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New Generation Semi-Automatic Thermosonic Wire Bonder

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Abstract: The physical and technological aspects of wire ball-wedge bonding in the assembly of integrated circuits are considered. The video camera and the pattern recognition system (PRS) of new bonder helps to provide accurate positioning of the bonding tool on the chip pads of integrated circuits. The formation of the loop wire cycle is ensured by the synchronous movement of the bonding head along the Z axis and the working table along the XY axes based on the servo drive. A feature of the bonder is that it can bond all the wire loops of the electronic device according to the pre-recorded program without needing to align the bonding points.

Keywords: High frequency ultrasonic; Gold wire bonding; Ball formation; Bonding tool; Matching parts of ultrasonic transducer

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1. Introduction

Today's global industry produces more than 60 billion types of electronic devices a year. This variety includes devices that control the systems of personal computers (PC), spacecraft, aircraft, cars, televisions, mobile phones, digital cameras, DVD players, and many more. The market requires more features in smaller, faster, cheaper devices, which are assembled in many frameworks such as chip-scale package (CSP), ball grid array (BGA), wafer-level chip-scale package (WCSP), true chip-size package (TCSP), plastic leaded chip carrier (PLCC), small outline integrated circuit (SOIC), small outline package (SOP), and many more.

Assembly of more than 90% of these frameworks is associated with the technology of interconnections by gold and aluminum wires [1]. Thus, interconnect technology is the critical technology that connects the pads of semiconductor chips to the outside pads of electronic devices. Modern chip bonding in semiconductor technology involves high-temperature Au-Si eutectic spray (377 °C) method and widely used of low-temperature adhesives and solder, which requires wire bonding to be done at temperatures of 120–180 °C, instead of 200–250 °C. The high degree of integration of the IC and the reduction of chip pads leads to the need to use for interconnections of small diameter gold wire (17.5 μm–20 μm). This makes new requirements on the accuracy of the bonded points and necessitates the automation of the alignment of the bonding tool with the small contact pads of electronic device.

2. Ultrasonic bonding systems

It is known that the quality of work of any wire bonder in electronic products using ultrasound is determined by its ultrasonic system, which includes an ultrasonic transducer (UST) and an ultrasonic generator (USG). Increasing the requirements for equipment performance and reducing the size of the contact pads on the crystals requires precise operation of the ultrasonic system. The supplied electrical oscillations from the USG are converted by the UST into mechanical vibrations. In turn, the matching of the bonding tool with the UST is required. The requirements for the bonding tool for ultrasonic bonding can be formulated as follows:

(1) The shape and dimensions of the instrument must provide efficient transmission of ultrasonic vibration energy with a gain of > 1.

(2) The material of the tool should provide the minimum attenuation of US vibrations and should not chemically interact with the output material.

To preserve the spectrum of natural frequencies and the type of oscillations (bending in particular), it is necessary to observe the following condition [2]:

$$\frac{\lambda}{d} > (2.5–5)$$

where λ is the wavelength of the bends vibrations; *d* is the cross-sectional diameter of the bonding tool.

Connection of wire of small cross section ≤ 20 microns at the lowered temperature of a bonding zone (120–180°C) for industrial application of new semiautomatic bonder has the following characteristics:

(1) A precision bonding head with programmable force of the bonding tool on bonding positions according to a given profile and ultrasonic transducer with high resonance frequency (100 or 135 kHz).

(2) Uses precision wire break-feed mechanism.

(3) Digital ultrasonic generator with phase locked loops (PLL) of high frequency and with high resolution of parameter setting (amplitude, duration of output pulse).

(4) Bonding process control at each connection point, which will improve the quality of the products.

Until the early 1990s, ultrasonic bonding systems used ultrasonic frequency of about 60 kHz. Since 1991, leading manufacturers of assembly equipment have been actively using ultrasonic high-frequency systems in the range from 90 to 140 kHz [3].This was due to the development of "smart-card" technology, when it was necessary to carry out the process of bonding the gold wire using the "ball-wedge" method on the ribbon with chip from Heraeus (Germany) at a temperature not exceeding 140 °C. Previous operation of ultrasonic systems of high frequency in the range of 90–140 kHz has shown that this ensures high quality and reliability of connections at a temperature of 120 ºC and, with lesser bonding time. This is almost 100 ° C less than the temperature of thermosonic bonding at a standard frequency of 60 kHz (200–220 °C).

Given the requirements of modern production of electronic products and the experience of using ultrasonic bonder model EM-4320U [4], OJSC Planar-SO has developed a new generation of semi-automatic bonder EM-6705-2 (**Figure 1**).

The EM-6705-2 is a semi-automatic model that performs ball-to-wedge bonding.

Figure 1. Thermosonic wire bonder EM-6705-2

The unit is equipped with ball bonding head, USG, negative electronic flame-off (NEFO) which provide connection of terminals with a gold/copper wire diameter of 17.5 μm –75 μm. The software allows you to quickly select the appropriate bonding parameters in the program menu on display. To solve the problem of high-quality connection, the bonding system contains the following mechanisms and sub-systems:

(1) Wire feed with stepper motor mechanism using standard 2-inch wire coils from manufacturers such as SPM (Malaysia) and Heraeus (Germany).
(2) Precision servo drivers in Z and X-Y coordinates with a resolution of 1 μm and a high-speed touch sensor to determine the moment of contact of the bonding tool with the bonding pad, ensuring minimal deformation of the wire before bonding.
(3) Bonding head with programmable loading device, providing minimum force when touching the bonding point from 10 G to 15 G and the required bonding force profile (constant, trapezoidal, stepped) with a discrete load setting of not more than 0.2 G in the range from 10 G to 150 G
(4) Ultrasonic generator (USG) with a frequency range of 60–140 kHz and an output power of up to 4 W (or up to 10 W) with a set resolution of 0.01 W. To reduce the welding temperature to 120–180 °C, a model range of ultrasonic transducers with an increased resonance frequency in the range of 98 kHz ± 2 kHz (or up to 136 kHz) and a low impedance (10–25 Ω) was developed.
(5) Output current of NEFO regulated in the range 5–50 mA.

The bonder contains two control units: on the right is a control unit with a built-in small computer and a 19-inch PC display; on the left is the control unit for the drive and peripherals. The control system performs programmable movements of the bonding head in the Z coordinate (vertically) and the work table in the X-Y coordinates.

All welding parameters are programmed via the display and stored in the system memory. Each stitch bonding point and the stitch (loop) shape itself can be individually programmed and stored in the system memory. Thus, it is possible to name the program of bonding of the specific device and save it in the system memory.

To pre-align the tool with the bonding point, a video captured by a charge-coupled device (CCD) camera and cross-hair is displayed. After moving the bonding head to the alignment position, you can slowly move the bonding head closer to the bonding position by rotating the mouse wheel to accurately align the tool end with the bonding position. This software option is useful when assembling devices with

welding points of different heights and with small contact pads (40–50 microns). However, the main bonding mode is automatically carried out according to the recorded program using the embedded pattern recognition system and CCD video camera.

The peripheral system control interface contains a discrete I / O based on a PCI-1750 board and RS-232/USB channels. The bonding head can be easily removed after loosening the locking screw and disconnecting the flat cable connector. The main control buttons of the operator is a standard PC keyboard. On the panel of the right control unit there are power buttons of the systems (on/off), and an emergency stop button for the drives.

When setting the tearing speed, it is also necessary to take into account the breaking force of the wire and its relative elongation. Precision actuators in X and Y coordinates and their software interpolation allow the formation of stable loops at length of 150–200 microns. The flexibility of loop formation is provided by a set of programmable parameters shown in **Figure 2**.

The output power of USG can be controlled via RS-232 or an 8-bit parallel port. The wide range of operating frequencies allows to use this USG with high frequency UST for upgradation of the operating bonders with the system of 60 kHz.

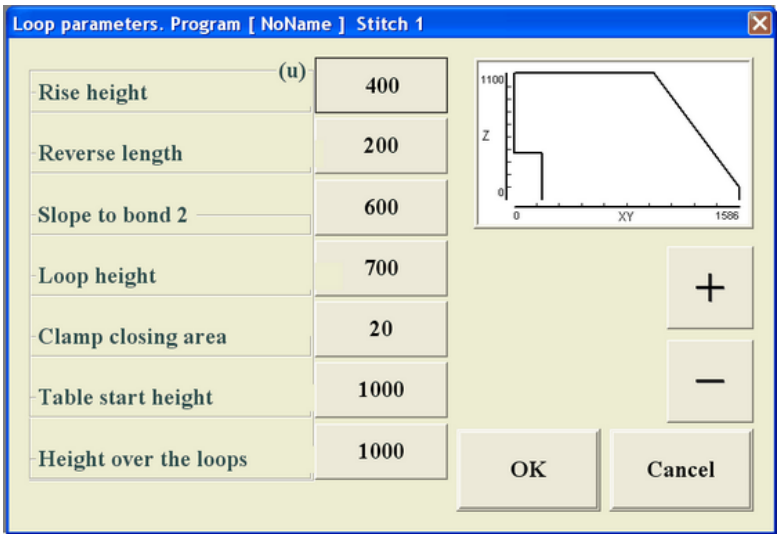

Figure 2. Loop programming section

The ultrasound setup results (resonance frequency in Hz and impedance in Ω) are displayed on the connection setup display. The built-in phase locked loops (PLL) system supports the operation of ultrasound at the resonant frequency of the ultrasonic transducer (UST). Typical phase and impedance diagrams obtained using the impedance analyzer are shown in **Figure 3**. The latest models of generators produces diagrams for quick diagnostics of the ultrasound system and view the result of matching bonding tool with UST.

