Palestine Polytechnic University

College of Engineering and Technology

Electrical and Computer Engineering Department

Graduation project:

Video signal transmission via optical fiber communication system

Project Team:

Sawsan Abu Dawoud **Mervat al_Khayyat**

Project Supervisor:

Eng.Ahmad Qdemat

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Dedication

To the beacon of this world…

The master of creatures…

The Imam of all messengers…

The illiterate who taught the literates…

Prophet Mohammad – Peace and Blessings Be Upon Him.

I would like to extend my deepest love, respect and appreciation to those who helped me and stood by my side, all the time, during my struggle to reach this success.

To those whom I grew up between them; the kind-hearted and passionate: My Parents (May Mighty Allah grant them a long and healthy life).

To my dear brothers, whom I filled with joy and happiness when I see them…

To my dear sisters, the symbol of tenderness and giving.

To all of those who shared me my memories, stood by my side, supported me and have been there when I needed them: My Colleagues and Friends.

I Do Grant All of Them My Research

Gratitude and Appreciation

I would deeply like to express my thanks and gratitude to my parents, brothers and sisters for their continuous and passionate support.

I would also like to extend my highest gratitude to all of my teachers at the computer and electrical engineering department for their support, guidance and tolerance.

My everlasting appreciation would also be recorded to each and everyone who helped me , in anyway, through doing this research…

THANK YOU

Abstract

This project aims to transmit video signal through fiber optic system, this system consists of transmitter, receiver and the optical fiber as communication channel.

In the system the video file will be divided into frames using matlab software to send one frame at a time which any lost in data at any time will not affect the all system performance, these pictures are taken from PC in Ethernet format, then this out coming signal should be converted to serial using wiz110sr to inter the digital optical system (transmitter and receiver) which is serial channel.

Then this data through the optical transmitter and travel in the fiber then to be detected in the receiver is in serial form, and before it come to the receiver pc it should convert to Ethernet form using another wiz110sr board.

The received pictures are collected to form the video file by using matlab software, lastly the video is displayed.

To convert the Ethernet data to serial data and versa by using wiz110sr board, we need to choose the operation mode of wiznet, also the network configuration such as IP address and port number should be specified, and the serial configuration must be the same at the two wiz110sr board and this configuration should be suitable for optical system.

Table of contents

List of Tables

List of Figures

Chapter 1

Introduction

1.1 Prefaces.

1.2 Project Importance.

1.3 Project Objectives.

1.4 Literature Review.

1.5 Requirements.

1.6 Time Plane.

1.7 Expected Cost.

1.8 Project Risks.

1.9 Road Map.

Chapter One

Introduction

1.1 Preface:

Optical fibers are extremely thin stands to ultra pure glass which are designed to transmit light signals from transmitter to receiver. Those signals represent electrical signals that include, in any compression, video, audio or data information. Modern fiber optic communication systems can be extra ordinary complex as the data rates, channel counts, and transmission distance increase. However, the basic principle behind fiber is relatively simple.

In this project, an optical fiber will be the communication channel. First, the video signal will be divided into frames using matlab simulink . Then, these pictures are taken from a PC in Ethernet format, and will be converted into serial using serial to Ethernet converter (wiznet). The output from the wiznet enter a driving circuit (to convert the 15v into 5v) and then this signal is converted into light in the transmitter circuit by the light emitter to enter the fiber optic cable, and then to reconvert the light into the digital signal in the receiver side by the light detector. Then the driving circuit will convert the 5v into 15v signal to fit the wiznet module that converts serial format to Ethernet format to rearrange the frames by using another matlab simulink and display the video at the receiver PC.

1.2 Project Importance:

The importance of this project stems from its dependency on the fiber optic technology for communication. The reason for choosing the fiber optic is that it is extremely convent in communication for several reasons which will be discussed later in the project. On the other hand, since optical communication using fiber optical is one of the most important technique in communication over long distance these years, it has a lot of advantages over other media-like electromagnetic waves or copper wires as the perfect security, and a negligible loss amount over long distance .This project gives a good understanding for the operation of optical fiber communication system, and how we can transmit a video signal over fiber.

1.3 Project Objective:

The main objectives of the project are:

1- To understand the complete communication system using fiber optics.

2- To use the designed system in application (transmit video signal) to ensure its Efficiency.

3- To study the optical power which can be transmitted through the fiber channel.

4- To study the communication losses in the system.

1.4 Literature Review:

Literature review related to fiber optic:

In reference [1] a measurement principle based on beam reflection is described theoretically calculated curves and measured values are given. The results provide an essential theoretical and design basis for the measurement of curved surfaces with fiber-optic sensor. This sensor, which is composed of eight symmetrically cross-arranged receiving fibers and one centered emitting fiber, can accomplish distance measurement with high vertical resolution of 0.1 μm through compensation of the impacts caused by fluctuations of the surface reflectivity and light power.

In reference [2] a condition associated with cyanosis and diminished pulse oxymora values, has been reported after use of local anesthetics to facilitate fiber optic intubations. The majority of reports in the literature details this development during diagnostic procedures such as endoscope and bronchoscope. A case of methemoglobinemia in a multiple-injury patient with an unstable compressive-flexion injury of the cervical spine undergoing fiber optic intubations is presented.

In reference [3] a review of lithium modulators for fiber-optics communication.

The current status of lithium-niobate external-modulator technology is reviewed with emphasis on design, fabrication, system requirements, performance, and reliability.

The technology meets with the performance and reliability requirements of current 2.5, 10, and 40-Gb/s digital communication systems, as well as CATV analog systems. The current trend in device topology is toward higher data rates and increased levels of integration. In particular, multiple high-speed modulation functions, such as 10-Gb/s return-to-zero pulse generation plus data modulation, have been achieved in a single device.

Over the past decade, as the demand for telecommunications services and bandwidth has boomed, the need for and advantages of external modulation in fiber-optic transmissions systems has been firmly established. In higher speed digital communication applications, fiber dispersion has limited system performance.

Lithium niobate (LiNbO3) external modulators provide both the required bandwidth and the equally important means for minimizing the effects of dispersion.

In reference [4] a fully three-dimensional theoretical study of the extraordinary transmission of light through subwavelenght hole arrays in optically thick metal films is presented. Good agreement is obtained with experimental data. An analytical minimal model is also developed, which conclusively shows that the enhancement of transmission is due to tunneling through surface plasmons formed on each metal-dielectric interface. Different regimes of tunneling (resonant through a "surface plasmon molecule," or sequential through two isolated surface plasmons) are found depending on the geometrical parameters defining the system.[4]

1.5 Requirements:

Hardware components:

1-PCs to send the video signal and another one to display it.

2-Wiznet board that convert from serial to Ethernet and vice versa.

3-the driving circuits components (RS232, LED ,capacitors).

Software lists:

1-Matlab program.

2-Configuration tool program and device terminal program for wiznet.

3-Java program (socket program).

1.6 Time Plane:

The time plane and task descriptions for first and second semesters are shown in tables below.

Table (1.1) the first semester Time Plane

Week Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Data gathering & Analyzing																
Requirement Analysis																
Studying fiber Optical																
Studying the design of tr. &the rec.																
Documentation																

Table (1.2) the second semester time plane

Week task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Project modification																
Hardware search																
Software (java)																
Software (matlab)																
Driving circuit design																
Hardware implementation																
Documentation																

1.7 Estimated Cost:

The estimated cost of the project hardware is shown in the table (1.3).

Table (1.3) estimated cost

Components	Cost ($)	number
Ethernet-serial converter	85	1
Serial-Ethernet converter	85	1
LAN cable	3	2
Serial cables	10	2
5v power adapter	15	2
RS232 driving circuit components	30	2

1.8 Project Risks:

The project may face some problems and risks that we have to declare in the early time of the project design and manipulation. The project should avoid these problems to work in its high efficiency. So, when we find a risk, we try to solve it without affecting the total project as much as we can. These risks may include:

1- Illness or absence of the team member.
2- Technology specification change.
3- Unavailability of some project needed components under the pressure of Political environments.
4- Some of project component do not work correctly will affect the whole system.
5- Lack of experience using lab instrument.
6- Latency of some component arrival.
7- Strike university academic and problems.

1.9 Project Road Map:

The project consists of five chapters. Each chapter describes a specific area of the Project. The contents of each chapter are as follow:

Chapter One "Introduction":
This chapter gives a general idea about the project, explains the project importance, and main objective, also it contains literature review of the studies related to the Project. Besides, it includes requirements, the time plane, road map and the total estimated cost of the project.

Chapter Two "Theoretical Back Ground":
This chapter gives a clear picture about the system theoretical background related to main feature of the fiber optic cables, and a general idea about the project.

Chapter Three "The System Design":
In this chapter we will study the receiver and the transmitter module design, the signal transmission in the fiber and, of course, the losses in the system design.

Chapter Four "Video Transmission":
How to convert the video signal from the Ethernet into serial ? In order to load this signal into the transmitter circuit, we should establish a driving circuit to make the signal suit for transmission and in the receiver side we will reverse this technique to get the original video signal.

Chapter Five "System Test":
In this chapter we will study the efficiency of the system by testing the video signal transmission.

Chapter 2

THEORATICAL BACKGROUND.

Chapter Two

Theoretical background

This chapter provides and illustrates back ground for the project related topics, and components.

2.1 Light Wave System Component:

The role of the optical channel is to transpose the optical signal from the transmitter into a receiver without distorting it. Most light wave system use optical fiber as the communication channel because silica fiber can transmit light with losses as small as 0,2dB/Km.

Even then, optical power reduces about 1% after 100Km for this reason fiber losses remain an important design issue and determines the repeater or amplifier spacing of a long –haul light wave system.

2.2 Project General Idea:

In this project the optical channel will carry an optical signal which represents a digital video signal represented by zeros and ones, this on and off signs will be modulated by the transmitter circuit which contain alight emitting diode (laser)**,** which convert the electrical signal into a ray of light that can be carry into along distance using fiber optic cable, and then in the receiver side a light detector will detect the received optical signal and convert it into the corresponding digital signal (electrical signal).

The idea of this project was to use the optical communication system to send a digital video signal, the signal will be in Ethernet format and to transmit it in the designed transmitter circuit that will be converted into serial format which means serially transmission through fiber, and also serially receiving of the data in the receiver circuit.

to do the converting from Ethernet into serial in the transmitter side, and the opposite in the receiver side we use especial kit to do the task in the proper way.

2.3 Fiber Optic Cables:

Optical fibers are extremely thin strand of ultra pure glass designed to transmit light signal from a transmitter to a receiver, these signals represent electrical signals that include, in any combination video, audio, or data information.

The raw material of optical fiber must be transparent to the light emitted from the light source included in the transmitter. But the term optical fiber is generic as it concerns lots of types of fibers of different materials (glass, plastic, etc) with different dimension and performance (for example, the attenuation range from less than (1dB/Km).

The fiber consists of three main regions:

1-The core: it consists of a cylinder of transparent material having different characteristics with a certain refractive index n_1, its diameter from 9 micron (Mm) to 100 micron in the most used fiber.

