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Exploration on the Construction of Undergraduate Talent Training System for Intelligent Connected Vehicles

Fayi Yan[a,*], Xuejian Pei[b], He Lu[c], Xinhai Li[d], Zongxi Zhang[e]

School of Mechanical and Electrical Engineering, Shandong Jianzhu University, Fengming Road, Jinan, China
[a]yanfayi@sdjzu.edu.cn, [b]1242813054@qq.com, [c]1207752387@qq.com, [d]lixinhai19@sdjzu.edu.cn, [e]zhangzongxi@sdjzu.edu.cn
[*]Corresponding author

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Abstract: The intelligent connected vehicle major is not included in the national undergraduate major catalog, and there is no existed case as the reference for undergraduate talent training. This paper explores the training path and mode of undergraduate talents in intelligent connected vehicle, and constructs a "1+2+3+5" innovative talent training mode, which is one major direction of intelligent connected vehicles, two engineering capabilities, three sets of knowledge systems and five major reform measures. Based on artificial intelligence, a curriculum system of advanced assisted driving and unmanned driving with software technology, hardware technology and communication technology is constructed. The talent training program is formulated and the practical teaching platform for the integration of industry and education is constructed.

1. Introduction

With the advancement of science and technology, intelligent connected vehicle technology has been widely emphasized at home and abroad. The United States of American released the Policy Guidelines for Autonomous Vehicles in 2016, Japan plans to form a complete autonomous vehicle market by 2025, and the European Union actively promotes the research development and application of intelligent networked vehicles, and promotes the technological innovation and transformation of intelligent networked vehicles. In China, the intelligent networked vehicles industry has risen to the height of national strategy and is increasingly penetrating all aspects of economic development and social life. The "14th Five-Year Plan" of China points out that China will accelerate the research and development of the basic technology platform of intelligent (Internet-connected) vehicles, as well as key components such as software and hardware systems, wire-control chassis and intelligent terminals.

Intelligent networked vehicles specialty is a discipline that combines many theories and practices [1-2], and it is mostly offered in many higher vocational colleges and universities in China's general higher education institutions [3]. Due to the high demand for talent in the intelligent networked

vehicles industry and the rapid development of the industry, the specialty has a good development prospect. The jobs that graduates can engage in include intelligent networked vehicles overhaul technician, vehicles intelligent product test engineer, driverless car test engineer, and so on. However, at present, the intelligent networked vehicles specialty is not included in the national undergraduate specialty catalog of ordinary institutions of higher education, and there is an extreme lack of high-level talent in the intelligent networked vehicles industry. To accelerate the improvement of intelligent networked vehicles technology talent support system in Shandong Province and even the whole country, to meet the talent demand of the country's vigorous development of intelligent networked vehicles industry, and to open up new channels for college students' employment, Shandong Jianzhu University has established the university-enterprise cooperation intelligent networked vehicles undergraduate professional direction, explored the intelligent networked vehicles undergraduate talent cultivation mode, and constructed the talent cultivation program and curriculum system. The research of this paper has important exploration and reference significance for the new industry and new discipline construction of intelligent networked vehicles.

2. Talent cultivation mode construction

2.1 Talent cultivation mode

At present, many vocational colleges and universities have mostly founded the intelligent networked vehicles specialty [4], but few domestic undergraduate colleges and universities have founded this specialty, and there is a serious lack of applied high-level intelligent networked vehicles undergraduate talents in China. The training of traditional vehicle engineering professionals in Shandong Province is also facing the dilemma of not being able to adapt well to the needs of employers, and there is an urgent need to change the mode of talent training. Based on maintaining the existing characteristics and advantages, we comprehensively reform the existing education concept, actively explore the innovative and entrepreneurial talent cultivation path and cultivation mode, and construct the innovative talent cultivation mode of "1+2+3+5", as shown in Figure 1. This cultivation model is one intelligent networked vehicles professional direction, two engineering capabilities, three sets of knowledge systems, and five professional reform measures. The two engineering abilities include engineering practice ability and innovation ability; the three sets of knowledge systems include artificial intelligence, communication technology, and hardware and software technology; the five professional reform measures include reconstructing the curriculum system, establishing a perfect teaching quality improvement mechanism, improving teaching methods, establishing an innovation ability cultivation system, and integrating the teaching of industry, teaching, and research.