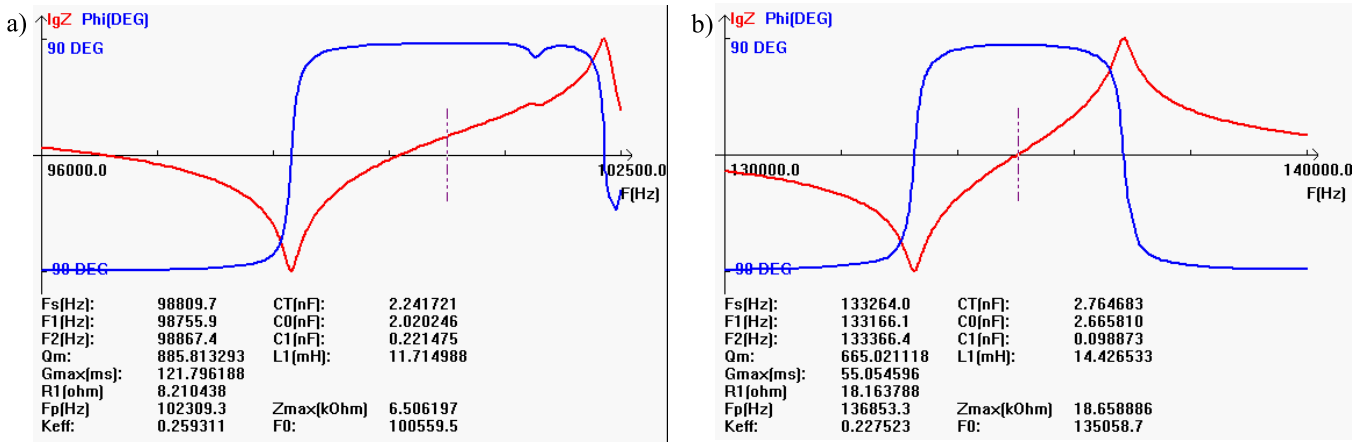

Figure 3. Impedance (blue) and phase (red) diagrams of transducers for ball wire bonding: a) UST with resonance frequency 988 kHz and impedance 8,2 Ohm(left); b) UST with resonance frequency 1333 kHz and impedance 182 Ω (right)

3. Physical and technological aspects of wire formation

The process of thermosonic bonding generally consists of four stages [5], as shown in **Figure 4**. In the first stage (preliminary deformation), the wire is deformed by 10–15% in the vertical direction under the action of the applied load to the bonding tool. The amount of pre-deformation plays a decisive role in the subsequent bonding process. If the deformation is too strong, the crystal structure of the metal of the contact surface and the wire itself changes significantly, which in turn causes the quality of the bonded joint to deteriorate.

In the second stage (cleaning), under the action of external load and ultrasonic oscillations, shear stresses occur in the wire, leading to the rupture of the surface oxide film, as well as the oscillating movement of the wire relative to the contact pad. These movements help to remove the oxide film and other contaminants from the contact surfaces. The vibration energy is used to clean surfaces from oxides and other contaminants. Only a small fraction of the energy deforms the wire. The tool oscillates together with the wire along the contact surface.

In the third stage (deformation), the plastic deformation of the wire predominates due to the heating of the wire by ultrasonic vibrations. As a result, setting points are formed and conditions are created for diffusion in the joint volume. During this phase, the temperature of the wire increases. The oscillations level the friction surfaces, causing the temperature at the point of contact to rise. The metals are ground to each other until the distance between the crystal lattices is interatomic. The high temperature of the contact spot stimulates the mutual diffusion of atoms in the lattice dislocation, and the metals are thermally released in the bonding zone. From this point on, the tool oscillates separately from the fixed wire, causing a further rise in temperature.

In the last stage (diffusion), which is the final formation of the micro bonded joint, intermetallic phases are formed due to the diffusion process. There is no significant increase in temperature or deformation. The heat given off by the friction of the capillary against the surface of the bonded wire is used to heat the bonding spot. This causes further release of metal at the bonding site. The tempering process stabilizes the bonding zone, and due to the gradual curing of metals in the diffusion zone, the joint is not brittle.

The magnitude of the mechanical energy of the ultrasonic vibrations introduced into the zone of formation of the micro-bonded joint is determined mainly by their amplitude A and frequency w, as shown in the equation below:

$$E = 1/2\, \rho V\, (\mathrm{Aw})^2$$

where ρ is the density of the material, and V is the volume of the joint zone.

Increasing the frequency of ultrasonic oscillations for bonding micro-wires should be considered as an opportunity to reduce the magnitude of the oscillation amplitude without changing the acoustic power. Reducing the amplitude of oscillations in turn reduces the alternating stresses in the bonded materials and the risk of fatigue failure, the probability of which is especially high when bonding thin wires.

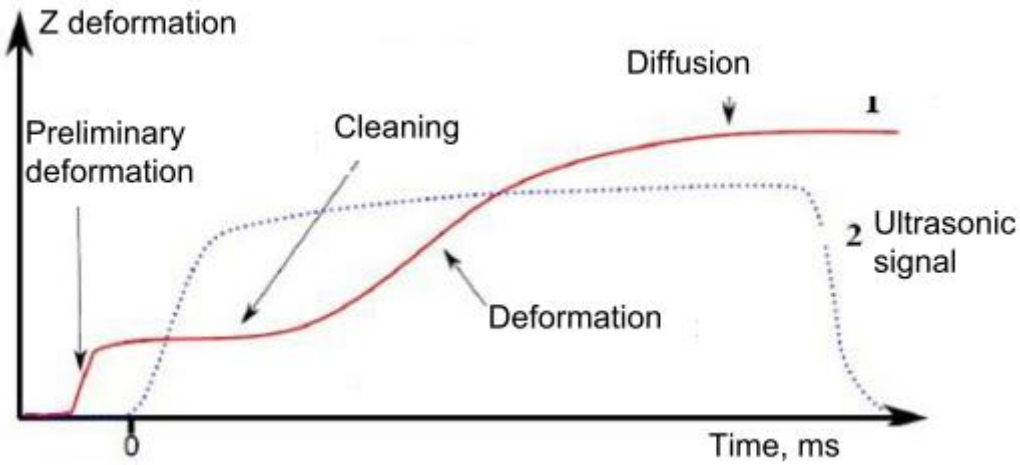

Figure 4. Stages of formation of the connection by the thermosonic "ball-wedge" wire bonding method

As is known, bonding of gold wire by the "ball-wedge" method begins with the process of forming a ball at the end of the gold wire. The EM-6705-2 uses the technology of applying high-voltage negative polarity to the sparking wand, which allows balls of stable diameter to be obtained [6]. The appearance of the gold ball at the end of the gold wire is shown in **Figure 5**. **Figure 5** shows the ideal transition of the ball into the wire, the so-called "neck," which is a critical place in the formation of the ball due to the annealing of the wire during its melting. The size of the annealed wire, the so-called heat-affected zone, depends not only on the strength of the formed bridge, but also on its formation [7]. The appearance of the first ball bonding is shown in **Figure 6**, and the second butt bonding in **Figure 7**.

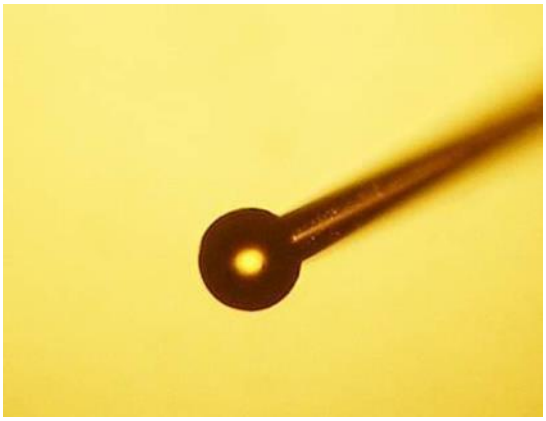

Figure 5. A typical outer ball obtained on a gold wire with a diameter of 20 microns on the EM-6705-2 model

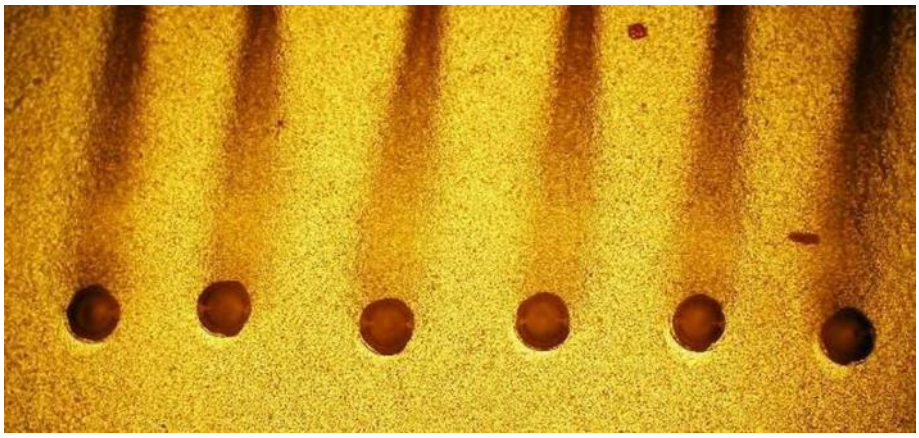

Figure 6. First ball bonding received on a gold wire with a diameter of 20 microns on the EM-6705-2 system

Figure 7. Appearance of the second bonding (wedge) obtained on a gold wire with a diameter of 20 microns on the EM-6705-2 system

4. Conclusion

A new generation of semi-automatic system for gold wire bonding, the EM-6705-2 bonder, which can be used in small-scale production of electronic products, is presented. The main bonding mode is automatically carried out according to the recorded program using the embedded pattern recognition system and CCD video camera. This system can be useful in educational institutions for micro-bonding for research and training.

