

LOW-COST LASER BASED WIRELESS AUDIO TRANSMISSION

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ABSTRACT

The aim of this project is to design and construct a low cost laser based wireless audio transmission system with more useful features. Using such system we can communicate with our neighbors wirelessly. Instead of bounded optical guided medium, free space transmission of light from a laser diode is used as the carrier signal from the transmitting circuitry. The photodiode of the receiver must be accurately oriented and aligned with the laser beam from the laser diode. No sound will be heard from the loud speaker of the receiver, if there is any obstacle in the path of the laser beam. The analog audio signal from the mobile phone is sent to the transmitter circuit through 3.5mm stereo to RCA cable. Just before the analog to digital conversion occur the two left and right channels are separated and send individually to the analog to digital module. The PCM2902 stereo audio codec with single – ended analog input/output and S/PDIF interface integrate circuit responsible for the main action of the system. The analog signal is applied to the OPA2353 operational amplifier at both starting points of transmitter and receiver for low noise. High speed operation which laser diode makes the system ideal for low cost, high speed wireless transmission of audio signals in half duplex manner.

Keywords: Laser, Free space transmission of audio, Analog to digital conversion, Digital to analog conversion

1. INTRODUCTION

Laser is being used in number of applicational fields such as military, medicine etc. Laser has its own characteristic features such as monochromatic, coherent, and the intense beam output travel in straight line. Laser is nowadays widely used as a carrier wave, which can provide alternative substitute for coaxial wire band communication systems with problem of interference faces in case of electromagnetic waves. Our project system is free from such and high deal of security is available.

Laser light can travel several hundred meters and with a parabolic light reflector, up to several kilometers¹. Although it can travel such long distance, the signal should have in features of high quality, low noise and high speed. An important advantage of transmitting audio signal with the use of laser beam is ability for better encryption. Because a laser beam is externally narrow, it is virtually impossible for someone to tap into the link without proper permission. The signaling is interrupt, if someone intercepts the laser beam. Not only for high security application but also S/PDIF interface provides high accuracy for the digital signal transmission.

Actually, there are some special integrated circuits can be used for interfacing transceiver with stereo analog to digital converter. But in here this work has used PCM2902 as it is a stereo audio codec interface transceiver with Stereo ADC. The integrated ADC within the PCM2902 is capable of supporting 16-bit data from 8 kHz up to 48 kHz. The signal-to-noise ratio (SNR) of the ADC module at 48 kHz is 89dB. Also it can be powered with a 5 V source. And the signal-to-noise ratio of the DAC module at 48 kHz is 96 dB with the same power as ADC².

Here, the PCM2902 stereo audio codec integrated circuit is used for both transmitting and receiving units. TPS73701 voltage regulator is used for power supply and OPA2353UA dual Op- amp is also used to low pass filtering method which continuously filter the audio signal and transmit and low noise high speed transmission of the signals.

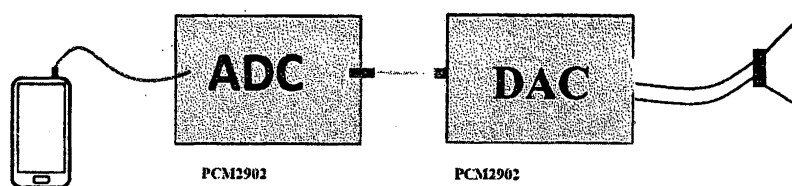


Figure 1: Wireless Audio signal transmission system block diagram

2. EXPERIMENTAL

2.1. Methodology

The proposed system consists of three major units. They are;