2-the cladding: the cladding surrounding the core and it is a coaxial layer of another transparent material with refractive index n_2 , (lower than that of the core), the cladding confines the light in the core, the cladding typically has diameter of 125 micron.

The core and the cladding complete the structure of the fiber acting as optical waveguide. The core and the cladding cannot be separated and generally they consist of the same material (glass-glass or plastic-plastic), some times they are made of different material (core of glass and cladding of plastic).

3-the coating layers: is the outer region of the optical fiber and it is also called the buffer or the coating, it is a plastic material provide protection and preserves since the mechanical structure of the fiber is too fragile. Therefore, it is reinforced with various coating layers (primary buffer ,intermediate buffer, and secondary buffer).

2.3.1 Fiber Optic Types:

1-Single mode fiber: an optical fiber that carries only one ray of light, the ray of light can contain several wavelengths. The core should be less than 3.2µm. Single-mode fibers are most often used in high precision scientific research because the allowance of only one propagation mode of the light makes the light easier to focus properly.

2-Multi-mode optical fiber multimode fiber or MM fiber is a type of optical fiber mostly used for communication over shorter distances, such as within a building or on a campus. Typical multimode links have data rates of 10 Mbit/s to 10 Gbit/s over link lengths of up to 600 meters—more than sufficient for the majority of premises applications.

Multimode fiber has higher "light-gathering" capacity than single-mode optical fiber. In practical terms, the larger core size simplifies connections and also allows the use of lower-cost electronics such as light-emitting diodes (LEDs) and vertical-cavity surface-emitting lasers (VCSELs) which operate at the 850 nm and 1300 nm wavelength (single-mode fibers used in telecommunications operate at 1310 or 1550 nm and require more expensive laser sources. Single mode fibers exist for nearly all visible wavelengths of light).

There are two types of multimode fiber; multimode step-index fiber and multimode graded-index fiber.

-In multimode step-index fiber the core index of refraction is higher than the index of refraction, the light that enters at least the critical angle is guided along the fiber.

A disadvantages of multimode fiber is that they suffer from; intermodal dispersion.

-Graded–index refers to the fact that the refractive index of the core gradually decreases farther from the center of the core. The increased refraction in the center of the core slows the speed of some light rays, allowing all the light rays to reach the receiving end at approximately the same time, reducing intermodal dispersion. This allow graded-index fibers to have much larger bandwidth than step-index fibers.

2.3.2 Fiber Optic Advantages:

The main advantage of fiber include:

1- immunity from fiber optic holds a great advantage over copper media since it can handle high speed signal over extended distance.

2- Electromagnetic (EM) radiation and lighting: because the fiber itself is made from dielectric (no conducting) materials, it's unaffected by EM radiation.

3- Immunity from electromagnetic is important in modern aircraft designs. And it is the key reason to use fiber devices in commercial security and intelligent transportation system.

4- Lighter weight: this feature refer to the fiber optic itself, in real world applications copper cables can often be replaced by fiber optic cables that weight at least ten times less.

5- For long distance, a complete fiber optic system (optical fiber and cable, plus the supporting electronics) also has a significant weight advantage over copper system; this is not true for short system, because fiber optic system almost always require more elaborate, and thus larger and heavier electronics than copper system.

6-Higher band width:

Fiber has higher band width than any alternative available; the band width of the copper is limited, a modern fiber optic system with similar or superior signal quality for 50 miles or more without needing intermediate amplification (repeaters), even at that, most modern fiber optic communication system uses less than a few percentage of fiber inherent band width.

7- Better signal quality:

Because fiber is immune to EM interference, has lower loss per unit distance, and wider band width, signal quality is usually better compared to copper.

8- Lower cost: fiber certainly cost less for long distance application, however, for signal transmission requirements over distance of few feet, copper will be cheaper. The cost of fiber itself is cheaper per unit distance than copper if band width and transmission distance requirements are high.

2.4 Principle of Operation:

2.4.1 Reflection:

The law of reflection states that, when light ray is impinging upon a reflective surface at an angle of incident θ_1, it will be reflected from that surface with an angle of refraction θ_2 equal to the angle of incident.

This law played a key role in understanding the behavior of light wave to travel through a dielectric medium; a total internal reflection is relevant to the physical dimension, and other properties of the optical fiber, power losses is a direct result of the light wave travelling through the optical fiber.

The principle of total internal reflection governs the operation of optical fiber as shown in fig 2.1.

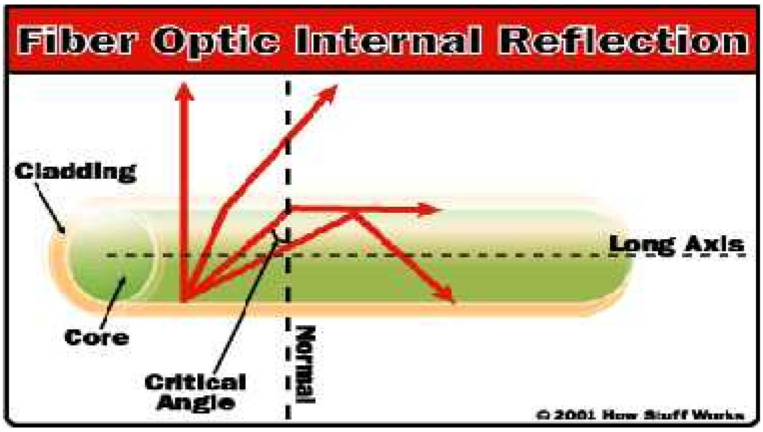


Fig (2.1) Reflection.

2.4.2 Refraction:

Refraction is the changing in wave direction according to change in it is speed. This phenomena occurs when the wave move from one medium to another at an angle. A very important parameter of the dielectric material is the refractive index (n). This parameter is characteristic of the dielectric material based on material density.

The refractive index is expressed as the ratio of the velocity of light of the dielectric material.

$n=c/v$.

Where: n= refractive index.

c=velocity of light.

v=velocity of light in dielectric medium

The refractive index in the cladding material is lower than that of the core .

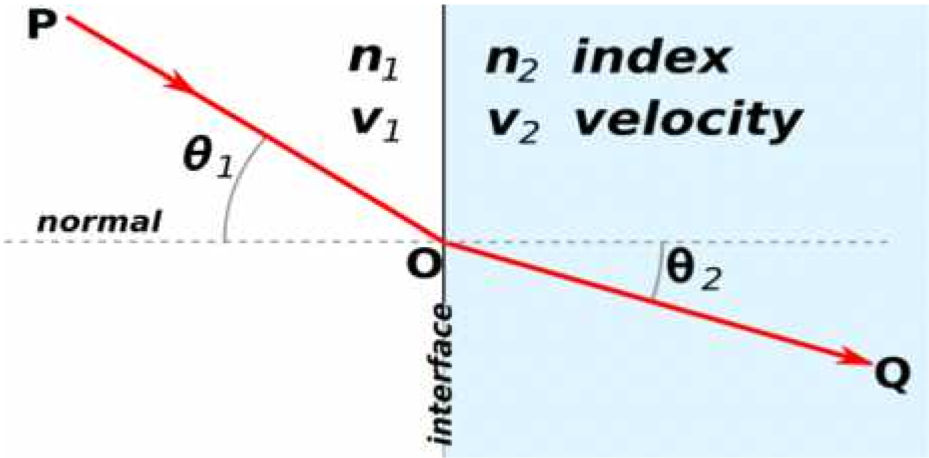


Fig (2.2) Refraction.

2.4.3 Diffraction:

When alight ray is intercepted by a sharp object or passes through a small hole or narrow window, it will diffract which means that it will bend around the sharp object or the of the small hole or the narrow window.

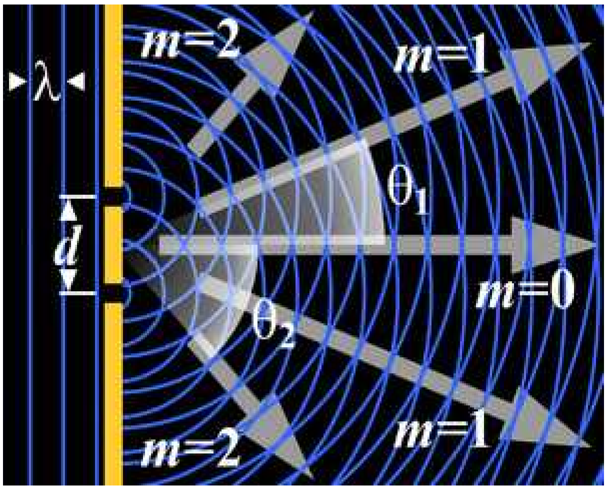


Fig (2.3) Diffraction.

2.3.4 Acceptance Angle And Numerical Aperture:

Acceptance angle is characterizes the range of angles over which the system can emit or accept light, it is expressed in terms of numerical aperture as shown in fig 2.4

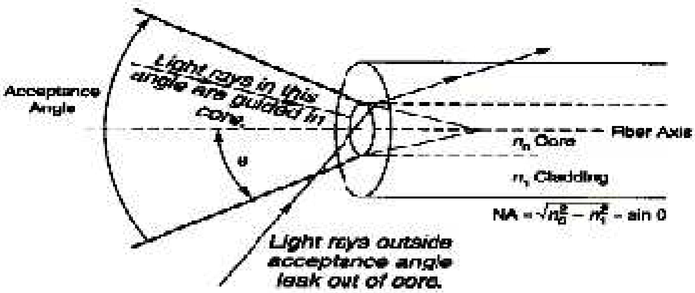


Fig (2.4) Acceptance angle.

Numerical aperture is the optical coupling efficiency between optical fiber and optical source; it also defined as maximum acceptance angle.

NA= n sinϴ.

Where n is the refractive index.

2.5 Attenuation and Dispersion:

2.5.1 Attenuation:

Attenuation in optical fiber is caused by several intrinsic and extrinsic factors. Two intrinsic factors are scattering and absorption. The most common form of scattering, ray Leigh scattering as fig 2.5 is caused by microscopic non-uniformities in the optical fiber.

Nearly 90% of the total attenuation can be attributed to it. It becomes important when the size of structure in the glass it self are comparable in size to the wavelength are less affected than short wavelength. The attenuation coefficient (α) decreases as the wavelength (λ) increase and is proportional to λ^4. Rayleigh scattering increase sharply at short wave length.

