Comparasion Analysis of Video Quality on Codec VP8 and H.265 PBX Server with Pixel Conversion Method

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***Abstract*— Many studies and research are continuously being develop to improve the quality and capability of video compression. Compression of the video is done with the help of a video codec, in the video there are several types of video codecs including VP8 and H.265. These two codec models have very high resolutions for video. In addition, in implementing video calls, the determination of the codec do not able to prove the results of video quality. To be able to know the quality of the resulting video, codec quality testing can be done through pixel conversion which can later be analyze for video quality when making calls. In this study, a comparison of the performance of the VP8 and H.265 codecs will be carried out using the FreePBX server as a Raspberry Pi-based Video Call Server and is expected to find out which codecs are appropriate to use for the video call process. Based on the results of the comparison study between the two codecs, it shows that the value of the QoS (Quality of Service) parameter includes packet loss codec H.265 with a resolution of 720 lower with a value of 0.95%. The throughput value of the VP8 codec with 720p resolution is higher with a value of 1275.36 Kbps. The delay value in the H.265 codec with VGA resolution lower with a value of 6.78 ms. The results of the pixel conversion test show that the H265 codec has a higher PSNR value of 55.64 dB and a lower MSE value of 5.66.**

Keywords*— *Video Call, H.265 Codec, VP8 Codec, Pixel Conversion, QoS.

I. INTRODUCTION

Technological developments bring various influences on the communication process between humans. Technology in the telecommunications sector has developed rapidly and has made some people look for alternatives to communicate at a more affordable cost. To overcome this solution, users can take advantage of the internet network when carrying out communication processes such as voice or video using a VoIP system. VoIP is telephone communication by displaying images or sounds that are transmitted. [1]

In the example case, the use of a VoIP system is often used for video communication to make it easier to convey information. Video communication in a VoIP system is an alternative communication used when making long distance calls. Various studies and research continue to be developed to improve the quality and capabilities of video compression. Video compression is done with the help of video codecs, video codecs can be electronic components or software capable of compressing and decompressing videos. Various types of codecs are implemented to suit device compatibility. [2] In video call services, the codec greatly affects the quality of the sound produced, because the codec determines the compression technique, encoding, bit-rate, frame size, and others. [3] So that the function of the codec is to re-encode the audio signal to be transmitted so that its size becomes smaller and can save bandwidth and processor work. [1] In the video itself there are several types of video codecs including VP8 and H.265. These two codec models have very high resolutions for video. [4] In addition, video calls are affected by network quality which will affect the quality of video calls, such as differences in delay and throughput because video calls require real time communication between users. [5]

In addition, in implementing video calls, the determination of the codec has not been able to prove the results of video quality. To be able to know the quality of the resulting video, codec quality testing can be done through pixel conversion which can later be analyzed for video quality when making calls. Another thing that affects when making video calls is that it requires no small amount of money, because some hardware must be provided, such as the server used for the Video Call Server. To be able to reduce costs in the construction of Video Calls, the solution is to use a Mini PC that can function as a Video Call Server. By implementing a Mini PC for the construction of a Video Call Server, it is hoped that the server will be able to serve several users of the Video Call application, and still be able to produce video and audio quality in accordance with the quality of service [6]-[9]

II. METHOD

A. Research Design

The stages of research to be carried out are shown in the flowchart shown in Fig. 1.

