Reform of Talent Cultivation Based on Deep Learning Technology

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Abstract. In modern times, since talents with a background in new engineering in colleges and universities play a vital role in society, it is further reform and practice that universities need to strengthen in engineering education. Taking the software engineering talent training program in universities as an example, this paper analyzes the current situation of software engineering talent cultivation against the background of new engineering. In light of the emerging issues, this paper introduces the student-centered education concept. Then, according to the characteristics of software engineering majors, relevant suggestions in terms of curriculum system, teaching mode, and teaching management are offered, which aim to foster the development of world-class software engineering talents. Besides, this paper designs an image denoising module, as well as a dense residual dynamic region-aware convolutional neural network (DRDRNet), for the smart teaching platform to assist instructors in obtaining teaching photography with high quality and improve teaching quality. Quantitative and qualitative experiments have demonstrated the denoising performance of the proposed module.

Keywords: Talent Cultivation · Image denoising · Teaching reform · Neural network

1 Introduction and Background

Against the background of new engineering, many academics in the country have studied how to accelerate the pace of constructing a system for cultivating professional talent [1]. Additionally, sophisticated technologies such as cloud computing, artificial intelligence, "Internet +", and big data in advancing society have gained much interest and success against the backdrop of new engineering. How to apply the strong professional advantages of software engineering to college education reform, realize the integration of practice and theory, science and education, innovation and entrepreneurship, and

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cultivate software engineering with the capacity for dual innovation is an urgent issue that must be resolved. In this paper, we drill down into the development demands of software engineering in colleges and universities under the background of new engineering and provide corresponding talent cultivation solutions and proposals. Moreover, we design an image-denoising module as well as a dense residual dynamic region-aware convolutional neural network (DRDRNet), which can be embedded in the smart teaching platform. Notably, this proposed DRDRNet can assist teachers to obtain teaching photography with high quality and improve teaching quality.

2 Current Situation and Challenges in Software Engineering Education

Traditional software engineering training generally consists of public general courses, basic and professional software engineering courses, and graduation design. Although this form of education can expand the reserved professional knowledge for students, it does not match the requirement of society for inventive and applied ability. This section examines the current situation and challenges of traditional training mode from two perspectives.

2.1 Teaching Mode and Management

At present, there are two prevalent contradictions in Chinese higher education. The first inconsistency exists between group education and individual development, In the current college education mode, all students are trained according to the same training standards and take the same course. This leads to students' inability to develop according to their own interests, just like the products of the assembly line, which cannot meet the needs of the society for the diversity of talents. While the second paradox resides between the huge ability expectation for graduates from society and the backward knowledge-oriented education system. With the progress of society and the development of science and technology, the demand of enterprises for talents is increasing. The lagging college education cannot provide enough high-level talents for social enterprises. In addition, there are some non-negligible factor obstacles to the development in some colleges and universities, such as the inadequate concept of engineering education, imperfect teaching management system, ambiguous talent training positioning, relatively lagged training mode, and professional settings that cannot be effectively adjusted to market demand. These above-mentioned results in graduates being unable to adapt to the competitive mechanism of the employment market and cannot establish a situation where both businesses and graduates benefit [2].

2.2 Course System and Teaching Contents

Some colleges and universities exhibit the characteristic of rigidly complying with the undergraduate training plan, which results in unreasonable and lagging curriculum design. Additionally, practical teaching remains focused on the verification experiment of the classical theory, which lacks issues from actual tasks or contemporary situations

and lacks a structured application procedure and comprehensive teaching framework. For example, AI technology has become a new development trend at this stage. In such a big environment, the courses of colleges and universities are still carried out around the basic software engineering many years ago. Students are confused about their future development, and enterprises can not recruit suitable talents. Then, it is challenging to promote the inventive consciousness and motivation of students by revisiting the theory and analyzing their reflections. However, students from software engineering, who are expected to be equipped with knowledge generalization and continuous learning ability, must consistently learn to leverage not only relevant professional information but also a variety of resources to address difficulties at work or on projects.

3 Direction for Software Engineering Education Reform under the Background of New Engineering

3.1 Student-Centered Teaching Concept

1) Reformation in Teaching Mode.