To improve students' engineering practical and innovative abilities, we will reconstruct the curriculum training system and create a knowledge system of artificial intelligence, communication technology, and software and hardware to meet the current knowledge needs of employers for graduates. Based on science and technology competitions, with students as the main body and teachers as the lead, we strengthen the integration of competition and teaching to enhance students' innovation and entrepreneurship abilities and engineering practice abilities. In the process of talents cultivation, we will innovate the talent cultivation mode of school and enterprise cooperation, and enable enterprises to deeply participate in the cultivation process.

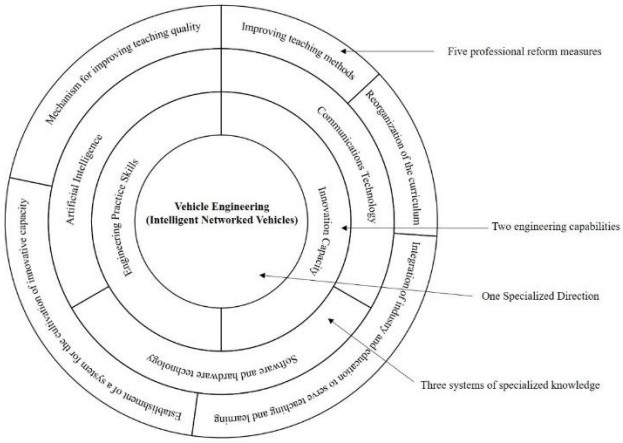

Figure 1: "1+2+3+5"Talent Cultivation Mode

2.2 Training programs

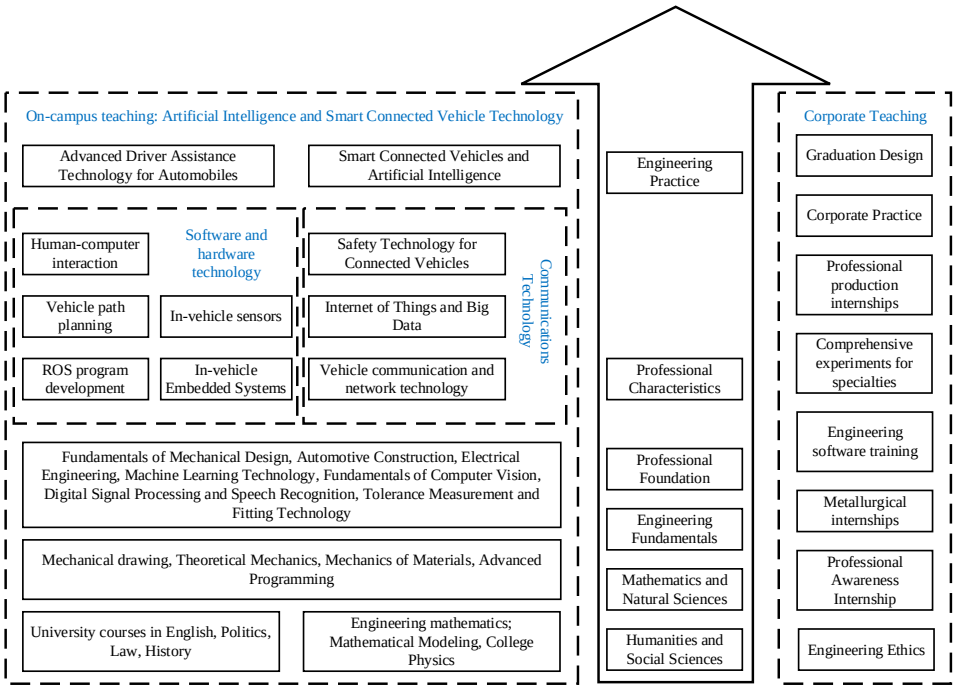

Figure 2: Cultivation Program of "Accreditation Standard for Engineering Education" in the Direction of Intelligent Networked Vehicles

The professional cultivation program highlights the brand-new curriculum system and practical links and consolidates the foundation of cultivating application-oriented innovative talents. To better meet the changing needs of enterprises for talents, industry elements, and enterprise resources are introduced into the formulation of the training program for the professional direction of intelligent networked vehicles. The traditional curriculum system for vehicle engineering has been restructured. In theoretical teaching, in addition to traditional vehicle engineering courses, a curriculum system for advanced assisted driving and autonomous driving based on artificial intelligence and supplemented by software, hardware technology, and communication technology has been constructed to meet the needs of enterprises for cutting-edge knowledge and abilities of graduates. In the practical teaching link, through "engineering cognition - engineering training -

engineering practice” step by step, we gradually improve students' engineering practice and innovation ability, promote the coordinated development of students' theoretical knowledge, practical ability, and vocational quality, solidify the foundation of cultivating applied innovative talents, and initially form the direction of intelligent networked vehicles specialization in the integration of industry and education. Applied innovative talents training program is shown in Figure 2.

