A comparative analysis of different digital modulation scheme for QoS support (using matlab).

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Tables of Content

Data and Formatting of Data

What we have as data?

1) Random generated Number or Text.
2) Image (**Using now in Implementation**)
3) Audio

What type of data accepted by the digital modulation?

Basically , the input data which accept in the digital modulation is in the m-ary formatted binary data.

M-ary modulation technique used in digital modulation to reduce channel bandwidth.

In short, one or more bit are transmitted simultaneously.As the number of bit increases error also increases

M represent Modulation level and Number of Combination.

Formula :-

M = 2^k k = 1,2,-----N

K is Number of Bit

M-ary Format Example

Digital Data :- 1101

Example 1 :

$M = 2^{\wedge}\mathbf{1} = 2$ (number of bit(k) $= \mathbf{1}$)

$M = 2$

1	1	0	1	$=$	1	1	0	1

M-ary Format

Example 2 :

$M = 2^{\wedge}\mathbf{2} = 4$ (number of bit(k) $= \mathbf{2}$)

$M = 4$

11	01	$=$	3	1

M-ary Format

Preprocessing of Data

1) Image data to Binary data

   The method where RGB Value are converted in binary and store as array.

2) Binary data as M-ary format

   The method where binary data converted m-ary format

Image data to Binary data Example

0 0 1 1 1 1 1 1 0 0

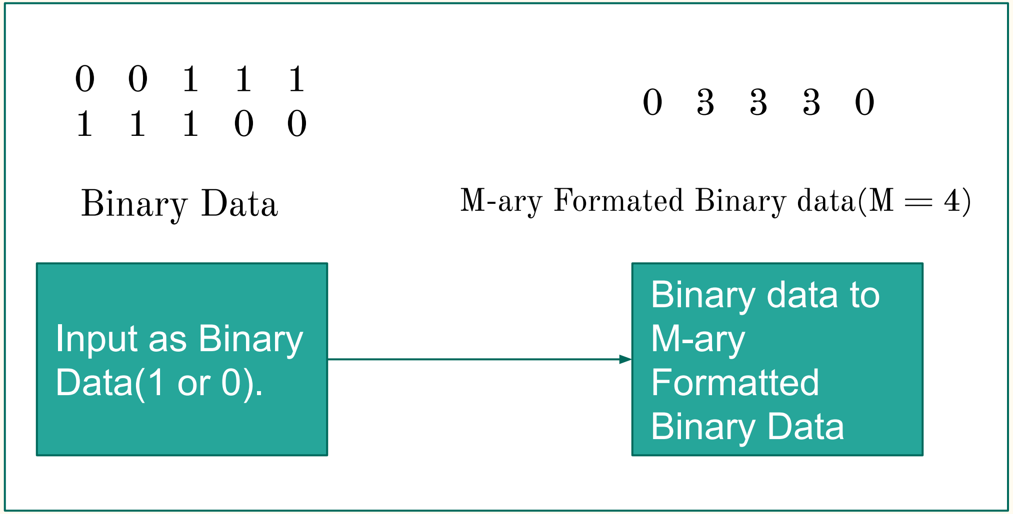
Original Image

Binary Data

Input as Image Data (Pixel Value) → Image Data to Binary data

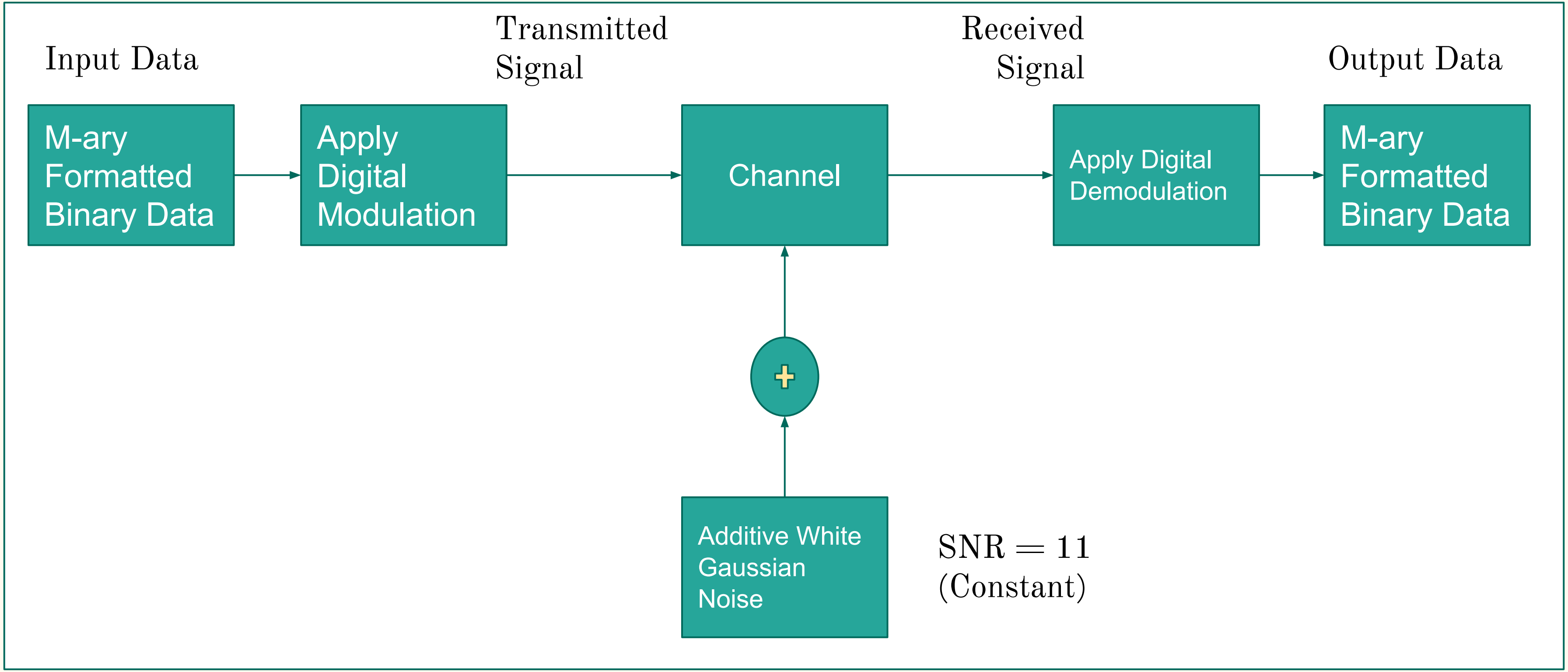
1) Take RGB value of pixel
2) Convert RGB value in binary
   R - 00001111
   G - 11110000
   B - 10101010
3) Put in RGB sequence in binary format
4) Put in array
5) repeat 2,3,4 till last pixel value

Binary data as M-ary Format



Digital Modulation and Demodulation Methodology

Methodology Of Digital Modulation & Demodulation



Cont...

M-ary Formatted Binary Data is actually in digital format but in different combination of bit number.

To get Comparative Analysis of the different digital modulation technique , We have to pass the signal to the channel with constant snr 11.

The Output of the Demodulated in M-ary formatted data with error.

