A Design for Experimental Program of Artificial Intelligence and Machine Vision Based on Online Learning

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Abstract. Aiming at the design for experimental program of Machine Vision in the course of artificial intelligence, this paper puts forward a concrete plan of experiment of Machine Vision in AI course as well as a concrete implementation of online learning. Through two aspects of basic knowledge and frontier technology, the design progressively demonstrates the concrete way of combining theories with practice, which enables polytechnic college students to obtain basic AI knowledge and technology quickly.

Keywords: AI course · Machine Vision · Experiments · Online learning

1 Introduction

As a multidisciplinary course, AI has made breakthroughs in machine learning, natural language understanding and some other fields. AI is not only an important branch of computer science, but also one of the core professional courses of computer science, software engineering, Internet engineering and so on. At present, AI is developing rapidly in China, but it is also facing a huge shortage of talents. Many colleges and universities in China have already set up courses related to AI. It is urgent for polytechnic colleges to cultivate practical talents of AI. However, most of the AI courses in polytechnic colleges lack a plan for practical links of AI courses, and there is no concrete design for experimental program.

2 Problems in the Teaching Practice of AI

In polytechnic colleges, there are various types of students, whose foundations are uneven. They are more willing to "do" than "use their brains". It seems that the AI technology, in comparison with abstract theory, arouses more initiative of polytechnic college students. AI involves so many subjects, abstract contents and so much knowledge that it is widely-involved and high-theoretical. Thus, it needs a good mathematical foundation and strong logical thinking to understand it well, which makes it difficult for teachers and students to communicate effectively in class. The teaching process should be more vivid, combined with words, images and videos.

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At present, there are many kinds of experimental platforms for AI courses and programming languages such as C++, Python and MATLAB, can not be unified. As a result, students can't concentrate on AI-related algorithms while spending too much time on programming languages. At the same time, the traditional experimental cases are mostly abstract problems, and the content of experiment is biased towards theories, so it is difficult to see the intuitive results of the problems. With the rapid development of AI, Machine Vision has become a hot issue currently, and students are eager to master this latest technology.

Because of their weak foundation, it is difficult for students of polytechnic schools to settle down to preview and review. As the Internet develops, the platform for online learning plays an important role. First of all, teachers upload relevant videos which is required in the next lesson on the platforms for online learning such as Blue Ink Cloud, to attract students' attention. It's a good beginning for students to actively search the information related to the subject. Then basic knowledge points and principles are explained in the class for further mastery of related technologies. After demonstrating the experiment in class, if the students do not consolidate it in time, they will easily forget the knowledge points. Students can also use the platform to consolidate the knowledge they have learned in their spare time.

3 Design for Experimental Program of Machine Vision in the AI Course

Now Machine Vision is one of the researching hotspots in the field of AI. Machine Vision, in short, is a visual system simulated by machines instead of human beings. At present, combining the theories of AI with Machine Vision can effectively stimulate students' interest and initiative. The purpose of experiment is not only to consolidate knowledge points taught in theoretical courses, but also to cultivate students' programming habits.

3.1 Platform for Machine Vision Experiment

OpenCV, an open source computer Vision library, is used in the process of teaching. It supports many functions which can efficiently implement common algorithms of Machine Vision. OpenCV is developed by C/C++ and it has Python, Java, MATLAB and other interfaces. Students only need to master the basic principles of the algorithm and the specific parameters of the functions provided by OpenCV. Then we can invoke a function directly and see the intuitive result of it.

3.2 A Concrete Plan of Experimental Program

The courses of AI in polytechnic colleges should focus on practice. Machine Vision is an attractive breakthrough in AI. Machine Vision has a lot of application just as one of so many AI courses. It is reasonable that layering what will be taught not only can enhance students' understanding of knowledge points in an orderly and in-depth way, but also can provide knowledge for the introduction of follow-up experimental cases.

This paper divides contents of the experiment into three levels: basic knowledge points, frontier technologies and online learning.