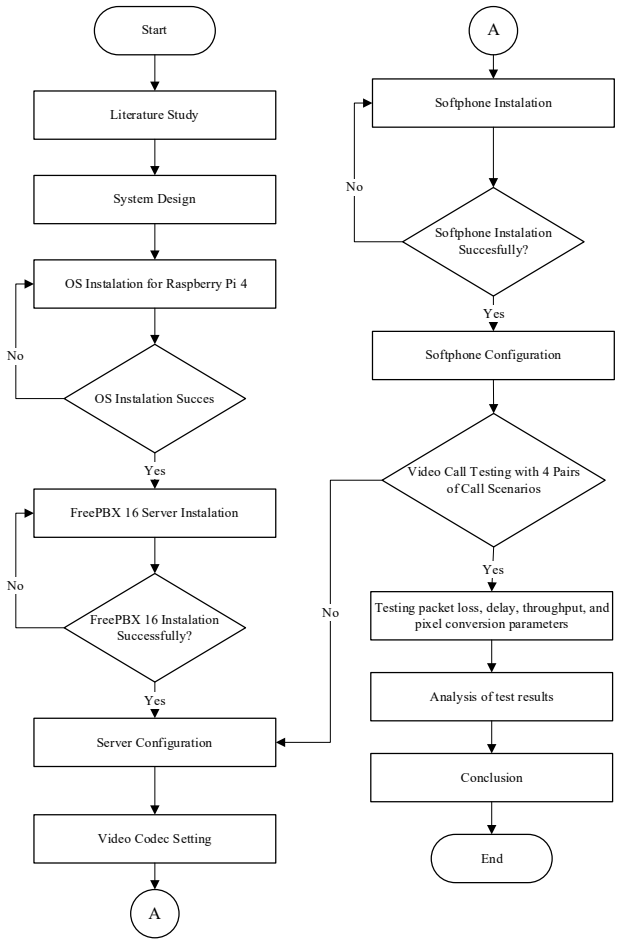

Figure 1. Flowchart Design

Design that will be carried out in making the system, with the following explanation:

1. The research implementation begins with a literature study, namely studying about previous research related to system design and the theoretical basis that supports system design, as well as learning about *Codec* VP8 and *Codec* H.265 used during the *video call*.
2. The second stage is system planning. At this stage is the creation of a network topology that is used as a Video Call Server. In addition, it determines the test scenario for video calls made using the TP-Link Router's local network.
3. The third stage is OS installation on the Raspberry Pi 4. At this stage, the OS that will be used in the testing process is installed, namely Raspbian using the Python programming language. If the installation process still fails, it will be repeated again for the Raspbian OS installation.
4. The fourth stage is to install the Video Call server. The installation process is carried out using the FreePBX 16 video call server. If the installation process fails, the server will be reinstalled. After the installation process, the configuration process on the server will continue by creating the required extensions and setting the video codec to be used. Video codec settings are done twice for VP8 and H.265 which will be tested alternately.
5. The fifth stage is to install the Linphone softphone on an android phone that will be used during the video call testing process. The Linphone installation process was carried out 8 times according to the number of clients during testing. If the installation process fails, the Linphone will be reinstalled.
6. The sixth stage is configuring the Linphone softphone by creating an account that matches the extension on the specified server. In addition, it performs configuration by setting the codec according to the test plan.
7. The next stage is testing using the FreePBX 16 server with alternate codec settings, namely VP8 and H.265. In the test scenario, 4 pairs of calls were made. After that, the test data is obtained based on the parameters that have been determined.
8. The next stage is to analyze the use of VP8 and H.265 codecs used in the video call process according to parameters such as packet loss, throughput, delay, and image quality viewed through Matlab software.
9. The last stage is drawing conclusions from the research that has been done.

B. System Design

The research design to be carried out is shown in the block diagram shown in Figure 2.

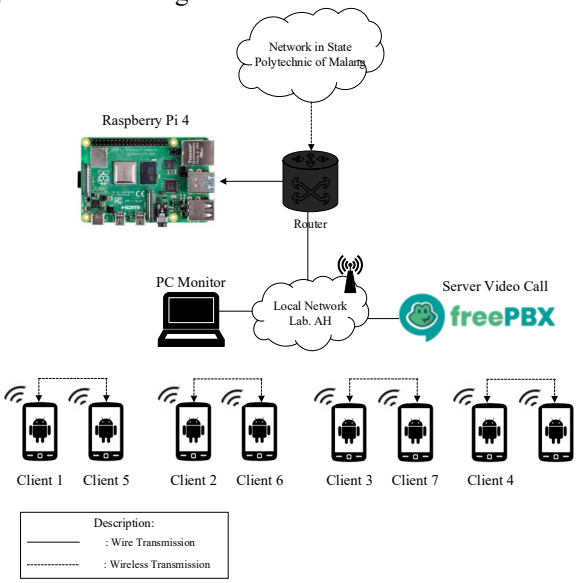

Figure 2. Block Diagram System

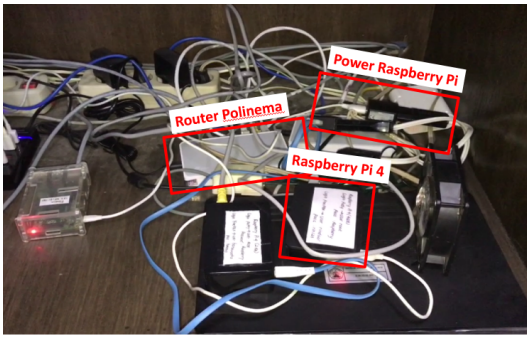

Figure 3. Implementation of System Design

In Fig. 2 shows the display of the system design block diagram, which displays the test flow to be carried out. The service implementation process for video calls uses the internet network at the Malang State Polytechnic and is connected to a router using a wireless network. From the router it is connected to a Raspberry Pi 4 device using a cable transmission media. Next is the configuration process for each softphone. The call testing process is carried out with 4 pairs of calls and 4 test scenarios.