Different Digital Modulation Scheme

Modulation and Demodulation method and Modulation level used

The digital modulation scheme used in comparative analysis

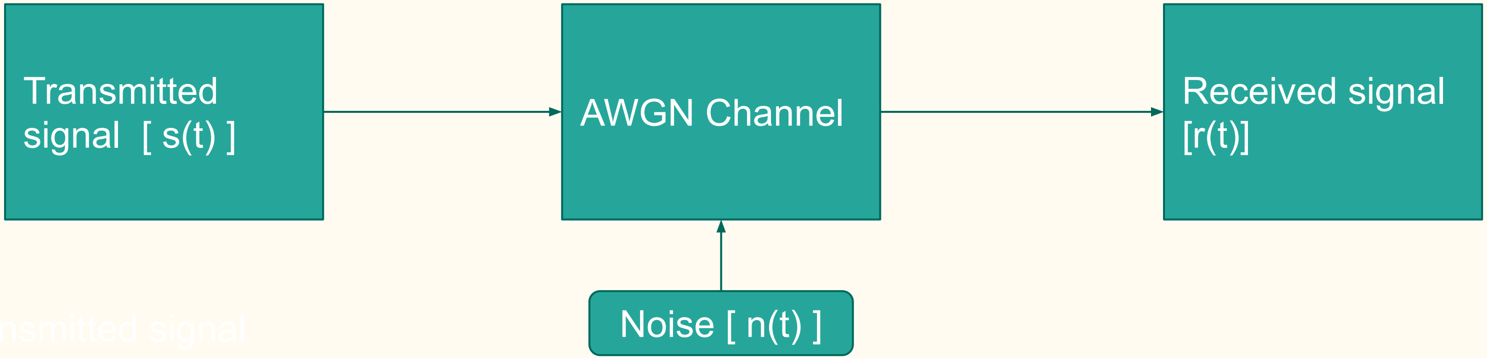
Different Digital Modulation Scheme

Name Of Digital modulation Schema	**Modulation level**
PAM(Pulse Amplitude Modulation)	2, 4, 8
QAM(Quadrature amplitude modulation)	2, 4, 8
PSK(Phase shift keying modulation)	2, 4, 8
DPSK(Differential phase shift keying modulation)	2, 4, 8
FSK(Frequency shift keying modulation)	2, 4, 8

Channel Noise & Errors Checker Method

AWGN as Channel and Noise Generator

AWGN(Add white gaussian noise) method adds white Gaussian noise to the input signal.



$r(t) = s(t) + n(t)$

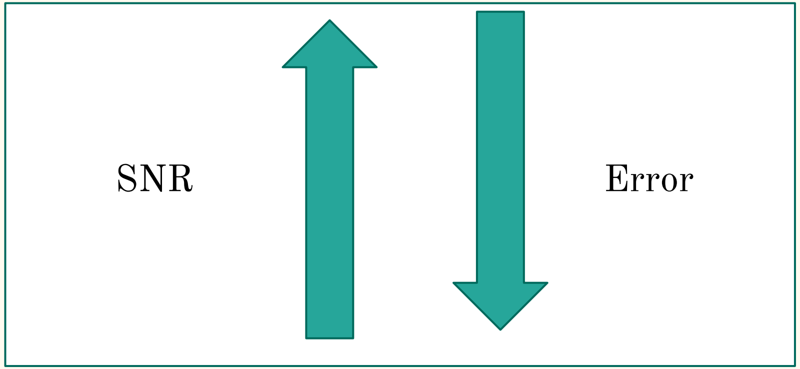
r(t) is received signal,s(t) is transmitted signal and n(t) is add white gaussian noise

Signal to Noise Ratio (SNR)

SNR is ratio of the power of signal to the power of background signal.

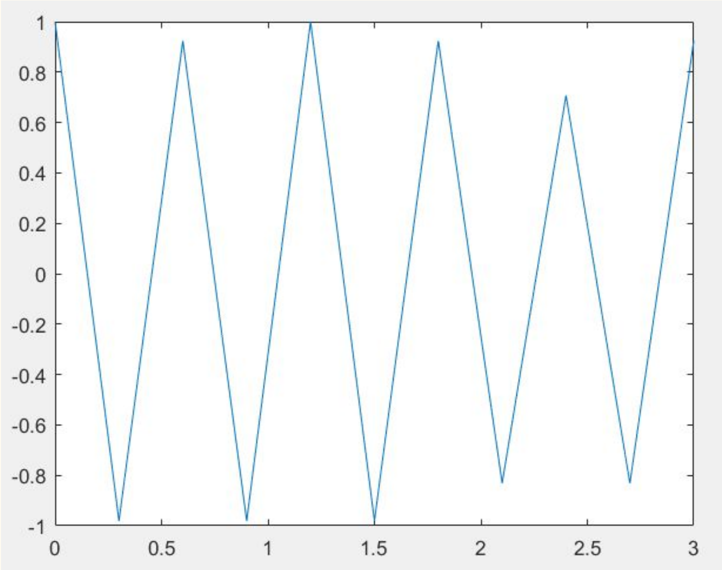
SNR = power of signal / power of background noise.

Power measured by decibel(dB) of signal.