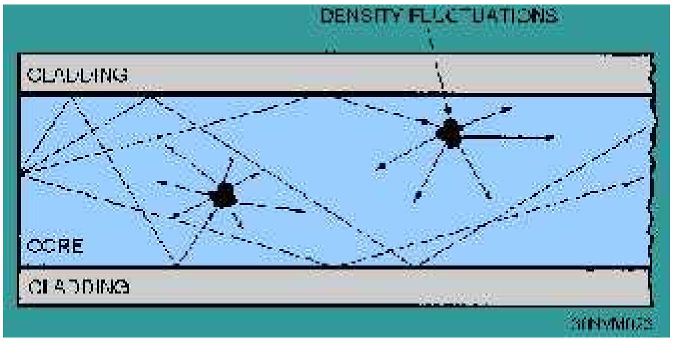


Fig (2.5) ray Leigh scattering

Absorption illustrated in fig 2.6 can be caused by the molecular structure of the material, impurities in the fiber such as metal ions, OH- ions (water), and atomic defects such as unwanted oxidized elements in the glass composition; these impurities absorb the optical energy and dissipate the light as a small amount of heat.

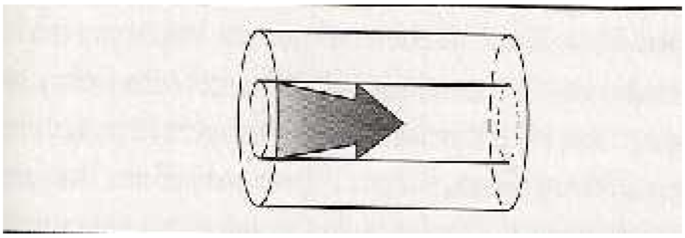


Fig (2.6) Absorption.

In optical fiber link, other losses can be due to too narrow loops in the path of the optical cable bending losses as in fig 2.7 or to junction of more lengths of fiber.

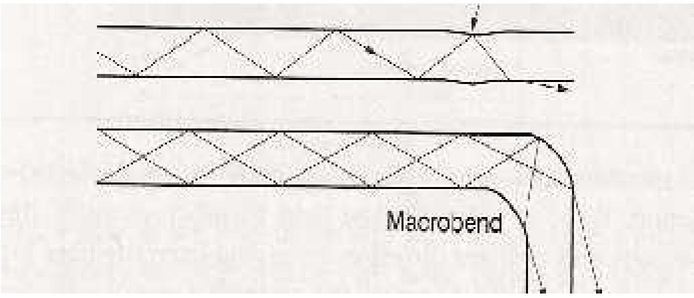


Fig (2.7) bending losses.

The amount of attenuation caused by an optical fiber depends on fiber length and the wavelength of the light traveling through the fiber.

2.5.2 Dispersion:

Dispersion is the time distortion of an optical signal that results from the many discrete wavelength components traveling at different rates and typically results in pulse broadening.

There are two different types of dispersion in optical fibers; Intermodal and intramodal Dispersion.

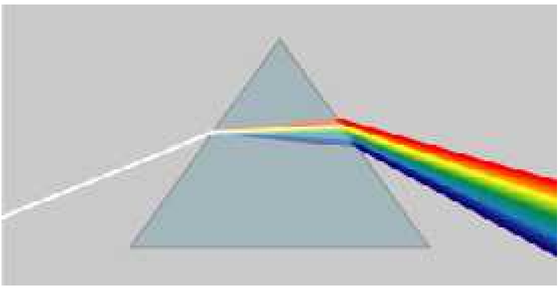


Fig (2.8) dispersion

Intramodal or chromatic dispersion occur in all types of fibers. It depends primary on fiber materials. There are two types of intramodal dispersion; the material dispersion and waveguide dispersion. Intramodal dispersion occurs because different wavelength of light travel through different materials and different waveguide structure at different speeds.

Intermodal or modal dispersion occurs only in multimode fiber. It occurs because each mode travels a different distance over the time span.

All kinds of the losses affect the system performance and it was very clear when the optical fiber is used to send the data, and the related resulted to the losses is explained in chapter five .

Chapter 3

System Design

Chapter Three

System Design

3.1 Introduction:

To transmit a signal in optical communication system the optical fiber module that consist of transmitter and receiver is used to transmit a video signal through a fiber optic cable. In order to transmit an optical signal into optical channel the input data is converted into optical rays to spread in the channel and then in the receiver side. The light is reconverted into electrical by the photo detector.

In this project we will use the ready module of fiber transmitter and receiver that exists in communication lab in the university.

3.2 Project Block Diagram:

The video file is taken from Ethernet port of PC, then it is converted to serial and send to the system transmitter.

The output signal from receiver is in serial form, it converts to Ethernet form to enter the PC as shown in fig 3.1. The wiznet serial to Ethernet gateway (WIZ110SR) is used for conversion from Ethernet to serial and versa.

These wiznet devices give 15 volts, and the fiber module operates at 5 volts, so the driving circuit that consist RS232 and other components as shown in fig 3.2 is required to convert the voltage to use in the system.

This driving circuit is called RS232 shifter board.

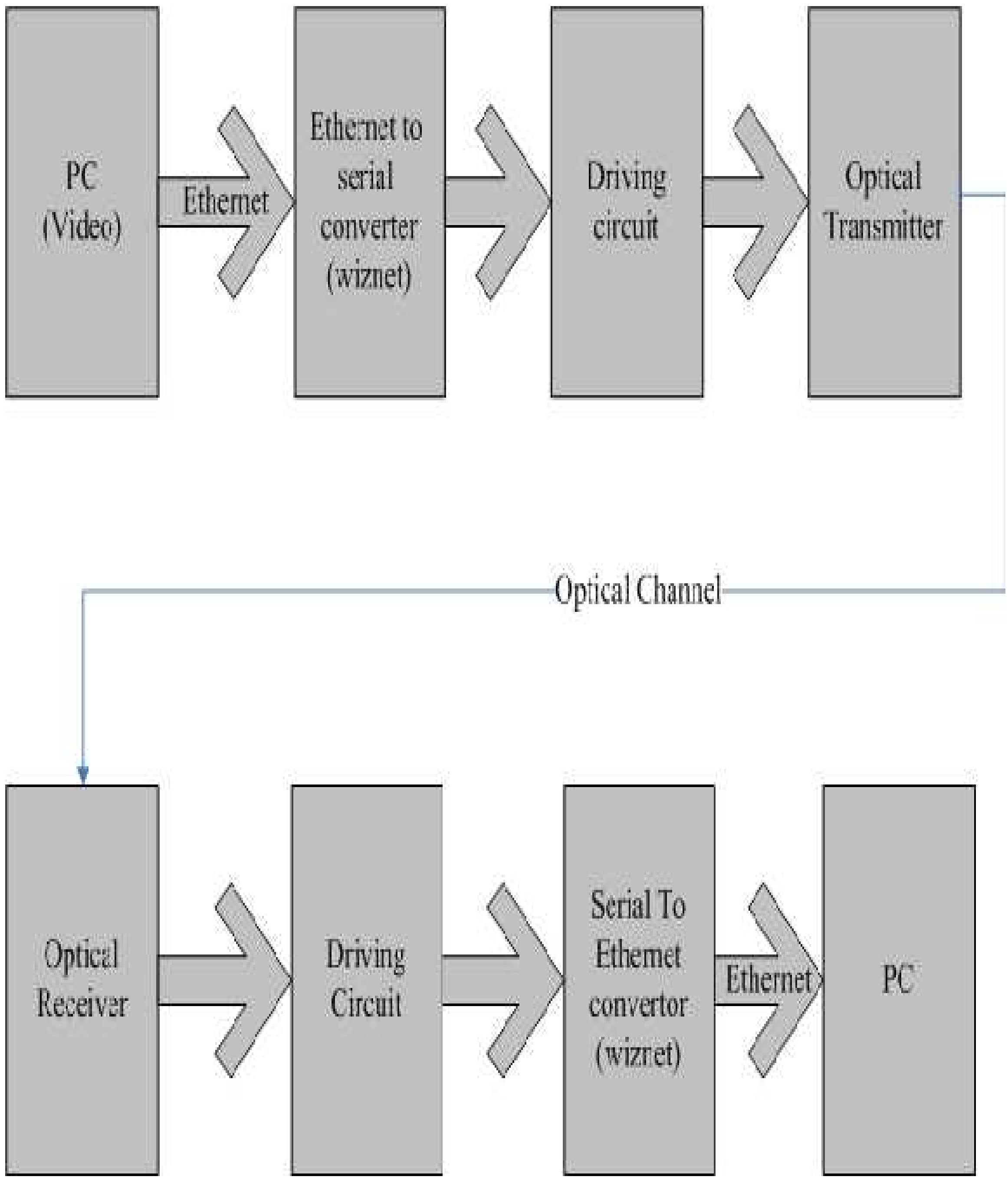


Fig (3.1) block diagram of project

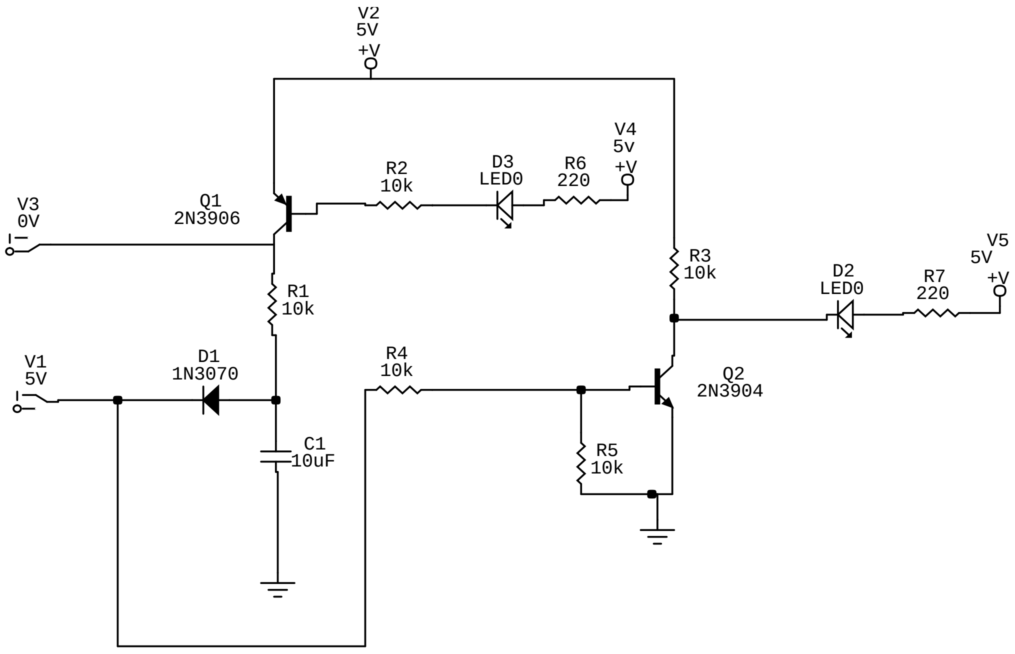


Fig (3.2) RS232 shifter

3.3 Optical Transmitter:

Optical transmitter is an important part of optical fiber communication system that convert the electrical signal into optical form, and to launch the resulting optical signal into the optical fiber.

3.3.1 Transmitter Driving Circuit:

The driving circuits depend on the application requirements data format, and the light source LED can be driven by suitable current source, however, semi conductor laser must be biased to current level near threshold and then modulated through an electrical time dependent signal.

