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Research on the Tutoring Effectiveness of College Students' Teaching Evaluation Based on Intelligent CAD

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Abstract: The importance of the degree of healthcare for learning pressure in university teaching evaluation is reflected in its far-reaching influence on improving the quality of education, optimizing the learning experience, and promoting the all-round development of students. In order to improve the effectiveness of college students' evaluation of teaching, this paper analyzes the effectiveness of college students' evaluation of teaching combined with the big data technology of the Internet of Things and proposes an intelligent algorithm to analyze the kinematics and dynamics of the skeletal model of classroom students. Moreover, this paper establishes the exoskeleton kinematics model by using the D-H method, describes the relationship between the joint variables and the end of the exoskeleton, and verifies the correctness of the model establishment by sitting and standing. In addition, this paper compares the Newton-Euler and the Lagrangian methods and chooses the Lagrangian method to analyze the dynamics of the lower extremity exoskeleton and solve the torque of the driving joint. The experimental research shows that the teaching evaluation system for college students based on the big data analysis technology of the Internet of Things proposed in this paper can effectively improve the teaching evaluation effect and improve teaching efficiency.

Keywords: Internet of things; big data; college students; teaching evaluation; effectiveness
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1 INTRODUCTION

Innovating the teaching evaluation method of college students is an important measure to implement the requirements of the "Overall Plan for Deepening the Reform of Education Evaluation in the New Era," reform teacher evaluation, promote the mission of teaching and educating people, and ensure the quality of teaching [1]. In particular, in a situation where the teaching evaluation method of college students has developed from a unified traditional teaching evaluation to a diversified scientific teaching evaluation, the teaching evaluation method needs to highlight the actual performance of education and teaching and pay more attention to the fundamental support of "process quality" and "structural quality" to the development of education. Student evaluation of teaching is a normalized system widely used in the teaching process of colleges and universities, and it has always been an important basis for the evaluation and reform of teaching quality in colleges and universities [2].

The degree of healthcare for learning pressure plays a vital role in the evaluation of university teaching, which not only directly affects the quality of teaching and students' academic achievement but also has a profound impact on creating a positive learning environment and promoting students' active participation and all-around development. Through effective care measures, student satisfaction can be enhanced, and their loyalty to educational institutions can be enhanced while preventing and alleviating mental health problems and supporting the emotional and psychological well-being of students. In addition, caring for learning stress helps ensure educational equity so that all students, regardless of background, have the support they need to succeed in their academic and professional careers. This care also contributes to the formation of a student-centered education culture that encourages open communication and personalized teaching, which ultimately enhances the reputation of educational institutions, attracts more outstanding students and teachers, and produces high-quality talents for society who can cope with the challenges of the future. Student evaluation of teaching pays attention to the growth situation of the student group and the process of forming the quality of education. It has the characteristics of directness, flexibility, and efficiency. Student evaluation of teaching changes the student's identity from the evaluator to the evaluator, which is the embodiment of the modern teaching concept with students as the core and subject of teaching [3]. Judging from the existing students' teaching evaluation process, it can be seen that most of them use the form of students' scoring and evaluation of teachers' teaching, but the students, as the main body of evaluation, have different degrees of evaluation and teaching burnout, and over-evaluation and abandonment are typical symptoms [4].

Although the existing form of student evaluation of teaching measures the teaching quality of each course to a certain extent, it is more from the subjective perspective of students, ignoring the impact of other factors. Especially in the horizontal comparison between different courses, due to the existence of structural factors such as course attribute, teaching time, student background, and teaching content, the final student evaluation results cannot be fully explained only by teachers' teaching performance. At present, a variety of student evaluation methods with mathematical support have been developed, including regression analysis, analytic hierarchy process, factor analysis, and fuzzy evaluation. Liu Yujing and others built a student-centered college curriculum teaching quality evaluation model through regression analysis based on Kuhn's theory of students' learning input and harvest in combination with the situation of Chinese college students [5]. Sulis et al. introduced a number of factors that jointly affect the teaching process (academic year characteristics, curriculum characteristics, student characteristics, and project dimensions) into the framework of the generalized mixed model for analysis so as to adjust students' perception and evaluation of university teaching quality and improve the flexibility of measurement [6]. In terms of the application of the analytic hierarchy process, Qiu Wenjiao and others built a trinity evaluation index system of inquiry-based classroom teaching, which is "teachers' classroom teaching, student's classroom performance, and exploration effect detection," and used the analytic hierarchy process to assign weights to the three dimensions of evaluation indicators [7]. Chen Limin and others built a developmental student evaluation system for colleges and universities based on the concept of developmental evaluation and determined the index weight by using the analytic hierarchy process and expert ranking method [8]. Rana et al. used the analytic hierarchy process to measure the relative weight of each parameter, established a student evaluation model for basic mathematics teachers, and added expert specifications to the category of ability to meet educational goals [9]. In terms of the application of factor analysis and fuzzy evaluation, Sengewald et al. compared the use of traditional confirmatory factor analysis (CFA) and multi-level confirmatory factor analysis (ML-CFA) in the student assessment scale model and discussed the advantages of ML-CFA in measuring curriculum quality [10]. Carlucci and others proposed a framework for analyzing students' evaluation of higher education teaching quality, integrating two evaluation methods, a standardized control chart and ABC analysis based on fuzzy weight, to reveal the risk problems affecting teaching quality and the courses that need continuous improvement [11]. The diversified methods of student evaluation of teaching have laid the foundation for further innovation. The traditional method of students' evaluation of teaching is based on students' evaluation of the teaching quality of the courses they have learned. For example, the specific practice of building a "double first-class" college G in China is that students evaluate teachers' teaching, teaching content, teaching methods, teaching attitudes, and teaching effects at the end of the course, and the average value of all students' teaching evaluation scores is taken as the teaching quality score of teachers of this course. The following problem is that in the process of students' evaluation of teaching, they only pay attention to the evaluation of teachers by students but ignore the influence of students' personality differences and curriculum factors. For example, the teaching quality of teachers will be affected by the course categories with different difficulties, the audience groups with different foundations, and the teaching requirements with different standards. In fact, a scientific and effective student evaluation system should not only assess teachers' teaching performance but also consider the influence of objective factors such as students' personality differences and courses. Teaching quality should be regarded as a process of continuous participation and interaction between teachers and students [12]. It is often one-sided to evaluate teaching results only by students' subjective evaluation of teaching while ignoring the influence of other factors. It is even more impossible to directly compare teaching evaluation results among different courses to find gaps, thus reducing the effectiveness of teaching quality evaluation. Therefore, a fair and flexible method of students' evaluation of teaching should be to find common factors that affect the teaching quality of different courses while fully considering teachers' teaching factors so as to achieve a horizontal comparison of teaching quality between different courses.

