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Research Article

Intelligent Interactive English Teaching System for Engineering Education

Hui Shi[1] and Cong Shi[2]

[1]*Office of Foreign Language, Basic Teaching Department, Changchun University of Architecture and Civil Engineering, Changchun, Jilin 130607, China*
[2]*College of the Humanities, Jilin University, Changchun, Jilin 130012, China*

Correspondence should be addressed to Cong Shi; shicong@jlu.edu.cn

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In order to improve the effect of English teaching, this paper combines with the intelligent algorithm to construct an intelligent interactive English teaching system for engineering education. In the process of interactive data processing, this paper specifies the time that a single pulse needs to be maintained and controls a counter to maintain a certain number of FPGA clocks. Moreover, data processing is completed in the digital domain, the modulation method is digital quadrature amplitude modulation, data transmission is generally in the form of a real signal, and the modulated IQ signal is converted back to a real signal. After constructing an intelligent interactive English teaching system for engineering education, this paper verifies that the intelligent interactive English teaching system for engineering education has certain effects through simulation teaching combined with the expert evaluation method.

1. Introduction

Interactive education is a teaching method developed on the basis of traditional educational theory. The essence of scaffolding education is to use the child's proximal development zone as a space for educational intervention to provide help for children's learning, thereby encouraging children to learn actively and efficiently [1]. The main feature of interactive education is to focus on educating students who need specific and unique educational strategies to help them understand. In teaching practice, interactive education attaches great importance to mutual help and encouragement among student groups. Therefore, teachers should help students understand important knowledge points and flexibly use the understanding ability of the student group to connect them with new knowledge points [2]. Also, the conversation must have a purpose and direction so that students and teachers understand classroom goals. At the same time, the teacher's comments to the students should induce the students to make constructive responses more actively. To sum up, the interactive education proposed in this paper is a way to achieve equal communication and independent interaction on a free educational platform under the macro educational situation, through teachers' teaching and students' learning around a certain issue or topic [3].

A new teacher-student relationship can be established. When the concept of equality in education is generally recognized by the society and becomes more and more popular, it is an important moment for the interaction between teacher and student education. But the truth is that kind of teacher-student relationship is still hard to come by. Therefore, although people have equal views and also, with the expansion of the influence of utilitarianism, there is no sincerity. In the minds of many students, teachers have become leaders who help students achieve good results, but in the minds of many teachers, students are the effective means for them to obtain due benefits or excess material [4]. Due to the development consciousness of utilitarianism and the expansion of the influence of utilitarianism, most teachers and students only work hard on their own goals. Ignore or despise it altogether. Under such a premise, the estrangement between teachers is also increasing, and the communication is decreasing day by day. Not only the dialogue relationship between teachers cannot be formed, but also various distortions occur one after another [5]. Therefore, a new type of teacher-student relationship must be formed in the current education and teaching, and this relationship must focus on the interaction between teachers. Only when teachers discover their own shortcomings in the process of equal interaction, they can be improved from the perspectives of knowledge, experience, personality, spirit, and humanities. On the other hand, education embodies the essence of human development and realizes its own value. Educational anthropology points out that people are born with great deficiencies and deficiencies in their abilities [6]. However, it is because of these imperfections and undeterminedness of human beings that they endow human beings with a strong potential to shape themselves. Another important means of correctly shaping themselves is to use education to exert various potentials and deal with complex and changeable situations and the living environment so as to achieve more meaningful innovation and development. People also have the developmental nature of their own value affirmation. But people who lack themselves are not real people [7]. The essence of human development should include self-development. It is the basis for people to assimilate and adapt to external things. Human self-affirmation theory, on the one hand, shows that human social activities are conscious social activities. By considering the interests of others, meeting their own needs, and storing long-term goals and feedback results, the "subject self" and the "object self" are unified with each other. On the other hand, it also makes human beings aware of the existence of self and their role and status in society. Therefore, interactive teaching uses self-interaction to enrich the connotation of life and achieve the optimal performance of the individual [8].

To carry out interactive oral English teaching in the classroom, the thinking, environment, management, and other factors of teachers and students are all restricted, so a suitable teaching and management system is regarded as a guarantee condition. First of all, the implementation of interactive oral language teaching should change the concept of teachers and students. Teachers should strengthen the study of modern advanced educational theories and teaching strategies and form their own scientific teaching concept system, which is reflected in teaching practice [9]. For students, a change in learning attitude is also important. Students are the main body of teaching and must participate in all teaching activities. Second, stimulate the intrinsic motivation of students. Teachers should not teach certain learning skills in isolation but should combine them and focus on teaching. Therefore, teachers must combine spoken English with listening, reading, and writing. Different interactive activities can stimulate students' intrinsic motivation and generate higher interest in learning [10]. Third, in the classroom, create a relaxed and pleasant classroom environment. In order to achieve the best teaching effect of each class, teachers must prepare carefully and fully. Before class, choose topics and situations that students are familiar with and design interesting and reasonable interactions. Finally, the classroom time in teaching is very limited, and students must have extra time to further consolidate classroom knowledge, increase opportunities for oral practice, and improve their communication skills. The advocacy of the interactive language teaching method can not only stay at the theoretical level but must be implemented in the practice of oral English teaching [11]. Only in this way can we cultivate English talents who can adapt to the needs of real life and work. Teachers should proceed from reality, analyze students' personality factors according to teaching content and requirements, and flexibly grasp teaching objects and environmental conditions. There are many factors that affect the development of students' communicative competence, and this may also be affected by other factors, such as the increase of students' vocabulary, the expansion of basic knowledge, intelligence, personality, gender differences, and other factors. The degree of its influence needs more empirical research to verify. In conclusion, the research on the interactive oral English teaching mode is a challenging and necessary work. In future teaching, educators still need to continue to explore [12].

