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Discussion on Case Base Construction of Postgraduate Digital Image Processing Course under the Perspective of Artificial Intelligence

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Abstract: With the rapid development of artificial intelligence technology, the teaching of digital image processing for graduate students has been confronted with challenges. In order to improve graduate student's artificial knowledge, artificial intelligence technology is introduced into the construct the case example of digital images, case teaching schemes are established, case examples of digital images processing are updated and optimized, case-driven teaching method and continuous improvement scheme are discussed. The practical teaching result proves that the optimized case base and case-driven teaching method can better cultivate the engineering application ability and creative thinking of graduate students.

1. Introduction

The teaching of digital image processing graduate course mainly adopts theoretical teaching, which is boring and monotonous, and students' interest in learning is not strong, and it fails to realize the cultivation of innovative thinking and practical ability. Digital image processing technology has been extensively used in various fields of society, such as transportation, education, space exploration and industrial production, and is a technology that has been vigorously developed in recent years[1]. In order to respond to the development of the society, universities take "digital image processing" course as the core professional course for undergraduate and postgraduate students of electronic information[2]. In the teaching of graduate students, the content of the digital image course is extremely similar to the teaching content of the undergraduate level, resulting in the limited knowledge gained by the graduate students through studying this course, thus making the digital image processing course "undergraduate" in the graduate education[3].

The education of electronic information postgraduates focuses on the cultivation of practical and engineering ability, and it is difficult to realize the cultivation of engineering ability of postgraduates by the way of theoretical lectures, therefore, it is urgent to explore a new teaching mode of digital image according to the characteristics of digital image and combined with the characteristics of the times. Case teaching based on engineering applications can not only guide students to identify problems, analyze and solve them with what they have learned, but also

promote the mastery of theoretical knowledge through practical cases. At present, case teaching has become an important means to improve the quality of graduate training, and has been gradually applied to the teaching of graduate courses[4].

In recent years, with the rapid development of artificial intelligence technology, the field of digital image processing has brought many technical problems to be explored, and digital image processing technology and artificial intelligence technology have become inseparable[5]. In view of this, this paper addresses the shortcomings of insufficient case teaching in digital image processing teaching for postgraduate students, combines the frontier theoretical technology of artificial intelligence, establishes a set of digital image processing teaching case library integrating three levels of artificial intelligence information processing technology: image processing, image analysis and image understanding, studies the optimization of teaching content and methods based on course cases, guides students to use digital image processing technology to solve engineering application problems, and cultivates students' innovative ability and practical ability[6-7].

2. Existing Problems with Graduate Programs in Digital Image Processing

“Digital Image Processing” as a specialized course for postgraduate students in electronic information, emphasizes the close integration of theory and practice. Digital image processing involves many contents and is widely used in daily life. The teaching work should strengthen the teaching of engineering applications and strengthen the case teaching content[8]. Current digital image processing course teaching mainly adopts the traditional teaching method, using the "spoon-feed" method to teach the basic principles and theories, and insufficient research on application cases, with the following shortcomings:

1) Insufficient content and number of digital image cases, not covering the prefatory technical content of digital image processing. At present, the digital image processing case library mainly involves the traditional methods of image processing, while there are fewer cases and practical teaching contents about artificial intelligence, teachers update the image processing case library according to their personal understanding, lacking unified planning and guidance, and the digital image case library has different contents and uneven difficulty, which can not realize the teaching of digital image processing for applied postgraduate students.

2) Insufficient relevance and application of digital image processing cases. Most of the digital image processing cases for postgraduate students are designed on the basis of undergraduate digital image processing experiments. Although digital image processing experiments have been carried out for many years, the teaching orientation and teaching content of these courses and experiments have not been synchronized with the development of information technology in a timely manner, and there is a lack of cutting edge cases that combine with practical applications, resulting in students not being able to use the knowledge they have learned to effectively solve realistic problems.

