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Implementation of Real-Time Video Recording and On-Line Learning System in Education Field

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Abstract: In this study, we have implemented a real-time video recording and on-line learning system in education filed. The system can record professor video and computer screen images in the class lectures then automatically upload to the back-end multimedia server. And, this system can be applied to after-school tutoring such as college or dental school, etc. Students can choose the courses in order to facilitate learning. In this system, it consists of three components: capture agent, core server and courseware. Capture agent based on Aforge.Net framework which has two major features: video recording and automatic uploading. In class, the professor can activate capture agent by specifying audio-visual contents and then upload the recorded materials to core server. Core server will convert the materials to the appropriate format and publish online then. And, courseware is based on OpenCart structure which adopts the design framework of MVCL (Model View Controller Language). The framework can separate the representation of information from the users' interaction with it. The server is core server of matterhorn which receiving video, video compile and video release.

Key words: Matterhorn, OpenCart, Aforge.Net Framework, MVCL, recording

INTRODUCTION

In recent years, the booming internet and electronic products, led to the speed of the internet for increasingly demanding. Under the network bandwidth increase, more and more films platform emerging such as YouTube (2015), Vimeo (2015), Youku (2015) and other famous film platform which are beginning to offer video uploading and viewing services. Traditional teaching is always limited by time and distance because students are often in remote mountainous areas and cannot get a good learning resources and quality teaching; people in the big cities, the daily live are very busy and it is difficult fixed time out to learn.

For the reasons mentioned above, this study will propose a set of simple and convenient instant recording instructional videos and can watch instructional videos online system. So this study integrates a real-time video lessons teaching and auxiliary system architecture and implementation. And, the system development is based on Matterhorn (Ketterl *et al*., 2009).

MATERIALS AND METHODS

Relative researches

Matterhorn: Matterhorn can provide services as have recording, scheduling, file management, movie encoding, transmitting video and audio content, etc. Users can upload videos and audio files throuth interface, Matterhorn will convert and publish these files. Futheremore, the other mechanisms such that the transfer download uses a progressive media server streaming (Progressive streaming) (Streaming, 2015) while transmission is a real time streaming (RTSP, 2015) as can instantly view real-time streaming media and server the need for live broadcast randomly tap Play purposes. By SolrWiki (2015) which provides local search index and provides Really Simple Syndication (RSS) and Atom (2015) then you can put the films to the learning management system.

.Net framework: .Net framework (Deng, 2009; Lammel *et al*., 2011) is provided by Microsoft programming model architecture. Aforge.Net framework (2015) is an extension of the model out from .Net framework. Next, the class libraries and image processing system use a detailed description of the main functions those are DirectShow and Ffmpeg (DirectShow, 2015).

OpenCart: OpenCart (2015) is a famous open-source E-commerce sites which are very popular forum, translated by national users which has reached 18 kinds of language packs including Chinese, Russian, French, Spanish, German, Japanese, etc.

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Related technology: This system is a series of three programs. In order to enable them to communicate with each other, thus achieving a series of data transfer functions. Hypertext Transfer Protocol (referred to as HTTP) (Dai, 2001) is a widely used protocol in the internet. REST (2015) (Representational State Transfer) is a web service architecture, usually using HTTP, URI (2015), XML and HTML protocols and standards. The format of the return resources are HTML (2015), XML (2015), JSON (2015) and so on (Lin, 2008).

RESULTS AND DISCUSSION

System introduction

System architecture: The system is divided into capture agent, core server and courseware three parts. Capture agent can be divided into two main functions, record videos and automatically upload videos. The system architecture shown in Fig. 1.

Capture agent: The recording can be divided into two types: schedule recording and manual recording. Capture agent functions can be divided into four blocks: web, schedule, upload, video and device interface shown in Fig. 2.

Core server: Core server receives, the capture agent uploaded files and tranfers releasin (Ketterl *et al*., 2009). Core server is divided into two parts and the first part the reception, then the other part video publishing features shown in Fig. 3.

