A Robust Watermarking Algorithm for Medical Images Based on Neural Network and Chaotic Mapping

Yang Ai, Jing Liu*, Kun Li, Chunfeng Song

Faculty of Network Science, Haikou University of Economics, Haikou, China

*Corresponding Author

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Abstract: At Present, the Existing Encryption Methods and Access Control Cannot Meet the Information Security Requirements of Medical Data, While Digital Watermarking Technology Can Effectively Avoid the Disadvantages of Traditional Cryptography Technology. in the Early Days When Digital Watermarking Technology Was Proposed, It Was Mainly Used for Copyright Protection and Authenticity Identification of Digital Products. in the Medical Field, We Not Only Hope to Effectively Hide the Watermark Information, But Also Hope That the Watermark Can Resist Various Attacks on the Network and Have Good Robustness, Which Will Not Affect the Medical Data Carrier Itself, and the Human Eye Cannot Perceive the Existence of the Watermark and Obtain Its Content. Based on the Practical Application, We Also Hope That the Watermark Embedding Capacity Can Meet the Actual Needs. to Solve These Problems, a Robust Watermarking Algorithm Based on Neural Network and Chaotic Mapping is Proposed.

1. Introduction

The Wide Application of Digital Media Brings Many Conveniences, But Also Brings Many New Problems. Compared with Traditional Media, the Reproduction and Distribution of Digital Media Are Extremely Fast and Difficult to Trace. Copyright Protection Methods Commonly Used in Traditional Media Are Not Applicable in Digital Media [1]. Due to the Replicability of Digital Products Themselves and the Wide Spread Based on the Network, Many Potential Safety Problems Are Brought Accordingly. with the Development of Medical Imaging Technology and the Popularization of Hospital Information Network, a Large Number of Medical Images Containing Physiological, Pathological and Anatomical Information of Patients Will Be Produced Every Day in a Modern Hospital [2]. Medical Image is a Complex Image That Reflects Human Biological Tissue. the Image Has a Large Amount of Information and is Difficult to Process. Medical Image Protection is a Key Link in Medical Image Research and Has Great Practical Value for the Application and Development of Clinical Medicine [3]. Because Medical Images Contain High Noise, and the Boundaries between Various Tissues Are Fuzzy, and the Gray Levels inside the Tissues Are Very Uneven and the Contrast is Relatively Low, It is Difficult to Achieve the Expected Effect by Using Traditional Processing Technology [4]. the Digitalization of Medical Information Brings Great Convenience to the Storage and Transmission of Medical Information. At the Same Time, There Are Also Serious Security Problems Such as Malicious Attacks, Tampering and Illegal Possession [5]. Today's Encryption Methods and Access Control Have Been Difficult to Meet the Information Security Requirements of Medical Images, and It is Urgent to Seek New Information Security Technology Measures.

Tampering with Digital Media is More Difficult to Track and Detect Than Traditional Media. Some Malicious Tampering Can Easily Lead to Serious Consequences, Especially in Some Special Applications, Such as Medical and Military Fields. [6] Medical Image Protection is the Technology and Process of Dividing an Image into Several Regions Based on Similarities or Differences between Objects in the Image. It is a Key Step in Medical Image Research and a Prerequisite for High-Level Medical Image Understanding and Analysis [7]. Reasonable and Effective Image Protection Results Can Extract Very Useful Information, Which is Very Important for Identifying

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Target Objects in Images and Retrieving Images. It is Also Very Important for High-Level Image Analysis and Understanding in Image Engineering. Function [8]. Medical Images Acquired for Various Reasons Inevitably Have Characteristics Such as Blur and Unevenness, and the Results Processed by Traditional Image Protection Methods Are Difficult to Meet the Needs [9]. Digital Watermarking is to Permanently Embed Data into a Word Multimedia Work, Which Will Not Cause the Subjective Quality of the Host Media to Decline, and Will Not Cause People to Notice That the Hidden Information May Be Carried in the Multimedia Information [10]. in This Paper, a Robust Digital Image Watermarking Algorithm Based on Neural Network and Chaotic Mapping is Proposed, and the Embedding Strength of the Watermark is Adaptive to the Image. the Watermark Implemented by This Algorithm Has Good Robustness to Common Image Processing and Geometric Transformation.

