

Courses reform of mould courses based on field augmented reality facing engineering education certification

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Abstract. Mould courses are crucial components of the mechanical manufacturing course system, and their innovation and reform can inspire new approaches to college education reform, as for the engineering education certification process. The augmented reality mould disassembly and assembly teaching scheme that is proposed in this paper can help students master the structure and processing of complicated moulds, and thus make comprehensive use of the relating learning knowledge and skills. By understanding of the typical structural design and assembly of moulds, students can learn actively by interaction of the three teaching strands of instruction, case study, and assessment. This will raise the level of instruction throughout the courses as well as student participation and interest. The proposed AR auxiliary system is a new approach to essentially foster students' capacity for independent learning, knowledge understanding, and innovation and production in the age of digital learning and engineering education certification.

1 Introduction

The Washington Agreement, known as the international pact for reciprocal recognition of engineering education, provides the inspection criterion for engineering education and serves as the internationally recognized quality assurance system. With China's entry into the agreement in 2016, new standards for the calibre of China's higher education were also established. This effectively promoted the fusion of domestic engineering education with global standards.

In our domestic schools and universities, there are currently no effective and systematic plans to provide a sequence of courses leading to professional engineering certification or mechanical manufacturing and automation majors. The standard PPT teaching method combined with the chalkboard method makes it tough to arouse students' interest and is ineffective for encouraging them to take initiative and improve their mobility. One of the areas of curriculum teaching reform study is how to convey the curriculum content in a more vivid manner.

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This study focuses on mould-related courses, such as mould design, and proposes an assisted teaching technique based on field augmented reality projection for disassembly and assembly, and offers suggestions for teaching reforming and building.

2 The existing problems in mould teaching

Mould course feature rich knowledge points, high background curriculum system requirements, and high practical operability since they are crucial courses in mechanical specialization [1]. Mould assembly practice can help students in schools and universities develop their practical skills as well as their analytical and problem-solving abilities, enabling them to use newly acquired information skills and abilities to finish the design and installation of standard mould structures [2]. The following flaws are identified in the current mould design course operation and current traditional mould design teaching practices:

(1) The teaching approach is somewhat traditional. The teaching strategies are rather dated. There aren't many case studies and evaluation points sprinkled throughout the classroom, practice, and assessment in the standard teaching practice, which combines multimedia course ware instruction with mould disassembly and assembly practice teaching. Additionally, because of the small experimental class size, students were unable to become comfortable with the mould assembly fast. This had an impact on the teaching outcomes and made it difficult to help students develop their practical skills and creative design thinking.

(2) There is little usage of new information technology in the mould teaching classroom. 3D and 2D modelling software [3] is used in other mechanical courses. And there is no relationship between the disassembly experiment and the general curricular design, making it challenging to pique student's interest in something comparable. Because modern information technology is not integrated into the courses, the traditional teaching approach cannot accurately reflect the background features of the mould courses.

(3) There is a broad instructional gap for teaching and practicing. The connection between teaching and experiment is not strong enough, students cannot use the knowledge they have gained in a flexible manner, and the teaching effect cannot satisfy the teaching requirements since there are many set procedures in classroom teaching.

Due to the typical teaching approach, pupils lack conceptual understanding and possibilities for application of the course material [4]. The problem of the mismatch between theoretical knowledge and practical application and the students' failure to properly comprehend professional knowledge and practical application of knowledge are both caused by the constrained experimental class hours.

3 Researches on reforming of mould courses

Due to the significance of mould courses, numerous schools and universities have established mould design, mould design and manufacturing, or mould CAM courses [5]. Some institutions have even established specialized mould majors. In response to the necessity for educational reform, many educators or scholars have also proposed their own approaches or ways for the mould design course's teaching mould change.

(1) From the standpoint of professional engineering certification [6], it is essential to adhere to the paradigm and standards of the Sydney Agreement, to carry out professional construction for international certification, to implement result-oriented education, and to develop results-oriented curriculum systems. It is also necessary to carry out the full process, comprehensively evaluated professional courses in a scientific and reasonable

manner, and to enhance the professional connotation. The referenced indicator should be process-oriented, student-centred, and results-driven.