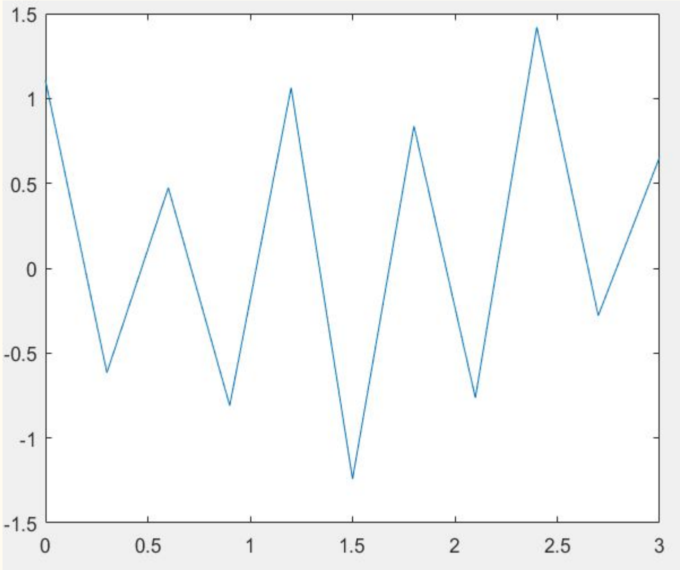


AWGN Example with constant (SNR =11)

Transmitted signal



Received signal with Noise



Error Detection Technique

1) Bit Error Rate (**Bit to Bit**)[Digitally]

   The comparison of input data to output data.

2) Peak Signal to Noise Ratio (**Image to Image**)[Using Pixel value]

   The comparison of input image to output image.

Bit Error Rate(BER) Example

Input Date :-

0	1	1	1	0	1	0	1	0	1

Output Data :-

0	1	1	**0**	0	1	0	**0**	0	1

Number of bit(A) = 10

Number of error bit(B) = 2

Bit error rate = B/A = 2/10 = 0.2

Bit error rate (%) = (B/A)*100 = 20%

In Coding part,
biterr(dataIn,dataOut)

Peak Signal to Noise Ratio (PSNR) Example

1)**Original vs Original image**

Psnr = INF(100)

Which means image has no change.

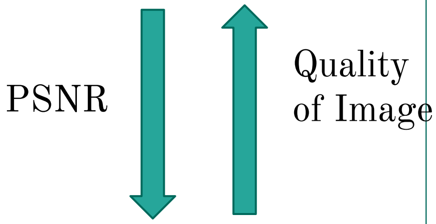
2) **Original vs Noisy image**

Psnr = 15.70

Psnr as much as low the image noisy too much.

In Coding part,

psnr(img1,img2)



Original Image

Noisy Image

Working On Demodulated Data

Gathering Image from received M-ary data.

1) Convert M-ary Formatted Binary Data to the Sequential Binary Data .
2) Convert the binary data to the pixel format.
3) Reshape the pixel array to the image (x,y)
4) Save Image

Image as Output or Simulation Results

PAM(M=4,SNR=11) = [BER = 1.35%]

Original Image

Received Image

PAM(M=8,SNR=11) = [BER = 12.6%]