Under the new paradigm of engineering, student-oriented education and administration will place students at the center, i.e., universities supply students with high-quality environments and services based on their genuine needs, with complete regard for the personalities and traits of students. Thus, not only based on the current needs of economic and social development but also employment-focused, colleges and universities should strengthen the construction of discipline, improve teaching content and curriculum system, and optimize professional settings and structure. Then, to enable students to acquire new knowledge and further graduate skills, teachers should modify traditional teaching modes into advanced ones, such as blended teaching [3], flipped classrooms [4], and practice teaching [5]. Additionally, to assist regional industrial-economic transformation and structural upgrading, universities should actively pursue collaboration with enterprises in technological research and jointly cultivate skilled talent to meet societal needs with enterprises to promote the combination of academic and vocational education [6].

2) Cultivation of Double-creative Talents.

New engineering emphasizes that the construction of engineering education must conform to contemporary development trends, break the boundaries of disciplines, highlight the equal importance of practice and theory, and also demand the frontier and intersection of professional knowledge. In addition, universities should guide students' independent learning, and encourage them to take an active part in related innovation activities, such as New Trends in Image Restoration and Enhancement (NTIRE) and Qualcomm AI Innovation Challenge, and Imagine Cup. These measures can develop students' capacity for experimental analysis and design as well as their sense of teamwork and competitiveness. Also, it fosters the cultivation of compound talents with innovative and entrepreneurial abilities for the country.

3) Improvement in Teaching Quality.

The essential benchmark for gauging the effectiveness of education, as well as the origins and ends of college work, is the quality of talent training. On the one hand, the

evaluation of curriculum teaching quality assists college instructors in improving their teaching ability through quantitative indicators; on the other hand, it supports university management departments in perceiving the teaching situation on time, strengthening teaching access and monitoring, and enhancing high-level personnel training.

3.2 Restructuring Software Engineering Education

Software engineering is distinguished by its confluence of knowledge and technology, extensive graduate employment, and high societal demand. Students from software engineering must confront the industry trends, and then combine these professional and advanced skills, such as blockchain, big data, artificial intelligence, and cloud computing. Under the influence of new technology, colleges and universities should revise and improve talent training programs based on the requirements of society and enterprise. Specifically, universities should invite some industry experts and software engineers to organize lectures and impart some software engineering relevant industry knowledge and cutting-edge technology to students; universities can also perfect the curriculum system, and establish popular software engineering technologies like blockchain, artificial intelligence, big data, and cloud computing. Some senior experts from enterprises can also be invited to explain the specific work of enterprises and the current hot directions to students. Or organize students to visit and study in large enterprises, practice during holidays, etc., so as to improve students' understanding of what to do in software engineering, as well as their future development and employment prospects. Besides, universities can stress the idea of a "race to promote" and establish a competition platform, containing innovation and entrepreneurship, the International Collegiate Programming Contest (ICPC), and hacking and defense competitions, to enhance the innovation skills and competition awareness of students.

4 Image-Denoising Module for Smart Teaching Platform

As mentioned before, when implementing blended teaching, which integrates traditional teaching and online learning, it is inevitable to encounter some pictures or videos with poor visual quality. To address this problem, we propose an image-denoising module named dense residual dynamic region-aware convolutional neural network (DRDRNet), which can be embedded into the smart teaching platform to assist instructors to obtain teaching photography with high quality and improve teaching quality. Specifically, this plug-and-play 17-layer lightweight denoising module as shown in Fig. 1, which consists of two blocks: extraction block (EB) and dynamic region-aware convolution (DRConv) [6]-based dense residual block (DDRB), is designed based on deep learning technology. On the one hand, we utilize 11-layer EB to extract deep coarse features. Concretely speaking, the EB is composed of two types: Conv and Conv + BN + ReLU. The Conv in the first layer with 64-filtered of size $3 \times 3 \times c$ is employed to transform noisy images into linear features, where c denotes the channel number of the image. When the input is a grey image, c is 1; otherwise, c is 3. Subsequently, we fit the Conv + BN + ReLU in the 2–11 layers of the DRDRNet, where the convolutional operation with 3×3 kernel size is leveraged to generate a coarse feature batchnormalization (BN) is applied to reduce