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Disclosure statement

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Multifunctional Intelligent Security Integrated System of Highway Level Crossing

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Abstract: In consideration of the safety of drivers, we designed a multifunctional intelligent security guarantee integrated system for highway level crossing. Different from the existing intersection signs on the market, intelligent highway-level intersection indicators are based on the use of deep learning and computer vision technology to build a convolutional neural network model that can accurately recognize traffic accident images and traffic jams in a short period of time as well as obtain real-time road and highway meteorological environment information.

Keywords: Traffic safety; Guarantee system; Deep learning; Signal control

Online publication: February 17, 2023

1. Introduction

With the increasing number of urban vehicles, how to carry out rescue work in traffic accidents and avoid traffic congestion has become an important issue that has to be addressed by the smart highway traffic management. With the existing technology, the commonly used traffic accident identification methods include the global positioning system (GPS) data analysis method and image recognition method. The GPS data analysis method can be used to analyze the driving speed and direction of vehicles with GPS data and determine the occurrence of traffic accidents by identifying data anomaly points. The limitation of this method is that it cannot guarantee the accuracy and completeness of the GPS data collected by mobile terminals. In addition, many traffic accidents occur at a low speed or very-low speed driving state, so it is difficult to distinguish abnormal events from normal events by relying on speed alone. The image recognition method, on the other hand, uses the pictures taken by an on-board camera to determine the occurrence of accidents based on image recognition technology. The limitation of this method lies in the diversity of traffic accidents and the complexity of the image recognition algorithm itself. Ensuring comprehensive coverage and timely identification of accidents entail high calculation and communication costs and consideration of accuracy.

2. Study overview

Deep learning and computer vision can quickly build a convolutional neural network recognition and discrimination network model that can obtain real-time road information and road meteorological environment information accurately through images of traffic accidents and traffic jams. It also provides real-time road condition information of intelligent signs, including warning signals with LED intelligent signs, reminding drivers to pay attention to dangerous situations ahead [1]. At the same time, the data obtained by the photosensors are processed to determine whether it is necessary to open the light-emitting

band for auxiliary lighting. An intelligent highway monitoring system integrating road operation condition monitoring, highway emergency event monitoring, and highway meteorological environment monitoring is proposed. This provides a blueprint for evaluating traffic accidents and traffic congestion as well as a large amount of effective data for subsequent research.

3. System composition

The highway level crossing multifunctional intelligent security integrated system comprises a light-emitting diode (LED) display, solar panels, the Raspberry Pi 4B motherboard, a microcontroller secondary control board, a shell, and an external perception part that is equipped with a humidity sensor, a carbon dioxide sensor, a temperature sensor, and an ambient light sensor of five parts. Through the Raspberry Pi 4B motherboard, the corresponding algorithm programming is adopted to monitor the traffic situation at highway level crossings, with text reminders derived from safety accident judgment transmission signals (**Figure 1**).

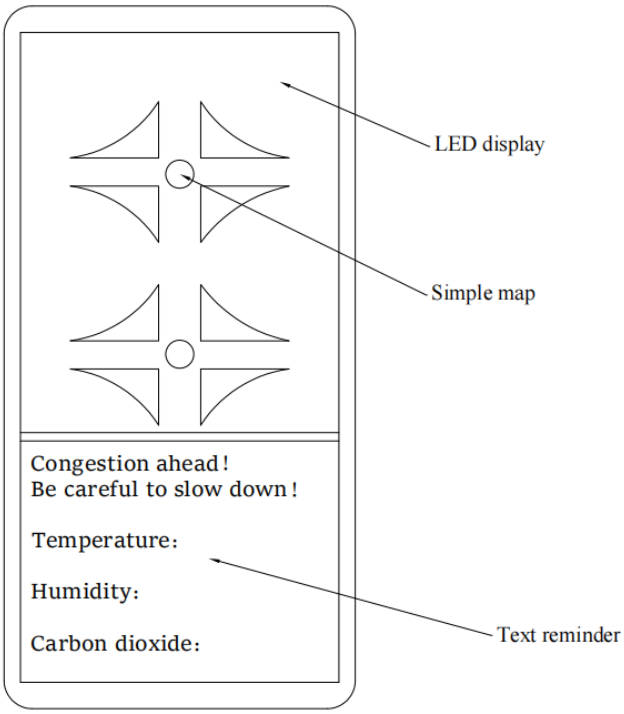

Figure 1. Schematic diagram of the main screen

Deep learning is used to identify the convolutional neural network of traffic accidents and traffic congestion. Through multiple training, the accuracy is high, and the output results of the two models that run at the same time are solved. The identification and discrimination of safety accidents are performed by a convolutional neural network. It is one of the best algorithms to complete the image recognition task. The purpose of designing a convolutional neural network is to imitate human learning and distinguish the samples by training and testing the input samples from simple to deep. Neural networks can reduce image classification errors and generate high recognition rates. In addition, compared with the traditional method, the advantage of convolutional neural network is that it can automatically extract the target features, identify the feature rules in the sample set, and solve the low efficiency and low classification accuracy problem [2]. Following data acquisition, a wireless transmission module is used to realize stable transmission to the data processing center and LED display screen after data encryption in various weather conditions. The wireless transmission module directly transmits information through the network; hence, its transmission speed is

relatively fast, and the information is in an encrypted information system to ensure information security. The control module includes the Raspberry Pi 4B motherboard and a secondary control board, Arduino UNO, which is used to receive data measured by the humidity sensor, carbon dioxide sensor, temperature sensor, and ambient light sensor. The secondary control board controls the LED display screen, while the Raspberry Pi 4B motherboard uses deep learning-based image recognition technology to identify traffic congestion and traffic accident scenes through machine vision (**Figure 2**).

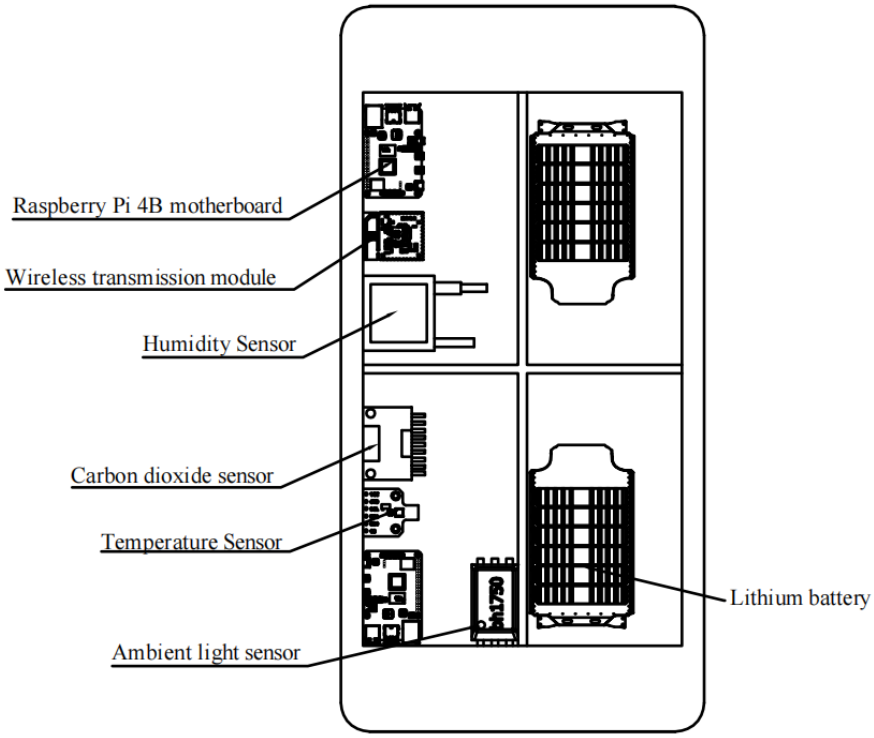

Figure 2. Schematic diagram of the control module

In order to better remind the driver of the road ahead, the LED display uses simple maps, text reminders, or voice broadcasts. In order to address traffic issues at night, photovoltaic power generation is used to power the LED display screen. During the day, the solar panels supply energy to the road sign and charge the lithium battery [3]. When the Raspberry Pi 4B motherboard processes the data obtained by the photosensitive sensor, the light-emitting band opens for auxiliary lighting.