Fig. 3 shows a display of the results of the implementation of the system design where the Raspberry Pi 4 server that has FreePBX installed is connected to the router at State Polytechnic of Malang.

C. *Matlab Program Design*

Program will be shown in the block diagram shown in Figure 4.

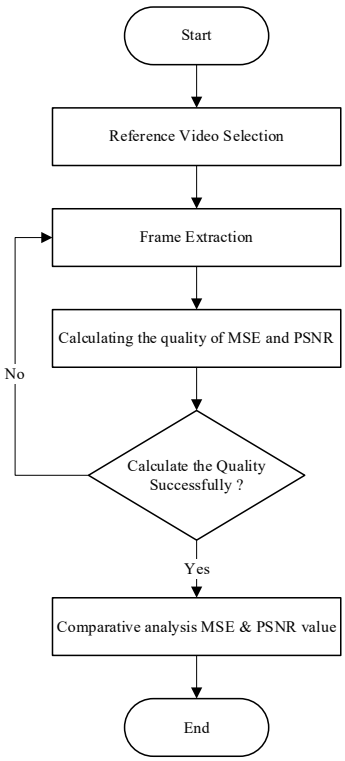

Figure 4. Matlab Flowchart Design

In Fig. 4 is a display design for testing image quality with the pixel conversion method performed on Matlab software. The process begins with selecting the video to be used, then proceeds with frame extraction. After that, the calculation process for image quality is carried out through the MSE (Mean Squere Error) and PSNR (Peak Signal to Noise Ratio) parameters.

III. RESULTS AND DISCUSSION

A. *Video Call Testing*

Process of testing a video call using the VP8 codec can be shown in Fig. 5. Meanwhile, the video call testing using the H.265 codec can be shown in Fig. 6.

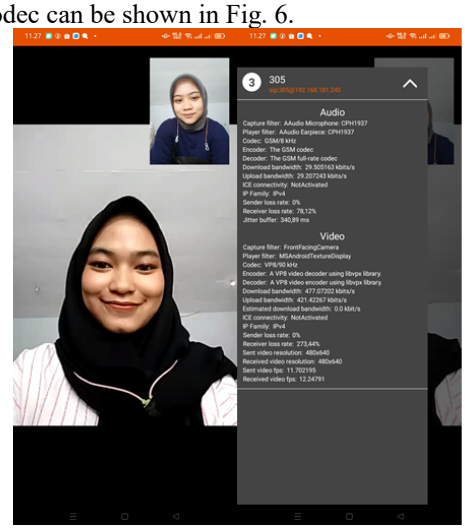

Figure 5. The results of the Video Call Testing with the VP8 Codec

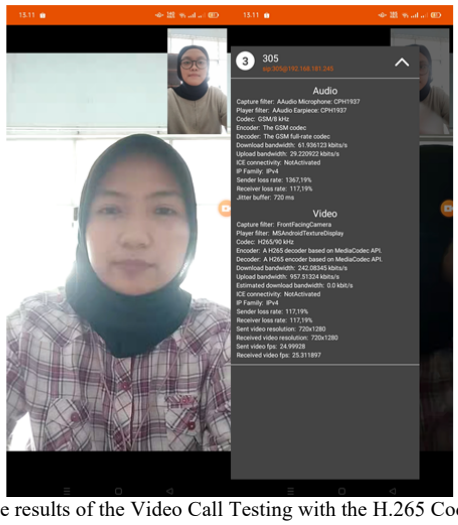

Figure 6. The results of the Video Call Testing with the H.265 Codec

B. *Discussion of Packet Loss Test Resul*

TABLE I
PACKET LOSS TEST RESULTS

Resolution	Client	Packet Loss (%)				Resolution	Client	Packet Loss (%)			
		Ged. AH		Ged. AI				Ged. AH		Ged. AI	
		VP8	H.265	VP8	H.265			VP8	H.265	VP8	H.265
720p	1	4,8	4,2	6,5	5,8	VGA	1	2	0,3	4,6	5,5
	2	3,5	1,1	5	3,5		2	3,6	0,8	5	4,7
	3	5,5	0	5,3	4,2		3	4,5	3,5	4	6,3

