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LASER BASED AUDIO COMMUNICATION SYSTEM

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ABSTRACT
This paper involves building a scaled down, simple laser communication system that is used to send audio signals over a distance. The free space communication system used here consists of a transmitter that super imposes an audio signal into a light source. The receiver contains a photo detector and is connected only through an optical path with the transmitter, with air as the free space medium. The light source is a laser diode and the detector is a semiconductor-based photoresistor made of Cadmium Sulfide (CdS).

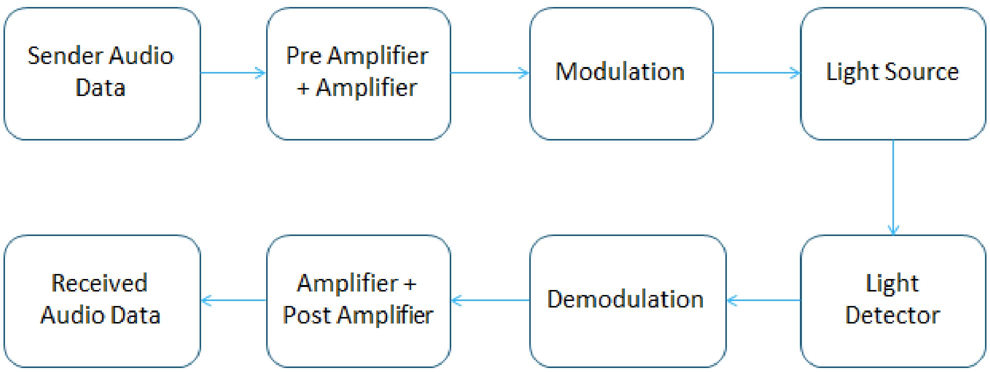
KEYWORDS: Audio communication system; laser; free space optical communication; visible light communication

INTRODUCTION
A laser communication system falls under the category of both free space optical communication systems and visible light communication systems, and uses visible light between 400 and 800 THz (780–375 nm). This field is gaining widespread importance due to the following factors: use in High power applications, higher data transmission rates, no interference as in the case of Electromagnetic Radiation, is cost effective and provides higher bandwidth. Although they are Line of Sight Communication systems and can be used only for shorter distances due to reflection, scattering and interference phenomena of light, they have the benefit of eliminating the need for broadcast rights and heavy duty cable connections.

This technology has already been used to provide temporary connectivity for disasters, sporting events and in space based communications. But they have gained importance in recent times to satisfy bandwidth needs for heavy uplink and downlink of data used in today's generation.

This paper is a modest attempt to create a laser communication system that can be used to send audio data from point A to point B.

BLOCK DIAGRAM REPRESENTATION



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SYSTEM DESCRIPTION

Transmitter

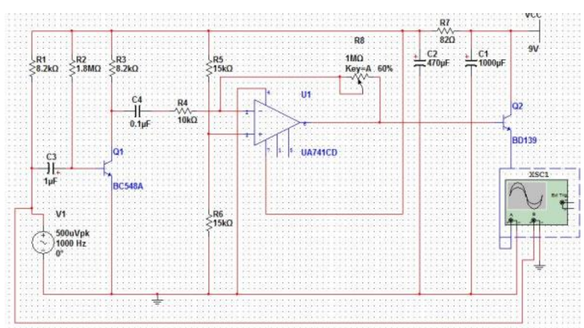
The transmitter circuit is constructed by using pre amplifier and amplifier circuit. A modulation technique is required to modulate the audio signal onto a carrier wave so that noise distortion can be reduced while increasing the Signal to Noise Ratio (SNR). In our optical communication system, this carrier signal consists of light pulses sent out in short intervals. Here the modulation technique used is Frequency Modulation Scheme. An electronic oscillator produces a repetitive, oscillating electronic signal. Oscillators convert direct current (DC) from a power supply to an alternating current (AC) signal. For FM transmission, information signal is superimposed with respect to frequency onto a carrier wave. In our circuit, the oscillator is used for generating a carrier wave in VHF frequency band (88 Mhz-108 Mhz) suitable for FM transmission. The frequency of carrier wave called central frequency, which is tuning frequency of circuit, is determined by parallel L-C branch. After modulation, the signal is then super imposed onto the narrow beam of light. A pen torch is used for this purpose as it is not destructive and does not provide a high intensity beam that can be harmful to people around the beam, while at the same time maintaining the signal strength required for good SNR. To provide a continuous supply of audio, we connect the information end to an MP3 player using a 3.5 mm jack.

