Research on Autonomous Learning Management Software Based on Mobile Terminal

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Abstract. There is a large amount of data calculation in the data transmission from the mobile terminal to the server edge. Psychologically assisted autonomous learning management software provides users with learning resources and learning activities to stimulate and maintain learning motivation. According to the software requirement, the whole development architecture is established based on the mobile terminal device, and the client mobile terminal device responds to the user operation and sends the data request to the Web server. The server adopts module entity to reflect the system database concept, divides the task into different modules according to the decision result, and reduces the delay of data transmission. The client is mainly composed of three interfaces: system login module, online learning module and support service module, which correspond to different activities respectively. The test results show that the psychologically aided autonomous learning management software based on mobile terminal device can reduce CPU usage and memory usage and improve performance.

Keywords: Mobile terminal equipment · Psychological assistance · Autonomous learning · Management software · Software development · Learning management

1 Introduction

The progress of science and technology, the improvement of people's living standards, promote the popularity of mobile phones. In the era of mobile phone popularization, people get more and more information through handheld mobile devices and wireless communication networks, and with the further development of Internet technology, mobile development technology has developed to make the performance of developed apps better. In the 21st century, wireless communication technology is gradually replacing wired communication technology to become the mainstream of the industry, which also prompted the innovation and progress of distance learning. With the development of mobile technology more and more mature, there are a variety of mobile software on the market such as mobile hitchhiking software, mobile ordering software to provide our lives with greater convenience. The development trend of mobile learning is

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also advancing rapidly, so the research on the implementation technology of mobile online education is of great practical significance. Mobile terminal devices with mobile phone and other media can effectively overcome the disadvantages of book learning and computer learning. As a new type of learning resource, the learning resource based on mobile device shows strong interactivity and interest by virtue of powerful multimedia technology, various forms of touch and simple and easy-to-learn operation habits, which is an important difference between mobile learning resources and traditional learning resources [1, 2]. Today's management software is facing the impact of the Internet and cloud. In particular, the development of mobile Internet challenges the timeliness of management software. Developers need to master important information and data at the first time. Therefore, it is of great significance to develop and study learning software.

Reference [3] proposes the development and Application Research of the data evaluation management software for primary school students' physical health test. The data evaluation and management software of primary school students' physical health test is divided into three important functional modules: score scoring, score warning and sports advice, and students' personal score sheet. It has the characteristics of strong operability and clear scoring interface. Setting up color scoring early warning can dynamically understand the physical health development of students, provide sports suggestions for early warning scores, and effectively assist teachers in teaching and students in autonomous learning. This method can reduce CPU utilization, but the data transmission rate is low. Reference [4] proposes the development and application of teaching management software for nursing interns. The software system is composed of three modules: Intern information entry, internship quality assessment and rotation management. After referring to relevant literature, the software quality evaluation questionnaire is compiled based on the theoretical framework of the international standard ISO/IEC9126 quality model. SPSS17.0 software was used for data entry and statistics. This method is feasible, but the CPU occupation is high.

Therefore, the research on the development of self-regulated learning management software based on mobile terminal equipment is proposed. After fully understanding the user's needs, formulate corresponding functional modules according to the needs. Use the web server, streaming media server and database server to build the overall development architecture of the mobile terminal device and reduce the memory consumption. Develop the server-side program of the psychological assistance independent learning management software through MyEclipse program to improve the overall performance of the system.

2 Development of Psychologically Assisted Autonomous Learning Management Software Based on Mobile Terminal Devices

2.1 Requirement Analysis of Psychologically Assisted Autonomous Learning Management Software

Before you can design software, there must be clear requirements. Only when the requirements are clear, can the R&D personnel develop the corresponding functional software according to the requirements and ensure the smooth development and testing of the

system. The software system designed in this way can meet the needs of more people. On the other hand, it can also ensure the feasibility of the project research practice. Psychological Aided Autonomous Learning can make use of the learning resources and activities provided by the network to choose the learning content and learning goal, stimulate and maintain the learning motivation, make the learning plan, determine the learning time, adjust the learning strategy, take the initiative to create learning situations for meaning construction, and promote the activities of problem solving and social interaction. Different user roles have different needs, from the perspective of learners, we hope that learning forms can replace the PCs through mobile terminal device learning, to obtain better learning experience and improve learning efficiency. It is hoped that the mobile terminal will be more user-friendly, beautiful, smooth in performance and can watch the learning videos you want to learn. Psychologically assisted autonomous learning management software diagnoses, evaluates and gives feedback to self-learning activities, continuously monitors and adjusts learning, perfects the learning process of self-knowledge system, and enables learners to constantly enrich and improve themselves, thereby improving learning and work efficiency and laying a good foundation for lifelong learning. From the point of view of software function, this paper analyzes the requirements of psychologically assisted autonomous learning management software. The specific functionality you should have for your software is shown in Fig. 1.