3) Focusing on the construction of bottom-level cases and insufficient middle and top-level teaching cases. Digital image processing contains three levels: digital image processing, image analysis, and image understanding. Current postgraduate teaching cases mainly include image enhancement, image geometric transformation, image frequency domain processing, image inpainting and other image processing bottom-level contents, and lack of cases of image processing middle and high level.

4) Insufficient development of teaching platform for digital image processing cases. Digital image processing cases require high configuration of hardware platform and support of software such as Matlab, OpenCV and Python. The current case teaching platform only realizes traditional case teaching and cannot realize the frontier cases of image processing based on deep learning,

which does not reflect the trend of digital image development.

3. Digital image processing course case library construction

Case construction is aimed at learning in order to practice and applying theoretical knowledge to application problems, establishing a library of typical, cutting edge and applied course cases, stimulating postgraduate students' interest in learning digital image processing courses, and cultivating students' ability to solve engineering application problems[9].

Current classical cases of digital image processing, designed to verify a specific theoretical knowledge, have a certain gap with the actual problem. Focusing on solving practical problems, integrating current intelligent information processing technology with digital image processing course case construction, using MATLAB, OpenCV, VC++, Python and other program development platforms to implement artificial intelligence and digital image processing algorithms, and building a digital image processing case construction framework that incorporates artificial intelligence is shown in the Figure 1. On the existing digital image processing cases, introduce cutting-edge intelligent information processing technology, optimize the existing image processing bottom cases, build middle and high level cases of image analysis and image understanding based on cutting-edge artificial intelligence technology, solve the shortcomings of insufficient middle and high level cases of digital image processing, in order to enrich teaching resources.

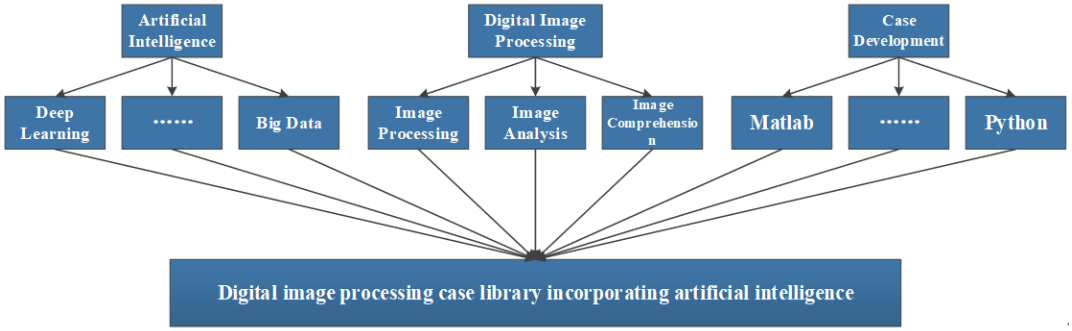

Figure 1: Construction route of digital image processing case base

3.1. Case Library Design Principles and Solutions

1) Comprehensive coverage of teaching content, highlighting key points

In the case construction, the three levels of theoretical knowledge of digital image processing should be carried through in the case teaching, and highlight the key contents. Deepen the understanding of theory through case teaching, guide students to apply theoretical knowledge to analyze and solve practical problems, cultivate the ability to solve engineering problems independently, and improve the teaching effect. Comprehensive application cases can be designed to cover multiple knowledge points of digital image processing, and a separate case can be designed for the main knowledge points to achieve comprehensive coverage of knowledge points.

2) Focus on the advanced and practical construction of cases

Introduce the current cutting edge technology and the latest research results into the teaching cases and replace some of the old cases to highlight the important theories, cutting edge and practical technologies. For example, adding wave atomic cases while keeping the original frequency domain processing cases; adding application-oriented cases such as deep learning in image understanding.

3) Cases focus on engineering problem solving to improve students' system design and programming skills

Focusing on practical problem solving, case construction is linked to actual engineering problems, cultivating students' practical ability, researching current scientific research projects and master's theses in digital image processing, constructing engineering cases, and focusing on the practical construction of cases.