An element of effective interaction is that both parties have a deep understanding of each other. With the continuous expansion of enrollment in colleges and universities in recent years, in order to cope with the constraints caused by the shortage of teachers, modern undergraduate education often implements a large class system, and professional course teachers rotate teaching according to the curriculum settings in the talent training plan. Due to the teaching tasks of grades and different classes, the teaching workload is large, the class is in a hurry, the get out of class is in a hurry, and the communication time between teachers and students is very small [13]. Many teachers are unfamiliar with the information of the students in the class they teach, and even after a semester of course teaching, teachers do not know most of the students in the class. Similarly, due to the lack of communication, students do not understand the professional expertise and research fields of the teachers [14]. Although blended teaching expands the time and space for teachers and students to communicate, teachers and students can interact at any time, but online interaction still cannot ignore the mutual understanding between teachers and students. To strengthen mutual understanding between teachers and students, we can start from the following two aspects: first, teachers can establish a written class student information book. Considering that teachers are busy with teaching, this work can be handed over to the class study committee or monitor [15]. In the information book, teachers can collect each student's name, photo, personality, hobbies, future career vision, and other information and use the spare time to compare the information book to understand the students and master each student's personality [16].

In order to improve the effect of English teaching, this paper combines intelligent algorithms to construct an intelligent interactive English teaching system for engineering education to promote the quality of English teaching reform.

2. Intelligent Interactive Teaching System Optimization Algorithm

2.1. The Spin and Precession of the Nucleus. The nucleus is usually composed of protons with positrons and uncharged neutrons, and the particles that make up the nucleus have an intrinsic property called spin. Spin describes the property of particles such as neutrons or protons in the nucleus of an atom to spin around an axis in a certain direction, and spin particles have angular momentum. The charge of a proton is one unit of positive charge, so the spin of a proton generates a magnetic field, which we call a magnetic moment. The opposite neutron, although neutral to the outside, still has positive and negative charges inside it. Since the distribution of the two charges is not uniform, a magnetic moment will also appear on their spins. Therefore, both the proton and neutron spins that make up the nucleus generate magnetic moments. The magnetic moments formed by the two cancel each other out, so if you want the nucleus to have a net spin to the outside, the number of protons or neutrons inside the nucleus should be odd. Moreover, if an object is to be able to produce magnetic resonance, its nuclei must have a net spin.

The spin of the hydrogen atom is shown in Figure 1(a), and the magnetic moment formed by it is equivalent to a tiny magnetic needle, as shown in Figure 1(b).

Put the atomic nucleus (photon in this paper) into the external uniform magnetic field B. Since the external magnetic field B has a moment on it, the photon must rotate around the direction of the external magnetic field B while maintaining its original spin motion. As shown in Figure 2, this kind of rotation is called precession. In layman's terms, a top rotates by itself and makes a circular motion in the vertical direction.

A photon with a magnetic moment t is placed in the external static magnetic field $\vec{B}_0$ and is acted by a moment, and the magnitude of the moment $\vec{T}$ can be calculated by formula (1):

$$\vec{T} = \vec{\mu} \times \vec{B}_0. \tag{1}$$

Under the influence of the moment $\vec{T}$, the relationship between the photon's spin angular momentum $\vec{J}$ and the moment $\vec{T}$ is expressed as formula (2):

$$\vec{T} = \frac{\mathrm{d}\vec{J}}{\mathrm{d}\vec{t}} = \vec{\mu} \times \vec{B}_0. \tag{2}$$

The relationship between the magnetic moment $\vec{\mu}$ of a photon and the spin angular momentum $\vec{J}$ can be expressed by formula (3):

$$\vec{\mu} = \gamma \vec{J}. \tag{3}$$

Among them, y is the magnetic spin ratio of the photon. Any substance placed in the magnetic field can obtain a certain degree of magnetization, and the magnetic spin ratio is a measure of the degree of magnetization it obtains. Combining formulas (1)–(3), we get

$$\frac{\mathrm{d}\vec{\mu}}{\mathrm{d}\vec{t}} = \gamma \vec{\mu} \times \vec{B}_0. \tag{4}$$

The above formula is a key theoretical expression for the spin and precession of the hydrogen nucleus, explaining the correlation between the change of the magnetic moment and the uniform magnetic field applied externally.

On the other hand,

$$|\mathrm{d}\vec{\mu}| = \gamma \left| \vec{\mu} \times \vec{B}_0 \right| \mathrm{d}t = \gamma \mu B_0 \sin\,\theta \mathrm{d}t. \tag{5}$$

Comparing formula (4) and (5), it can be known that

$$|\mathrm{d}\phi| = \gamma B_0 \mathrm{d}t. \tag{6}$$

The angular velocity w is defined as

$$\omega = \left| \frac{\mathrm{d}\phi}{\mathrm{d}t} \right|. \tag{7}$$

Therefore, from formulas (6) and (7), we can get

$$\omega = \gamma B_0. \tag{8}$$

This is the famous Larmor precession equation in the field of magnetic resonance. We habitually call o the angular frequency of proton precession, the corresponding frequency f is called the Larmor frequency, and o is the angular frequency of the interaction moment i precessing around B in the static magnetic field. The magnetic field strength B is measured in Tesla (T) as the basic unit for photons, that is, protons. When the unit of interaction moment i is rad $\cdot T^{-1} \cdot s^{-1}$, the unit of o is rads. For convenience of representation, the unit of interaction moment is often expressed in $MHz \cdot T^{-1}$, such as the interaction moment of photon $y = 42.6\,MHz \cdot T^{-1}$. According to this constant, it can be calculated that the Larmor frequency is about 64 MHz in an external magnetic field of 1.5 T, as shown in Figure 3.

