Development of Higher Vocational Artificial Intelligence Course based on Enterprise Real Project

Yuehong Zhou1*, Liqi Wang2, Rui Ma2

1Department of Communication and Information Engineering Shanghai Technical Institute of Electronics and Information Shanghai, China
2Shanghai Yi Ku Intelligent Technology Co., Ltd. Shanghai, China
* Corresponding author: zhouyuehong@stiei.edu.cn

Abstract—In the era of intelligence, the development of artificial intelligence technology has greatly promoted the demand of relevant professional courses. This paper mainly analyses the framework and implementation process of the enterprise real project “garbage sorting robot system” which is the project carrier of artificial intelligence course. On this basis, according to the knowledge system of artificial intelligence technology, the relevant teaching knowledge points and teaching methods of artificial intelligence course are designed.

1. INTRODUCTION
In the 21st century, the popular intelligent tools such as voice assistant of mobile phone, home smart speaker and face-scanning payment bring convenience to people in life [1]. Artificial intelligence has become the core driving force of industrial transformation, and has a profound impact on the world economy, social progress and human life [2].

With the rapid development of artificial intelligence, it is promoted to establish artificial intelligence specialty and construct the corresponding courses [3]. Located in Shanghai which is the highland of artificial intelligence development, Shanghai Technical Institute of Electronics and Information (STIEI) has actively responded to the "Action plan for innovation of artificial intelligence in colleges and universities" issued by the Ministry of education in April 2018 to strengthen the construction of artificial intelligence major [4][5]. The major named artificial intelligence technology service has been set up in the school of Communication and Information Engineering, STIEI. The first batch of students in this major will be enrolled in September 2020. With the purpose of the training of applied talents in higher vocational colleges, the students of artificial intelligence technology service major will be trained to have the basic professional knowledge of artificial intelligence, and take the product service and application of artificial intelligence as the main target employment post [6].

With the opportunity of practicing and research in Shanghai Yi Ku Intelligent Technology Co., Ltd., we participated in the development of a set of teaching resources for garbage sorting robot system. Based on python programming, this set of course resources combined with the basic knowledge points of artificial intelligence, such as speech recognition, image recognition, robot serial port communication, and can be used as project resources of comprehensive training courses for artificial intelligence major or artificial intelligence elective courses for relevant major groups.
2. CURRENT SITUATION OF ARTIFICIAL INTELLIGENCE

2.1. Development of artificial intelligence technology

The term "artificial intelligence" (AI) was first put forward at Dartmouth Institute in 1956. Since 1970s, it has been known as one of the world's three cutting-edge technologies (space technology, energy technology, artificial intelligence), and is also considered as one of the three cutting-edge technologies (genetic engineering, Nano science, artificial intelligence) in the 21st century [7]. With the rapid development of artificial intelligence algorithms such as neural network and deep learning, as well as information and communication technologies such as big data, cloud computing and high performance computing, artificial intelligence begins to develop rapidly.

As a key technology in the intelligent era, artificial intelligence will increasingly become the engine of a new round of industrial revolution, and will have a profound impact on the international industrial competition pattern and the international competitiveness of country. To seize the historical opportunity of the second machine revolution, China takes the advantage of national strategy such as "Internet +", "made in China 2025" and "AI +" to strive to inject intelligent ideas into the new normal of economy and develop artificial intelligence technology and industry [2]. On July 20, 2017, the State Council issued "the development plan for the new generation of artificial intelligence", which defined the development of the new generation of artificial intelligence as the strategic objectives in China, marking that the development of artificial intelligence has officially risen to the height of national strategy. Since the release of the plan, 19 provinces (including municipalities directly under the central government and autonomous regions) have issued 26 special policies on artificial intelligence, and put forward their respective development orientation and goals [5]. According to the World Artificial Intelligence Conference (WAIC) in 2020, the scale of Shanghai's artificial intelligence industry exceeds 140 billion yuan, and the scale of robot industry accounts for 1/9 of the world [8].

2.2. Development of artificial intelligence courses

With the rapid development of artificial intelligence, the construction of artificial intelligence discipline and specialty also needs to be accelerated. According to “China new generation of artificial intelligence development report 2019”, more than 30 colleges and universities have established AI colleges, and 75 universities have set up 89 secondary disciplines or interdisciplines related to artificial intelligence. AI enterprises accelerate the growth of high-level AI talents by building joint laboratories, research institutes and research centers with research universities, and a multi-level AI talent training system is gradually formed [5].

According to “White paper on artificial intelligence standardization” drafted in 2018, artificial intelligence is divided into five architectures: foundation, platform support, key technology, product service and application. The basics of artificial intelligence include terminology, reference architecture, data, test evaluation, and other basic areas. The platform support of artificial intelligence is composed of cloud computing, big data, perception and interconnection, chip, edge intelligent computing. The key technologies contain natural language, human-computer interaction, computer vision, biometric recognition, virtual reality (VR) and augmented reality (AR). Product services are divided into robots, vehicles, terminals and intelligent services. Artificial intelligence is mainly applied in manufacturing, smart city, intelligent transportation, medical treatment, logistics, smart home and finance [9].