Original Image

Received image

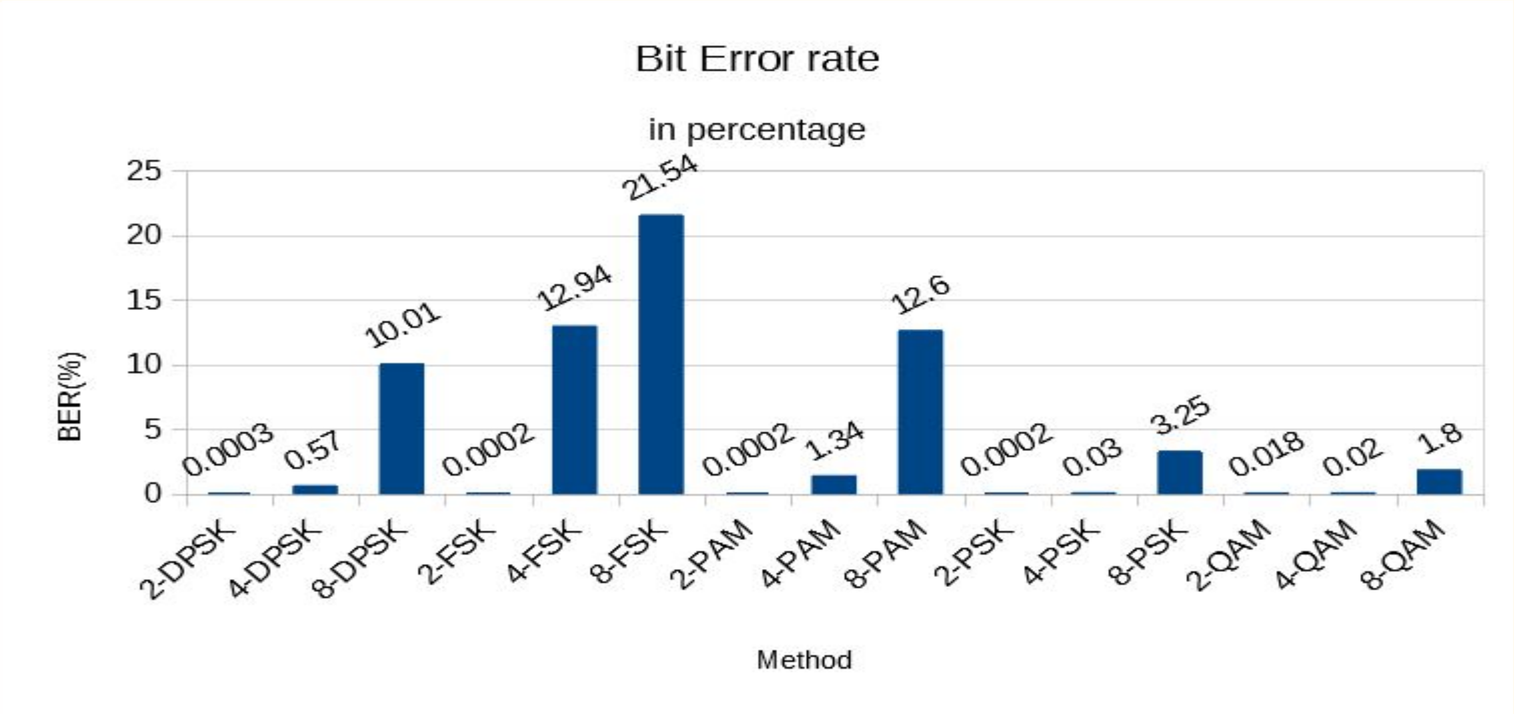
Graph Report

