SUPPLEMENT ARTICLE

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Abstract

001 | Current approaches to enamel remineralization: from fluoride to biomimetic technologies

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Abstract: In recent years, dental remineralization has gained much attention from clinicians as a treatment procedure for demineralized teeth. With the aim of avoiding the loss of the dental structure, the application of specific substances on early caries or erosions can promote the deposition of inorganic ions on the dental surface thus reverting the pathological process. Fluoride is well known for its ability to inhibit demineralization and promote remineralization. Fluoride ions are able to replace the hydroxide ions contained in the hydroxyapatite crystal structure of the teeth thus forming the mor resistant fluorapatite. In fact, the lower solubility of fluorapatite compared to that of hydroxyapatite results in higher acid resistance of the enamel when exposed to exogenous and endogenous acids. Despite this, some limitations are related to fluoride use like the action dependent on phosphate and calcium ions availability, the effect limited to the enamel outer surface, and the risk of fluorosis. On the basis of this consideration, recent research has been focused on the development of non-fluoridated remineralizing agents based on different technologies. Among the others, the most relevant remineralizing substances are represented by Amorphous Calcium Phosphate (ACP), Casein Phosphopeptides – Amorphous Calcium Phosphate (CPP-ACP), bioactive glass, self-assembling peptide, and nano-hydroxyapatite (n-HAP). The aim of the present research is to describe the different remineralizing agents now available on the market and to critically review the evidence regarding their true clinical potential.

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002 | Establishment of Optimal Non-Pharmaceutical Clinical Information Management to Alleviate Spinal Stenosis

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Objectives: Spinal stenosis causes back pain by narrowing the spinal canal, neuromuscular canal, and intervertebral cavity in the center of the spine. It progresses slowly over months to years and rapidly worsens when trauma occurs. Spinal stenosis occurs in the 50s and 60s and women tend to show more trends. Spinal stenosis can lead to spinal cord injury, leg pain, motor sensory impairment, neurological symptoms in the legs and urination disorders. To this end, it is necessary to prevent spinal stenosis through the application of a non-pharmaceutical clinical information management. Therefore, this study is to establish an optimal clinical information management for non-pharmaceutical therapy to alleviate spinal stenosis.

Methods: The subjects of this study were 108 people who visited the orthopedic surgery located in the metropolitan area to participate in this paper. The data were conducted through interviews and surveys from May 5 to July 2, 2021. In order to alleviate spinal stenosis, a t-test was performed before and after non-drug clinical information was applied. The condition of spinal stenosis was performed by a t-test over time

Results: The research results are as follows. Firstly, garlic intake continued to significantly decrease symptoms of spinal stenosis after application than before clinical information management was applied was applied (t = 6.25, p<.01). Secondly, acupressure significantly decreased spinal stenosis after application than before clinical information management for non-drug treatment (t = 2.79, p<.01). Thirdly, for non-pharmaceutical treatment, the spinal stenosis decreased significantly after application than before clinical information management (t = 4.18, p<05). Fourthly, in stretching, the condition of spinal stenosis improved significantly 10 days after application than before clinical information management

Conclusion: From the derived results, it was confirmed that clinical information management can contribute to alleviating spinal stenosis. It is also effective for other spinal diseases and is expected to contribute to applied research

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003 | Pixel Correlation Constraint based Pathological Liver Vessel Segmentation

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Objective: Semantic segmentation is widely used in many fields, such as medical images, autonomous driving, satellite images, etc. The goal of semantic segmentation is to predict pixel-wise labels. The existing deep-learning-based segmentation network relies on massive annotation samples to achieve good segmentation performance. However, the well-trained segmentation models still need to improve in some areas, especially the boundary areas. In the paper, we present a pixel correlation constraint for pathological liver vessel segmentation, which is a critical step for diagnosing microvascular invasion.

Methods: In the paper, we propose a dual-branch network composed of one encoder and two decoders. The framework is given in Figure 1. The encoder is used to extract basic features for the prediction task. The two decoders are devised to predict segmentation and super-pixel results, respectively. The super-pixel is a group of pixels that share common characteristics (pixel intensity and color). Considering the similarity of the super-pixel's internal feature and the differences among the super-pixels, we add the pixel correlation constraints to guide the semantic segmentation prediction. Specifically, we randomly sample the two pixels in the same super-pixel as the positive sample and the inside and outside two pixels along the segmentation boundary as the negative sample. Similarly, we hope that the differences in the pixels' features in the same segmentation label are less than those in the different segmentation labels. We sample many pairs of pixels, some of them in the same label are as the positive samples, and others in the different labels are as the negative samples.

In a word, the objective function consists of the cross entropy loss, the super-pixel segmentation loss, and the super-pixel constraint loss. The dual branch facilitates the segmentation network to learn more discriminating features, which benefits in achieving better segmentation results. Meanwhile, the pixel correlation constraint can effectively improve the segmentation performance of existing deep learning models on boundary areas.

Results: We experiment with the UNet[1] as the backbone. The experiment result shows that the proposed method with pixel correlation
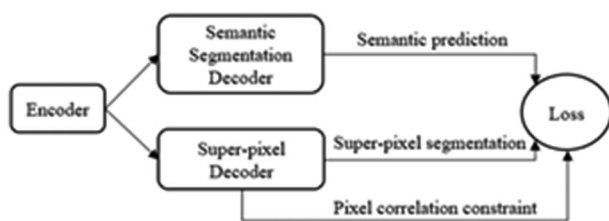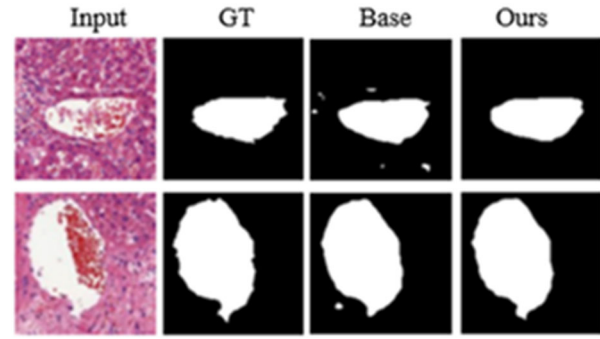

FIGURE 2 Visual results. [Colour figure can be viewed at wileyonlinelibrary.com]

constraints achieves the segmentation mIoU (mean Intersection-over-Union) metric from 90.69 % to 97.25% on the dataset MVI [2]. What's more, the proposed method can effectively improve the segmentation performance in boundary areas, as shown in Figure 2.

Conclusion: In this paper, aiming to improve the pathological liver vessel segmentation performance of the existing method, we present a pixel correlation constraint and devise a dual-branch network. The experiment shows that the proposed method can effectively improve the performance of the segmentation. The proposed pixel correlation constraint is pluggable for existing semantic segmentation networks.

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004 | An Interesting Point Detector for Tumor Medical Image Analysis

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Objectives: Detecting interesting points of tumor medical images is a critical problem in medical image analysis. Many methods are proposed in the literature to solve this problem. However, interesting points detected in a medical image are often cannot be detected in tumor medical images of the same scene taken under different situations. We will design a detection method that is robust under affine geometric transformation.

Methods: It seems reasonable that unifying several detecting methods into one algorithm might produce better detection results. The group of methods should be inherently similar to be mathematically sound for unification. We choose affine differential invariants of images for

FIGURE 1 The framework of the proposed dual-branch network.

our purpose. The Hessian matrix ($I_{20}I_{02} - I_{11}I_{11}$) of an image is already widely used in feature detection. Another second order relative differential invariant is ($I_{20}I_{01}I_{01} - 2I_{11}I_{10}I_{01} + I_{02}I_{10}I_{10}$). There are four less known affine differential relative invariants of order three: ($I_{30}I_{01}^3 - 3I_{21}I_{10}I_{01}^2 + 3I_{12}I_{10}^2I_{01} - I_{03}I_{10}^3$), ($I_{30}I_{02}I_{01} - 2I_{21}I_{11}I_{01} - I_{21}I_{02}I_{10} + I_{12}I_{20}I_{01} + 2I_{12}I_{11}I_{10} - I_{03}I_{20}I_{10}$), ($I_{30}I_{12}I_{02} - I_{30}I_{03}I_{11} - I_{21}^2I_{02} + I_{21}I_{12}I_{11} + I_{21}I_{03}I_{20} - I_{12}^2I_{20}$), ($I_{30}^2I_{03}^2 - 6I_{30}I_{21}I_{12}I_{03} + 4I_{30}I_{12}^3 - 3I_{21}^2I_{12}^2 + 4I_{21}^3I_{03}$). Interesting points are determined by combining local maxima of these invariants.

