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Streaming Media Implementation in Moodle-based E-learning Application

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Abstract—Teaching and learning processes develop over time, and the technology behind it are growing too fast, which makes the process of learning with online media (or often referred to as e-learning). This phenomenon is interesting to examine because some e-learning systems that exist today are not yet fully secure, in the sense that it is still easy to disseminate without any copyright and they are not used wisely. The purpose of this research is to produce an application that can be used as a media for e-learning of streaming audio and video without storing the file on local cache device so that the file residing in e-learning media cannot disseminated. As a research methodology using deductive qualitative method, data collective process done by literature study, interview and observation. After the data collected, the result is e-learning software based on website and mobile that can be used to stream media files without downloaded. The result of this research and analysis shows that streaming with RTSP protocol can be used in e-learning software with a limited number of users.

Keywords—Darwin Streaming Server, e-learning, Moodle

I. INTRODUCTION

The evolution of information technology today has an impact on many things, such as the learning process. The use of information technology during the learning process is often encountered and easily accessible today. One of the impacts of evolution on learning process is e-learning method. Learning process using e-learning media enables the teachers and students to do the learning process anywhere and anytime.

E-learning involves searching for methods to reduce the problems caused by the distance between the teachers and the students [1].

Performing the learning process with the help of e-learning media means that teachers and learners are not required to meet each other, so the learning process can still go on. By that means, learning materials are sent by the teacher to learners via electronic media, such as computers and smartphones. The materials can be in form of a slide presentation, audio or video files, or a combination of those three examples.

In order for learning materials to be accessible to the users, they need to be stored. Examples of such storage are Google Drive and Dropbox, which are public storage places. The disadvantage of using public storage is that the user needs to

pay for a storage subscription. Moreover, the data or files stored on online storages are mixed with others, meaning that kind of public storage security is classified as a weak level.

Other than that, it is necessary to pay attention to the method of accessing the learning materials. There are several ways to access a file from online storage, such as downloading and streaming methods. The difference between those two is how the file is transferred to users' devices. The download method requires the user to download the whole file first, then save it to their device, in order to see or play the file; in contrast, the streaming method allows user directly see or play the file while the file is still downloading. This can happen because while streaming a file, users will get some chunks (part) of the file that can be played directly from user's device.

The streaming method can also be applied when accessing any file, so the file is not stored on the user's device. This is important so that that the user cannot disseminate the file illegally.

With the use of private storage and streaming method to access files, files can have a higher protection level.

II. LITERATURE REVIEW

A. E-Learning

E-learning can be defined as a learning activity based on computer or electronic media and tends to be educational [2]. These electronic media can be computers, smartphones, and tablets owned by users and have access to e-learning media. Contents on e-learning media are usually based on multimedia files, such as slide presentation, audio files, audiovisual files or combination of the three. Learning materials that use such media are called multimedia learning [3].

B. Moodle

Moodle is one of the e-learning portals developed using the Learning Management Systems (LMS). LMS means, using the Moodle platform, that e-learning portals can be modified according to the school or agency's preferences or required features. In addition, Moodle is also an open-source application, so developers can develop the Moodle platform in accordance with their needs [3].

According to Sukari [4], LMS characteristic can be developed into the following features:

1. **Sharing Material.** Provides a platform for teachers to provide learning content to learners.
- Forum and chat. Provide interactive communication services such as chat or non-interactive forums.
- Exercises. Provides features that enable learners to know their level of understanding of what have been learned.
- Recording grades. Provides feature to be able to record, manage and track students' scores according to the learner's needs.
- Recording logs. Provides features that allow recording of students or faculty's activities.

The advantages of using Moodle are as follows [5]:

- Lessons can be acquired by the students in Moodle.
- Students can do their learning activity wherever and whenever they want.
- Moodle features are beneficial for teachers to manage their lessons provided by them for their students.