(1) **Basic Knowledge Points**

The basic knowledge points of Machine Vision refer to the theories and basic methods in the field of vision, which have been developed relatively well so far. These widely-used knowledge points in the field of Machine Vision, can lay a foundation for further learning. In the process of teaching them, it is necessary for students to have a certain foundation of advanced mathematics, linear algebra, theory of probability, etc. Polytechnic school students have a weak foundation in this aspect, so we have to simplify knowledge points, weaken the process of formula derivation and use modern teaching methods and multimedia facilities to enable students to understand the basic knowledge points more deeply.

(2) **Frontier Technologies**

Frontier technologies refer to the theories and methods of Machine Vision, which are still being explored and developed. For example, deep learning attracts the most concern in the field of AI, as well as target detection, image recognition, automatic driving and other issues. All of those involve advanced technologies such as OpenCV and Tensorflow. These advanced technologies can provide polytechnic college students with a rapid access to AI, making up for the inadequacies of some professional knowledge and mathematics. From the aspect of practical problems and the application of technology, we can see the intuitive experimental results efficiently and quickly.

(3) **Online Learning**

Students preview before class through the platform of online learning, mainly by watching related videos and the direct results of algorithm experiments. Firstly, students should have a deeper understanding of knowledge points, and then go to class with the doubts. After the teacher's demonstration of the experiment in class, students can also review and consolidate the experiment through platform online learning after class, in order to strengthen the relevant knowledge points they have learned. Besides, they can also use the platform to ask questions. Teachers can know the situation of students' preview before class, and then focus on the knowledge points in class. After class, teachers can rethink and improve the teaching effects according to students' completion of the experiment.

3.3 A Concrete Design for Experimental Program

This paper takes the experimental case of Hough Circle Detection based on Machine Vision as an example. Before class, some examples of Hough Circle Detection will be shown on the platform of online learning, in order to have a preliminary understanding of Hough Circle Detection. The general equation of the induced circle is drawn forth as $(x-a)^2+(y-b)^2=r^2$. Therefore, a circle has three variables, the center coordinates (a, b) and the radius r, which means more computation. The function "cvHoughCircle ()" provided in OpenCV can set the range of radius r, which is equivalent to a priori

setting. For each r, it can reduce the amount of calculation to find each a and b in two-dimensional space. Firstly, the image input is edge-detected to obtain its boundary points called the foreground point. If there is a circle in the image, the outline must belong to the foreground point. Then we express the general equation of a circle in another way, through coordinate transformation. It means that we transform the equation from X-Y coordinate system to A-B coordinate system. The circle will be written in the form of $(a-x)^2+(b-y)^2=r^2$. Therefore, a point on a circular boundary in the X-Y coordinate system corresponds to a circle in the A-B coordinate system. And many points on a circular boundary in the X-Y coordinate system, corresponds to many circles in the A-B coordinate system. Since these points in the original image are all on the same circle, the transformed a and b must also satisfy all the circular equations in A-B coordinate system. The intuitive phenomenon is that these circles corresponding to these points intersect at one point. The intersection may be the center of the circle. By counting the number of circles at the local intersection and taking each local maximum, the coordinates of the center of the circle corresponding to the original image can be obtained. Once a circle is detected under a certain r, the value of r is determined accordingly

The above is the basic principle of Hough Circle Detection, which is the basic knowledge point. It is a little difficult for polytechnic college students to implement the algorithm of this principle directly. Therefore, the introduction of the Hough Circle Detection function in the open computer visual, which is the cutting-edge technology, is necessary and helpful. The parameters in the cvHoughCircle() function provided in OpenCV are given to the students in detail, and students are required to call the program by themselves. Then, the students need to test the given image. If they get a circle, it proves the experiment is successful. After the experimental course, the basic knowledge points and the experimental related demonstrations will be combined and sent to the experimental teaching video platform. By this means, the students can use the platform for online learning to review and consolidate the knowledge points. In the end, the students summarize the experimental content and write an experiment report.

4 Conclusion

In this paper, the author deeply studies the design for experimental program of Machine Vision, and puts forward the concrete planning and implement scheme of experiment in AI courses. It includes the use of the platform for online learning, which is popular in recent years. The design of the experimental scheme demonstrates the specific way of linking theory with practice. AI has come into people's lives. As a cradle for cultivating applied talents, polytechnic colleges are urgently needed to explore the teaching methods of AI courses, which are suitable for the characteristics of students in polytechnic colleges.

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