2.2. Intelligent Light Interaction Phenomenon. Resonance is a phenomenon that can be seen everywhere in the environment we live in. However, resonance does not happen all the time. It can only appear under certain circumstances. For the atomic nucleus, the resonance phenomenon requires an external magnetic field, and its resonance frequency is related to the magnetic field and some properties of the atomic nucleus itself. It can be seen from the above analysis that when the spin magnetic moment increases, its resonance frequency is determined by the applied magnetic field B_0 and its own magnetic spin ratio y, that is, $\omega_0 = \gamma B_0$. At the same time, the angle 0 between the spin magnetic moment i and the external magnetic field B maintains the original value and has not changed, so the energy of the photon is exactly the same as before, and the system remains stable. At this time, if a changing magnetic field $\vec{B}_1$ ($B_1 \ll B_0$) is added to the outside of the vertical plane in the direction of the applied static magnetic field B, and its frequency is assumed to be ω_1, it is possible to change the energy of the photon. Hereinafter, for the convenience of description, the rotating coordinate system xyz shown in Figure 4 is introduced, $\vec{B}_1$ is

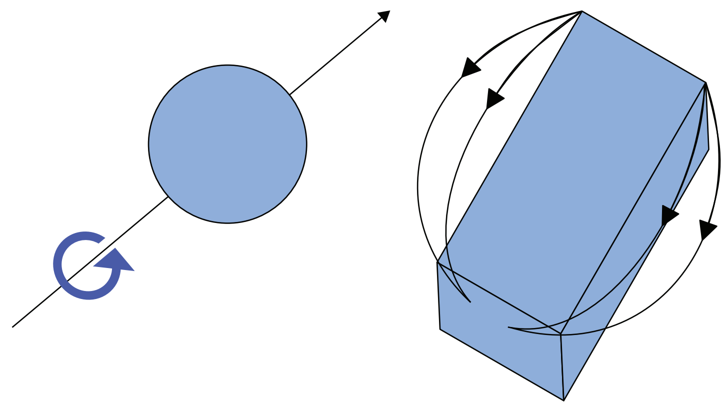

Figure 1: Photon spin moment and its equivalent. (a) Photon spin moment. (b) Equivalent bar magnetic moment.

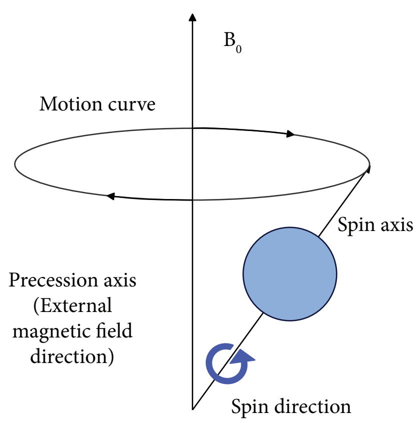

Figure 2: Precession of photons in an external magnetic field.

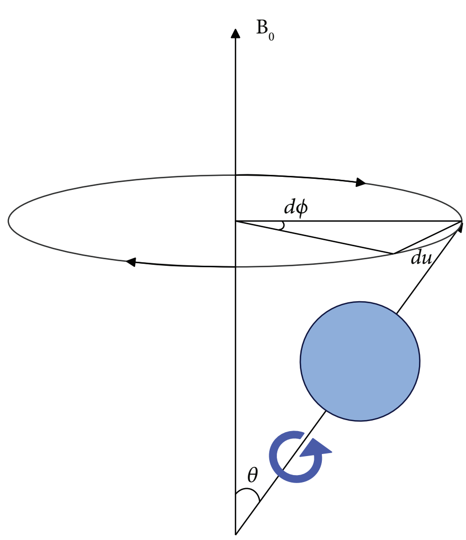

Figure 3: Mathematical analysis of photon precession.

along the y-axis direction, and $\overrightarrow{B}_0$ is along the z-axis direction.

According to the Larmor precession equation discussed earlier, $\overrightarrow{\mu}$ will process along $\overrightarrow{B}_1$ at this time, and the precession angular frequency is

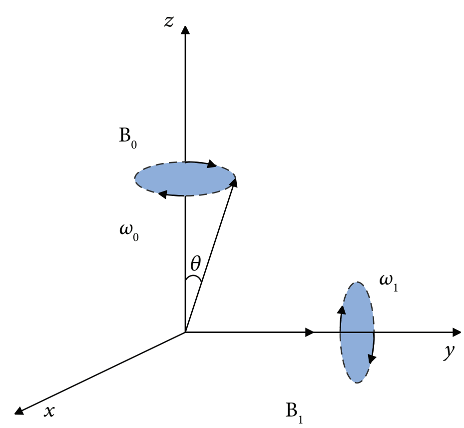

Figure 4: Nutation of photons.

$$\omega_1 = \gamma B_1. \quad (9)$$

Since $B_1 \ll B_0$, $\omega_1 \ll \omega_0$. Therefore, the precession process is very slow relative to the Larmor frequency. The external condition of this precession is the addition of a radio frequency field on the basis of the static magnetic field. In physics, the extremely slow precession described above is called nutation. Because the magnetic moment t is nutated under the action of the radio frequency field B, the original angle 0 between the magnetic moment ji and the static magnetic field B fluctuates, and the angle 0 between the two is also called the nutation angle. The angle 0 represents the energy of the interaction moment i. In the external static magnetic field B, if 0 becomes larger, it means that the magnetic moment i has obtained some energy, and the provider of the energy is the external radio frequency field B. The above process is the phenomenon of intelligent light interaction. Therefore, for the photons placed in the static magnetic field B, in order to make them interact with light, not only does the external magnetic field B need to be applied, but it also has special requirements for its frequency, which is the same as the Larmor frequency of photon precession.

$$\omega_1 = \omega_0 = \gamma B_0. \tag{10}$$

2.3. FPGA Data Processing. In the second part of the LabVIEW code, that is, the FPGA part, the data in the cmdFIFO is first read and split, as shown in Figure 5(a), and the data flow of the FPGA code is shown in Figure 5(b).