C. Streaming Technology

Streaming is a technology used to send data content in a computer to another computer through a local network or the internet. The data transmitted can be anything, but usually audio or video [6]. The difference between download and streaming technology lies in how to access the files. For the download method, files are required to be downloaded completely onto the user's device before the user can access it. Meanwhile with the streaming method, a snippet of the file that has been downloaded can be directly accessed by the user.

According to Narang [7], there are three streaming methods:

Progressive Download. The progressive download method is the simplest and most common method of delivering audio or video content. This method works by sending contents from an audio or video file via the HTTP protocol from the server to user's device. On the user's device, it will download some part of the content. Then the downloaded section will play on the user's device. That way, users do not have to wait too long to download the entire file on their device.

Real-time Streaming. This content delivery method typically uses the RTMP or RTP protocol as the transport file. As the name implies, this method will send a snippet of the audio or video content to the user in real-time. This means that users can only see snippets of content sent by the server.

Adaptive Streaming. The adaptive streaming method is the most common method nowadays. This is because this method has the ability to adapt to the condition and speed of the user's internet – so that the audio or video files will continue to be received by the user in accordance with the conditions and speed of the user. If the speed of the user slows down, then the delivered pieces will be downgraded. On the other hand, if the speed of the internet is back to normal, then the quality of pieces that are delivered will be adjusted as good as the user's internet conditions.

4 D. Real-Time Transport Protocol (RTP)

Real-time Transport Protocol (RTP) is a standard protocol that is used as a hub for data transmission, such as audio and video, in real-time. The meaning of the real-time word is RTP allows users to get chunks of audio or video data content directly when audio or video is played. The advantage is that chunks which are transferred to the client are not stored on the local cache client device, because these chunks will be directly erased after the client receives and sees the chunks [8-10].

4 E. Real-Time Streaming Protocol (RTSP)

Real-time Streaming Protocol (RTSP) is a protocol that resides on an application layer that is useful for controlling the delivery of data that is done in real-time. The RTSP protocol allows clients to request servers on the play, stop, pause and seek [8-10].

F. Darwin Streaming Server

Darwin Streaming Server is a software used to serve as streaming server with RTP and RTSP protocol. It was developed by Apple and is open source [11].

Before the video file can be played through Darwin Streaming Server the file needs to be added hint track to the file. Hint track is useful for the media player to recognize streaming files and can be played on the media player. The Darwin Streaming Server software also provides features for authentication and authorization of video files to be played. That way, only users who have rights can view the video file.

III. SYSTEM DESIGN AND IMPLEMENTATION

In system design, there are 2 servers, namely web server and streaming server. Both servers have a data storage application on NAS storage. Clients can access web servers on the local network with various devices, such as computers, laptops and smart phones. System design can be seen in Figure 1.

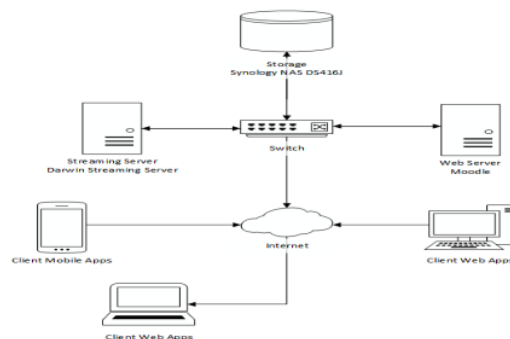


Fig. 1. System Architectural

The limitation of this system is to only focus on the protection of audio and video files that can be seen by the user. Thus, users can only see and listen to audio and video files but cannot download. On the web server, Moodle will be installed to be able to provide e-learning services. Meanwhile, on the

streaming server computer, Darwin Streaming Server application will be installed to provide a streaming service.

A. Use Case Diagram

There are three actors in the system to be created, such as administrator, teachers and students.

1) Use Case Diagram Administrator

In Figure 2, it can be seen that the administrator can manage users, the subject of learning and user registration. Previously administrators need to login first before they can manage the system.

