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Exploration on the Teaching Reform of Python Programming Course for UAV Application Technology

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Abstract

With the in-depth integration of artificial intelligence and unmanned aerial vehicle (UAV) technology, Python programming has become a core skill that students majoring in UAV Application Technology must master. However, traditional Python courses suffer from problems such as generalized content and low integration with professional fields, making it difficult to meet the industry's demand for interdisciplinary talents. Taking the UAV Application Technology major of Zhejiang Business Technology Institute as an example, this paper explores how to construct a Python programming course system oriented to real UAV application scenarios from the aspects of teaching content, teaching mode, and assessment methods, aiming to improve students' engineering practice ability and innovative thinking.

Keywords: Python Programming; UAV Application; Teaching Reform

1. Introduction

The rapid development of the UAV industry is profoundly changing the operation modes of many sectors, including surveying and mapping, agriculture, logistics, and security. Intelligence is the core trend in the development of UAV technology. Python, with its concise syntax, abundant library support, and wide application in data processing, computer vision, and artificial intelligence, has become the preferred programming language for UAV secondary development and intelligent applications. For students majoring in UAV Application Technology, mastering Python is not only about learning a programming language, but also about acquiring the key to unlocking the intelligence of UAVs.

However, the current public Python courses in higher vocational colleges generally have the problem of poor connection between teaching content and students' majors. Students often "learn without knowing how to apply", resulting in unsatisfactory outcomes in cultivating learning interest and application ability. Therefore, in view of the characteristics of the UAV Application Technology major, carrying out the teaching reform of the Python Programming course and integrating abstract programming knowledge with specific UAV application scenarios is an inevitable requirement for cultivating high-quality technical and skilled talents.

2. Reform of Teaching Content and Reconstruction of Curriculum System

To address the disconnection between the course and professional applications, it is essential to implement a radical reform of the existing teaching content and reconstruct a curriculum system deeply integrated with professional characteristics. The core idea of the reform is "scenario-driven and project-oriented", taking the real needs of the UAV industry as the starting point and ultimate goal of teaching.

2.1. UAV Application-Oriented Introduction of Course Content

When explaining Python basic syntax, general cases related to calculation or information management are replaced with micro-cases directly related to UAVs. For example, when learning variables and data types, UAV flight control parameters (such as flight altitude, speed, and battery voltage) can be used as examples; when learning loops and conditional statements, a simple logic judgment for simulating UAV autonomous obstacle avoidance can be designed; when learning functions, a functional module for calculating UAV endurance mileage can be encapsulated. This approach helps students establish a strong connection between programming and their major from the beginning of the course, thereby stimulating their learning interest.

2.2. Construction of a Modular Project-Based Curriculum Structure

The entire course is divided into several core application modules, such as "UAV Flight Data Processing and Visualization", "Batch Processing of UAV Aerial Images", "Introduction to Target Recognition Based on Computer Vision", and "UAV Simulation Control Programming". Each module focuses on a specific UAV application field and is supported by a throughout project. In the process of completing projects, students gradually learn and master key technologies such as data analysis libraries (Pandas, Matplotlib) and image processing libraries (OpenCV, Pillow), integrating knowledge points into practice and unifying fragmented learning content.

2.3. Strengthening the Introduction of Cutting-Edge Technologies

In the latter part of the course, basic concepts of UAV control protocols (e.g., MAVLink) and simple applications of UAV simulation platforms (e.g., AirSim) are appropriately introduced. This not only broadens students' horizons by helping them understand the great potential of Python in advanced UAV applications such as autonomous flight and swarm control, but also lays a solid foundation for their subsequent learning of more professional courses and future engagement in UAV secondary development work.

3. Innovation of Teaching Modes and Methods

High-quality teaching content requires innovative teaching modes to maximize its effectiveness. We advocate a shift from the traditional "teacher-centered" one-way indoctrination to "student-centered" active inquiry, focusing on promoting flipped classrooms, online-offline blended teaching, and a practical mode combining "simulation and physical operation".