Nowadays, some teachers may lower their requirements in order to obtain better evaluation results, relax classroom management, "turn a blind eye" to students' lateness, sleeping, playing with their mobile phones, or even being absent from school, and ignore the actual situation and give students high marks. Similarly, students give teachers good evaluation results in order to "repay" teachers. Through the survey of more than 200 students in a local university in Hubei, it was found that 43.7% of the students will give teachers with loose classroom management and lower test difficulty higher teaching evaluation results, 26.5% of the students will not dare to give low scores because of fear of teacher retaliation, 61.2% of the students will give higher evaluation to teachers who can give various "conveniences" in learning, and 68.1% of the students will give lower evaluation to teachers who are serious, rigid and ruthless [13]. From the above survey results, we can see that the "cooperation" strategy of teachers and students has brought obvious negative effects. At present, in colleges and universities, it is commonplace for teachers to delimit the scope before the examination and "let water" for examination and correction. Teachers who go against the line will be complained about by students and will not be understood. Although there are many problems in the system of student evaluation of teaching, its importance cannot be ignored. A survey of a local university in Hubei found that 51.5% of teachers agree with students' evaluation of teaching, and 78.7% of students agree with the importance of students' evaluation of teaching [14]. In addition to the situation in which both teachers and students choose "cooperation," there is also the situation in which both teachers and students choose "dismantling." Such dismantling will only form a vicious circle. Under the influence of the negative effects of the game between teaching evaluation and learning evaluation, teachers let the results of teaching evaluation go. Some students thought that teaching evaluation had little to do with themselves and were indifferent to them [15]. According to the survey, 65.9% of the students think that "the phenomenon of students' random evaluation of teaching is very serious". As an important means of teaching evaluation, teaching evaluation, and learning evaluation, if they cannot play their role, will have a profound impact on teaching quality and its improvement. Therefore, we must get rid of the dilemma of the game and really play the role of the evaluation system [16]

In order to form a benign game between teaching evaluation and learning evaluation, the position of teachers, students, and managers in teaching evaluation must be clarified. Teachers are the main stakeholders in students' evaluation of teaching and cannot be excluded from the evaluation of teaching. Teachers have the best understanding of the situation of their own group and the right to speak, so they should participate in the design of teaching evaluation indicators. In the actual process of learning evaluation, students occupy a certain position in learning evaluation through the influence of teaching evaluation right on teachers, but obviously, learning evaluation should not be affected by students [17]. In the actual process of evaluating teaching and learning, managers become the leaders. They design evaluation indicators and use the evaluation results to assess teachers. The absence and dislocation of teachers, students, and administrators in the evaluation of teaching and learning can lead to many problems. To ensure a good game between teaching evaluation and learning evaluation, we must re-position the position of teachers, students, and managers. In student evaluation of teaching, teachers, and students should occupy the main position, and managers are the role of service providers. In terms of teachers' evaluation of learning, teachers should reasonably occupy a leading position, be free from influence and interference, and ensure the objectivity of the evaluation of learning. Only by clarifying the position of teachers, students, and administrators in the evaluation of teaching and learning can we guarantee the full play of the evaluation function of teaching and learning. An important reason for the formation of the dilemma of teaching evaluation and learning evaluation is the poor communication between teachers and students [18]. The students do not understand the teachers' efforts in the courses they teach and do not understand the teachers' good intentions, which leads to a misunderstanding that teachers only raise their requirements to "torture" themselves, which is inhuman. Some teachers have little or even wrong information about students. Some teachers think that students want to have loose classroom management, low learning requirements, and be able to pass the exam easily. Therefore, these teachers will cater to the students' psychology in order to obtain better teaching evaluation results. But in fact, some students do not think so. Such understanding deviation forms a nonbenign game between teaching evaluation and learning evaluation. Therefore, in order to form a benign game between teaching evaluation and learning evaluation, we must build an effective channel for communication between teachers and students. Teachers should express their expectations and requirements to students, ask for their opinions, investigate their actual situation, carry out targeted teaching, and give feedback from time to time. And students should also show their attitude to teachers and put forward reasonable requirements. Only when the communication channels between teachers and students are unblocked can they obtain correct information about each other, understand each other's true intentions and attitudes, and be avoided? it is conducive to the realization of a benign game between teaching evaluation and learning evaluation [19].