Results: We tested the proposed method on TCIA (The Cancer Imaging Archive) images with different affine distortions. Derivatives of images are obtained by convolutions of image kernels as described in the following figures.

$$\boxed{\begin{array}{ccc} -1 & 2 & -1 \end{array}} \qquad \boxed{\begin{array}{c} -1 \\ 2 \\ -1 \end{array}}$$

FIGURE 1 The convolution kernels for the first order derivatives

$$\boxed{\begin{array}{ccccc} 1 & -4 & 6 & -4 & 1 \end{array}} \qquad \boxed{\begin{array}{ccc} 1 & -2 & 1 \\ -2 & 4 & -2 \\ 1 & -2 & 1 \end{array}} \qquad \boxed{\begin{array}{c} 1 \\ -4 \\ 6 \\ -4 \\ 1 \end{array}}$$

FIGURE 2 The convolution kernels for the second order derivatives

It is found that an interesting point detector can only be robust to some tissue points. It is unlikely to use a single detector to detect all types of interesting points. We should use suitable detector for the detection of different tumor images.

Conclusions: The proposed method can be used in medical image analysis for tumor detection, classification, and recognition. There are also affine differential relative invariants of order four for detector construction. Convolution kernels for image derivatives need to be well designed for better performance.

005 | The Effect of Acupuncture on Vagus Nerve Under Heart Rate Variability Was Investigated Based on Data Mining

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Objective: Clinical observation and basic experimental studies have found that acupuncture can regulate the function of vagus nerve, so as to play the role of anti-inflammatory, regulating heart rate, blood pressure, gastrointestinal modynamics and so on.Heart rate variability analysis is a quantitative measurement method that can accurately reflect the cardiac vegetative nerve function, and has the characteristics of repeatable detection, non-invasive, stable and easy to operate.This paper aims to study the effects of acupuncture on vagus nerve in heart rate variability by using data mining and association rule technology, explore the relevant mechanism, and provide guidance and basis for clinical acupoint selection.

Methods: The clinical literatures on vagus nerve treatment by acupuncture were retrieved from CNKI full-text journal database, Wanfang Data Platform, Weipu Chinese Journal, China Biomedical Literature Database, Pubmed and EMbase.MicrosoftExcel2021 software was used to establish a database to collect the frequency, frequency, location of the acupoints and the use of heart rate variability parameters, and conduct descriptive analysis;SPSSStatistics28.0 and SPSSModelerSubscription18.0 software is adopted to improve the frequency analysis, correlation analysis and systematic cluster analysis.

Results: A total of 52 literatures were included, with 52 groups of acupuncture prescriptions, involving 50 acupoints and 14 meridians, and the total frequency of acupoints was 96 times.In the prescription, acupoints were mostly used on the head, face, neck and limbs. The top five acupoints were Neiguan(Pc6), Zusanli(ST36), Shenmen(Ht7), Guanyuan(CV4) and Sanyinjiao(Sp6), respectively. Acupoints of the hand Jueyin pericardium meridian, hand Shaoyin heart Meridian and foot Yangming stomach meridian were used more frequently.The analysis of acupoint compatibility and association rules showed that the most correlated acupoints were Guanyuan(CV4)-Zusanli(ST36).The often commonly used heart rate variability parameters are LF, HF, LF/HF, SDNN and RMSDD.

Conclusions: Acupuncture often selects acupoints on the limbs to regulate vagus, and the core acupoints areNeiguan(Pc6), Zusanli(ST36), Shenmen(Ht7), which have a great impact on the heart rate variability parameters LF, HF, LF/HF, SDNN and RMSDD. Acupuncture can complete the regulation of viscera-related functions by regulating the afferent fiber - nucleus of solitary tract - dorsal vagus nucleus - efferent nerve pathway.These studies can providing the acupoint selection ideas and basis for clinical research on the mechanism of acupuncture regulating vagus nerve.

006 | Research Status and Trends of Acupuncture and Moxibustion for Tumor Treatment Based on CiteSpace

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Objectives: This study aimed at exploring the research hotspots by conducting a visual analysis on knowledge map of related literature in China concerning acupuncture and moxibustion for tumor treatment in recent 10 years based on CiteSpace.

Methods: With "acupuncture and moxibustion" and "tumor" as the research topics, literature concerning acupuncture and moxibustion for tumor treatment from January 2012 to November 2022 was retrieved from the Chinese database on CNKI, and the data was imported to CiteSpace6.1.R3 software to perform a visual analysis of the authors, institutions and keywords, etc.

Results: A total of 1076 papers were retrieved, and 831 papers were included after selection. The number of annually published papers was on the rise and the number of annually published papers increased rapidly in the last five years. The map generated included 233 institutions and 316 authors. Guangzhou University of Traditional Chinese Medicine was the institution which had the largest number of publications (83 papers), and there were 4 authors who had published more than 4 papers in one year. A team with GUO Yi, WANG Bin and CHEN Bo and others as the core was formed. The communication between authors was limited within the team, with less cooperation between institutions. There were a total of 294 keywords. When the topic-related keywords were excluded, the top five keywords of frequency were "chemotherapy", "breast cancer", "warm acupuncture", "electroacupuncture" and "gastric cancer". The cluster showed that research fields mainly included "gastric cancer", "colorectal cancer", "warm acupuncture", "nausea and vomiting" and "breast cancer".

Conclusions: The study on acupuncture and moxibustion for tumor treatment is now developing vigorously. And there are a variety of treatment methods. At present, the clinical research mainly focuses on the related adverse reactions of acupuncture and moxibustion for tumor chemotherapy treatment. The study on nausea and vomiting caused by warm acupuncture and moxibustion for gastric cancer and colorectal cancer chemotherapy treatment may become a cutting-edge development trend.

007 | Three-dimensional analysis of pharyngeal airway characteristics in adolescents related to facial skeletal pattern

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Objective: The upper airway refers to the anatomical part from the top of the nasopharynx to the lower end of the cricoid cartilage, including the nasopharyngeal, velopharyngeal, oropharyngeal and laryngopharyngeal segments, which are the basis for the exchange of gases between the body and the atmosphere. This study was intended to probe into the relationship between adolescent patients with different sagittal skeletal facial malocclusion and pharyngeal airway morphology.

Methods: A total of 85 teenagers aged 12–18 who had cone-beam computed tomography were divided into 3 groups: skeletal Class I, Class II, and Class III according to their ANB angles. The volumes of the upper pharyngeal portion and nasopharynx, and the volume and morphology of the lower pharyngeal portion and its subdivisions (velopharynx, oropharynx, and hypopharynx) were assessed. Correlations between variables were calculated by the Spearman correlation analysis. Correlations between the logarithms of airway volumes and the ANB angle values were evaluated as continuous variables with linear regression.

Results: It was observed that the minimum axial area (AxMin) in the Class II group were preferentially smaller than those in the Class III group and Class I groups. In addition, the lower pharyngeal portion, the velopharynx, and the total airway respectively, and significantly different morphology. Class I facial skeletal pattern subjects are significant differences between Class II groups and Class III groups in the nasopharynx. Furthermore, L1/MP correlated with the upper pharyngeal portion. Also, MP/FH correlated with the upper pharyngeal portion.

Conclusions: Adolescent patients with type II orofacial type have a smaller minimum airway cross-sectional area in the hypopharyngeal cavity, velopharyngeal, and oropharynx than those with type I and III orofacial type. The airway shape of patients with skeletal class II is mostly slender, which is smaller than that of skeletal class I and III. Furthermore, the size of the upper airway in patients with different sagittal orofacial types is closely related to dentition and jaw structure. However, there was no significant difference in the size of the pharyngeal airway between the three types of adolescent patients with different sagittal osseoplanes.

