Research on the Construction of Innovation Practice Center for Robot Engineering Oriented to New Engineering Discipline

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Abstract. Robot engineering, as a new specialty with wide cross-section and great cooperation, has not yet been a systematic practice project to meet the requirements of new engineering discipline. Therefore, under the background of new engineering discipline, systematization of cross-knowledge related to robotics, construction of innovation practice center and training of practical talents combining theory with practice are the key points of the research. Firstly, this paper defines the core concepts and limits the scope of research, and puts forward the specific objectives, main contents and innovative breakthroughs of the construction of innovation practice center. And it gives the research methods, concrete measures and implementation steps. Through the construction of innovative practice ecosystem platform, a new model of innovative practice of robotic collaborative education, which meets the requirements of the development of new science and technology, is constructed and designed. It will achieve cross-disciplinary innovation in different disciplines and it can be extended to the cultivation of talents in new engineering disciplines in other colleges and universities in the whole country.

Introduction

In recent years, the United States, the European Union, the United Kingdom, Japan, Russia and other countries have formulated national development plans. China has also introduced the "Made in China 2025"[1-2]. Robot is the second position of the top ten strategies, and its importance is self-evident. As robots and artificial intelligence begin to reconstruct the way of human production, life, learning and thinking, the cultivation of innovative practical talents has become a new era topic[3-4]. Robot engineering is not only a new professional discipline under the engineering discipline, but also will infiltrate into other disciplines and specialties of the new engineering discipline. It will be the core driving force for the promotion of the "new engineering discipline" construction. Systematization of cross-knowledge related to robotics is the theoretical basis and factual basis for innovative practice research.

Robot engineering, as a new specialty with wide cross-section and great cooperation, is still based on the practice training scheme of traditional specialty. And there is no high-quality practical course matching with it. At the same time, the existing methods of robot practice lag behind the needs of personnel training[5]. As a new specialty, it expands from the original single direction to several directions. It needs to supplement the corresponding experimental and practical equipment and sites to meet the needs. At the same time, as a new specialty, it meets the needs of the development of "new engineering discipline" in our country[6]. A certain number of practical comprehensive practical training projects must be carried out. At present, the universities which open this major have not generally met this requirement. Therefore, how to carry out innovative practice in robot engineering under the background of new engineering discipline, systematize the cross-knowledge related to robot specialty, build innovative practice center and cultivate practical talents combining theory with practice are the key points of the research.

Research Cores and Scopes

Definition of Core Concepts

(1) Combining robot with intelligent control, we independently develop robot innovation practice system to stimulate innovation engine.

(2) A new education mode of robot engineering practice driven by specific needs under the collaboration of industry, university and research is actively explored.

(3) Students' spirit of craftsmanship in learning, persistent lifelong learning, solidarity and cooperation, down-to-earth and realistic work, and national feelings of concern for social development is cultivated.

Limitation of Research Scopes

For the construction of innovative practice center of robot engineering, the scope of research should be limited as follows:

(1) Construction positioning: Can the Robot Innovation Practice Center become a bridge between classroom and society? Can we solve the problem of inadequate innovation practice in the training system of robot engineering?

(2) Training mode: What qualities and abilities should students possess in order to realize the construction orientation of the Robot Innovation Practice Center, and accord with the construction orientation of robot engineering?

(3) Construction realization: How to build a scientific innovation practice training center so that students can have the desired quality and ability? What kinds of feedback information or core indicator are used to evaluate, continuously improve and optimize the construction of innovation practice centers?

Obviously, this is a multi-variable system with large inertia lag. A lot of exploration and practice are needed to obtain the optimal solution. At the same time, in the process of construction, we have to consider the students' learning status, employment situation and the strength of teachers, the expectation of the main body of running a school for the construction platform, the corresponding resources, the industrial environment of the school, etc. These all constitute the boundary conditions for the construction of innovation practice center, and also limit the scope of research.

