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THE INTERNET OF THINGS NETWORK FOR HUMAN HEALTH DIAGNOSTICS BASED ON SMART PHONE DATA THE IRIS OF THE EYE

Abstract
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INTRODUCTION

Modern iris medicine began at the end of the 18th century and was first developed in Europe and North America. In modern iris medicine, the accuracy of the atlas is high, and it is widely used in the world. It has been recognized by iris doctors all over the world. The International Iridologist Practitioners Association, or IIPA for short, is the largest international iris medicine organization in the world, which takes promoting and continuously improving the research and development of iris medicine as its mission. The development and application of iris medicine in developed countries have been widely recognized in recent years. Iris diagnostics is an effective means of preventive medicine. Through the detection of 800000 patients in Russia, it was found that the detection rate of iris medicine for diseases was as high as 85 %.

In recent years, iris medicine and iris diagnosis and treatment have been developing in various countries. Iris medicine (iris medicine, iridology, iris diagnostics, etc.), based on morphology, observes, predicts and infers the overall physique of the human body, the reality of the overall health, the occurrence and recovery of diseases by studying the morphological changes of the iris of the human eye, such as changes in color, color spots, structure, and pupil. It is a scientific and practical technology that reflects the genetic constitution of the human body and the defects of various organ systems. It is also a complete medical system including examination (detection), diagnosis (judgment and evaluation) and treatment (conditioning). The Internet of Things for human health diagnosis based on iris data can provide more detailed and accurate diagnosis for iris medicine.

The aim of this paper is to use human iris images for diagnosis, realize non-contact iris diagnosis, detect eye diseases, and make the diagnosis of eye diseases more convenient.

When the organs in the body change, the iris will also change accordingly. Therefore, observing an iris image is like observing a body organ. Health detection through the iris, observing whether the iris is bright or dark, whether there are holes or damage, the color of the iris, etc., is conducive to human beings to detect the root cause of the disease early and provide targeted and timely treatment to eliminate the disease in the bud and achieve Disease prevention and health care purposes. And iris diagnosis is done by taking pictures of the iris of the eye under natural light, and then the doctor performs corresponding image analysis, so there will be no damage to the eyes. The purpose of this paper is to use human iris images for diagnosis, realize non-contact iris diagnosis, detect eye diseases, and make the diagnosis of eye diseases more convenient.

To achieve this goal, the following tasks were solved in the paper. The task of this paper is to develop a system based on medical Internet of Things and deep learning, which uses human iris images for diagnosis, realizes non-contact iris diagnosis, detects eye diseases, and makes the diagnosis of eye diseases more convenient. The Internet of Things (IoT) and deep learning technology have brought new possibilities to computer-assisted iris image diagnosis, which has many advantages in diagnosing eye diseases. Its advantage is first reflected in the convenience of data collection. Based on Internet of Things technology, various smart devices (such as smartphones, wearable devices, etc.) can be used to quickly and conveniently collect patient's iris image data. This greatly improves the efficiency and coverage of data collection. Real-time monitoring and early warning: By integrating iris image data with other health indicators of patients (such as intraocular pressure, blood sugar, etc.) in real time, an intelligent monitoring system can be established to analyze and provide early warning of changes in eye diseases in real time. Moreover, deep learning has powerful expressive capabilities. Using deep learning models such as convolutional neural networks, richer and more distinguishable features can be automatically extracted from iris images, greatly improving the accuracy of diagnosis. Cloud computing has high-performance analysis capabilities. In the future, iris image diagnosis tasks can be deployed to the cloud, and the powerful computing power of cloud computing can be used for efficient analysis and decision support, significantly shortening diagnosis time. Telemedicine and intelligent decision-making capabilities, based on the Internet of Things and cloud computing technology, can realize remote iris image diagnosis services and provide professional diagnosis and treatment for patients in remote areas. At the same time, the diagnostic system can also provide doctors with intelligent decision support. In addition, this technology can also continuously learn and iteratively optimize the diagnostic model. By continuously accumulating new iris image data and feeding it back to the deep learning model, it can achieve continuous learning and iterative optimization of the diagnostic system, improving the accuracy and reliability of diagnosis.

GENRAL DESCRIPTION OF WORK

Relevance of the subject

The work corresponds to paragraph 1 «*Digital information and communication and interdisciplinary technologies, production based on them*» of the State Program of innovative development of the Republic of Belarus for 2021–2025. The work was carried out in the educational institution Belarusian State University of Informatics and Radioelectronics.

The aim and tasks of the work

Human iris images play an important role in the diagnosis of eye diseases. Different pathological characteristics of eye diseases have different iris characteristics of human eyes. These eye diseases can be effectively identified and diagnosed through conventional diagnostic methods, but this requires professionals and specialized instruments and equipment, and can only be performed by experienced doctors. However, in some areas with limited medical conditions, the lack of professional doctors and other medical resources prevents many patients with eye diseases from receiving timely and effective treatment. In order to solve this problem, an intelligent system that automatically diagnoses eye diseases is needed to alleviate the pressure of insufficient medical resources in some areas. With the development of the Internet of Things and artificial intelligence technology in the medical field, with the help of the Internet of Things network, an Internet of Things platform based on deep learning and neural networks can be built to build a database of human eye iris images by recording and classifying patients' iris images. These human eye iris images are then used to train deep neural network models to accurately diagnose eye diseases.