The optical transmitter consists of an optical source, multiplexer, a modulator and a channel coupler.

Semiconductor laser or light emitting diode are used as optical source because of their compatibility with the optical- fiber communication channel.

The driving circuit is designed to supply a constant bias current as it supply the modulated electrical signal, and in order to keep the average optical power constant we use a servo loop as shown in fig. 3.3.

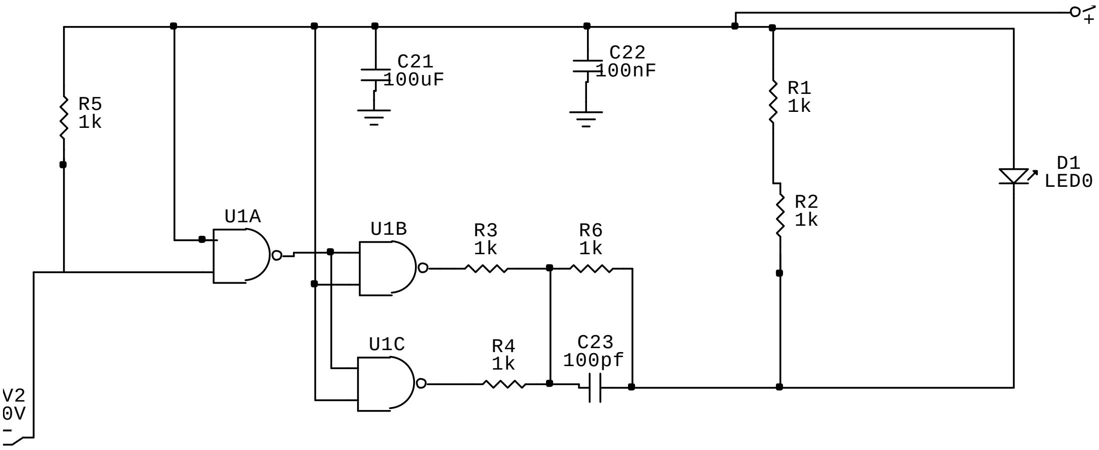


Fig (3.3) the driving circuit of transmitter.

In this simple drive circuit that control the average optical power through feed back mechanism, a photo diode monitors the laser output and generates the control signal which used to adjust the laser bias level.

In the drive circuit shown in the fig the signal represented by a voltage of +5V corresponding to the binary datum 1, and by a voltage of 0V corresponding to the binary datum 0, is applied to a network of NAND gates. These three gates are connected as inverter: the first one acts as separation buffer, but the other two gates are connected in parallel and generate a certain current quantity.

The driving circuit can be connected to the led, and the resistor R6 has been connected to obtain the current value across the led's.

3.4 Optical Receiver:

Receiver is an important device in optical fiber communication systems that convert optical signal into electrical signal to recover the transmitted signal.

The coupler focuses the received signal onto the detector.

The detector is used to convert optical signal into electrical signal according to converting the variation of power into a varying electrical current.

There are many types of photo detector such as phototransistor, photomultiplier, and photodarlingtons but the suitable one can be used in fiber system is semiconductor photodiodes.

3.4.1 Receiver Driving Circuit:

The optical signal carried by the fiber is detected by the PIN photodiode included in the detector. The photodiode generates a current proportional to the incident radiation. The trans-impedance amplifier, assembled inside the same detector, supplies an output voltage proportional to the input current.

The detector can be connected to the following circuit. The voltage signal is amplified and squared by three consecutive gates (IC-8MC10116) and it is applied to the converter (transistor T8-T9) in fig. 3.4.

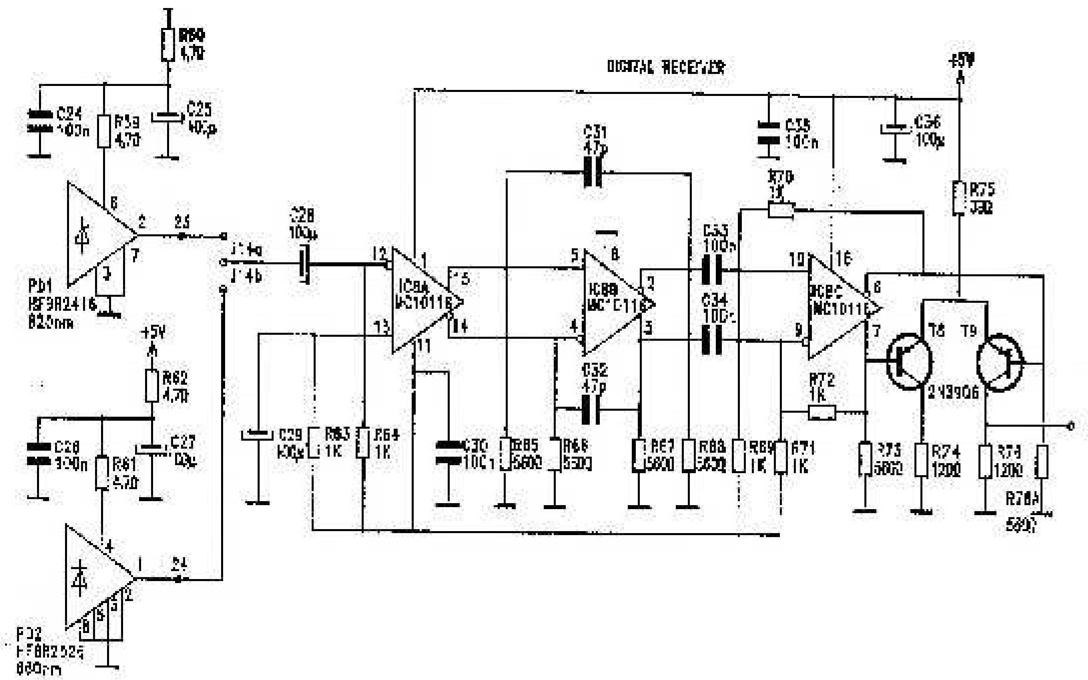


Fig (3.4) equivalent circuit of optical receiver

The photodetector is coupled in AC or DC to the amplifier, and the capacitor blocks the direct current offset. This prevent the passage of a possible direct current offset superimposing the signal. This can be obtained through the use of coders .

3.5 WIZ110SR:

WIZ110SR is a protocol converter that transmits the data sent by serial equipment as TCP/IP data type, and converts the TCP/IP data received through the network into serial data to transmit to the equipment.

Fig 3.5 WIZ110SR Board.

When the data is received from serial port, it is sent to W5100 by MCU. If any data is transmitted from Ethernet, it is received to the internal buffer of W5100, and sent to the serial port by MCU as shown in fig 3.6. MCU in the module controls the data according to the configuration value that user defined.

RJ45 Ethernet cable can be used to connect the WIZ110SR to the network, cross over serial cable to connect it to the serial device, and Connect 5V DC adaptor for power supply.

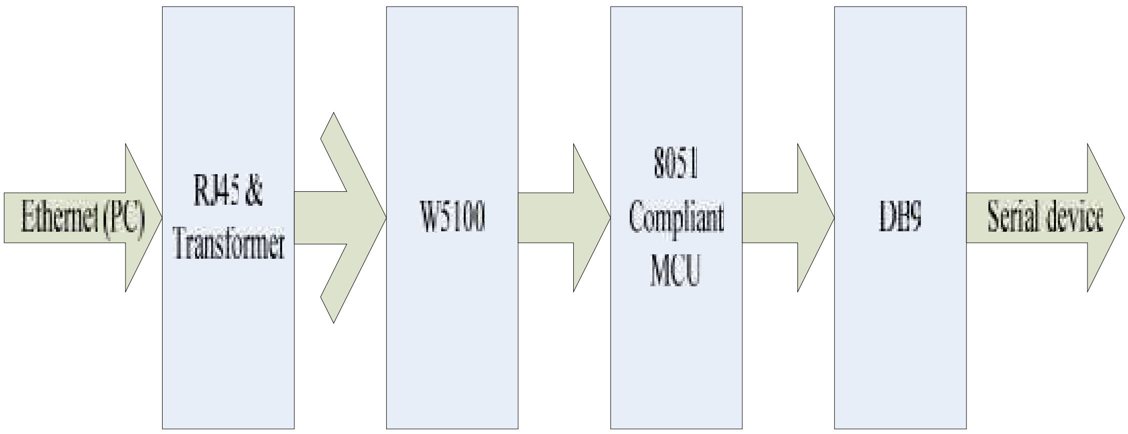


Fig (3.6) block diagram of WIZ110SR Board.

3.6 Project Software:

In this project a single connection between two computers is made, so that the TCP/IP socket is created to send and receive video files, In other words, the socket is bidirectional.

After creation of the socket the configuration of socket such as IP address and port number can be determined, then get data to send it or implement read function.

Socket is the combination between IP address of the host or network interface and port number which has been assigned to it as shown in figure 3.7.

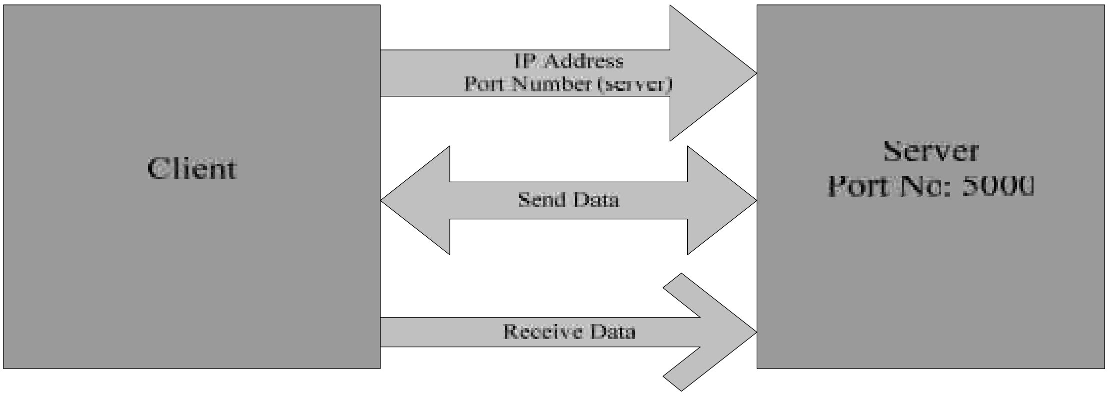


Fig (3.7) socket block diagram.

TCP/IP is referred to transmission control protocol internet protocol, TCP/IP socket is a stream socket that means TCP/IP is considered to be a long stream of data that is transmitted from one end of the connection to the other end and another long stream of data flowing in the opposite direction, and TCP/IP is connection based protocol where the two ends of the communication link must be connected at all times during the communication.

TCP/IP is reliable socket this means that the packets that are sent by TCP/IP contain a unique sequence number, the starting sequence number is communicated to the other side at the beginning of communication, the receiver acknowledges each packet, and the acknowledgment contains the sequence number so that the sender knows which packet was acknowledged, this implies that any packets lost on the way can transmitted (the sender would know that they did not reach their destination because it had not received an acknowledgment). Also packets that arrive out of the sequence can be reassembled on the proper order by the receiver. Further, timeouts can be established because the sender knows (from the first few packets) how long it takes on average for a packet to be sent and its acknowledgment received.