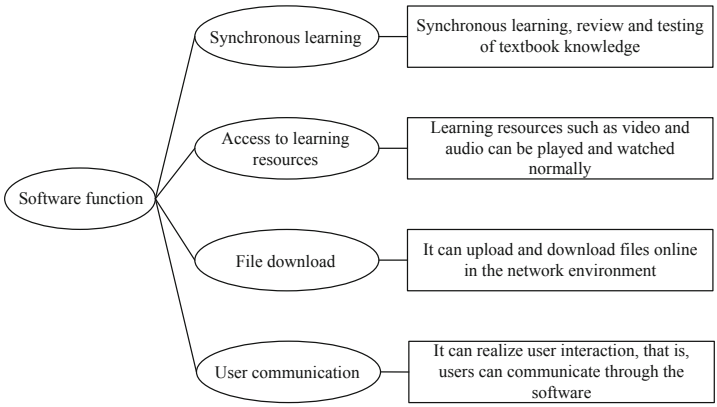

Fig. 1. Functions of psychologically assisted autonomous learning management software

Software for learners to provide learning resources to assist classroom learning, to help learners expand the classroom learning content, through the test to help learners master the learning content. Simultaneously these study content and the test content also can carry on the renewal along with the classroom content renewal. Learners should make self-planning and self-management according to their actual situation, and advocate respecting, trusting and exerting learners' initiative in the process of learning. In the process of autonomous learning, learners must actively reflect on their own learning process and learning results, and adjust the learning plan and learning objectives according to the results so as to learn effectively. Simple text and image content will make learners feel bored in the learning process, which requires the software to present

video and audio resources to help learners easily grasp the knowledge to learn, so the software must be able to support the normal play of audio and video materials. On the one hand, autonomous learning advocates self-planning, self-monitoring, self-reflection and self-evaluation, which are all open in the whole process of autonomous learning, and on the other hand, abundant resources in the network can be shared freely by learners according to their needs.

With the software running, the software will occupy more and more devices, so it needs software to support the uploading and downloading of files, so as to reduce the memory occupied by the software. Uploading important files from mobile devices to the server or obtaining the latest learning resources from the server can help learners to share the resources and ensure the normal operation of the software on mobile devices [5]. Through network or multimedia teaching resources and modern information technology, network autonomous learning communicates with students and teachers to solve difficult problems in the process of autonomous learning. Help learners to establish contact through communication, so that learners can get timely help in the learning process. For developers, the reliability and implementation of software products and the stability and maintainability of the software are the key requirements in the process of software development, hoping to develop a popular and stable software products.

2.2 Establishment of an Overall Development Architecture Based on Mobile Terminal Devices

Architecture is a general description of the overall structure and components of software, and a framework for software development. Users establish contact through mobile communication networks between mobile devices terminals and servers. The server side of the development of psychologically assisted autonomous learning management software includes Web servers, streaming media servers and database servers. As functional requirements increase and user numbers increase, the number of servers increases with the maintenance iterations of the application, requiring cluster management of the various servers. When the user manipulates the client, the client mobile terminal device responds to the user's actions by sending data requests to the Web server. The database server stores users' personal information and all kinds of learning resources to ensure the safety and storage of users' data. The connection between a user and a streaming media server is established through a web server. When a user applies for playing video and audio, the user first makes an application to the streaming media server through the web server, and the streaming media server responds to the content requested, and then feedback the content of the streaming media response to the user through the web server [6]. The server receives the response from the client and responds to the connection request or data request according to the logic rules in the corresponding interface. Finally, the queried data is returned to the client in a JSON string format. The database is used to store user information, video information and all kinds of self-learning resource information. The overall development architecture based on mobile terminal devices is shown in Fig. 2.