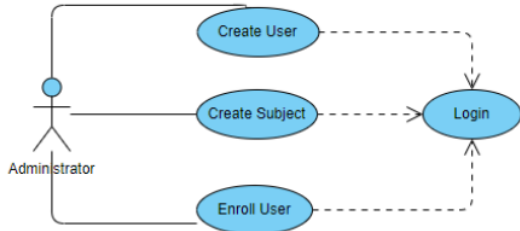


Fig. 2. Use case diagram of Administrator

2) Use Case Diagram Teacher

In Figure 3, it can be seen that the teacher can add the materials in the subjects other than just looking at the content of the subject. In addition, learning materials that are protected can be added and viewed by the teacher after login on the system has been created.

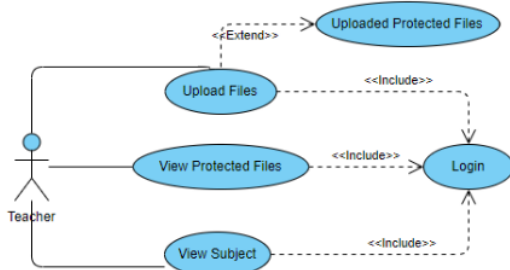


Fig. 3. Use case diagram of teacher

3) Use Case Diagram Students

In Figure 4, students can only see subjects and materials files when they have logged in.

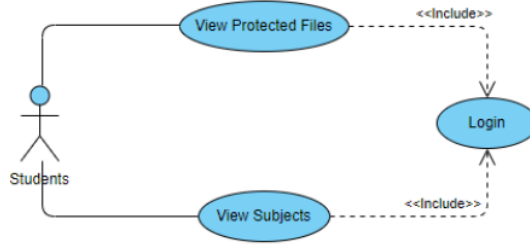


Fig. 4. Use case diagram of Students

B. Streaming Mechanism

The flowchart for the protected Media Streaming Application can be seen in Figure 5.

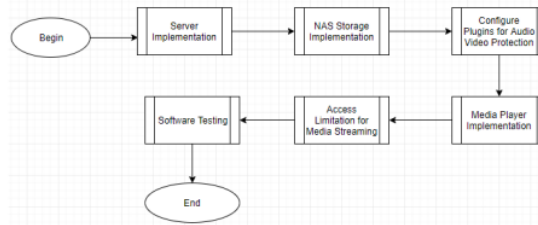


Fig. 5. Flowchart of Application Project

After teacher uploading files, the conversion process will be carried out for audio and video, then it will be stored on the storage media. Files that have been uploaded are then adjusted to the desired quality. In this application, there are 3 media qualities namely: Low, Medium and High. During the conversion process, the protocol adjustment process is also carried out so that the file can be run with the RTSP protocol.

The video file quality specifications that become the references for converting the uploaded video file can be seen in Table 1.

TABLE I. VIDEO QUALITY TYPE

Video Quality	Video Size	Video bit rate (Kbps)	Audio bit rate (Kbps)	Total bit rate (Kbps)
CIF (low)	384x216	268 - 468	32	300 - 500
D1 (medium)	852x480	736 - 1136	32	800 - 1200
HD (high)	1280x720	1672 - 2272	64	1800 - 2400

Three kinds of audio file quality can be seen in Table 2.

TABLE II. AUDIO QUALITY TYPE

Audio Quality	Audio bit rate	Audio Codec	File Format
Low	32 kbps	MP3	.mp3
Medium	64 kbps	MP3	.mp3
High	128 kbps	MP3	.mp3

IV. RESULT AND TESTING

System testing is done by added functions of the Moodle app and testing the streaming of files on the streaming server. The test results are as follows.

A. View Testing on Moodle Application based on Mobile

This test is done by experimenting on every new page created in the Moodle Mobile app. Devices used in testing were Xiaomi Redmi Note 3 and iPhone 5s smartphones.