Some of the devices comply with the national requirements for environmental protection, using LED lamps as a luminous module and solar panels to assist in power generation [4]. This helps achieve the same luminous effect with less electricity and reduce the consumption of electricity and pollution of light source.

4. Structural composition

The basic mechanical structure of the multifunctional intelligent security guarantee integrated system includes the main structure and the lifting structure [5], in which the main structure is fixed and connected to the lifting structure.

4.1. Main structure

The main structure includes a moving plate, a fixed plate, universal wheels, adjusting rods, and a spring. Universal wheels are arranged below the moving plate [6], an adjusting rod is interspersed with the outer wall of the moving plate, and a fixed spring is arranged above the moving plate (**Figure 3**).

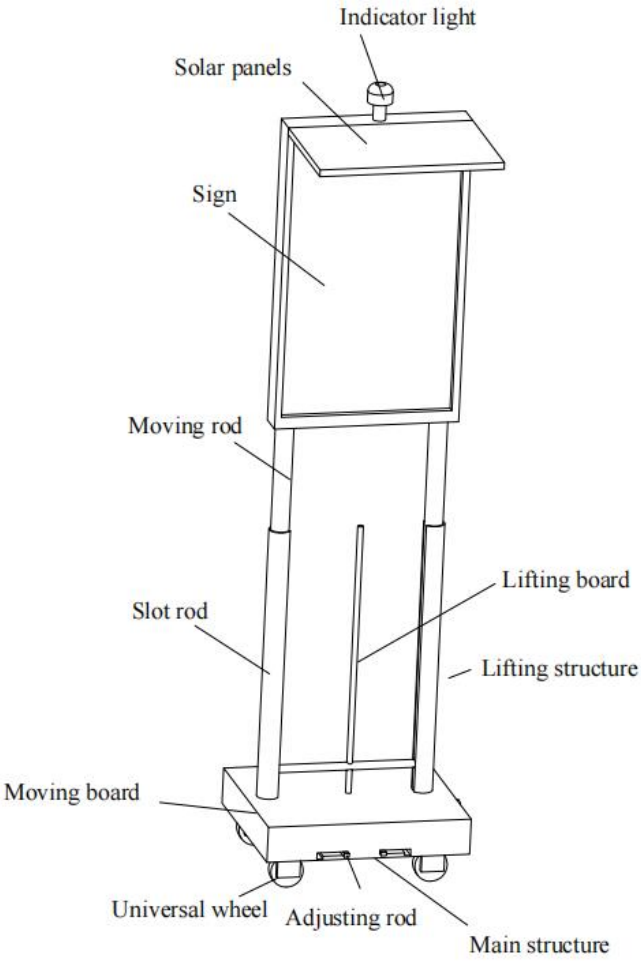

Figure 3. Schematic diagram of the main structure

4.2. Lifting structure

The lifting structure includes rotating lever, gears, bearing, lifting rod, slot rod, moving rod, indicator, indicator light and solar panels; the two gears are fixed on the top of the lifting rods; a moving rod is interspersed above the rotating lever, a connection board is fixed above the moving rod, an indicator light is fixed above the connection board, and the front of the board is connected to a solar panel [7]. Four fixed plates are used to fix the mobile signs to the ground, thus effectively preventing the wind blowing down the signs (**Figure 4**).

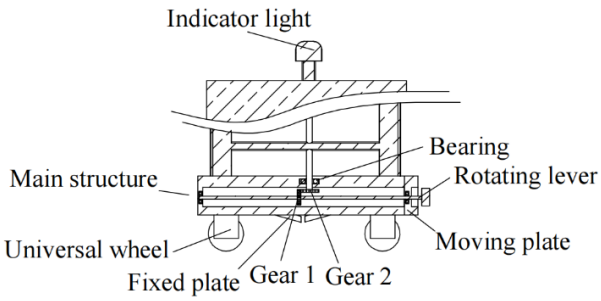

Figure 4. Schematic diagram of the lifting structure

4.3. Function implementation

The four adjusting rods are moved forward and backward to fit into the four grooves at the front and rear ends of the moving plate. Then, they are moved to the left and right sides. The four adjusting rods drive the four fixed plates to flip down. The four adjusting rods are attached to the fixed grooves above the four fixed plates. There are also anti-skid grooves on the left and right sides of the four fixed plates, which should be in contact with the ground. Subsequently, the moving plates are attached to the four fixed plates to secure the movable sign and prevent the movable sign from being shifted by the wind. The connecting groove rod is fixed above the moving board, and the four universal wheels are respectively fixed to the four corners below the moving board. With the four universal wheels, the moving board can be moved [8], thus saving time for workers and improving work efficiency. Below the moving plate, there are four grooves, and the four fixed plates are fixed to the inner walls of the four grooves. The two ends of the four springs are connected to the right side of the fixed plate and the four sides of the moving plate [9-12]. When withdrawing the four fixed plates, the four adjusting rods must be moved to the left and right sides; then, under the action of the four springs, the four fixed plates should be turned up and then taken back. The forward and backward movement of the four adjusting rods fixes the movable sign to prevent the movable indicator from shifting when the wind blows.

There are three bearings, which are embedded in the grooves on the right side and above the moving plate. The rotating lever is inserted into two bearings in the groove on the right side of the moving plate, while the bearings above the moving rod run through the groove below the outer surface of the moving plate and extend above the second gear. Rotating the rotating lever drives the first gear. This in turn drives the rotation of the lifting rod via the second gear. There are two groove rods. Threaded holes can be seen in the middle of the moving rod, and the upper part of the outer surface of the lifting rod is threaded. The threads are connected to the threaded holes in the middle of the moving rod. There are two groups of slot rods, there is a threaded hole in the middle of the lower part of the moving rod, and there is a thread on the outer surface of the lifting rod. Through the rotation of the lifting rod in the thread, the two groups of grooved rods move inward, and the moving rod can be adjusted according to the height of paving. The indicator plate is attached to the surface, while the back end of the solar panel is attached to the front end of the indicator [13].

The reflective film is pasted on the signboard, making it shine at night, so that it can be seen by motorists. In addition, solar-powered indicator light is an existing technology [14]. Indicator lights can be lit through the solar panel, so that drivers can see them from far.

5. Conclusion

The system shows the real-time traffic conditions at the level crossing, the road danger instructions ahead, and the real-time warning of traffic accidents, thus providing more guidance for drivers. Intelligent indicator signs make use of the light from LED intelligent signs, as well as the streetlights and reflective belts for auxiliary lighting. At night, their brightness can be adjusted depending on whether there are vehicles or not so as to effectively reduce energy consumption and improve resource utilization [15]. The moving plate can be moved with the four universal wheels to reach a specified location, and the four adjusting rods can be moved forward and backward to reach the four grooves at the front and rear ends of the moving plate. The four adjusting rods can then be moved to the left and right sides, driving the four fixing plates to flip down. The four adjusting rods can then be fixed to the fixed grooves above the four fixed plates, and the anti-skid grooves on the left and right sides of the four fixed plates should be in contact with the ground. The moving plates should then be fixed with the four fixed plates to fix the movable indicator sign and effectively prevent the wind blowing away or down the road signs. To some extent, there is significance in preventing traffic congestion and improving traffic flow.

Disclosure statement

The authors declare no conflict of interest.

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Information Security Management Measures for College Archives Under the Network Environment

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Abstract: The construction of archives in colleges and universities in China is in the process of development and improvement. With the development information technology, the informatization of college archives has been accelerated. Network technology is developing rapidly in our country, and the number of network users has increased significantly. The use of network technology in university archives management can improve the management efficiency and quality of archives, but the safety factor has dropped significantly. For example, the archival system may face many problems such as virus infection, system paralysis, or cyberattacks, which affects the security of the university archives. Therefore, this paper presents an analysis of these problems in detail, and proposes corresponding solutions, so as to optimize and improve the information security management of college archives.

Keywords: Network environment; University archives; Information security management

Online publication: March 28, 2023

1. Introduction

At present, China's science and technology and network technology are developing rapidly. These technologies are widely used in various industries in society. The integration of network technology and archives information management in colleges and universities can realize the informatization of archives, thereby improving the efficiency of archives management. However, there are certain dangers and loopholes in its actual application. Network technology has many advantages and characteristics such as fast sharing and transmission, but these can also be the disadvantages. The faster the development of network technology, the wider the spread of a virus can be, which not only poses a threat to the security of university programs, but also has a certain impact on people's daily lives. Therefore, it is necessary to optimize the system and rectify any problems discovered to improve the overall quality and efficiency of university archives information security management.

2. Characteristics of university archives

2.1. Complexity

University archives are the historical records in the form of audios, videos, icons, and texts of various activities that occurred in colleges and universities, such as scientific research, or records related to the government, management, and teaching, which are meaningful to schools and the society. Colleges and universities consist of many students; there are undergraduates and postgraduates, local students and foreign students, full-time and part-time students, with each student having his/her own file. The files can be a hardcopy or an electronic one, and the same goes for school teachers. Moreover, the archives of leaders of

the colleges and universities need to be specially managed [1]. In addition, there are a variety of club activities and departmental activities. There are different preservation and management methods for different archives, and the duration and time of all archives are different.