As can be seen from Figure 5(b), after the FPGA reads the data from the register, it is divided into four original signals, namely, amplitude signal, frequency signal, synchronization signal, and hold signal. The synchronization signal is directly output after a delay of $14 + n$ clock cycles and sent to the RF receiving board through the PXIe bus. The reason for the delay is that the operation of the digital quadrature modulation module in the FPGA requires 13 clock cycles and the data transmission delay of the previous cycle, so a total of 14 cycles are delayed. In this way, when the radio frequency signal is modulated, the synchronization signal is sent out at the same time to achieve the synchronization function of the spectrometer transmitter and the radio frequency power amplifier. The hold signal is an unsigned number, which represents the number of clock cycles that a data point should hold. For example, if a signal needs to be held for 1us, the value of the hold signal should be 100. Because the clock period is 100 MHz, the period is 10 ns. The implementation method in this paper is to specify the time that a single pulse needs to be held. By controlling a counter, it aims to keep a certain number (such as 100) of FPGA clocks. Since the clock frequency of the FPGA is fixed at 100 MHz, the holding time of a single pulse can be controlled by changing the number of clocks.

The data processing of the spectrometer transmitter designed in this paper is completed in the digital domain, and the modulation method is digital quadrature amplitude modulation (QAM). There are two main advantages of this method. First, quadrature amplitude modulation has higher bandwidth utilization than ordinary amplitude modulation. Since the baseband signal is divided into the I-channel and the Q-channel mutually orthogonal signals, the little difference between the different signals will be amplified, which can well suppress the appearance of noise. Second, the reason for using digital modulation rather than analog modulation is that digitized signals are easier to manipulate. For example, it is very simple to decompose a digital baseband signal into an in-phase component and a quadrature component, and we only need to phase-shift it. Moreover, it can ensure that the two signals are strictly orthogonal, but it is very difficult to achieve the same function in the analog domain, and the final effect is not ideal. The principle of digital quadrature amplitude modulation is shown in Figure 6.

Since the data read from the cmdFIFO on the FPGA side are all real signals, if you want to perform digital quadrature amplitude modulation, you need to convert this real signal into mutually orthogonal I and Q signals. It can be converted using the LabVIEW code shown in Figure 7.

The FXP in the figure represents the conversion of real numbers into fixed-point numbers, the input is the real number array of U32, and the output is the quadrature I-channel and Q-channel signal arrays; that is, the real signal is converted into a complex signal. The main reason why the real signal is converted into a complex signal is that the frequency domain of the real signal has a common symmetrical spectrum. In the process of modulation or demodulation, this part of the conjugated and symmetrical spectrum may be mixed into the signal bandwidth and introduce artifacts, which will affect the imaging quality. The spectrum of a complex signal has only a positive part, so no conjugate symmetry part is introduced.

If we assume a real signal, then to make its spectrum easier to observe, we can make

$$x(t) = \cos(\omega_0 t) = \cos(2\pi f_0 t). \tag{11}$$

According to the Fourier transform formula,

$$F(\omega) = \int_{-\infty}^{+\infty} f(t) e^{-j\omega t} \mathrm{d}t. \tag{12}$$

When we bring it into the formula, we can get its spectrum as follows:

$$X(\omega) = \pi[\delta(\omega - \omega_0) + \delta(\omega + \omega_0)]. \tag{13}$$

It can be seen that the spectrum of $x(t)$ is divided into two parts, the signal spectrum is $f_0 = 300$ Hz, and the sampling frequency is $f_s = 1000$ Hz. By using MATLAB to draw its spectrum image, the result is shown in Figure 8(a):

The real signal $x(t)$ is added to the imaginary part to become a complex signal:

$$x_1(t) = \cos(\omega_0 t) + j\sin(\omega_0 t). \tag{14}$$

Similarly, its spectrum is calculated as

$$\begin{aligned} X_1(\omega) &= \pi[\delta(\omega - \omega_0) + \delta(\omega + \omega_0)] \\ &\quad + j\{-j\pi[\delta(\omega - \omega_0) + \delta(\omega + \omega_0)]\} = 2\pi\delta(\omega - \omega_0). \end{aligned} \tag{15}$$

When the signal spectrum $f_0 = 300$ Hz and the sampling frequency $f_s = 1000$ Hz, the spectrum image can be obtained as shown in Figure 8(b). Comparing the two spectrum images, it can be seen that when the real signal is converted into a complex signal, the conjugate component of the complex frequency domain part disappears, and only the positive frequency domain component is retained. Compared with the former, the spectral energy is doubled. This is the reason why this paper converts real signals into IQ two-way quadrature signals to form complex signals. This is also the reason why in the field of communication, real signals are used in the actual information propagation process, and complex signals are used in signal processing.