3.1. Full Implementation of the Flipped Classroom Mode

The flipped classroom mode of "online knowledge learning and offline practice deepening" is fully implemented. Standardized knowledge such as Python basic syntax and library function explanations is made into micro-course videos, requiring students to complete online learning and self-assessment before class. Class time is completely freed up for project practice, group discussions, Q&A on difficult points, and

code debugging. The teacher's role is transformed from a knowledge transmitter to a learning guide and project manager, enabling more precise guidance for each student or group and greatly improving classroom efficiency and student participation.

3.2. Building a Zero-Cost and High-Fault-Tolerance Practical Environment with Virtual Simulation Platforms

UAV hardware has high costs and operational risks, making it unsuitable as a direct object for beginners' programming practice. By introducing UAV virtual simulation software, students can write Python scripts on computers to control virtual UAVs in completing tasks such as takeoff, route planning, and target tracking. This mode is not only safe and efficient, but also allows students to make various attempts without hesitation, verify their algorithms and logic, and cultivate rigorous programming habits and bold innovative spirits.

3.3. Creating a Competitive Learning Atmosphere of "Promoting Learning and Teaching through Competitions"

Combined with course projects, small-scale UAV application programming competitions are regularly organized, such as "The Best Route Planning Algorithm Competition" and "The Fastest Image Recognition Application Competition". Competitions not only test students' learning outcomes, but also stimulate their sense of competition and teamwork spirit. Excellent competition works can also be used as teaching cases to feed back into classroom teaching, forming a positive teaching cycle.

4. Reform of Assessment Methods and Evaluation System

To objectively and comprehensively evaluate students' learning effects and comprehensive abilities, it is necessary to reform the traditional assessment method where scores are determined solely by a final exam. Instead, a diversified evaluation system that combines process-oriented and summative assessment, and emphasizes both knowledge and ability should be established.

4.1. Strengthening the Proportion of Process-Oriented Assessment

The final score is determined by regular homework, classroom performance, mid-term project inspection, and final project results, with project completion status playing a dominant role. What we focus on is not only whether the code submitted by students can run, but also their ability to analyze problems, code standardization, documentation habits, and teamwork performance during the project development process. This guides students to shift their learning focus from "preparing for exams" to "completing projects well".

4.2. Highlighting Applicability and Practicality in Assessment Content

The summative assessment at the end of the semester adopts the form of "on-site programming + project defense". In the on-site programming part, a new UAV application problem derived from real industry needs is given, requiring students to solve it through programming using the knowledge they have learned within a specified time. In the project defense session, students or groups are required to present their course projects, clearly explain the project's design ideas, technical implementation, innovations, and application value, and answer questions from teachers.

4.3. Introducing Multi-Dimensional Evaluators to Enhance the Objectivity of Evaluation

In team projects, a "intra-group mutual evaluation" and "inter-group mutual evaluation" mechanism is introduced, enabling students to learn to examine the advantages and disadvantages of their own and others' work from different perspectives, and cultivate critical thinking and communication skills. At the same time, engineers from cooperative enterprises can be invited as judges to participate in the final project defense. Their evaluations not only provide authoritative industry certification for students' learning outcomes, but also offer valuable feedback for the direction of the course reform.

5. Conclusion

The teaching reform of the Python Programming course for the UAV Application Technology major is a systematic project, whose core lies in breaking disciplinary barriers and deeply integrating programming teaching into professional application scenarios. By reconstructing the teaching content oriented to UAV application projects, innovating the student-centered teaching mode, and establishing a diversified process-oriented evaluation system, we can effectively stimulate students' learning motivation and significantly improve their ability to transform programming knowledge into solutions for practical industry problems.

Looking forward, we will continue to deepen school-enterprise cooperation, introduce more cutting-edge industrial cases and technical standards into the course, and strive to develop this course into a cornerstone for cultivating high-quality interdisciplinary talents of "programmer + pilot" in the UAV field, thereby contributing to the development of the regional UAV industry.

Declaration of Conflicting Interests

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