The software details is describe in the following flow chart.

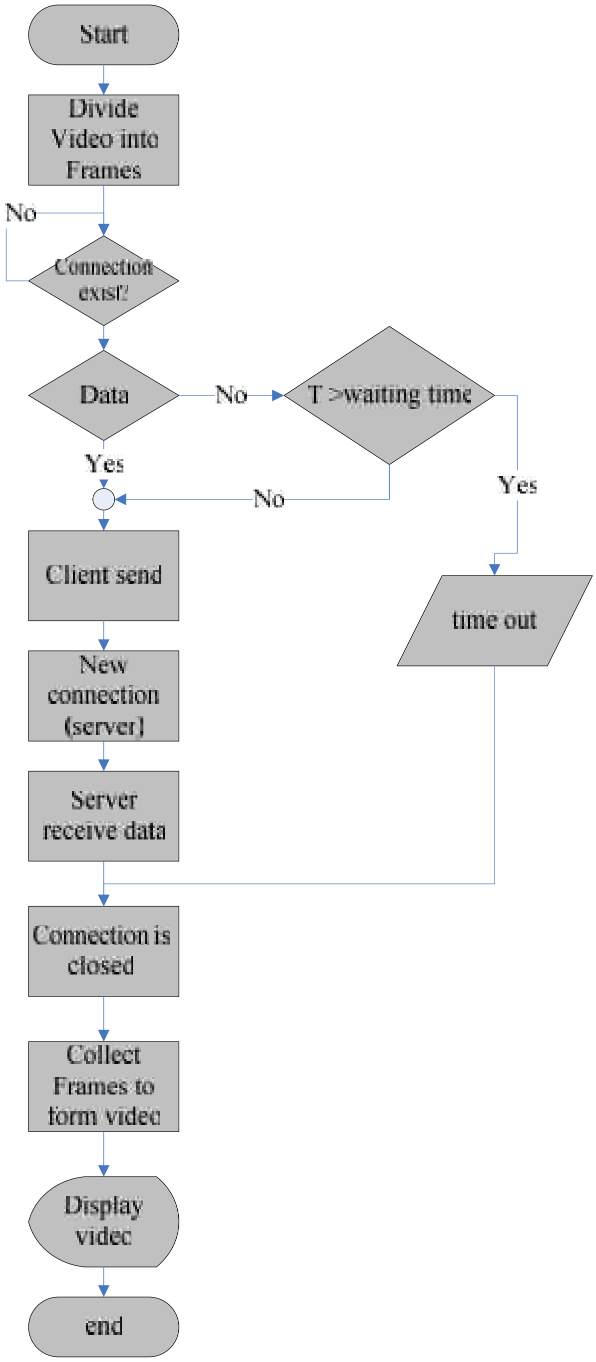


Fig (3.8) Project software flow chart.

The client mode is chosen for computer devices and the wiz110sr board as server in the first side that located before optical module and at another side that located after the optical module the PC is chosen as server and wiznet as client.

At the TCP server mode, WIZ110SR waits for the connection requests. In normal time WIZ110SR is on the waiting status, and if there is any connection request from the monitoring center, the connection is established, and data communication is processed. Finally connection is closed. In order to operate this mode, Local IP, Subnet, Gateway Address and Local Port Number should be configured first. As illustrated in figure 3.9, data transmission proceeds as follows:

1-The host connects to the WIZ110SR which is configured as TCP server mode.

2-As the connection is established, data can be transmitted in both directions from the host to the WIZ110SR, and from the WIZ110SR to the host.

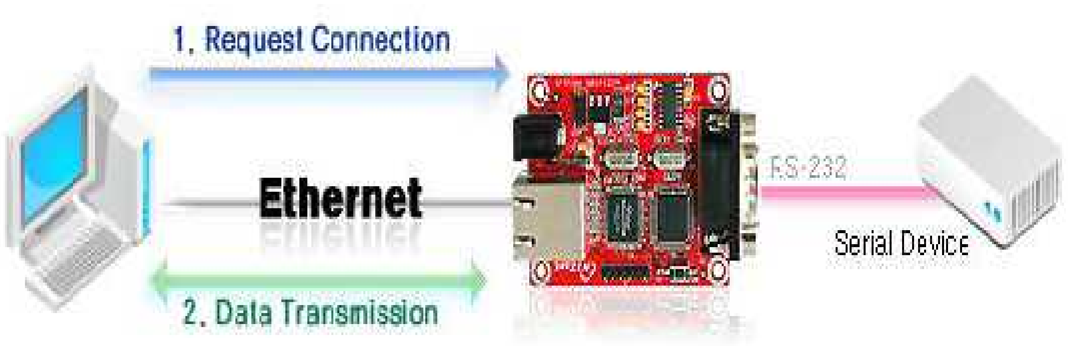


Fig (3.9) TCP server mode.

If WIZ110SR is set as TCP client, it tries to establish connection to the server. To operate this mode, local IP, subnet, gateway address, server IP, and server port number should be set. In TCP client mode, WIZ110SR can actively establish a TCP connection to a host computer when power is supplied. As illustrated in figure 3.10, data transmission proceeds as follows:

1-As power is supplied, WIZ110SR board operating as TCP client mode actively establishes a connection to the server.

2-If the connection is complete, data can be transmitted in both directions from the host to the WIZ110SR and from WIZ110SR to the host.

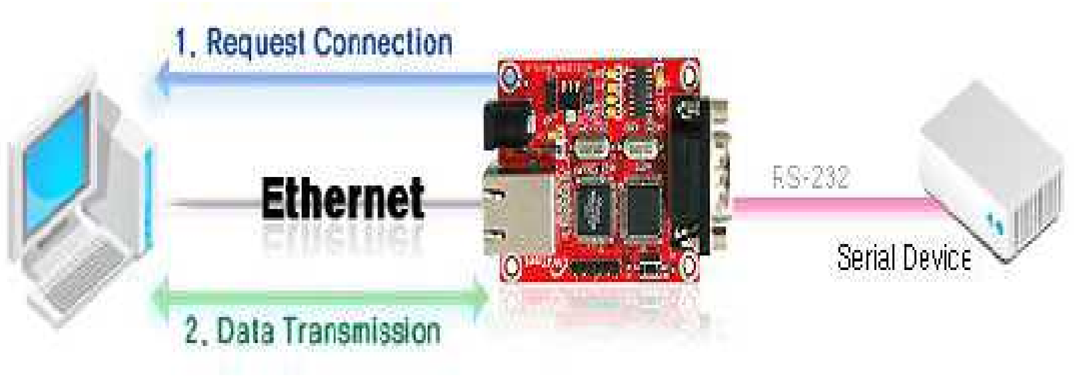


Fig (3.10) TCP client mode.

The socket makes the network connection in the sequence as shown in figure 3.11 and steps in follow:

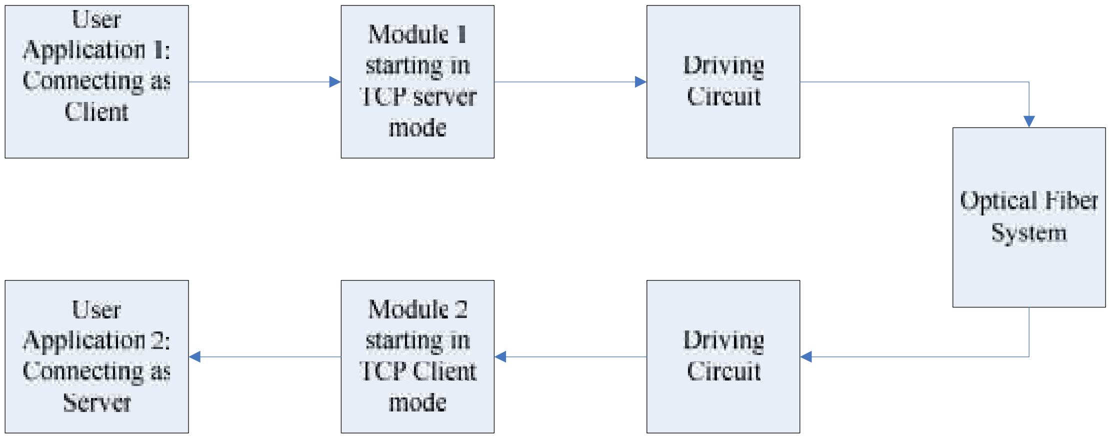


Fig (3.11) Network connection.

1- Module1 starts up in TCP server mode:

In this mode module 1 just waits for connections from client.

"User application 1" starts as client and attempts to connect to module1 using module1 IP address and port Number.

2- Module1 establishes the connection with "User application 1".

3- "User application 1" starts the transmission of data

4- Module1 receives the data from "User application 1" through the Ethernet port.

5- Module1 stores the received data in a buffer

6- Module1 then transfers the data from the buffer to the serial port.

7- Module2 receives the data on the serial port and sends it directly to the Ethernet port.

8- Using “User application 2” IP address and port no, Module2 attempts to connect with “User application 2” as a client

9- “User application 2” establishes the connection with module2.

10- Module2 starts the transferring of data received from the serial port to “User application 2” through the Ethernet port.

11- Module2 receives the data and stores it in a buffer and then to a file on the disk

The configuration tool program used for configure the wiznet board at different modes that can the board operates on them. By using this program we can specify some configuration such as IP adders, port number, subnet, gateway and others.

In this project we use server and client modes, and determine the IP adders and port number by using the configuration program as shown in fig 3.12.