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008 | The complete chloroplast genome of *Blidingia minima*, a kind of green macroalgae with medicinal value

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Objective: *Blidingia minima* (Nägeli ex Kützing) Kylin, 1947 is a kind of marine macroalgae with global distribution. It mainly grows on the rocks in the intertidal zone and has application value in medicine, food, and feed. For example, it has the medicinal value such as hypoglycemia and anticancer. Phylogenetic research based on the complete chloroplast genome of *B. minima* is significant for the development of

genetically engineered drugs and the protection of biological genetic resources.

Methods: Fresh macroalgae of *B. minima* was collected from Dongsha Sandbanks, Yancheng, Jiangsu Province, China (33°19′57.059″N, 121°01′30.097″E). After cleaning the surface of *B. minima*, we sent the sample to Sangon Biotech (Shanghai) Co., Ltd. for DNA extracting and high-throughput sequencing. The genomic shotgun library and paired-end sequences were obtained using the TruSeq DNA Sample Prep Kit and the Illumina HiSeq 2500 platform. All sequenced *Ulva* and *Blidingia* species were taken as models for sequence annotation about the *B. minima*. The GeSeq software and Plastid Genome Annotator software were used for annotation before the homology comparison was used for correction. After obtaining the complete chloroplast genome of *B. minima*, we downloaded sequences from the NCBI database. All sequences were aligned with the BioEdit sequence software, and a Maximum-likelihood phylogenetic tree with *B. minima* and other 14 complete chloroplast genomes was constructed by using the MEGA 10 software.

Results: The complete chloroplast genome of *B. minima* was a circular molecule of 170,702 bp in length (GenBank accession number NC054284), and the percentage of A & T (70.78%) was higher than C & G (29.22%). The base composition of the chloroplast genome was A (36.67%), G (15.16%), C (14.06%), and T (34.11%). The *B. minima* chloroplast genome encoded 88 genes, including 59 protein-coding genes, 23 transfer RNAs genes, and six ribosomal RNAs genes. Also, the result showed that *B. minima* belongs to the genus *Blidingia* and is closely related to the genus *Ulva*.

Conclusion: The complete chloroplast genome sequence of *B. minima* was reported. This study will be helpful in understanding the genetic diversity of Ulvaceae, and provide the basis of organelle genome annotation for the further application of *B. minima* in the medical field.

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009 | Anti-inflammatory Activity of *Tilia tuan* extracts

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Objective: Macrophages exert its function through the production of effector molecules including nitric oxide, which display a wide range of important biological functions in inflammation, tumor and cardiovascular system. *Tilia* species are traditional medicinal plants for the treatment of influenza infections, fever, inflammations, sedatives, and diaphoretics. *Tilia tuan* Szyszyl has been used by the folk people of the Bai and Yi minorities in China to treat inflammation, rheumatism and pain, but there was no previous evidence about its anti-inflammatory effect. In this study, we determine the anti-inflammatory effects of the fractions of *T. tuan* on LPS-stimulated nitric oxide (NO) production in RAW 264.7 macrophages.

Methods: The air-dried leaf of *T. tuan* were extracted three with 70% aqueous EtOH, followed by being filtered and concentrated under vacuum to afford a crude extract. The extract was then partitioned with *n*-hexane, EtOAc, and *n*-BuOH, respectively. The EtOAc-soluble fraction was further separated by column chromatography using a gradient eluting system of aqueous MeOH (10% to 100%) to afford seven fractions (FA-FF). Each fraction was evaluated for the inhibition against LPS-stimulated nitric oxide (NO) production in RAW 264.7 macrophages.

Conclusion: There were five fractions exhibited obvious inhibitory activity. The inhibitory rates of ractions FB-FE against LPS-stimulated nitric oxide (NO) production in RAW 264.7 macrophages at 50 μM ranged from 54% to 87%, superior to that of the positive control L-NMMA at 50 μM. This study reinforces the use of *T. tuan* in folk medicine and suggests its utility for anti-inflammation.

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010 | A Mobile APP for Capturing Phenotypic Traits of Grain Crops and Chinese Herbal Medicine in the Field

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Background: In the era of artificial intelligence(AI), computing is everywhere. Software is everywhere because that software is the soul of device. In order to improve the efficiency of capturing the phenotypic traits of field plants and ensure the scientific and information management of plants test data, a data-capturing mobile APP is constructed to collect the field soybean plants phenotypic traits. It is well used in col-

lecting other grain crops and Chinese herbal phenotypes in the field. Following we take the soybean plant phenotypes collection as an example to illustrate the design and implementation of the mobile APP, and the application of AI technology in it.

Methods: The mobile APP is developed based on C/S structure, and its backend uses Eclipse development platform, JAVA programming language and MySQL database that are all open source and free resources. The front end of APP uses HBuilder X platform and MUI framework to realize a compilation that can run on both Android and IOS operating systems. The main functions of the mobile APP include six modules: plant management, plant picture management, breeding experiment management, data interface of lodging resistance measuring device, data entry and plant line query with flexible functions. It is one of the subsystems of the soybean computational breeding platform (SCBP) system. Firstly, planning and designed breeding experiments are carried out through the PC end of the SCBP system, and then the phenotypic information of scheduled soybean plants is collected in the field. Pictures and their relevant information are sent to the cloud and then analyzed by the SCBP system deployed in cloud servers. A deep learning-based algorithm which recognizes the flower color, flower number and leaf shape is designed and deployed in the cloud server to capture relevant data from photoes and filling them in the platform databases.

Results: The mobile APP achieves the high-resolution phenotypic capture of field plants with simple equipment. It is simple and easy to use in the field. With the recognization algorithm, difficulty of using LCD phones in the sunshine is avoided. To save traffic, APP users can also take pictures in the field and upload them to the cloud server where there are WIFI.

Conclusions: The practice has proved that the mobile APP is simple and practical. It is convenient for breeders to capture phenotypic traits anytime and anywhere. The method is very flexible and can be applied in many fields.

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011 | Extraction optimization, hypolipidemic activities in vitro and prediction model of a novel compound polysaccharides from Chinese herbal medicines by orthogonal design and quantitative theory

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Objectives: The optimization of extraction and hypolipidemic activities in vitro of a novel compound polysaccharides (CPs) and the prediction model of cholesterol-binding capacity were investigated in present research.

Methods: The CPs were extracted from Chinese herbal medicines (CHMs), which consisted of *Folium nelumbinis, Fructus crataegi, Fagopyrum tataricum, Lycium barbarum, Semen cassiae* and *Poria cocos* with the mass ratio of 2:4:2:1:1.5:1. The $L_9(3^4)$ orthogonal experiment design was adopted to optimize the extraction process of CPs. The binding force of fat, cholesterol and cholate of CPs were determined, and the forecast model of cholesterol-binding capacity was established by quantitative theory.

Results: The content of total carbohydrate, uronic acid and protein was 76.41%, 5.64% and 3.18% in the CPs. The consequences of range and variance analysis indicated that the influences of liquid-solid ratio, extraction temperature, time and mode on the cholesterol-binding capacity of CPs were significant ($P < 0.05$), which was in sequence of extraction time > liquid-solid ratio > extraction temperature > extraction mode. The strongest CPs cholesterol-binding capacity of 5.92 mg/g was obtained under the optimal extraction condition as follows: liquid-solid ratio 35:1 mL/g, extraction temperature 65°C, extraction time 75 min, and extraction mode ultrasonic-assistant extraction. The established prediction equation was accurate and reliable ($R = 0.95$). Furthermore, the binding force for fat, cholesterol and cholate of CPs were 26.49 ± 1.68 g/g, 5.00 ± 0.05 mg/g, 11.59 ± 0.11 mg/g at a dosage of 150 mg, severally, which were prominently stronger than those of cellulose ($P < 0.05$).

Conclusions: Therefore, CPs could be applied as a potential natural lipid regulator in pharmaceutical or functional food fields.