After the conversion of the real signal is completed, the digital modulation work is required, and the output of the digital quadrature amplitude modulation can be written in the following form:

$$\begin{aligned} s_{\mathrm{QAM}}(n) &= I(n)\cos(\omega_0 n\pi) + Q(n)\sin(\omega_0 n\pi), \\ n &= 1, 2, \ldots, N. \end{aligned} \tag{16}$$

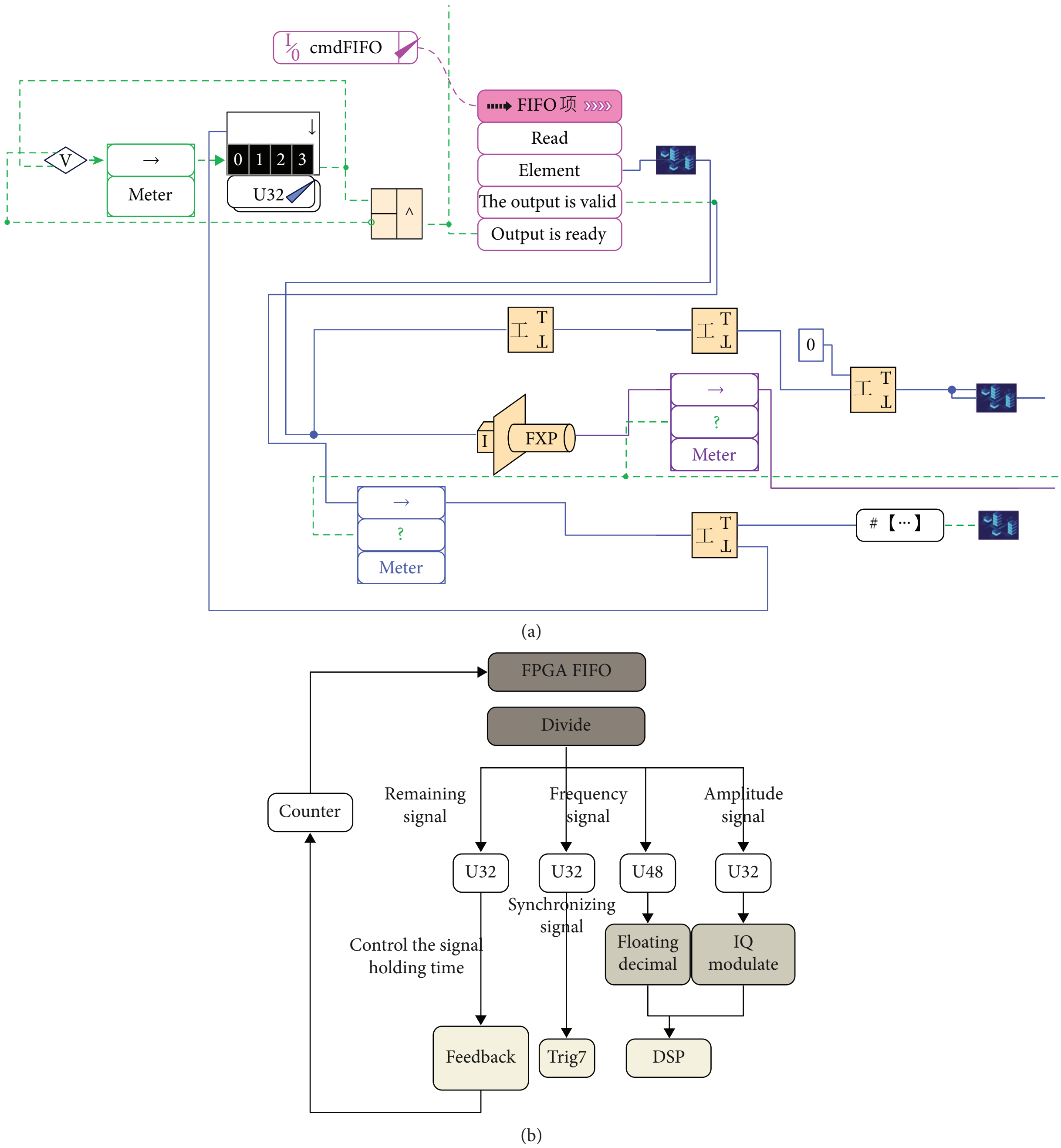

Figure 5: FPGA data module. (a) FPGA reads data. (b) FPGA signal flow of the transmitter.

Among them, r is the sampling interval. The ω_0 in formula (16) is converted into a common frequency unit, namely

$$s_{QAM}(n) = I(n)\cos(2\pi f_0 n\pi) + Q(n)\sin(2\pi f_0 n\pi),\quad n = 1, 2, \ldots, N. \tag{17}$$

In the LabVIEW FPGA programming designed in this paper, the digital quadrature amplitude modulation is completed by the Frequency Shift module (DSP), and the output (data out) of this module is determined by formulas (18) and (19):

$$I_{out}(n) = I_{in}(n)\cos(2\pi f_0) + Q_{in}(n)\sin(2\pi f_0), \tag{18}$$

$$Q_{out}(n) = I_{in}(n)\sin(2\pi f_0) + Q_{in}(n)\cos(2\pi f_0). \tag{19}$$

Because before the real signal shown in Figure 9 is converted into an IQ signal, in the processing of the input signal, the I-channel signal is the original real signal unchanged, and the Q-channel signal is set to 0. Then, the Q

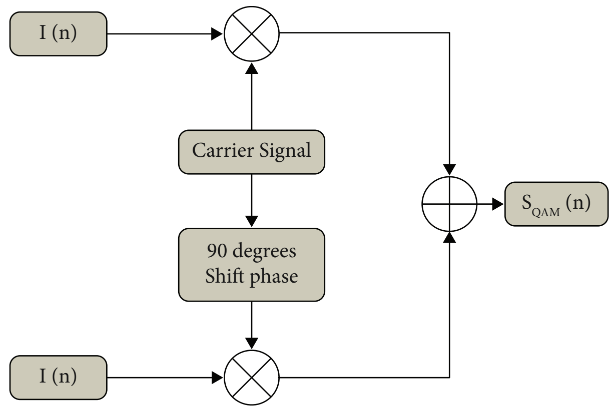

Figure 6: Schematic diagram of digital quadrature amplitude modulation.

