

OPTICAL USB CABLE USING CONTROLLED FIBER POSITIONING

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Abstract—Fiber optic systems are important telecommunication infrastructure for world-wide broadband networks. Wide bandwidth signal transmission with low delay is a key requirement in present day applications. The position of an optical fibers is controlled so that the fiber is not bent at a radius below its minimum bend radius. Presented module connects peripheral device with a computer via USB cable. Optical USB Communication protocol is used for long distances which are used for Communication between point to point and point to multipoint. Fiber does not radiate any of the signals it communicates the way copper based transmissions do. It cannot be proximity monitored nor cause interference to any adjacent electronic equipment. Sensitive military and corporate applications are now widely deploying fiber for even the shortest transmission distances. It is also used in many applications such as high speed cable internet access and optical storage systems. We are going to implement and demonstrate prototype of Optical USB (2.0) system for long distances by using PIC microcontroller to a PC via the USB port using fiber.

Index Terms— Serial Communication, PIC Microcontroller, Power supply, Drivers ckt, USB port, Networking.

I. INTRODUCTION

Today, the most widely used optical technology is optical fiber for high-speed interconnections, such as in server racks, connecting offices, buildings, metropolitan networks, and even continents via submarine cables. The term “photonics” is taken to cover all applications of light technology, from the ultraviolet part of the spectrum, through the visible, to the near-, mid- and far-infrared. Photonics is increasingly being used in data communication because it provides more ultra-high-capacity and speed in storage, communication and computation[1].

The purpose of this project is to explain how to interface a PIC microcontroller to a PC via the USB port and the concepts are universal. USB is a system for connecting a wide range of peripherals to a computer, including pointing devices, displays, and data storage and communications products. USB 2.0 with a data rate of 480 Mbit/s is commonly used. In this system, an USB host and an USB device are connected via a cable. USB is a system for connecting a wide range of peripherals to a computer, including pointing devices, displays, and data storage and communications products.

In this project, PC is used as data generator. PC contains software like terminal. in which baud rate is set to be 9600bps. If user enters character on PC it will be sent to USB to serial converter. Usb to serial converter is interfaced to PIC microcontroller's serial port. Data received serially in microcontroller will be sent out in the form of 1 0 bits to transmitting LED. Transmitting LED converts data 1 0 bits to ON OFF of light which is transmitted along optical fiber.

At receiver end photo-transistor will convert light into voltage and its sent to signal conditioning ckt. After signal conditioning signal becomes suitable to

0-5V TTL logic and then it can be interfaced to microcontroller..Microcontroller received that data serially and its displays character on LCD. USB protocol provides communication between computer and peripheral device. Its construction is based on 3 layers:(a)functional, which covers high-level relations between a computer program and a peripheral device,(b)logic, responsible for the flow of data stream, (c)physical, including wires, connections, analog devices.[2] Physical connection consists of 4 wires – 2 for power and 2 for bi-directional differential data transmission. The same set of wires may be shared by up to 127 peripheral devices.

II. IMPLEMENTATION

Fig.1 The project has two units in it. 1st unit is transmitter unit, which consists of microcontroller, driver circuit, LED, optical transmitter cable, LCD and PC. 2nd unit is receiver unit. It has microcontroller, driver circuit, optical receiver cable, LCD. PC is the important unit at the transmitter section. Through terminal or flash magic on PC, data is passed to the transmitter section through max232. For this transmission, RS232 cable or BAFO cable can be used. The microcontroller at the transmitter section is programmed in such a way that, data received is transmitted serially to LED through driver circuit and then to optical transmitter cable end. Now, through this optical fiber cable, data is transmitted to other end at receiver section. Receiver section has optical receiver L14F1 transistor. This received data is then given to signal conditioning circuit. Received data is first go through the waveform shaping using comparator IC LM358 and then to hex inverter IC 74LS04. This signal is then serially received by microcontroller at receiver section. This received data is displayed on LCD interfaced with the microcontroller PIC16F877A.