012 | Herbage Recognition Based on Knowledge Distillation in the Field of Herbal Medicine

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Objectives: There are abundant grassland resources in Inner Mongolia Autonomous Region, and herbage plays an important role in the growth and nutrition of cattle and sheep. However, the traditional monitoring of grazing behavior of cattle and sheep relies on continuous manual observation and recording by researchers for a long time, which is time-consuming and laborious, and also easy to cause misjudgment. Therefore, there is an urgent need for an efficient, intelligent and accurate technology to recognize the species of herbage.

Methods: To improve the accuracy and speed of herbage recognition on edge computing devices, a knowledge distillation algorithm is used

to compress complex convolutional neural network models, and it is applied on a jeston nano development board. In this paper, a herbage dataset is constructed, containing a total of 3889 photos of 22 species. The Cutout data enhancement method is used to equalize the number of herbage for the problem of long-tailed data in the herbage dataset, and a threshold-based image segmentation algorithm is used to separate the herbage from background to prevent the influence of specific growth environments on herbage recognition. Resnet101 is chosen as the teacher network to distill the knowledge of the lightweight model MobileNetV2.

Results: Compared with the teacher network, the accuracy of MobileNetV2 after knowledge distillation is lost by 0.11%, but the amount of model parameters is reduced by 18 times, and the speed of processing a single picture on the training platform is increased by 2.46 times. Compared with MobileNetV2 before knowledge distillation, the accuracy of MobileNetV2 after knowledge distillation increased by 3.08% and reached 95.76%. After knowledge distillation, MobileNetV2 is deployed on jeston nano, and the recognition speed reaches 0.100705s/image, which can achieve the real-time effect.

Conclusions: Experiments show that our method can successfully identify 22 species of herbage, and the knowledge distillation algorithm is used to reduce the number of parameters, which is successfully applied to the jeston nano development board.

013 | Research on design of medical protective clothing based on simulated annealing algorithm

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Objective: Heat dissipation of nursing suit is an important research topic in medical field. In the outdoor epidemic protection of medical personnel, heat conduction stress response may be caused in summer due to exposure to high temperature thermal radiation environment, high physical activity intensity, and wearing thick protective clothing. Therefore, how to evaluate human body-clothing environment heat exchange and human thermal response in high temperature environment is an important means to protect the life and safety of medical personnel. The results of this paper can be used for the prediction of human thermal physiological parameters, comfort evaluation and heat conduction experiments in high temperature environment.

Methods: Medical protective clothing is generally divided into single-layer and multi-layer. The garment studied in this paper is assumed to have four layers, in which the first layer is in direct contact with the external environment and the third layer has gaps with the skin. To establish the model, the skin temperature of the dummy in the high-temperature laboratory was set as 37°C. Using the heat conduction model, the optimal thickness of the high temperature overalls and the temperature change outside the skin of the dummies under different

constraints were found. Human experiment, virtual experiment and PDE simulation were used to simulate and experiment human thermal reaction fire in high temperature environment.

Results: The mathematical model of the constraint was established considering that the temperature outside the skin of the dummy did not exceed 47°C for 60 minutes and 44°C for 5 minutes. Through analysis, we get that the optimal thickness of layer II measured by Lingo software is 8mm when the ambient temperature is 65°C. When the ambient temperature is 80°C, the optimal thickness of the second layer and the second layer are 8mm and 5.6mm, respectively, according to the programming constraint model and Lingo software.

Conclusion: The model is established on the basis of general mathematical and physical equations and has applicability. In this model, the simulated annealing algorithm is used to divide the problem into several criteria, so that the solution of the problem has a certain level. , of course, in the solution of the mathematical physics equations, we just will investigate group after simple classification, take the general way to fast, not to more detailed division of boundary conditions, and the various parameters in various solutions given only for general or universal situation, given the lack of specificity. Based on this, we can divide the equation randomly according to the Monte Carlo method, and then formulate the parameters to determine the global stability of the equation. For other high temperature medical protection equipment, we can adopt the same method, can determine the heat transfer rate according to the wave equation, combined with this model can give the basic characteristics of heat protection materials. In the subsequent research, the model will be further improved by other heat transfer methods, so that the model can be used to study the temperature distribution of various parts of thermal protection clothing in different high temperature environments, which has certain practical significance for medical and other related fields.

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014 | Research on Contribution rate evaluation method of battlefield medical emergency equipment system based on Grey target theory

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Objective: Aiming at the contribution rate evaluation problem of battlefield medical first aid equipment system, the evaluation index of system contribution rate was constructed, the evaluation criteria of key technologies were established, and the bulls-eye value of main indicators of equipment was calculated and sorted by using grey

target theory algorithm, which provided a new scientific method for the contribution rate evaluation research of battlefield first aid equipment system.

Methods: Based on the grey target theory, the grey target comparison method of battlefield medical emergency equipment takes the target equipment and the existing domestic and foreign samples of similar equipment as reference. By establishing all the technical and tactical indicators and weights that affect the equipment capability, the index data of all the target equipment and reference equipment are obtained, the polarity of each performance index is determined, the standard mode is obtained, and the grey target transformation is carried out. The bullseye degree of each technical index of equipment and standard mode was calculated and sorted. The larger the bullseye degree was, the closer it was to the standard mode and the stronger the comprehensive efficiency was. The approximate equivalent thought was that the greater the contribution rate of equipment was.

Results: It can be seen from the final grey target comparison results that the bullseye coefficients of each equipment relative to the standard mode equipment are ranked as follows: equipment $Z_2 \approx$ target equipment $Z_0 >$ Equipment $Z_3 >$ Equipment Z_1, and target equipment $Z0$ achieves nearly excellent comprehensive performance as equipment $Z2$ due to the balanced comprehensive technical index performance. Through the above ranking, we can approximate evaluate the good contribution rate of target equipment $Z0$ in the current similar equipment system.

Conclusion: Based on the grey target theory, the contribution rate of battlefield medical emergency equipment system is evaluated. The target equipment is compared with the existing samples of similar equipment at home and abroad for reference. The standard mode equipment of this kind of equipment is generated through the technical index system. The equipment contribution rate can be approximately equivalent evaluated, and its rigorous and scientific demonstration process provides a new scientific method for the study of the contribution rate of battlefield medical emergency equipment system.

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015 | Cause analysis and prevention and treatment of sports ankle sprain in college students

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Objective: Ankle sprain is one of the most common injuries in sports, and the general causes of sports.Combined with the actual situation of teaching work, the causes and treatment of ankle joint injury in college students are analyzed and discussed, and then the corresponding preventive measures are put forward from the causes.

Methods: All undergraduate medical records were obtained for 82 (132) patients in 2019 – 2022, aged 18 – 22 years, 60 males, and 22 females.Statistical analysis was conducted according to the trauma site, nature, and movement, and we observed or talked with some injured students.Patients with minor injuries and injuries were given routine, local and special technical examination, and X tablet patients with obvious ankle swelling, pain, limited movement, suspected fracture and dislocation were confirmed.

Result: Of the 82 medical records, 66 ankle injuries were 66,80% of the total trauma and 16,20%, and 6 had meniscal trauma. Basketball, football, volleyball, track and field were ranked by incidence rate. In basketball, 49 injuries, accounting for 60 percent. Most of the injured were boys, while the girls used volleyball and basketball as the main injury sports. Medical records of 82 cases showed that soft tissue incidence was the highest, accounting for 87%. In the statistics, it is found that there are more minor injuries, which shows that the teaching is related to the teacher's guidance and teaching means.The number of male ankle injuries is higher than that of girls, mainly because boys are more antagonistic and competitive than girls, and they are keen to express themselves in sports, competitive, coupled with the lack of injury prevention concept and prevention knowledge.

Conclusion: Prevention of sports injury is of great significance to widely carry out mass sports, sports teaching and sports training. The following points should be paid to for the prevention of ankle ligament movement injury: 1) strengthen theoretical knowledge and improve self-protection awareness; 2) strengthen the scientific nature of teaching training, especially strength training and flexibility training; 3) prepare activities before exercise or training to make the ankle fully active and provide ankle protection; 4) strengthen medical supervision and conduct safety inspection and management of site equipment; 5) reasonably arrange teaching, training and competition.

