Proceedings of the International Conference on Inventive Research in Computing Applications (ICIRCA 2018)
IEEE Xplore Compliant Part Number:CFP18N67-ART; ISBN:978-1-5386-2456-2

ASK based Image Transmission for Aerial Applications

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***Abstract*- This paper illustrates the acoustic transmission of an image from source node to destination node for aerial application. The image data is been transmitted from transmitting node using speaker and received at receiver end using microphone. The signal design and detection is done with the help of MATLAB scripting. The matlab simulation results were found satisfactorily.**

Keywords: ASK, AWGN, Aerial Acoustic Communication, Image Processing, Signal Processing

I. INTRODUCTION

Underwater communication possess real time data transmission from source node to destination node. The factors such as attenuation, delay spread, reflection, refraction, scattering and presence of obstacle like fish or human being in channel in-between may affect the acoustic link establishment while signal travelling from one end to another end. It is necessary to execute the real time acoustic experiment transmission with proper modeling to have guaranteed communication [1].

The Amplitude Shift Keying (ASK) modulation encompasses the information in the signal amplitude in which the levels of the amplitudes are the bits encoded in each symbol. The aerial acoustic channel corrupts the received signal amplitude hence after detection the equalization needs to be done to combat with corrupt signal. The advantage of using ASK modulation is we can analyze pulse response of the system which is more readily understandable [2][3]. The Amplitude Shift Keying modulation is adapted because it is simple to implement and it requires less hardware for bit transmission and detection synchronization [4]. The ASK modulation is power efficient and require single carrier for transmission. This modulation scheme is suitable for bio-telemetry applications. The basic idea behind ASK modulation is to utilize the node power efficiently for transmission as well as during reception provided both speaker and microphones are synchronized [5].

This paper introduces transmission and reception experiment of image as input data from one user to another user with MATLAB. We considered AWGN channel as communication channel for conduction of experiment. The simulation was made with MATLAB programming and results were found satisfactorily. The remaining part of this paper is as follows. In section II Modeling of ASK based communication systems explained. Section III describes Simulation of ASK based communication using MATLAB programming. In section IV results of simulation experiments are discussed and section V concludes the paper.

II. IMPLEMENTATION OF ASK BASED COMMUNICATION SYSTEM

The simulation and modeling of ASK communication system was applicable for aerial underwater acoustic applications. A modeled block diagram of ASK modulator, which modulates the input data stream at frequency 20 KHz with sampling rate of 9600.

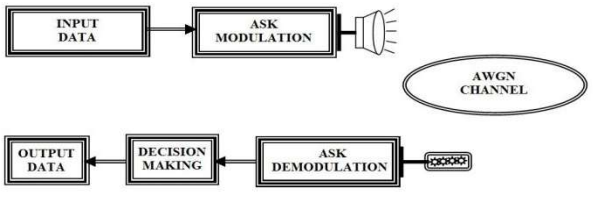

Figure1. Block diagram of ASK based communication system

The FFT operation was performed on ASK modulated data to convert the time domain signal in to frequency domain signal [6] [7]. The modulated data has been transmitted through speaker of source transmitter in air domain and recorded by microphone of intended destination receiver. The communication channel was considered to be Additive White Gaussian Noised channel. As underwater noises are of two types: 1. Ambient noise and 2. Man-made noise. The sea consists of both noises whereas ambient noise sources can be described as having continuous spectrum and Gaussian statistics as mentioned in [8].

The block diagram of ASK based communication system is as shown below. The recorded sound data has been sent to MATLAB scripting tool via speaker of receiver node and processed in order to get the original data stream back. The IFFT operation was done on received frequency domain signal to convert the time domain signal. Then the de-mapping operation was performed on received complex signal using ASK demodulator. The decision has been made using comparator block in order to get the binary data using MATLAB programming. Thus the binary stream converted in to matrix in order to get the image.

III. SIMULATION OF ASK BASED COMMUNICATION USING MATLAB PROGRAMMING

The experiment was conducted with help of image data as an input data to prove the design of proposed model of ASK based communication system. A cropped part of an image was chosen as an input to system. In order to save the processing time, a resized-cropped image was considered for experimental analysis. The binary data of an image is accessed from the MATLAB workspace.

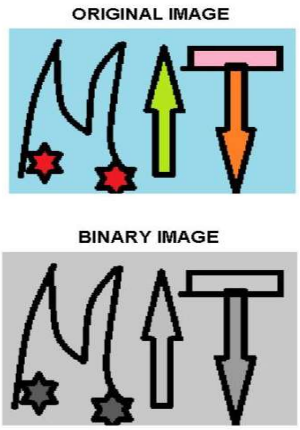

Figure 2. (a) Original color image, and (b) A resized-cropped binary Image

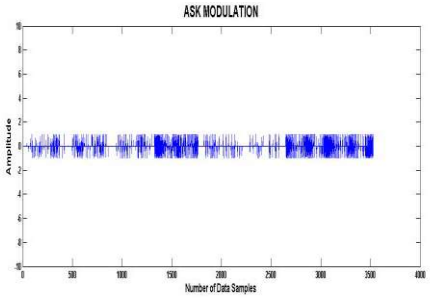

Figure 3. ASK modulated signal

The binary data is modulated with ASK technique at carrier frequency of 20KHz as shown in Figure. The FFT operation was done on modulated data [9]. Then the signal was propagated through air (AWGN channel) via transducer operating on 20KHz. The transmitted data was recorded by microphone and further sent to MATLAB tool for signal processing. The experimental set-up is as shown in Figure below.