- Transmitting Unit
- Channel Unit
- Receiving Unit

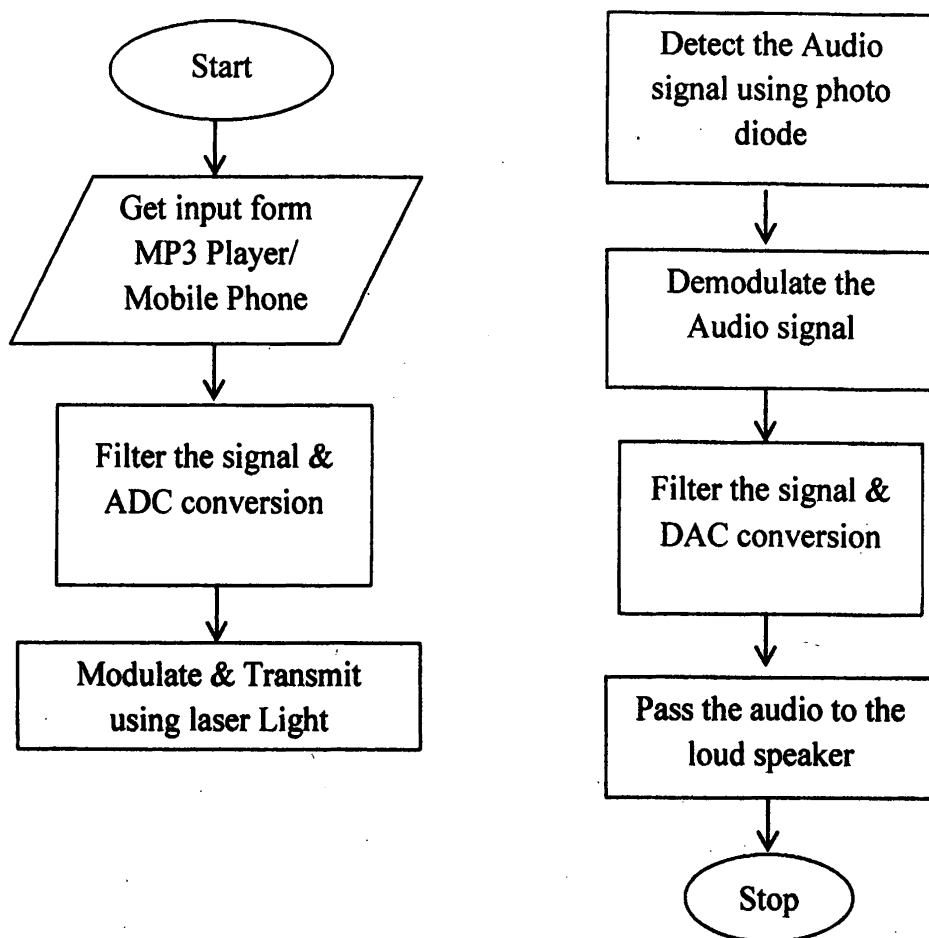


Figure 2: Flow chart of the proposed Transmitter and Receiver

The transmitting Unit comprises TPS73701 low drop out voltage regulator for power supply, OPA2353 dual operational amplifier modulate the signal for low noise high speed transmission and PCM2902 for interfacing the analog signal with S/PDIF and analog to digital conversion and digital to analog conversion. The circuit diagram of the both transmitting and receiving units for proposed system are given below.