This paper analyzes the effectiveness of college students' teaching evaluation based on the big data technology of the Internet of Things so as to improve the evaluation effect of college teaching.

2 KINEMATICS AND DYNAMICS ANALYSIS OF SKELETAL MODELS FOR CLASS STUDENTS

As an open-chain space linkage mechanism, the student lower limb exoskeleton model can be regarded as a series classroom student model composed of a hip-waist link, thigh link, calf link, and ankle link. The basic function of the classroom student model is to assist the user in walking, so it is necessary to establish a kinematics and dynamic model to provide a theoretical basis for the control analysis in actual motion.

The student lower limb exoskeleton model is worn on the human leg, which is symmetrical from left to right. When walking, it mainly moves in the sagittal plane. Therefore, only the movement of one of the legs in the sagittal plane is considered during kinematics and dynamic analysis.

2.1 Kinematics Analysis of Student Lower Limb Exoskeleton Model

The kinematics analysis of the classroom student model mainly studies the kinematic characteristics of the classroom student model, and the force and torque during the movement process are not considered. The model kinematics of classroom students is divided into forward kinematics and inverse kinematics. In the subject, the exoskeleton inputs specific joint parameters according to the predetermined gait trajectory, and this paper mainly conducts forward kinematics analysis on it.

The D-H parameter method is currently the most widely used kinematic modeling method, which uses a homogeneous transformation matrix to represent the pose relationship of adjacent links. The modeling steps are as follows: 1) Algorithm to establish D-H coordinate system; 2) Algorithm to determine D-H parameters; 3) Algorithm to calculate adjacent link pose transformation matrix; 4) Algorithm to establish kinematic equation. In this paper, in order to facilitate the kinematic analysis of the exoskeleton, the exoskeleton is simplified to a three-link rigid structure. The structure diagram and the established D-H coordinate system are shown in Figure 1.

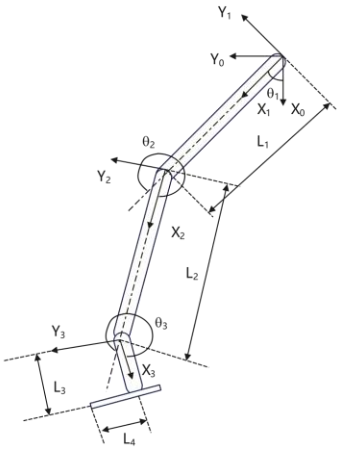


Figure 1: Structure diagram and D-H coordinate system of student lower limb exoskeleton model.

The coordinate system (0) is the base coordinate system, which is also the world coordinate system of the model, and the coordinate systems (1), (2), and (3) are the connecting rod coordinate systems. When θ_1 is equal to 0, coordinate system (1) coincides with coordinate system (0). According to Figure 1, the exoskeleton D-H parameters can be determined.

The D-H parameters represent different geometric meanings, represent the rotation angle of the connecting rod i itself, and represent the length of the connecting rod i itself. e_l represents the offset distance between the connecting rod i-1 and the connecting rod i, and θ_i represents the angle between the connecting rod i-1 and the connecting rod i. According to the D-H method, the space transformation matrix of the adjacent connecting rod coordinate system is:

$$ {}_{t}^{i-1}T=\begin{bmatrix} \cos\theta_t & -\sin\theta_t & 0 & a_{t-1} \\ \sin\theta_t\cos\alpha_{t-1} & \cos\theta_i\cos\alpha_{t-1} & -\sin\alpha_{t-1} & -\sin\alpha_{t-1}e_t \\ \sin\theta_1\sin\alpha_{t-1} & \cos\theta_t\sin\alpha_{t-1} & \cos\alpha_{t-1} & \cos\alpha_{t-1}e_t \\ 0 & 0 & 0 & 1 \end{bmatrix} \tag{1} $$

By substituting the D-H parameters in Table (1) into Equation (1), we can get:

$$ {}_{1}^{0}T=\begin{bmatrix} \cos\theta_1 & -\sin\theta_1 & 0 & 0 \\ \sin\theta_1 & \cos\theta_1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \tag{2} $$

$$ {}_{2}^{1}T=\begin{bmatrix} \cos\theta_2 & -\sin\theta_2 & 0 & L_1 \\ \sin\theta_2 & \cos\theta_2 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}^{2}_{3} \tag{3} $$

$$ T=\begin{bmatrix} \cos\theta_3 & -\sin\theta_3 & 0 & L_2 \\ \sin\theta_3 & \cos\theta_3 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \tag{4} $$

