

# The Reform and Exploration of Digital Image Processing Course under the Background of Artificial Intelligence

Jun Bai <sup>a, \*</sup>, Hongmei Yan<sup>b</sup>, Ying Hou<sup>c</sup>

School of Communication and Information Engineering, Xi'an University of Science and Technology, Yanta Road, Xi'an, Shaanxi, China

<sup>a</sup>878875090@qq.com, <sup>b</sup>214508780@qq.com, <sup>c</sup>19559393@qq.com

\*Corresponding author

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**Abstract:** Digital image processing is the theoretical basis of computer vision which is an important branch of intelligent information processing, it has been identified as the main course of artificial intelligence related majors in many universities. With the rapid development of intelligent technology, the original digital image processing course teaching exposed many problems, which deviated from the subsequent talent training program. This paper makes some preliminary exploration on the teaching content, teaching method and examination method of this course, to promote the intellectual science and technology undergraduate professional training and professional construction to provide a little advice, which is based on the talent training program of Intelligent Science and technology specialty in our college, from the angle of theory teaching and practice teaching.

## 1. Introduction

In recent years, with the rapid development of artificial intelligence technology, the theory, technology and application of intelligent science have become an important growing point of information technology innovation. In order to occupy the commanding point of artificial intelligence talents training, Peking University created the first undergraduate education of Intelligent Science and Technology in 2004<sup>[1]</sup>, then dozens of domestic colleges and universities added the specialty one after another. As of the end of 2017, a total of 71 universities nationwide have set up 86 secondary disciplines or cross-disciplines around the field of artificial intelligence<sup>[2]</sup>. Our School is no exception, relying on the school's original electronic information science and technology professional discipline advantages, using in the field of intelligent perception and image processing research foundation and teacher strength, at the beginning of 2019, it was successfully approved as a new major in intelligent science and technology.

In order to survive and develop, the new major must form its own special subject system and characteristic curriculum as soon as possible. In the course system setting, we refer to the course setting of "Intelligent Science and technology" major in many domestic universities, and fully consider the characteristics of coal information processing in our university, " Intelligence combined with information processing " has been established as a professional feature. The construction of professional curriculum system is the focus of our construction. As an important professional course in information processing technology, the course of digital image processing has become the foundation of the research and development of other subjects, especially in the field of computer vision and artificial intelligence, digital image processing technology has become its foundation and core technology<sup>[3]</sup>.

## 2. The Digital Image Processing Course Teaching Present Situation and the Question

The course of digital image processing is an important professional course for the major of

electronic information science and technology. The digital image processing course is still listed as an important professional course in the latest intelligent science and Technology Professional Training Plan. With the adjustment of specialty orientation, it is necessary to integrate artificial intelligence technology into the original specialty construction, which will pose higher challenges for teachers and students. The original curriculum content, teaching methods and evaluation mechanism must be adjusted accordingly to meet the needs of the community for talent.

The course of digital image processing has been offered in our college for more than ten years. During these years, the teachers have been trying to adopt various new teaching methods and means to improve the teaching effect, and have achieved fruitful results, trained a large number of professionals. However, compared with the rapid development of artificial intelligence technology in recent years, the curriculum construction of this course also shows its hysteresis and disconnection with the actual application. They are as follows:

(1) In recent years, with the rapid development of digital image processing technology, many advanced algorithms have appeared in the fields of artificial intelligence, computer vision and other engineering tasks. In the theory and practice teaching, we should update and perfect the teaching content, introduce new technology into the traditional theory teaching.

(2) In the previous course teaching, due to the limited time, the teachers put their energy on explaining the algorithm and principle of each knowledge point, and neglect the connection of knowledge modules. In fact, the digital image processing technology is the synthesis of multi-technology in the application, we should integrate many knowledge points, take the application as the background, train the student to discover the problem, to solve the problem the ability, therefore must reform the teaching method, improves the school hour less and the teaching goal not to match the question.

(3) Most of the languages used in the course of experiment teaching are MATLAB or C. at present, with the development of artificial intelligence, Python, a very powerful programming language suitable for intelligent signal processing, has gradually shown its advantages<sup>[4]</sup>. In order to unify the teaching requirements and objectives of the following courses, we should extend the experimental programming language and take Python as the experimental language in the experimental teaching of this course.