Resolution	Client	Packet Loss (%)				Resolution	Client	Packet Loss (%)			
		Ged. AH		Ged. AI				Ged. AH		Ged. AI	
		VP8	H.265	VP8	H.265			VP8	H.265	VP8	H.265
	4	1,6	0	1,8	4,3		4	1,3	0,6	4,2	5,3
	5	4,8	1,1	6	5,3		5	2	0,3	4,6	5,6
	6	3,5	1,2	5	3,2		6	3,6	0,8	5,2	4,6
	7	5,5	0	4,7	5,3		7	4,5	3,4	3	6,4
	8	1,1	0	1,4	2,3		8	1,3	0,6	4,2	5,3
Average		3,7875	0,95	4,4625	4,2375	Average		2,85	1,2875	4,35	5,4625

In the Table I shows the results of packet loss testing on video calls for call scenarios as much as 4 pairs or 8 clients. The lowest average packet loss value is shown on calls with the H.265 codec using 720p resolution and at the AH Building State Polytechnic of Malang with a value of 0.95%. This is due to the ability of each codec to show stability through at least lost or unreadable packets. Meanwhile, the highest packet loss was on calls with the H.265 codec using VGA resolution and carried out at the AI Building of the State Polytechnic of Malang with a value of 5.46%. From the average packet loss value above, it shows that it is included in the good category.

C. Discussion of Throughput Test Results

TABLE II
THROUGHPUT TEST RESULTS

Resolution	Client	Throughput (Kbps)				Resolution	Client	Throughput (Kbps)			
		Ged. AH		Ged. AI				Ged. AH		Ged. AI	
		VP8	H.265	VP8	H.265			VP8	H.265	VP8	H.265
720p	1	1184,9	1203,9	1105,5	1113,3	VGA	1	802,5	1049,2	697,4	703,8
	2	1280,4	1203,9	1105,7	1122,3		2	802,2	1049,2	706,1	704,0
	3	1250,4	1203,9	1105,6	1097,9		3	802,0	1049,2	687,8	704,0
	4	1190,7	1203,9	1105,7	1078,1		4	800,7	1049,2	696,3	704,1
	5	1250,0	1203,9	1105,6	1113,3		5	802,3	1049,2	696,9	703,9
	6	1175,5	1203,9	1105,4	1125,3		6	805,4	1049,2	708,1	703,9
	7	1350,2	1203,9	1106,0	1091,6		7	802,0	1049,2	680,2	704,1
	8	1520,9	1203,9	1105,7	1095,7		8	809,9	1049,2	696,7	704,4
Average		1275,4	1203,9	1105,6	1104,7	Average		803,4	1049,2	696,2	704,0

In Table II shows the display of the throughput value test results for video calls made at the AH Building and the AI Building of the State Polytechnic of Malang. Table 2 shows that calls are made with scenarios of 4 pairs or 8 clients. The lowest average throughput value is shown by the VP8 codec with VGA resolution carried out at the AI Building with a value of 696.2 Kbps. While the highest throughput value is shown by the VP8 codec with 720p resolution which was carried out in the AH Building with a value of 1275.4 Kbps. From the results of the average throughput above, it shows that this value is included in the very good category. This can happen because the resolution used is higher so that it has the ability to provide more throughput, besides that the ability of the codec to provide throughput is also quite large.

D. Discussion of Delay Test Results

TABLE III
DELAY TEST RESULTS

Resolution	Client	Delay (ms)				Resolution	Client	Delay (ms)			
		Ged. AH		Ged. AI				Ged. AH		Ged. AI	
		VP8	H.265	VP8	H.265			VP8	H.265	VP8	H.265
720p	1	12,097	12,879	11,78	15,61	VGA	1	12,403	14,848	12,33	13,25
	2	17,121	11,109	13,39	11,82		2	10,898	10,967	13,3	12,64
	3	10,216	21,574	11,08	13,66		3	10,548	11,864	11,26	12,78
	4	33,372	8,878	11,53	12,97		4	24,364	12,686	11,76	12,19
	5	11,966	11,175	11,96	12,26		5	13,42	11,151	12,88	12,85

Resolution	Client	Delay (ms)				Resolution	Client	Delay (ms)			
		Ged. AH		Ged. AI				Ged. AH		Ged. AI	
		VP8	H.265	VP8	H.265			VP8	H.265	VP8	H.265
	6	16,672	13	12,18	11,76		6	10,875	10,924	12,31	11,2
	7	10,381	21,5	12,77	11,46		7	11,57	10,869	11,08	12,96
	8	20,09	6,258	12,34	12,29		8	27,563	12,676	13,58	11,71
Average		16,48	13,29	12,12	12,72	Average		15,20	11,99	12,31	12,44

In Table III shows the results of testing the delay parameters for video calls which were carried out in the AH Building and the AI Building of the State Polytechnic of Malang. Table 3 shows a call scenario of 4 pairs or 8 clients. The lowest average delay value is shown in the H.265 codec with VGA resolution which was carried out in the AH Building with a delay value of 11.99 ms. The delay value affects the device's ability to process data, which means that the Linphone softphone is more optimal in displaying data using the H.265 codec with the same frame. While the highest delay value is shown in the VP8 codec with 720p resolution which was carried out in the AH Building with a delay value of 16.48 ms. Based on the results of the delay above, it shows that the value is included in the very good category because it has a value of less than 150 ms.