2.3 Practical teaching mode

In practical teaching, the mode integrating “experiment-internship-training” [5] is constructed to promote the integration of subject competitions into practical teaching, and to enhance the cultivation of engineering practical and innovative abilities.

At present, courses such as artificial intelligence and communication technology are difficult to learn, and students majoring in intelligent connected vehicles have relatively weak cultural qualities. Therefore, the knowledge points of various professional courses are guided by experiments, internships, and practical training cases. Cases such as “Artificial Intelligence Experimental Development Platform” and “ROS Robot” practical training are designed to integrate and connect various knowledge points, integrate complex theoretical knowledge into various practical training projects, and integrate teaching into practical training project.

Taking practical training projects as the carrier, we incubate many science and technology competition projects, and guide students to participate in all kinds of science and technology competitions. A new mode of practical teaching with students as the main body, teachers as the leading role, and integrating the first, second, and third classrooms has been established. The "pyramid shaped" competition system at the national, provincial, school, and departmental levels has been established. We have set up a platform for college and school competitions to strengthen students’ basic knowledge and ability. We actively encourage students to participate in national and provincial high-level subject competitions.

2.4 Joint laboratories and teams for industry-education integration

In terms of talent training orientation, it has always been closely centered on the development of the vehicles industry and emerging industries in Shandong Province and the whole country. We have raised funds from various sources to build training bases; built intelligent networked vehicle research centers with Shandong Industrial Technology Research Institute and other research institutes; and carried out internships and project cooperation with well-known enterprises such as China National Heavy Duty Truck Group Co. Ltd., SAIC Group, and Xiaopeng Automobile. Through the establishment of joint laboratories and joint teaching, it actively carries out education and teaching and industry-university-research cooperation. It builds a multi-level industry-university-research cooperation model based on project research and scientific and technological services, with technology development and transfer as the core, and with the construction of cooperation platforms. By introducing enterprise resources into the classroom, integrating professional education into industrial practice, and relying on the practical education bases jointly built by schools and enterprises, the university and enterprises will build a “double-body” practical teaching mode, to realize the sharing of resources and the complementation of each other's strengths.

3. Curriculum developments

3.1 Talent Training Objectives

According to the requirements of the new construction of the new engineering discipline, the undergraduate program of Intelligent Networked Vehicles, by the intrinsic connection of the structure of knowledge, ability, and quality and the law of education and teaching, cultivates talents with all-round development in morality, intelligence, physical fitness, aesthetics and aesthetics, who have mastered more systematic knowledge of the basic sciences in the field of Intelligent Networked Vehicles and more extensive knowledge of the technological basics, and possessed the necessary professional knowledge and basic skills. The graduates should be strong, adaptable, capable, and high-quality senior specialists with practical engineering ability and certain research ability who can engage in vehicles manufacturing, design, and research and development in the related departments of intelligent networked vehicles.

3.2 Talent Training Competency Objectives

Students of this program mainly study the theory and knowledge of vehicles theory, vehicles design, and manufacturing, vehicles electronics technology, artificial intelligence technology, vehicles advanced assisted driving, control science and engineering, computer science and technology, vehicles communication technology, and management science and engineering, and are trained in the development and design of software and hardware for intelligent networked vehicles, automobile manufacturing, automobile electronic control, automobile testing, and automobile service, etc., and have the basic ability to engage in the design and manufacturing, experiment and research, and service in the field of intelligent networked vehicles engineering.

Graduates should have the following key knowledge and competencies:

The first is engineering knowledge. Students are able to apply mathematics, natural sciences, engineering fundamentals, and professional knowledge to solve complex engineering problems in the field of intelligent connected vehicles.

The second is problem analysis. Students are able to apply the basic principles and technical methods of the acquired knowledge to technical problems in the field of smart connected vehicles through literature research, technical analysis, identification, presentation, and study to obtain valid conclusions.

The third is design/develop solutions. Students are able to undertake the design, development, and solutions related to the field of intelligent connected vehicles, and can design intelligent vehicles that meet specific product requirements. In addition, students are able to demonstrate innovation awareness in the design process, taking into account factors such as society, health, safety, law, culture, and the environment.