To achieve this aim, the following tasks were solved in the dissertation:

1 Establish a human iris image database for different eye diseases. In order to deeply understand and diagnose eye diseases, it is necessary to establish a human eye iris image database containing a variety of different eye diseases. The database will collect samples of human eye iris images from patients and compare the samples. Classify and record for subsequent research and analysis. Through this database, a large amount of human eye iris data can be accumulated, providing valuable resources for the research and diagnosis of eye diseases.

2 Extract iris features corresponding to different eye diseases. For the preprocessed iris data, an edge detection algorithm is used for feature extraction. Edge detection algorithm is a commonly used feature representation method in image processing. By applying edge detection algorithms to iris data, it can be used for subsequent model training and eye disease prediction.

3 Use the machine learning and neural network tool CNN (Convolutional Neural Network) to train the preprocessed iris image data to generate a model that can predict eye diseases. After obtaining the preprocessed iris features, the convolutional neural network is used to train the iris data. By associating the extracted iris features with corresponding eye diseases, a model capable of predicting eye diseases based on iris features is trained. The model will have high accuracy and generalization capabilities and can be used to predict and diagnose different eye diseases.

4 Establish an IoT network for eye disease diagnosis and develop corresponding disease diagnosis systems. In order to achieve rapid diagnosis and remote monitoring of eye diseases, it is necessary to establish an Internet of Things network and develop a corresponding disease diagnosis system. By connecting the patient's iris image collection device to the Internet, the system can collect and transmit the patient's iris images in real time. These images can be analyzed and diagnosed by previously trained eye disease prediction models, thereby providing timely health status feedback and early warning to doctors and patients. Such IoT networks and disease diagnosis systems will greatly improve the diagnostic accuracy and treatment effect of eye diseases, while providing patients with convenient and reliable medical services.

Personal contribution of the author

The content of the paper reflects the individual contributions of the authors. This includes studying the iris structure, training the model, running the system, analyzing the results, and drawing conclusions.

Testing and implementation of results

The main provisions and results of the dissertation work were reported and discussed at: International scientific and technical seminar "Technologies of information transmission and processing" (Minsk, April, 2024) and 60th scientific conference of graduate students, undergraduates and students (Minsk, March, 2024).

Author’s publications

According to the results of the research presented in the dissertation, 3 author’s works was published, including: 3 articles and abstracts in conference proceedings.

Structure and size of the work

The dissertation work consists of introduction, general description of the work, three chapters with conclusions for each chapter, conclusion, bibliography.

The total volume of the thesis work is 84 pages, including 79 pages of text, 41 figures, 3 tables, a list of bibliographic sources used, and a list of author's publications on the topic of the thesis.

Plagiarism

An examination of the dissertation «*The Internet of Things Network for Human Health Diagnostics Based on Smart Phone Data the Iris of the Eye*» by Zhao Yi’an was carried out for the correctness of the use of borrowed materials using the

network resource «Antiplagiat» (access address: https://antiplagiat.ru) in the on-line mode 29.5.2024. As a result of the verification, the correctness of the use of borrowed materials was established (the originality of the thesis is 84.36 %)

SUMMARY OF WORK

This article introduces related concepts in Chapter 1: The structure of the human eye is introduced in Section 1.1. In Section 1.2, several different iris texture features are introduced in detail. In Section 1.3, this article introduces the method of iris diagnosis in detail. In Section 1.4, this article details the origin and development process of iridology. In Section 1.5 In Section 1.6, this article introduces the introduction of computer-aided iris diagnosis and its key points. In Section 1.7, this article introduces the feasibility of iris diagnosis and treatment. In Section 1.8, this article the benefits of using computer technology for iris diagnosis are described.

This article introduces several eye diseases and related concepts in Chapter 2: The use of IoMT to analyze the iris is introduced in Section 2.1. In Section 2.2, the advantages of using IoMT to analyze iris are introduced in detail. In Section 2.3, this article details the research status of iris image-assisted diagnosis and treatment in various countries. In Section 2.4, this article details the origin and development process of iridology. In the chapters following this chapter, the diagnosis of three eye diseases by this system and the process of using this system for iris image processing are introduced.

The iris images obtained under natural conditions have varying degrees of eyelash and eyelid occlusion, so the iris image must be preprocessed before image fusion. In this paper, Hough transform is used to locate the inner and outer boundaries of the iris. After detecting the outer edge of the iris, the sclera can be removed.

Chapter 3 of this article introduces the experimental results of diagnosis using the Internet of Things and iris image-assisted iris diagnosis and treatment system, as well as the structure of the network service system and the operating process of the system, as well as the data sets required for training the model. Train a model on a selected dataset and report validation results and compare between several different models.