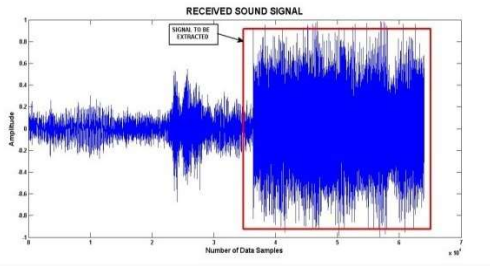

Figure 4. Received sound signal

At receiving end the recorded sound data gets converted to time domain by performing FFT operation [10]. Further the decision making was done with the help of comparator in Matlab to get the raw binary image data stream.

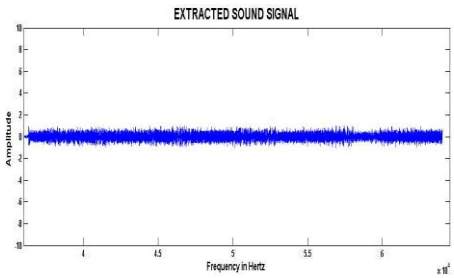

Figure5. Extracted data from received sound signal

The flow chart describes the operation to be done on the received extracted data samples to get the binary image data back.

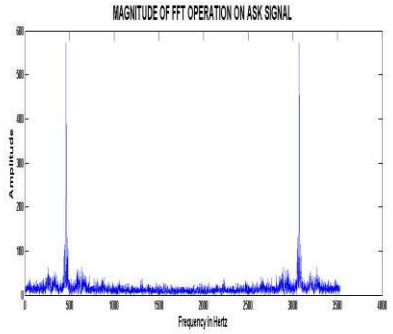

Figure6. Magnitude of FFT operation on ASK modulated data

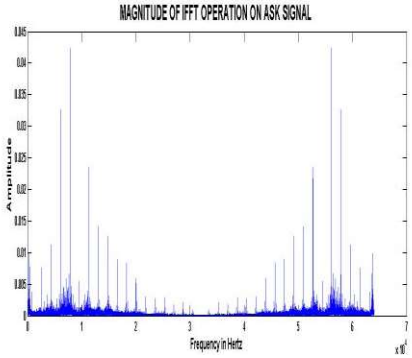

Figure 7. The magnitude of received sound signal

The processing steps are as follows:

1. Observe an color image, change color image into gray-scale image.
2. Modify and pick the gray-scale image.
3. Change the gray-scale image to binary image.
4. Renovate unsigned integer 8 data type to 2 format data type.
5. The double type is given input to the proposed ASK system.
6. The double type formatted into 1Dimensional format.
7. Change the 1Dimensional data format into 2-Dimensional data format i.e. matrix format.
8. Complete binary-to-decimal operation on the 2-Dimensional Matrix data.
9. Alter the matrix double data format in to unsigned integer 8 data format.
10. This unsigned integer 8 data convert it into 2-Dimesional matrix data format, as shown in Figure 9.

IV. RESULT

The recovered image, resembles with original gray scale image as shown in Figure.9 but it is lossy nature-wise.

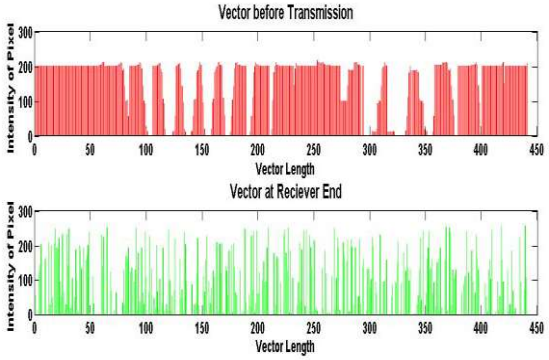

Figure 8. Pixel Intensity before transmission and after reception

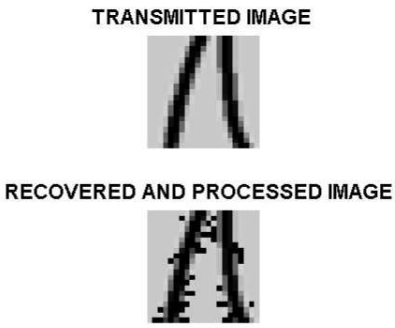

Figure 9. Gray-scale Image before and after processing

The amplitude of transmitted vector of an gray scaled image is compared with amplitude of received vector of processed image to get the bit error rate is as shown in figure 8. The BER of the system performance was generated with help of Matlab programming tool. The BER of proposed system is $9.683\ e^{-4}$ with data rate of 1.165 kbps sent from source node to destination node in AWGN environment. To improve the image quality and data rate by adapting Binary ASK modulation with adaptive equalization in future [14][15].

V. CONCLUSION

The ASK based simulation model of transmitter and receiver is implemented and observed the satisfactory performance and analysis of transmission and reception via with MATLAB for

aerial underwater applications. The results were concluded by comparing original image with recovered image in MATLAB tool.

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