2.2. Advancement

At present, our country's society is developing rapidly, and the scientific research capabilities of universities are gradually highlighted. They are important bases for knowledge growth and innovation, where many academic resources and scientific research resources can be produced. Every year, students and teachers in colleges produce research output with much effort [2]. For example, teachers and students in colleges and universities will write various reports and papers based on their own research results every year to represent the development of science and technology, which in a way highlight the advanced nature of college archives.

2.3. Accessibility

Archives can be shared among institutions or to the public in accordance to relevant requirements. However, the sharing of scientific research archives need to be well-managed. If the research results and reports are not disseminated and released in a timely and extensive manner, the research results will not be fully utilized. This is not only a waste of school resources, but also waste of social resources.

2.4. Confidentiality

University archives contain a lot of content, many of which cannot be made public. Among them, the content that cannot be disclosed includes the following: party and state secrets, archives containing related technologies and patents developed on campus, and files involving personal privacy. In addition, all faculty and staff files cannot be borrowed. However, the files can be borrowed under special circumstances with the approval of relevant departments [3]. The lending party must do a good job in keeping the files and keeping them confidential, and the files cannot be transferred. The files cannot be dismantled or altered while being lent. The files need to be cared for and must be returned in time after they are used. At present, our country has realized network-based archives information security management, which can optimize the confidentiality of archives. The security management of archives information in colleges and universities is of great importance. Therefore, it is not only necessary to make full use of archive resources, but also to ensure the security of archive information. Therefore, we need to continuously optimize and improve archives security management to and ensure the security of archives.

3. The current situation of the application of archives in colleges and universities

At present, the networked information security management of university archives in our country is in the process of development, and the number of intranet users is relatively small. Software of archives management in colleges and universities are usually either purchased from other companies [4] or developed collaboratively by the school and a company. However, the above two forms of file management systems and file management software have some disadvantages. Moreover, the number of talents related to archiving of many colleges and universities are lacking, which leads to a shortage of talents in professional management.

3.1. Insufficient archives awareness

In the current file information security management work, most personnel have insufficient management awareness. Many people think as long as their usernames and passwords are not disclosed, the security of their information will not be affected. This is also an important manifestation of insufficient security

awareness. Hackers can steal user passwords through advanced technologies. Some people believe the security of their devices can be ensured by installing anti-virus software, but many people do not know enough about the application and updates of anti-virus software, which leads to potential safety hazards.

3.2. Insufficient management system

According to the current development and construction of archives management departments in colleges and universities, there are many problems in information security. Besides, there are certain limitations in the application of security management models. Along with the lack of understanding of the role of Internet security deployment, these problems will have an impact on the security of archives and information [5]. Some hackers will attack the loopholes in the system to obtain information. If these problems cannot be effectively resolved, the information security of university archives will be affected and even lead to data loss or network paralysis in serious cases.

3.3. Virus violation

Both Trojan horse and worms are bad factors that can affect network security. Among them, worms mainly infect files, and this virus can travel and self-replicate through the network. If the network system is infected with worms, the network traffic of electronic devices will be greatly increased, and the operating speed of electronic devices will also be reduced. Some worms will cause file damage and loss, and cause some problems to the software. Trojan horse is a professional term among hackers, which means attack. If a computer is invaded by a Trojan horse, hackers can control the computer through the virus, and at the same time delete and download the software and data in the computer at will.

4. Measures for management of archives information security in colleges and universities under the network environment

4.1. Strengthening security development capabilities

The security of the university's archive network can affect the security of the archive resources. Applying network technology to college archives improves the overall level and quality of archives security information management, but it is easy to become dependent on computers. Computers are used as the main tool to compile computer systems in accordance with relevant specifications and requirements. There is no major difference in how anyone operates and manages the system. In order to effectively realize file security management in the network-based platform, it is necessary to strictly follow the relevant requirements, so as to reduce the problems existing in file management. Under the network environment, the information security management of archives in colleges and universities mainly depends on network and computer technologies. Network technology experts are also needed to manage the archives. The computer system itself has certain weaknesses, and security problems are prone to occur, which will affect the security of archive information. Although some research have been done on information security management in China, most of the computer products still come from abroad, which hinders the development of China's information security, seriously lacks a self-protection system, and has been in a passive state [6]. Therefore, at present, our country should improve the development capabilities of information security technology, conduct research, and develop more software and systems suitable for university archives information security management, which is conducive to ensuring the security of archives and providing support for archives information security.

4.2. Optimizing firewall technology

Firewall technology is mainly established on the basis of information technology and network technology. Firewall technology is gradually being applied in public and private networks. The application of firewall

technology can ensure the safe and stable operation of the network system as much as possible [7]. There are a few main functions of firewall technology. Firstly, firewall technology can ensure network security. The application of firewall technology can effectively improve the security of the network by filtering the unsafe factors existing in the network. Second, the application of firewall technology can optimize network security issues. In the security configuration scheme, firewall technology can be applied to all security software, so that this technology can be integrated with the network, and the problems in the network system can be discovered and resolved in time. Third, the application of firewall technology can avoid the leakage of file information. Through the application of firewall technology, the internal network can be effectively divided, so as to isolate the key network, internal network, and other networks to ensure the security of archive information [8].

4.3. Improving network development capabilities

In the current network environment, a large number of resources can be linked to the Internet, and all grid nodes are connected through the Internet. Through Internet technology, different network nodes can be effectively linked, and users can monitor and manage the network environment. The grid mainly guarantees the security of the environment through the security infrastructure [9]. Network security facilities can help ensure secure communication, effectively avoid data leakage, and also support single sign-on for users. Through the application of security technology, the convenience and security of the network computing environment can be improved to ensure the information security of university archives, and different access rights can be set for different users to improve the security of archive information.

4.4. Improving the comprehensive quality of archives management personnel

An important factor in the file management work is the file management personnel. If we want to use college archives to provide better services for the school, we need archives managers to continuously improve their comprehensive ability and quality. (1) Archives managers need to have a strong ability to write official documents, and they also need to improve their ability to use equipment. (2) Archives managers also need to have rich knowledge and improve their comprehensive ability through continuous learning. (3) Archives management personnel need to have correct ideas and ideology and be innovative. (4) Managers also need to have good communication and interpersonal skills so that they can alleviate problems that occur the archives department and provide good publicity for the archives, so as to gain people's trust and support, and improve their own reputation. (5) Besides, managers also need to have good comprehensive ability and management skills, including the ability to process and obtain different information, so as to realize resource sharing. Archival management personnel also need to have strong computer operation ability and effectively master computer security technology. If they encounter hacker intrusion and virus intrusion, they need to actively do a good job in resistance to ensure the security of archival information resources.

4.5. Improving the hardware environment of archives information security in colleges and universities

In a network environment, the archives information security management work in colleges and universities is facing the threat of the network. To avoid the loss of data and resources, the archives department needs to purchase advanced equipment with high safety factor and quality. Different scope of authority can be set for different archive information to ensure the security of archives [10]. When carrying out the security management of archives information in colleges and universities, it is necessary to install anti-virus software. Computer virus is an important object of intrusion by archives departments of universities, and it

is also an important target of digital archives information security management. Data-scanning technology can be applied, and anti-virus software should be installed and updated regularly to ensure the anti-virus capability of the software, and so that the defects of the system can be rectified in time to ensure the security of the information.

5. Conclusion

Generally speaking, under the network environment, the information security management of college archives is constantly being optimized and developed, which can further expand the application scope of information technology and provide users with more convenience. However, there are many shortcomings in its application, which should be analyzed, and targeted countermeasures needs to be put forward. These countermeasures include strengthening development capabilities of our country, optimizing firewall technology, improving network development capabilities, improving the overall quality of archives management personnel, and improving the hardware environment of university archives information security.

Disclosure statement

The author declares no conflict of interest.

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Effective Paths of Junior Middle School English Autonomous Learning Under the Background of "Internet+"

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Abstract: Under the background of "Internet +" learning method, junior high school English independent learning is individualized, autonomous, and interactive. "Internet +" learning can not only improve students' learning efficiency and learning quality, but also promote their comprehensive development. Therefore, in this paper, we analyzed the significance of developing junior high school English autonomous learning under the background of "Internet+," explained the theoretical basis of autonomous learning, and how the concept of "Internet +" can be integrated into English teaching.

Keywords: "Internet+"; Junior high school English; Independent learning

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1. Introduction

Nowadays, with the continuous development of internet technology, "Internet+" has become an indispensable part of people's lives. As an important course in the basic education provided in China, "Internet+" should be actively applied in junior high school English lessons to promote the improvement of students' English literacy under the background of the new curriculum reform. As an efficient learning method, autonomous learning plays an important role in junior high school English teaching. Therefore, teachers need to actively carry out various teaching activities while considering the situation of their students to create a good atmosphere for independent learning so that students can better adapt to the independent learning mode of junior high school English under the background of "Internet +" [1-3].

2. The significance of independent learning of English in junior high schools under the background of "Internet+"

2.1. Emphasize the dominant position of students in classroom teaching

Based on the concept of "Information 2.0" and "Internet+," autonomous teaching of junior high school English will better reflect the "people-oriented" teaching idea and promote the deepening and implementation of the new curriculum reform.

First, learning English independently in junior high schools under the environment of "Internet+" will jointly play the role of "Internet+" information and technology to improve the effectiveness of English learning and enable students to learn and think independently and help them to be good at thinking so that they may have more English cultural connotations, more English knowledge bases to broaden their English horizons, deepen their understanding of English and enhance their learning subjectivity [4].