2. Overview of Medical Image Digital Watermarking

Medical Images Are an Important Source of Information for Medical Personnel to Understand and Diagnose the Patient's Condition. They Have Very Important Basis for Medical Diagnosis and Generally Maintain Their Stability without Any Modification or Adjustment. Image Protection Technology is One of the Important Topics and One of the Important Difficulties in the Field of Image Processing. It is of Great Significance for Image Understanding, Image Analysis, Pattern Recognition and Computer Vision. No Matter What Kind of Processing Method, Its Ultimate Goal is to Extract the Target Region of Interest, Only for Different Images, Different Processing Requirements, Different Processing Methods Are Used. the Acquisition Price of Ct, Mri, Pet, Us and Other Images in Medical Images is Very High, Each Examination Cost Hundreds of Thousands, Which is in Stark Contrast to the Cost of Digital Images Acquired by Ordinary Digital Cameras.

Medical Image Protection is Based on the Characteristics of Different Images and the Requirements of Medical Diagnosis. through Processing Methods, the Information of Tissues and Organs is Presented to Doctors in a More Intuitive and Visual Way, Thus Improving the Accuracy of Diagnosis [11]. No Matter from Which Aspect, Any Operation That May Cause Loss to Medical Image is Not Desirable, So in the Aspect of Copyright Protection and Content Authentication of Medical Image, We Need to Continuously Strengthen Research and Analysis. in the Case of the Arrival of the Next Image Data Frame, the Corresponding Motion Detection Algorithm is Used to Determine Whether There is an Abnormal Situation in the Image. If There is an Abnormal Situation, the System Starts the Enclosure to Store the Abnormal Image Data, Otherwise It Will Not Be Stored Directly. as Shown in Figure 1, the Image Path Determination Process.

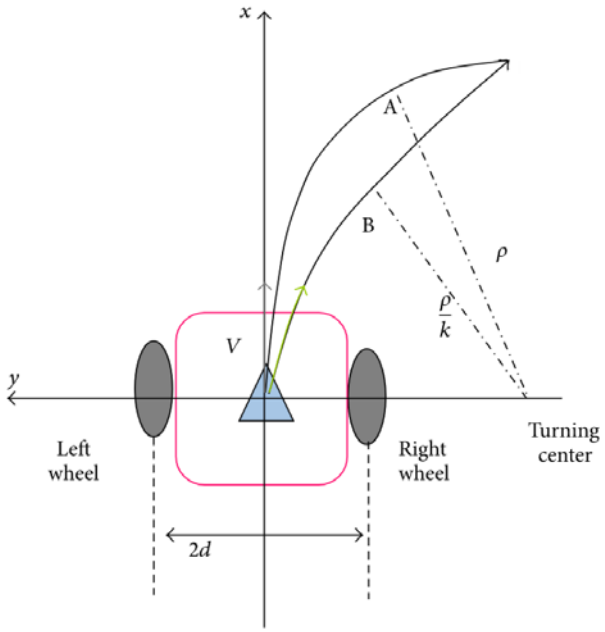

Fig.1 Image Path Judgment

In the medical system, the confidentiality protection of medical information is very important, which is very important for medical image retrieval, true integrity authentication and related effective management. Due to the difference between the imaging principle of medical images and the characteristics of human tissues themselves, the formation process of images is susceptible to tissue movements such as offset field effect, noise and local body effect. Therefore, compared with ordinary images, medical image protection inevitably has the characteristics of blur and non-uniformity. Digital watermarking technology mainly includes two processes: watermark embedding and extraction. Watermark embedding model, the specific process is to select the key and load the watermark into the original image through embedding algorithm. When searching for the optimal initial clustering center, two operators, crossover operator and mutation operator of genetic algorithm are simultaneously added to the traditional particle swarm algorithm, so that the advantages of the two algorithms are complementary, and the defect that the particle swarm algorithm is easy to fall into local optimization is overcome.

3. Medical Image Analysis Based on Neural Network and Chaotic Mapping

Conventional digital watermarking technology is mainly used for the protection of intellectual property rights of electronic information, etc. The basic characteristics of digital watermarking are applied to deal with small extraction of watermark information in respective application scenarios. The watermark information is embedded into the medical image as the third feature of the image. Once the user makes a corresponding retrieval request, the watermark information in the image is extracted by the server and compared with the user request information to judge. After incorporating fuzzy theory, each model can belong to several different categories, but there are different membership degrees for each category. The higher the membership degree, the greater the possibility that this model belongs to this category [12]. The crossover operator is used to exchange information between pairs of particles and improve the ability of particles to search in new directions. The mutation operator is used to improve the ability of particle swarm algorithm to jump out of local optimization and to keep the population diversity by preserving the population processing strategy in particle swarm algorithm.