Graph Report based on

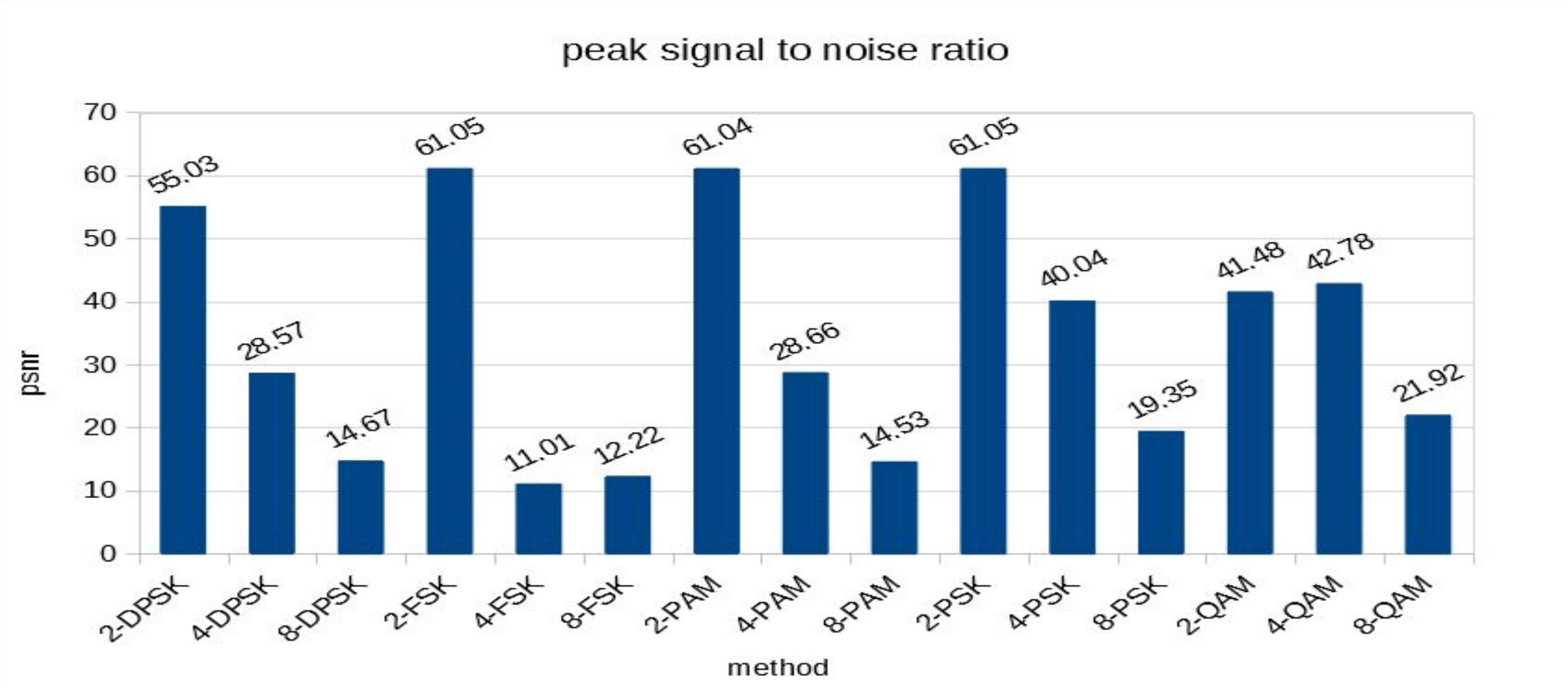
Bit Error Rate(Bar Graph)