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016 | Research on the Nonlinear Oscillator for Imitating the Behavior of Central Nervous System in Rehabilitation Medicine

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Objectives: Periodic motions of vertebrates, such as walking, swimming, and crawling, are results of coordination of many bodies controlled by their central nervous systems. The central nervous system generates periodic bio-stimulus signals for controlling muscles, and varies them according to the received signals from the brain for changing the motion pattern of muscles. Aiming at imitating the various periodic motions of the central nervous system via one model, we promote a nonlinear oscillator which has the variable response trajectories.

Methods: According to the invariant set theory, a nonlinear dynamical system has a stable limit cycle whose derivative respect to time equals to zero. Therefore, if a closed curve with the adjustable shape can be designed as the limit cycle of a dynamical system, this dynamical system can generate the variable periodical response. On this base, by making the derivation of a closed curve in the phase plane equal to zero, this closed curve is designed as the limit cycle of a nonlinear oscillator that for imitating the central nervous system. Furthermore, the stability of the Cardioid oscillator is analyzed according to the LaSalle invariant set theory, and its independent and coupling responses are simulated.

Results: Aiming at the independent nonlinear oscillators, even though the initial conditions are different ((-14, 152), (10, 90), and (19, -120)), these nonlinear oscillators spontaneously converges to a same steady-state response trajectory. With the changing of the symmetry of the oscillator's limit cycle, the time ratio of its forward trajectory increases from 38% to 62%. When a nonlinear oscillator disturbed by a pulse signal with amplitude of 45, frequency of 1Hz, delay of 0.5s, and duty ratio of 1%, its response trajectories converges to the steady-state trajectory. The converging times of the oscillators from the same initial conditions to a state on the limit cycle are 15ms, 5ms, and 2ms, when their corresponding converging gains are 0.005, 0.02, 0.5, respectively. Aiming at the coupled oscillators, when two coupled oscillators' coupling gains are equal to 5, their response trajectories from the different initial conditions are synchronized to the same steady-state trajectories. On the contrary, when their coupling gains are equal to 5 and -5, respectively, their response trajectories from the same initial conditions are synchronized to two steady-state trajectories with 0.5s delay.

Conclusions: The above mentioned results indicate that: (1) regardless with the initial condition, the proposed nonlinear oscillator can spontaneously generate the variable periodical steady-state response trajectory, (2) the response trajectories of the coupled oscillators are synchronized with the fix phase.

017 | Effects of Health Information System on Prevention of Psychological Degradation after Hysterectomy in Adult Women in Urban Areas

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Objectives: The incidence of uterine cancer in Korea is about 15.7 per 100,000 people, and the mortality rate is about 3.8 per 100,000 people. In the case of cervical cancer stage 1, a hysterectomy is performed. The rate of hysterectomy in Korea is more than twice as high as the OECD average. Hysterectomy causes not only physical aftereffects but also psychological loss. Hysterectomy is a complication in 23 per cent of women. Menopause symptoms may appear due to decreased female hormones after hysterectomy. More than 50 percent of women complain of various aftereffects after hysterectomy. Therefore, this study measures the effectiveness of health information system application on prevent psychological deterioration after hysterectomy in adult women in urban areas.

Methods: This study conducted a survey of 82 patients who visited the gynecology department in K area from April 6 to June 17, 2022. T-test was performed before and after the application of the health information system to prevent psychological degradation after hysterectomy. Psychological symptoms after hysterectomy were compared before and after application for 8, 16, 24, 32, and 40 days.

Results: The research results are as follows. Firstly, after hysterectomy, the quality of sleep increased significantly after application than before application of the health information system(t = -6.13, p<.05). Secondly, depression after hysterectomy decreased significantly after application than before application of the health information system(t = 4.86, p<.01). Thirdly. psychological conditions improved significantly when exposed to sunlight for more than 30 minutes each day than when not exposed(t = -2.79, p<.01). Fourthly, when listening to music, it was found that psychological state improved after 8 days of application than before the application of the health information system.

Conclusion: Through the results of the above study, the health information system has been verified to be effective in preventing psychological degradation in patients with hysterectomy. Therefore, after application of the health information system, it will contribute to psychological treatment not only for hysterectomy patients but also for other cancer patients.

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018 | A Robust Image Source Identification Method of Telemedicine Based on CNN

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Objective: In telemedicine system, patient remotely sends to doctor smartphone photos of prescription, diagnosis, and so on. To prevent these smartphone photos from tampering, image source forensics plays an important role. However, there are still some problems for the existing image source identification methods such as the huge amount of training data and so on.

Methods: We propose an image source identification method using multi-scale constraint convolution network and attention mechanism. The proposed method learns features by multi-scale convolution layers. The shallow convolution layer outputting feature map subtracts deep convolution layer outputting feature map, to eliminate the features relating to image content information. Using several multi-scale constraint convolution layers fuses features to learn enough features to increase accuracy. Using SENet, an attention mechanism model weights features to enhance the features relating to camera parameters.

Results: We collected 20*11 marked prescription photos from 11 types of cameras as a training dataset, and collect 20*11 unmarked prescription photos as a test dataset. The experimental results show that the accuracy of the proposed method reached 99.60%.

Conclusion: The proposed method can achieve high accuracy with only a small amount of training data. It can be seen that our method is superior to other existing methods in the same field. So it really suitable for some application scenarios with low resources, such as identify the authenticity of the photos uploaded by users in the telemedicine diagnosis system.

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019 | Fusing Multi-graph Structures for Visual Question Answering

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Objective: Medical VQA (visual question answering) requires high accuracy to help with diagnosis and medical advice. For VQA methods based on a graph and graph deep learning such as spatial graph, scene graph and so on, a kind of graph describes some kind of features, but ignores the other features, which leads to relatively low accuracy of VQA.

Methods: To improve accuracy, this paper proposes a new method by fusing multi-graph structures to describe more features. The proposed method fuses three graph structures weighted by questions, including spatial graph, scene graph and latent relation graph. Former two graphs may enhance latent relation graph. In features learning process, the proposed method constructs reduce-redundancy operation for the network layer. The proposed method designs pseudo tag to map graph structures and text to the pseudo tag's feature space; calculate the similarity between texts and pseudo tags, the similarity between graphs and pseudo labels; calculate weighted and sifted features and a matrix of graph structures according to similarity consistence of text and graph structures.

Results: Comparative experiments show the proposed method accuracy is 70.92%, BUTD method accuracy is 65.67%, DFAF method accuracy is 70.34%, MuREL method accuracy is 68.41%, MCAN method accuracy is 70.9%, ReGAT method accuracy is 70.58%, MLIN method accuracy is 70.28%.

Conclusion: The proposed method can fuse multidimensional features to enhance medical VQA method efficiency without extra parameter cost. However, the proposed method needs a fine auxiliary loss function, or VQA would be involved in outputting constant. The proposed method can help doctors make diagnosis, and has great application potential in the future intelligent medical and AI medical fields.

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020 | Detecting Unknown type of faceswap deepfake images with enhanced mask learning

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Objective: Deep learning enables deepfake to generate high quality human face images, which brings biological human identification very severe challenges. Existing methods [1-2] show poor generalization to unknown type of faceswap deepfake samples. We hope to improve detecting ability of unknown faceswap deepfake images.

Methods: Based on face-x-ray[2], we proposed a generative adversarial network to learn better adaptive mask for different faces. Our network includes 7 Convolution layers and 7 squeeze-and-Excitation layers to build a U-Net like generator network structure, while exploiting a typical Convolution Neural Network as our discrimina-

tor network. With a convex hull difference loss added into normal GAN loss, we can learn enhanced mask to generate a more generalized faceswap deepfake dataset to support faceswap detection. Our detection network uses EfficientNet-b0 to extract mask feature and designs a CNN based Encoder-Decoder model to achieve detection.

