

Teaching Research and Practice of Machine Vision Course Based on Case Teaching Method

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Abstract: Machine vision is a research hotspot in the field of artificial intelligence and also an important professional application course in the computer direction of higher education. Traditional teaching methods focus on the teaching of theoretical knowledge and lack the cultivation of students' abilities to analyze and solve practical problems. Therefore, the teaching reform of this course is particularly important. The case teaching method provides an effective way to achieve this goal. This paper first analyzes the current situation of machine vision course teaching in higher education, and introduces the case teaching method. Then the case teaching method is introduced into the teaching of machine vision course, and the teaching process is introduced in detail, including four aspects: case selection, case presentation, case analysis and discussion, and case summary. Thus, while the machine vision course focuses on enabling students to deeply understand and master theoretical knowledge, it also places equal emphasis on cultivating students' comprehensive abilities such as problem-solving and analysis skills, innovative thinking, and teamwork.

1. Introduction

With the rapid development of science and technology, machine vision has increasingly become a hot research area in the field of artificial intelligence. As an multidisciplinary course, it has extensive applications in numerous fields such as autonomous driving, industrial automation, intelligent transportation, medical diagnosis, etc. It is an important professional application course for undergraduate students majoring in computer science, automation, intelligent science and technology and other majors in institutions of higher learning. However, the current construction of the machine vision curriculum system is not perfect. The courses often focus on theoretical explanations and lack the cultivation of students' abilities to analyze and solve practical problems. Students have obvious deficiencies in the ability to transform relevant theoretical knowledge into practical engineering applications.

Under the background of new engineering, the machine vision course should place greater emphasis on cultivating students' application abilities as well as their comprehensive capabilities to analyze and solve complex engineering problems. The introduction of the case teaching method provides an effective way to achieve this goal. The case teaching method is a teaching approach in

which teachers explain knowledge using typical cases, enabling students to understand and master theoretical knowledge through the analysis and discussion of these cases[1]. It integrates real application cases into the teaching process, allowing students to deeply understand and master the knowledge while solving practical problems, which helps to cultivate students' problem analysis ability, innovative thinking ability and teamwork ability, so as to improve student's comprehensive abilities. At the same time, the case teaching method can also enable students to have a better understanding of the needs and challenges of machine vision technology in practical applications, enhance students' practical ability and professional quality, and lay a solid foundation for students' future employment and career development.

In conclusion, it is of great practical significance to study the application of the case teaching method in the machine vision course. By introducing the case teaching method into the teaching of the machine vision course, the teaching effect can be effectively improved, and high-quality professionals in machine vision who meet the needs of social development can be cultivated, providing strong talent support for the development and application of machine vision technology.

2. Machine Vision Course

2.1. Course characteristics

As a professional course integrating multiple disciplines, the machine vision course has remarkable characteristics such as a wide coverage of content, complex theories, strong practicality, and rapid knowledge updates. The Machine Vision course emphasizes the close combination of theory and practice. This course not only includes rich theoretical knowledge, such as digital image processing, machine learning algorithms, deep learning algorithms, etc., but also places great emphasis on practical operation abilities, such as image acquisition, modeling, and the programming implementation of algorithms. Therefore, it places high demands on students' comprehensive abilities.

With the continuous development of technologies such as artificial intelligence and deep learning, new technologies and methods in the field of machine vision are emerging constantly. For example, the convolutional neural network in deep learning has achieved remarkable results in aspects such as image recognition, object detection, and binocular vision, and it continuously promotes the widespread application of machine vision technology in fields like autonomous driving, intelligent transportation, and industrial automation. Therefore, the content of the machine vision course needs to keep up with the latest trends of cutting-edge technologies.

2.2. Current teaching problems

(1) Difficulty in understanding abstract knowledge. Some theoretical knowledge in machine vision, such as complex image processing algorithms and mathematical models, is rather abstract. Students may find it difficult to understand and master during the learning process. For example, when studying the task of object detection, students need to understand the principles of object detection tasks, algorithm frameworks, convolutional neural network models, etc. This poses a certain degree of difficulty for some students with a weak mathematical foundation. Therefore, by introducing practical cases, such as the case of using machine vision for human detection, students can see how a series of complex algorithms including image acquisition, preprocessing, feature extraction, and classification are applied to practical scenarios. By combining the abstract theoretical knowledge with specific application examples, students can better understand and master the principles and methods of object detection.