In the application of artificial intelligence, robot is one of the most popular applications. The upsurge of artificial intelligence also brings the boom of robots. Robot education is considered by modern educators as an effective tool to cultivate students' creativity and imagination. It integrates many disciplines such as mechanics, electronics, programming, physics, mathematics, art design, which is helpful to the cultivation of students' logical thinking ability, innovative spirit and practical ability. At the same time, it also lays the foundation for the construction of science and engineering talents, which conforms to the trend and demand of curriculum reform in China [3]. Robots will also play an important role in the basic teaching of artificial intelligence. The development of robot applications in various industries will become an important part of the artificial intelligence industry.
3. SYSTEM DESIGN OF GARBAGE SORTING ROBOT SYSTEM

The garbage sorting robot system developed by Shanghai Yi Ku Intelligent Technology limited company uses robotic arm to imitate robot operation of pick up and throw garbage, which is controlled by custom-built program on the artificial intelligence speech vision core board. It also needs a vision system to capture garbage picture and microphone array to give tips of operations such as announcing the sorting result. These components are also controlled by programs on the board. Thus the garbage sorting robot system in this teaching demonstration is composed of vision system, artificial intelligence speech vision core board, microphone array, smart robotic arm, automatic opening and closing lid garbage bins and garbage picture cards (See Fig. 1).

First of all, the main program in the artificial intelligence speech vision core board is started to initialize various devices. After initialization, a voice announcement will be made to inform users that they are ready, such as "start garbage sorting". The microphone array collects the user's voice command, such as "what kind of garbage is this?", then the camera in the vision system is called to find the garbage image card and capture the image. The captured image is processed by image processing programs in the artificial intelligence speech vision core board for easy recognition. The process includes following operations such as image enhancement, edge detection and noise filtering, etc. Then the extraction of target contour feature for the image is made to obtain the position coordinate information of garbage image card. The object recognition API is called to recognize the processed image to get the object name. Therefore, the object name is used by the garbage sorting API to get the garbage classification result. Finally the garbage classification result information is broadcast to the user by voice, such as "this is recyclable garbage". According to the result of garbage classification type, the instruction is sent to automatic opening and closing lid garbage bins to open the corresponding garbage bin. At the same time, the coordinate information of the garbage image card is transmitted to the smart robotic arm to complete the operation of picking up the garbage image card at the designated position and putting it into the garbage bin of the corresponding classification (See Fig. 2).

![Figure 1. Garbage sorting robot system structure.](image-url)
4. ARTIFICIAL INTELLIGENCE COURSE TEACHING DESIGN

4.1. Design the knowledge system of artificial intelligence courses

Modules in garbage sorting robot system such as voice interaction, image recognition, garbage classification, garbage bins control and smart robotic arm control can all be used as relevant teaching modules of artificial intelligence courses.

All the programs in this system are written by Python, so Python is the basic programming tool in this course. If students do not have the basic knowledge of Python language, they must learn Python programming language basics in the initial stage of the course. The knowledge of Python language used in this system involves basic data structures, syntax, import and call of common modules, function, object oriented concept, exception handling, call-back and recursion, decorator, module and package design.

Voice interaction module need to use the microphone array to collect sound and is achieved by artificial intelligence speech vision core board with programs, which involves the related knowledge as followings: the acquisition of sound, playback and synthesis, speech recognition and speech synthesis technology application based on open source technologies such as iFLYTEK, semantic parsing.
technology such as aiui interface, json parsing, scene classification and simple man-machine voice dialogue program design.

Image recognition module uses the cameras in the vision system to capture the image and is realized by artificial intelligence speech vision core board with programs, which involves the related knowledge as followings: control camera taking pictures, read, save, display, cutting and scaling of pictures, color space transformation, threshold and contour, histogram equalization, morphology open and close operation, convolution filter, specific color filter, Hough lines detection, Hough circle detection, the concept and principle of neural network, the basic application of Tensorflow API, LeNet structure, LeNet classification model application.

As the garbage sorting module involves the operation of database, which requires database expertise, the garbage classification API developed by the external website is used in this course. Only the item name needs to be input as the parameter of the web request, and the garbage classification result (in text form) can be obtained after calling the garbage classification API. The use of external APIs is also an essential skill for current AI applications, so that more functions can be used in AI development to improve development efficiency. This module involves related knowledge as followings: Python crawler concept, sending request to the specified URL, reading web response content, JSON parsing.

The garbage bin control module needs to use the automatic switch lid of the bin, which uses Arduino to control the four-way motor and is connected to the artificial intelligence speech vision core board via USB serial port. The artificial intelligence speech vision core board is programmed to control the lid switch of the garbage bins. This module involves the following knowledge: view port information, create serial instance object, properties and methods of serial object, use serial object for serial port data transmission, byte data transformation.

Smart robotic arm connects to the artificial intelligent speech vision core board via USB serial port and controlled by the programs on the board. This module involves the following knowledge: robotic arm serial port communication, robotic arm return to initial position, robotic arm instruction queue control, robotic arm movement mode, the coordinate system of robotic arm, robotic arm movement control, robotic arm suction card function, robotic arm throw trash command.

4.2. Implementation of artificial intelligence courses
In the actual teaching, students can be guided to find out the functions of each module in the garbage sorting robot system as a project case, and then the relevant knowledge points are explained how the system is implemented. Thus students will master the knowledge of artificial intelligence while vividly understanding the application scenarios. In the practice part, students can be encouraged to modify part of the system code, such as voice command, which helps students further understand the role of some key technologies in every functional module. In this way, students will gradually realize the whole garbage sorting robot system at the end of the course and gain a great sense of achievement. After learning a certain function module, students can also imitate and complete a similar small function project as an extended learning, such as using open source technology to realize the conversation with the voice assistant, recognize a specific object picture, control a garbage bin’s lid with voice command, and control the robotic arm to move and grab objects.

5. Conclusion
With the further development of artificial intelligence technology, the artificial intelligence professional course will be innovated constantly. With close cooperation of school and enterprise, the company's real project can be transformed into the carrier of artificial intelligence professional course teaching project, which can make the teaching vivid and more close to practice in the process of "learning by doing" and "doing by learning".
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