DEVELOPMENT OF RELAY LIVE STREAMING SERVER IN SMK NEGERI RAJAPOLAH USING RASPBERRY PI

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ABSTRACT

SMK Negeri Rajapolah has a live streaming system that is managed by the live streaming committee where the system uses live streaming on YouTube social media. The current system has shortcomings such as not being able to send live streaming shows to various social media (Youtube and Facebook) in a single broadcast as desired by SMK Negeri Rajapolah because it has not been integrated with a streaming streaming relay because it is feared that the committee has difficulty in managing and controlling the relay server. The solution to this problem was proposed to the SMK Negeri Rajapolah with the aim of building a relay streaming server with RTMP so that the live streaming coverage committee of SMK Negeri Rajapolah could send live streaming shows to various social media (Youtube and Facebook) and integrate the relay streaming server with the existing system. This research also aims to build a local website to facilitate the live streaming reporting committee in controlling and operating the relay streaming server. In its implementation, the live streaming server relay using raspberry pi runs well as evidenced by the results of testing the functionality of the system running 100% as expected. From the results of testing the Quality of service, system can run on a minimum bandwidth of 128Kbps with a delay value of 52ms, jitter 271.57ms, and 0% packet loss. In the process of testing the goals, the objectives of this study were achieved as evidenced by getting a score of 112 in testing objective 1, score 101 in testing objective 2 and score 103 in testing objective 3.

Keywords: Broadcast, Relay Live Streaming Server, Social Media, RTMP, Quality Of Service, Raspberry Pi

1. INTRODUCTION

SMK Negeri Rajapolah is one of sekolah menengah kejuruan negeri that located at Jl. Ciinjuk No. 1 Rajapolah Kabupaten Tasikmalaya. SMK Negeri Rajapolah was established on the initiative of the North Tasikmalaya community, which began in the 2007/2008 school year through a decree from the Head of the District Education Office of Tasikmalaya No. 895.1 / 1125 / Disdik / 2008. Every year in SMK Negeri Rajapolah has a lot of activities that can be documented such as student art performance activities, student sports week activities, seminar activities for students, as well as class 3 student release activities. by the live streaming committee where the system uses live streaming on YouTube social media. The current system consists of an encoder (broadcaster) that directly sends live streaming video data to YouTube social media with video input from 1 camera. SMK Negeri Rajapolah desires to cover every activity in the form of live streaming video where in this process this live streaming video can be sent not only on Youtube social media but on Facebook social media where this process can be done in one broadcast.

Live streaming on social media Youtube and Facebook use the RTMP protocol service as the protocol where video delivery must go through RTMP Broadcaster but in its implementation RTMP Broadcaster can send video broadcast only to 1 server service only and cannot send to multiple server services simultaneously except through services relay server where SMK Negeri Rajapolah does not yet have this relay server service.

In previous studies carried out the application of streaming server technology in virtual development with the results of virtual classes with effective performance and in this study suggest using a streaming server relay service so that audio and video can be shared again [1]. Research on performance analysis of Raspberry Pi-based RTMP live streaming server has also been done before with the results of the RTMP Protocol has a smaller throughput value compared to RTSP and RTMP delay value is smaller than RTSP so RTMP is faster in sending video [2]. In this study also stated that the Raspberry Pi is a mini computer that has the quality and features like a computer in general that is fit for use for server needs, especially Apache, Lighttpd and Nginx [2]. Raspberry Pi has a linux-based operating system, there are several operating system variants that can be used Raspberry Pi including Bodhi, GeeXbox, Pidora, Raspbian, RISC OS Open, RaspyFi, Raspbmc [3].

Of the problems that exist as a solution in this study it is proposed to build a live streaming server relay service using raspberry pi. This service will be used by the live streaming committee at SMK Negeri Rajapolah as a relay server to send live streaming video to social media services YouTube and Facebook simultaneously.

2. RESEARCH CONTENTS

2.1. *Video Streaming*

Video streaming is a media that has the function of receiving images and sound in which streaming itself is a process of sending data in a continuous and permanent stream, meaning that it allows the user to access and use the file sent by the server before the whole file is fully received. The word streaming in the dictionary means flow or streaming but nowadays streaming is better known as a technology that allows sending data over the internet and also a technology that can compress audio and video files so that it makes it easier to send them over the internet network. In sending data or files, it converts it into a time-stamped packet called a stream package [4].

