© 2015 IJSRSET | Volume 1 | Issue 2 | Print ISSN : 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

Wireless Transmission of Audio Signal using Coherent Optical Signal

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ABSTRACT

This paper intends to demonstrate wireless transfer of an audio signal via a coherent optical signal in free space between two independent systems. The principle behind said communication is conversion of audio signal to light signal via the application of modulation and amplification into a high intensity laser source that is detected by a photovoltaic cell and is then demodulated and amplified back to the audio signal.

Keywords: LM386, Laser, Photovoltaic cell, Optical communication

I. INTRODUCTION

Communication via the use of laser is a fast emerging technology that aims to transmit data using very high intensity lasers. Lasers (Light Amplification by Stimulated Emission of Radiation) produce a highly coherent pulsed beam of light with a very low noise ratio, making it a perfect transmitting source for a wireless communication system. This system relies on the concept of LOS (line of sight) wherein there are no obstructions between the transmitter and receiver.

Laser based communication can input more data and transmit the data packets more efficiently than radio waves and at very high bandwidth requiring no prior compression. Lasers are also immune against electromagnetic interference and can operate in full duplex mode.

Laser communication is currently being extensively used for data transmission between satellites with space being devoid of any obstructions providing a conducive transmission medium. Future uses include free space optics based system, that provide data rate up to 10 GB/s for distances up to 5 Kms.

II. METHODS AND MATERIAL

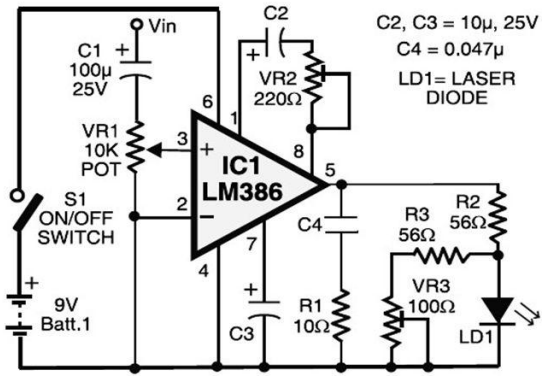

Figure 1. Transmitter

The transmitter inputs a low voltage recorded audio signal that is passed through an audio amplifier (LM386) that amplifies the signal and modulates it into appropriate electrical signal which is amplified by a 9V independent DC power source, the high intensity signal is sent to a laser emitting diode that produces a coherent optical beam.

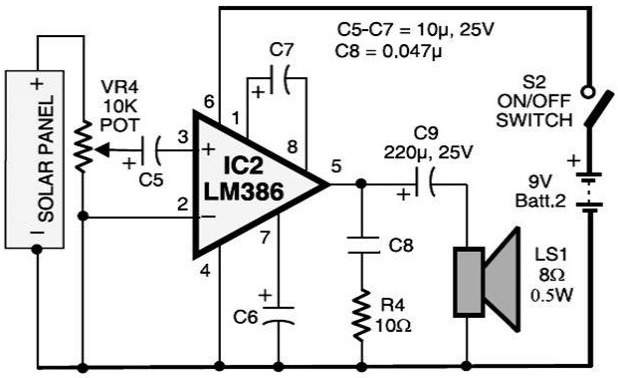

Figure 2. Receiver

Laser beam transmitted is received by a low input photovoltaic cell that converts the high intensity optical signal into a low voltage electric signal. This signal is then amplified through an audio amplifier (LM386) via a high voltage DC source. This signal is then transmitted to a speaker that produces an audio output.

LM386 (Audio amplifier)

It is an integrated circuit which consists of a low voltage audio amplifier; the IC consists of an 8-Pin Dual in Line package and can output 0.5 watts power using a 9V DC power supply.

Modulator/Demodulator

Modulation is an intrinsic requirement for long distance communication in which a high frequency carrier signal is modulated in accordance to the input message signal so as to shield the message signal from channel interference.
The demodulator removes the message signal from the received signal compensating for the channel error and attenuation.

Working

In this circuit the low voltage input signal is input to an LM386 amplifier with maximum output of 1W and gain between 20-200 which amplifies the signal and sends it to a laser diode with maximum operating voltage of 2.6V and current of 45mA. The capacitors C2 and potentiometer VR2 are used to vary the gain of the amplifier and the input audio signal is varied using the potentiometer VR1. The intensity of the laser beam varies with the amplitude of the audio signal.

The laser beam received is incident on the photovoltaic cell which converts the variations in the beam into a varying amplitude electric signal. This low voltage signal is then demodulated and further amplified using the low power amplifier LM386 whose gain is adjusted via the capacitor C7 and the signal from the photovoltaic cell is varied by the potentiometer VR4 and the DC bias is removed by capacitor C5 and the signal is then sent to the speaker through capacitor C8.

