A MULTILEVEL NRZ CODING FOR TRANSMISSION OF DIGITAL SIGNALS

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ABSTRACT

Removing problems associated with bipolar and Manchester coding techniques is one of the challenging problems this paper proposes a multilevel Non-Return-to-Zero NRZ coding technique for the transmission of digital signals, that helps in overcome these problems. It utilizes different D.C levels for representing a '0' &'1' with a NRZ method. In this paper power spectral density, circuit is proposed for generation line code, advantages and disadvantages of this technique are also shown.

Keywords: Line Coding, Non-Return-To Zero (NRZ), Power Spectral Density, Multilevel Signal, Probability Of Error.

I INTRODUCTION

As the technology advances in every field, we found many advances in communication also which requires advances in different types of information such as- multimedia, real-time video, images data, and audio. In this paper we analyze one of the important parameter of digital signal transmission i.e. line coding. Most of the portion of communication is in analog form, it is now being replaced rapidly by digital communication. The digital data can be transmitted by various transmissions. This technique is called line coding and they have become standards in telecommunication and computer networks.

Coding can be classified as- source coding, error control, line coding. Source coding is used to remove the redundancy in the information source. Error control is a method to detect and correct errors by introducing redundancy to the stream of bits to be sent to the channel. Line coding is often used for digital data transport.

Signals are either in the form of analog or digital. The analog signals are first digitized. These signals are known as baseband signals. Baseband signals are the fundamental group of frequencies in an analog or digital waveform that may be transmitted along a pathway or processed by an electronic circuit. When these base band signals are transmitted without superimposing and modulating on a high frequency signals then the communication system

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known as baseband communication system. The baseband digital communication system is made up of several elements such as – source, multiplexer, line coder and regenerative repeater. PCM is the pulse code modulation and is also known as digital pulse modulation technique. This means that the PCM output is in the coded digital form. It is in the form of digital pulses of constant amplitude, width and position. Fig.1 shows PCM techniques, the essential operation s in the PCM transmitter are – sampling, quantizing and encoding. The PCM signals cannot be directly transmitted because of intersymbol interference (ISI). In communication system, when data is being transmitted in form of bits the output produced at the receiver due to other bits with the output produced by the desired bit ,this is Intersymbol interference. to take care of synchronization and DC level , line coding is done before the signal is transmitted. Fig.2 shows the block diagram of the line encoder and decoder as used in transmitter and receiver.



II. LINE CODING

In telecommunication, a line code (also called digital baseband modulation) is a code chosen for use within a communications system for the purpose of baseband transmission. Line coding is also used for digital data transport.Binary 1's and 0's, such as in PCM signaling, represented various serial-bit signaling formats called line codes. Commonly used encoding techniques are-

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- Unipolar Non Return To Zero
- Unipolar Return To Zero
- Polar Non Return To Zero
- Polar Return To Zero
- Bipolar Non Return To Zero
- Bipolar Return To Zero / Alternate Mask Inversion Return To Zero (RZ-AMI)

Fig .3. Shows the waveforms for the different line coding techniques. If the bit rate is slow a Non- Return to Zero (NRZ) is enough but this introduces DC component. S o to remove this problem, use bipolar variation of NRZ-L. If the probability of each polarity is equal to each other then bipolar NRZ-L produces small DEC component. In Manchester bi-phase each binary symbol is divided into two parts with having identical duration and different polarities and these codes can eliminate DC component. In telephone networks AMI code is used where the polarity of a binary signal is positive and negative alternatively. MI has important advant5ages- having very low DC component and short bandwidth. But in case of AMI or NRZ signal, transmitted signal is equal to zero when binary '[0' is to be transmitted. The absence of transmitted signal causes synchronization loss at receiver. If long sequence of binary '0' are being transmitted, to preserve synchronization add pulses when long strings of 0's are being transmitted. This coding is high density bipolar coding HDB3. B8ZS (Binary 8-zeroes suppression) is also used to solve the problem related to synchronization. in this whenever eight successive 0,s are detected, this Unicode automatically insert a special 8 bit sequence, but in a higher bit rate this technique fails.fig 4 shows B8ZS and HDB3 coding techniques.



Fig 3. Different line codes

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Fig 4. B8ZS and HDB3 line codes

III. MULTILEVEL NRZ SIGNAL

This technique helps in removing problems related to B8ZS and HDB3. It utilizes different DC levels for the representation of '0' and '1'.

A '1' represented by '3A/2' for duration 0 to Tb/2 and as '-3A/2' for duration Tb/2 to Tb. A '0' is represented by '3A/4' for duration 0 to Tb/2 and '-3A/2' for duration Tb/2 to Tb.

$$x(t) = +\frac{34}{2} \qquad 0 \le t \le Tb/2$$

$$x(t) = -\frac{34}{2} \qquad Tb/2 \le t \le Tb$$
For $a_k = 1$

$$x(t) = +\frac{34}{4} \qquad 0 \le t \le Tb/2$$

$$x(t) = -\frac{34}{4} \qquad Tb/2 \le t \le Tb$$
For $a_k = 0$

Fig 5 shows the NRZ signal waveform, in this with a DC level (3A/2 to -3A/2) when '1' is transmitted and another DC level (3A/4 to -3A/4) when '0' is transmitted.

The power spectral density is the graph of power per unit of frequency as a function of frequency. Is shown as:

$$\frac{|P\delta(f)|^2 * \sum_{n=-\infty}^{\infty} R\tau(n) * e^{-j2\pi fnt}}{Tb}$$

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Multilevel NRZ coding , power spectral density is shown as:



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IV. ADVANTAGES

- It makes easy for extraction of time as in this there is a transition of DC amplitude level at after every Tb/2 time duration irrespective of data transmitted.
- It helps in adding extra layer of security to encrypted signal.
- We do not need to add extra voltage levels if we use multilevel NRZ coding technique.
- If this technique used then we can easily acquire timing information which is required for repeater circuits.

V. DISADVANTAGES

The disadvantage of multilevel NRZ are- it has multiple DC transition level and has intersymbol interference effect (ISI).

VI. THE CIRCUIT PROPOSED FOR THIS TECHNIQUE

Fig 7. Shows the block diagram consist of timer IC 555, a switch, digital input signal, a channel, an amplifier and output. Timer IC 555 utilizes to generate a pulse waveform of specific frequency and given as an input to switch. Encrypted waveform is used as a decision making signal. The switch works as the input given by digital input signal , if the input signal is '1' then the timer IC passed through amplifier circuit which amplifies the timer output from a DC level, otherwise output of timer is given to an output of channel. Then multilevel NRZ signal is obtain at the output.



Fig 7. Block diagram for coding signals using multilevel NRZ coding

VII. APPLICATION

This technology has many application in communication system like- telephony, ethernet , photobiology etc.

VIII. CONCLUSION

In this research paper we show the effective method to control the problems related to bipolar and manchester line coding. For generating multilevel NRZ code circuit also generated and power spectral density of this line code also shown.

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