(2) Insufficient application ability. Traditional teaching methods focus on the transmitting of

theoretical knowledge, students often demonstrate insufficient ability when applying the knowledge they have learned to solve practical problems. They may have a good command of various algorithms and models, but when faced with actual machine vision application scenarios, such as obstacle detection in autonomous driving, automated detection of industrial products, and cargo recognition in logistics automation, they do not know how to select appropriate technologies and methods, nor how to carry out systematic design and development. So, it is necessary to take practical applications as the guiding principle. By introducing cases, students can learn how to apply the knowledge they have learned to specific scenarios, so as to cultivate their engineering thinking and practical abilities.

(3) Limited practical teaching resources. The practical teaching of the machine vision course requires the provision of corresponding software and hardware devices. However, these software and devices are often expensive, especially the shortage of costly computing power resources, resulting in limited opportunities for students to carry out practical operations. Therefore, case teaching method can make up for the shortage of practical teaching resources to a certain extent. Although students may not be able to operate all the hardware devices and software platforms in person, by analyzing the system design, implementation process, as well as the problems encountered and solutions in practical cases, students can understand the overall process of machine vision projects and key technical points, accumulate practical experience, and improve their ability to solve practical problems.

3. Case Teaching Method

3.1. Related work

The case teaching method is a teaching approach based on cases, and it is a new type of open and interactive teaching method. It originally originated from the Harvard Business School. After its implementation, it has achieved remarkable results. Later, this method was gradually introduced into other fields and has been widely applied and developed. Currently, the case teaching method is developing well, with extensive applications and continuous innovation. Jun Guo et al. applied the case teaching method to the teaching of mine fire prevention course, and transformed the latest scientific research achievements of mine fire intelligent warning and control system into cases introduction of the curriculum[2]. He Jun applied the case teaching method in college enterprise management teaching, and regarded the case teaching method as an important way to achieve teaching reform[3]. Xiaochuan Wang et al. discussed the necessity of the application of case teaching method in public administration teaching through the application of case teaching method on the premise of public administration study[4]. Globally, the importance of case teaching method is becoming increasingly prominent and it is generally regarded as an effective means of cultivating students' practical operation abilities and innovative spirit.

3.2. Advantages

In the traditional teaching mode, the classroom is centered around the teacher, focusing on one-way transmission knowledge. However, under the case teaching mode, the teacher first carefully selects appropriate cases and then guides students to conduct in-depth analysis of the cases through independent exploration and group cooperation. In this way, a platform for thinking, discussion and analysis is established for students, making them the core subjects of the classroom. Therefore, case teaching method has many advantages:

(1) Enhance learning interest. Traditional teaching methods often focus on the imparting of theoretical knowledge, and the teaching content is rather dull, making it easy for students to feel

bored. In contrast, case teaching method transforms abstract theoretical knowledge into practical scenarios through real and specific cases, making learning more interesting and appealing. It can stimulate students' learning interest and initiative, and improve the learning effect.

(2) Enhance practical ability. In the process of analyzing and solving case problems, students need to combine the theoretical knowledge they have learned with practical cases. This not only deepens their understanding and memory of theoretical knowledge but also improves their practical operation ability[2].

(3) Cultivate comprehensive abilities. In the case teaching method, students need to think deeply and analyze the complex problems in the cases. Therefore, it can exercise their critical thinking and logical reasoning abilities, enabling them to learn how to analyze problems from multiple perspectives and propose solutions, thus improving their comprehensive abilities. At the same time, the case teaching method is usually carried out in the form of group discussions. Students need to divide tasks and cooperate, as well as exchange ideas within the team, so as to enhance their teamwork and communication abilities.

4. The Application of Case Teaching Method in Machine Vision Course

In the machine vision course, the case teaching method is an important teaching means. Its teaching process is advanced by combining theory with practical cases. From case introduction, case presentation, case discussion and analysis to summary, all links are closely interlocked. The specific process are shown in Figure 1.