The last is research. Students can use scientific methods such as technical analysis, design, simulation optimization, and test to study complex technical engineering problems in the field of intelligent connected vehicles based on their learned scientific principles and knowledge

3.3 Curriculum construction

According to the above talent cultivation goals and ability cultivation objectives, the curriculum system applicable to the undergraduate specialty of intelligent networked vehicles in applied undergraduate colleges and universities is formulated.

The first is the main courses.

Specialized basic courses: mechanical design foundation, electrical engineering, tolerance fit and

measurement technology, automobile construction, machine learning technology, computer vision foundation, digital signal processing, and speech recognition.

Specialized courses: automotive theory, automotive design, automotive testing, vehicle sensors, wire-controlled chassis, vehicle embedded systems, automotive CAD, vehicle communication and network technology, automotive advanced assisted driving technology, unmanned vehicle theory and design, automotive new energy technology, automotive manufacturing process and so on.

The second is the main practical teaching courses.

Comprehensive engineering training, basic mechanical design course design, automotive design experiment week, automotive electronics technology experiment week, artificial intelligence experiment week, automotive perception experiment week, ROS programming experiment week, automotive vehicle and road cooperation experiment week, automotive advanced assisted driving experiment week, graduation design, etc.

4. Construction of practical platforms for industry, academia, and research

To adapt to the new development situation of Intelligent Networked Vehicles (INV) and actively create various teaching and practice platforms, the Modern Industrial College of Intelligent Networked Vehicles (MICV) is declared and constructed.

4.1 Co-construction of internship and training bases

Constructing the internship training base of Modern Industrial College of Intelligent Networked Vehicles, which contains six experimental training rooms, including artificial intelligence algorithm programming, intelligent driving, intelligent networked vehicles-environmental perception, intelligent networked vehicles-wire control technology, vehicle-circuit coordination, and new energy power system testing. With this training base as the core carrier, the distributed internship training bases will be built to realize the integration of school-land and school enterprises and to create a physical experimental internship training platform for the synergy of industry, academia, research, and application.

4.2 Teacher development

Shandong Jianzhu University explores a two-way talent flow mechanism between universities and enterprises, establishes a flexible personnel system, and establishes an effective path for selecting industry associations, and enterprise talent backbones to teach at the university. In addition, Shandong Jianzhu University explores the implementation of a special position plan for industrial teachers (mentors), and improves the mechanism for introducing, certifying, and using part-time industrial teachers. We have jointly established a group of practical positions for teachers in enterprises, and also we built the Modern Industry College into a “dual teacher and dual ability” teacher training base. Shandong Jianzhu University has launched a joint teaching program between school and enterprise mentors to promote the exploration of teacher incentive systems and build a high-level teaching staff.

4.3 Construction of industry-academia-research service platform

Shandong Jianzhu University establishes the “Intelligent Connected Vehicle Application Industry Education Integration Center” to promote the integration of science and education, strengthen the joint efforts of schools and enterprises in technology research and development, product research and development, achievement transformation, and project incubation. The purpose is to jointly

complete teaching and research tasks, share research results, and produce a batch of technological innovation achievements. Collaborative innovation is carried out around key issues in industrial technology innovation. Shandong Jianzhu University leverages its comprehensive advantages in talent and expertise to directly serve regional economic and social development, promote the transformation and application of applied scientific research results, and promote industrial transformation and upgrading. At the same time, we will timely introduce research results into the teaching process, promote active interaction between scientific research and talent cultivation, and play a demonstrative role in industry university research cooperation.

5. Conclusions

The construction of a talent cultivation system of intelligent networked vehicles undergraduate specialty is a brand new topic, which has neither cases for reference and reference, nor authoritative institutions and experts to give sufficient research. The School of Mechanical and Electrical Engineering of Shandong Jianzhu University has actively founded the undergraduate specialty of intelligent networked vehicles, and has made bold exploration from the construction of talent training mode, the formulation of talent training program to the construction of curriculum system and the construction of platform for integration of industry, education and research, and has achieved remarkable results, realizing the innovation of teaching resources, talent training mode and platform for integration of industry, education and research and providing useful references for the creation of intelligent networked vehicles undergraduate specialty in the same type of ordinary colleges and universities. The automobile undergraduate program provides a useful reference.

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