3.2. Optimization of case teaching content

Table 1: Updated case of digital image processing

Teaching content	Case name	Core technologies	Engineering applications
Image enhancement processing	Rain and fog image clarification processing case	Retinex technology	Traffic, public security system monitoring
Image frequency domain processing	DWT domain digital watermark case	Wavelet transform	Secure encryption, Copyright protection
Image edge detection	The case of recognition of remote sensing images	Contour extraction technology	Military aircraft identification
Color image encoding	JPEG encoding case	DCT, entropy coding technology	Communication, Electronic Information
Geometric transformation techniques for images	Case of super-resolution reconstruction of images	Residual Convolutional Neural Network	Multimedia Information
Image inpainting and Reconstruction Techniques	Motion image deblurring case	Constrained least squares filtering	Film and television production
Morphological image processing techniques	License plate digital recognition case	Hit and miss morphology	Transportation, Security
Feature extraction techniques for images	Remote sensing technology environmental monitoring case	SIFT feature technology	Geoenvironmental monitoring
Comprehensive case	Mask obscuring face inpainting case	HRNet segmentation, GAN network inpainting network	Public Security, Finance, etc.
Comprehensive case	Operation scene behavior recognition case	CNN detection network, Openpose skeleton extraction	Industrial production, public monitoring
Integrated digital application case	CT image COVID-19 recognition technology	Transfer learning	Medical Imaging

The original case of digital image processing is based on the basic technology of digital image processing and designed on the basis of the courses taught in the undergraduate program, mainly focusing on the underlying content of image processing and involving less design of cutting edge technology. As the most prevalent direction of artificial intelligence technology, deep learning technology has shown better performance in many fields and is widely used. Among them, many models such as convolutional neural networks, residual networks, generative adversarial networks, long-short term Memory Networks, and deep belief networks perform significantly better than traditional image processing methods in the field of image processing. Digital image processing

case construction draws on classic teaching cases, engineering application cases and scientific research topics at home and abroad, incorporates cutting edge artificial intelligence processing algorithms into the cases, and establishes a set of digital image case library consisting of basic cases, thematic cases and comprehensive cases, which is integrated into the teaching of digital image processing theory, and the improved case library.

Each case preparation includes the focus and difficulty of the technology, the name of the case, the analysis process and key technology of the case, the actual engineering problem solved, the reflection and discussion content and so on. The cases provide test data, procedures, and implementation software using Visual Studio, Matlab, opencv, and Python, and the improved case library is shown in Table 1.

4. Design of Case Study Teaching Model

In order to improve the engineering practice ability of postgraduate students, a case driven teaching approach is implemented based on the establishment of implementation cases based on frontier technologies of artificial intelligence[10], and the teaching mode is adjusted from both theoretical teaching and experimental teaching.

4.1. Case driven theory teaching

After realizing the creation of the case library, determine which teaching contents introduce the corresponding cases, and determine the way of teaching each case, the way and time of presentation and so on., so as to effectively support theoretical knowledge. Adopting the teaching method of combining teaching materials and cases, introducing practice in theoretical teaching, interspersing theory in practical teaching, demonstrating cases and analysis through cases. The teaching use the requirements of engineering applications to guide the problem to be solved, analyze the theoretical techniques involved in solving the problem, construct an overall route to solve the case, and give a detailed description of the techniques involved in each route; Theoretical knowledge is explained throughout the case study, and knowledge is taught in front of students in the form of a case study, so that students can understand the main points of knowledge; Cases are presented in a simulated and visualized manner to achieve verification of theoretical techniques and to exercise students' ability to solve engineering application problems.

Some of the integrated cases can be discussed in groups or practiced outside of class. During the theoretical lectures, students are guided to use theoretical knowledge to solve engineering problems, discuss cases in groups, write group discussion reports, and stimulate students' creative thinking ability. For more difficult cases, arrange students to review the literature after class, complete the design of the case route in the form of an assignment, and write a scientific and technical report.

4.2. Case driven laboratory teaching

Experimental teaching focuses on the cultivation of practical engineering ability, constructs targeted, engineering and application-oriented experimental content, and enables students to use cutting edge technology to solve practical engineering problems, thus realizing the spiral teaching process of theory-practice-engineering.

