tests, imaging tests, etc., and between medical history, flow, signs, laboratory tests, imaging tests, etc. The content of the pain knowledge base needs to be used in the process of building the relevant relationship. The specific rules are combined with clinical practice, and are designed using the project combination method after discussions with external experts and members of the research team. The later system is continuously updated and improved according to the deep learning algorithm. The specific position of each item is determined according to the average score of the importance of the items by the experts: the average score of the expert opinion $>$ 4.5 points is the main item day, the average score of the expert opinion is 4–4.5 is the secondary item day, and the average score of the expert opinion is 4 points for auxiliary items.

4.4 Algorithm Model Construction

As a mathematical model based on probabilistic reasoning, deep learning is a new method for the expression and reasoning of uncertain knowledge. At present, deep learning has been widely used in intelligent systems dealing with uncertain information, including medical diagnosis, expert systems and other fields. Therefore, this system uses deep learning as an algorithm model in the diagnosis process of pain pathological factors. Deep learning mainly studies the method of uncertainty knowledge expression and reasoning. It is a directed acyclic graph with probabilistic annotations, which can predict unknown events by probabilistic methods based on knowledge base knowledge and existing data. The deep learning structure is composed of variable nodes and arrows connecting these variable nodes. Each node represents a random event variable, and the arrows represent the interdependence between nodes. The appearance of a cause node may lead to a certain result, which can be expressed as a conditional probability, not an inevitable situation. The conditional probability table is a collection of conditional probabilities used by deep learning to describe each variable node. Deep learning can quickly obtain the probability combination of each basic event according to the network structure and the conditional probability table of the relationship between each node.

4.5 Algorithm Design

The essence of the diagnosis of pain pathological factors is to obtain the patient's specific "pain pathological factors diagnosis" based on various symptoms, signs, laboratory tests, imaging tests and other auxiliary examinations. There may or may not be a certain relationship between different symptoms, signs, laboratory tests, and imaging tests. Deep learning can well describe symptoms, signs, laboratory tests, imaging tests and "diagnosis of pathological factors of pain" this relationship between.

This system uses deep learning to study the relationship between symptoms, signs, laboratory tests, imaging and other tests and "pain pathological factor diagnosis". Pain symptoms, signs, laboratory examinations, imaging examinations and other medical record information sorted out from previous literature and clinical medical records, "pain pathological factors diagnosis" as each node in deep learning.

According to the rules in the pain knowledge base, the system will repeatedly match the input symptoms, signs, laboratory tests, imaging tests, etc. According to the rules, the diagnosis results of corresponding pain pathological factors can be obtained. The system records and stores medical history information, diagnosis and syndrome differentiation results to form a new database. The computer uses the learning algorithm of deep learning to automatically learn, analyze the relationship between medical history information and "pain pathological factor diagnosis" and data characteristics, determine the probability distribution according to the statistics of the data, form the pain pathological factor diagnosis and deep learning structure and its prior Probability table. With the continuous increase of data, the computer constantly updates and improves the deep learning structure and its prior probability table, which will improve the accuracy of its application. See Fig. 1.

4.6 System Development

The system is developed using the JAVA programming language, based on the BS architecture of J2EE, and supports multi-platform data docking and browser access. The backend adopts the mainstream framework in java: spring for transaction management, which is convenient for decoupling, simplifies development, supports AOP programming, supports declarative transactions, facilitates program testing, facilitates integration of various excellent frameworks, and reduces Java EE API The advantages of difficulty in use; mybatis has relatively high flexibility for underlying data operations; maven manages jar packages; the architecture uses spring mvc, and Spring Web MVC is also an implementation of the service-to-worker model, but it can be optimized, and the front-end controller is Dispatcher The Servlet application controller is actually split into a handler mapper (Handler Mapping) for processor management and a view resolver (View Resolver) for view management, and the page controller/action/processor is the implementation of the Controller interface (it can also be any POJO class); supports localization parsing, theme parsing, and file uploading, etc., provides a very flexible

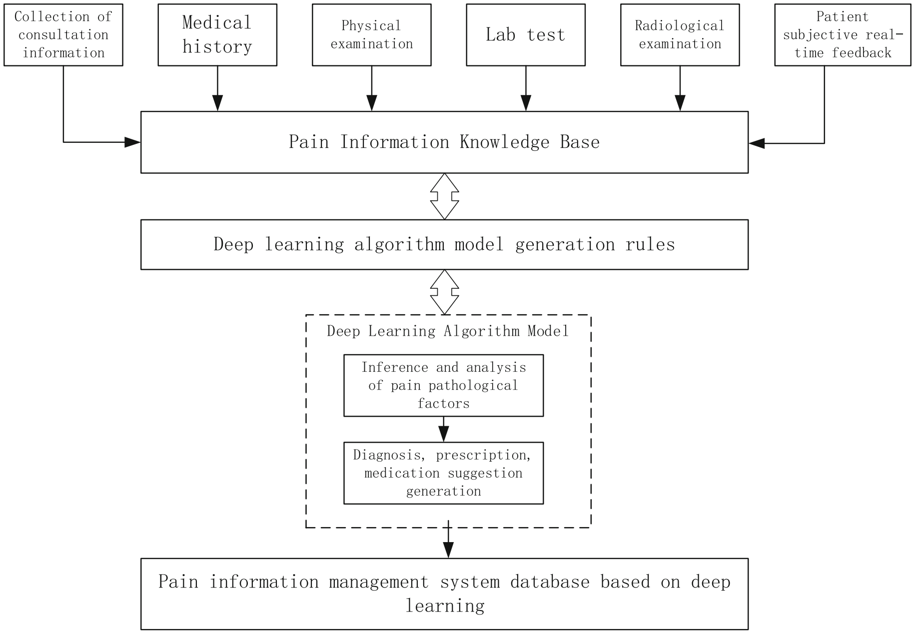

Fig. 1. Architecture Diagram of Pain Information Management System Based on Deep Learning

data verification, formatting, and data binding mechanism, and provides powerful contractual programming support that conventions are greater than configurations (principle of convention priority).

5 Functional Modules

Infusion monitoring: visualized and centralized monitoring of infusion status, real-time data collection and timely alarm. It can improve the safety of infusion and save the cost of medical management.

Pain assessment uses deep learning algorithms and mobile terminal assessment tools to transmit pain assessment values remotely. It can reduce report registration, form electronic medical records, and improve work efficiency.

Quality control management: provide statistics on the analgesic effect and workload of postoperative analgesia. It can assist the department to optimize the quality management of postoperative analgesia.

Patient-side application: prompting patients to self-control analgesia and guiding patients to self-evaluate their pain. It can improve the quality of analgesia and reduce the insufficient analgesia.

6 Summarize

Effective management of pain information, including research on the interaction between equipment and the Internet of Things, realization and optimization of postoperative analgesia and pain management processes, based on the above components to achieve analgesia, and provide effective services and assistance to patients; hospitals use artificial intelligence deep learning, Internet of things technology and other informatization methods can improve overall work efficiency, standardize technical processes, reduce management costs, and enhance the image of hospitals. Serve patients better!

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