RECEPTION OF VOICE SIGNAL USING SQUARE WAVE FREQUENCY MODULATION

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Dedicated especially to my Father, Mother, my brothers and Sisters, my beloved mate and my truly friends.

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ABSTRACT

This project is referred to the designing of reception of voice signal (300Hz to 3000Hz kHz) using square wave frequency modulation. It is intended to receive the signal from transmitter source by using optical fiber system. This device is focusing on the application of FSK demodulation and Square to Sine Oscillator circuit which has their own function to complete this square wave/digital modulation. The aim of this project is to use digital signal because it is much easier to transmit and offer less room for errors to occur and produces the accurate data transmission that is faster transmission rates and better productivity. FSK Demodulation has been chosen because it is the most common form of digital modulation in the high-frequency radio spectrum, and has important applications in telecommunication circuits. It uses FSK Demodulator XR2211 IC and work as data signal converted into a specific frequency or tone in order to transmit it over optical fiber or LED source to a destination point. Carrier frequency for this demodulation is 30 kHz While Square to Sine Wave Oscillator is an approach to generating sine waves is to filter a square wave. This leaves only the sine wave fundamental as the output. This project uses the application of an optical fiber as the transmission medium due to relative newness of the technology. It provides the better system performance, immunity to electrical noise, lower signal attenuation (loss) and resistant to temperature variations and many others.

ABSTRAK

Projek ini merujuk kepada pembinaan litar penerima bagi isyarat suara (300 ke 3000Hz) yang menggunakan modulasi frekuensi segi empat. Ia berupaya untuk menerima isyarat tersebut daripada sumber penghantar dengan menggunakan system fiber optik. Rekaan ini tertumpu kepada aplikasi demodulasi anjakan frekuensi dan juga segiempat-sinusoid yang mempunyai fungsi yang tersendiri untuk memenuhi modulasi digital ini. Sasaran projek ini ialah menggunakan modulasi digital kerana ianya mudah untuk di hantar dan hanya ralat yang kecil untuk berlaku dan juga membawa kepada penghantaran data yang jitu dalam penghantaran yang cepat dan juga produktiviti yang lebih baik. Demodulasi FSK di pilih kerana ianya adalah satu kebiasaan dalam modulasi spectrum radio frekuensi tinggi dan mempunyai kepentingan aplikasi dalam litar telekomunikasi. Ia menggunakan IC XR2211 FSK demodulator akan berfungsi sebagai penukaran data masukan ke dalam frekuensi tertentu untuk di hantar melalui fiber optik atau punca cahaya LED ke titik destinasi. Frekuensi karier untuk demodulasi ini adalah 30kHz. Manakala segiempat-sinusoid digunakan untuk menghasilkan isyarat sinusoidal dan menapis isyarat segi empat. Hanya isyarat sinusoidal akan terhasil di bahagian keluarannya. Projek ini menggunakan aplikasi fiber optik sebagai medium penghantaran berdasarkan kaitannya denagn teknologi terkini. Ia di lengkapi dengan sistem keupayaan yang baik, ketahanan untuk isyarat ganguan elektrik, kehilangan isyarat yang kecil dan tahan dari variasi suhu dan sebagainya.

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NOMENCLATURE

FO	-	Fiber Optic
RX	-	Receiver
TX	-	Transmitter
DB	-	Decibels
DBM	-	Decibels Meter
KM	-	Kilometer
FSK	-	Frequency Shift Keying
PCB	-	Printed Circuit Board
FM	-	Frequency Modulation
RF	-	Radio Frequency
DC	-	Direct Current
HF	-	High Frequency
LED	-	Light Emitting Diode
VCO	-	Voltage Controlled Oscillator
VREF	-	Reference Voltage
ASK	-	Amplitude-Shift-Keyed
PC	-	Personal Computer
POF	-	Plastic Optical Fiber
MHz	-	Megahertz
PLL	-	Phase Locked Loop
IC	-	Integrated Circuit
LCD	-	Liquid Crystal Display
UV	-	Ultra Violet

CHAPTER 1

INTRODUCTION

This chapter will discuss about the project developed with an overview

1.1 Application Background

The transmission of analog voice signals may attractive in small, short-haul systems. In addition, fiber optic sensor systems may incorporate analog transmission. Requirements that analog transmission places on applications include high signal-to-noise ratio and high source linearity. While analog transmission can be attractive for short-haul or medium-haul systems, it is unattractive for long-haul systems where digital techniques (square wave frequency modulation) provide better performance. According to this, the goal of this project is to improve the size, quality and range of the communication system for devices using the square wave frequency modulation.