The framework of the iris diagnosis system based on Web services is shown in Figure 1. The system adopts B/S architecture, and the system is divided into two parts: Web front-end and server-side. The user first selects the type of disease that needs to be detected on the Web, and then uploads an iris image of the patient's eye. After the image is uploaded successfully, the server will generate a folder to store the image file. When the user clicks "Diagnosis", the server will preprocess the iris

image and extract the corresponding iris features, and then call the stored model to classify and diagnose the iris features. After the diagnosis is completed, the server returns the disease type and confidence level of the diagnosis results to the Web client for display.

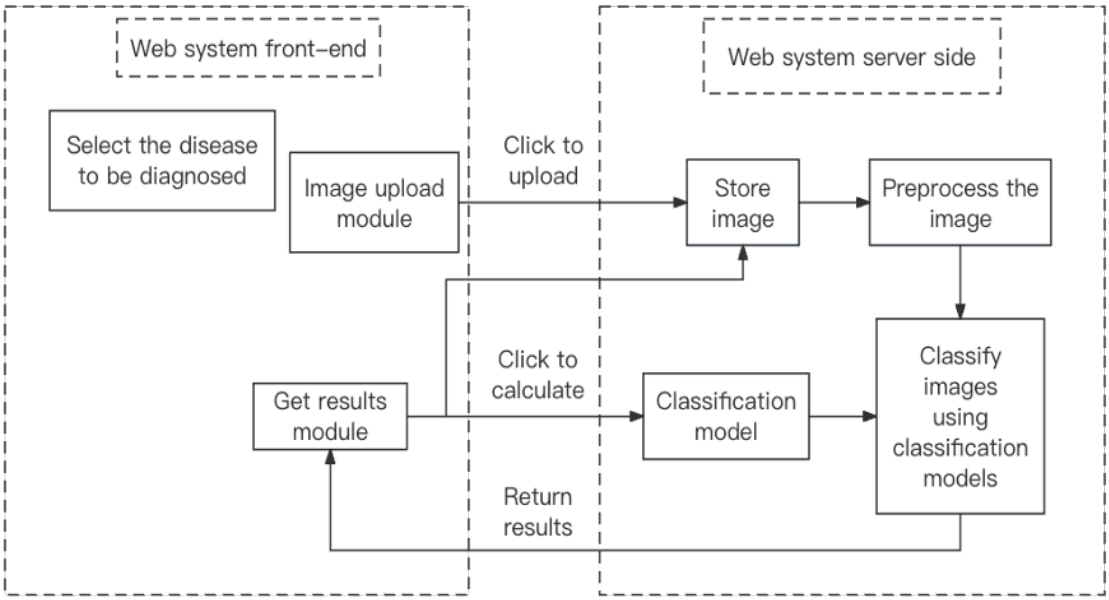

Figure 1 – Web service system structure diagram

CONCLUSION

Contributions and innovations of this thesis

As a combination of traditional Chinese medicine visual examination and western medicine iridology, iris diagnostics plays a huge role in the field of human sub-health evaluation and disease prevention. It has gradually been valued by various countries in the world. As a subject that has attracted widespread attention from the world, iris diagnostics has developed an iris-assisted diagnosis system based on this discipline has become an inevitable trend. This article uses Internet of Things image processing technology, combined with deep learning and machine learning related knowledge to process iris images, extract iris pathological features, and build an iris auxiliary diagnosis system on this basis. The main contributions and innovations of the whole paper can be summarized as follows:

1 Learn the background significance and development status of the iris auxiliary diagnosis system and learn to analyze the human eye structure and iris texture classification and characteristics to lay the foundation for iris feature extraction [1–A].

2 Realize the construction of the iridology diagnosis rule framework and formulate iris feature description rules based on the diagnostic rules. Program and build an iris auxiliary diagnosis system based on iris feature extraction. Outline the implementation of this system and analyze the operation of the system [2–A].

3 Train the model and use this system to conduct simulation detection to obtain diagnostic results with high credibility.

Further research work

Although the research in this article has achieved certain results, including extracting iris feature values and building an iris-assisted diagnosis platform, there are still some shortcomings. There is still work to be completed and supplemented in the future. The work is as follows:

1 The iris positioning and feature extraction algorithms in this article need to be further optimized to obtain a higher accuracy rate.

2 Due to limited resources, the iris-assisted diagnosis system built in this article does not have the support of authoritative medical data. A large number of reasoning rules should be added to the system in the future to enhance the reliability of the system [3–A].

LIST OF AUTHOR'S PUBLICATIONS

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3–A Yi'an, Z. Crimp wheel extraction of iris images during iris diagnosis / Z. Yian // 60-я научная конференция аспирантов, магистрантов и студентов, Минск, 11-15 марта 2024 года / Белорусский государственный университет информатики и радиоэлектроники; – Минск, 2024.