2.2. RTMP

RTMP is short for Real-Time Messaging Protocol which is a protocol designed by Adobe Flash Platform for transmitting audio and video data. RTMP protocol technology is available and supports sending audio and video files with AMF, SWF, FLV, and F4V file formats supported by Adobe Flash Player. RTMP was originally a protocol that was only specialized and developed by Macromedia to stream audio and video files over the internet network between the server as a server and the flash server as a user [5]. At present the RTMP protocol has been released freely and completely as a protocol that can be used in general.

2.3. Nginx

Nginx is a server software that was opened free of charge and made by Igor Sysoev and was made for the public as well as public users in October 2004. Initially Igor Sysoev designed this Nginx application to overcome the c10k problem which at the time was a problem that was related to the problem with the performance of handling 10,000 connections simultaneously. Nginx was built by offering advantages in the form of very low memory usage with high concurrency [6]. Apart from offering advantages in the form of very low memory usage with high concurrency, Nginx is a software that can be modified according to the wishes of its users for example other than as an HTTP server, Nginx can also operate as an IMAP / POP3 proxy server, as a load balancer, as a HTTP cache, much more is also included as a streaming server using RTMP in addition to the Nginx-RTMP-Module [7].

2.4. Raspberry Pi

The development of technology is now highly developed, including the technology of making mini computers where one - only Raspberry Pi. The Raspberry Pi is a single-board mini computer device the result of technology created by the Raspberry Pi Foundation. Raspberry Pi is small in size almost the size of a credit card [8]. But despite its small size, the Raspberry Pi is equipped with a processor, RAM, and ports and other hardware that can be found on a computer normally. Raspberry Pi can also do and process like a computer like editing documents, playing audio, playing video, and many other things. Raspberry Pi itself has a special operating system called Raspbian OS which is a derivative of Debian linux. although it has a special operating system called Raspbian OS, Raspberry Pi does not rule out the possibility to be able to use other operating systems such as Ubuntu Core, Ubuntu MATE, Pirate OS, OSMC, RISC OS.

2.5. Quality Of Service (QoS)

QoS is short for Quality of Service which is a technique, method or a mechanism that guarantees the performance of computer networks, especially on the internet and the provision of application services in computer networks, QoS seen, measured from the service provider perspective. QoS is very different from QoE (Quality of Experience) where QoE assessment is done from the user's perspective. QoS is very much related to data on multimedia, on multimedia services, and on real time multimedia. For this reason, it is very necessary to understand the protocol used in multimedia services and compression techniques which are the main points of multimedia on the internet and other factors that influence the quality of a service on the internet [9]. Besides that, Quality of Service or QoS can be said as a terminology where this terminology is used to define the characteristics of a service or service of a network [10].

2.6. Research Methodology

In this study using a quantitative research approach to the form of descriptive research in which in this case facts and information can be described systematically, factually and accurately based on direct observations in the field [11]. The research methodology in this study has stages - the stages of the stages used in this study are seen in the research flowchart as shown in Figure 1.

Figure 1. Research Steps

2.7. Analisis Arsitektur Sistem Yang Berjalan

The stages of the running broadcast system can be broken down into several points including:

1) The Registrar retrieves the bitrate, resolution, and type of compression information from the official Google page for YouTube assistance with the url address https://support.google.com/youtube/answer/2853702?hl=en.
2) The committee makes a display on the youtube page with the url address https://www.youtube.com/my_live_events where on this page the committee will manage the display information such as the title of the show, the display resolution, RTMP URL Youtube server and retrieve the Streaming Key where the RTMP URL information Youtube server and Streaming Key will be used at the encoder configuration stage.
3) The committee will operate and configure the encoder settings with the encoder settings information obtained in point 1, the encoder operation is to manage the camera input and send the video obtained from the camera to Youtube through an internet connection in this process the encoder performs the encoding process based on the encoder settings that have been configured.
4) Video data from the encoder is sent to the internet with the RTMP protocol. The video data sent in this section is a video that has been through the encoding process as described in point number 3.
5) The internet will forward the video from point 3 to the social media streaming service in this case Youtube in accordance with the RTMP URL of the Youtube server and Streaming Key which information is obtained at point 2 and the configuration is done at point 3.