Research Contents

Research Objectives

Based on the robot engineering being constructed in Harbin University of Science and Technology, this paper proposes a set of overall plan for the training of innovative practical talents and the construction of innovative practice center. The specific research objectives are as follows:

(1) Innovative Practice Center for robotics and intelligent control is constructed. Combining robot with intelligent control, modular design is carried out, innovative practice system is developed independently, and innovative engine is stimulated. The cultivation of national mission and innovative spirit runs through all links and combines with practical activities at different levels to stimulate students' innovative consciousness, activate innovative thinking, master innovative methods and solve practical scientific and engineering problems.

(2) A new mode of cultivating innovative and practical talents through the cooperation of industry, university and research is explored. Emphasis is placed on methods, abilities, problems, thinking, process and practice, high vision, new perspectives, solid foundation, wide caliber, wide cross-cutting and large collaboration in education and teaching. We actively explore a new mode of education for innovative engineering practice driven by specific needs and tasks under the collaboration of industry, university and research.

(3) Down-to-earth craftsman spirit and scientific spirit of unremitting exploration are cultivated. In the process of innovative practice, we should adhere to the principle of moral integrity and cultivate

people. What we have to do are to scientifically plan all links of students' development, to realize the seamless connection between education and teaching, to teach knowledge and conduct, and to cultivate students' down-to-earth craftsmanship. The core competitiveness of five-dimensional talents with learning, creativity, expression, organization and execution is promoted. The cultivation of students' core qualities is focused. Students' scientific spirit of advocating truth, rational thinking and exploring is stimulated.

Main Contents

With the help of the national policy of "school-enterprise alliance, industry-university cooperation", we will build an efficient training mode for innovative talents and an ecological innovation practice center, and propose a set of training mode for innovative practical talents suitable for popularization and application. It will provide a boost engine for the cultivation of innovative talents needed by the new economic development in the region, and give ideas and suggestions for the construction of new subjects and specialties. Specific research contents are as follows:

(1) Construction of Ecosystem Platform for Innovative Practice

Five innovative practice ecosystems are independently developed: Cube-solving robot innovation system, man-machine game intelligent control innovation system, intelligent low-cost urban innovation system, Multi-agent Cooperative robot control innovation system and sharing autonomous follow-up robot innovation system. Cube-solving robot is a mechatronic platform which integrates cube-solving algorithm, computer vision, robot control and other disciplines. It can achieve fast and stable cube-solving robot. Man-machine game system integrates multi-disciplinary knowledge such as artificial intelligence, image recognition, motion control, robot control and so on. Intelligent low-cost urban innovation system integrates intelligent city sand table model, large screen display and assembly of large data background, intelligent hardware, big data, intelligent control and other disciplines of integrated innovation platform. The control innovation system of multi-agent cooperative robot is an innovation platform composed of Four-rotor aircraft, ground mobile robot, intelligent vehicle and control system. Shared autonomous tracking robot innovation system, based on machine vision module, has the function of following consumers and helping consumers load goods. It can be used in supermarkets, airports, parking lots, railway stations, production workshops and other places to help people carry goods, reduce load, and liberate hands. Five innovative practice systems can provide students with innovative thinking design and professional training, such as artificial intelligence, deep learning algorithm, big data, machine vision, motion control, image recognition, embedded system, program design, mechanical design, intelligent hardware, Internet of Things, big data, Android system programming, python, Java programming, Trajectory Planning, Wireless Sensor Networks, MATLAB, Virtual Reality, etc.

(2) Exploring a new systematic training mode for innovative and practical talents in robot engineering

In accordance with the guiding ideology of "strengthening the foundation, broadening the specialty, teaching students in accordance with their aptitude and focusing on training", innovative practical education and new subject education reform oriented to the country and region should be carried out in accordance with the basic and general education in the first grade, interest and orientation in the second grade, and professional innovation project training mode in the third and fourth grades. It will build a new adopting research-based teaching mode of innovation and practice with theoretical classroom + course-muting platform + practice center + school-enterprise cooperation. A flexible management mode is to cultivate high-quality innovative talents.