Therefore, there is:

$$ {}_{3}^{0}T={}_{1}^{0}T\,{}_{2}^{1}T\,{}_{3}^{2}T=\begin{bmatrix} r_{11} & r_{12} & r_{13} & p_x \\ r_{21} & r_{22} & r_{23} & p_y \\ r_{31} & r_{32} & r_{33} & p_z \\ 0 & 0 & 0 & 1 \end{bmatrix} \tag{5} $$

Among them,

$$ \begin{aligned} & r_{11}=\cos\ \theta_1+\theta_2+\theta_3 \\ & r_{12}=-\sin\ \theta_1+\theta_2+\theta_3 \\ & r_{13}=0 \\ & p_x=L_1\cos\theta_1+L_2\cos\ \theta_1+\theta_2 \\ & r_{21}=\sin\ \theta_1+\theta_2+\theta_3 \\ & r_{22}=\cos\ \theta_1+\theta_2+\theta_3 \\ & r_{23}=0 \\ & p_y=L_1\sin\theta_1+L_2\sin\ \theta_1+\theta_2 \\ & r_{31}=0 \quad r_{32}=0 \quad r_{33}=1 \quad p_z=0 \end{aligned} $$

If the exoskeleton toe is assumed to be the end position, the end position coordinates are:

$$\begin{bmatrix} x_e & y_e & z_e & 1 \end{bmatrix}^T = {}_3^0T \begin{bmatrix} L_3 & L_4 & 0 & 1 \end{bmatrix}^T \quad (6)$$

In order to verify the correctness of the model, the standing and sitting postures of the exoskeleton were selected for verification, as shown in Figure 2.

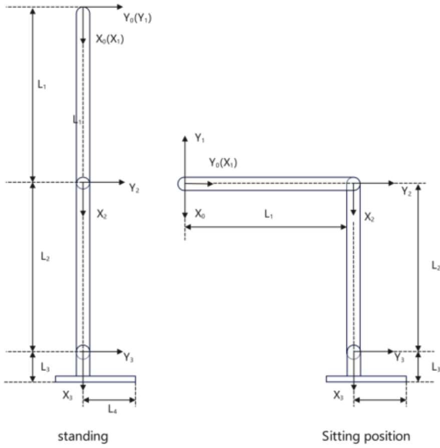


Figure 2: Sketch of the standing and sitting postures of the lower limb exoskeleton model of students.

In standing posture, $\theta_1 = 0, \theta_2 = 0, \theta_3 = 0$. By substituting it into formula (6), we get:

$$\begin{bmatrix} x_e & y_e & z_e & 1 \end{bmatrix}^T = \begin{bmatrix} L1 + L2 + L3 \\ L4 \\ 0 \\ 1 \end{bmatrix}$$

In the sitting posture, $\theta_1 = 90°, \theta_2 = 270°, \theta_3 = 0$. Substituting it into formula (6),

Obviously, the calculation results are consistent with the actual situation, indicating that the kinematics analysis of the students' lower limb exoskeleton model is correct.

2.2 Dynamic Analysis of Student Lower Extremity Exoskeleton Model

Like kinematics analysis, dynamic analysis of the classroom student model also includes forward and inverse problems.

At present, the Newton-Euler method and the Lagrange method are the most commonly used and classical methods for dynamic analysis. The Newton-Euler method uses the Newton-Euler equation to obtain the connecting rod method through an iterative method. It only solves the change of the movement trajectory of each connecting rod in the classroom student model with respect to time. In this paper, the Lagrangian method is used to analyze the dynamics of the student lower limb exoskeleton model system.

For the classroom student model system, the Lagrangian function L is the difference between the total kinetic energy K of the system and the total potential energy U of the system, expressed as:

$$L(q,\dot{q}) = K(q,\dot{q}) - U(q) \tag{7}$$

Each connecting rod of the classroom student model is regarded as a rigid body, and the kinetic energy of the i-th connecting rod is:

$$K_i = \frac{1}{2} m_t {}^l v_{cl}^{Tl} v_{cl} + \frac{1}{2} \omega_l^{Tcl} I_l {}^l \omega_t \tag{8}$$

The total kinetic energy of the system is:

$$K = \sum_{t=1}^{n} K_i \tag{9}$$

The potential energy of the i-th connecting rod is:

$$U_i = m_l {}^0 g^{T0} p_{cl} \tag{10}$$

The total potential energy of the system is:

$$U = \sum_{i=1}^{n} U_t \tag{11}$$

The Lagrangian dynamics equation of the classroom student model system is expressed as:

$$F_t = \frac{d}{dt}\frac{\partial L}{\partial \dot{q}_l} - \frac{\partial L}{\partial q_l} \tag{12}$$

Aiming at the student model of the lower limb exoskeleton model in the classroom, assuming that there is no interference between the two legs, only one mechanical leg is modeled, and its dynamic equation is deduced. Because only the medullary joint and the knee joint are actively driven, the ankle joint is passively driven, and the weight of the lower part of the ankle joint is very light. Therefore, the exoskeleton dynamics model is simplified to a two-link structure, as shown in Figure 3.