The presentation layer on the server side directly contacts the user, receives and transmits user data and displays data fed back from the business logic layer. The cloud server, which is the bridge between the user side and the edge service side. On the one hand,

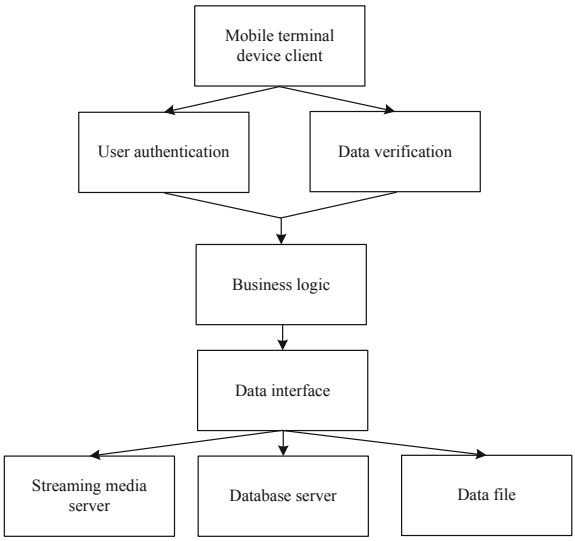

Fig. 2. Overall development architecture based on mobile devices

the cloud needs to communicate with the end user to achieve user login, personal information management and analysis; on the other hand, the cloud needs to communicate with the edge server to regularly update the local database resources of psycho-assisted autonomous learning resources server and to detect and monitor the running status of the whole software. Business logic handles logic, such as accessing the data layer according to the business logic and then receiving feedback from the data access layer to the presentation layer according to the business logic to implement software functions. Software through the network course information stored in the database, the database will have a corresponding record, and through the relevant attributes of the entity to describe the meaning of each field expression. The edge server and the cloud server establish a long TCP-connected communication link, through which the cloud and the edge can interact. When the user clicks the video playback, the data of the video in the server is read by the link address, and the video is played at the mobile terminal for the user to watch and learn. The related attributes of network curriculum entity include curriculum name, curriculum category, curriculum description and so on. The main purpose of this information is to record and manage the course data. The main function of the data access layer is to operate the database, receive the instructions from the business logic layer to add, delete and check the database, and feed back the results to the business logic layer.

The architectural pattern of the MVC used by the client. The mobile terminal operating system is open source and easy to operate, and has an optimized graphics library and powerful multimedia functions. The built-in database can meet the developer's requirements for data. For example, the Android operating system open source, developers can get the source code for free and use the platform to develop Android applications. In the process of coding, the common class and the same logic code are extracted for all the network requests, which makes the logic code of the whole project clear and avoids the bloatiness of the whole project [7]. At the same time, the Android system

provides developers with good services, allowing developers to develop applications in the process to solve their problems in a timely manner. Part of the business logic can be realized through the centralized data processing mechanism on the cloud, for example, monitoring and management of mobile terminal devices can be realized through the cloud server, and terminal devices can communicate with the cloud server through the public network bandwidth HTTP.

2.3 Software Server-Side Design

The Psychologically Assisted Autonomous Learning Management Software server-side program is developed using MyEclipse. The server is used to support data interaction. The server side uses module entities to reflect the system database concept. According to the functional business points of the mobile learning system, the users and courses are designed, and the correlations between these entities are analyzed in detail. The system E-R diagram is obtained from the entity relationship model, as shown in Fig. 3.

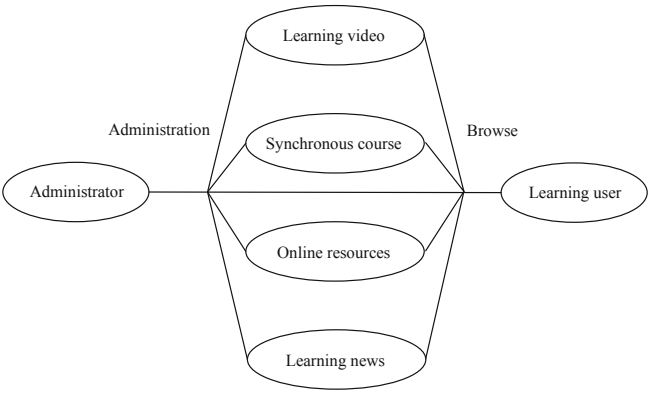

Fig. 3. Database entity relationships

According to the business requirements of the application software system, the edge server needs to send the edge data generated by mobile client to the cloud server through TCP long connection. In order to solve the problem, this paper proposes a method to calculate the network delay threshold, which is suitable for different application environments according to the requirements of different systems. In the cloud server, the edge server database resources should be updated regularly and mobile terminal devices should be monitored. We ran multiple script files in the Worker Man architecture to enable real-time communication between the edge server and the cloud server. The learning video entity is the storage of information such as the address of the video, the ID of the video, etc. Each video played has an associated record in the video table. The video resources of the mobile platform are saved on the video server by dynamically generating the video playback address, and then saved in the video table by linking. Through the analysis, we know that the choice of network threshold will mainly affect the following three factors: the accuracy of recognition, network transmission delay,