Results: We use real face dataset CelebA[3] to train our enhanced masks and generate our faceswap dataset. We use typical FaceForensics++ [4] and Celeb-DF[5] as test dataset to evaluate performance to detect unknown type of faceswap deepfake images. Experiments show that the proposed algorithm performs well in the case of unknown faceswap methods, and achieves AUC improvements of 0.994% on Face-X-ray[2], 7.08% on Two-branch[1] and 3.6% on Xception, respectively.

Conclusion: Our algorithm uses GAN to learn enhanced mask to select best fusion of faceswapping, which solves unreasonable tampering area problem. With fully utilized mask feature, our algorithm achieves better detection performance on unknown type of faceswap deepfake images.

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021 | Mask based Continuous Frame Faceswap Video Generation for Deepfake Detection

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Objective: As a typical deepfake technology, faceswap can generate high quality human face videos which are biological confusing to affect public cognition. Existing faceswap video detection methods [1-2] mainly depend on faceswap videos generated frame by frame, whose dataset is focused on specific faceswapping types and lack of generalization. However, mask based faceswap video generation enhacing generalization [3] cannot support continuous frame generation, keeping an open issue.

Methods: We propose a continuous frame faceswap video generation algorithm based on Face-X-ray[3]. We randomly select a target face image to replace background face frame by frame in a video. For each frame, we use Delaunay triangulation to divide the background face into several small triangles, and perform piecewise affine transformation on each small triangle to achieve smooth alignment of the two faces. Then we design a Generative Adverserial Network based on Convolution Neural Networks to generate mask and continuous faceswapping videos. We also offer an optimized dataset covering facial and background information up, which only contains faceswapping area to shield the interference features except the fusion features for deepfake detection.

Results: We use CelebA as the real image dataset and FaceForensics++ [4] and CelebDF[5] as the video dataset. We compare several detection models (LipForensics[1], Two-branch[2], EfficientNet-LSTM) training on the optimized dataset with on FaceForensics++ dataset. The performance is testing detection AUC on Celeb-DF dataset. Experiments show that our optimized dataset can help models get AUC improvement no less than 8.03%.

Conclusion: Our algorithm uses triangulation and affine transformation to solve mask based continuous frame faceswap video generation. With our mask enhanced dataset, deepfake detection performance is remarkbly improved.

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022 | Research on shortest path of medical communication network based on minimum spanning tree algorithm

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Objective: According to the needs of wartime medical treatment, a wired medical communication network with 139 large and medium-sized cities as nodes was established, and special medical network connection equipment was set up in each city. The total length of the shortest medical communication line was calculated under the condition of ensuring full connectivity. In other words, the graph takes 139 urban medical services as nodes and medical communication lines in reality as edges. Consideration should also be given to economy, network connectivity, network attack defense, and connectivity of important medical cities.

Methods: To study, analyze and model the undirected graph of healthcare construction in 139 cities in China. Firstly, the minimum spanning tree algorithm is constructed and the connectivity criterion – connectivity is calculated. Secondly, through computer simulation, Python running diagram algorithm is used and the graph is generated. Finally, analytic hierarchy process and Matlab tools are used to compare the quantified data and get a better model. After continuous comparison, 139 data connections are generated, and the traversal is finished to obtain the shortest path, which is displayed by invoking Baidu Map API to simulate the minimum spanning tree to increase readability.

Results: In this healthcare network diagram, the connection performance of a single connection is poor. Once attacked, it immediately results in multiple connected components and greatly reduced connectivity. Once the nearest neighbor n-point connection medical network graph is constructed, the anti-attack performance is greatly improved, and the strengthening of medical treatment in important cities also greatly improves the weight in the model.

Conclusion: The advantages of this model lie in its combination of medical treatment, economy and connectivity, strong anti-attack capability, and strengthening the medical treatment in important cities. By simulating random damage and connectivity, the connectivity performance of the model in the face of attacks can be accurately measured. The shortcoming of this model is that it is too abstract and does not analyze the strategic significance of medical treatment in specific cities. It only abstracts medical cities as nodes and increases the distinction between important medical cities. In the real promotion, the strategic position of the real medical city must be considered.

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023 | A summary of the Research on the Mechanism of Tuina Manipulation on Respiratory System

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Objective: The incidence of respiratory system diseases is the highest among all system diseases. With the increase of its incidence year by year, the prevention, diagnosis and treatment of respiratory system diseases are also increasingly valued. Tuina therapy is a traditional external treatment of Chinese medicine, which has played an important role in the treatment of many respiratory diseases in recent years. Up to now, there have been many clinical reports on the treatment of respiratory diseases with tuina, but few studies have systematically studied its mechanism of action.

Methods: The following electronic databases will be searched from establishment to Sep 2022: Cochrane Library, MEDLINE, Web of Science, EMBASE, Springer, Pub Med, World Health Organization International Clinical Trials Registry Platform, China National Knowledge Infrastructure, Wan-fang database, Chinese Scientific Journal Database, Chinese Biomedical Literature Databases, and other databases.

Results: Tuina can regulate the respiratory system directly or indirectly through the acupoints and parts on the body surface.

Conclusion: The paper analyzes and summarizes the mechanism of tuina on the respiratory system, with a view to providing reference for the follow-up study of this subject and providing guidance for clinical practice.

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024 | A study on cognitive behavior and psychology of selective torsion in adolescents

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Objective: To investigate the cognitive behavior and psychological condition of testicular torsion in adolescents.

Methods: A total of 1200 students and parents were selected from 12 middle and primary schools of Xingtai, including 600 students and parents, respectively. A total of 100 patients with testicular torsion were selected as research objects to compare the psychological status before and after the psychological intervention of the patients with testicular resection and reduction.

Results: The awareness rate of adolescent parents on testicular torsion and related knowledge was between 24.17% and 69.50%. Among them, for "what is the main pathogenic factor of testicular torsion" were the lowest. The awareness rates of " the incidence of testicular torsion teenagers", " youth is of testicular torsion were necrosis and irreversible atrophy of the first cause" and " familial heredity history is a risk factor for testicular torsion " were all lower than 45.00%. The most common testicular pain related behaviors in adolescents were impingement and trauma (51.00%), followed by intense exercise (46.33%), excessive masturbation (9.83%) and quiet sleep (17.33%). Before intervention, the SAS and SDS of the patients with orchiectomy were higher than those with testicular reduction and retention, and the difference was statistically significant.

Conclusion: The awareness rate of adolescents and their parents on testicular torsion and related knowledge is low. The most common behaviors related to sudden testicular pain in adolescents are impact and trauma. The psychological status of orchiectomy patients after operation is not satisfactory, but it is obviously improved after psychological intervention.

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025 | Research on Medical Quality Evaluation Model and Monitoring Management Mode under the Background of Big Data

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Objective: The medical industry is one of the most important pillar industries of the whole country and society, and medical data, as the carrier of medical industry information, is worthy of further exploration in this field. This paper applies data mining ideas to medical big data, which is a meaningful attempt to integrate big data technology with traditional medicine.

Methods: Firstly, the medical data in this paper are described. Secondly, the data mining, outlier detection algorithm and clustering algorithm are introduced, and the medical quality evaluation method is simply described. Finally, an improved outlier detection algorithm based on KNN is proposed. Dynamic threshold and comparison range are set and multiple pruning operations are carried out to reduce the time complexity of the improved algorithm, The division of the proportion of hospital outliers based on statistics and improved KNN is used as an outlier index to evaluate the medical quality of the hospital, focusing on the evaluation of defects and outliers.

Results: The experimental results show that the outlier index can detect the hospitals with poor medical quality, and the improvement of KNN algorithm greatly reduces the time complexity of KNN algorithm.

Conclusion: The medical quality evaluation model in this paper combines traditional medical thought and data mining thought. The model was optimized through experiments and applied to medical big data management.

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026 | Development of Providing Transport Application Using LBS and Open Data for Disabled People

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Objectives: There are various means of transportation for non-disabled people, but those with disabilities are quite limited. This study proposes an application that enables people with disabili-

ties to move more conveniently and safely. LBS (Location Based Service) A location-based service (LBS) refers to wireless content services that provide specific information according to a user's changed location. Based on this, public data is used to provide convenient facilities for the disabled and to respond quickly in case of emergency.