Most analog fiber optic communications systems intensity modulates the optical source. In intensity modulation, the intensity of the optical source's output signal is directly modulated by the incoming electrical analog baseband signal. A baseband signal is a signal that is in its original form and has not been changed by a modulation technique.

While most fiber optic systems employ digital modulation techniques, there are certain applications where analog modulation techniques are preferred.

In fiber optic communications systems, optical signals that reach fiber optic receivers are generally attenuated and distorted. The fiber optic receiver must convert the input and amplify the resulting electrical signal without distorting it to a point that other circuitry cannot use it.

As stated previously, a fiber optic receiver consists of an optical detector, an amplifier, and other circuitry. In most fiber optic systems, the optical detector is a PIN photodiode or APD. Receiver performance varies depending on the type of detector used. The amplifier is generally described as having two stages: the preamplifier and the postamplifier. The preamplifier is defined as the first stage of amplification following the optical detector. The postamplifier is defined as the remaining stages of amplification required to raise the detector's electrical signal to a level suitable for further signal processing. The preamplifier is the dominant contributor of electrical noise in the receiver. Because of this, its design has a significant influence in determining the sensitivity of the receiver.

The output circuitry processes the amplified signal into a form suitable for the interfacing circuitry. For digital receivers, this circuitry may include low-pass filters and comparators. For analog receivers, this circuitry may also include low-pass filters.

Receiver sensitivity, bandwidth, and dynamic range are key operational parameters used to define receiver performance. One goal in designing fiber optic receivers is to optimize receiver sensitivity. To increase sensitivity, receiver noise resulting from signal-dependent shot noise and thermal noise must be kept at a minimum. A more detailed discussion of receiver shot and thermal noise is provided later in this chapter.

In addition to optimizing sensitivity, optical receiver design goals also include optimizing the bandwidth and the dynamic range. A receiver that has the ability to operate over a wide range of optical power levels can operate efficiently in both short and long-distance applications. Because conflicts arise when attempting to meet each goal, trade-offs in receiver designs are made to optimize overall performance.

1.2 Project Objectives

This project is focusing on how to demodulate the voice signal by using square wave frequency or digital modulation at the reception part. The design of an optical receiver depends on the modulation format used by the transmitter. Since most lightwave systems employ the binary intensity modulation, we focus on optical fiber receivers. We decided to build and implement a digital receiver for the reception of voice signal by using the optical fiber as the transmission medium. At the end, the result should produce a product that will allow user to received voice signal from transmitter circuit. Here, we can implement system to receives the voice and being transmitted using the Fiber Optic technology. The signal needs to be process by using suitable digital demodulation technique (FSK Demodulation) and then produce the output to speaker system.