Secondly, autonomous teaching of junior high school English under the environment of "Internet+" can enrich teacher's teaching experience, improve their understanding of the content and purpose of English courses. Besides, autonomous teaching embodies the unity of instruments and humans, and has fundamental, practical and comprehensive characteristics, thereby it can also stimulate students' enthusiasm for English learning, help students to adapt to their future development needs, allows students to be the main body, and build a student-centered learning environment [5].

2.2. Help teachers to implement core qualities education in English teaching

Promoting the autonomous teaching in junior high school in the "Internet+" era will help teachers deeply understand the new curriculum standards, emphasize English literacy; improve students' higher-order thinking ability and expand their horizons and overall level of English.

First, in the "Internet+" environment, the implementation of autonomous teaching of English in junior high schools will help improve students' language acquisition and expressing levels. Teachers should help students build a complete set of language sense, pragmatics, and context. The teaching activities created with the idea of understanding, practical application, knowledge transfer, and innovation can improve students' language construction, application level, so that they can communicate in English. Besides, it can help develop higher-order thinking abilities in English such as speculation, reasoning and argumentation, critical evaluation, and imaginative creation. If students can think in English and are able to analyze the content of English courses, their English learning effect and literacy will be improved.

Second, many online resources can be utilized through the integration of the Internet and self-learning, and students can be exposed to different cultures from different countries in various ways. In this way, the students' horizons can be broadened, their learning fields can be expanded, and their understanding of the national culture can be deepened. Students can then communicate better with foreigners and spread the Chinese traditional culture, which is where the application and interactive value of English courses can be reflected to the greatest extent [6].

3. Theoretical basis of English self-learning in junior middle schools under the background of "Internet+"

From a systematic point of view, self-learning is a dynamic activity is a continuous process. Self-regulation is a kind of ability with internal structure and components, which is continuous over a long period of time. The understanding of its internal operation mechanism will help to design and guide specific English teaching practice.

In the 1990s, Zimmerman integrated the views of various researchers and established a relatively complete theoretical system on autonomy. Zimmerman (see **Table 1**) pointed out that the criteria for judging a person's autonomy, the "controls" should be used as the standard. When these six domains can act autonomously, the degree of autonomy is high; otherwise, the degree of autonomy is weak. This article is mainly based on Zimmerman's "autonomous learning" theoretical framework [7].

Table 1. Research framework of Zimmerman's autonomous learning

Scientific question	Psychological dimension	Control	Autonomous essence	Autonomous process
Why learn?	Motivation	Choice to participate	Intrinsic or self-motivated	Goals, efficacy, values, attributions
How to learn?	Method	Method of choosing	Scheduled or automated	strategy, relaxation, etc.
When to learn?	Time	Time limit	Timed and effective	Time management
What to learn?	Learning outcomes	Learning outcomes	Self-awareness about learning outcomes	Self-monitoring, self-judgment, behavior control, will
Where to learn?	Environment	Physical environment	Sensitivity and adaptability to physical circumstances	Selecting and organizing the learning environment
Learn with whom?	Social	Social environment	Sensitive and adaptable to social circumstances	Choose a role model, ask for help

4. The effective paths of junior middle school English autonomous learning under the background of "Internet+"

Under the background of "Internet+," teachers and students should have a certain knowledge about "Internet+," and traditional teaching concepts should be modified to integrate multimedia technology into student-centered learning activities such as task-based and project-based learning, so that students are motivated to converse in English and their English self-learning ability can be improved.

4.1. Students and teachers need to fully understand the constraints of English autonomous learning under the background of "Internet+"

English education under the background of "Internet+" consists of four factors: teacher, task, student, and internet environment. The goals of task- based learning can only be achieved by fully integrating the four factors. According to the self-determination theory, when students can manage their own behavior (why learn?), they will be able to manage their work (how to learn?), and form safe and enjoyable relationships with others (manage their social environment), which will drive their internal motivation, and they can actively take corresponding measures to achieve their goals (how to learn). On this basis, based on the "high-efficiency" approach of junior high school English autonomous learning under the "Internet +" condition, there are several "variables" (factors) that can influence the students' independent learning "under the network environment" are analyzed, as shown in **Figure 1**.

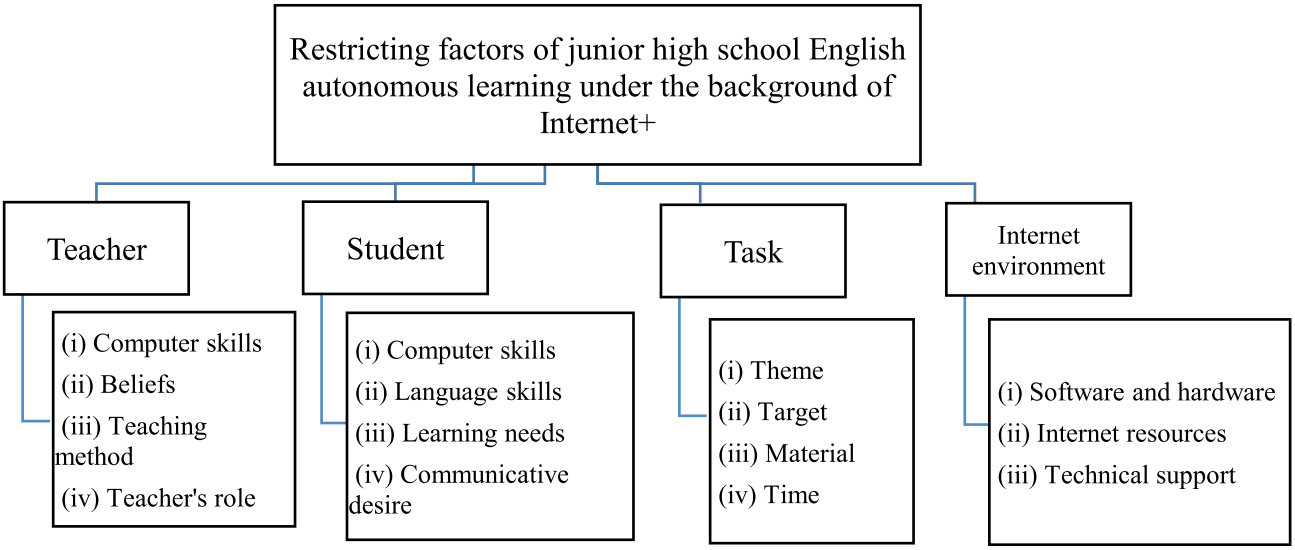

Figure 1. Constraining factors of task-based teaching under the background of Internet+

Through understanding the factors that affect the self-learning of English junior high school under the "Internet+" environment, teachers and students can create a more realistic and vivid teaching environment together, which in turn stimulates students' enthusiasm for learning, and promote students' autonomy.

4.2. Changing traditional teaching concepts under the background of "Internet+"

In the context of "Internet+," teachers should actively change traditional teaching concepts and use multimedia technology to stimulate their students' motivation in learning, so that the efficiency of classroom teaching and students' independent learning ability can be improved.

The design of classroom learning activities should start from the analysis of the teaching subject and the assessment of the network environment. Then, related tasks can be assigned, and the objectives, topics, materials and expected completion time of the tasks can be determined. Students should perform the tasks in groups under the guidance of the teachers, and resent them or conduct group discussions on the task completed and the results obtained. Teachers should ensure that the students complete their tasks according to the requirements, encourage, and help disadvantaged students to participate more in group activities, give tips on the meaning of words and provide adequate support when needed. After the task is over, the teacher should also give evaluation and feedback on the implementation of the task and the content presented or discussed by the students, so that students can reflect on the learning process, summarize the successes and failures. In this way, students will understand their weaknesses in the process of implementing the tasks, as shown in **Figure 2**.

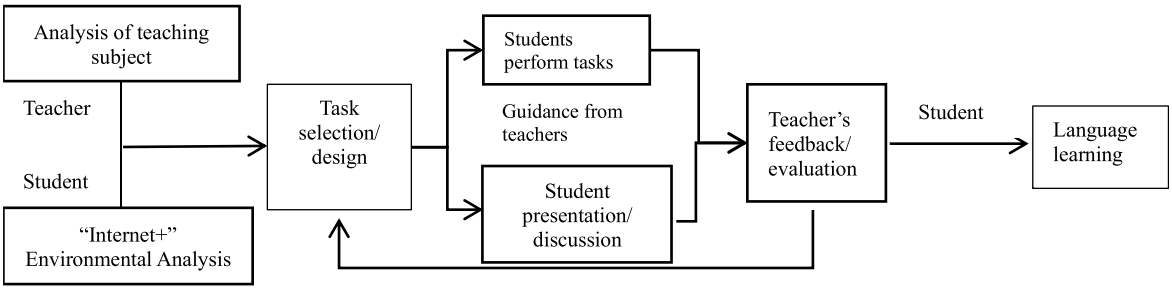

Figure 2. Framework design of classroom autonomous learning tasks under the background of Internet+

When formulating learning tasks, teachers can scientifically analyze students' existing English proficiency, and then formulate targeted, scientific, and rational learning tasks for students based on their English knowledge and learning ability, so that students can develop their self-learning ability and independently transfer and apply the English language, and finally improve their comprehensive English literacy. For example, a pertinent, scientific and rational weekly learning task can be formulated for students with weaker foundation, as shown in **Figure 3**.