(4) At present, the examination mode of the course is single, and most of them are closed-book examination, the contents of the examination are heavy on theory and light on practice, and the examination of the students' actual ability is not in place. The construction of the specialized laboratory is insufficient, and the comprehensive and innovative practical teaching links are relatively weak, which limits the cultivation of the students' practical ability and innovative spirit, and leads to the insufficient ability of the students to solve practical problems by using the knowledge of intelligent science and technology.

In view of the shortage of current teaching mode of digital image processing course, it is urgent to explore a new teaching mode of digital image processing course which is suitable for the background of artificial intelligence for the purpose of student-centered and training students' innovative practice ability.

### **3. Thoughts on the Reform of Digital Image Processing Course in the Specialty of Intelligent Science and Technology**

#### **3.1. Reform of Curriculum and Experimental Contents**

Under the background of intelligent science and technology, the course and experimental content of digital image processing must be reformed. In the digital image processing theory teaching and the experimental teaching content, should closely combine the current artificial intelligence technology<sup>[3]</sup>. The traditional digital image processing course mainly includes the following contents: Introduction, Digital Image Foundation, image transformation, image enhancement, image restoration and image compression coding, image segmentation or image description, etc. Computer Vision is a branch of artificial intelligence. It is suggested to add some classical tasks or cases

related to image processing technology in the course of digital image processing, such as image classification, object recognition, object location, object detection, image semantic segmentation. Taking the teaching of image classification as an example, this paper first introduces to the students how to solve this kind of problem, that is, to extract features first, and then to use classifiers for classification. Then it introduces the current methods based on artificial intelligence, that is, feature learning and classification using deep learning. Through this kind of example explanation, can effectively enhance the student's study enthusiasm, also is advantageous to the student grasps this direction application concrete solution method, enhances the student to the theory knowledge comprehensive utilization ability, to improve students' ability to analyze and solve practical problems.

In the experiment teaching, besides the confirmatory experiment, take the actual application as the background, designs the comprehensive experiment content. For example, face recognition, license plate recognition, coal recognition, image retrieval and other tasks, these are typical applications in the field of digital image processing. In these applications, need to apply to a variety of digital image processing technology core algorithms, in order to solve these problems, students need to take the initiative to analyze each step of the operation required to use knowledge points, so as to better promote students' understanding of the algorithm, cultivate students' ability to analyze and solve problems. In addition, students are encouraged to use new theories and methods to solve old problems, cultivate students' innovative ability and stimulate students' interest in learning. This paper designs an open experiment, which takes the hot task of artificial intelligence algorithm in computer vision as the content, combines with the teachers' scientific research and production practice, instructs the students to consult the literature and carry out the special topic investigation. The open experiment was summarized by the way of practice report. This method is helpful for students to understand the current advanced new theories and new methods, and to cultivate students' ability of scientific and technological innovation.

### **3.2. The Reform of Teaching Methods**

The course of digital image processing involves many subjects, many knowledge points, rich teaching content, strong application, complicated course content, difficult, and practical, because of the limited teaching time, it's hard to tell the whole story. It is suggested that we should try to combine “Reverse classroom” and “Practical application case-driven” into the existing teaching system of digital image processing course, which breaks the traditional “Teaching before learning” mode, to strengthen students' participation in the curriculum, effectively cultivate students' learning enthusiasm and engineering practice ability<sup>[5]</sup>.

“Turn over the classroom” adopts the “Learn first, teach later” model, transfers the initiative of the student from the teacher to the student, thus stimulates the student's subjective initiative. “Flip Class” is to turn the two stages of knowledge imparting and knowledge internalization, that is, students finish watching and learning the online teaching video before class, and discuss in group in class, the important knowledge point explanation and the special topic discussion way realizes the knowledge internalization. In this teaching mode, the teacher plays the role of the study director, the guide, the student is the real initiative researcher.

“Practical application case-driven” teaching method refers to the teacher will be carefully selected image application case assignment to students (individuals or groups), so that students query the relevant information, and then in the process of programming to fully internalize the course of theoretical knowledge.