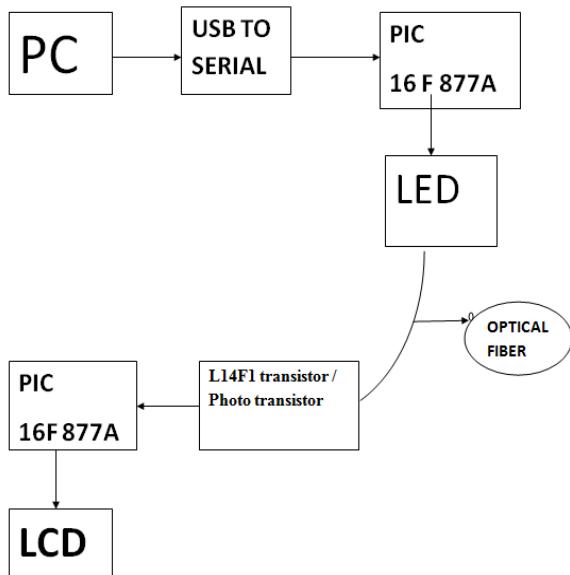


FIG1: Block Diagram of Usb to serial converter is interfaced to PIC microcontroller' serial port

III.HARDWARE DESIGN OF OPTICAL USB

A. Serial Communication: In general, there are three communication methods used in modern data acquisition systems between computer and peripherals: traditional RS232 serial port, parallel port, and universal high-speed data acquisition card. But not all these methods are ideal. Here are some examples, the transmission speed of RS232 serial port is too low to meet the requirements of real-time, the connection of parallel port is complicated, and high-speed data acquisition card based on ISA or PCI is complex and expensive. As a standard universal serial interface, the best advantages of USB interface is its high speed, feasibility, support for Plug and Play, and automatic. The USB (Universal Serial Bus) is a fast and flexible interface which can be used to connect electrical devices to a PC, and, as such, has become one of the most popular device interfaces [3]. Its merits are its ease of connection, fast data rate and the fact that most personal computers support it. [3]. A serial communications interface (SCI) is a device that enables the serial (one bit at a time) exchange of data between a microprocessor and peripherals such as printers, external drives, scanners, or mic. Serial communication is a communication technique used in telecommunications wherein data transfer occurs by transmitting data one bit at a time in a sequential order over a computer bus or a communication channel. It is the simplest form of communication between a sender and a receiver. Because of the synchronization difficulties involved in parallel communication, along with cable cost, serial communication is considered best for long-distance communication. The SCI contains a parallel-to-serial converter that serves as a data transmitter, and a serial-to-parallel converter that serves as a data receiver.

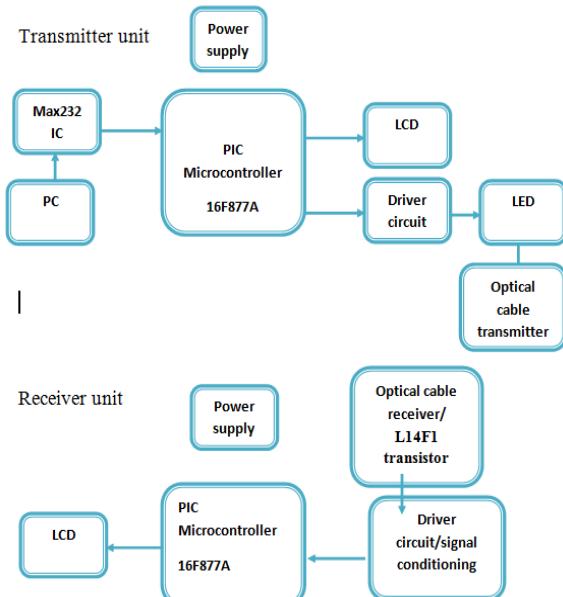


FIG2: Block Diagram of Usb to serial converter of hardware implementations

1. PIC16F877 Microcontroller:

8-bit microcontrollers with 40-pins flash microcontrollers that operate in a range 2.0 to 5.5 V at 20 MHz with internal oscillator. It has high performance RISC CPU, interrupt capability, direct, indirect and relative addressing modes, 8K flash Program Memory, 368 bytes of data Memory (RAM), 256 EEPROM data Memory, Programmable code protection, power saving sleep mode, 8-bit analog to digital converters (ADC), serial peripheral interface modules, USART, 3 timers & 5 ports. The microcontroller is well suited for this remote application, because of its low-power consumption, high speed, power on reset facility, in circuit programming & debugging.

2. RS-232 Specifications:

RS 232 is a serial communication cable used in the system. Here, the RS 232 provides the serial communication between the microcontroller and the outside world such as display, PC or Mobile etc. So it is a media used to communicate between microcontroller and the PC. RS-232 is a “complete” standard. This means that the standard sets out to ensure compatibility between the host and peripheral systems by specifying 1) common voltage and signal levels, 2) common pin wiring configurations, and 3) a minimal amount of control information between the host and peripheral systems. Unlike many standards which simply specify the electrical characteristics of a given interface, RS-232 specifies electrical, functional, and mechanical characteristics in order to meet the above three criteria. In our project the RS232 serves the function to transfer the edited notice (or data) from PC (VB software) to the microcontroller, for the further operation of the system.