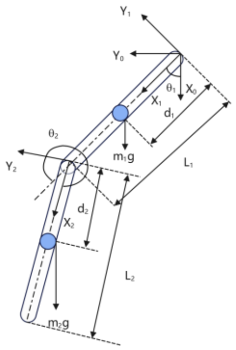


Figure 3: Structure diagram of the dynamic model of the student lower limb exoskeleton model.

The coordinate system $\{0\}$ is the base coordinate system, m_1、m_2 is the mass of the thigh rod and the calf rod, d_1 is the distance from the center of mass of the thigh rod to the joint, d_2 is the distance from the center of mass of the calf rod to the knee joint, and θ_1、θ_2 is the joint angle.

The dynamic equation of the student lower limb exoskeleton model system is:

$$T = \frac{d}{dt}\frac{\partial K}{\partial \dot{\theta}} - \frac{\partial K}{\partial \theta} + \frac{\partial U}{\partial \theta} \tag{13}$$

The angular velocity and linear velocity at the center of mass of the thigh rod are:

$$^{1}\omega_1 = \begin{bmatrix} 0 \\ 0 \\ \dot{\theta}_1 \end{bmatrix} \tag{14}$$

$$^{1}v_{c1} = ^{1}v_1 + ^{1}\omega_1 \times ^{1}p_{c1} = \begin{bmatrix} -d_1 \sin\theta_1 \dot{\theta}_1 \\ d_1 \cos\theta_1 \dot{\theta}_1 \\ 0 \end{bmatrix} \tag{15}$$

The angular and linear velocities at the center of mass of the calf bar are:

$$d^2\omega_2 \ = ^2_1 R^1\omega_1 + \dot{\theta}_2 \cdot ^2 \vec{Z}_2 = \begin{bmatrix} 0 \\ 0 \\ \dot{\theta}_1 + \dot{\theta}_2 \end{bmatrix} \tag{16}$$

$$\begin{aligned} ^{2}v_{c2} &= ^{2}v_2 + ^{2}\omega_2 \times ^{2}p_{c2} \\ &= ^2_1 R^1 v_1 + ^2_1 R^1\omega_1 \times ^1 p_2 + ^2\omega_2 \times ^2 p_{c2} \\ &= \begin{bmatrix} L_1 \sin\theta_2 \dot{\theta}_1 \\ L_1 \cos\theta_2 \dot{\theta}_1 + d_2 \ \dot{\theta}_1 + \dot{\theta}_2 \\ 0 \end{bmatrix} \end{aligned} \tag{17}$$

For the thigh bar, its kinetic energy and potential energy are:

$$K_1 = \frac{1}{2} m_1 {}^1 v_{c1}^T v_{c1} + \frac{1}{2} \omega_1^{Tc1} I_1 {}^1\omega_1 = \frac{1}{2} m_1 d_1^2 \dot{\theta}_1^2 + \frac{1}{2} I_{zz1} \dot{\theta}_1^2 \tag{18}$$

$$U_1 = m_1 {}^0 g^{T0} p_{c1} = -m_1 g d_1 \cos\theta_1 \tag{19}$$

For the calf rod, its kinetic energy and potential energy are:

$$
\begin{aligned}
K_2 &= \frac{1}{2} m_2 {}^2v_{c2}^{T} {}^2v_{c2} + \frac{1}{2} {}^2\omega_2^{T} {}^{c2}I_2 {}^2\omega_2 \\
&= \frac{1}{2} m_2 L_1^2 \dot{\theta}_1^2 + m_2 d_2 L_1 \cos\theta_2 (\dot{\theta}_1 + \dot{\theta}_2) \dot{\theta}_1 \\
&+ \frac{1}{2} m_2 d_2^2 (\dot{\theta}_1 + \dot{\theta}_2)^2 + \frac{1}{2} I_{zz2} (\dot{\theta}_1^2 + \dot{\theta}_2^2)^2
\end{aligned} \tag{20}
$$

$$
U_2 = m_2 {}^0g^{T} {}^0p_{c2} = -m_2 g \left[L_1 \cos\theta_1 + d_2 \cos(\theta_1 + \theta_2) \right] \tag{21}
$$

The Lagrangian function of the student lower limb exoskeleton model system is:

$$
L = K_1 + K_2 - U_1 - U_2 \tag{22}
$$

By calculating $\frac{d}{dt}\frac{\partial K}{\partial \dot{\theta}_1}, \frac{\partial K}{\partial \theta_1}, \frac{\partial U}{\partial \theta_1}, \frac{d}{dt}\frac{\partial K}{\partial \dot{\theta}_2}, \frac{\partial K}{\partial \theta_2}$ and $\frac{\partial U}{\partial \theta_2}$ respectively, we get:

$$
\begin{aligned}
\frac{d}{dt}\frac{\partial K}{\partial \dot{\theta}_1} = & (m_2 d_1^2 + m_2 d_2^2 + m_2 L_1^2 + 2 m_2 d_2 L_1 \cos\theta_2 + I_{zz1} + I_{zz2}) \ddot{\theta}_1 \\
& + (m_2 d_2^2 + m_2 d_2 L_1 \cos\theta_2 + I_{zz2}) \ddot{\theta}_2 \\
& - m_2 d_2 L_1 \sin\theta_2 (2\dot{\theta}_1 \dot{\theta}_2 + \dot{\theta}_2^2)
\end{aligned} \tag{23}
$$