The experimental teaching process adopts a "three-stage" model. In the pre-experimental stage, the problems to be solved are presented to motivate students to design the experimental content; The experimental process focuses on the guidance of theory, and students complete the whole experiment independently. Later in the experiment, the whole process is shown in the form of solving engineering cases. Experiments are divided into three levels of difficulty: primary,

intermediate, and advanced. Primary experiments are completed under the guidance of teachers, and students master the basic skills and processes of experiments; Intermediate experiments are mainly guided by teachers' theories and problem-solving methods, and students complete the subsequent experiments independently; Advanced experiments aim at solving engineering problems, completing the design and implementation of experiments, and the teacher only evaluates the results of the experiments to achieve the cultivation of innovative practical skills.

4.3. Conducting second classroom case design teaching

Conduct second classroom digital image processing engineering case teaching to create conditions for postgraduate students to be able to get further development. Take digital image processing cases as a carrier, combine cutting edge intelligent information processing technology, and practice the idea of theoretical innovation and practical innovation. Guide students to use artificial intelligence technology to solve digital image processing problems from the perspective of engineering applications, develop relevant image processing products, and form scientific and technological achievements such as patents and papers.

Utilize open labs, organize digital image processing interest groups, participate in information processing design competitions, and participate in scientific research projects to explore innovative image processing topics, propose ideas and solutions to digital image processing problems in engineering, complete algorithm development and software design, and complete innovative case design works to further enhance students' innovation and practical skills.

By focusing on international conferences on image processing, machine vision, and artificial intelligence, students will be introduced to cutting edge digital image processing cases, so that they can discover, analyze, and build on the shortcomings of existing cases and update them with cutting edge artificial intelligence methods to enhance the performance of existing cases and develop the ability to innovate technology.

Understand the application of image processing products to various fields such as production, life and industry, evaluate the application of existing image processing intelligent products and analyze and discuss the shortcomings. To arouse students' interest in learning from multiple perspectives such as image processing product applications, innovative products, and theoretical research.

5. Case application analysis and continuous improvement program

1) Introduction of cases updated with artificial intelligence technology to increase the number of cases and achieve full coverage of digital image processing application areas.

Focusing on the cutting edge, practicality and comprehensiveness of cases is the core content of case building. Case building is the primary task of building cutting edge cases by collecting and organizing in multiple ways and aspects. While increasing the number of cases incorporating AI technology, focus on the construction of case quality, establish a case update mechanism, evaluate and grade the teaching value of cases, and eliminate some simple and low practical cases.

2) Update the teaching concept of cases and enhance the case driven teaching method

Teaching methods are a key aspect of case driven theory teaching. Teachers must update their teaching philosophy, establish a technical connection between theory and application practice, continuously improve teaching methods, and continuously improve case driven theory teaching methods with the concept of problem identification, and continuously improve teaching standards.

3) Continuous improvement of case teaching mechanism to achieve continuous evaluation of cases

Establish a mechanism for evaluating the whole process of case teaching, and establish a

mechanism for pre-teaching evaluation, mid-term and final evaluation of teaching. Where the teaching quality is poor and the practicality of the case is not strong, propose improvement or elimination programs and review the focus on representativeness, practicality and frontiers in the subsequent case teaching.

6. Conclusion

This paper discusses the shortcomings of teaching digital image processing cases in the context of the rapid development of artificial intelligence technology. Analyze and discuss the design principles, case optimization, teaching methods, case evaluation and improvement methods of digital image cases, integrate the cutting edge artificial intelligence technology into the construction of digital image cases, and build a digital image case teaching case library, teaching methods and evaluation system. The use of case driven teaching can deepen students' understanding and application of theoretical knowledge, cultivate innovative thinking, improve the ability to solve engineering problems, and enhance the teaching effect. It has been initially applied in the teaching of graduate students, and has obtained a good teaching effect, while improving the enthusiasm of students to learn digital image processing.

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