3. MAX232:

MAX232 is compatible with RS-232 standard, and consists of dual transceiver. Each receiver converts TIA/EIA-232-E levels into 5V TTL/CMOS levels. Each driver converts TTL/ COMS levels into TIA/EIA-232-E levels. The MAX232 is characterized for operation from - 40°C to +85°C for all packages. MAX232 is purposed for application in high-performance information processing systems and control devices of wide application.

4. Power Supply:

Microcontroller required 5v dc power supply, We are using is lead acid 12v 1.2Ah battery to achieve this 12VDC is applied to bridge rectifier and filter circuit, then by using fixed regulator IC7805, continuous 5Vdc supply is provided to microcontroller.

5. IC7805:

The 7805 three-terminal positive regulator is available in the TO-220/D-PAK package and 5V fixed output voltage, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents

IV. SOFTWARE DESIGN AND IMPLEMENTATION

A. BER(Bit-Error-Ratio): Receiver can be determines the logic state of each transmitted bit, where BER is the bit error ratio, $E(t)$ is the number of bits received in error over time t , and $N(t)$ is the total number of bits transmitted in time t . Bit error ratio is a statistical parameter. The measured value depends on the gating time, t , over which the data is collected and on the processes casing the errors.[4,5]

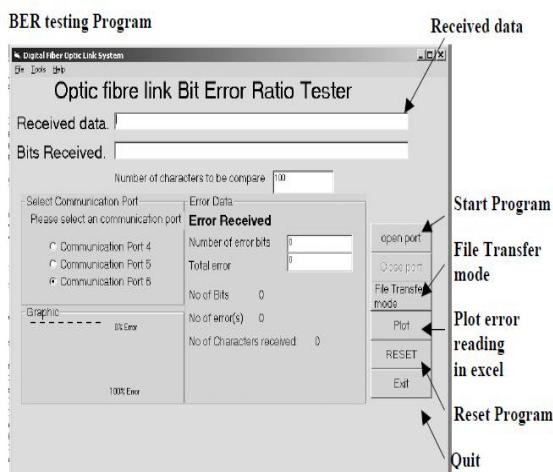


FIG 3. BER tester screen shot.

1.Mickro ICD(In-circuit Debugger):

mikro ICD is highly effective tool for **Real-Time debugging** on hardware level. ICD debugger enables you to execute a mikroC program on a host PIC microcontroller and view variable values, Special Function Registers (SFR), memory and EEPROM as the program is running

2.USART:

USART hardware module is available with a number of PICmicros. mikroC USART Library provides comfortable work with the Asynchronous (full duplex) mode. It can easily communicate with other devices via RS232 protocol (for example with PC). We need a PIC MCU with hardware integrated USART, for example PIC16F877.

3.Flash Magic: Flash Magic is Windows software from the Embedded Systems Academy that allows easy access to all the ISP features provided by the device. Flash Magic provides a clear and simple user interface.

V. ADVANTAGES

1. Fibre optic cables have a much greater bandwidth than metal cables. The amount of information that can be transmitted per unit time of fibre over other transmission media is its most significant advantage. With the high performance single mode cable used by telephone industries for long distance telecommunication.
2. An optical fibre offers low power loss. This allows for longer transmission distances.
3. Fibre optic cables are much thinner and lighter than metal wires.
4. Fibre optic cables are immune to electromagnetic interference.
5. USB 2.0 increases the productivity of user applications and allows the user to run multiple PC applications at once or several high-performance peripherals simultaneously.
6. USB 2.0 (High-speed USB) provides additional bandwidth for multimedia and storage applications and has a data transmission speed 40 times faster than USB 1.1.

VI. DISADVANTAGES

1. Cost - Cables are expensive to install but last longer than copper cables.
2. Transmission - transmission on optical fibre requires repeating at distance intervals.
3. Fragile - Fibres can be broken or have transmission loses when wrapped around curves of only a few centimetres radius.

- However by encasing fibres in a plastic sheath, it is difficult to bend the cable into a small enough radius to break the fibre.
4. Protection -Optical fibres require more protection around the cable compared to copper.