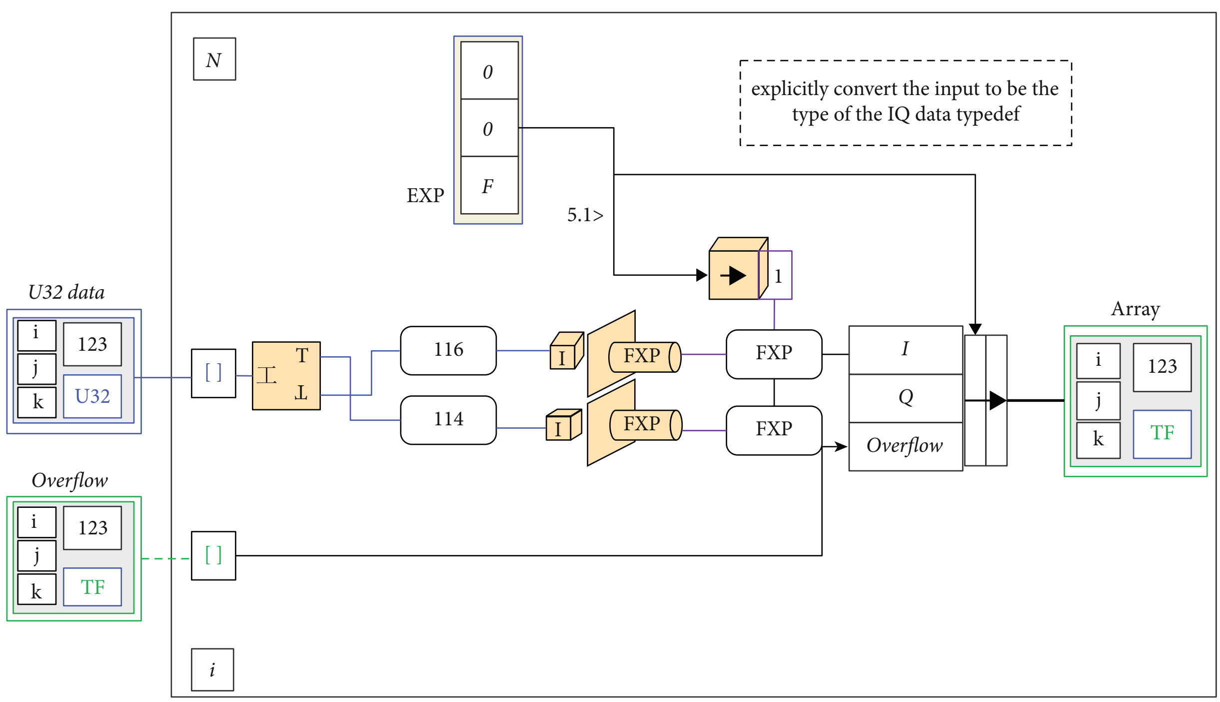

Figure 7: The process of converting a real signal into an IQ signal.

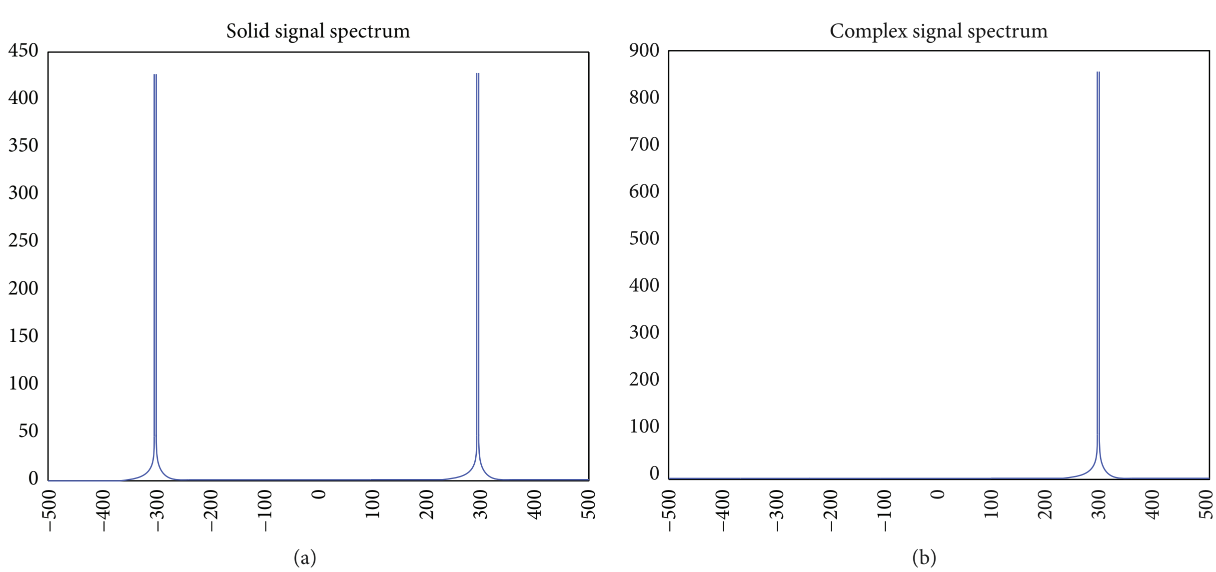

Figure 8: Signal spectrogram. (a) Spectrum diagram of real signal. (b) Spectrum diagram of complex signal.