(2) From the perspective of project teaching [7], the importance of project teaching approach in vocational education is clarified, and the project teaching evaluation standard is presented from the course setting. By emphasizing the manufacturing, assembly, debugging, maintenance, and other skills, the effective and practical training and teaching techniques are investigated to grow the first-line skill talents in the mould industry. The steps of ‘task’, ‘plan’, ‘implementation’, ‘check’, and ‘evaluation’ for teaching is adopted.

(3) The teaching should be carried out by using online and offline mixed classroom teaching [8], to increase the depth and breadth of instruction and to improve students’ understanding of the fundamental structure and components of stamping dies. These methods are combined with mould module of NX. Alternatively, a set of process methods spanning the mould design process also exist on the CATIA or other modelling software. This type of strategy is sophisticated and information-based.

(4) New techniques for teaching classes on mould using augmented or virtual reality are proposed [9,10]. Many are based on the interactive design of computer web pages or mobile phone applications. The knowledge material is simulated, and instructions are carried out in the simulated environment, in a virtual learning environment. Some are created using the Unity 3D virtual reality platform, and they apply the human-computer interaction education method to create simulation training systems that can expose the system’s structure, function, and important technology.

These teaching strategies and ideas serve as a fantastic resource for our mould course’s upcoming teaching redesign. An essential thinking difficulty in the reform of mould design teaching is how to enable students to create the knowledge system of mould design in a shorter teaching period due to the restricted amount of time allotted for the course.

4 The application of case teaching method assisted by field augmented reality projection

An information projection assisted mould disassembly and assembly teaching platform was created with the use of self-made experimental equipment projection to address the drawbacks of conventional mould teaching. In Figure 1, the framework of the system is displayed. The framework is built after an analysis of the characteristics of the experiments for mould based on augmented reality. The actual assembly site and virtual assembly information are integrated.

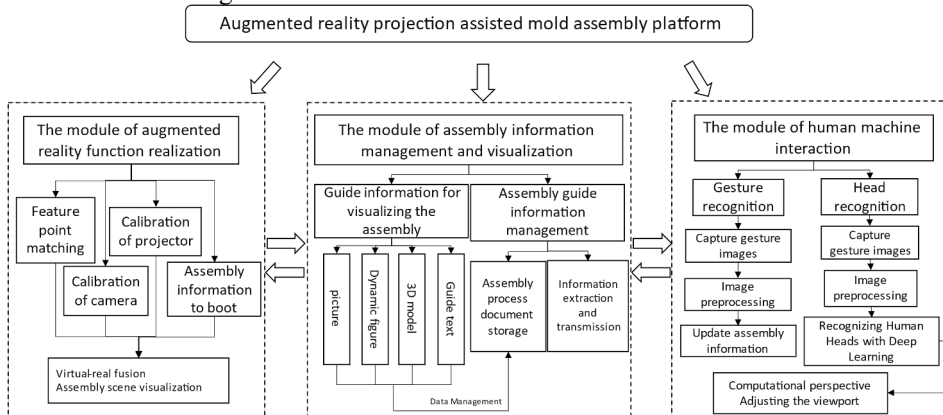


Fig. 1. Framework of augmented reality assisted assembly system.

The following are the specific function modules. It primarily consists of the human-computer interactive module, the assembly information management and visualization module.

The picture acquisition and processing, joint calibration of the camera projector, recognition and matching of image features are all included in the realization module. The real-time positioning of 3D models in actual assembly scenes are established and serves as the foundation for the projection of supplemented guiding data onto the assembly site. All types of guidance information can be precisely projected onto the specific position of the site. The display position of the 3D model can be updated with the movement of the assembly parts.

Data support for the visual components is provided by the assembly information management and visualization module. The mould components are organized into blocks, with a list of details about the procedure by XML files. In order to optimize the description of complicated information and clearly convey the assembly phases, the platform is enhanced by 3D model, voice, assembly animation, and image combination.