$$
\frac{\partial K}{\partial \theta_1} = 0 \tag{24}
$$

$$
\frac{\partial U}{\partial \theta_1} = m_1 g d_1 \sin\theta_1 + m_2 g L_1 \sin\theta_1 + m_2 g d_2 \sin(\theta_1 + \theta_2) \tag{25}
$$

$$
\begin{aligned}
\frac{d}{dt}\frac{\partial K}{\partial \dot{\theta}_2} = & (m_2 d_2^2 + I_{zz2})(\ddot{\theta}_1 + \ddot{\theta}_2) + (m_2 d_2 L_1 \cos\theta_2) \ddot{\theta}_1 \\
& - (m_2 d_2 L_1 \sin\theta_2) \dot{\theta}_1 \dot{\theta}_2
\end{aligned} \tag{26}
$$

$$
\frac{\partial K}{\partial \theta_2} = -(m_2 d_2 L_1 \sin\theta_2)(\dot{\theta}_1^2 + \dot{\theta}_1 \dot{\theta}_2) \tag{27}
$$

$$
\frac{\partial U}{\partial \theta_2} = m_2 g d_2 \sin(\theta_1 + \theta_2) \tag{28}
$$

The above-calculated quantities are substituted into the dynamic equation (13) and organized into a state space equation as follows:

$$
T = M(\theta)\ddot{\theta} + V(\theta, \dot{\theta}) + G(\theta) \tag{29}
$$

$M(\theta)$ is the $n \times n$-dimensional mass matrix, $V(\theta, \dot{\theta})$ is the $n \times 1$-dimensional centrifugal force and Coriolis force vector, and $G(\theta)$ is the $n \times 1$-dimensional gravity vector.

Finally, the joint driving torque T_1、T_2 is obtained:

$$\begin{aligned} T_1 = & \left(m_2 d_1^2 + m_2 d_2^2 + m_2 L_1^2 + 2 m_2 d_2 L_1 \cos\theta_2 + I_{zz1} + I_{z22}\right)\ddot{\theta}_1 \\ & + \left(m_2 d_2^2 + m_2 d_2 L_1 \cos\theta_2 + I_{zz2}\right)\ddot{\theta}_2 - m_2 d_2 L_1 \sin\theta_2 \left(2\dot{\theta}_1\dot{\theta}_2 + \dot{\theta}_2^2\right) \\ & + \left[m_1 g d_1 \sin\theta_1 + m_2 g L_1 \sin\theta_1 + m_2 g d_2 \sin\left(\theta_1 + \theta_2\right)\right] \end{aligned} \tag{30}$$

$$\begin{aligned} T_2 = & \left(m_2 d_2^2 + m_2 d_2 L_1 \cos\theta_2 + I_{zz2}\right)\ddot{\theta}_1 + \left(m_2 d_2^2 + I_{zz2}\right)\ddot{\theta}_2 \\ & + \left(m_2 d_2 L_1 \sin\theta_2\right)\dot{\theta}_1^2 + m_2 g d_2 \sin\left(\theta_1 + \theta_2\right) \end{aligned} \tag{31}$$

Considering that the part below the ankle joint of the exoskeleton is ignored when establishing the dynamic model, the driving torque required by the pastern and knee joints should be slightly larger than T_1、T_2 in the actual movement process.

3 RESEARCH ON THE EFFECTIVENESS OF COLLEGE STUDENTS' TEACHING EVALUATION BASED ON BIG DATA ANALYSIS TECHNOLOGY OF THE INTERNET OF THINGS

The wireless sensor network in this system is a data aggregation network, and the nodes in the network can be divided into a wireless data acquisition terminal (Terminal), data transfer node (Coordinator), and database station (Station). The wireless sensor network uses a 433MHz ultra-long-distance wireless transmission module for networking. The structure of the network is shown in Figure 4.

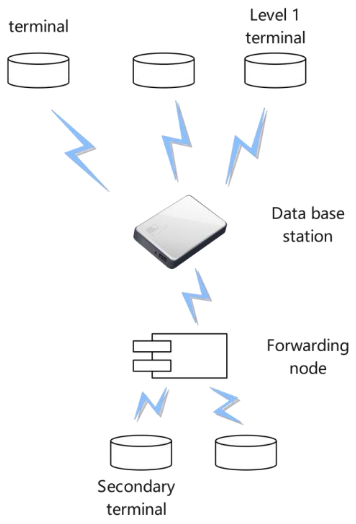


Figure 4: Wireless network structure diagram.