mobile computing. Therefore, the optimization goal can be summarized as the following three objectives: to improve the accuracy of system identification, reduce the network transmission delay and reduce the computational complexity. The migration decision engine determines whether a task is executed locally, in the cloud, or on an edge server, and divides the task into modules to be executed on different devices according to the decision. There is a transmission delay in the data transmitted from the mobile end to the edge end, and the recognition accuracy of the transmission task can be described as follows:

$$p = \sum_{m=1} q_m \times \alpha \tag{1}$$

In formula (1), p represents the overall identification accuracy of the software; m represents the number of mobile terminal devices; q_m represents the identification accuracy of the inference task of the checker; and α represents the network latency threshold to be solved. If the system determines that the current network delay is high, the task requires the mobile side to carry out an additional reasoning, which increases the amount of mobile computing. When a terminal application sends a task execution request, the monitor detects the availability of cloud and edge server resources, including computing load, network transmission capacity, response aging, and so on. Each additional computation on the mobile device can be seen as a loss of overall system performance, so we use a loss function to express the effect of increased computational pressure on software performance on the mobile side. The formula is:

$$g(\alpha) = \sum_{m=1} h_m k(\alpha)\beta \tag{2}$$

In formula (2), $g(\alpha)$ represents the increased calculated pressure loss at the mobile end; h_m represents network transmission latency; $k(\alpha)$ represents the time taken by the mobile device to perform a single inference; and β represents the checker score. When the network is congested, it will increase the computational pressure of the mobile terminal, reduce the communication delay between the mobile terminal and the edge terminal, and reduce the overall software response time. On the one hand, the edge server sends packets to the cloud periodically, including user's personal information, user's behavior data, edge server's CPU load, memory usage and so on. Edge servers take on the computing and storage capabilities of part of the cloud servers, helping to complete tasks with high real-time requirements. The decrease in response time is an improvement in the overall performance of the software, so we use the gain function to represent the increase in the performance of the software due to the decrease in response time. The formula is:

$$f(\alpha) = \sum_{m=1} h_m k(\alpha)(\gamma - \alpha) \tag{3}$$

In formula (3), $f(\alpha)$ represents the gain in software performance; γ represents the delay in communication for this task. In the process of migration, it is necessary to consider not only the energy consumption for data uploading from the terminal to the edge, but also the energy consumption for receiving the results.

2.4 Software Client Design

The client of psychologically assisted autonomous learning management software is coded in Java language, and the SDK is selected as the development environment. The client of psycho-assisted autonomous learning management software is mainly composed of system login module, online learning module and support service module, which corresponds to different activities. After the client program starts, the system first runs the welcome interface, then enters the system login module, starts the entire program flow. The system login module is implemented by LoginActivity. User download apk installation successfully enter the user name and password, click on the login, the client java code through the post request to the user name, password, mobile phone IMEI value and other information sent to the back end. The backend uses a set of validation logic to determine whether the current user has access to the mobile learning system, and if so, enters the main interface or prompts the user to contact the administrator for device binding [8]. The user login process is shown in Fig. 4.

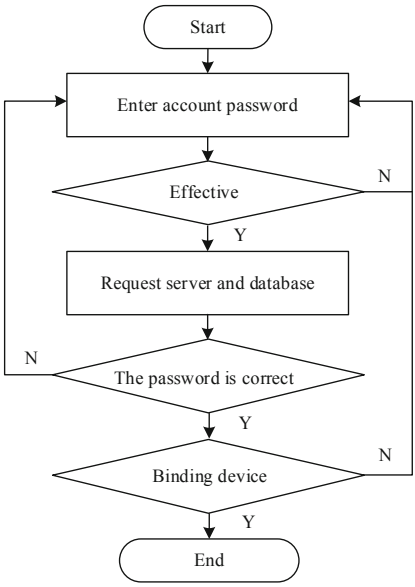

Fig. 4. User login process

After the user login interface is used to input the username and password, the system sends an HTTP request to verify the validity of the learner's identity, and returns the verification result to the customer, if the verification is valid, the user enters the system; otherwise, the system gives an error message. Learners can also register a new account through the system login module. Use the getText ().toString () method to get the account number and password entered by the user. If the current user does not enter any information, clicking Login will prompt for the account number or password via Toast. The account and password entered by the user are then sent to the server via a post