The platform can interact more easily thanks to the human-computer interface module. The update of on-site assembly information and the rationalization of the observation model perspective are realized with the implementation of gesture recognition and head recognition services. The software interface for the auxiliary assembly platform is shown in Figure 2. The part structure tree is shown on the left side of the diagram, and the assembly text description is shown on the right. The assembly phase information including animation and model would be projected onto the desktop when the students choose the mould setting phase. The projector will display text, image, animation, and 3D content.

After the on-site posture registration, the 3D model is projected to the corresponding position of the workbench. The location image of the field operator is gathered during the 3D presentation in order to update the model display angle using head recognition. To make it easier for pupils to acquire assembly attention information during process, the guidance voice is played simultaneously in each disassembly/assembly step. In Figure 3, the assembly example is displayed.

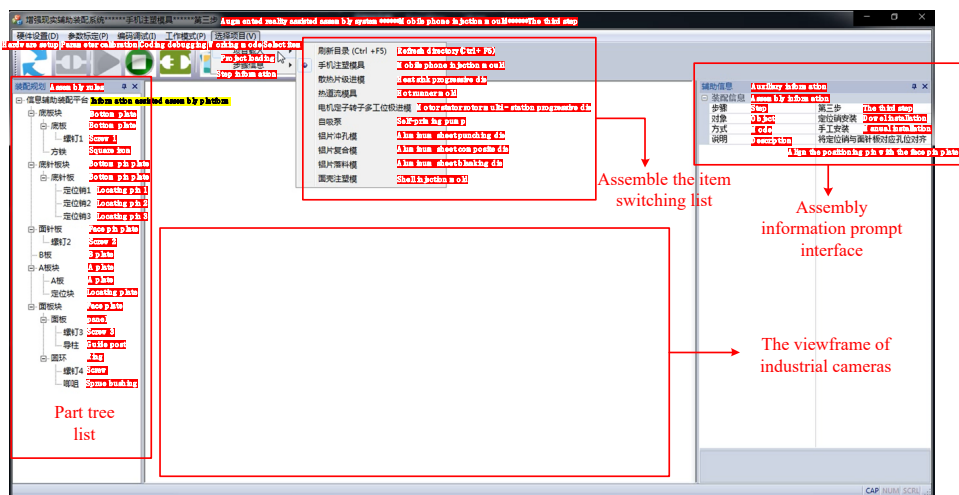


Fig. 2. Software interface diagram of auxiliary assembly platform.

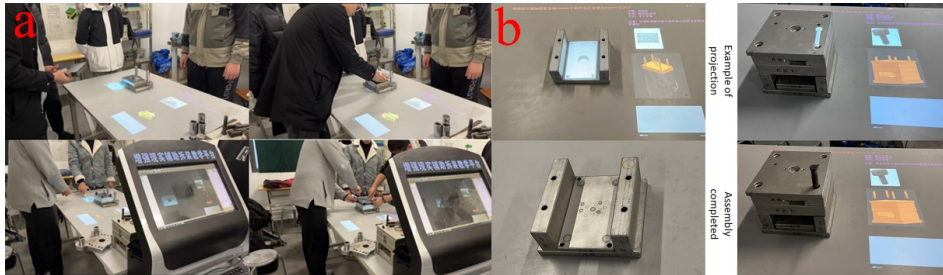


Fig. 3. Examples of experimental course operations (a) Examples of student field operations (b) Example of projection guided assembly.

5 Conclusion

The direction of future development is toward the fusion of information technology and curricular instruction. New forms of interaction include virtual reality and augmented reality. This paper evaluates the inadequacies of conventional mould education and actively investigates curriculum reforming strategies based on the study of various mould teaching techniques and ideas. The mould design course was taught using an augmented reality example that produced specific results with a benchmark value. At the same time, emerging technologies like augmented reality are in a constant state of development. Additionally, we'll keep enhancing the quality and delivery of mould courses.

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