In the traditional sports monitoring and management system, the phenomenon of surrogate brushing has always been a difficult problem to solve. In the manual stamping method, it is usually judged by comparing the face picture on the campus card with the running student to see whether there is a swiping behavior. This method will lead to longer card swiping time, and the original queuing phenomenon will be more serious. The fingerprint recognition system can solve the problem of surrogate brushing very well by using the fingerprint recognition method, but there are also many problems in the fingerprint recognition system, as follows: (1) It takes a lot of time manpower and material resources for teachers to organize students to enroll their fingerprints before running. (2) The one-time success rate of fingerprint identification is low, resulting in long student waiting times and serious queuing. (3) It needs to occupy a lot of memory to store fingerprint information and student ID information, and the system design is complicated. (4) The act of collecting fingerprints involves the collection of personal privacy. Before, a company promoted the fingerprint identification system in schools, which caused a great storm of public opinion in society. Finally, various colleges and universities removed the system. Aiming at the problems of the traditional anti-substitute brush system, this system innovatively designs a fast face recognition system, which uses the characteristics of the skin color of the face to identify different areas on the face. Face recognition has many advantages unmatched by other biometric technologies, and everyone has a different face, making it possible to distinguish through faces quickly. The program processing flow of the face recognition module is shown in Figure 5.

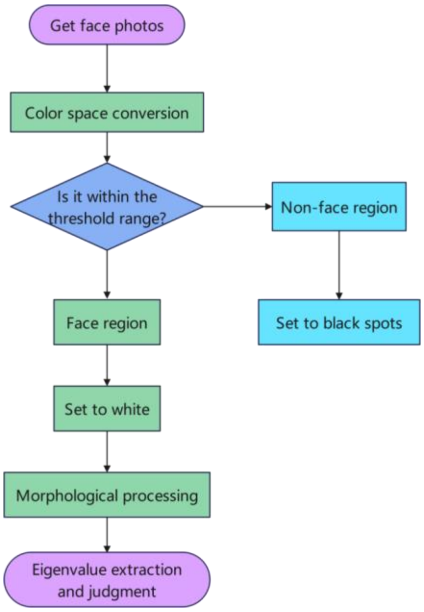
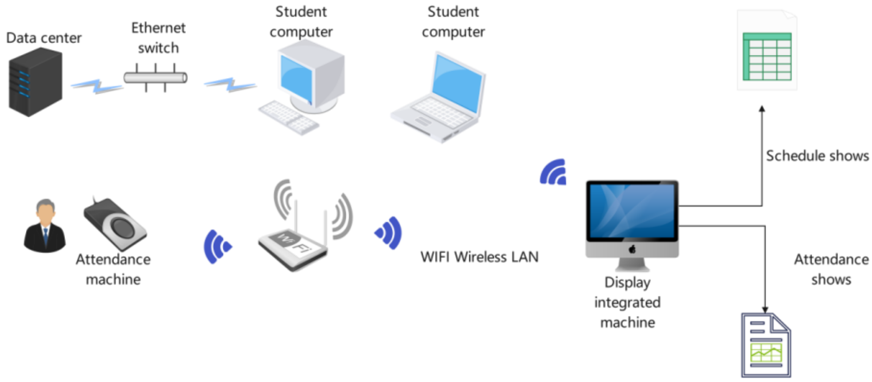


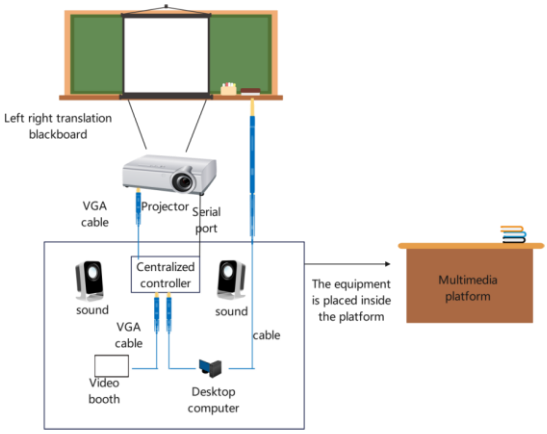
Figure 5: Flowchart of face recognition processing.

The construction of smart classrooms will provide a unified software and hardware platform for front-line teachers, classroom management and maintenance personnel, educational affairs, and supervision departments. It promotes the improvement of the teaching environment, the innovation of teaching methods, the improvement of teaching quality, and the improvement of the quality of students' learning experience, and promotes the reform of teaching equipment management, teaching process management, and teaching resource management in an all-around way. Moreover, it improves overall safety, saves energy, and provides a safer, more comfortable, and more convenient place to work and study for all administrators, teachers, and students. The project collects the audio and video signals of each classroom by installing network central control, cameras, pickups, and other equipment in the classrooms, uploads them to the management center through the network, and automatically saves them for a certain period of time. In the management center, the corresponding display screen, management software, resource software, teaching evaluation software, and teaching private network are configured to form an intelligent teaching system platform.

Smarter classrooms have installed a new teaching and attendance system. Classes must reserve classrooms in advance, and the reserved classrooms are intelligently reserved through the distribution of timetables, which can effectively avoid the problem of conflict between classrooms used by different classes.



(a) Networking of the educational administration system



(b) Schematic diagram of the multimedia equipment management system

Figure 6: Smarter classroom system.

In today's teaching activities, multimedia equipment is inseparable. Teachers can prepare the documents required for the class before class and project them through the projector during the class. Teachers can teach not only through text and pictures but also through video. The overall multimedia equipment includes a projector, console, audio, and so on. At the same time, the multimedia equipment management system can also record the teacher's commute to and from work. Through this system, teachers can input knowledge to students through eyes, ears, mouth, body, and heart, and students can also receive knowledge in a more pleasant atmosphere in a three-dimensional environment. The main functions of the multimedia equipment management system are as follows: (1) It breaks through the traditional board teaching, allows teachers and students to study in a healthier environment, and conducts interactive teaching between teachers and students through multimedia. (2) It gets rid of the pointer and operates the system through infrared induction or touch screen. (3) The system control is not decentralized; all equipment can be controlled through a single point, and it can be networked and remotely controlled. (4) Each teaching class is recorded with a camera, and the recorded video can be shared on the Internet. Figure 6 shows the smart classroom system.