B. Main Page

All the courses that are being followed will be displayed on the main page. If the user is a teacher on the course, a button will be displayed to add Protected Audio Video resources to the course. If the user is a student on the course, then the Protected Audio Video resource is displayed only on the course. The comparison of the main display page of Protected Audio Video can be seen in Figure 6.

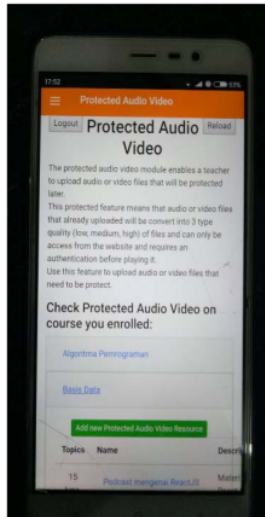


Fig. 6. Main page of Protected Audio Video

C. New Added Page

Add form, which is used for adding resource Protected Audio Video, is displayed on the new added page. Users with the student status can choose which section will be given resource in Protected Audio Video. Comparison of display page add

new resource Protected Audio Video can be seen in Figure 7.

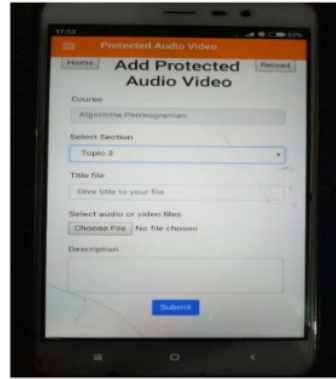


Fig. 7. Adding Page for Audio and Video Files

On this page, users who have a teacher status on the course can change the description of the Protected Audio Video resource that has been added. Comparison of page views change resource Protected Audio Video can be seen in Figure 8.

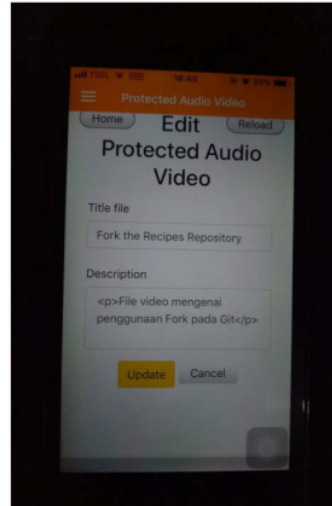


Fig. 8. Edit Page for Files

D. Streaming Testing

This test is done by playing video and audio files to know how much bandwidth is needed when accessed by more than one user.

Packet loss experienced is quite large when the user who passed through the connection reached 100 can be seen in Table 3.

TABLE III. MEASUREMENT OF HIGH QUALITY VIDEO

Number of Users	CPU Process (Server)	Throughput (Kbps) (Server)	Sum of Packets	Bit Rate (Kbps)	Packet Loss
1	6%	2019	18878	1678.661	0 %
10	8%	14531	18411	1633.332	1.39%
20	21%	55239	17302	1525.885	5.03%
50	13%	60977	15067	1319.283	14.02%
100	21%	80890	10043	857.189	40.4%

Packet loss only shows the number below 2%, even though the connected user reaches 500 can be seen in Table 4. It can be concluded that when a file with small bitrate is streamed, the server can provide service to the user without any obstacles.

TABLE IV. MEASUREMENT OF HIGH QUALITY AUDIO

Number of Users	CPU Process (Server)	Throughput (Kbps) (Server)	Sum of Packets	Bit Rate (Kbps)	Packet Loss
1	2%	128	7656	128	0 %
100	10%	13008	7656	128	0 %
200	9%	26048	7656	128	0 %
300	14%	39006	7592	127	0.8%
400	15%	52097	7544	126	1.4%
500	12%	64914	7517	126	1.8%

V. CONCLUSION

In Accessing Protected Audio Video on Moodle, it requires a stable connection and enough bandwidth to be able to play files without any obstacles. The local Ethernet network connection is a solution to play files with the RTSP protocol. Darwin Streaming Server application optimizing service can be done by changing the configuration of the maximum throughput and maximum connections in the Darwin Streaming Server configuration file.

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