E. Discussion of Pixel Conversion Test Results

TABLE IV
PIXEL CONVERSION TEST RESULTS IN AH BUILDING

AH Building									
Resolution	Client	VP8			Resolution	Client	H265		
		Packet Loss	MSE	PSNR			Packet Loss	MSE	PSNR
720p	1	4,8	12,34	50,53	720p	1	4,2	12	49,77
	2	3,5	10,5	52,5		2	1,1	9,11	51,2
	3	5,5	14	48,7		3	0	5,66	55,64
	4	1,6	8,74	53,88		4	0	6,4	54
VGA	1	2	8,85	46,33	VGA	1	0,3	5,7	47,22
	2	3,6	10,65	44,9		2	0,8	6	45,67
	3	4,5	12,5	43,47		3	3,5	10,44	44,9
	4	1,3	8,2	47		4	0,6	5,86	45,7

In Table IV shows the results of pixel conversion testing for video calls carried out in the AH Building. Pixel conversion testing is done using Matlab software with call scenarios of 4 pairs or 8 clients. The highest PSNR value is shown by the H265 codec with a value of 55.64 dB with 720p resolution. This shows that the H265 codec has a better value with the test scenario carried out in the AH building using 2 different video resolutions. From the table above, it can be seen that the greater the PSNR value, the smaller the MSE and packet loss values.

TABLE V
PIXEL CONVERSION TEST RESULTS IN AI BUILDING

AI Building									
Resolution	Client	VP8			Resolution	Client	H265		
		Packet Loss	MSE	PSNR			Packet Loss	MSE	PSNR
720p	1	6,5	20	39	720p	1	5,8	17,8	42,9
	2	5	17	42		2	3,5	13	51,3
	3	5,3	17,3	42,5		3	6	19	38,7
	4	1,8	14	45		4	4,3	16,4	41
VGA	1	4,6	20,7	38,2	VGA	1	5,5	21,5	38,03
	2	5	21,34	38		2	4,7	20,8	38,11
	3	4	20	40,7		3	6,3	22,34	36,7
	4	4,2	20,33	39,2		4	5,3	21,4	38,05

In Table V shows the results of the pixel conversion test for video call calls carried out in the AI Building. Pixel conversion testing is done using Matlab software with call scenarios of 4 pairs or 8 clients. The highest PSNR value is shown by the H265 codec with a value of 51.3 dB with a resolution of 720p. This shows that the H265 codec has a better value with the test scenario carried out in the AH building using 2 different video resolutions. From the table above, it can be seen that the greater the PSNR value, the smaller the MSE and packet loss values.

IV. CONCLUSION

Based on the results of testing and discussion of the system that has been carried out, the following conclusions can be drawn:

1. The design of the FreePBX system using Raspberry Pi 4 as a video call server has been done on the Malang State Polytechnic network. Servers installed in Jartel Laboratorium using routers that are available and can be accessed from all area of the State Polytechnic of Malang, the implementation is shown by the difference in the server IP value of 192.168.181.245 with the client IP value in the AH Building 192.168.130.94 and the AI Building 192.168.183.55.
2. The results of video quality measured by Matlab software show the H.265 codec with 720p resolution has the highest PSNR value of 55.64 dB and MSE value of 5.66 for testing in the AH Building. While the video quality results in the AI Building show the same codec, namely H.265 720p resolution with a PSNR value of 53.88 and an MSE value of 8.74.
3. QoS measurements included packet loss, throughput, and delay parameters. the H.265 codec with 720p resolution is lower than the VP8 codec with a value of 0.95%. The throughput value of the VP8 codec with 720p resolution is higher than the H265 codec with a value of 1275.36 Kbps. The delay value in the H.265 codec with VGA resolution is lower than the VP8 codec with a value of 6.78 ms. While the test results at the AI Building for the value of packet loss on the H.265 codec with a resolution of 720p is lower than the VP8 codec with a value of 3.36%. The throughput value of the VP8 codec with 720p resolution is higher than the H265 codec with a value of 1105.65 Kbps. The delay value in the VP8 codec with VGA resolution is lower than the H265 codec with a value of 11.89 ms.

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