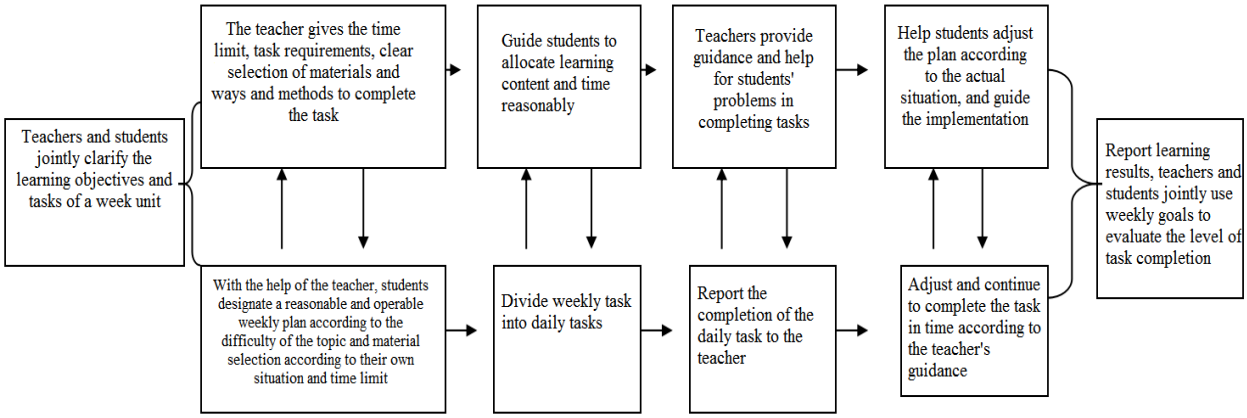

Figure 3. Weekly "Internet +" independent learning task

In this process, teachers can create a good independent learning platform for students by applying internet technology in junior high school English teaching. Teachers can use internet technology to display the related knowledge points the basic skills that will be covered in the course, so that students can adjust and improve the learning tasks according to the knowledge structure they have mastered [8,9] . Teachers can also set up a learning module specially for junior high school English independent learning on online platforms to teach English more efficiently, help students better understand English knowledge, and improve their use of English knowledge to solve practical problems.

4.3. Carry out project-based learning under the background of "Internet+," to improve students' independence, and cooperative and thinking skills

Project learning is a learning activity where teachers and students work together to complete a project. It is a kind of "behavior-oriented" teaching method. Project learning is a constructive teaching mode, in which teachers turn their lessons into a "project" and make students ask challenging and provocative questions based on real-world situations. On the basis of mastering the basic ideas and basic principles of the project, students use higher-level theoretical knowledge to guide the continuous advancement of practical knowledge. Finally, the results of the project are presented for discussions and evaluation in groups. Project learning has the following characteristics, as shown in **Table 2**.

Table 2. Characteristics of project learning

Practical	The themes of the projects are realistic, making students' learning more targeted and practical.
Autonomous	Students can choose the content and method of presentation according to their own interests, which can effectively promote the development of creative ability through independent learning.
Development	The combination of long-term projects and stage projects constitutes a cognitive process for realizing educational goals.
Comprehensive	Project learning requires interdisciplinary knowledge, network resources and comprehensive ability to solve problems.
Openness	Students' exploration methods around the theme and final presentation and evaluation are diverse and selective.
Evaluation	The evaluation focuses on the process of students' ability development in project activities, and its content includes the performance of students participating in all aspects of activities and the quality of homework.

In the process of project-based English learning, students need to use a large amount of theoretical knowledge and online information resources for scientific research, design, and practice. This self-directed learning approach is more suitable for senior high school students, and its learning process is shown in **Figure 4**.

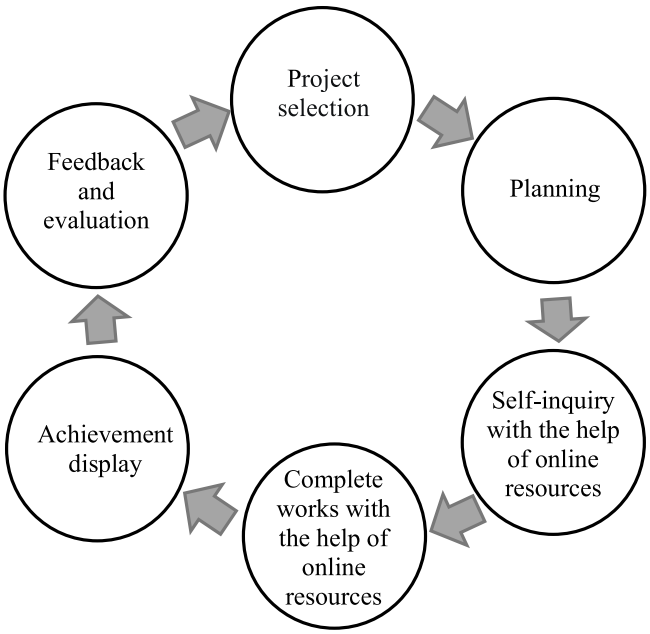

Figure 4. Basic links of project-based learning

An example of the project can be "A foreign blogger Johnny came to Beijing for the first time, hoping to experience Beijing's unique cultural customs. Therefore, you are to introduce Beijing's cultural customs and attractions to him." can be assigned to students, so that they can explore this topic, see **Figure 5**, **Figure 6**, and **Table 3.**

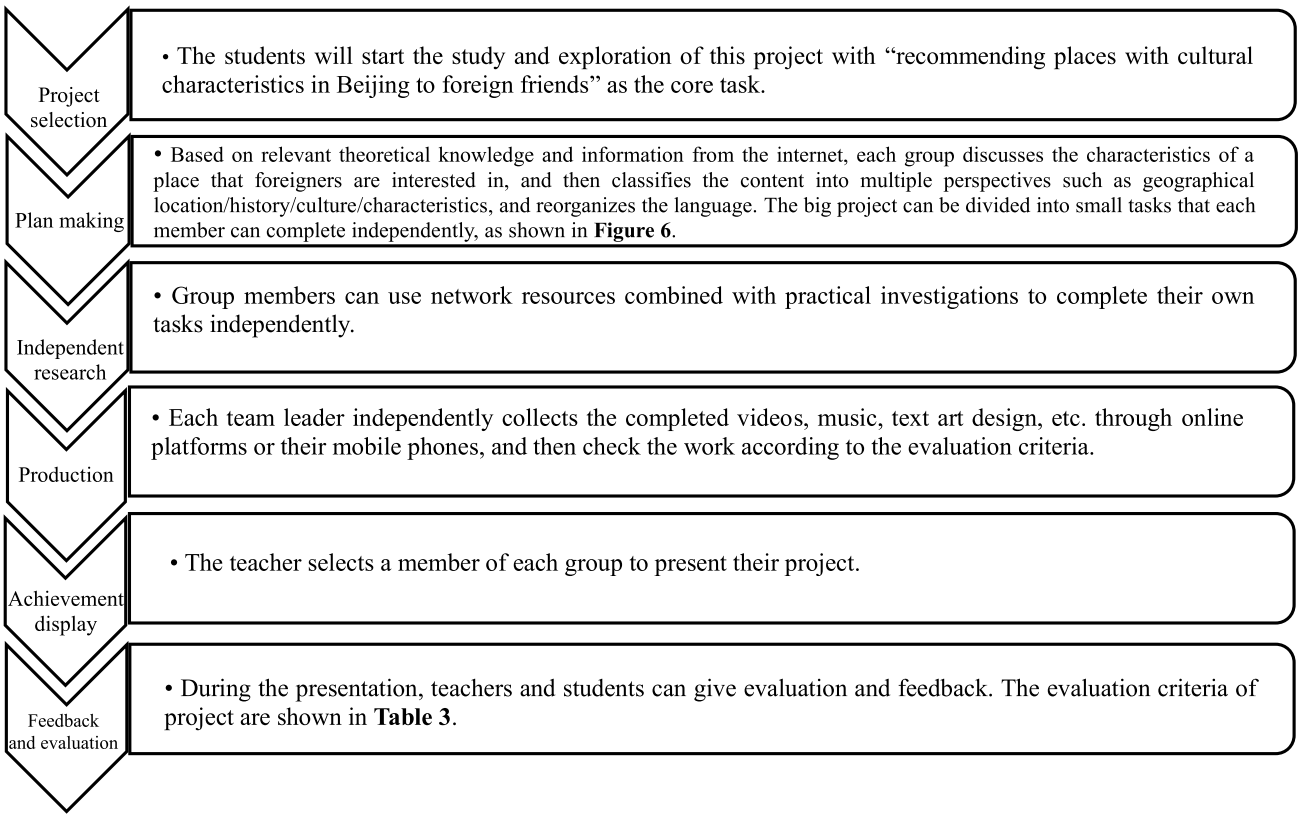

Figure 5. Project-based learning process of recommending the culturally distinctive Beijing places in Beijing