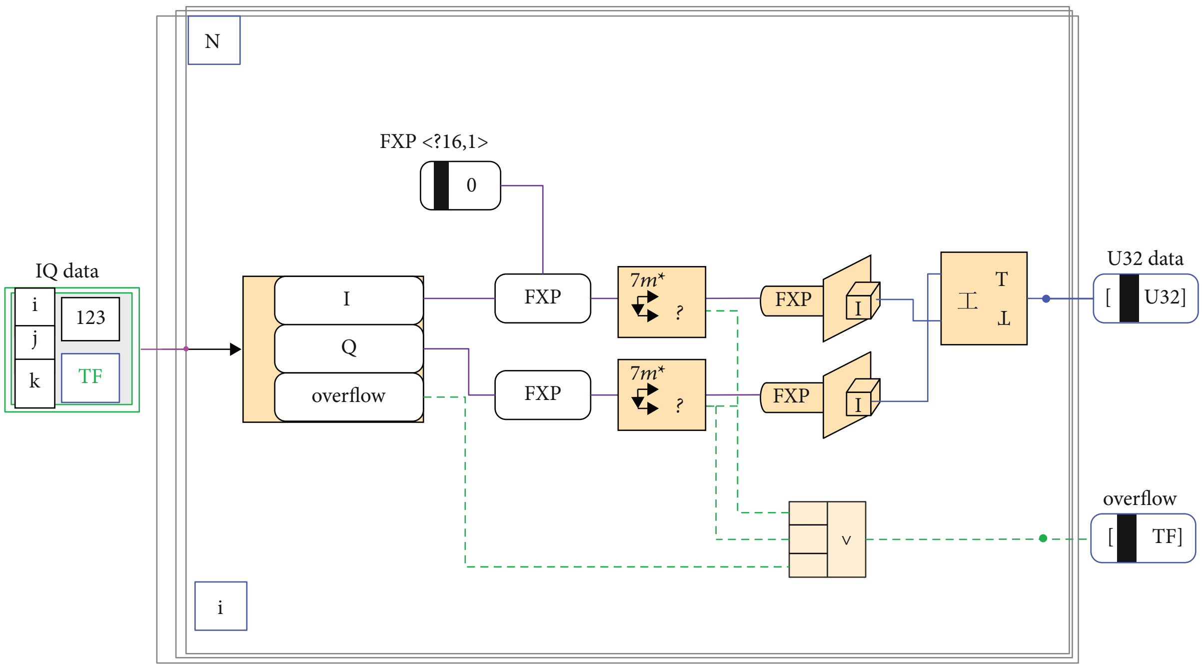

Figure 9: The process of converting an IQ signal into a real signal.

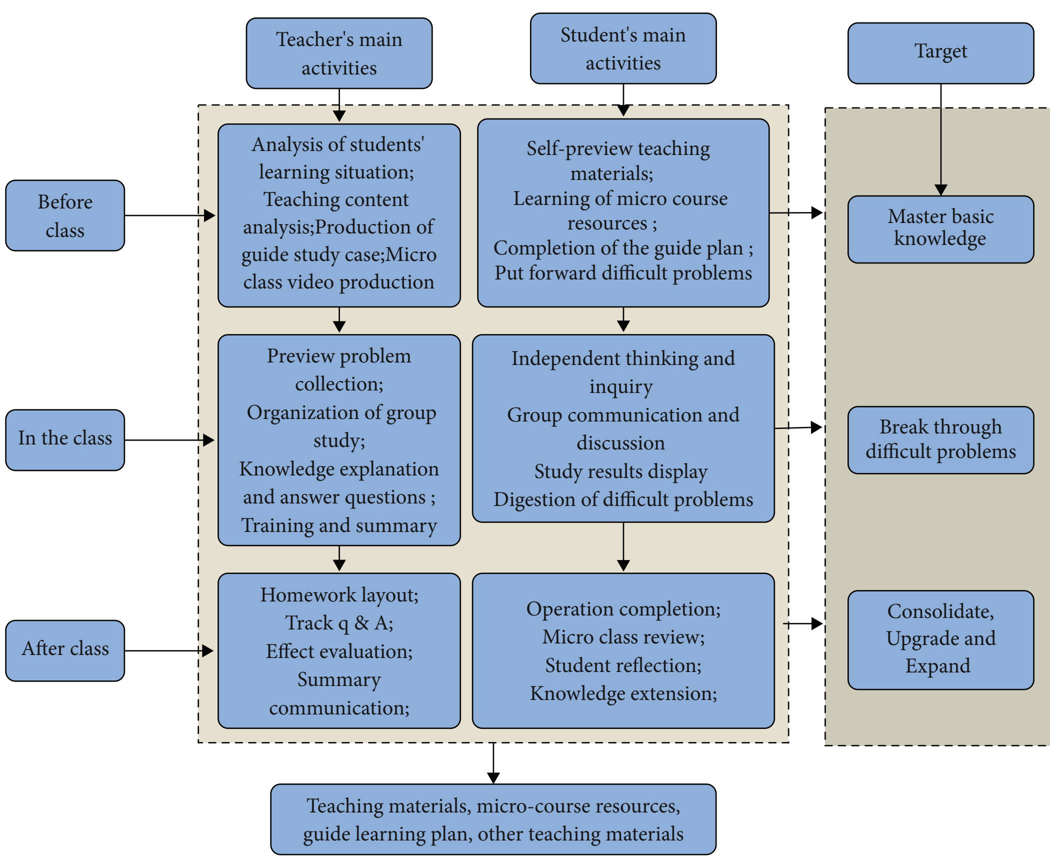

Figure 10: The English teaching model of the interactive integration of guided study plans and microlectures.