request. The client needs to interact with the server side of the mobile learning system at runtime, such as user login validation, requesting course information data, sending feedback data, etc. [9]. The server will check the database according to the transmitted information. If the account password is wrong, the feedback will be given to the client if the account password is wrong; if the account password is correct, the server will further determine whether the current mobile device is bound. If the device has been bound, the server will be allowed to log in otherwise, please contact the administrator to bind the device. After the server responds to the information, it judges what is returned. If the server returns 2, it indicates that the user name has been registered, prompting the user to "User Name Already Exists"; if the server returns 1, it indicates that the user name has not been registered, then the user can enter the password and nickname in the text box, save the user name, password and nickname entered by the user in the User table in the server database, and return the message "Registration Succeeded". When the registration is successful, the software will automatically close the current page and jump to the software homepage, and display the user's nickname in the homepage. Data requests are sent to the server when the client program is implemented using the Apache Http Client project built into Android. When the server side completes the data operation, it returns the results as JSON data to the client. The course of this topic is mainly through the mobile phone player defined on the end to play video, and through the mobile phone to watch learning.

The online learning module is implemented by LoginActivity. After the learner enters the main interface of the system, all the functions of the system are displayed through the main form page, MainActivity. When the user clicks on the course list, the click event response from the RecycleView jumps to the video playback interface through Intent and passes the url of the video playback to the playback interface through the intent putExtra () method. Online learning module includes course browsing, resource downloading, communication and discussion, and system notification. Learners can choose according to their needs. Courseware learning is mainly composed of mobile learning resources such as text, pictures and audio. Through the presentation of detailed text and pictures, the learners can understand the learning content systematically. Video learning provides users with short videos to help them learn better on the move. In order to help learners to broaden their knowledge field and have a more comprehensive and objective understanding of the new technology or practice research, the latest cutting-edge technology and practice research are provided to the learners through diversified media presentations in extracurricular extension. The playback interface gets the object of the Intent through the method of getIntent (), which then calls the getStringExra () method to get the playback link. Finally, the playback address is set through the myvideo.setVideo Path () method for video playback.

Upload and download module helps users download resources to their own smart terminal through the client, but also can upload their own resources to the server, and other users can share resources through download. Support service modules are implemented through the SupportActivity. The module includes four functions: modifying the name, modifying the password, logging off and logging on, and relevant information, which are displayed by switching between main form pages. When the user jumps to the upload and download interface, they will see the download list in the download area. Click the

download button next to the download list to download the files they want. When a user wants to upload a file, clicking the upload button will bring up a dialog asking the user to select the file to upload. The user can upload the file to the server by clicking the upload button. Based on the above process, the software of autonomous learning management based on mobile terminal device is developed.

3 Experimental Study

3.1 Experimental Preparation

The aim of software testing is to ensure the final quality of software, and the testing of software is carried out with the whole process of software development. The software client side test selects the handset which the user occupies in the market to use many carries on the real machine test. Through the real machine test, the overall functions of the system are evaluated and analyzed. The server system adopts the common hardware equipment as the test platform. The hardware test environment is as follows: CPU: Core i78 Series; Memory capacity: 64 GB; Graphics card: Intel supercore graphics card 630. The test environment for the database server is as follows: operating system: Windows 10; database system: MySQL; database administration tools: Navicat Premium in Chinese. In the process of development, we can use USB connection and APK to run on Android smartphone, which can realize the content of ALM software design. In unit testing, the function of each module must be tested. Only the function of each module is normal can the software run normally in the process of integration testing. Then, the compatibility and performance of mobile application are tested to test the dependence of software on mobile hardware and whether the portability is satisfied. Select 50 Android mobile terminals with high usage rate for performance testing to verify the performance of the designed software.