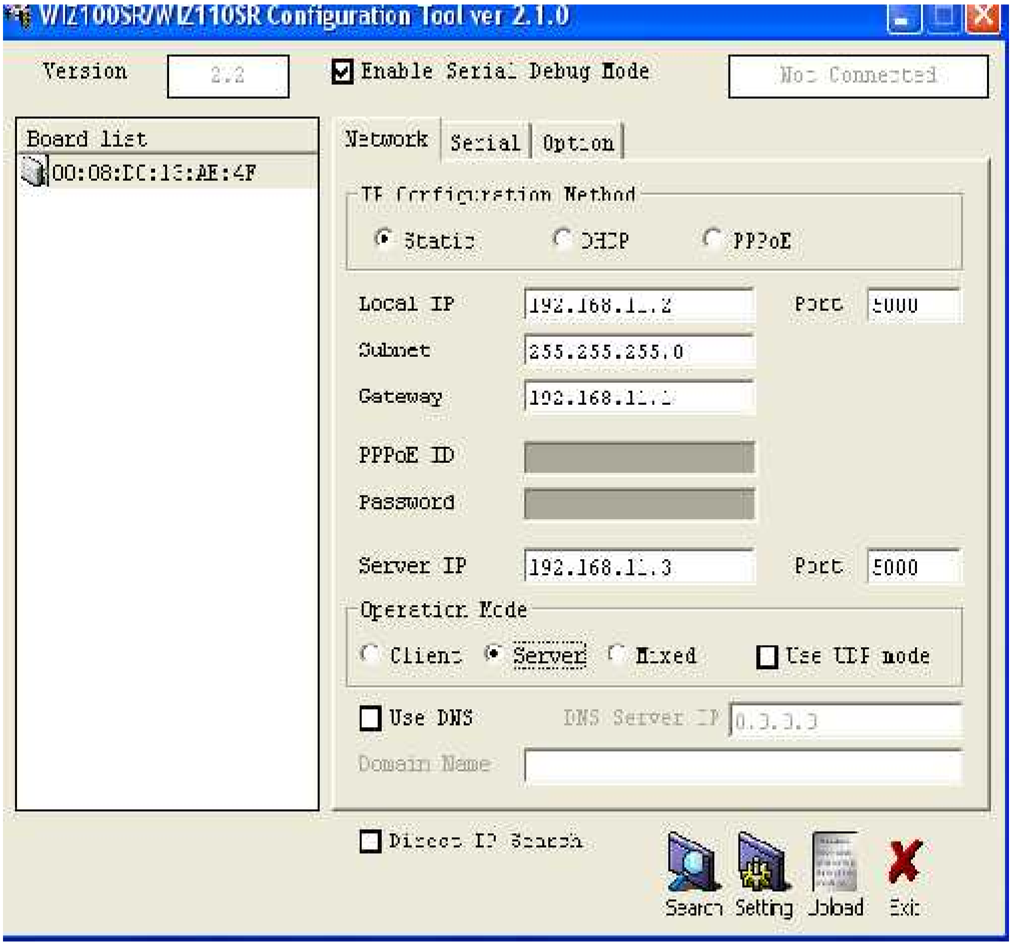


Fig (3.12) configuration in server mode.

Chapter 4

Video Transmission

4.1 Introduction.

4.2 Video Transmission Requirements.

4.3 Video Programming Technical.

4.4 Transmission Media.

Chapter Four

Video Transmission

4.1 Introduction:

Video signals transmission is complicated than sending of voice or data.
Digital systems convert the time varying electrical signal into streams of 0's and 1's that represents the binary data.

Video signals encode continually the picture and sound changing. The image of video principles based on the scanning, and the picture contains many parallel lines with different intensity along the line.
Video signal consists of three primary colors, blue, red and green and each color has electron beam differ from the other beams. Also the video signal contains the voice and synchronization signal.

Video signal contains the information that required to draw the lines. These lines have different intensity along the lines.
The signal through the lines can transmit point by point from one line to another.
The video signal encodes the color, brightness and sound of each point.
The way that the signal carries information depends on the format of encoding.

4.2 Video Transmission Requirements:

Video signal require more transmission capacity than voice and digital data.
data rates can be reduce by a factor of 10 to 60 for video transmission, by using sophisticated digital compression and they depend on the picture series transmission, so that the single images cannot compressed much. Transmitter talk to receiver, so that video signals can be transmitted in standardized formats.
Video is transmitted at 50 to 550MHz. the video bandwidth extend from 0 to 5.5MHz.
Video transmission generally is over single mode fiber at 1300 or 1550nm.

4.3 Video Programming Technical:

The video file has been divided into files which represent the successive photos (frames) that make the video picture, using matlab we use a block diagram shown in fig 4.1 for the division task.

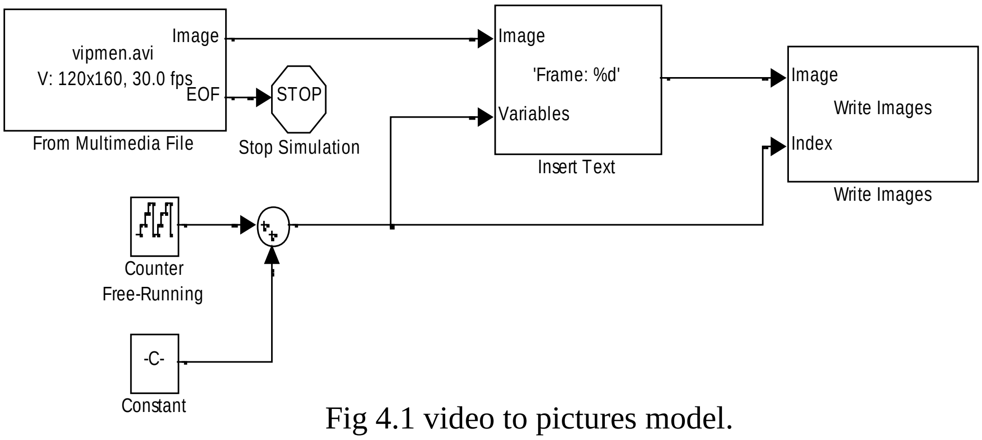


Fig 4.1 video to pictures model.

In this model the wanted video file is indicated to transfer and the folder where to save the output photos, the counter count the number of the frames and using the socket program to select the file which contain the photos to send it to the special IP number and the port number to the wiznet, the socket send the photos from the file in order.

The following flow chart in fig 4.2 shows the sequence process on the video file to obtain the sequence frames.

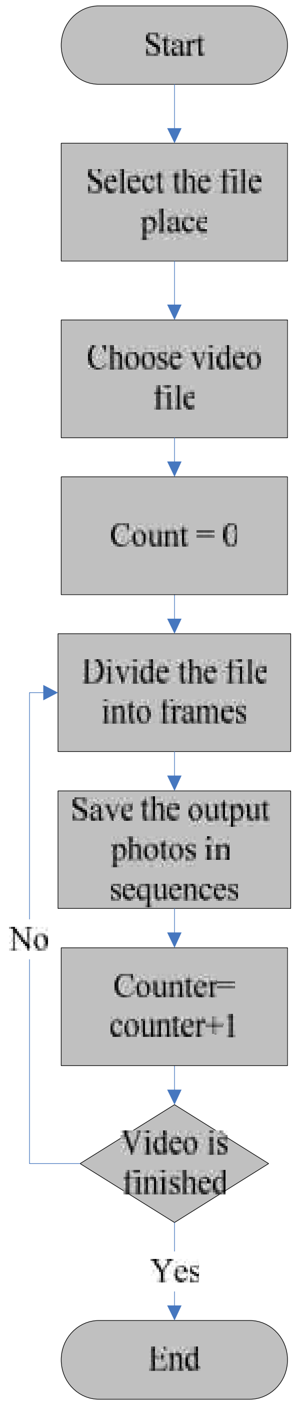


Fig (4.2) division flow chart.

And in the receiver side, the socket receives the sent photo and by downloading it in a given folder in the same order, the transmitter sends it and using files to video model which shown in fig 4.3, we can rearrange the photo and display the video.

In this model the read image block reads the images in a successive order to return to the counter value until it reaches the specified end value which detects the final photo which mean the end of the movie.

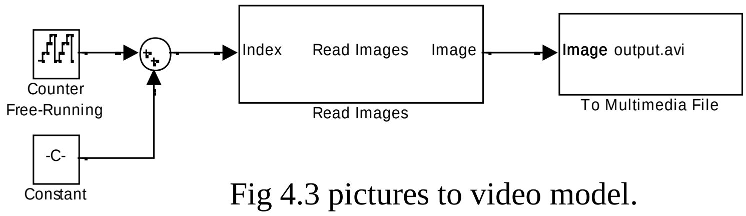


Fig 4.3 pictures to video model.

The flow chart that describes the frames rearranges process to form the video file is shown in fig 4.4.

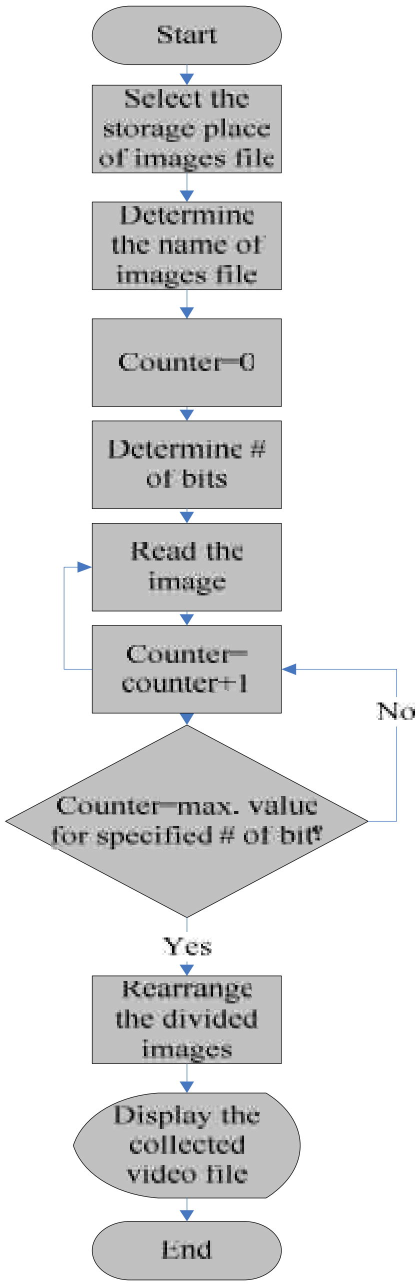


Fig (4.4) frames rearrange process.

4.4 Transmission Media:

Fiber optics is the transmission media that can be used in this project. Video transmission through fiber requirements vary widely and also requires high quality of transmission.

Fiber transmission has many advantages such as light weight, small size, high signal quality, long transmission distance, and immunity to electromagnetic interference, also offers more subtle advantages, notably avoiding the need to adjust transmission equipment to account for differences in cable length.

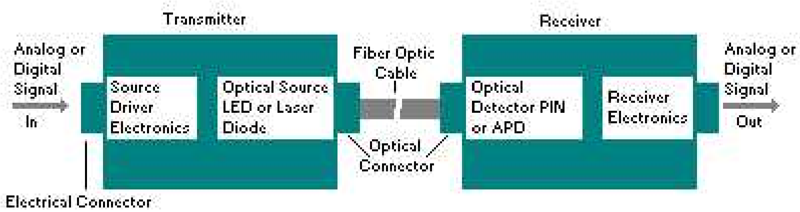


Fig (4.3) optical communication systems

Chapter 5

System Test

5.1 System Technique.

5.2 Conclusions.

5.3 Future work and recommendation.

Chapter five

System test

5.1 Test Technique:

To test the project hardware part by part, the following procedure have been done:

1-first we connect the two converters serially, using cross over cable as shown in the fig 5.1.