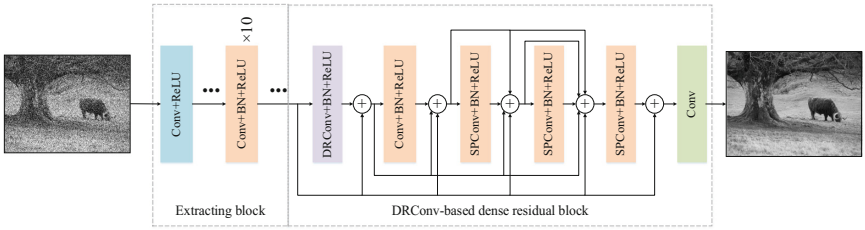

Fig. 1. Network architecture of image denoising module in the smart teaching platform.

gradient explosion, and rectified linear unit (ReLU) is utilized for nonlinearity. On the other hand, DDRB with 1 layer of DRConv + BN + ReLU, 4 layers of Conv + BN + ReLU, and 1 layer of Conv is introduced to obtain salient features from the output of EB. Notably, DRConv is implemented to mine the semantic relationship between coarse features and extract robust semantic features. Moreover, DDRB is enhanced by dense residual connections to avoid the gradient disappearance problem and facilitate noise feature reuse, thus improving noise removal effects.

5 Experiments

5.1 Training and Test Datasets

To objectively assess the denoising performance of the DRDRNet, we trained a grey synthetic noisy image denoiser using a public dataset Train 400 [7] with 400 grey pictures. Specifically, the size of Train 400 is 180×180. We use the Berkeley segmentation dataset (BSD68) [8] with 68 images and another dataset Set12 [9] with 12 images to evaluate the performance of the proposed DRDRNet.

5.2 Comparisons with State-of-the-Art Denoising Methods

The well-designed DRDRNet compares with popular denoising methods for both quantitative and qualitative comparison, i.e., expected patch log likelihood (EPLL) [10], the block-matching and 3D filtering (BM3D) [11], weighted nuclear norm minimization (WNNM) [12], image restoration CNN (IRCNN) [13], fast and flexible denoising network (FFDNet) [14] and a cascade of shrinkage fields (CSF) [15]. For quantitative experiments, we conduct denoising experiments on BSD68 and Set12 datasets with noise levels of 15 and 25. Our proposed method achieves very competing performances on BSD68 among these models, i.e., BM3D and FFDNet. Besides, the DRDRNet also has excellent effects on Set12 at both noise levels 15 and 25. The visual effects of the DRDRNet are competing. For example, DRDRNet recovers more texture details of the image than BM3D, IRCNN, etc. Also, DRDRNet restores a clearer strip than many popular methods, i.e., FFDNet and IRCNN as shown in Table 1. Therefore, we have proposed a functional denoiser in both quantitative and visual performances.

Table 1. PSNR (dB) results of several networks on BSD68 for noise levels of 15 and 25

Models	EPLL [10]	BM3D [11]	WNNM [12]	IRCNN [13]	FFDNet [14]	CSF [15]	Ours
$\sigma = 15$	31.21	31.07	31.37	31.63	31.63	31.24	31.68
$\sigma = 25$	28.68	28.57	28.83	29.15	29.19	28.74	29.22

6 Conclusion

This paper investigates the talent training mode of software engineering under the background of new engineering, elucidates the existing problems from the perspectives of teaching mode and management, and course system and teaching contents, then discusses the current situation of software engineering in the context of new engineering. To meet the requirements of social and economic development, colleges and universities should be guided by the demands of industrial development, construct a competency-based curriculum system, establish a "double-qualified" teacher team, strengthen school-enterprise cooperation, implement a diversified and open practical teaching system, and improve the talent training program. Additionally, we propose an embedded dense residual dynamic region-aware convolutional neural network (DRDRNet) to improve the visual quality of teaching pictures. The main components of DRDRNet serve the following roles. The EB extract deep coarse features and the following DDRB mine the semantic relationship between features and refines obtained features thus constructing latent clean images. Quantitative and qualitative evaluations indicate that our proposed DRDRNet is remarkably efficient for image denoising.

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