3.2 Results and Analysis

Through unit test, the user's basic information, including user's username, login password and nickname, can be uploaded to the database on server side. Click the menu button of each learning interface can normally jump to the corresponding interface, click the text button of each interface can display the corresponding text. Click on the video and audio buttons, video and audio can play. In the Mobile Application Compatibility Test, all kinds of mobile terminals have passed the adaptability test, which shows that the psycho-assisted autonomous learning management software has a high adaptability. The CPU usage and memory usage were selected as evaluation items, and the tests were carried out under the conditions of 10 and 50 mobile terminals. The test results of the psychological assisted autonomous learning management software designed this time are compared with the method of reference [3] and the method of reference [4]. The test results are shown in Tables 1, 2, 3, and 4.

Table 1. Number of mobile terminals with 10 CPU usage (%)

Number of tests	The proposed method	The method of reference [3]	The method of reference [4]
1	4.56	13.92	18.47
2	4.62	15.47	22.84
3	4.64	16.84	**19.68**
4	7.57	18.64	15.56
5	**8.88**	17.28	17.22
6	6.26	15.59	19.35
7	5.63	14.32	18.93
8	7.22	**19.64**	16.01
9	8.35	13.28	17.24
10	5.51	16.52	18.52

When the number of mobile terminal devices is 10, the CPU utilization of the proposed method is 6.32%, which is 9.83% and 12.06% lower than that of the comparative method.

Table 2. Number of mobile terminals with 50 CPU usage (%)

Number of tests	The proposed method	The method of reference [3]	The method of reference [4]
1	8.47	23.40	19.49
2	9.88	24.87	18.07
3	10.04	**25.58**	17.25
4	8.67	22.29	20.66
5	11.21	21.66	**28.33**
6	12.35	20.39	21.52
7	**13.52**	22.21	19.05
8	9.96	21.54	22.84
9	8.23	23.13	20.22
10	10.12	20.50	16.43

When the number of mobile terminal devices is 50, the CPU utilization of the proposed method is 10.25%, which is 12.31% and 10.14% lower than that of the comparative method.

Table 3. Number of mobile terminals 10 Memory usage (MB)

Number of tests	The proposed method	The method of reference [3]	The method of reference [4]
1	69.41	109.67	115.24
2	71.28	110.48	106.48
3	60.07	108.84	118.75
4	65.64	102.51	104.86
5	71.35	103.20	109.23
6	72.52	105.32	112.02
7	**73.16**	112.66	118.65
8	64.83	103.93	114.51
9	65.29	115.59	**121.94**
10	68.92	**116.25**	103.27

When the number of mobile terminal devices is 10, the memory occupation of the proposed method is 68.25 MB, which is 40.60 MB and 44.25 MB lower than that of the comparative method.

Table 4. Number of mobile terminals 50 Memory usage (MB)

Number of tests	The proposed method	The method of reference [3]	The method of reference [4]
1	79.42	154.48	182.09
2	78.85	**162.89**	175.64
3	72.58	150.56	172.31
4	82.66	153.63	146.34
5	79.33	151.30	163.27
6	78.55	149.24	169.85
7	64.22	148.57	175.66
8	**88.14**	146.11	**182.63**
9	81.45	145.72	163.45
10	80.73	142.58	167.72

When the number of mobile terminal devices is 50, the memory occupation of the proposed method is 78.59 MB, which is 71.92 MB and 91.31 MB lower than that of the comparative method. Because the method in this paper combines mobile terminal equipment and wireless network communication technology, it can reduce the CPU occupation and memory occupation of autonomous learning management software, and

effectively improve the performance of management software. Therefore, the psychologically aided autonomous learning management software based on mobile terminal device has passed the performance test, which meets the basic requirements of online.

4 Conclusion

With the rapid development of Internet and mobile devices, smart mobile devices have become more and more popular. Smart mobile devices have become an irreplaceable part of people's life. In this paper, the management software of psychologically assisted autonomous learning is developed based on mobile terminal devices. After analyzing the requirements of the psychological assisted self-learning management software, the overall development architecture is established through the web server, streaming media server and database server. According to the decision-making results, the tasks are divided, and the development and research of the management software for psychological assisted autonomous learning are completed. Through the real machine test, the software has good compatibility and performance test results, to meet the development needs. In the design of mobile learning project, how to combine mobile devices and learning situation effectively, strengthen the impact of mobile technology on the social relations of learners, and better enable learners to enjoy the advantages of mobile technology in supporting situational cognition, social learning and informal learning.

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