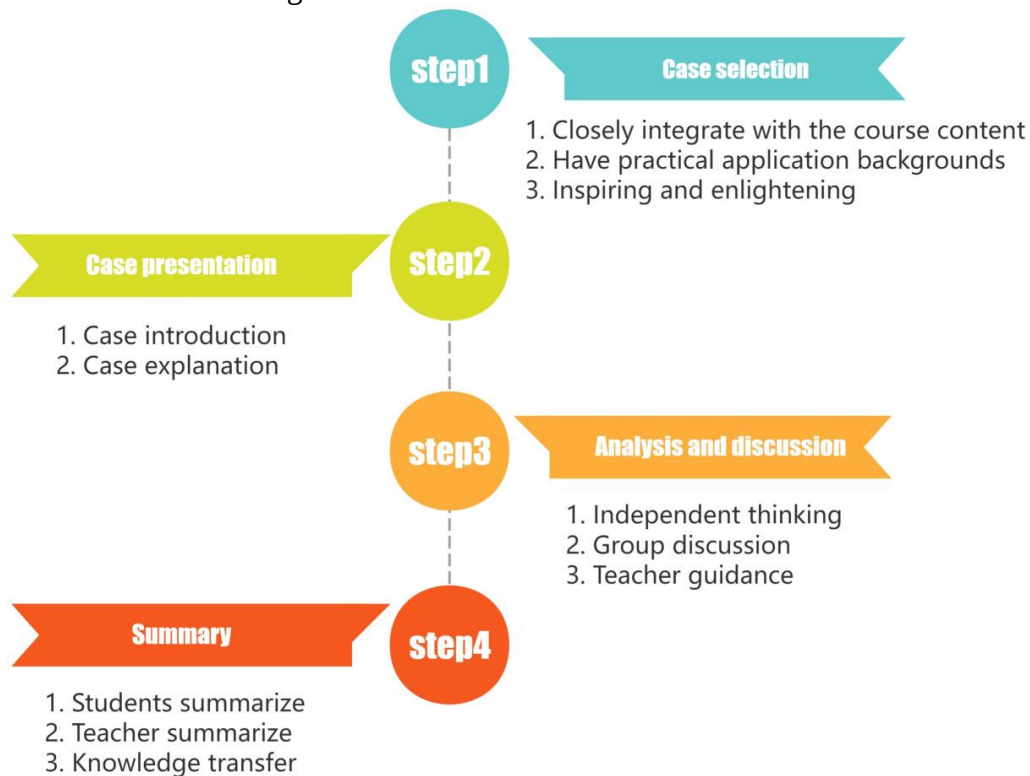


Figure 1: The teaching process of case teaching method in machine vision course.

4.1. Case selection

To apply the case teaching method in the machine vision course, we need to carefully collect and sort out the cases before class, and select the appropriate cases according to the teaching objectives.

This ensures that the cases can effectively help students understand and master the relevant knowledge and skills of machine vision.

The following key points should be noted during the case selection process:

(1) **It is necessary to closely integrate with the course content.** The cases should be closely related to the basic theoretical knowledge in the machine vision course to ensure that the cases can cover the main knowledge points of the course. For example, when studying object detection, a complete automated license plate detection case based on machine vision can be selected, which involves multiple aspects such as image acquisition, image preprocessing, feature extraction, license plate positioning, character recognition algorithms, model selection and training, etc., enabling students to have a comprehensive understanding of the object detection system.

(2) **The cases should have practical application backgrounds.** Currently, machine vision is widely applied in fields such as autonomous driving, industrial automation, smart agriculture, medical assistance, etc., including lane line detection, obstacle detection, intelligent logistics, robot navigation, surgical navigation, and so on. Selecting these cases can enable students to understand the important role of machine vision in real life and enhance their learning interest and application abilities.

(3) **The cases should be inspiring and enlightening.** A good case should be able to stimulate students' thinking and curiosity, and guide students to actively explore solutions to problems. For example, when explaining the image segmentation algorithm, a complex image case containing multiple different objects can be presented, allowing students to think about how to accurately segment these objects according to their characteristics, thus leading to the introduction of different image segmentation algorithms and their application scenarios.

4.2. Case presentation

In the case teaching method, teachers play an extremely important role in presenting cases in class. They not only need to stimulate students' learning interest but also ensure that students have a comprehensive and clear understanding of the cases, guiding students to think and analyze.

First, case introduction. Teachers can introduce cases in various ways. For example, when introducing the object detection chapter, they can play a video of robots performing the yangko dance on the Spring Festival Gala stage or talk about the application of the automatic license plate recognition system in intelligent transportation, which can improve traffic efficiency. This can attach students' interest and allow them to quickly immerse themselves in the case scenario.

Then, case explanation. Teachers should explain the case background, relevant information, and the problems it faces to students in detail. Taking license plate detection as an example, they should explain the requirements of the intelligent transportation system for the accuracy and speed of license plate recognition, the characteristics of license plate images in different scenarios, and the possible interference factors, etc., to ensure that students have a comprehensive and clear understanding of the case.