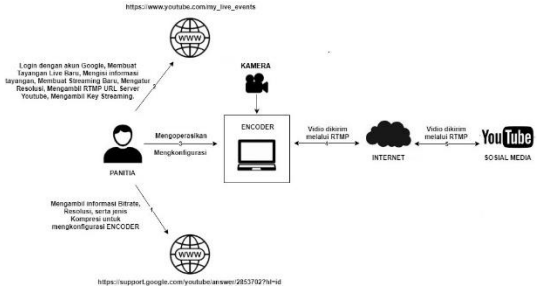


Figure 2. Current System Architecture

2.8. Analysis of Systems Architecture Offered

Referring to the running system shown in Figure 2, there are a number of additional systems as a proposal where the system architecture proposed in this study consists of 3 sub architectural analysis parts, namely encoder integration analysis, relay server analysis and upstream integration analysis.

In the encoder integration analysis sub-architecture is part of the encoder which will be managed by the committee in this case the committee uses OBS as encoder software and android smartphone as camera input and other data such as ip relay server and stream name. In this section also where the committee determines the video resolution and bitrate and type of compression that will be used video resolution data as well as the bitrate and type of compression that can be used can be obtained from the Youtube help page with the url address https://support.google.com/youtube/answer / 2853702? Hl = en.

In the relay server analysis architecture sub built on 2 sides, namely the front-end and back-end. Front-end is the side that is seen and managed by the committee. Front-end includes the user interface, and computer network needed to access the relay server service in the form of a Website (RapoWeb) application. While the Back-end side is on the raspberry pi server which includes the RapoWeb server, nginx, nginx-rtmp-module, and the process of sending data to the upstream, and other configurations.

On the upstream integration analysis sub-architecture explains how upstream in this case social media Youtube and Facebook can communicate with a relay server. In the process of integration between the upstream and relay server, the relay server system requires the url data stream and the stream name obtained from the upstream site which is the Youtube site with the url address https://www.youtube.com/my_live_events and Facebook with the url address https: // www.facebook.com/live/create. General description

of the proposed system architecture can be seen in Figure 3.

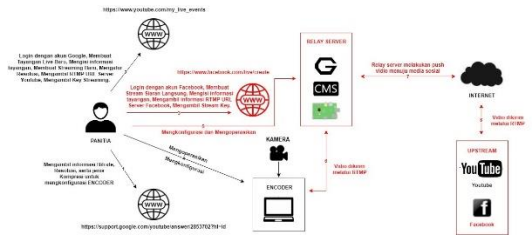


Figure 3. System Architecture Offered

2.9. Analisis Perangkat Lunak Pembangun Server

Server builder software in this study also performed an analysis of the needs of the server builder software to be used. The following details of the software needed are shown in Table 1 and Table 2.

Table 1. Software Needs For Relay Streaming Server

Analysis of the Need for Relay Streaming Servers		
No	**Software Name**	**Information**
1	Nginx	Used as a live streaming PORT 1935 server relay and PORT 80 website
2	Nginx-RTMP-Module	The module used by Nginx support for RTMP
3	Stunnel	Supporters so that Nginx can send data to RTMPS
4	Leafpad	Used as a text editor on the server
5	Build-Essentials	Used in the compilation process of Nginx and Nginx-RTMP-Module

Table 2. Software Needs For Website

Analysis of the Need for a Website (Server Interface)		
No	**Software Name**	**Keterangan**
1	PHP	Used so that the server can run PHP files
2	Phpmyadmin	As the interface of mysql on the server
3	Mysql	As a database processing application

2.10. Analysis of Server Builder Hardware

The hardware used in this study can be seen in Tables 3 and Tables 4.

Tabel 3. Server Hardware (Raspberry Pi)

No	Hardware	Specification
1	CPU	1.4GHz Cortex-A53 64-bit quad-core processor
2	RAM	1 GB
3	SD Card	16 GB
4	Wifi Card	2.4 GHz and 5 GHz dual-band wireless LAN
5	Bluetooth	Bluetooth 4.2/BLE
6	NIC	Faster Ethernet, Power-over-Ethernet support (with separate PoE HAT)

Tabel 4. Server Support Hardware

No	Hardware
1	HDMI Cable
2	VGA Cable
3	HDMI to VGA converter
4	Power Adapter for Raspberry Pi
5	Mouse
6	Keyboard

2.11. Analysis of Social Media Integration in the Proposed System

Social media in this study is intended for social media Youtube and Facebook, this social media will act as a video receiver from the PUSH results conducted by the Relay Server. This social media will be integrated with the Relay Server by means of the Relay server storing RTMP URL and Stream Key information provided by the social media server where the storage process is carried out by the Committee on the upstream manage page on the RapoWeb Relay Server, RTMP URL information and Stream Key for Youtube can obtained on page https://www.youtube.com/my_live_events while for Facebook can be obtained on page https://www.facebook.com/live/create. Figure 3.8 will describe the flow in the relay server integration with the Upstream carried out by the Committee.