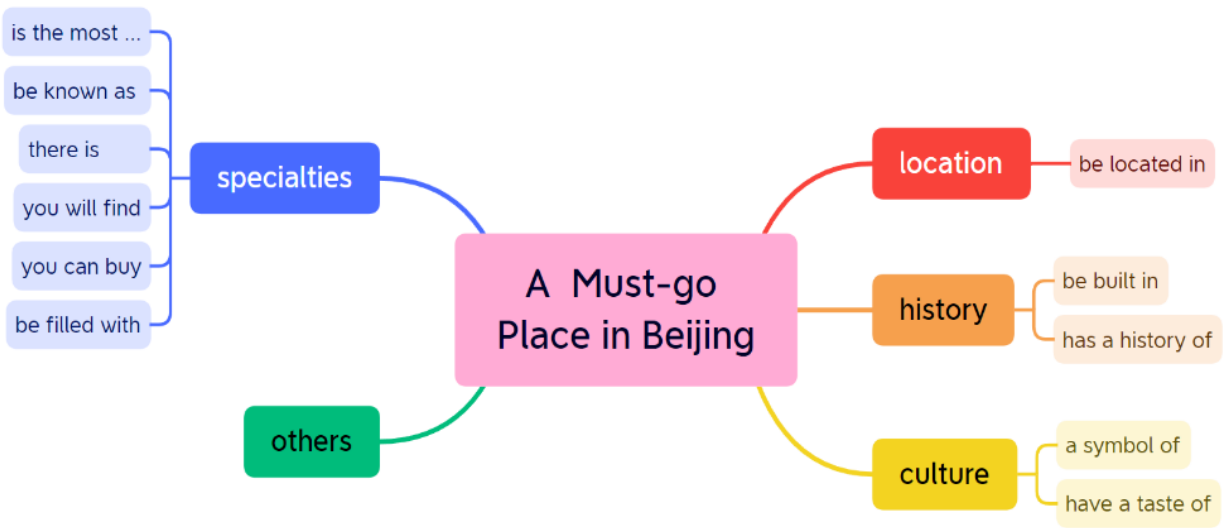

Figure 6. The planning map of recommended places in Beijing

Table 3. Rubric for projects related to Beijing characteristic cultural places

Items	Assessment criteria	Score				
		5	4	3	2	1
Content	Are the reasons to visit the places explained from different perspectives? (history, specialty, etc.)					
	Are the cultural features of the recommended places described clearly? Is the significance of visiting the places stated?					
Structure	Are there introduction, body, and conclusion? Are the recommendations written logically with proper linkers?					
Language	Are superlatives and comparatives used correctly?					
	Are the features of the recommended places described with suitable vocabulary and sentence structures?					

In the process of completing the project, students gradually build up their language awareness, reconstruct their language knowledge, and use the language they have learned to hold meaningful conversations. Therefore, students will be more interested in learning English, and then participate in independent thinking, cooperative inquiry, and evaluation and reflection activities. After careful preparation by the team, on-site investigation, collection of online materials, writing of promotional manuscripts, production of exquisite promotional advertisements and recording of vivid short films, the students have a deeper understanding of Beijing's culture, thus students' cultural confidence can be enhanced. Project research can cultivate students' ability to understand, and think about problems from different perspectives, and express their ideas rationally and methodically.

4.4. Stimulate students' interests in independent learning under the background of "Internet+"

Under the background of "Internet+," students can learn English through internet technology. Therefore, junior high school English teachers can create a good learning atmosphere for students by using multimedia technology in classroom teaching, so that students will be interested in learning and improve the efficiency of independent learning. For example, teachers can play some interesting video clips to teach their students new vocabulary. This will not only enable students to understand more vocabulary, but also stimulate their interest in learning [10-13]. Therefore, teachers need to actively apply multimedia technology to improve the teaching effect and stimulate students' interests in learning English independently.

5. Conclusion

In conclusion, in the "Internet+" environment, the flipped teaching method can highlight the subjectivity of students, improve the practicality and comprehensiveness of English learning, improve the evaluation method of English learning, and strengthen the guiding role of teachers, etc. All of these greatly promote the integration of "Internet+" technology in junior high school English learning, and realize the comprehensive and independent development of students.

Disclosure statement

The author declares no conflict of interest.

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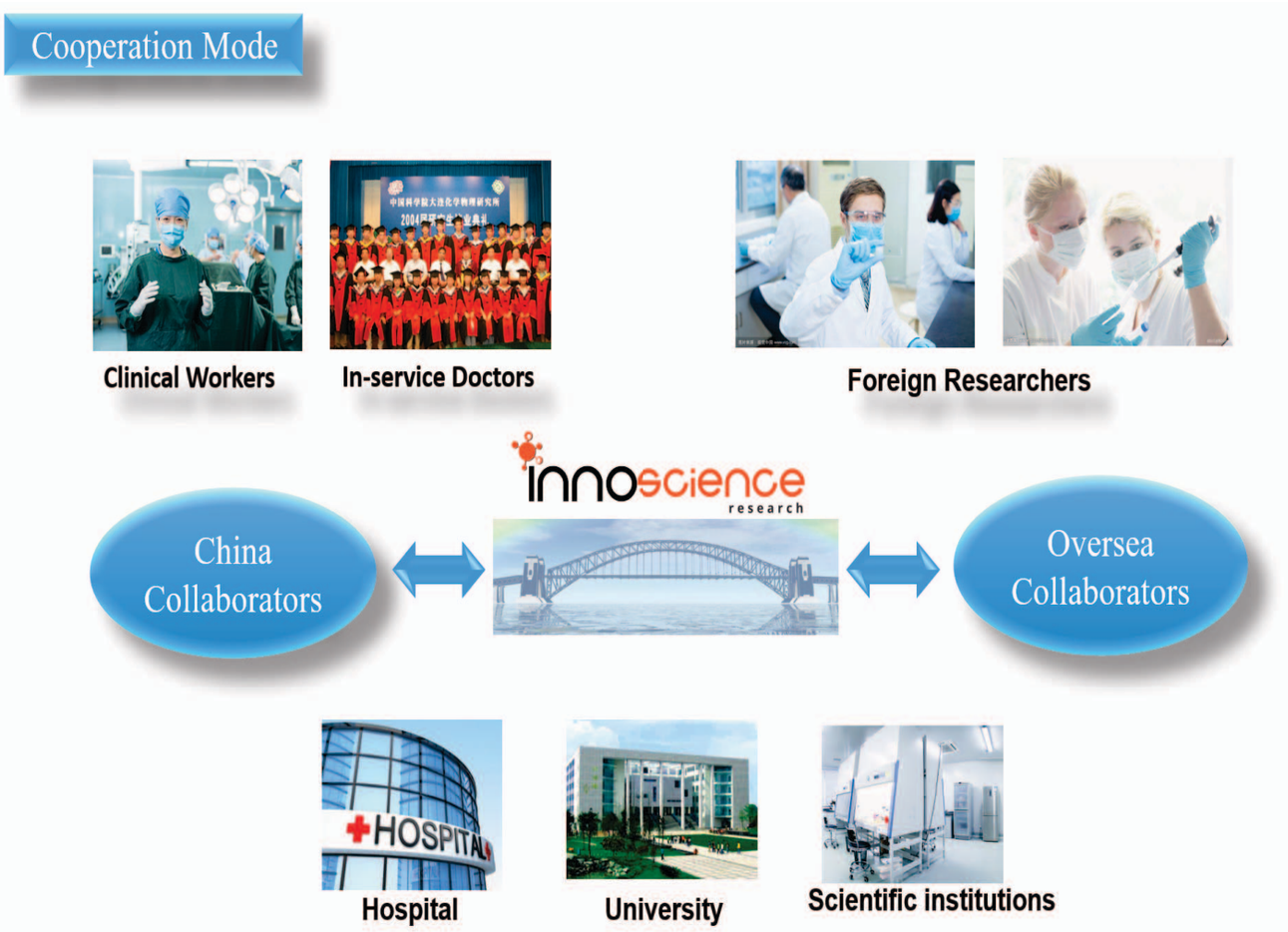

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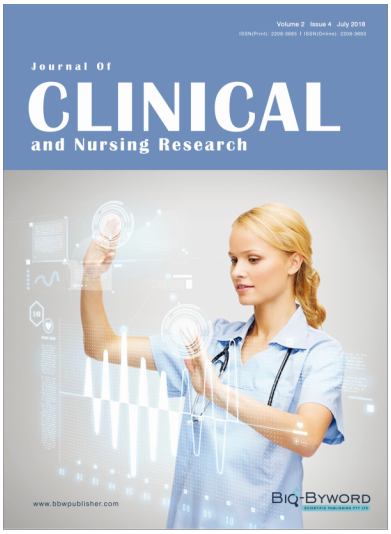

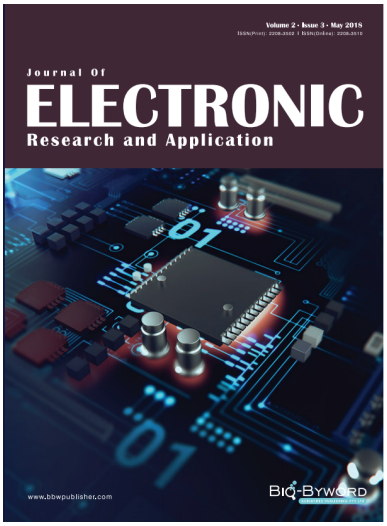

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