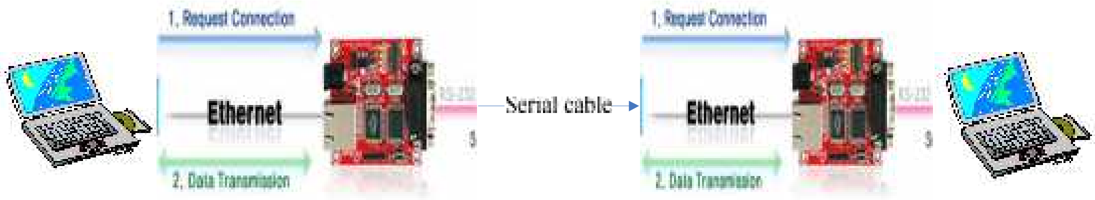


Fig (5.1) first test connection.

The file in this way received successfully with unaffected losses. Also all types of data such as text, photos, and video files can be transmitted without any problems.

2-to examine the driving circuits with the converters; connect the converter with the driving circuit to the transmitter side and to the receiver side, also we connect Tx with Rx of the driving circuit as shown in the fig 5.2

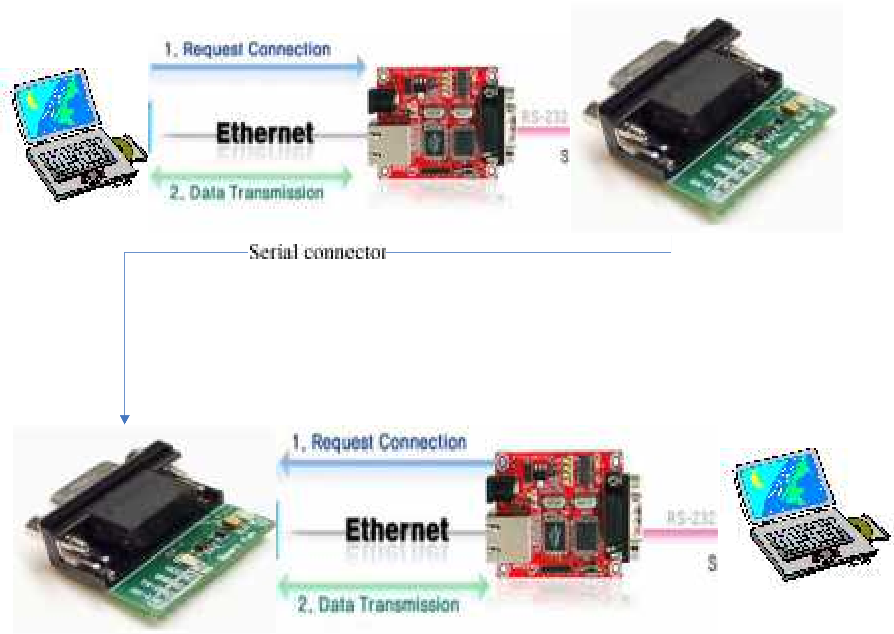


Fig (5.2) second test connection.

This test also was successfully to send and receive all types of data, these two tests shows that the software is work correctly and the hardware (converter and driving circuits) is also work in the desired way.

Also the received signal monitored on oscilloscope, and we take a video signal that shown in fig 5.3 as example.

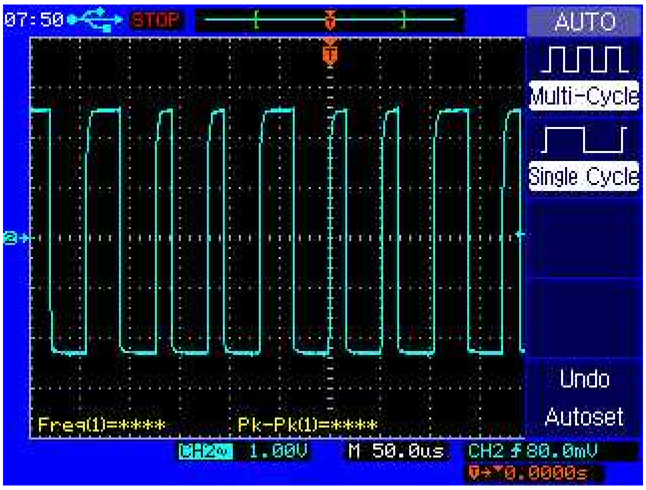


Fig (5.3) video signal.

In this case the input and output signals are the same.

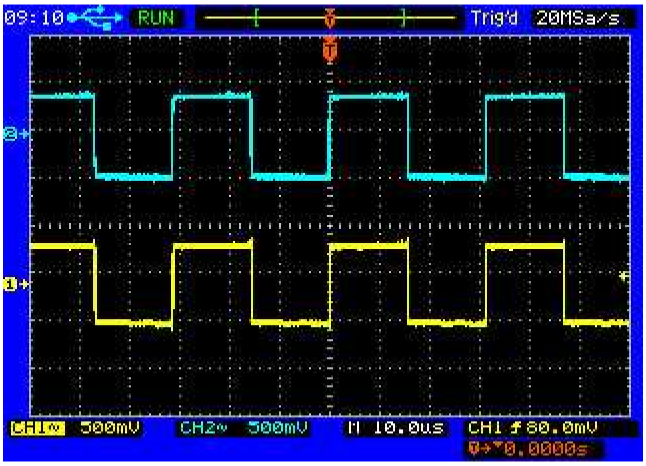
3- at this test the fiber optic cable was connect between the led in the optical fiber transmitter and the photo detector in the receiver.

This test is divided into cases; the first one was occur when the internal digital data was used for generator as shown in fig 5.4.

Fig (5.4) third test connection.

In this case the received signal can monitored on oscilloscope without any problems and the test was successfully.

Also we examine the fiber by send digital signal generated by internal source in the same module and receive the same digital signal, the result is observed on oscilloscope is shown in fig 5.5, where the blue signal is the signal before the optical source and the yellow one is the signal after the digital receiver.



Fig(5.5) the internally sent and received data.

The second case was occur when the external data for generator was used as shown in fig 5.6.

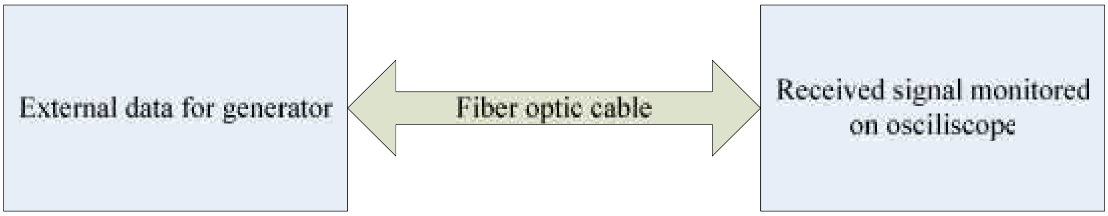


Fig (5.6) fourth test connection.

Also in this case the signal monitored on oscilloscope without any problems.

The results of this test show that the fiber is perfect medium to transfer data with unnoticed loss.

The little noise is notice in the system if the two signal maximized and compare it, as shown below in fig 5.7.

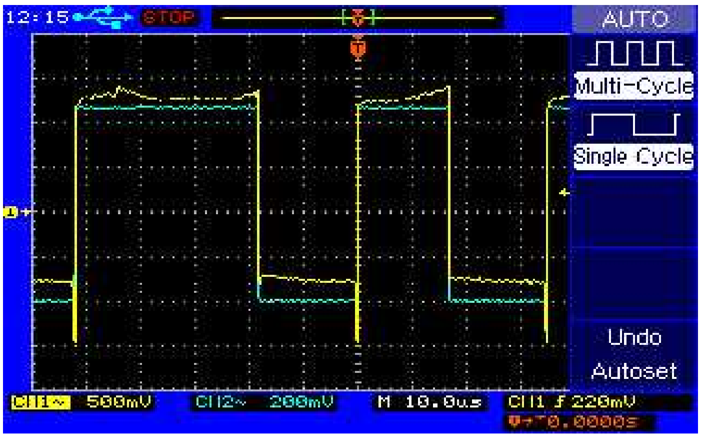


Fig (5.7) noise in fiber.

4-at final test we connect the fiber serially between the transmitter and the receiver as shown in the figure below.

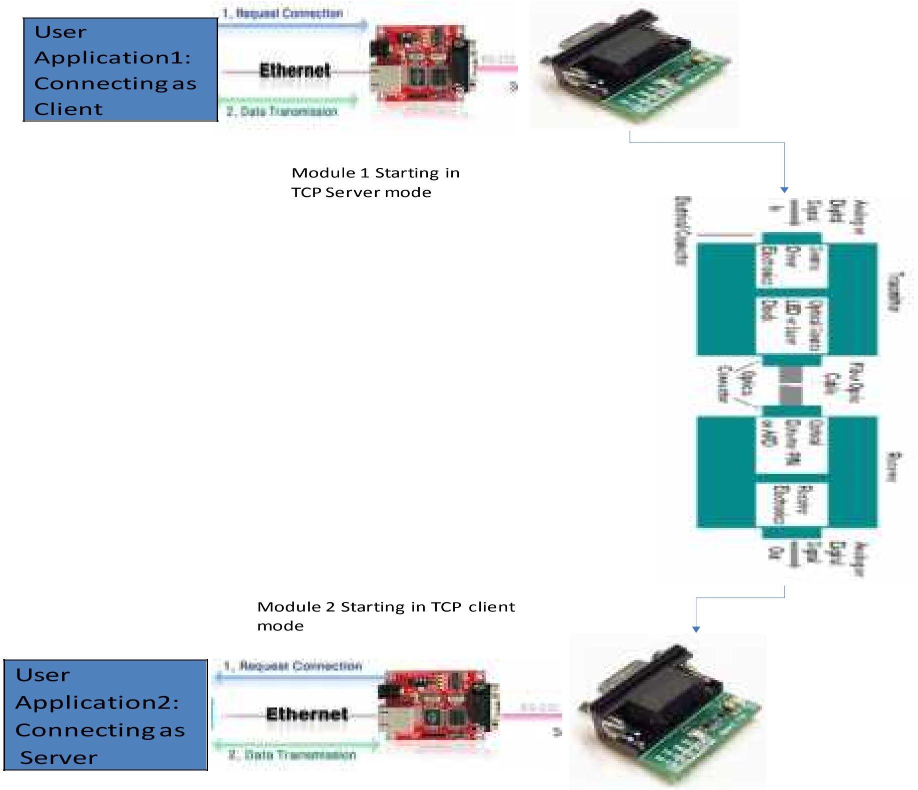


Fig (5.8) fifth test connection.

We send a 4MB text file over the fiber as the experiment, the input (yellow) and output (blue) signal monitored on oscilloscope, these signals shown in fig 5.9.

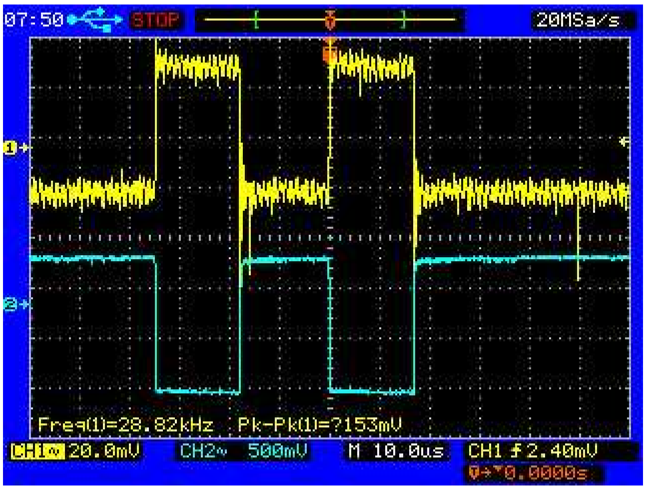


Fig (5.9) the text input and output signals.