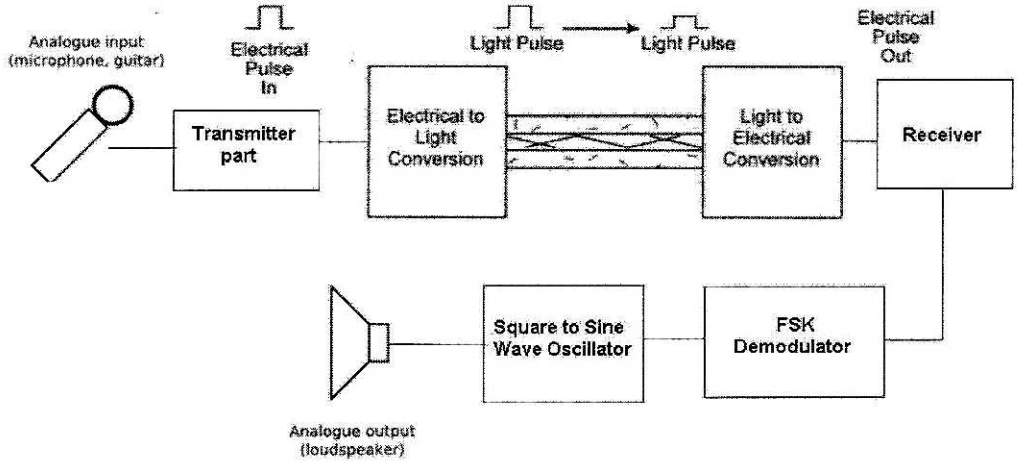

Figure 1: Block diagram of project

The capability and range of the transmission operation for this device also has been tested now on to future works for completing the objectives needed. The receiver unit can be separates in some ranges from transmitter circuit so that the signal can be transmitted to the receiver via optical method. The expected range that can be separate among both receiver and transmitter unit is about 1 meter and 3m. However, the actual range of operation for this device in depends on the environment mechanism like noise, component error or other interruption.

1.3 Problem Statements

The main goals of this project are to built and assemble the digital receiver unit (speaker) using the combination of FSK Demodulator and Square-to-Sine Oscillator circuit. This project will produce the high quality of the voice reception device of the one way communication system. The device has the approximate range of its operation where the transmitter can be separated from speaker approximate at about 1 meter (depends on the length of fiber optic cable).

The application of the square wave frequency modulation at the transmission medium becomes the main objective of completing this project. Before that, the study of using infrared LED and its operation have been study to get the understanding of optical transmission concept. From review, the end of result for this project should be the receiver unit allows users to receive audio signal from the audio source which is microphone, from certain range from transmitter unit. The range of LED transmit and LED receive will influence the quality of voice. This will be discussing more on the result chapter.

1.4 Scope of Work

There are several scopes that have been applied to make sure the project is on the grid to achieved optimum results.

1.4.1 Analysed and studied about the square wave or digital communication system and its operation.

This method is focusing on studying the basic operation of fiber optics and the application of transmission medium in this project.

1.4.2 Digital Modulation and demodulation techniques.

These techniques are the most important application in the transmission operation where the transmitter applied the FSK modulation technique and the receiver applied the digital demodulation schemes as the main goals oh this project.

1.4.3 Application of Square-to-sine Oscillator.

The digital application for this device which is one approach to generating sine waves is to filter a square wave. This leaves only the sine wave fundamental as the output. Study of this part has been covered lots in the previous semester.

1.4.4 Application of infrared as the pre-test standby before fiber optic cable been applied.

This step is done so that the understanding of the optical & digital transmission concept has been done lot.

1.4.5 Simulate circuit using MULTISIM software.

The MULTISIM software has been used to do the simulation of circuit designed before fabricate the actual circuit. This is also useful to study the theoretical result for circuit operation.

1.4.6 Design and simulate receiver circuit using PROTEUS 6 professional software for PCB design.

The PROTEUS 6 PROFESSIONAL has been used to do the simulation of circuit designed before fabricates the actual circuit. This software also can be used to convert the schematic design to PCB layout.

1.4.7 Study the parameter considered for the FO communication link

The important parameter of FO communication link such as sensitivity of the connector, fiber loss, and splice loss has been study to find out the Power Budget and capability of this communication system in order to retrieve the voice signal.

1.4.8 Construct the receiver circuit of reception compartment.

For this step, the etching technique is the best way to fabricate the circuit schematic. Etching technique provided best design layout and it simply easier and faster while doing fabrication.

1.5 Thesis Structure

The whole contains of this thesis is about the project that have been done during year 4. This thesis has been divided into five chapters in order to provide readers to understand the whole thesis about the Reception of Voice Signal Using Square Wave Frequency Modulation).

1.5.1 Chapter I

This chapter discussed about the project synopsis, objective, problem statement, and scope of work that has been applied in order to complete the project.

1.5.2 Chapter II

Chapter II is cited about the background study of application of FSK Demodulator circuit for receiver unit. The application of FM demodulation and its operation has been discussed and explain clearly using the XR-2211 which is a monolithic phase-locked loop (PLL) system especially for the data communications applications. The theoretical implementation about the FSK Demodulator also has been discovered. This chapter includes a basic principle for Fiber Optics which is the chosen transmission medium for this project.