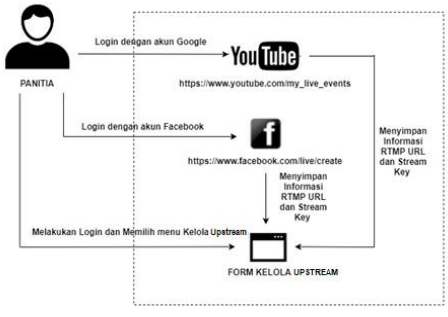


Figure 4. Social Media Integration Steps

2.12. Perancangan Sistem

A. Use Case Diagram

Use case diagrams designed for system development are shown in Figure 5.

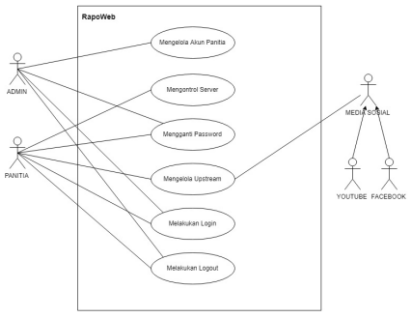


Figure 5. Use Case Diagram Website Interface

B. Actor Identification

The definitions of each actor contained in the use case are explained in Table 5.

Tabel 5. Actor Description

No	Actor	Description
1	Panitia	The committee gets access rights as follows: 1) Can log in as a committee 2) Can control the streaming server 3) Can manage upstream 4) Can change the committee account password 5) Can logout the committee
2	Admin	Admin get access rights as follows: 1) Can log in to the admin account 2) Can manage committee accounts 3) Can change admin account password 4) Can logout the admin account
3	Facebook	The actor in charge of giving the Stream Key
4	Youtube	The actor in charge of giving the Stream Key

2.13. Interface Implementation

A. Interface of Users as Panitia

Implementation of the user interface on the example page committee can be seen in Figure 6 and Figure 7.

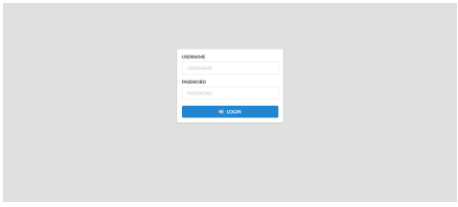
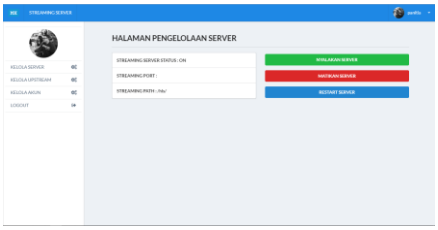


Figure 6. Login Panitia



Gambar 7. Manage Server Page

2.14. System Testing

Functional testing is carried out using the black box method in order to find out whether the system's functionality has worked in accordance with the expected results

A. Testing on the Website Interface

Based on the results of functional testing using the black box method on the overall functionality of the software that was built with data entered using test data samples, it can be concluded that the functionality of the software that was built was in accordance with the expected output.

Tabel 6. Black Box Testing on Web Interface

Komponen Uji	Jenis Pengujian	Hasil Pengujian
Login	*black box*	[✓] Accept
Manage Servers	*black box*	[✓] Accept
Manage Upstream	*black box*	[✓] Accept
Manage Account	*black box*	[✓] Accept
Logout	*black box*	[✓] Accept

B. Testing On Relay Streaming Server

Based on testing using the black box method on the Relay Streaming Server performance functionality, it was concluded that the Relay Streaming Server performance functionality can run and deliver output as expected, which can send videos to Facebook and Youtube upstream simultaneously..

Tabel 7. Black Box Testing on Relay Streaming Server

Input Video	Which are expected	Test result	Conclusion
Camera	Relay Streaming Server System sends video from the Camera to upstream Youtube and Facebook simultaneously	Videos from Cameras appear on Youtube and Facebook live streaming pages simultaneously	[✓] Accept

C. QOS Testing

Based on the tests conducted it can be concluded that the streaming system can work well at a minimum bandwidth of 128 Kbps because if using bandwidth below 128 Kbps automatically the broadcaster will not be connected to the server, this test uses the category of references [12].