Figure 7 shows an example of the student feature recognition algorithm in the second part of this paper.

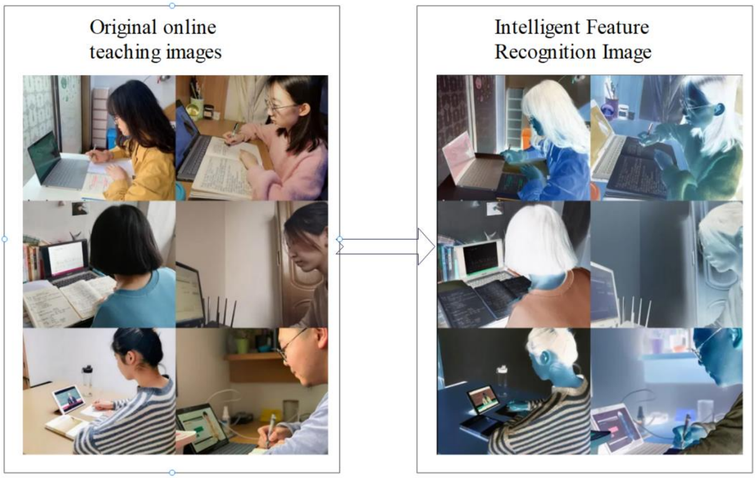


Figure 7: Example diagram of student feature recognition algorithm.

The effectiveness of the teaching evaluation system for college students based on the big data analysis technology of the Internet of Things proposed in this paper is verified, and several sets of experiments are carried out in combination with the actual situation. Finally, the statistical table of effective shown in Figure 8 is obtained.

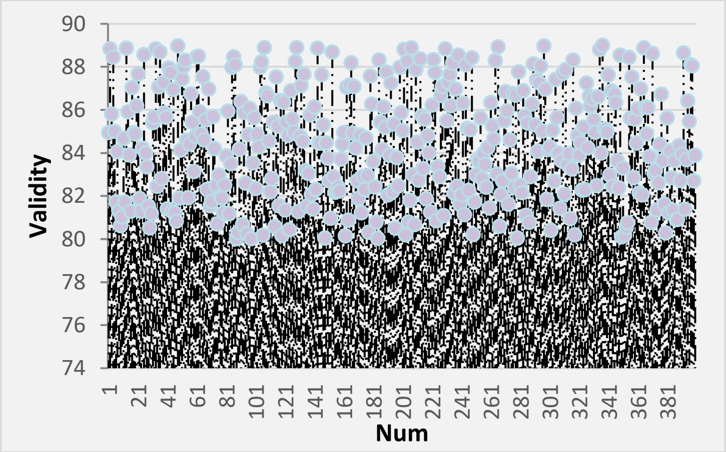


Figure 8: Statistical diagram on the effectiveness of college students' teaching evaluation based on the big data analysis technology of the Internet of Things.

From the above research, it can be seen that the teaching evaluation system for college students based on the big data analysis technology of the Internet of Things proposed in this paper can effectively improve the teaching evaluation effect and has a certain effect on improving teaching efficiency.

4 CONCLUSIONS

By systematically focusing on and alleviating the stress of learning, higher education institutions are able to create a more supportive and inclusive academic environment for students, which not only contributes to improved academic achievement and mental health but also enhances student satisfaction and engagement with the educational process. In addition, the study of the degree of caring for learning stress provides an important dimension for the teaching evaluation system of higher education, which helps education decision-makers and teachers to understand the needs of students better and develop effective teaching strategies and interventions, so as to promote students' socio-emotional learning and cultivate their key abilities to cope with future career and life challenges. Therefore, the study of the degree of caring for learning stress has an indispensable academic and practical value for promoting educational innovation, realizing educational equity, and improving the overall effectiveness of the education system.

"Student evaluation of teaching," as a method of evaluating teachers, has a good starting point, and "student evaluation of teachers" is also a very common practice in Western universities. If the evaluation form is set up reasonably and the operation methods and results are handled properly, this method can play a certain evaluation role. "Students' evaluation of teaching" has its advantages, but there are quite a few problems to consider in the operation process. If one aspect is ignored or handled improperly, it will affect the effectiveness of the evaluation and eventually lead to its failure. Judging from foreign experience, most Western universities adopt this method as the main teacher evaluation method. However, they have been practiced for a long time in terms of publicity and operation and have been tested for reliability and validity of the evaluation. This paper analyzes the effectiveness of college students' teaching evaluation based on the big data technology of the Internet of Things and improves the evaluation effect of college teaching. The research shows that the teaching evaluation system for college students based on the big data analysis technology of the Internet of Things proposed in this paper can effectively improve the teaching evaluation effect and has a certain effect on improving teaching efficiency.

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