III. RESULTS AND DISCUSSION

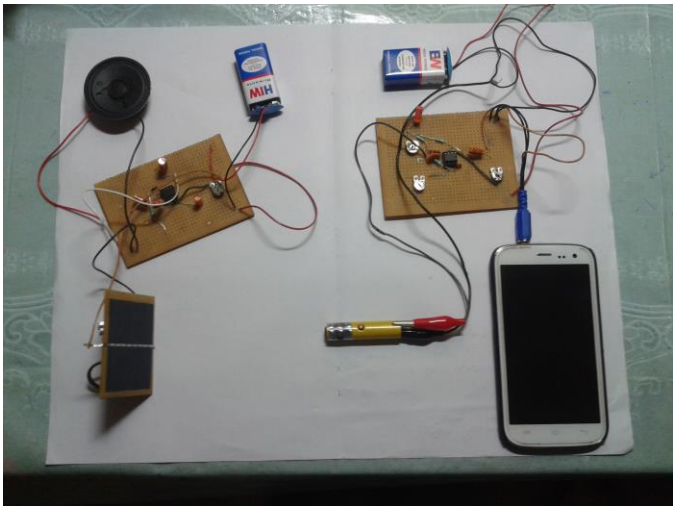

Figure 3. Circuit

This system works sufficiently well and a comprehendible audio signal is received at the output. The system works best if operated upon in a dark room so as to minimize the unwanted signals being generated due to the ambient light present.
The communication system can further be improved upon by

- Using a photo resistor instead of a photovoltaic cell due to an increased

responsiveness of the photo resistor to the incident signal.

- A signal amplifier can be used to increase the intensity of the transmitted signal and make it louder.
- An active notch filter at the receiver side can be used to remove a large part of the induced noise in the channel.

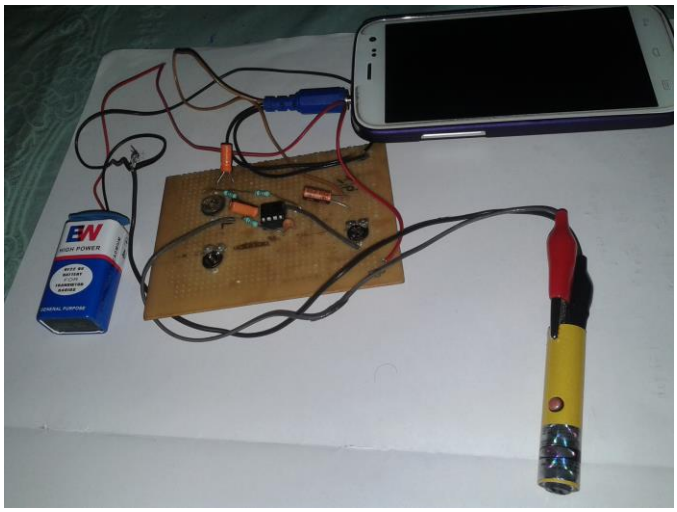

Figure 4. Transmitter

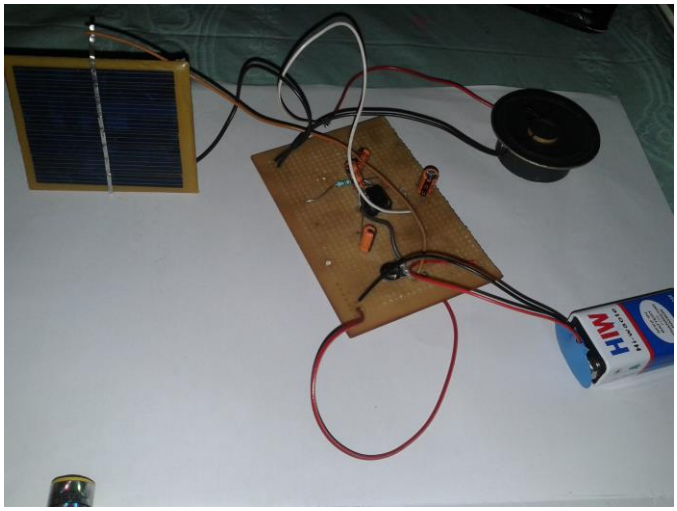

Figure 5. Receiver

IV. CONCLUSION

Laser communication is a very secure form of communication and can be used for long distances due to its property of coherent length. This type of communication has a very huge scope for future researches and applications. It was observed that there were some disturbances in the reception of the data due to presence of the room light.

V. REFERENCES

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