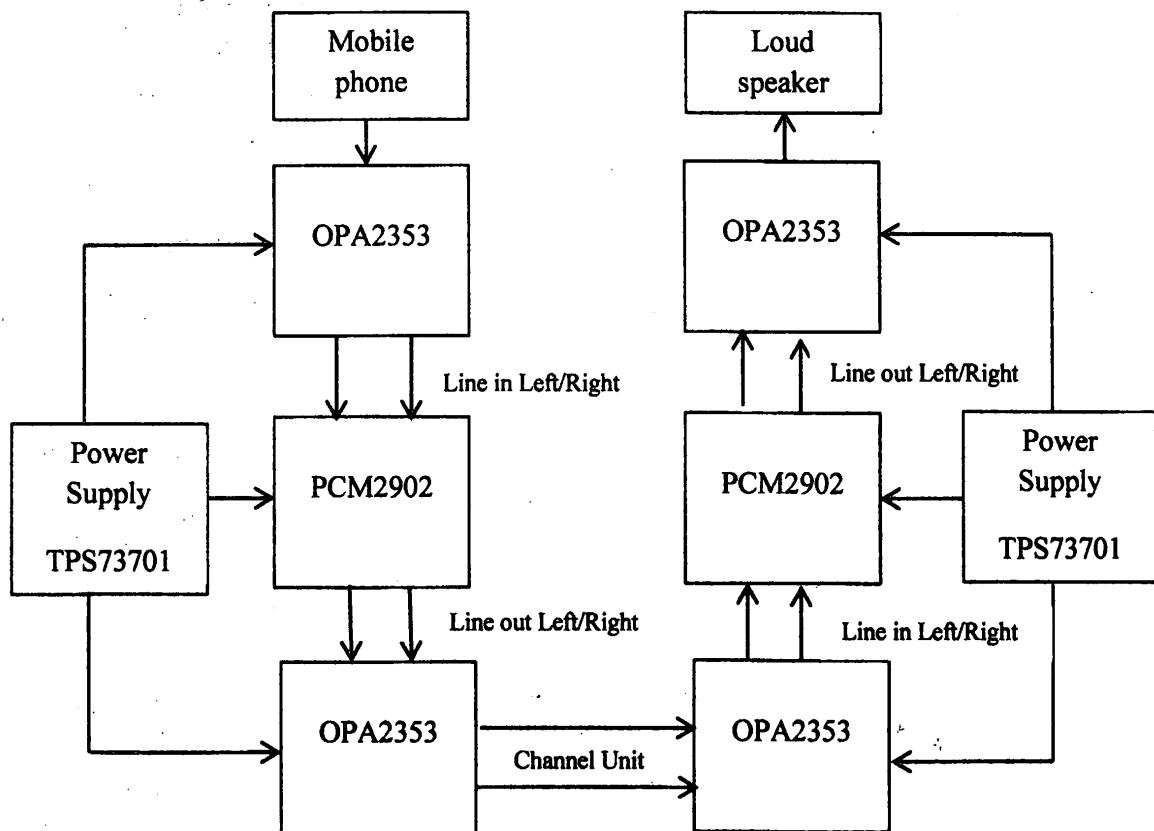


Figure 3: Block Diagram of the proposed and constructed system

2.2. The Components of the Designed and Constructed Circuit

2.2.1. Laser Diodes

Laser diodes (LDs) are more recent technology which has grown from underlying LED fabrication techniques. LDs still depend on the transition of carriers over the band gap to produce radiant photons; however, modifications to the device structure allow such devices to efficiently produce coherent light over a narrow optical bandwidth LDs exhibit a second form of photon generation process, stimulated emission. In this process, photons of energy are incident on the active region of the device. In the active region, an excess of electrons is maintained that in this region, the probability of an electron being in the conduction band is greater than it being in the valence band.

2.2.2. PCM2902 Stereo Audio Codec IC

PCM 2902 is a stereo audio codec single ended analog input output and S/PDIF interface IC. It has 16 Bit Delta – Sigma ADC and DAC having maximum 48 kHz DAC sampling rate and 48 kHz ADC sampling rate. When comes to stereo ADC, performed 89 dB and DAC 69 dB signal-to-noise ratio. This is a stereo audio codec with USB-compliant full speed protocol controller and S/PDIF and works without software code.

Pin diagram of the PCM2902 codec IC and functional block diagram were shown in following figures ².

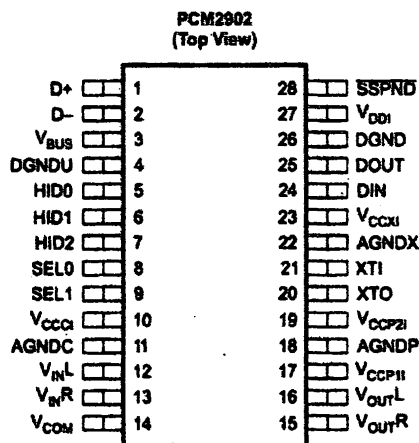


Figure 4: Pin Diagram of the PCM2902

2.2.3. OPA2353 Op- Amp

OPA2353 is a CMOS operational amplifiers are designed for low cost, miniature applications. They are optimized for low voltage, single supply operations, low noise; Rail-to-Rail input/output and high speed operations make them ideal for driving sampling analog to digital converters. OPA2353 is a dual op- amp miniature MSOP-8 surface mount IC ³.

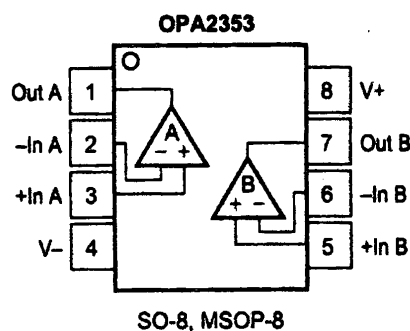


Figure 5: pin diagram of OPA2353

3. RESULTS AND DISCUSSION

The final outcome of the project is to transmit an audio signal that is being transmitted through the free space laser light which has to be properly received at the opto electronics receiver. Then the audio is decoded with S/PDIF interface. The error in the received signal is observed to be low. Also it is low cost and effective for the domestic disturbance free transmission of audio signal at high speed.

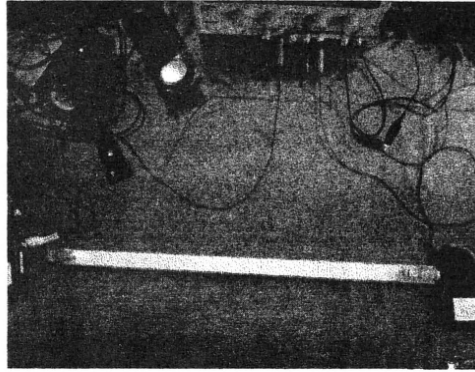


Figure 6: Proposed and Constructed System

4. CONCLUSION

Using this circuit we can communicate with our neighbors wirelessly and with low cost. It can be also used in inaccessible areas and conference halls. Whenever in future, it can be commissioned with satellite for communication. And instead of the short range laser, high range lasers can be used with range of few hundred meters. This constructed system is low cost and efficient for wireless multimedia communication applications.

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