In order to prevent the amount of watermark information from being too large, the embedded original watermark image cannot be too large. This also shows that there is no need to embed too much information in medical images, as long as a meaningful watermark that uniquely identifies the image or secret information is embedded. For signals, due to band limitation, signal energy is mainly distributed in the low frequency region. Therefore, for noisy signals, the proportion of noise energy is small in the low frequency region and large in the high frequency region. Therefore, the focus of denoising should be on the high frequency region. Figure 2 shows the structure of a medical image analysis system.

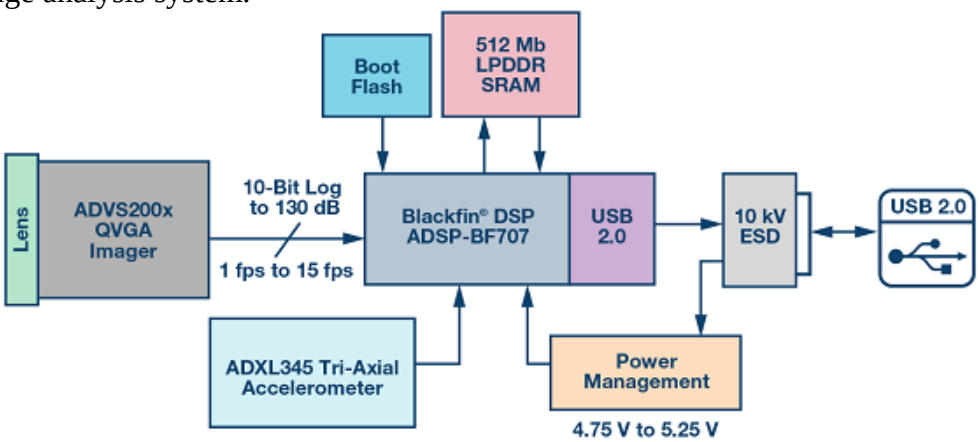

Fig.2 Structure of Medical Image Processing and Analysis System

In contrast to some strong comparisons, the wide dynamic algorithm is used to compress the original data into a dynamic range. In this process, it should be ensured that there is no problem

with the wide dynamic image original data. Because wavelet transform has zoom function and time-frequency localization, it can remove noise and preserve the details of the image, so it can reconstruct high-quality images. Analytic hierarchy process is used to comprehensively evaluate the perceived risks. The relative importance of each factor in the same level with respect to the same factor in the previous level is compared and a pair comparison matrix is constructed. The statistical results are shown in Table 1.

Table 1 Data Comparison Results of Perceived Risk

	Residence time	Arrival rate	Visits
Residence time	1	0.42	0.79
Arrival rate	0.86	1	0.58
Visits	0.76	0.58	1

Watermarks used for copyright protection of medical images are generally meaningful symbols, hospital identification or patient information. On the one hand, this information is relatively intuitive, which is convenient to clearly determine the copyright ownership when necessary. On the other hand, the amount of information in this information is relatively small, and the corresponding requirements for embedding capacity are relatively low. In order to protect the security of embedded information, additional scrambling and encryption are usually required before embedding the watermark. From the perspective of visual perception, image protection seems to be a very easy problem to solve. In actual image processing, it is a very difficult task. The simplest and most common method to reduce the over-fitting of image data is to artificially enlarge the training data set by using the transformation method of preserving labels. At the noise, the edge stop function may reach a local minimum, making the model more sensitive to noise. Embedding electronic medical records including patient information, diagnosis and treatment information, etc. into medical images, strengthens the management of medical images and electronic medical records, realizes the binding of electronic medical records and medical images, effectively maintains diagnostic consistency and prevents information matching errors.

4. Conclusion

With the continuous improvement of digital storage and transmission technology of medical images, digital medical images are increasingly widely used in medical diagnosis and related research fields. The transmission of digital works between networks is becoming more and more convenient, which leads to copyright and tampering of digital works. Therefore, digital watermarking technology appears and develops rapidly. Digital watermarking technology can effectively authenticate image copyright information and content integrity by embedding hidden information in the image as a watermark. Medical images may be subject to information security issues such as interception, tampering, and illegal copying during network transmission. The edge stop function may reach a local minimum at the noise, making the model more sensitive to noise. Digital watermarking technology can embed iconic digital information or some secret information into medical images, which can be used as an important technical means for copyright authentication and tamper detection of medical images. The medical image digital watermarking method proposed in this paper can ensure that it is difficult for the outside world to recover watermark information without knowing the key, and it can effectively ensure the invisibility and security of watermark information.

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