Specific implementation can be divided into pre-class video learning, class discussion and answer questions, after-class application of case realization and homework completion. In pre-class video learning, teachers are required to release course videos, course handouts, reference books and teaching aids in advance on relevant online platforms such as massive open online course, SPOOC, instant messaging software, blue ink cloud software, etc. These materials strive to be short and concise, closely linked to the basic knowledge points of the curriculum, and have a certain appeal. In order to reverse the realization of the class, each class needs to add some knowledge points to

explore or expand the topic, in order to facilitate the discussion in the class at the same time to stimulate students to think, deepen the understanding of the relevant knowledge points. For example, the purpose of image compression, the international coding standard of image compression and the principles and characteristics of various coding methods are given. At the same time, in the theory teaching, when teaching the traditional image processing core algorithm content, each module carries on the cut-in through a current image processing domain relatively new case, such as two-dimensional code recognition, license plate recognition, handwritten Chinese character recognition, fingerprint recognition, pedestrian detection and analysis, etc., arouse the enthusiasm of students.

In addition, it is necessary to develop experimental teaching projects reasonably, and pay attention to increasing the design, comprehensive and exploratory experimental projects. In experimental teaching, students are encouraged to learn Python, OpenCV, TensorFlow and other tools by themselves through online courses to complete some simple practical tasks. Python is a free and open source cross-platform high-level dynamic programming language with simple syntax and readable code, which is very suitable for beginners. In a sense, writing in Python can achieve fewer lines of code for a task, such as image processing. In addition, for image processing, machine learning and deep learning, there are many libraries available for Python, such as OpenCV, Dlib, etc. Now some libraries suitable for machine learning and deep learning, such as Tensorflow, Keras, Caffe, Theano, etc., can be called in Python. And because of the simplicity of the Python language, it is easier to use them in Python [6]. For college students without too much experience, it is easier to master the language itself, so they can spend most of their energy and time on thinking of ways to solve problems, so as to stimulate students' interest in learning and improve their ability to find and solve problems.

### **3.3. Reform the Way of Curriculum Assessment**

The major of Intelligent Science and Technology is a cross-disciplinary and cross-applied undergraduate major, which integrates intelligent technology, communication technology, computer technology, control technology and other disciplines, its talent training plan should take into account the research-type, application-type and engineering-type and other diversified talent needs [7]. The traditional way of showing its unreasonable side by the usual result (10%) + mid-term result (10%) + computer result (10%) + final result (70%) = Total result. Among them, the mid-term and final results were all theoretical assessments, accounting for 80% of the total, which was enough to determine the final assessment results of the students. Many students could also obtain good results through rote memorization and pre-examination raids, however, this result is not enough to show a student's application ability, cannot well stimulate the students' innovation motivation and application ability training.

Therefore, in the reform of examination methods should try a variety of assessment methods, such as open-book, closed-book, written test plus to computer, oral test plus to written test, design works, small papers and so on. Teachers can choose different assessment methods or combinations of several forms according to specific conditions, and urge students to fully digest and absorb the lessons learned and grasp them flexibly. It is suggested that the examination should take the team as the unit instead of the individual student, and the students should form groups of 3 ~ 5 people freely. In each chapter after the arrangement of design, application of homework, combined with engineering cases, by students programming solutions or design. In the classroom teaching, design 2-3 times to student seminar-based content, student's speech, course report and so on will also be a part of the assessment. At the end of the term, comprehensive, open and practical tasks will be arranged, such as fingerprint identification, character identification, traffic police gesture identification, coal and rock identification, etc., such as publishing small papers, patent applications and so on. Through the combination of various examination methods, the students are more motivated to innovate and improve the ability of combining theory with practice.

#### 4. Conclusion

Digital image processing is a professional course which requires high level of mathematics and programming. In this paper, from the perspective of the undergraduate talents training of the new specialty-intelligent science and technology, we mainly aim at the deficiency of the traditional teaching of this course, from the angle of theory teaching and practice teaching, this paper probes into the teaching content, teaching method, teaching means and assessment of this course, it changes the traditional teaching concept which is mainly based on the teaching of classical theory knowledge, and combines the new problems, new techniques and new methods at present to strengthen the training of students' practical application ability and comprehensive quality, we hope to be able to "Point to face", will be effective methods to the intelligence of the curriculum, the new era of intelligent personnel training to provide a certain construction ideas.

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