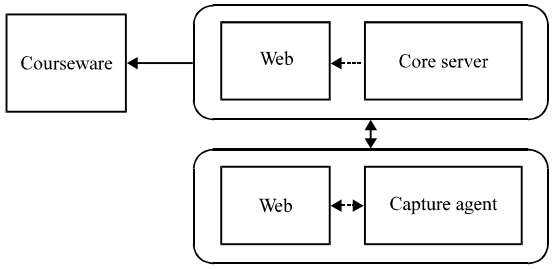

Fig. 1: Tutoring system architecture

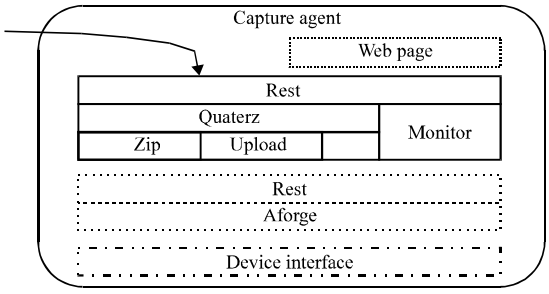

Fig. 2: Capture agent block diagram

Courseware: Courseware can be divided into foreground and background, the background of the main functions of teaching courses build and videos manage. Courseware system architecture can be divided into (System), reception (Catalog) and background (Admin) three blocks, shown in Fig. 4.

Courseware features

Automatic uploading: The finished recording instructional videos which it automaticly matches to the corresponding courses, replaces manually update problems.

Course category: By adopted department, class and teachers which make curriculum classification. So that students can take advantage of the department, class to orderly find the course. That they want to study (Fig. 5) or by course teacher to find the teacher all courses throught class (Fig. 6).

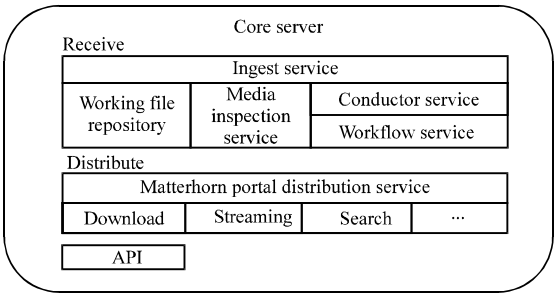

Fig. 3: Core Server block diagram

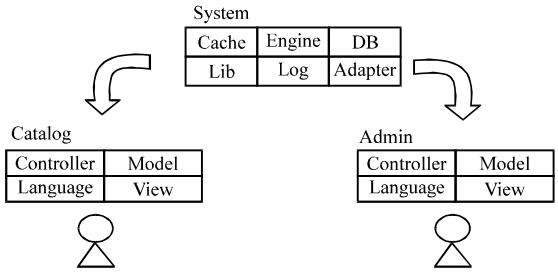

Fig. 4: Courseware architecture

Fig. 5: Course category by class

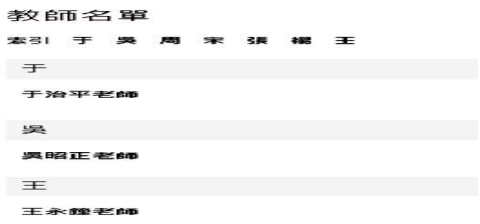

Fig. 6: Course category by teacher

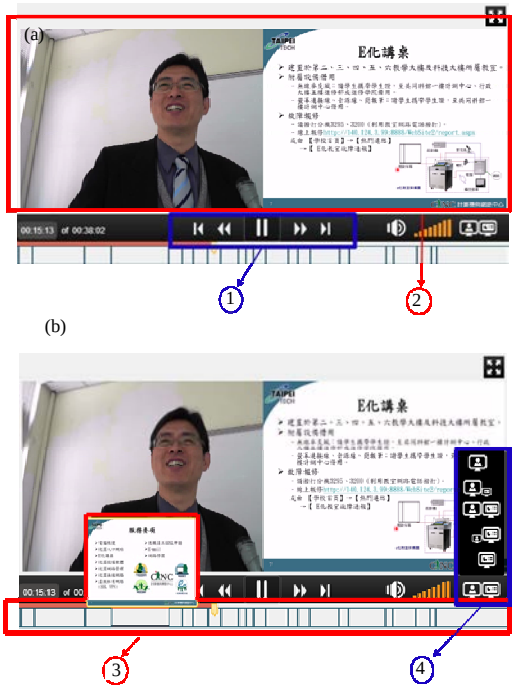

Fig. 7: Player function

Player:

- Basic media action: do play, pause, fast forward, chapter skip and other media operations, shown in Fig. 7
- Multi-streaming video: streaming video simultaneously plays two videos, shown in Fig. 3-7.
- Search navigation functions: made in accordance with the slide changes for navigation shown in Fig. 7a
- Dynamically adjusting streaming video screen: choosing the size of two separate streams screen or the screen displays the specified stream shown in Fig. 7b

System design and implementation

System environment requirements: Capture agent can be executed on a Windows environment which it simply needs to install JAVA and Microsoft .Net framework. Core server is using Matterhorn system and the system uses Ubuntu 10.04 Operating System (OS).

System operation process: This section describes the operation of the entire system processes and user actions which will cooperate with the process described in Fig. 8 and show the system operating according to different user roles action.

Action process:

- When capture agent starts going on to core server ask whether the recording schedule proceeding; if it has recording schedule then downloading video schedule going on
- When capture agent completes the recording and then which uploads files to core server
- After core server receiving files and which performs video transferring files. And then, after the conversion, it will put video files to a steaming server
- Courseware requests core server for video list to determine whether there is a video. If there is a new video, then it will put the video to courseware archives
- When users watch videos through ourseware, steaming server provides a video source in addition to playing a video through courseware player

Role operating action:

- Supervisor: The background system administrator of Courseware that is responsible for building and student management courses and by background management interface which changes the front desk layout settings
- Planner: Core server which planes the capture agent recording time. In other wise, through the web it can watch the uploaded core server conversion status and whether capture agent is online
- Professor: You can directly control capture agent to start recording or with planners to set time for recording
- Student: Taking course in courseware after taking the course you can watch core server video through courseware
- System detail design

Although, Matterhorn has capture agent and the basic video list page but Matterhorn is developed on a Linux system. Next, we will make a detailed description of the link between capture agent, courseware and core server. Capture agent, courseware and core server's internal structure and relationships shown in Fig. 9:

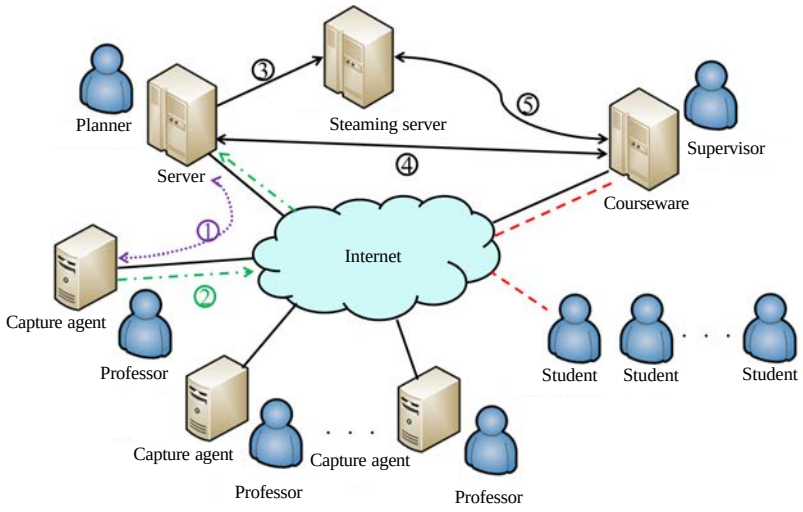

Fig. 8: System action and user diagram

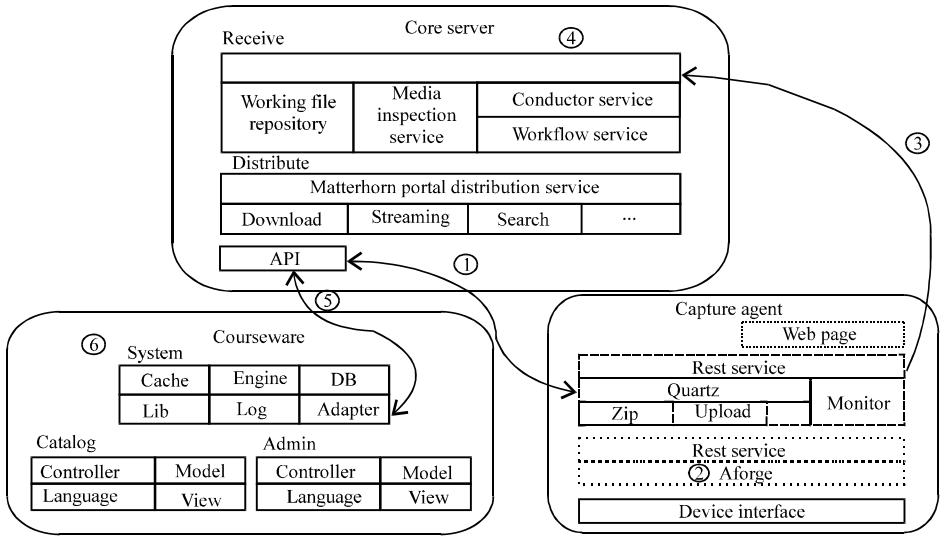

Fig. 9: System internal structure and relationship diagram

- Through REST way and core server's API, capture agent asked if, there was a recording schedule trip, if there is a new recording schedule, then it will schedule the downloading steps
- Capture agent will perform the recordingaction and it will make the image to video files
- Capture agent will let the finished video file upload to the core server Ingest service via REST approach
- Core server received video files and which makes new media and transfers into new media publishing
- Courseware Adapter is available through the Core Server API video list to determine the new-add video files and the video files will be updated and automatically archived to Courseware courses
- Courseware backstage is responsible for curriculum and student administration management and the front stage is a student electives, online videos watching

Capture agent: This section describes capture agent recording process according to inside step action process, the whole complete operation flow shown in Fig. 10:

- When the program starts, the console takes the initiative in action and capture agent initializes devices (example: camera, microphone) and makes sure the device working properly

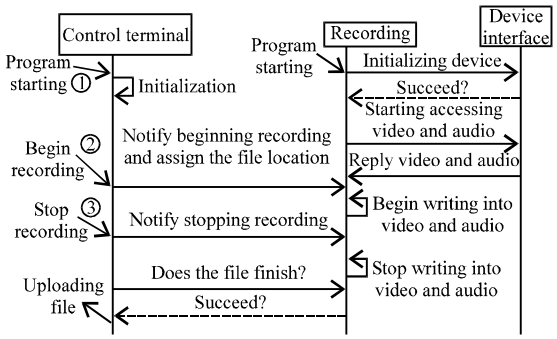

Fig. 10: Capture agent action diagram

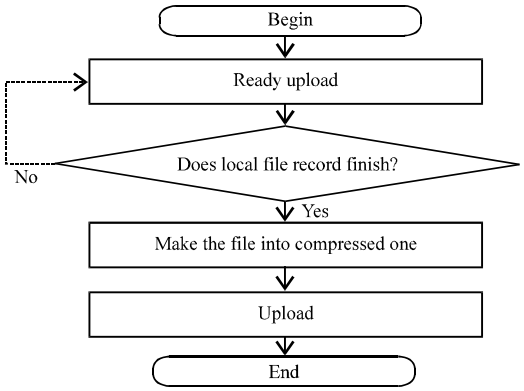

Fig. 11: Capture agent upload flowchart

- The control terminal which notifies capture agent to start recording and specify the file storage location, capture agent will write the captured image and audio into files
- The control terminal notifies capture agent stop recording, capture agent stops writing files and complete the file writing

After a period of time which the control and depends on the specified position to detect whether the file is complete, after the completion which compresses the files and uploads to core server.

Link between capture agent and core server:

- Recording schedule: Capture Agent starts or timing uses REST Method to ask core server whether booked recording schedule
- Upload: When the video is end, capture agent detects whether the file recording is finished according to the specified location shown in Fig. 11.