VII. APPLICATIONS

- USB cables are "Hot Pluggable", in other words you can connect and disconnect the cables while the computer is running without fear of freezing the computer
- USB cables are fast, transferring up to 480Mbps. Compare that to serial communication which transfers data at about 20Kbps
- USB cables carry power as well as signals. This allows for "USB powered" gadgets as well as recharging batteries in cameras and other USB peripherals
- USB cables are designed with several distinct connector types, making it easy to identify which plug goes into the computer and which plug goes into the peripheral device
- USB cables are a universal standard and are fairly easy to find and to afford
- The USB 2.0 specification for a Full-Speed/High-Speed cable calls for four wires, two for data and two for power, and a braided outer shield.
- One of the most significant innovations in USB over serial and parallel protocols is the addition of power to the specification. Plug in a USB device and it can be powered from the host computer
- If the USB 2.0 five-meter limit is not long enough for your needs, you can purchase one or more USB hubs or special cables. There are two types of hubs: powered and unpowered. Higher power draw devices may require a powered hub.
- USB 2.0 does not always mean High-Speed. This is usually, but not always, the case. A device labeled USB 2.0 can operate at Full-Speed instead of High-Speed.
- Pericom's USB2.0 products increase device functionality and protect circuitry from accidental damage. USB 3.0 products increase the world's leading consumer electronics interconnect to a maximum transmission speed of 5 Gbps with full-duplex capabilities. Our USB 3.0 products maintain signal integrity, support independent charging ports, and increase functionality.
- Advantages optical fiber communication system has a wide range of application in different fields namely

- a)Public network field which includes trunk networks, junction networks, local access networks, submerged systems, synchronous systems etc.
- b)Field of military applications.
- c)Civil, consumer and industrial applications.
- d)Field of computers.

CONCLUSION

By using Optical USB Protocol, we can communicate two devices for upto long distances. For its future scope we can use USB hub for the connections of multiple number of computers with each other in star topology so that we can communicate for large distances even upto 10m to 1km. Current computers are often equipped with 6 or 8 USB ports where each device connects directly with its own cable to the computer. When USB was just released, most computers were only equipped with 2 USB slots and if we wanted to connect more devices to our computer we have to use an USB hub. A hub is really nothing more than a repeater and splitter of USB signals, often with its own power supply connection which sits in between the computer and one or more peripherals. The nice thing is that the maximum USB cable length only applies to each cable segment in the system, not to the total cable length between our computer and the peripheral. If you use one USB hub, the maximum distance between the computer and the device doubles to 10 meter, because 5 meter cable is allowed from the computer to the hub, and a second 5 meter from the hub to the device

IX. RESULTS:

PC is used as data generator. PC contains software like terminal. in which baud rate is set to be 9600bps. If user enters character on pc it will be sent to USB to serial converter. Usb to serial converter is interfaced to PIC microcontroller's serial port. Data received serially in microcontroller will be sent out in the form of 1 0 bits to transmitting LED. Transmitting LED converts data 1 0 bits to ON OFF of light which is transmitted along optical fiber.

Microcontroller received that data serially and its displays character on LCD. This is how we have received data from USB and have sent it to another controller.

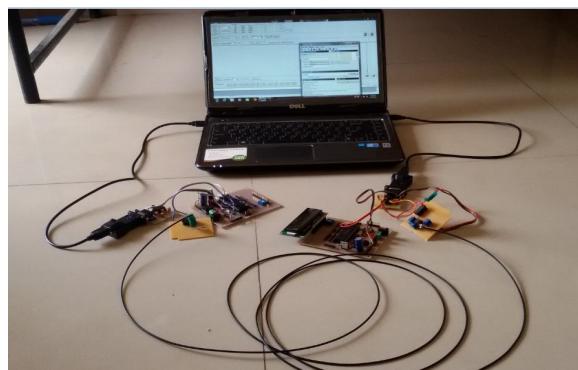




FIG 4.HARDWARE IMPLEMENTATIONS. USB TO SERIAL CONVERTER

ACKNOWLEDGMENTS

The goal of this paper is to design “Optical USB cable using Controlled Fiber Positioning “The function has been realized successfully. I wish to place on record my sincere thanks and whole hearted thanks to my guide Prof. Pagare R. A. under whose supervision this dissertation work has been carried out. It was his keen interest encouraging disposition and full co-operation that has made it possible for me to complete this work. I wish to place on record my sincere thanks and also acknowledge my indebtedness to Prof. Hendre V. S., Head of Electronics & Telecommunication Department, whose critical analysis careful comments and valuable suggestions have been immense help in completing this work. Lastly, I am thankful to all

those persons, who have contributed directly or indirectly in the completion of this project.

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