4.3. Analysis and discussion

In classroom teaching activities, as a guide, the teacher can follow the following steps according to the actual situation of the teaching content:

The first is independent thinking. Based on the case materials provided by the teacher and the teacher's introduction, students think independently about the problems in the case and try to use the knowledge they have learned to analyze the causes of these problems. For example, in the license plate detection case, students think about how to use object detection algorithms to accurately identify license plates, and how to deal with license plate images with issues such as lighting, tilting,

blurring, and occlusion during the detection process.

The second is group discussion. The teacher divides the students into groups and they start discussions centered around the case problems. Members within the group express their own opinions, and by combining the concepts of machine vision knowledge they have learned, they share their analysis ideas and preliminary solutions. For example, during the group discussion on license plate detection, they can explore how to optimize the image preprocessing steps to improve the accuracy of license plate positioning, the feasibility of different character segmentation methods, and how to solve the problem of lighting.

The third is teacher guidance. The teacher should continuously set different questions from the simple to the complex, guide the direction of the discussion in a timely manner, and promote the discussion to develop in depth. At the same time, teachers need to liven up the classroom atmosphere. Based on students' performance and feedback in class, they should constantly think about how to maximize students' learning enthusiasm and encourage students to speak actively, so as to enhance students' language expression ability as well as their understanding and analysis capabilities[5].

4.4. Summary

Teachers should summarize the case after the discussion. On the one hand, it helps to consolidate knowledge. It assists students in sorting out the knowledge points involved in the case analysis process, deepening their understanding and memory of relevant theoretical knowledge. At the same time, it integrates the knowledge from different disciplines involved in the case or different knowledge points within the same discipline. On the other hand, it helps to guide reflection and improvement. It enables students to think about their own strengths and weaknesses in the case analysis process, summarize experiences and lessons, so that they can continuously improve their ways of thinking and behavior methods in future studies and practices, and promote their self-improvement and growth.

Firstly, students summarize. The student representatives of each group make a summary speech. They summarize the advantages and disadvantages of the team in the process of case analysis, opinion expression, and idea exchange. They earnestly reflect on what inspirations they have gained from the case, what knowledge points they have learned, what knowledge gaps still exist, and in which direction they should make supplementary improvements[6].

Secondly, teacher summarize. The teacher conducts a comprehensive review of each group's report. First of all, teachers should recognize students' active participation, praise correct viewpoints and innovative thinking, identify existing problems and deficiencies, and propose directions for improvement. Then, teachers analyze the performance of different groups in aspects such as algorithm selection, parameter setting, and experimental verification, highlight key knowledge points and technical essentials, and guide students to deeply understand the principles and methods behind the cases. Finally, teachers encourage students to reflect on their performance during the case analysis process, including their strengths and weaknesses in the thinking process, teamwork, and communication skills. At the same time, teachers systematically organize and expand the knowledge related to the cases to help students build a complete knowledge system.

Thirdly, knowledge transfer. In case teaching, the link of knowledge transfer is extremely crucial. Teachers actively guide students to think deeply about the problem-solving methods in the cases and explore their applicability in other similar scenarios, so as to achieve effective knowledge transfer. For example, in the chapter on object detection, taking the license plate detection case as a starting point, teachers can inspire students to think about whether the technologies used in license plate detection can be extended to the recognition of vehicle brands and models. License plate

detection focuses on the recognition of specific characters. Although the recognition of vehicle brands and models has different focuses, there are similarities in the underlying logic of image recognition. Similarly, in the field of appearance defect detection of industrial products, teachers can guide students to consider whether they can draw on the image preprocessing and feature extraction methods in license plate detection. The objects faced by the appearance defect detection of industrial products are different from those of license plate detection, but there is reference value in removing noise interference and accurately extracting key features to achieve accurate judgment. This can help students flexibly apply knowledge and improve their ability to solve diverse problems.

5. Conclusion

Case teaching method plays a very important role in modern higher education teaching. This paper focuses on machine vision course, which is an important professional application course in computer direction of higher education, and analyzes the application method and significance of case teaching method in machine vision course. It can be seen that the case teaching method can play an important role in the teaching of machine vision courses, and the application results are remarkable. The successful application of this teaching method provides a useful reference for the teaching reform of other professional application courses in higher education, and is expected to promote the whole teaching mode of higher education to pay more attention to the cultivation of students' comprehensive ability.

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