Methods: Recently released smartphones have built-in GPS receiver, Wi-Fi communication module, Bluetooth communication module, Near Field Communication (NFC) module, accelerometer and gyroscope sensor that can receive location information from satellite. The Open API (Application Program Interface) is a set of various functions for developing software applications, and the Open API is a core technology that implements data opening and sharing. Anyone can use this to collect open data and provide services. Google Map APIs enable real-time map search. After receiving an API from Google site, it needs to insert the API Key into the interface to synchronize it.The information from open data provides a basic drawing of the railway station, the location of convenience facilities, and information on the movement paths using transportation facilities for the handicapped (elevators, wheelchair lifts, etc. By combining LBS, user information, augmented reality, and SNS, services related to the means of transportation for the disabled can be advanced.

Results: Based on the ICT technology of smart phone and LBS, the concept design of mobile application for the disabled was carried out. As a result of the study, it was possible to identify facilities that are inconvenient, build a social safety net, and suggest transportation for the disabled. In addition, it is possible to identify facilities and preferences mainly used by the disabled and provide the location of the disabled in real time so that the family can feel safe and necessary welfare benefit notification services.

Conclusions: This paper is the research so that people with disabilities can improve their quality of life and adapt to society by proposing an application based on LBS technology and open data. This proposal is expected that more related application services will be developed for handicapped people.

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027 | The Optimization of Learning Rate for Neural Networks

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Objectives: In recent years, neural networks (NNs) have been a powerful tool for regression and prediction. However, several hyper-parameters (e.g. a learning rate) are required by NNs. Therefore, this study proposes a mathematical model to optimize the learning rate for NNs.

Methods: A case study of a linear regression model (i.e. a simple NN) is given to illustrate how to optimize the learning rate for NN. In the model, the true value is y, and the predicted value is $\hat{y}$; furthermore, the predicted value could be estimated by $(wx + b)$, and the squared error function $F(w, b)$(i.e. $(\hat{y} - y)^2$) is adopted as the loss function with the weight w of the input x and the bias b. In this study, the distributions of the weight and the bias are assumed as uniform distributions. Therefore, the mean loss value (MLV) could be estimated by $\int \int F(w, b)dwdb = \frac{(wx+b-y)^4}{12x}$; moreover, the MLV with gradients (i.e. the gradient of weight $g_w = \frac{\partial F}{\partial w}$ and the gradient of bias $g_b = \frac{\partial F}{\partial b}$) and a learning rate (i.e. η) could be estimated by $\int \int F(w - \eta g_w, b - \eta g_b)dwdb = \frac{(wx+b-\eta g_w x-\eta g_b-y)^4}{12x}$ which is also denoted as $G(\eta)$.

Results: For optimizing the value of learning rate (i.e. η^*) with a lower error, the objective function is denoted as $\eta^* = \underset{0 \le \eta \le 1}{\arg\min} G(\eta)$; the gradient of learning rate could be considered as zero, which is shown in the following equation $\frac{\partial G}{\partial \eta^*} = \frac{(-g_w x-g_b)(wx+b-\eta^* g_w x-\eta^* g_b-y)^3}{3x} = 0$. Therefore, the optimized learning rate could be determined as $\eta^* = \frac{wx+b-y}{g_w x+g_b} = \frac{1}{x^2+1}$ for a gradient descent algorithm.

Conclusions: This study proposes a mathematical model based on a probability model for optimizing the value of learning rate, and a simple NN is given for prove the mathematical model. In the future, the proposed mathematical model could be adopted for determining the optimized learning rate of complex NNs.

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028 | Cognitive Neural Mechanism of Operators on Task Complexity in Human-machine Collaboration Toward Medical Surgery

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Objectives: For human-machine collaborative operation, task complexity leads to the deviation of operator's cognition, and finally affects the operation performance such as operation time, operation error rate and labor load difference. The aim of this paper is to measure the complexity of tasks, and then study the neural mechanism of the influence of different task complexity on the cognitive deviation of operators.

Methods: First, in order to accurately evaluate the task complexity, a task complexity measurement model is established based on information entropy, focusing on the diversity factors including the number and type of tasks. Secondly, a 16-channel EEG (Electroencephalogram) experimental paradigm for human-machine collaborative operation is designed, which is an orthogonal experiment of the number and type of tasks. The brain wave information of the operator was recorded in the experiment, and the cognitive complexity model of the operator was established. Finally, the relationship between EEG information and

operation performance in the process of human-machine collaborative operation is analyzed.

Results: In the process of human-machine collaborative operation, task complexity has a prominent impact on EEG information. The diversity of task types has a more serious effect on brain wave momentum than the number of tasks. The brain wave momentum of task type switching was 62.5 % more than that of task number switching. In addition, periodic rest can alleviate cognitive load and reduce cognitive complexity.

Conclusions: In human-machine collaborative operation, EEG information can directly reflect the cognitive complexity of operators and reveal the direct impact of task complexity on operation performance. The type and number of tasks have a significant impact on the cognitive deviation of the operator. This study established a task complexity model to accurately quantify the complexity of the task. At the same time, the EEG information model of operator's cognitive complexity is established, which can quantify the operator's cognitive deviation. By analyzing the relationship between cognitive complexity and operation performance, the cognitive neural mechanism related to operation performance is revealed when operators are engaged in different complexity tasks. In the human-machine collaborative medical surgery, the proposed approach can provide theoretical guidance for reducing the cognitive load of operators, and further reduce the error rate of medical operation.

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029 | Fast Recognition of Individual Life Characteristics of Fattening Pigs Based on Deep Learning

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Objective: With the large-scale and intelligent development of pig breeding in China, these have been put forward for pig fine management, disease prevention and control and product traceability of higher requirements. The main reasons are as follows: Firstly, in large-scale breeding, the number of pigs is large, the breeding density is large, and the speed of disease transmission is fast. Therefore, it is necessary to accurately monitor the health status of each individual pig 24/7 through artificial intelligence technology; Secondly, the use of electronic labels is not friendly to pig breeding, and close contact with breeding personnel in the detection process will bring breeding risks. Therefore, the principle of face recognition is used for reference, combined with the in-depth study of pig facial features, to ensure the fine management of pigs, improve the pig breeding industry chain, achieve the traceability of pork products, and promote the research of pig life characteristics.

Methods: The following methods are adopted in this paper:

1.Data set construction. 2218 fattening pigs facial features were collected in the farm and divided into two data sets. After image enhancement, 6980 images were formed to meet the training requirements.

2.Make better pig face detection model. In order to improve the extraction and fusion ability of YOLOv5s algorithm for fine-grained features and multi-scale features, this paper uses PSconv to improve the network structure of YOLOv5s, and constructs the pig face detection model of PS-YOLOv5s.

3.Optimize the face weight recognition model of fattening pigs. The model can be divided into training stage and testing stage for face weight recognition of fattening pigs. In the training phase, the model links the image identifier of the training set with the features of the pig face image, and uses the loss value calculated by the loss function to reverse transmit the self-updating network parameters; During the test, the facial features of fattening pigs are extracted from the query library and image library in the test set, the distance between features is measured, and the key features of fattening pigs are obtained by sorting.

Results: 1.The method of PSconv improving YOLOv5s model proposed is effective. 2. Further verify that CBAM optimizes ResNet50 effectively.

Conclusion: This paper provides a feasible research idea for realizing individual characteristics of fattening pigs in large-scale and intelligent pig breeding. This research has certain guiding significance and reference value for identifying biological characteristics and diseased individuals

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030 | Research on Multi-Stage Progressive Biological Detection Algorithm for Detecting Patient Status in Isolation Ward

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Objectives: Biometric recognition is a major research and application direction in the field of computer vision, and how to accurately detect the growth state of biology is currently challenging. Most of the existing growth state detection methods use a single object detection network, and the accuracy of this detection method will greatly reduce when applied to images with low-quality and complex background environments. To this end, we propose a novel multi-stage progressive detection algorithm based on the swin transformer model, a synergistic design that optimally processes these images.