- The input signal is very noisy signal, this noise affect the received signal and the received file on the server is open, but the error on received file occurred with high probability about 7%.
- this file took 16 sec for transmission, but it was take 5 sec in the first and second test.

Also we send video over the fiber and the result that monitored on the oscilloscope is shown in figures 5.10, 5.11.

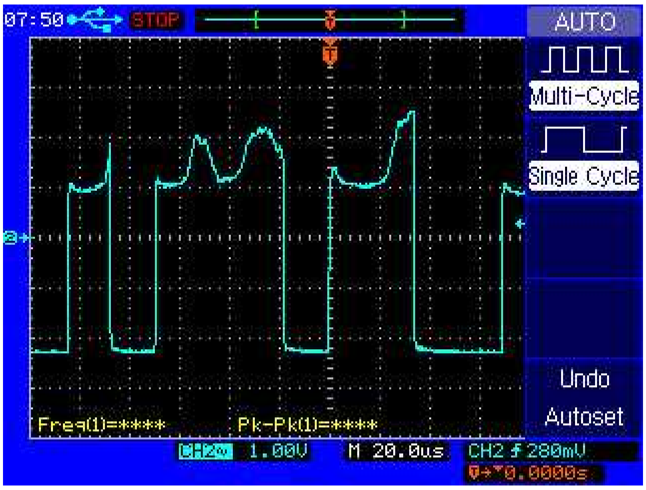


Fig (5.10) input signal.

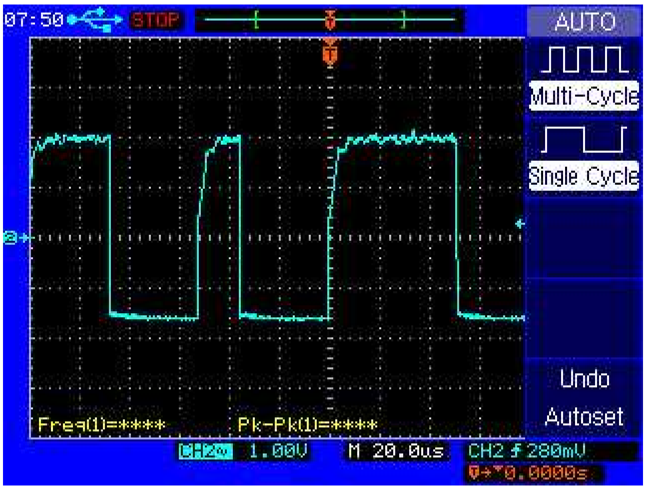


Fig (5.8) output signal.

The input and output signals are distorted since the existence of very high amplitude noise (2 volts), so that the signal can monitored on the oscilloscope but the received video file corrupted due to high noise.
Video file size is 8.85MB and took about 45 sec for transmission but it is takes 12 sec in the first and second test.

5.2 Conclusions:

-The work with fiber optic needs a very accurate and intensive care.

-The electronic components in the transmitter and the receiver circuits affect and reduce the speed of the optical fiber communication systems such as MC10116 which is a low speed amplifier exists in digital optical receiver when it is compared with the other types of amplifier that used for the same task, then to improve the efficiency of systems we can use a high speed amplifier types such as MC10216 is used instead of MC10116.

 - The optical module that exists in university communication lab use the led in transmitter circuit, to improve a fiber optic communication system efficiency we need very high speed laser instead of led, and to reduce the error effect in optical systems you need a laser with relatively high power and photo detector with high sensitivity, and in this way we can send data with low probability of errors.

- A little noise occurs in the system when we send data internally using the module fig. 5.12 shows the rise time for the sent signal and the received signal and it is found about 30nsec (similar).

Fig (5.12) rise time for the sent and received signal.

- The optical systems speed is vary high but practically the designed project governed by speed of the driving circuits (RS232 shifter board speed is 115.2 Kbps), transmitter /receiver circuits. and the Ethernet- serial converter (Wiznet speed is 230 Kbps).

And to improve the optical system speed the electronics components of the transmitter and the receiver with high speed parameter, for example the laser itself determines the speed of the transmitter circuit, in real fiber optics communication systems a powerful and a very high speed lasers are used which improve the speed of the systems.

5.3 Future work and recommendation:

1- The optical communication systems is very important in today communication systems, and working with such systems is very good to improve engineering skills if the equipment and module is supported in good manner. Unfortunately, the university module is bad to use and needs maintenance to work in a good way.

So, we recommend that the university should supply a good one for the students.

2- Also since the work using optical systems have a good advantage over all communication media we recommend that communication student should work in this field.

3- Reduce the fiber cable bending as possible to improve the random slopes time, and so the bits will become reach faster and more accurate.

I have found out that whoever wrote something today, he would say tomorrow : if I have changed this, it would be better or if I have added to it, that would be more helpful. Or if I have moved this information, that would become better or if I have left this information out, it would be more beautiful. These are a proof of deficiency of humans. And to improve this work the following future work can be done:

1- Design a high speed transmitter and a high speed receiver to make use of the speed advantage of the fiber, and then to get high speed fiber optical communication systems.

2- Improve the speed of the serially converter to fit the optical systems speed.

3- design software program that check the received data using digital signal processing like parity and correct it, in this way the efficiency of the system is improved.

4- make a good contact between metals and glasses to kill the noise, since the optical fiber module is very noisy module.

Appendix A

Socket Program:

1- Connection code:

```
package network.clientserver;

import java.net.Socket;
import java.io.OutputStream;
import java.io.InputStream;
import java.io.IOException;
import java.net.UnknownHostException;
import java.io.FileInputStream;
import java.io.FileOutputStream;
import java.io.File;

public class Connection {

     private OutputStream os;
     private InputStream is;
     private Socket socket;
     private String ipaddress;
     private int portNo = -1;
     private String dir;

    public String getDir() {
        return dir;
    }

    public void setDir(String dir) {
        this.dir = dir;
    }

     public Connection(String ipaddress, int portNo){
         this.ipaddress = ipaddress;
         this.portNo = portNo;
try{
             this.socket = new Socket(this.ipaddress,this.portNo);
             os = socket.getOutputStream();
             is = socket.getInputStream();
         }
         catch(UnknownHostException e){
              System.out.println("unknown host");
          }
          catch(IOException ioe){
              System.out.println(ioe.getMessage());
          }
     }
```

```
public Connection(Socket socket){


        this.socket = socket;
    try{
    os = socket.getOutputStream();
    is = socket.getInputStream();
    }
    catch(IOException ioe){
      ioe.printStackTrace();
    }

}

public void sendFile(String filename){

    File file = new File(filename);
   try{
    FileInputStream input = new FileInputStream(file);

    byte[] buffer = new byte[32*1024];
int bytesRead;
while ((bytesRead = input.read(buffer, 0, buffer.length)) > 0)
{
  os.write(buffer, 0, bytesRead);
}
  os.flush();
  input.close();
   }
   catch(IOException ioe){
      ioe.printStackTrace();
   }
  this.close();

  }

public void recvFile(String shareddir,String filename){

    int value = 0;



    FileOutputStream  out=null;
     byte[] buffer = new byte[1024];
    int bytesRead;
    try{
    File file = new File(shareddir + File.separator + filename);
    out = new FileOutputStream(file);
```

```
        while((bytesRead = is.read(buffer, 0, buffer.length))>0){

        out.write(buffer, 0, bytesRead);
          value = value + bytesRead;

        }
        }
        catch(IOException ioe){
            ioe.printStackTrace();
        }
        finally{
            try{
            if(out!=null)
            out.close();
            }
            catch(IOException ioe){
                ioe.printStackTrace();
            }

        }



      }

    public void close() {
            if (socket != null) {
                try {
                    socket.close();
                } catch (IOException e) {
                                            }
                socket = null;
            }
        }

   }
```

2- Connection Handler:

```
package network.clientserver;

public class ConnectionHandler implements Runnable {

    private Connection connection;
    private static int x;

    public ConnectionHandler(Connection connection){
        this.connection = connection;
        x = x +1;
    }
```

```
    public void run(){

        System.out.println("Starting new thread");

        connection.recvFile(this.connection.getDir(), "receivedfile" + x);
       }

}
```

3- server Code:

```
package network.clientserver;

import java.net.ServerSocket;
import java.net.Socket;
import java.io.IOException;
public class Server implements Runnable{

    private ServerSocket serversocket=null;
    private int port ;
    private String dir;

    public Server(int port,String dir){
        this.port= port;
        this.dir = dir;
    }

    public void run(){
        try{
        serversocket = new ServerSocket(port);
        }
        catch(IOException ioe){
            ioe.printStackTrace();
            return;
        }
while (true) {
     // s("\nServer is Ready, Waiting for requests...\n");
            //this.userinterface.sendtoText2(" ready and waiting on port " + this.port +
"\n");

      try {

        Socket connectionsocket = serversocket.accept();
       // this.userinterface.sendtoText2(connectionsocket.toString());
        connectionsocket.setSoTimeout(1000);
        Connection conn = new Connection(connectionsocket);
        conn.setDir(dir);
        System.out.println("Client is connected");
```

```
        new Thread(new ConnectionHandler(conn)).start();

      }
        catch(Exception e){
            System.out.println(e.getMessage());
          // this.userinterface.sendtoText2(e.getMessage());
        }

        }

    }

}
```

4- Start as client code:

```
package network.clientserver;
public class StartAsClient {

    public static void main(String[] args){

        Connection conn = new Connection("10.20.80.24",1234);
        conn.sendFile("/Users/Mohammed/peer2/Flowers.jpg");
    }

}
```

5- Start as server code:

```
package network.clientserver;
public class StartasServer {

    public static void main(String[] args){
      //  Server server = new Server(1234);

     //  server.start();

    }

}
```

Matlab program (File to video):

Read images Code:

```
function image = imageToFile(index, imageSize)

% Allow ourselves to use functions that are not
% supported by code generation.
eml.extrinsic('fprintf', 'imread', 'gcb', ...
    'slresolve', 'sprintf', 'strrep');

% Determine the name of the file
filename     = slresolve('filename', gcb);
filename     = strrep(filename, '\', '\\');
fullFilename = sprintf(filename, index);

fprintf('%s\n', fullFilename);

% Read the image.
im = zeros(imageSize, 'uint8');
im = imread(fullFilename);

% If the image is greyscale, turn it into RGB.
nColorPlanes = size(im, 3);
if nColorPlanes == 1
    image = repmat(im, [1 1 3]);
else
    image = im;
end
```

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