Peak Signal to Noise ratio (Bar Graph)

Bit Error Rate(bar graph) at SNR = 11



Peak Signal to Noise Ratio (Bar Graph) at SNR = 11



QoS checking Parameter

Selection Of Modulation Scheme Depends On

1) Bit Error Rate
2) Peak signal to noise ratio
3) Available bandwidth or bandwidth efficiency
4) Cost effective (less Computation)
5) System complexity

Conclusion

As the modulation level(M) increases bit error rate also increases . In the part of psk and qam, bit error rate is increases less compare to another modulation scheme.If we check the quality of image using psnr, the modulation level (4,8) of the fsk is approximately same.At QAM (M=2) ,the bit error rate is more as compare to another modulation scheme.Overall fsk(M=8) gives more bit error rate. Overall with best image quality and more bandwidth given by qam(M=8).

References

[1] Mishra, B. K., S. K. Singh, Mahendra Sharma, Umesh Sharma, and Rohit Mishra. "A Comparative Analysis of Different Digital Modulation Schemes with OFDM for QoS support over Wireless Network."

[2] Praba, N., and K. M. Ravikumar. "IMAGE TRANSMISSION IN OFDM USING M-ARY PSK MODULATION SCHEMES–A COMPARATIVE STUDY."(time of transmission)

[3] Cheong, Kai Y., Francis CM Lau, and Chi Kong Tse. "An M-ary transmission scheme for chaotic communication." In *Proceedings, Regional Inter-University Postgraduate Electrical and Electronic Engineering conference (RIUPEEEC)*, pp. 149-105. 2003.

[4] Al-Heeti, Mohamed M., and Mohammed A. Fadhel. "Comparative Analysis for Different Digital Modulation Techniques." *Journal of Southwest Jiaotong University* 55, no. 2 (2020).

[5] Uppal, Sabhyata, Sanjay Sharma, and Hardeep Singh. "Analysis of BER for M-QAM and QOS Enhancement for OFDM Systems." *Wireless Personal Communications* 86, no. 2 (2016): 513-520

[6] Ndujiuba, Charles U., Oluyinka Oni, and Augustus E. Ibhaze. "Comparative analysis of digital modulation techniques in LTE 4G systems." *Journal of Wireless Networking and Communications* 5, no. 2 (2015): 60-66.

[7] Sandip R.Udawant, and Satyawati S.Magar. 2021. “DIGITAL IMAGE PROCESSING BY USING PASS BAND MODULATION TECHNIQUES”. *International Journal of Innovations in Engineering Research and Technology*, March, 1-3

[8] Xiong, Fuqin. Digital Modulation Techniques. United Kingdom: Artech House, 2006.

[9] Chadhar, Raghavendra Singh, and Avinash Rai. "An Analysis of Digital Modulation Technique for Image Transmission over Wireless Channel."

Thank You