Methods: The proposed multi-stage progressive detection algorithm consists of three stages, stage 1: restoring low-quality images, stage 2: extracting valid biological regions, and stage 3: detecting biological growth states. Each stage uses Swin Transformer as the backbone network for feature extraction. Swin Transformer adopts the hierarchical structure in convolutional neural networks while enhancing the ability to capture long-range information, which allows the model to make good use of global information from shallow to deep layers. We introduce the Local Window Multi-Head Self-Attention module(LW-MSA), which performs non-overlapping window based self-attention instead of global self-attention. It significantly reduces the computational complexity of high-resolution feature map. Finally, to achieve sufficient interaction between different information in each stage, we build lateral connections between feature extraction blocks in adjacent stages to avoid any loss of information.

Result: To verify the effectiveness of the proposed multi-stage progressive detection algorithm based on the swin transformer model, comparison experiments are conducted with the Swin Transformer object detection network and the CNN-based detection algorithm Faster RCNN, respectively. The experiment uses our biological dataset containing a total of 2,000 images of 10 different species of plants such as Farfugium japonicum, and creeper, of which 720 are low-quality images with noise, blur, rain, and fog. The results show that our algorithm achieves 98.3% accuracy and bbox_mAP up to 81.8% on this dataset, with 12% and 18.6% improvement in accuracy, 16.2% and 21% improvement in bbox_mAP compared to Swin Transformer and Faster RCNN.

Conclusions: In this work, we propose a multi-stage progressive detection algorithm that improves the overall accuracy of detection by gradually restoring the input image and extracting valid target regions. In our experiments, this multi-stage detection algorithm outperforms the current mainstream single-target detection networks. In addition, our model possesses strong generalization capability and can be used in medicine for real-time detection of the status of patients in isolation wards and newborn babies in incubators, as well as for lesion detection on medical images.

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031 | Application of automatic object detection technology based on deep learning in Medical Image Processing

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Background: In recent years, the increase of open source high-resolution satellite remote sensing images (OSHRSIs) and the development of automatic object detection technology based on deep learning have promoted the research on ruins detection by archaeologists. The traditional remote sensing image ruins detection algorithms based on geographic information system (GIS) take time to design and have low accuracy of calculation results. Deep learning technology greatly improves the accuracy of remote sensing image ruins detection results and saves design and calculation time.

Methods: An automatic detection method based on STFI-RCNN is proposed to detect ancient city ruins in the Mongolian plateau region on OSHRSIs. Firstly, an improved Faster R-CNN based on Swin Transformer and FPN (STFI-RCNN) is proposed, which adopts Swin Transformer and FPN to extract features and solve multi-scale problems respectively, and local structures are optimized. Then, a dataset of known ancient city ruins based on OSHRSIs is established for model's training and evaluation. Finally, the model is used for automatic detection of ancient city ruins in selected areas of the Mongolian plateau.

Results: Experimental results show that the mAP of the model reaches 83.7%, which has obvious advantages compared with other models, and unknown ancient city ruins are detected in the research area.

Conclusions: The paper provides a potential method for ancient city ruins detection, which can be applied to other areas of the world in the future.

032 | Research on Data Enhancement Method of Image Segmentation Based on Convolutional Neural Network– Application of Medical Image Processing

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Objectives: The segmentation of medical images can separate the target features from the background in order to better observe the patient's condition, but can not be used for the precise discovery of special lesion area, in order to find the abnormal state of precancerous lesion cells in time, this paper aims to use convolutional neural network data enhancement method to distinguish cells in situ cancer stage.

Methods: This paper proposes a method of image enhancement based on CNNs, at first, this method constructs a class classifier, extracts the

image discriminant feature input convolutional neural network, and then extracts the cell features in the abnormal state from the amplified standardized features through a batch normalized algorithm, and uses it as a new input to further train the network parameters, thus obtaining the image enhancement data of in situ cancer cells, so as to achieve the purpose of highlighting early cancer cells.

Results: Through the experimental results on the public data set, the method proposed in this paper can effectively enhance the data information of the segmented image, compared with the existing image data enhancement algorithm, the accuracy of finding precancerous lesion cells is greatly improved. Compared with the HZ, GWA and AWB algorithms, the CNNs-based method proposed in this paper increases the data information by 2.56%, 3.13% and 2.44%; On this basis, the accuracy of identifying early cancer cells increased by 4.87%, 5.61% and 5.23%, respectively. It can be seen that the CNNs-based method can enhance the original image data more accurately, and then provide a powerful image basis for the accurate discovery of cancer cells in situ.

Conclusions: The image data enhancement framework based on CNNs and its related algorithms proposed in this paper is effective in discovering and generalizing the tiny features contained in medical images.

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033 | Research on Multimodal Medical Image Fusion Method Based on Fully Convolutional Neural Network

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Objectives: The fusion of different modal medical images can assist doctors comprehensive accurate judgment to carry out effective treatment, in order to solve the existing multimodal image fusion method in dealing with artifacts and block effect seriously two aspects, aims to use the fully convolutional neural network advantages in processing image, to solve the problems and improve the efficiency of image fusion.

Methods: This paper proposes a FCN-based multimodal image fusion method. This method first uses the characteristics of the FCN that can input the images of any size, and adjusts the proportion of the images of different modalities to achieve the optimal fusion standard, and then designs a image fusion algorithm based on component hierarchy to fuse images of different modes. A block detection algorithm based on multi-scale is designed and the block region is further optimized by adjusting convolution.

Results: On the basis of the experiment of the existing data sources, this paper puts forward the method comparing the existing image fusion method, the conclusion that is, the multimodal image fusion method based on the fully convolutional neural network can flexibly process for different modal images. Compared with the existing CNNs methods, FCN can expand the number of images for fusion processing by 25.35% due to the relaxed requirements on the size of the input images; the multi-scale-based block detection algorithm achieves 92.95% accuracy. On this basis, the fusion accuracy of FCN method is 4.77% higher than that of CNNs method, which shows that FCN method greatly improves the effect of image fusion. In terms of processing time, the FCN method is more flexible and can shorten the image preprocessing time compared with the CNNs method. According to the experimental results, the time of FCN is reduced by 17.78%, which greatly reduces the time of image fusion.

Conclusions: The proposed method and experimental results show that the FCN-based multimodal image fusion framework is effective and worthy of further study.

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034 | Research on Image Segmentation Algorithm Based on Machine Learning– Case Study on Medical Image Processing

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Objectives: Machine learning and deep learning methods represented by convolutional neural network have been widely introduced into the segmentation processing of medical images. However, due to the complexity of lesions and human organs, a fixed single learning method is not fully applicable to the segmentation of all medical images. This paper aims to draw general conclusions about the applicable principles of relevant methods by comparing different machine learning and deep learning methods on different modal images.

Methods: On the basis of the existing related research, this paper selects support vector machine, naive Bayes classifier, artificial neural network, convolutional neural network, five methods of X, CT, MRI and ultrasound, segment the images of the four modalities of X, CT, MRI and ultrasound, and compare the results of image segmentation.

Results: Comparing different machine learning and deep learning methods on different modality datasets, it can be concluded that different methods have different segmentation effects on the same modal image, for ultrasound images, the accuracy of SVM, Naive Bayes, artificial neural network, CNNs, and FCN was 85.83%, 92.75%, 94.33%, 98.14%, and 99.03%; the same method also has very different segmentation effects on different modal images. The segmentation accuracy of the four images using CNNs for X, CT, MRI, and ultrasound was 97.65%, 98.85%, 95.65%, and 98.14%. In terms of average accuracy, the accuracy of CNNs and FCN have better accuracy, the average accuracy of CNNs is 4.95 percentage points higher than that of artificial neural network, but the performance of CNNs in MRI image processing is 1.08 percentage points lower than that of artificial neural network. In the

practical application of medical field, different methods should be used for image segmentation according to different purposes and different modes to achieve the best diagnostic results.

Conclusions: This paper provides a series of general rules based on different image segmentation algorithms for different modal images, which has certain reference value for machine learning and deep learning related algorithms in image segmentation processing in the medical field.

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