The link between courseware and core server: Courseware timely requests the current the completed recording list to Core Server and to determine whether

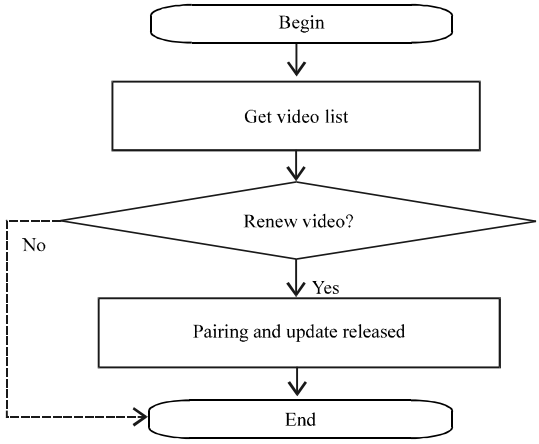

Fig. 12: Courseware adapter flowchart

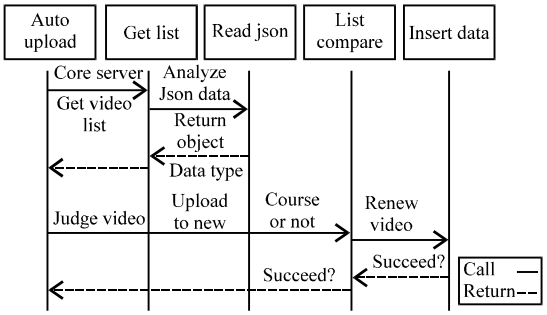

Fig. 13: Courseware adapter work diagram

there is a new film recording is completed shown in Fig. 12. The detailed operation procedure shown in Fig. 13 when triggering autouplaod, it will call get list using REST way request video list to Core Server. Then core server returns the JSON formatted data. Read jison makes data parse into object data types, then returns autouplaod and then handes data to list compare and compares with existed video list and paires with the curriculum.

Courseware database design: Courseware is mainly used to manage courses and related videos and record students selected courses. Courseware database design has four main tables:

- The student table is used to store the student's account, password and basic information
- The order_course table is used to store student subscription program information such as subscriptions to students and course code course
- The course information table is used to store programs such as instructor, course name, course descriptions

Field \ Data	1
Id	5
Firstname	Tsai
Lastname	Meng_fen
Email	100@ntut.edu.tw
Password	123456

Student: Data table

Field \ Data	1	2
Id	10	12
User_id	5	5
Course_id	88	92

Order_course: Data table

Field \ Data	1	2	3
Id	67	68	71
Name	Linear algebra	Elliptic curve	Linear circuit
Record_id	85863	57543	47245
Course_id	88	88	92

Media: Data table

Field \ Data	1	2
Id	88	92
Name	Engineering mathematics	Electronics
Code	311999	123456
Teacher	Ceng, Chuang_shuo	Gu, Bi_xue

Course: Data table

Fig. 14: Data table instance relationship

Fig. 15: Capture agent recording setting

Fig. 16: Capture agent operational interface

- The media table is used to store video information programs such as the video name and belonging courses

Table examples explaination: The following examples Fig. 14 will illustrate practical, interrelated and contents of the four tables. Student Tsai Meng_Fen subscribes to two courses, course name is Prof. Ceng Chuang_shuo's Engineering mathematics and Prof. Gu Bi_xue's Electronics. The Engineering nathematics have two videos the Linear algebra and Elliptic curve while the Electronics has the Linear circuit video. Which the table relationships shown in Fig. 14.

From student Table, we know that Tsai Meng_Fen's id = 5, related to order_course table and we can find two subscription courses, course_id = 88, 92. Then by the order_course table's course_id which will relates to the course table id. And, we know that the two courses belongs to Prof. Ceng's Engineering mathematics and one course belongs to Gu's Electronics, respectively. Through, course tablel id which will associate to a media table course_id while the course_id = 88 which has the Linear algebra and Elliptic curve the two videos while the course_id = 92 has a Linear circuit video.