Table 1: Experimental data.

Num	Interactive effect	Teaching improvement	Num	Interactive effect	Teaching improvement
1	82.21	85.47	21	82.14	87.49
2	79.61	84.36	22	80.64	85.47
3	80.71	83.90	23	81.69	86.35
4	77.32	87.27	24	83.65	88.62
5	81.29	89.81	25	84.65	90.55
6	80.96	90.80	26	79.47	83.33
7	84.98	90.52	27	84.34	85.32
8	81.51	89.97	28	85.98	87.43
9	79.57	83.96	29	84.26	87.62
10	78.47	84.22	30	81.06	87.34
11	79.51	87.40	31	81.90	89.55
12	78.78	83.30	32	77.41	90.50
13	80.08	90.28	33	81.74	90.76
14	79.37	85.36	34	81.55	86.38
15	78.33	84.20	35	82.12	88.82
16	85.40	89.22	36	77.21	87.61
17	80.98	90.52	37	82.50	84.64
18	78.92	83.71	38	77.78	86.60
19	79.49	87.30	39	77.08	87.11
20	84.76	88.12			

signal of the data in input to the Frequency Shift module is 0, and formulas (7) and (8) can be rewritten as

$$\begin{aligned} I_{out}(n) &= I_{in}(n)\cos(2\pi f_0), \\ Q_{out}(n) &= I_{in}(n)\sin(2\pi f_0). \end{aligned} \tag{20}$$

The output frequency of the the Frequency Shift block is determined by formula (21):

$$f_{out}(n) = \text{datarate}^{*}\text{frequencyshift}. \tag{21}$$

Among them, the data rate is determined by the clock frequency and the number of sampling points per cycle. In this design, the number of sampling points per cycle is 2, so the data rate is twice the clock frequency. The range of frequency shift is (−0.5, 0.5), the negative part represents the left shift of the frequency, and the positive part represents the right shift of the frequency. In the design of this paper, the maximum clock frequency is 200 MHz, so the maximum data rate is 400 MHz, and the maximum output frequency is 200 MHz, which can meet the emission of magnetic resonance imaging radio frequency pulses (about 128 MHz) with a magnetic field strength of 3 T.

So far, the digital quadrature amplitude modulation has been completed, the baseband signal has been modulated to a high frequency, and the data processing part has been completed. As mentioned above, in the field of communication, data transmission is generally in the form of real signals. Therefore, it is necessary to convert the modulated IQ signal back to a real signal. The conversion procedure is shown in Figure 9, and this process is the inverse process of the conversion process shown in Figure 7.

The converted digital modulation signal needs to be converted into a 16-bit digital signal in order to match the DAC of the adapter module. Through the digital IO port of the PXIe-7972, the signal is transmitted to the NI-5783 at a speed of 800 Mb/s, enters the DAC3484 to complete the digital-to-analog conversion, and then passes through a low-pass filter for output.

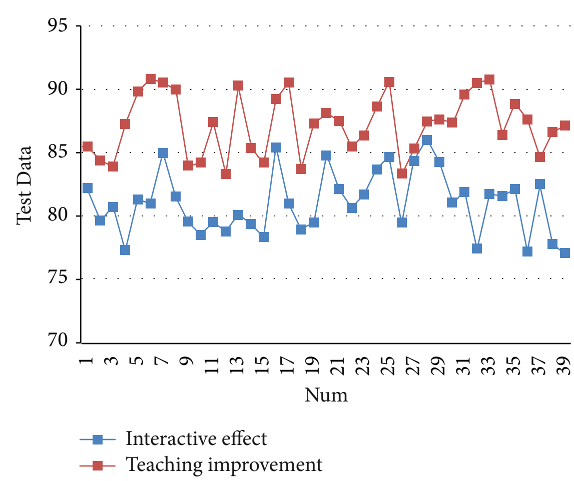

Figure 11: Statistical diagram of test data.

3. Intelligent Interactive English Teaching System

Based on the current situation of the application of the guided study plan, the concept of microlectures, the traditional study-guided plan, an English teaching model with interactive integration of the study-guided plan, and the microclass is constructed (Figure 10).

After obtaining the intelligent interactive English teaching system for engineering education, the effect of the intelligent interactive English teaching system proposed in this paper is verified. In this paper, the system proposed in this paper is evaluated through simulation teaching combined with the expert evaluation method, and the evaluation results shown in Table 1 and Figure 11 are obtained.

This paper verifies that the intelligent interactive English teaching system for engineering education has a certain effect through simulation teaching combined with the expert evaluation method.

4. Conclusion

Interaction design was originally a computer term. It refers to the process by which the system accepts input from the end user, processes it, and feeds the result back to the end user. Moreover, from the perspective of interaction, interaction is the exchange of information between the sender and the receiver, so there is interaction in all kinds of teaching. In fact, interaction is one of the most basic characteristics of classroom teaching. However, in different educational forms, the methods and characteristics of interaction are quite different. In order to improve the effect of English teaching, this paper combines intelligent algorithms to construct an intelligent interactive English teaching system for engineering education to promote the quality of English teaching reform. Through simulation teaching combined with the expert evaluation method, it is verified that the intelligent interactive English teaching system for engineering education has certain effects.

Data Availability

The labeled dataset used to support the findings of this study is available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

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