a. The formula used in testing delay [12]
Delay = Delay Total / Total Packet Received – 1

b. The formula used in testing jitter[12]
Jitter = Variation of Delay / Total Packet Received – 1

c. The formula used in testing throughput [12]
Throughput = Total Packet Received / duration of observation

d. The formula used in testing packet loss [12]
Packet Loss = Total Packet Sent – Total Packet Received / Total Packet Sent

Tabel 8. Delay Test Results

Bandwidth	Delay	Jitter	Throughput	Loss
1024 Kbps	19 ms (Baik)	0,044483553 = 44,48 ms (Baik)	52,1490277 bytes/s	0%
512 Kbps	33 ms (Baik)	0,084150416 = 84,15 ms (Sedang)	29,05731569 bytes/s	0%
256 Kbps	49 ms (Baik)	0,259709548 = 259,71 ms (Jelek)	20,28921641 bytes/s	0%
128 Kbps	52 ms (Jelek)	0,271574457 = 271,57 ms (Jelek)	139,5741264 bytes/s	0%

2.15. User Response Testing

Testing of users is done to the live streaming committee of Rajapolah State Vocational School using a questionnaire method with a Likert scale calculation. The Likert scale consists of statements which are complemented by 6 choices of respondent approval levels. Statements to be given to respondents in this test can be seen in Table 9.

Table 9. Test Statements Against Users

No	Statement
1	I feel the server management feature of the RapoWeb website application is very helpful in managing live streaming server relays
2	I feel the process of integrating social media with the RapoWeb website application is very easy
3	I feel the RapoWeb website application is easy to use
4	I feel the process of integrating an encoder (broadcaster) with a live streaming server relay is very easy
5	I feel that the live streaming server relay that has been built is very useful for the live streaming committee and the SMK Negeri Rajapolah
6	I feel that relay live streaming server is very helpful for the committee of SMK Negeri Rajapolah in carrying out live streaming activities towards social media Facebook and Youtube

For the category scale calculation formula for each objective are as follows:

Minimum = *Jumlah responden* x lowest score answer x number of questions to attract goals

Maximum = *Jumlah responden* x highest score of answer x number of questions to attract goals

Tabel 10. Range Scale Category On Testing Of Users For Validation Of Research Purposes

Index	Skala Kategori
24	Very Not Accomplished
48	Not Accomplished
72	Reached Enough
96	Reached
120	Very Achieved

After calculating the scores obtained from each test include a score of 112 for testing the statement on the first goal, a score of 101 for testing the statement on the second goal, and a score of 103 for testing the statement on the third goal so that it can be described as follows:

Figure 8. Testing Results on Users for Validation of Research Purposes

2.16. Conclusion Testing User Response

Based on the results of testing of user responses conducted using a questionnaire to the live streaming committee of Rajapolah State Vocational School and calculations were performed using the Likert scale method. In the results of this test it can be concluded that:

1) The first objective in this study gets 112 final points where the first goal in this study is to facilitate the live streaming reporting committee of SMK Negeri Rajapolah to send live streaming shows to various social media especially Youtube and Facebook by building a

relay streaming server that can be concluded Very positive help.

2) The second objective in this study gets final points 101 where the second goal in this study is to integrate relay streaming server with live streaming system that runs at SMK Negeri Rajapolah with an easy process for the committee to be concluded Very positive help.
3) The third objective in this study gets final point 103 where the third objective in this study is to facilitate the live streaming committee of SMK Negeri Rajapolah in controlling the relay streaming server by building a local website as a server interface can be concluded Very positive help.

3. CLOSING

3.1. Conclusion

The conclusion that can be drawn after going through the stages of building a live streaming relay system at SMK Negeri Rajapolah. So the research that has been done is concluded:

1) The facilitation of the live streaming committee of SMK Negeri Rajapolah in sending live streaming shows to various social media especially Youtube and Facebook with the existence of a built-in relay streaming server proved to be very positive to help this goal with a score of 112 in the testing process.
2) Relay streaming server that is built can be integrated easily with live streaming system that runs at SMK Negeri Rajapolah proven by the results of testing of live streaming reporting committee who find it easy to integrate the streaming streaming relay service server that has been built with the test results got a score of 101 which means the goal has been very positive to help.
3) The live streaming reporting committee of SMK Negeri Rajapolah is facilitated in terms of controlling the streaming server relay by having a local website built as a server controller interface. Evidenced by getting a score of 103 in the testing process which means the goal has been very positive to help.

3.2. Suggestion

The system that was built still has some shortcomings. System development and refinement is needed to be able to improve and enhance system functionality so that it can provide a good solution to existing problems.

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