System practical testing: This study implements a real-time video teaching tutoring systems which has system integration capture agent, core server, courseware three parts.

Capture agent operating procedures: Capture agent must first set the device while recording, according to the needs of the video screen to choose the number of the sound source and setting parameters shown in Fig. 15. After confirming the equipment properly then we start recording, operator interface shown in Fig. 16. In addition to operating capture agent recording video, we also record web videos via Instant Remote Capture Agent Method, web interface shown in Fig. 17.

Fig. 17: Real-time remote end recording control interface

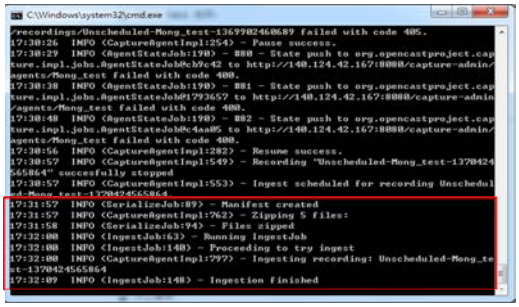

Fig. 18: Capture agent uploading caption

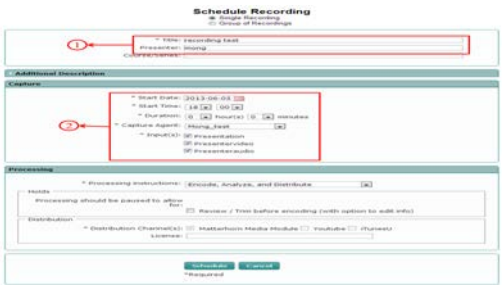

Fig. 19: Core Server recording schedule setting

- Through web-based control buttons to control capture agent video recording
- Thus, view capture agent that the finished recording videos
- Through, capture agent page monitors whether the equipment is working properly

After the end of the file uploading, it will return a successful signal whether the upload is successful. We can see this part of the action message from Fig. 18.

Core server management interface: Core server management interface is used to manage the uploading of the film and scheduled recording. From the core server management interface, you can know the scheduled recording time and curriculum. The following schedule settings page shown in Fig. 19, the label one part that

Fig. 20: Students log-in interface

Fig. 21: Student election courses interface

needs to enter the title and teacher's name. The label two part which you need to enter the start recording time and time length. The most important thing is to set capture agent and this section can selected as capture agent, only once in the this core server the registered capture agent will be displayed in the list. Finally, you need to select the part of the input source, choose whether you want two screens input and audio input. After above procedures completed and then it will complete the scheduled recording option settings.

Courseware operating procedures: Courseware is to provide students choosing courses what they want to learn and watch the course video from the online platform, so this section which will introduce students to the full operational processes. While students entering Courseware they must first login ID and password, as shown in Fig. 20. After the login is completed, you can choose courses according to your own preferences, clicking the label 1 as shown in Fig. 21, you can put it into this curriculum list. From the label 2, we know the course which has been added to a list of several courses.

After selecting course, to confirm the curriculum in the courses list, from the course name and course number in the courses list which we can check whether the nuclear program what they want to take. If taking the wrong course by the side red X label which is used to delete the courses list, shown in Fig. 22. After selecting the program, students can watch a list of selected courses list from the "Members Area" in "My course list" as

Fig. 22: Elective course list

Fig. 23: My curriculum list

Fig. 24: The Video page

shown in Fig. 23. Selecting a course in "My course list", you can choose a list of classroom courses in Fig. 24 and start watching the video.

CONCLUSION

In this study, we integrate a set of tutoring video to help educational institutions and we can view the tutoring video system in the video platform. This system is based on open-source software-Matterhorn and develop the software system to improve video recording problems on Matterhorn, so that it can operate on Windows OS. Also, through the open-source software OpenCart which is rewritten to fit the needs of our vidoe platform courseware.

Forwardly, we implement a real-time video teaching tutoring system after the actual testing process which has correct functions. Although, there is a need for reinforcement of the function, it is able to complete a process of immediate practical teaching videotaped tutoring systems. Moreover in this study, the integration of real-time video teaching and tutoring systems and many teach-oriented objects may continue to study, improve and develop in the future.

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