Receiver

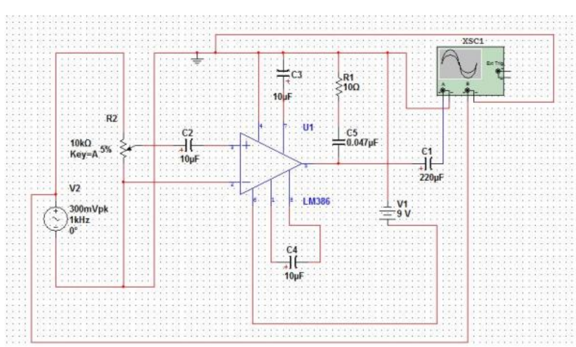
The receiver consists of a photodiode, along with a demodulation circuit and an amplifier to retrieve the audio signal. A cadmium sulphide photodiode is used. The photodiode also has traces of cadmium selenide as it attracts the visible light spectrum of light better. As this optical system is purely a Line Of Sight (LOS) scheme, the laser pointer must be properly oriented to the photodiode, such that the laser beam directly falls on the photodiode. A speaker is used to verify the sound received. For better analysis, our system uses a 3.5 mm jack at the receiver, which is then connected to the input side of a laptop. This is done to analyse and compare the received audio signal with the supplied audio signal. We use software like Wavepad sound editor to compare the audio signal sent and the audio signal received.

SIMULATION CIRCUIT

Transmitter



Receiver



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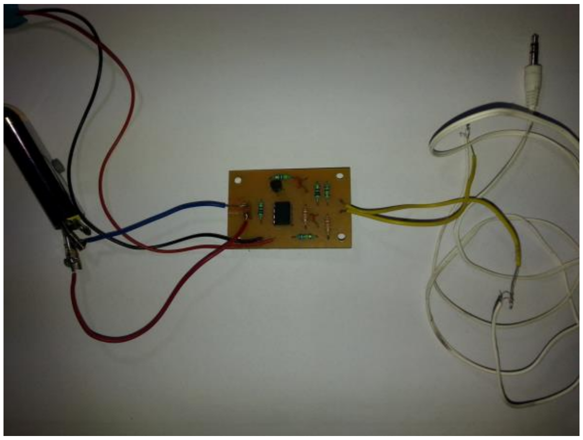
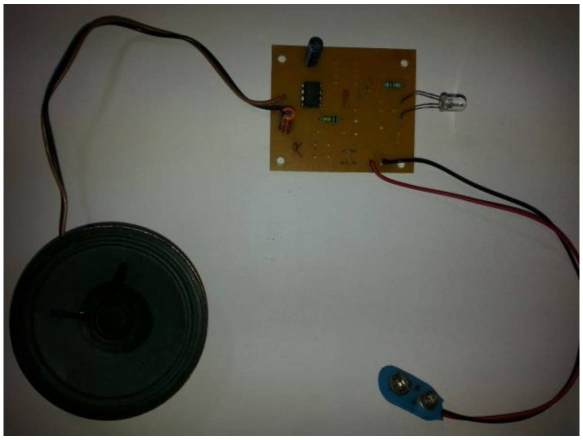
DEVELOPED CIRCUIT

Transmitter

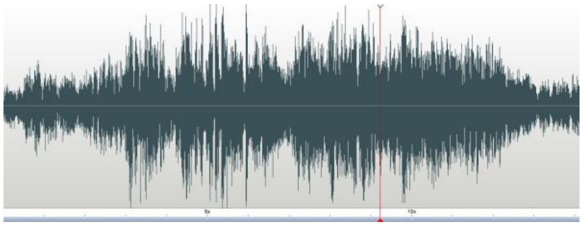


Receiver

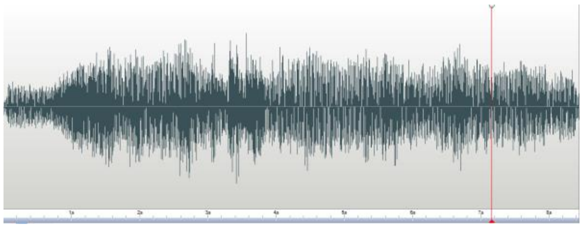


AUDIO SIGNAL COMPARISON

Input



Output



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INFERENCE

The received audio signal closely resembles the supplied audio signal. The distortion in the signal is due to the following reasons:

1. Keeping the laser diode focused on the photodiode is difficult as the laser is fairly focused and the photodiode is sensitive only at particular angles. This causes the photodiode to perceive the light signal in different ways, causing loss in signal strength.
2. Interference is expected when other light sources like those from a tube light or sunlight cause distortion of the waves.
3. Environmental effects like dust and humidity pose a problem in the transmission of the light signal. The amount of light scattered is more which affects the strength of the laser light. The presence of sharp object leads to diffraction and reflection phenomena also affect the strength of the received signal.

CONCLUSION

Ever increasing bandwidth which are in high demand have resulted in the emergence of laser communication systems. This is an exciting area as it provides transmission speeds of upto 1 gigabit per second. But laser communication poses certain limitations such as beam dispersion, atmospheric absorption, and attenuation due to rain, fog, interference from background light sources etc.

Multi-beam or multi-path architectures, which use more than one sender and more than one receiver, are used to overcome this problem. Some state-of-the-art devices also have larger fade margin (extra power, reserved for rain, smog, fog). Thus, this technology can very well be the ideal communication technology to be used in the near future.

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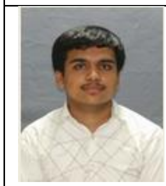	**Vishakh B V** Vishakh B V is a third year undergraduate student majoring in the field of Electronics and Communication Engineering at VIT University, Vellore in India. His research interests include speech processing and VLSI circuit design.