Laser Communication System using LM386 ICs, Laser Diodes and a Solar Panel

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Abstract— *This paper aims at transmitting data via. a medium (air), using a Laser Diode. The reception is accomplished by using a Solar panel. On both the sites of transmission and reception, LM386 ICs are used for amplification and modulation. The input is taken from a '.mp3' supported device, via. a 3.5mm jack (In this case a smartphone). The input taken is amplified and transmitted using a Laser diode and the beam is directed onto a Solar Panel. The solar panel and the reception system vary the intensity levels as required and eventually, the music is played out loud by the loudspeaker.*

***Keywords*— Laser Communication, Laser Diode,LM386 IC, Reception, Solar panel, Transmission.**

I. INTRODUCTION

'Laser Communication' has its roots deep rooted to the time of its invention, 1960. Ever since, it has been highly regarded as one of the most efficient and error free modes of transmission of data. Due to its high directivity and low Beamwidth, it has very high directional properties. Essentially, Lasers have very low interference, thereby allowing for multimode operations using optical fibers. In our case, transmission occurs only if there is a plausible line of sight (LOS), as no optical cables or fibers are used. This mode of communication is faster than other types of communications such as LEDs and Electrical cable systems, thanks to the fact that these pulses travel with the speed of light. These systems are used very widely around the globe for transmitting data, by undersea and underground fiber optic cable system deployment, making it the most preferred form of communication of all other systems.

II. METHODOLOGY

To put it into very banal and simple terms, here's how the process works: A digital low power signal is taken from a smartphone (or any other 3.5mm supported device) via a 3.5mm jack, Amplified, Transmitted, Received, Re- amplified, and finally played out using a loudspeaker. For all the power requirements at the transmission and reception sites, a 9V DC power supply (Battery) is used. A high input signal generated by this amplifier is then transmitted using a Laser Diode. This beam is directed towards a sensor, in this case a solar panel. A logical representation is given in figure(1). The circuit diagram for the Transmitter is shown in figure(2).

TRANSMITTER

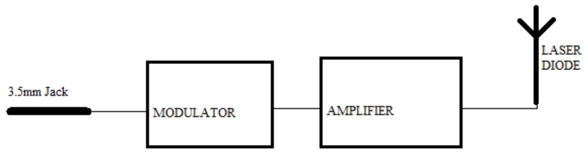

Fig.1

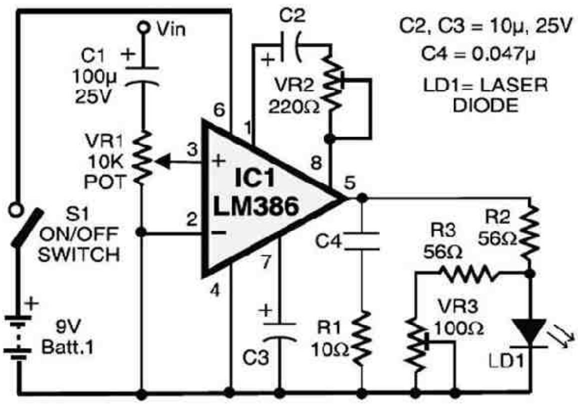

Fig.2

Working of the transmitter block

In this setup, the digital information received from the 3.5mm Jack is a string of 1s and 0s. This is observed in the intensity variations of the output from Laser Diode. This variation in the intensity level is converted into voltage levels by the solar panel. These low power values are amplified by the LM386, further to play music from the Speaker.

The maximum power output of a typical LM386 is 1 watt, while it's gain lied in the range of 20 to 200. Specifications of the laser diode indicate that the maximum operational voltage is 2.6V with a maximum current supported upto 50mA. Potentiometer VR1 is used to change the level of the input digital stream. The gain is varied by the combination of capacitor C2 and potentiometer VR2.

RECEIVER

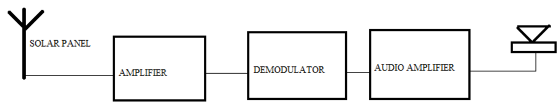

Fig.3

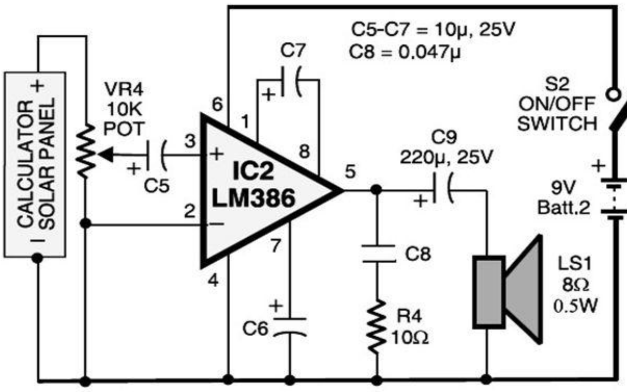

Fig.4

Working of the receiver block

The laser input obtained is optical in nature and is converted into low level voltage variations by the solar panel. These variations are amplified to a level that can be recognised by the loudspeaker. If this step is not carried out efficiently, the resulting variations from the loudspeaker are unnoticeable. Figure(3) gives the block-logical diagram of the receiver. Figure(4) gives the circuit diagram of the receiver. The gain of amplifier is fixed by the value of C7. Potentiometer VR4 is used to vary the signal intensity level from solar panel. C5 behaves as a coupling capacitor, removes DC voltages from the solar panel. C8 is used as a coupling capacitor to feed signal to speaker.

Roles and explanations of blocks and components:

1. Amplifier: The LM386 is a low power voltage amplifier designed to be used in low power and low voltage applications, hence amplified and high power outputs are obtained from the IC. The quiescent power drain is only 36 mW when operating at 9V DC supply.
2. Modulator: In radio communications, signals are transmitted over free space – air in this case. There is a probability that interference occurs if modulation is not carried out effectively. To avoid this, modulation is applied over all the spectral components of any given signal. In our case, external modulation is minimal as the input obtained from the 3.5mm jack is solely modulated in itself.
3. Solar Panel: This is the most key component, as the received signal has to be converted back into voltage variations. They have an advantage over many other pulse/light detection devices as they are economical and durable, on a relative scale.

Experimental Setup:

Fig.5

III. RESULTS

The given .mp3 song from the mobile is a low power signal, which is amplified, modulated, transmitted, de modulated, re-amplified, and physically playued out. Theoretically, there should be no or minimal aberrations. But, in real time application, it is observed that the played out music is slightly less crisp and unclear as compared to the original song on the mobile. These aberrations can be accredited to environmental noises and electromagnetic interferences from nearby gadgets with the experimental setup.

IV. LIMITATIONS

1. Although, technically speaking, Lasers and Laser diodes have unlimited range, in real time applications, we observe that the beam emitted may weaken after 20 – 30 meters.
2. Due to the inverse square law, light intensity decreases by square of the distance and area travelled, the light beam fails to be crisp and clear after 10 – 20 meters.
3. As digital information is sent over the medium; it is an observable that a few non- eradicable errors are introduced due to system faults. Though there may not be much of an issue, they do tend to decrease the quality of the sound produced and played at the loudspeaker.

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V. CONCLUSION

We have implemented and created a system that can transmit, receive and play any .mp3 song by taking a digital input and following it up with amplification & modulation techniques.

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