(3) Exploring a new mode of collaborative education combining school-enterprise cooperation with competition and lessons

We will invite renowned innovative practice teachers and entrepreneurs related to robot engineering to give training lectures, open the innovative practice center of robot engineering, set up the "Robot Association" for college students, and organize students to actively participate in various scientific and technological competitions. It will be a formation of "problem-oriented, demand-oriented, interest-oriented, ability-based, goal-oriented, curriculum-based, method-focused,

practice-based breakthroughs, competition test, network platform, process-based archives" of "practical project task-driven" innovative engineering practice collaborative education. The construction of the new model is conducive to promoting the whole chain of innovative practice in teaching and educating.

Research Methods and Measures

Research Methods

(1) Key cases of innovative practical education reform in new engineering disciplines are investigated and analyzed. Detailed investigation and analysis of world-renowned universities in innovation practice reform are conducted. Their common points are summarized. We aim at the actual needs of the market and industry to train innovative robot talents.

(2) The Robot Innovation Practice Center and the Student Robot Association are set up. Based on the five robotic design systems, an innovative practice center is built, from which the common modular development boards related to robotics are abstracted, which can reduce costs and make it easy for students to consolidate their foundation. On the basis of the existing robotic activity group of our team, we set up the "Robot Association" for college students to actively participate in various professional competitions.

(3) The cultivation of students' innovative practice is coherent, hierarchical and systematic. Innovative practice is systematized. The students' innovative practice growth files are established. In the first academic year, the innovative practice curriculum is the base, combining with the famous teachers of enterprises and institutes teach, lecture and basic training. In the second academic year, they engage in project-oriented professional basic training on the basis of tutor projects and project-setting. And in the third academic year, they carry out project-setting, thesis publishing, patent declaration and participation in combination with their professional knowledge. In the Fourth academic year, under the guidance of tutors, they complete graduation design.

Specific Measures

(1) Promoting Innovative Vision. Innovation practice center is opened. A platform for independent inquiry, knowledge application, and open vision is provided. Innovative thinking: inspire, guide and inspire students to find original innovative ideas. Innovative understanding: combining guidance with enterprise guidance to improve students' understanding of innovation. Innovative process: students complete innovative projects in groups, train cooperation consciousness and team spirit. Innovative display: participate in various competitions.

(2) Project Task-driven Innovation. Through the guidance of teachers from different disciplines and inspiring students to break through professional limitations to find valuable original innovative ideas, through classroom lectures, student reports, teacher-student discussions, practical experiments, complete the original form of innovative works, supplemented by enterprise visits and other extracurricular education, students understand and master the research method and realization way of scientific and technological innovation serving production and life.

(3) Innovative tutorial system management. The innovative class is composed of famous enterprise teachers and experts. It guides and cultivates students' life development planning, innovative inquiry ability, and lays a foundation for students' lifelong development. Starting from the second grade, students in the innovative class are equipped with innovative tutors, and individualized training under the guidance of tutors is implemented. The tutor is responsible for individualized guidance such as students' study, scientific research and training, and helps students to formulate professional training plans that are in line with their personality development.

Conclusions and Expectations

Through the study of the connotation and extension of the new engineering discipline, the main problems existing in the emerging robot engineering are analyzed. And the specific research objectives, main contents and implementation methods and measures are put forward to carry out the research on the construction of innovative practice center of robot engineering.

(1) It will take the independent development of the five innovative ecosystems as the core, build the innovative practice center and the organizational structure of the Robot Association, and enhance the innovative vision.

(2) The training of students' innovative practice should be coherent, hierarchical and systematic, and the new training mode of innovative practical talents in robotic engineering should be explored.

(3) We will cultivate students' ability to integrate theory with practice and solve practical problems, as well as their down-to-earth craftsmanship and scientific spirit of unremitting exploration.

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